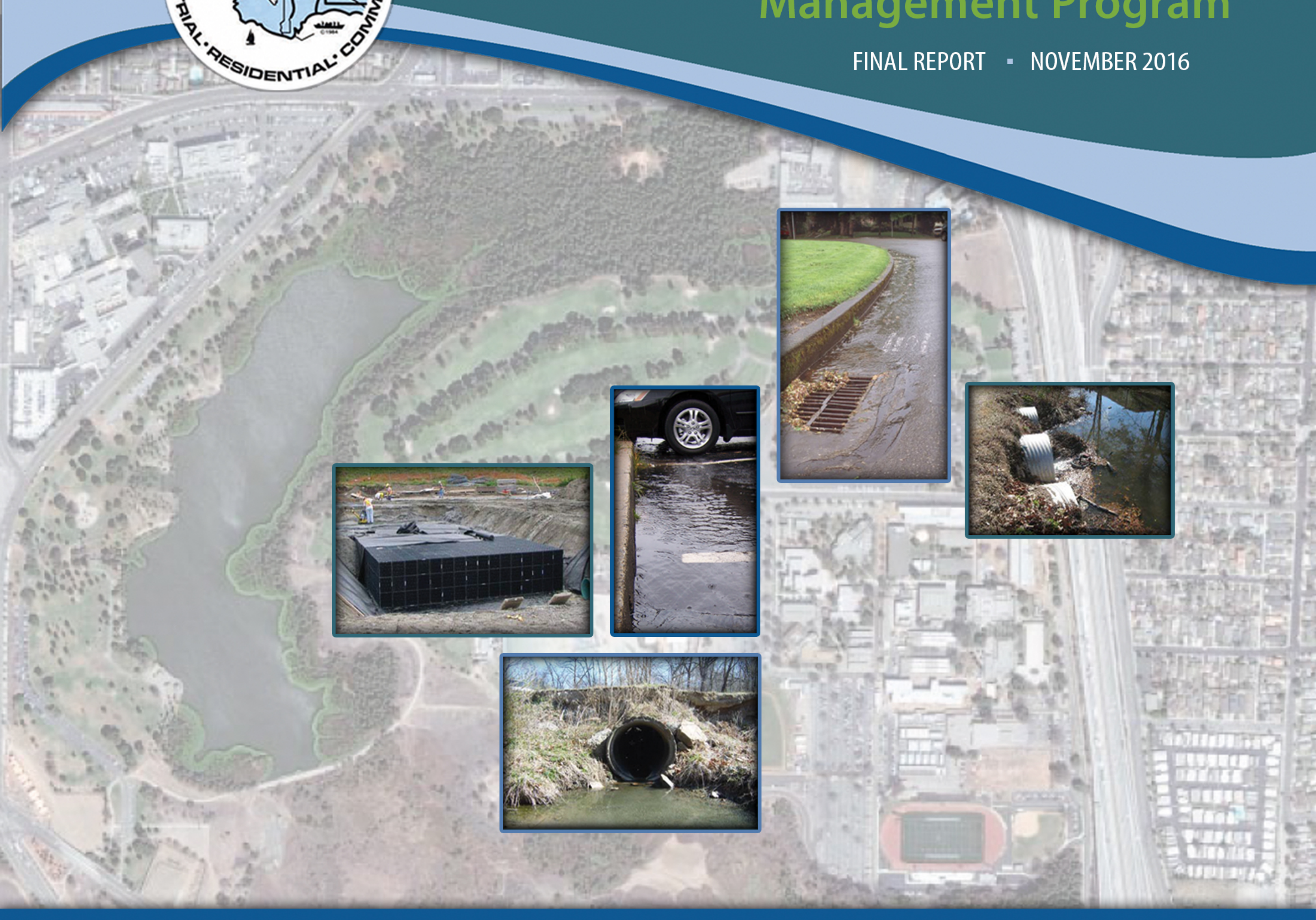
Machado Lake

Enhanced Watershed Management Program

FINAL REPORT ▪ NOVEMBER 2016



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City of Torrance, California

ENHANCED WATERSHED MANAGEMENT PROGRAM FOR THE MACHADO LAKE WATERSHED

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October 2016

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CITY OF TORRANCE, CALIFORNIA

MACHADO LAKE WATERSHED
ENHANCED WATERSHED MANAGEMENT PROGRAM

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LIST OF ABBREVIATIONS

ac-ft	acre-feet
ARS	Automated Retractable Screens
BMP	Best Management Practice
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CGP	Construction General Permit
City	City of Torrance
County	Los Angeles County
CPS	Connector Pipe Screens
CWA	Clean Water Act
DEM	Digital Elevation Model
EMC	Event Mean Concentration
EMWP	Enhanced Watershed Management Program
ET	Evapotranspiration
GIS	geographic information systems
GPS	Global Positioning System
HDSF	high-density single family
hm^3/yr	cubic hectometers or million cubic meters/year
HSG	Hydrologic Soil Group
HSPF	Hydrologic Simulation Program Fortran
ISA	Impervious Surface Area
kg	kilograms
kg/yr	kilogram per year
KMHRP	Ken Malloy Harbor Regional Park
LA	Los Angeles
LACFCD	LA County Flood Control District
lb/ac/yr	pounds per acre per year
LID	Low Impact Development
LARWQCB	Los Angeles Regional Water Quality Control Board
µg/kg	micrograms per kilogram
MCMs	minimum control measures
MFR	multi-family residential
mg/L	milligram per liter
MRP	Monitoring and Reporting Plan
MS4	Municipal Separate Storm Sewer Systems
MTA	Metropolitan Transportation Authority
MUN	municipal supply
MWDSC	Metropolitan Water District Southern California

NPDES	National Pollutant Discharge Elimination System
N-SPECT	Nonpoint Source Pollution and Erosion
OC	organochlorine
O&M	Operation and Maintenance
PCBs	polychlorinated biphenyls
PIPP	Public Information and Participation Program
PLAT	Pollutant Load and Analysis Tool
PRD	Permit Registration Documents
RAA	Reasonable Assurance Analysis
RARE	A Basin Plan designation for the aquatic life support category
REC 1	A Basin Plan designation for water contact recreational
REC 2	A Basin Plan designation for water non-contact recreational
RWLs	Recurring Water Limitations
SCAQMD	South Coast Air Quality Management District
SCCWRP	Southern California Control Water Research Project
SQMP	Stormwater Quality Master Plan
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
TMRP	trash monitoring and reporting plan
TN	Total Nitrogen
TP	Total Phosphorus
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WBPCs	Water Body Pollutant Classifications
WDRs	waste discharge requirements
WLA	Waste Load Allocation
WMMS	Watershed Management Model System
WMPs	Watershed Management Program
WQBELs	Water Quality-Based Effluent Limitations
WTM	Watershed Treatment Model

ENHANCED WATERSHED MANAGEMENT PROGRAM

1.0 INTRODUCTION

In order to satisfy the Los Angeles Municipal Separate Storm Sewer System (MS4) Permit (Permit) requirements, the City of Torrance (City) has developed this Enhanced Watershed Management Program (EWMP) for the Machado Lake Watershed portion within the jurisdiction of Torrance called TMDL Implementation Area (Implementation Area). The MS4 Permit was adopted on November 8, 2012, by the Los Angeles Regional Water Quality Control Board (Regional Board) and became effective December 28, 2012. The MS4 Permit was created for the purpose of protecting the beneficial uses in the receiving waters in the Los Angeles County region by ensuring that MS4s in the County of Los Angeles are not causing or contributing to exceedances of applicable water quality objectives. The MS4 Permit allows the permittees to customize their stormwater programs through the development and implementation of a EWMP to achieve compliance with certain receiving water limitations and water quality based effluent limits.

This EWMP documents the results of an effort to address impairments in the Machado Lake watershed with a comprehensive, phased approach of best management practice (BMP) implementation for the City. To develop this plan, BMPs to treat stormwater and dry weather flows to reduce nutrients, sediment, and other pollutants such as metals, bacteria, and toxics were identified and selected. As part of that process, benefits of management activities were estimated in terms of pollutant load reductions or improvement in water quality, to meet waste load allocations (WLAs) defined by approved total maximum daily loads (TMDLs) established for waters within the Machado Lake watershed.

1.1 Regulatory Framework

The Los Angeles Regional Water Quality Control Board (LARWQCB or Regional Board) adopted Waste Discharge Requirements (WDRs) for MS4 discharges within the Coastal Watersheds of Los Angeles County on June 18, 1990, (Order No. 90-079; NPDES Permit No. CA0061654). The WDRs were later amended on December 13, 2001 (Order No. 01- 182; NPDES Permit No. CAS004001 [as amended]). The current MS4 Permit (Order No. R4-2012-0175; NPDES Permit No. CAS004001) was adopted on November 8, 2012 and became effective on December 28, 2012.

The MS4 Permit contains effluent limitations, receiving water limitations (RWLs), Minimum Control Measures (MCMs), TMDL provisions, and outlines the process for developing watershed management programs (WMPs), including the EWMP. The MS4 Permit incorporates the TMDL WLAs applicable to dry- and wet-weather as Water Quality-Based Effluent Limitations (WQBELs) and/or Receiving Water Limitations (RWLs). Part V.A (pages 38-39) of the MS4 Permit requires compliance with the WQBELs and/or RWLs as outlined in the respective TMDLs.

1.1.1 Relevant TMDLs

A TMDL is a regulatory term used to describe a value of the maximum amount of a pollutant that a water body can receive while still meeting water quality standards. Attachment N of the MS4 Permit, titled "TMDLs in Dominguez Channel and Greater Harbor Waters Watershed Management Area" lists information on TMDLs and incorporates WQBELs and RWLs relevant to the DC WMG including the TMDLs identified in Table 1.1

Table 1.1 provides a summary of the various existing and pending TMDLs associated with each body of water the City discharges into.

Table 1.1 Summary of TMDLs for City of Torrance

Body of Water	TMDL Name	Pollutant(1)	Resolution Number	Effective Date
Machado Lake	Nutrient	Nitrogen, Phosphorus	R08-006	11 March 2009
	Trash	Trash	2007-006	6 March 2008
	Toxics	Pesticides, PCBs	R10-008	2 September 2010

Notes:
(1) Interim, final, and phased WLA are listed in Chapter 3 where applicable.
(2) The Resolution Name for what is referred to here as the Dominguez Channel Toxics TMDL is “Los Angeles and Long Beach Harbors Toxic and Metals TMDLs.” Dominguez Channel discharges into the Los Angeles and Long Beach Harbors.

1.2 EWMP Overview

The Machado Lake trash TMDL is being addressed this year (2016) with the Machado Lake TMDL Project and therefore not addressed in this EWMP. The process of BMP selection considered cost-effectiveness to promote a practical and implementable plan. This report also includes integrated approaches that consider BMPs that can address multiple pollutants cost-effectively, while considering parallel water resources planning strategies for the watershed.

The report is organized into nine sections that in summary provide the following information:

- Section 1 provides background information on the Machado Lake watershed and its impairments and associated TMDLs.

- Section 2 provides more detailed descriptions of the Implementation Area, including the geologic setting, land uses, hydrology, and hydraulics.
- Section 3 characterizes, evaluates, and prioritizes pollutants and their sources within the Implementation Area.
- Section 4 details an evaluation of existing programs, mainly nonstructural in nature, to address the pollutants of concern.
- Section 5 presents candidate sites for structural BMP implementation and describes the regulatory and permit requirements that might apply to the proposed BMPs and that might affect the timing, feasibility, and cost of management alternatives.
- Section 6 presents an alternatives evaluation of different structural and nonstructural BMP management options.
- Section 7 includes a discussion of the integrated nature of the plan and its relation to other water resources efforts in the region.
- Section 8 documents schedules for implementing BMPs to meet phased WLA schedule.
- Section 9 presents cost estimates for the BMP alternatives.

1.3 Machado Lake Watershed

The Machado Lake watershed is situated within the Dominguez Channel Watershed Management Area. Machado Lake is separate from Dominguez Channel and discharges, under storm conditions, to the Los Angeles Harbor. Machado Lake is considered a freshwater reservoir or lake approximately 40 acres in size located adjacent to Vermont Avenue south of its intersection with Pacific Coast Highway (USEPA, 2014b). The Basin Plan has identified the existing beneficial uses as WARM, WILD, RARE, WET, REC-1, and REC-2. Machado Lake is comprised of upper and lower basins separated by a lower earthen dam. The upper basin contains the 40-acre recreational lake created by the impoundment of stormwater runoff while the lower basin is a seasonal freshwater marsh of roughly 63 acres. The Wilmington Drain is a LACFCD facility managed by LACDPW tributary to Machado Lake. The earthen bottom section is characterized as a soft bottom vegetated channel, approximately 3,000 feet long. This portion of Wilmington Drain spans from Pacific Coast Highway to just north of Lomita Boulevard, bordered by mostly residential land uses to the west and the Interstate 110 to the east. Just south of Interstate 110 and upstream, the channel is concrete lined. Beneficial uses for the Wilmington Drain were identified based on the tributary rule, therefore have the same beneficial uses as Machado Lake (LARWQCB, 1994).

1.3.1 Geographic Setting

Machado Lake has a total drainage area of approximately 23 square miles and is located within the Dominguez Channel Watershed Management Area, although it is not tributary to the Dominguez Channel. Machado Lake overflows into Wilmington Drain during peak storm events. The lake itself is under the jurisdiction of the City of Los Angeles, while the drainage area is within the jurisdiction of several cities and unincorporated portions of Los Angeles County (County). The lake is located in the Ken Malloy Harbor Regional Park (KMHRP), which is a 231-acre Los Angeles City Park serving the Wilmington and Harbor City areas. The lake was originally created for inclusion into Harbor Regional Park in 1971, and intended for boating and fishing.

A map of the Machado Lake watershed and the different jurisdictions located within the drainage area is shown on Figure 1.1. The figure includes the boundary of the Machado Lake watershed and major storm drains.

The Machado Lake watershed can be divided into six primary subdrainage areas. These subdrainages are:

- The Walteria Lake
- Project 77/510
- Wilmington Drain
- Project 643 (72-inch Storm Drain)
- Project 643 (Figueroa Drain)
- Private Drain 553

Figure 1.2 shows the six subdrainage areas in Machado Lake watershed. As shown on the Figure, the Implementation Area drains the Walteria Lake, Project 77/510 and Private Drain 553.

1.3.2 Machado Lake Responsible Agencies

The responsible parties located within the Machado Lake Watershed include the cities of Los Angeles, Torrance, Carson, Lomita, Rolling Hills, Rolling Hills Estates, Rancho Palos Verdes, Redondo Beach, and Palos Verdes Estates, and unincorporated Los Angeles County.

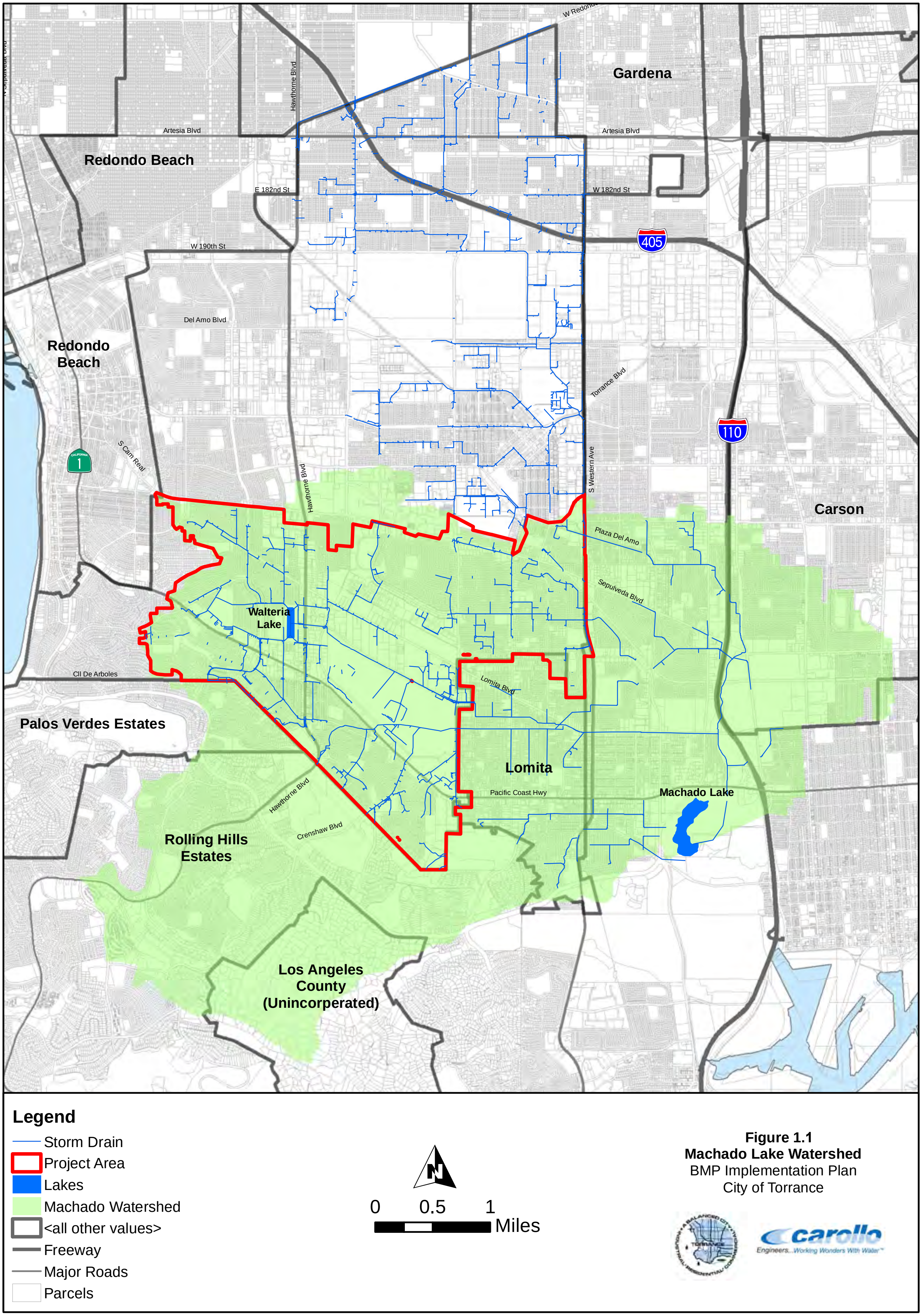


Figure 1.1
Machado Lake Watershed
BMP Implementation Plan
City of Torrance

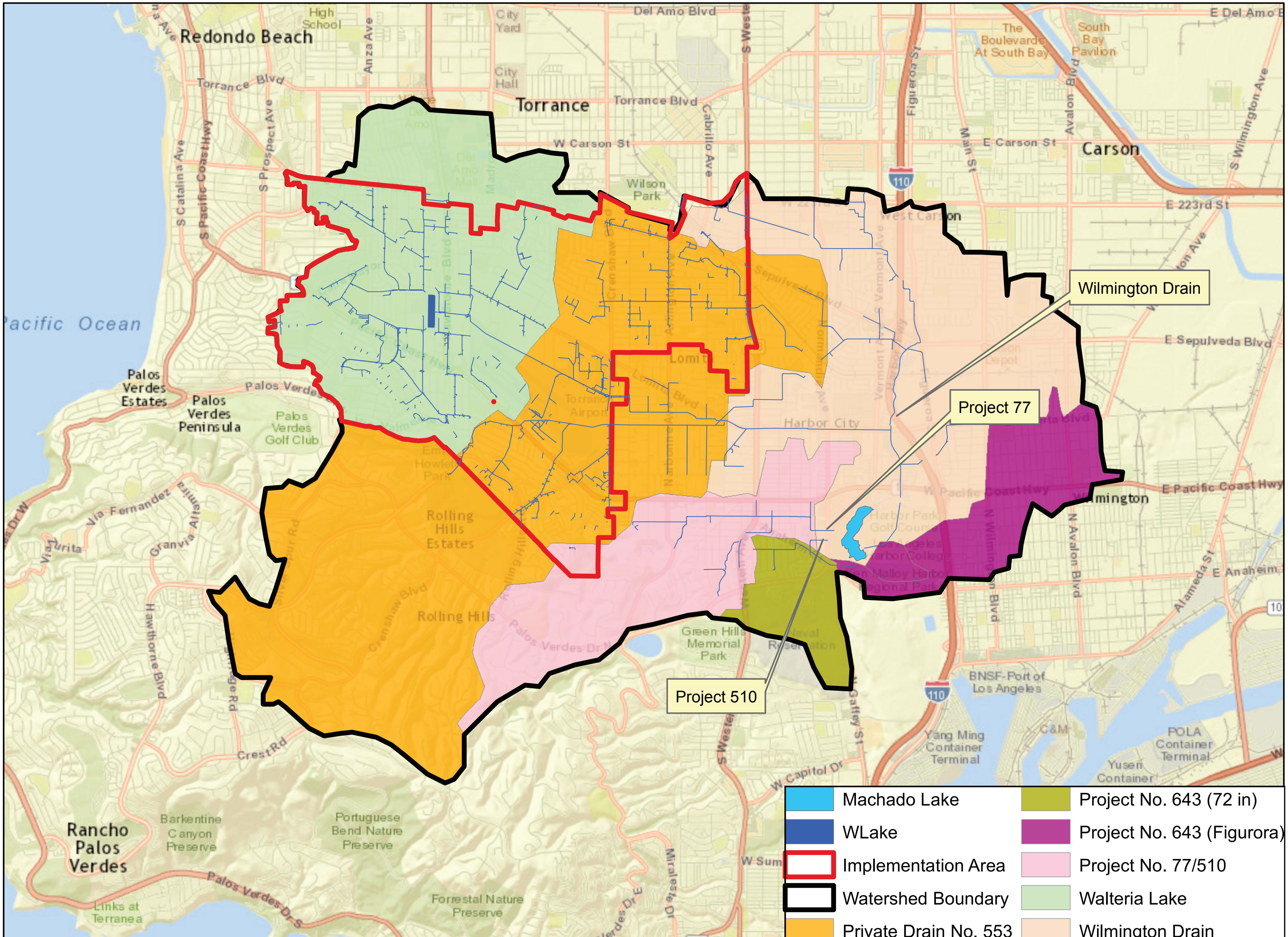


Figure 1.2 Machado Lake Watershed Subbasins

1.3.3 TMDL Implementation Area

The area of Torrance located in the Machado Lake watershed accounts for 30 percent of the total drainage area. The portion of City Redondo Beach is about 0.2 percent of the entire watershed and flows to a City of Torrance catch basin. However, the City of Redondo Beach has requested this portion draining to Torrance be removed from the Machado Lake Implementation Plan since it is being covered in the Beach Cities Group EWMP. For the purposes of this report, this area of Torrance located within the watershed is called the TMDL Implementation Area (Implementation Area).

The Implementation Area shown on Figure 1.1 is approximately 2,288 acres and includes Walteria Lake Sub Area and 237th Street Sump. These two sub areas are designated 85th Percentile Basins since they capture and retain storms events greater than the 85th percentile, 24-hour storm runoff.

1.3.3.1 Walteria Lake

The Walteria Flood Control Basin (Walteria Basin or Lake) is a man-made basin located in the City of Torrance. The Lake was built in 1962 by the Los Angeles County Flood Control District (LACFCD). Walteria Lake has a perimeter of approximately one mile and extends to an approximate depth of 100 feet. Walteria Lake's watershed is approximately 2,287 acres.

By jurisdictional area, Walteria Lake's watershed is 92.61 percent Torrance, 7.35 percent Palos Verdes Estates, and 0.04 percent Redondo Beach. The primary function of Walteria Lake is to provide flood protection. During storm and dry weather conditions Walteria Lake receives runoff from the surrounding sub watersheds. The water in the Lake is discharged during the dry season to pump out accumulated dry weather flows and after storm events to maintain flood protection for the adjacent communities. The discharge is pumped through the Project No. 584 storm drain and flows through the drainage network where it eventually discharges to Wilmington Drain. The Wilmington Drain is a soft-bottom open channel maintained by LACFCD. Surface water in Wilmington Drain can flow via gravity or an unmanned pump station into Machado Lake. To ensure the downstream capacity is available for other storm flows, Walteria Lake is only pumped down after runoff in the watershed subsides.

In October 2014, a Special Study Monitoring Program was commenced to analyze Walteria Lake (Special Study). The objective of the Special Study was to:

- Compare the mass of pollutants entering Walteria Basin and the mass of pollutants discharged.

- Assess inflow and outflow compared to TMDL waste load allocations.

As part of the Special Study, LACFCD is monitoring the 4 inlets to Walteria Lake. The City of Torrance is monitoring the discharges from Walteria Lake during pumping events. The Special Study spans 2 years, and preliminary results have been available since late 2015.

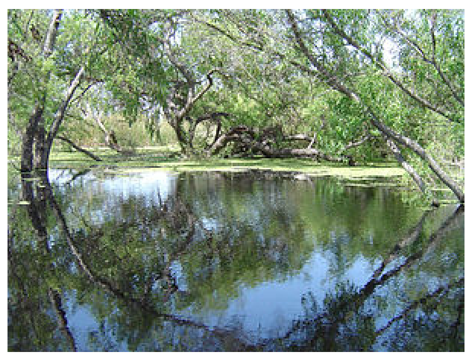
Pending the final results of the Special Study, an appropriate Regional BMP will be identified. A variety of BMPs are currently being investigated including:

- Application of aluminum sulfate to Walteria Lake.
- A diversion of the outflows from Walteria Lake to the Torrance Airport for infiltration into groundwater.
- Use of water collected in Walteria Lake to irrigate a nearby park or open space.

As the Special Study is completed in late 2016, funding and selection of appropriate BMPs will be determined. A BMP implementation strategy for Walteria Lake will be refined and reported through adaptive management.

1.3.3.2 Madrona Marsh and Sump

The Madrona Marsh and Sump watershed discharges stormwater into Walteria Lake watershed. Madrona Marsh Restoration and Enhancement Project installed passive wetland treatment system to treat water in the sump for nutrients and other pollutants. Madrona Sump Dredging Project will remove nutrient and toxic rich sediments, therefore not part of this plan.



1.3.3.3 237th Street Sump

The 237th Street Sump located in the implementation area is one of the active groundwater replenishment basins that are used to percolate stormwater into the groundwater basin. The 237th Street Sump which serves a drainage area of about 70 acres has no outlet, and is sized to capture runoff from at least the 85th Percentile, 24-hour storm event. Since this basin is designated as 85th Percentile Basin, stormwater improvements are not proposed. The sump has a capacity of about 2.5 ac-ft and the 85th Percentile 24-hour storm volume is approximately 2.48 ac-ft.

1.3.3.4 Discharge Locations

The City's stormwater system discharges into Machado Lake at several locations, which are indicated on Figure 1.3. As shown on this figure, these points of discharge are primarily located along the east boundary of the City's service area. The stormwater collection system shown on Figure 1.3 also shows how stormwater is routed throughout the Implementation Area. In general, the routing is as follows:

- Stormwater from the Walteria Lake Sub Area is ultimately routed to Machado Lake via the Project No. 584 storm drain which eventually discharges to Wilmington Drain. That is, discharge from Walteria Lake is pumped through the Project No. 584 storm drain and flows through the drainage network where it eventually discharges to Wilmington Drain.
- Stormwater from the Airport Sub Area is routed to Machado Lake via Project 584 and Wilmington Drain.
- Airport Southeast Sub Area does not drain directly into Machado Lake. Drainage from this area exit the City in an easterly direction where it is comingled with drainage from other agencies prior to flowing into Machado Lake via Project 77 and Project 510 storm drains.
- Walnut Sump Sub Area drains southeasterly to discharge into Wilmington Drain.
- Stormwater from the Baseball Field Sub Area is routed to Machado Lake via Wilmington Drain.

1.4 Water Quality Impairments

1.4.1 Designated Beneficial Uses

The existing beneficial uses of Machado Lake, as defined by the Los Angeles Regional Water Quality Control Board in the Basin Plan, include recreation (REC 1 and REC 2) and aquatic life support (WARM, WILD, RARE, and WET). The Basin Plan applies the municipal supply (MUN) beneficial use designation to Machado Lake, qualified by an asterisk, as a potential future use. Conditional designations are not recognized under federal law and are not water quality standards requiring TMDL development at this time. The Basin Plan designates beneficial uses to "all other inner areas." These beneficial uses for Implementation Area are shown in Table 1.2.

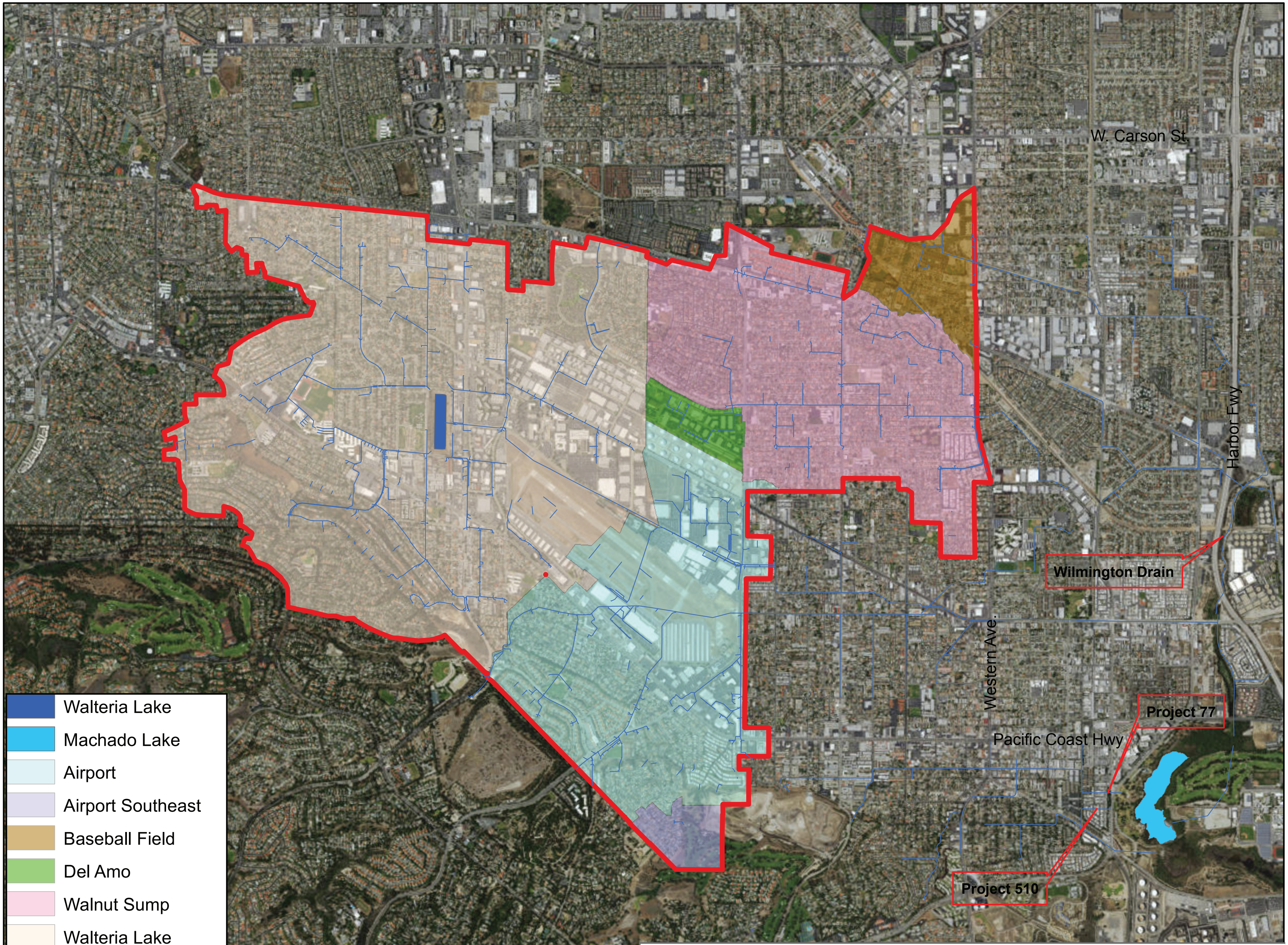


Figure 1.3 Stormwater Sub Areas and Discharge Locations

Table 1.2 Summary of TMDL Implementation Area Water Bodies

Water Body		Existing Beneficial Uses	Potential Beneficial Uses
Machado Lake	Machado Lake	WARM, WILD, WET, REC-1, REC-2	None
	Wilmington Drain[(1)]	WARM, WILD, WET, REC-1, REC-2	None

Note:
(1) Beneficial uses based on the tributary rule (LARWQCB, 1994).

1.4.2 2010 Section 303(d) List

Section 303(d) of the Clean Water Act (CWA) requires that "Each State shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for 303(d) listed impaired waters and establish TMDLs for such waters. A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the water body to assimilate pollutant loadings (the Loading Capacity) is not exceeded. TMDLs are required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis.

Nutrient enrichment to Machado Lake has resulted in high algal productivity; algal blooms have been observed in the lake during summer months. High nutrient concentrations also contribute to excessive and nuisance macrophyte growth. Algae respiration and decay remove oxygen from the water column, leaving insufficient oxygen for fish and other organisms to breathe. The decay of algal blooms and other eutrophic related impairments can also create offensive odors. This nutrient enrichment, or nitrification of the ecosystem, causes impaired Warm Freshwater Habitat (WARM), Water Contact Recreation (REC 1), and Non-contact Water Recreation (REC 2) beneficial uses in Machado Lake. Because of the high nutrient concentrations, algal blooms, odors and eutrophic conditions, Machado Lake was placed on the Clean Water Act 303(d) list of impaired waterbodies in 1998, 2002, and 2006. A schedule for developing TMDLs in the Los Angeles Region was established in a consent decree (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA) approved on March 22, 1999.

The consent decree combined waterbody-pollutant combinations in the Los Angeles Region into ninety-two (92) TMDL analytical units. In accordance with the consent decree, the Nutrient TMDL addresses nitrogen and phosphorus compounds and related effects for Machado Lake (analytical unit #76).

1.4.2.1 Waterbody Pollutant Combinations

Machado Lake is listed in the 1998, 2002, 2006, and 2008 Clean Water Act 303(d) lists of impaired water bodies as impaired due to chlordane, DDT, Dieldrin, Chem A, and PCBs in tissue. In addition to these approved 303(d) listings, there are sufficient data to document chlordane, DDT, and PCB impairments in sediment. The impairments were addressed in the Toxics TMDL. Chem A chemicals are bioaccumulative pesticides, which include chlordane and Dieldrin, and were addressed specifically through chlordane and Dieldrin. Clean Water Act 303(d) listing for Machado Lake and Wilmington Drain are presented in Table 1.3. TMDLs have been completed for nutrients, toxics, and trash.

Identification of the water quality priorities is a key component of the EWMP process. Part VI.C.5.a (page 58-60) of the MS4 Permit outlines the pertinent elements of the prioritization process as follows:

1. Water quality characterization (VI.C.5.a.i, page 58) based on available monitoring data, TMDLs, 303(d) lists, storm water annual reports, etc.;
2. Water body-pollutant classification (VI.C.5.a.ii, page 59) to identify water body-pollutant combinations that fall into three MS4 Permit-defined categories;
3. Source assessment (VI.C.5.a.iii, page 59) for the water body-pollutant combinations in the three categories; and
4. Prioritization of the water body-pollutant combinations (VI.C.5.a.iv, page 60).

The three MS4 Permit defined categories are:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality based effluent limitations and/or receiving water limitations are established in Part VI.E, TMDL Provisions, and Attachments L through R of the Municipal Separate Stormwater Sewer System (MS4) Permit.
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Water Resources Control Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State's Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
- Category 3 (Medium Priority): Pollutants for which there is insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable water limitations contained in Order R4-2012-0175 and for which MS4 discharges may be causing or contributing to the exceedance.

The water body pollutant classifications (WBPCs) were classified into one of the three MS4 Permit categories (Category 1-3). Those WBPCs with a TMDL were classified as

Category 1, those WBPCs listed on the State's 303(d) list as impairing a particular water body segment were classified as Category 2, and those remaining WBPCs without an associated TMDL or on the State's 303(d) list, but showing exceedances of water quality criteria were classified as Category 3. A summary of these categorizations is presented in Table 1.3.

Table 1.3 Water Body Pollutant Combinations for Machado Lake Watershed

Water Body	Category 1 (TMDL)	Category 2 (303(d) List)	Category 3 (Other)
Machado Lake	Trash, Total Phosphorous, Total Nitrogen, Ammonia, Chlorophyll-a, PCB (sed.), DDT (sed.), Chlordane (sed.), Dieldrin (sed.), Dissolved Oxygen	None	*E. coli*, pH
Wilmington Drain	None	Coliform Bacteria, Copper (diss.), Lead (diss.)	Total Nitrogen, DDT (sed.), PCB (sed.), Chlordane, Dieldrin (sed.)

The Machado Lake Trash TMDL states that agencies can comply with the WLAs by installing full capture trash screens on catch basins that discharge into Machado Lake through a progressive eight-year implementation schedule. Full capture trash screen must be installed on 20 percent of a city's catch basins by March 6, 2012 with 20 percent more each year until 100 percent of catch basins have trash screens by March 6, 2016.

The City is complying with the TMDL requirements through a joint project with the Cities of Lomita, Carson, Rolling Hills Estates, Palos Verdes Estates, and Rancho Palos Verdes to install Automatic Retractable Screens and/or Connector Pipe Screens onto catch basins that are tributary to the Machado Lake. Work within the City of Torrance also includes the installation of No Parking signs for Street Sweeping within the portion of Torrance tributary to Machado Lake.

1.5 Objectives of the EWMP and Approach

This EWMP outlines the management actions that may be necessary to ultimately attain compliance with the Machado Lake Nutrient and Toxics TMDLs (LARWQCB, 2009), within the Implementation Area of the Machado Lake watershed. The EWMP also includes management actions to reduce copper, lead, and bacteria loads to the Wilmington Drain which eventually discharges into Machado Lake. The Wilmington Drain is listed on the State's 303(d) List for copper, lead, and coliform bacteria. The BMP Implementation Plan calls for an integrated, adaptive management approach to utilize available resources effectively and efficiently. As new information becomes accessible through monitoring, the continued study of drainage patterns, diagnosis of problem sources, and new technologies for dry and wet weather treatment, and the plan may be modified as necessary. Implementation of the management actions described by the plan depends on feasibility, available funding, site-specific conditions, and various other factors.

1.5.1 Focus of the Plan

The Machado Lake EWMP must include implementation methods, a schedule, and proposed milestones to achieve compliance of the TMDL WLAs. The EWMP development requires identifying and selecting BMPs to treat stormwater or reduce pollutant loads, as well as developing estimates of benefits in terms of load reductions to meet WLAs. However, the BMP selection process must consider the cost-effectiveness to provide assurance that plans are practical and implementable.

The goal of the EWMP is to address current TMDLs except trash, with consideration of future potential TMDLs. The nutrient TMDLs is considered the primary focus of this implementation plan. A secondary focus is placed on toxics through removal of suspended sediments that toxics are associated with. The third focus is placed on copper, lead, and bacteria. The fourth focus is on trash because reporting on progress toward the trash TMDL implementation occurs annually and through a separate process. However, proposed BMPs that address trash have the potential to provide added benefit in addressing other pollutants, which is assessed in this Implementation Plan. Total nitrogen (TN), total phosphorus (TP), copper, lead, and bacteria source characterizations are provided in the plan.

This EWMP includes integrated approaches that consider BMPs that can address multiple pollutants cost-effectively. Additional benefits of BMPs, such as water storage/recharge and reuse, providing recreation space, improved natural habitat, source control, and public education, are considered in this Implementation Plan.

This EWMP also describes management options that are limited to the portion of Torrance located within the Machado Lake watershed. This area is termed the *TMDL Implementation Area* (Implementation Area) in this report and is represented in red on Figure 1.1. Some of the proposed nonstructural or programmatic BMPs, such as staff training or education programs, could apply citywide.

The Rolling Hills Estates watershed is a tributary of the Implementation Area, and flows directly to Walteria Lake, therefore not addressed in this plan.

1.5.2 TMDL Target

Key factors influencing the level of BMP implementation are the stormwater management targets expected to be achieved. For this project, multiple TMDLs and associated WLAs for stormwater runoff have been established for Machado Lake, which must be considered as a priority for developing the BMP Implementation Plan. The following provides a summary of applicable wet weather TMDL WLAs and implementation requirements, and methods for translating the requirements into management targets to address wet weather pollution.

1.5.2.1 Nutrients

The Machado Lake Nutrient TMDL was developed by the LARWQCB on May 1, 2008. The U.S. Environmental Protection Agency (USEPA) approved the Nutrient TMDL on March 11, 2009, and the approval letter was posted on April 8, 2009. The Nutrient TMDL was developed to address nutrient-related beneficial use impairments including the following Section 303(d) listings: eutrophication, algae, ammonia, and odor.

The City is subject to the requirements of the Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL per the LARWQCB's Resolution R08-006. Under the Regional Board's resolution, the City shall submit to the Regional Board's Executive Officer a Monitoring and Reporting Plan (MRP) within 1 year of the effective date of the resolution or propose a Special Study Work Plan following the requirements of one of three optional studies. The Special Study Work Plan details the approach proposed by the City to perform Optional Study No. 3, to assess compliance with the WLA on a mass basis for total nitrogen and total phosphorus originating from the City's Implementation Area. The Special Study Work Plan is complete and turned in to the Regional Board.

Resource agencies, local governments, project implementers, the scientific community, environmental groups, decision-makers at the city, county, state, and federal levels, and many others have continued to take meaningful steps towards the restoration of Machado Lake and its basin. Among these efforts, restoration activities are expanding through continued implementation of erosion control, stormwater management, and riparian restoration projects, development of the Machado Lake Nutrient TMDL that is providing a quantitative, science-based approach for pollutant reduction, and a strong research/monitoring effort to evaluate key ecological processes and response to water quality improvement projects. The Machado Lake Nutrient TMDL allows for the establishment of annual mass-based WLAs for TP and TN equivalent to monthly average concentrations of 0.1 milligram per liter (mg/L) TP and 1.0 mg/L TN, based on approved flow conditions. When the concentration based WLAs are met under the approved flow condition of 8.45 hm^3/yr (cubic hectometers or million cubic meters/year), the annual mass of the TP discharged to the lake will be 845 kilogram (kg) and the annual mass of TN discharged to the lake will be 8,450 kg. The City accounts for about 30 percent of the Machado Lake Watershed. Table 1.4 lists the interim and final WLAs based on this area. The interim WLAs for both total phosphorus and total nitrogen have been met as shown in Appendix B.

Table 1.4 Interim and Final WQBELS for Machado Lake Nutrient TMDL

	Dry Weather		Wet Weather	
Nutrient TMDL	**Interim WLA**	**Deadline**	**Final WLA**	**Deadline**
Total Phosphorus	1.25 mg/L	March 11, 2014	0.1 mg/L	September 11, 2018
Total Nitrogen	2.45 mg/L	March 11, 2014	1.0 mg/L	September 11, 2018

1.5.2.2 Toxics

Machado Lake is listed as impaired for chlordane, Chem-A, DDT, Dieldrin, and PCBs. The LAWQCB adopted the Machado Lake Toxics Total TMDL on September 2, 2010 (LARWQCB, 2010) and was approved by the State Water Quality Control Board and the USEPA. The pollutants listed within the Toxics TMDL include organochlorine (OC) pesticides and polychlorinated biphenyls (PCBs). These pollutants are associated with suspended sediments; therefore, the WLAs were calculated based on the fraction of suspended solids loading produced by each stormwater discharger, and assigned for both dry and wet weather. Compliance is measured either at the storm drain outfall of the permittee's drainage area, at representative storm drain outfalls representing the combined discharge of cooperating parties (if a coordinated compliance option is chosen by multiple permittees), or at an alternative compliance point approved by the Regional Board Executive Officer.

The WLAs assigned to Municipal Separate Storm Sewer Systems (MS4) permittees in the Toxicity TMDL BPA are concentration-based allocations (equal to the sediment numeric targets), and are listed in Table 1.5. The Toxics TMDL requires compliance with these WLAs by September 30, 2019.

Suspended solids serve as carriers of toxics such as pesticides, dioxins and PCBs. Removal of suspended solids therefore, will also lead to toxics removal. This EWMP addresses toxics through the removal of sediments. Removal of toxics is calculated as a fraction of suspended sediments removed by proposed stormwater treatment devices. This EWMP relied on toxics data developed from the Dominguez Channel Flow Monitoring Program.

Estimated baseline load for toxics is presented in Section 3 of this report.

Table 1.5 MS4 Permittees Toxics TMDL Waste Load Allocations

Parameter of Concern	Numeric Target for Sediment Concentration (µg/kg dry weight)	Waste Load Allocation for Suspended Sediment-Associated Contaminants(1) Concentration (µg/kg dry weight) Period	Waste Load Allocation for Suspended Sediment-Associated Contaminants(1) Compliance Averaging Period
Total PCBs	59.8	59.8	3-year average
DDT (all congeners)	4.16	4.16	3-year average
DDE (all congeners)	3.16	3.16	3-year average
DDD (all congeners)	4.88	4.88	3-year average
Total DDT	5.28	5.28	3-year average
Chlordane	3.24	3.24	3-year average
Dieldrin	1.9	1.9	3-year average

Note:
(1) The WLA applies to all MS4 Permittees including the County, Caltrans, General Construction and, industrial Stormwater Permittees, and other non-stormwater NPDES Permittees.

1.5.2.3 Bacteria, Copper and Lead

The Implementation Area contributes runoff to the Wilmington Drain, Project 77, and Project 510 storm drain lines as shown on Figure 1.3. Over 80 percent of the Machado Lake Subwatershed drains to Machado Lake through Wilmington Drain. Wilmington Drain is listed on the State's 303(d) List for copper, lead, and coliform bacteria. Table 1.6 shows the compliance schedule.

Table 1.6 Summary of Schedule for Interim and Final Milestones

Pollutant	Schedule Interim (09/30/17)	Schedule Final (09/30/32)	Source
Lead	122.88 µg/L	42.7 µg/L	Vehicle brake pads, atmospheric deposition, soil erosion
Copper	898.87 µg/L	69.7 µg/L	Vehicle tires, galvanized metal, atmospheric deposition
Fecal Coliform	REC-2 WQO 4000 #/100 mL(1)		Wastewater treatment plants, on-site septic systems, domestic and wild animal manure

Note:
(1) Obtained from Los Angeles Regional Water Quality Control Board (LARWQCB) Basin Plan Chapter 3 titled Water Quality Objectives, dated May 2, 2013 Section on In Waters Designated for Non-contact Water Recreation (REC-2)

1.5.2.4 Trash

The Machado Lake Trash TMDL requires that trash be eliminated in Machado Lake and on its shoreline either through assessment and collection or installation of full capture systems on discharges to the lake. The City is identified as a point source for trash based on being a permittee under the Los Angeles County Municipal Separate Storm Sewer System (MS4) NPDES permit. Based on the Machado Lake TMDL, the City's WLA is zero trash, meaning no trash may be discharged to the lake through the City's storm drains which discharge stormwater to the lake.

Figure 1.4 Automated Retractable Screens

The Machado Lake Trash TMDL became effective in March 2008. The trash monitoring and reporting plan (TMRP) was submitted to the LARWQCB in September 2008, and conditionally approved in December 2008. The City has implemented trash controls in the drainage areas to comply with March 6, 2016 final deadline. Therefore no further trash controls are proposed in this EWMP. The trash control project installed Automated Retractable Screens (ARS) and Connector Pipe Screen (CPS) systems as shown on Figure 1.4 that capture debris and prevent it from entering the Storm Drain System.

1.5.3 <u>Scheduled Total Maximum Daily Load</u>

Wilmington Drain, to which all of the County areas drain shown on Figure 1.1, is listed in the 303(d) list as impaired for metals (copper and lead) and bacteria. The additional pollutants of concern listed in Machado Lake are scheduled for TMDL development in 2014 or 2019. This EWMP also addresses metals and bacteria impairments in Wilmington Drain.

1.6 Reasonable Assurance Analysis and Watershed Control Measures

As part of the EWMP plan, a Reasonable Assurance Analysis (RAA) is conducted on a watershed level. The RAA consists of an assessment, through quantitative analysis or modeling, to demonstrate that the activities and control measures (i.e., BMPs) identified in the Watershed Control Measures section of the EWMP are performed to demonstrate that applicable water quality based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term will be achieved.

Watershed Control Measures are subdivided into:

- Minimum Control Measures,
- Non-Stormwater Discharge Measures,
- TMDL Control Measures, and
- Other control measures.

Schedules are developed for strategies, control measures, and BMPs to be implemented. The schedules will measure progress every two years during the permit term and incorporate:

1. Compliance deadlines occurring within the permit term for all applicable interim and/or final water quality based effluent limitations and/or receiving water limitations to implement TMDLs,
2. Interim deadlines and numeric milestones within the permit term for any applicable final water quality based effluent limitation and/or receiving water limitation to implement TMDLs, where deadlines within the permit term were not otherwise specified, and
3. Watershed priorities related to addressing exceedances of receiving water limitations.

1.7 Adaptive Management

An adaptive management process will be implemented every two years from the date of program approval, adapting the EWMP to become more effective, based on, but not limited to the following:

1. Progress toward achieving the outcome of improved water quality in MS4 discharges and receiving waters through implementation of the watershed control measures.
2. Progress toward achieving interim and/or final water quality based effluent limitations and/or receiving water limitations, or other numeric milestones where specified, according to established compliance schedules.
3. Achievement of interim milestones.
4. Reopening of TMDLs.
5. Re-evaluation of the highest water quality priorities identified for the Watershed Management Area based on more recent water quality data for discharges from the MS4 and the receiving water(s) and a reassessment of sources of pollutants in MS4 discharges.

6. Availability of new information and data from sources other than the Permittees' monitoring program(s) within the Watershed Management Area that informs the effectiveness of the actions implemented by the Permittees.

7. Regional Water Board recommendations.

8. Recommendations for modifications to the EWMP solicited through a public participation process. Based on the results of the iterative process, modifications necessary to improve the effectiveness of the EWMP will be reported in the Annual Report, and as part of the Report of Waste Discharge (ROWD).

Any necessary modifications to the EWMP will be implemented upon acceptance by the Regional Water Board Executive Officer within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

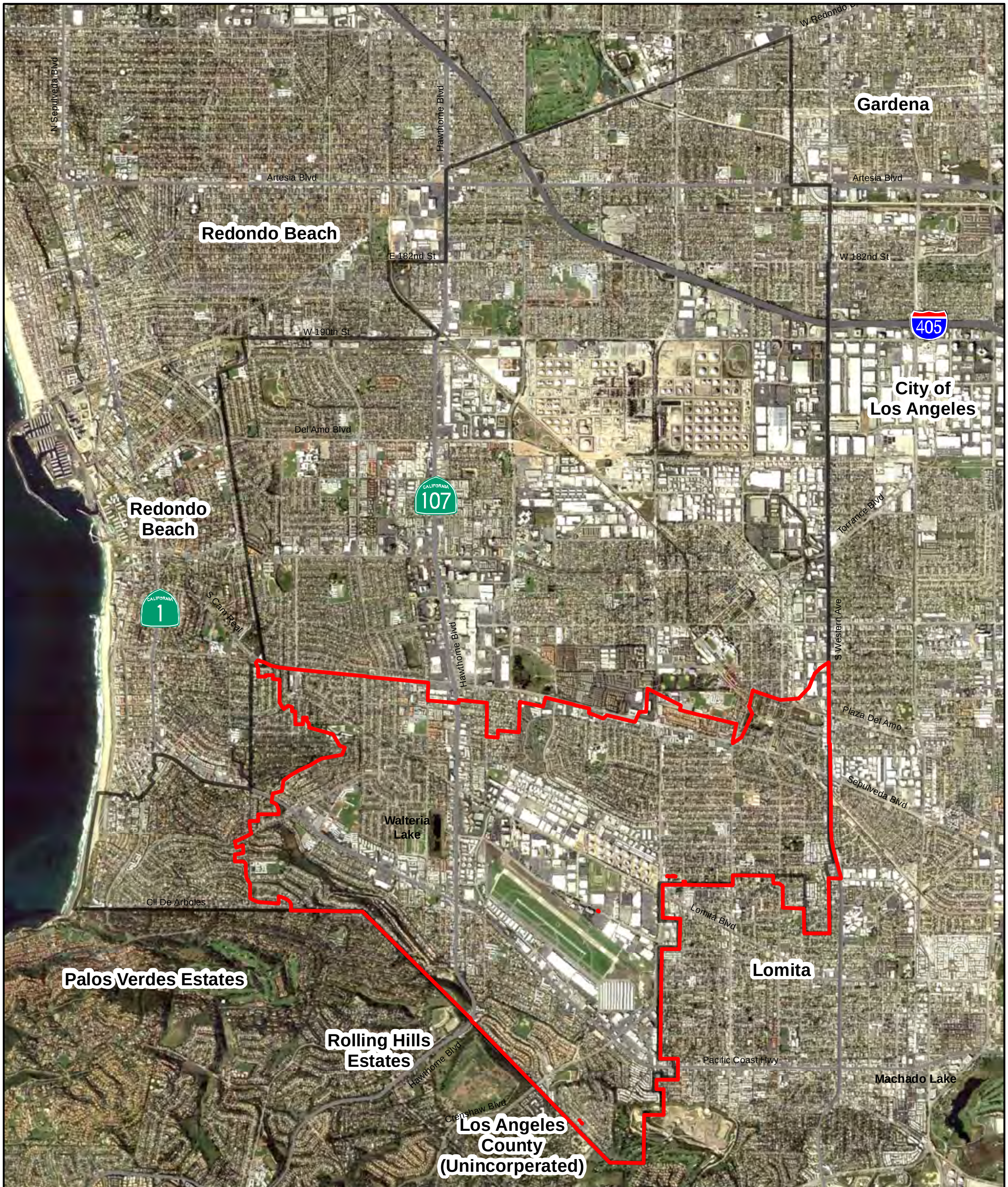
2.0 CITY OF TORRANCE TMDL IMPLEMENTATION AREA

The City is located about 15 miles south of Downtown Los Angeles (LA), in southern LA County, just north of the Palos Verdes Hills. The City was incorporated on May 12, 1921, and is just over 20.5 square miles in area. The City is bounded by Redondo Beach on the west and north, Lawndale and Gardena on the north, LA on the east, Lomita to the southeast, and Rolling Hills Estates and Palos Verdes Estates on the south. The City is also bounded by approximately 4,000 feet of Santa Monica Bay coastline. The City's storm conveyance systems are interconnected with neighboring city systems. Neighboring cities located at generally higher elevation such as Rolling Hills Estate and Palos Verde Estate discharge stormwater into the City's and/or LA County's storm conveyance systems located within the City's boundaries. Figure 2.1 shows an aerial view of the watershed and Figure 2.2 gives an overview of land uses in the Implementation Area.

The Implementation Area is about 4,241 acres, which equals approximately 32 percent of the City of Torrance. The Implementation Area also includes a very small area of Redondo Beach that drains directly to a Torrance catch basin. The land use category with the largest proportion within the Implementation Area is residential (43 percent), while open space accounts for about 18 percent. Residential land uses include high-density single family (HDSF), multi-family residential (MFR), and mobile homes. The land uses in the Implementation Area are listed in Table 2.1.

Table 2.1 Land Use in TMDL Implementation Area

Land Use	Acreage	% TMDL Implementation Area
Residential	1,810	43
Commercial	419	10
Industrial	256	6
Transportation	996	23
Open Space	758	18
Total	**4,239**	**100**



Legend

Project Area
City Boundary
Freeway
Major Roads

0 0.5 1 Miles

Figure 2.1
Overview of TMDL Implementation Area
BMP Implementation Plan
City of Torrance

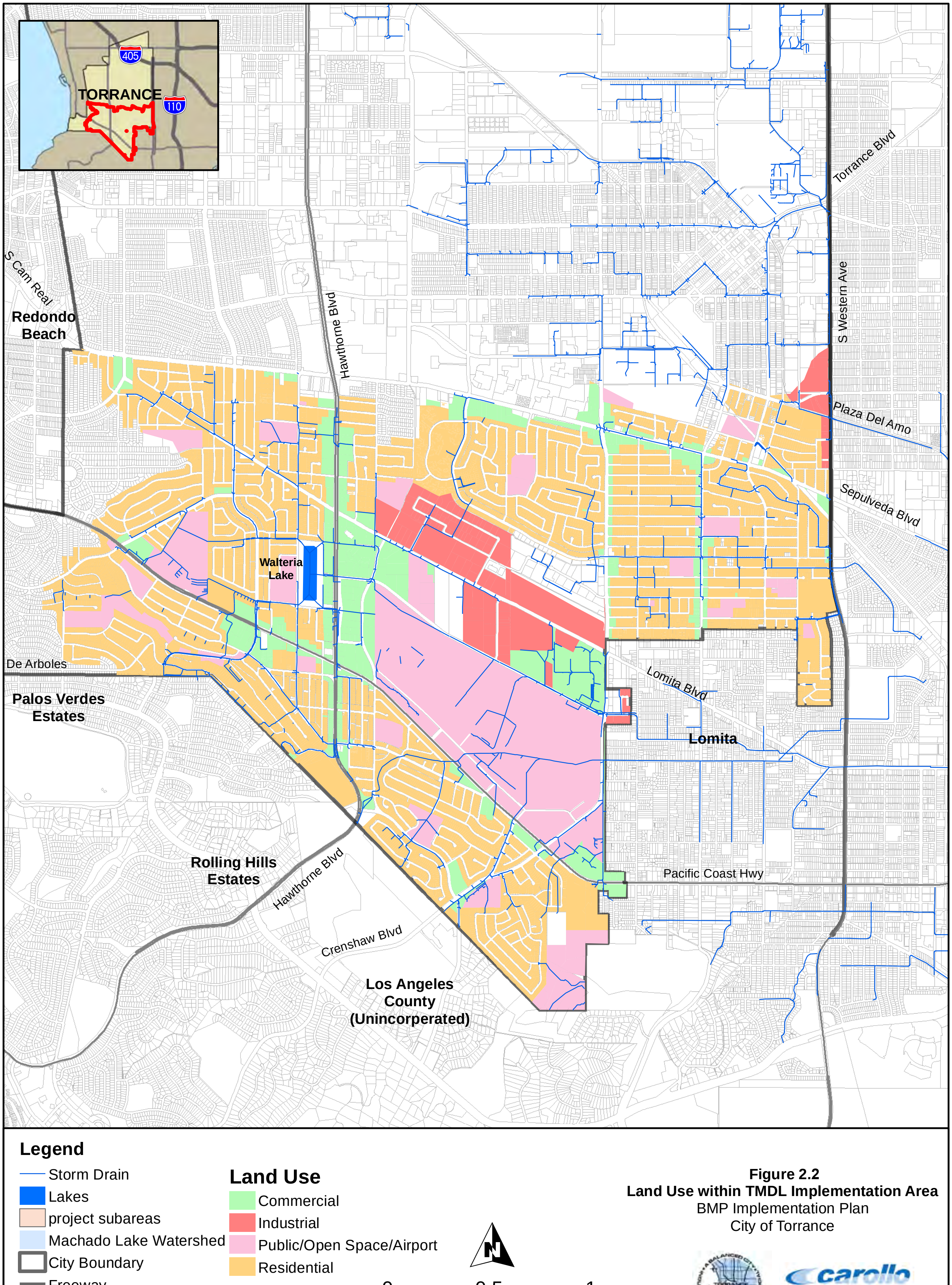


Figure 2.2
Land Use within TMDL Implementation Area
BMP Implementation Plan
City of Torrance

2.1 Geologic Setting and Soil

The soils found within the Machado Lake watershed are predominantly loam and clay. The most common soil type is Ramona Loam, which is observed in the Implementation Area. Ramona Loam is a compact soil with a large runoff coefficient at high rates of precipitation. Areas such as the Rolling Hills Estates and the lands along Highway 1 are composed of several different classifications of clay and loam such as Diablo Clay Loam and Montezuma Clay. Surficial soil infiltration rates range from about 0.027 to 0.81 inches per hour.

The predominant soil types found in the Implementation Area are listed by percentage in Table 2.2. The soil types found across the Implementation Area are displayed on Figure 2.3.

Table 2.2 Soil Types Distribution

Soil Classification[1]	Percentage of Soil within TMDL Implementation Area
Ramona Loam	21.4%
Yolo Sandy Loam	8.0%
Dublin Clay Adobe	35.3%
Oakley Fine Sand	35.4%
Total	**100.0%**

Note:
(1) LACDPW 2006 Hydrology Manual

2.2 Watershed Hydrology

As shown on Figure 1.1, the Machado Lake watershed is located in the southwestern area of the Dominguez Channel watershed and includes portions of the Cities of Los Angeles, Torrance, Lomita, Rolling Hills, Rolling Hills Estates, Carson, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, and the communities of unincorporated Los Angeles County, including Wilmington and Harbor City. As shown, a large portion of the Machado Lake watershed consists of the hilly regions of Rolling Hills Estates and Rolling Hills. This portion of the watershed is unique, as it consists of relatively steep hills with drainage into the canyons.

Machado Lake is about 40 acres in area, while the Machado Lake wetlands cover an area of approximately 64 acres. The lake and wetlands are located within the Ken Malloy Harbor Regional Park in the southeastern corner of the Machado Lake Watershed. Both Machado Lake and the Machado Lake wetlands serve as flood retention basins for the Machado Lake Watershed.

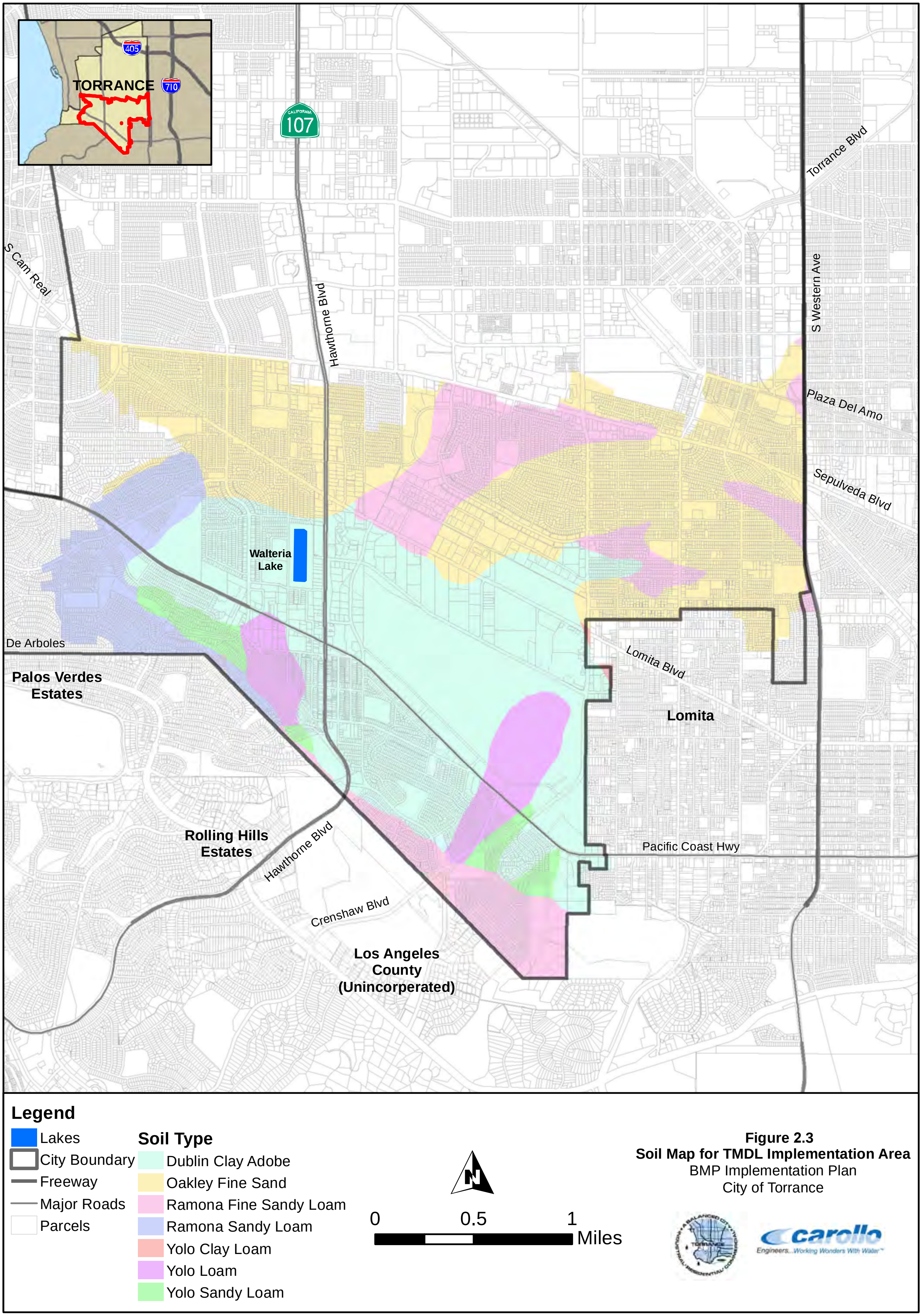


Figure 2.3
Soil Map for TMDL Implementation Area
BMP Implementation Plan
City of Torrance

2.3 Watershed Hydraulics

As the Implementation Area is highly urbanized, stormwater drainage is primarily conducted through an extensive network of underground storm drain facilities. The Los Angeles County Department of Public Works maintains the system of storm drains in the City of Rolling Hills Estates. The primary use of the Dominguez Channel and all other open channels in the Dominguez Channel watershed (including Wilmington Drain, Machado Lake, and Madrona Marsh) is flood protection.

Machado Lake receives urban and storm water runoff from a complex network of storm drain systems. The first of three primary storm drain channels that flow into Machado Lake is the Wilmington Drain. Approximately 65 percent of the runoff from the Machado Lake Watershed flows through the Wilmington Drain into Machado Lake. The other two primary storm drain channels as shown on Figure 1.2 are the Project No. 77 Drain and the Harbor City Relief Drain. Several smaller storm drains also discharges into Machado Lake, including Project No. 643’s Figueroa Street Outlet and a 72-inch diameter storm drain outlet. Machado Lake discharges at the southern end by overflowing a concrete dam into the Machado Lake wetland. Water discharges from the wetland through the Harbor Outflow structure and into the West Basin of the Los Angeles Harbor.

The Walteria Lake, located within the City’s boundaries, is owned and operated by LA County Flood Control District. It is approximately 1,005 acre-feet in capacity and receives raw stormwater mainly from Rolling Hills Estates, Palos Verdes Estates, and the City of Torrance. Effluent from the lake is pumped at a maximum rate of 57 cubic feet per second (cfs) through a force main system into a 54-inch diameter drain line that lies under Skypark Drive. The discharge eventually leaves the City near the intersection of Crenshaw Boulevard and Amsler Street.

3.0 POLLUTANT SOURCE CHARACTERIZATION AND PRIORITIZATION

This section identifies the potential sources of the pollutants of concern derived from both point and nonpoint sources. The discussion is provided in several parts: monitoring reports, modeling results, specific pollutant sources, and a source prioritization. Watershed monitoring results are summarized for reference in Appendix B. The focus of this characterization and prioritization is primarily within the Implementation Area. Both wet and dry conditions are discussed. The City's Pollutant Load and Analysis Tool (PLAT) was used to quantify the baseline pollutant loading of nutrients and other pollutants from the Implementation Area.

3.1 Characterization of Stormwater and Non-stormwater Discharge Quality

In order to begin to identify the sources of pollutants identified in the Waterbody Pollutant Categorization and prioritize implementation measures to address them, an analysis of stormwater and non-stormwater discharges from the MS4 was conducted using available data and information, including the following sources:

- Monitoring Reports and Data
  - Machado Lake Special Study
  - Port of Los Angeles Ambient Water Quality Monitoring Data (2005-2008)
  - City of Los Angeles Machado Lake Nutrient TMDL Monitoring Data (2011-2012)
  - County of Los Angeles Machado Lake Nutrient TMDL Monitoring Data (2012)
  - Los Angeles County 1994-2000 Integrated Receiving Water Impacts Report
- Basin Plan Amendments
  - Machado Lake Trash TMDL
  - Machado Lake Pesticides and PCBs TMDL
  - Machado Lake Nutrient TMDL

3.1.1 Machado Lake Special Study - Nutrient TMDL Monitoring

To meet the Nutrient TMDL's Optional Study #3 requirements and the aforementioned objectives, an approach that utilized existing water quality sampling information, and hydrologic modeling to characterize current wet and dry weather loading from the Implementation Area was followed. The Nutrient TMDL's Optional Study #3 is one of the main monitoring reports and data reviewed for this EWMP. Water quality samples were collected monthly at each monitoring location. During the wet season, dry weather sampling events were scheduled seven days after measurable precipitation, or after flow rates had returned to base levels typical of the season, whichever period was shorter.

A total of eight monitoring sites were selected for the Special Study. The characteristics of the monitoring sites are presented in Tables 3.1 and 3.2. Figure 3.1 shows the monitoring sites and associated drainage areas. Drainage areas were determined using GIS layers, provided by the City, of storm drains and the flow paths of Wilmington Drain. Land use calculations were determined using a GIS layer obtained from the City.

Monitoring for nitrogen and phosphorus constituents was performed during the Special Study. The monitoring results for total nitrogen, total phosphorus, and flow rate are displayed on Figure 3.2 and summarized in Table 3.3. Table 3.3 shows data gathered during the flow monitoring period between February and December of 2012. This data was used characterize the pollutants generated within the Implementation Area and also used for model calibration. The amount of pollutants entering the City from neighboring cities is represented by monitoring locations Tor-S6, Tor-S7, and Tor-S9. Monitoring sites Tor-S1, Tor-S2, Tor-S4 and Tor-S5 measure pollutants and flow leaving the city boundary. The locations of monitoring sites Tor-S1 through Tor-S9 are indicated on Figure 3.1 as S1 through S9.

The water quality sampling data was reviewed to identify whether site location or the timing of events affected the concentrations observed. The data set was reviewed in this way by constituent group, constituent, and, as necessary, constituent fraction (e.g., total and dissolved phosphorus). An analysis of sample variance showed that neither the site location nor event timing had any significant effect on the concentrations of the constituents measured during the study.

3.2 Potential Sources of Pollutants of Concern

The pollutants addressed in this section are toxics, metals, nutrients, bacteria, and trash. To generally describe the potential sources in the watershed, pollutant sources have been divided into the following categories: NPDES sources, road infrastructure, atmospheric deposition, and wastewater from sanitary sewer and SSOs. Typical sources of these pollutants are summarized in Table 3.4.

Table 3.1 Monitoring Sites for the Special Study - Nutrient TMDL Monitoring

Sampling Location Name	Map ID	Description	Primary Land Use	Lat-/ Long-itude	Upstream Storm Drain Name	Diameter (in) and Material
Tor-S1	S1	Located 40 ft north and 80 ft east of the intersection of Plaza Del Amo and Western Avenue. Basin name.	RES	33.82/ 118.31	City	36 RCP
Tor-S2	S2	Approximately 50 ft west of 246th Place and Pennsylvania Avenue intersection.	RES	33.80/ 118.33	City	33 RCP
Tor-S3	S3	Effluent of Walteria Lake, approximately 300 ft west of Hospital Drive and Skypark Drive intersection.	RES	33.81/ 118.35	Walteria Lake	54
Tor-S4	S4	Approximately 210 ft north and 85 ft east of 236th Street and Western Avenue intersection.	RES	33.81/ 118.31	City	9'-2"Wx11'H RCB
Tor-S5	S5	About 25 ft west of intersection of Bani Avenue and 250th Street (two pipes intersect from south and west).	RES	33.80/ 118.33	City	8'-9"Wx9'-7"H RCB
Tor-S6	S6	Approximately 600 ft east of Estates Lane and Crenshaw Boulevard.	RES	33.79/ 118.34	Rolling Hills E.	36 RCP
Tor-S7	S7	About 730 ft south of Rolling Hills Road and Madison Street intersection. Will monitor dry weather flow originating from Rolling Hills Estates.	RES	33.79/ 118.35	Rolling Hills E.	10'x10' RCB
Tor-S9	S9	About 830 ft east and 120 ft south of Paseo de las Tortugas and Vista Montana intersection. Will monitor dry weather flow originating from Palos Verdes Estates.	RES	33.80/ 118.36	Palos Verdes Estates	42 RCP

Legend

- Sampling Location
- Storm Drain
- Project Area
- City Boundary
- Freeway
- Major Roads

0 0.5 1 Miles

Figure 3.1
Special Study Sampling Locations
BMP Implementation Plan
City of Torrance

Table 3.2 Monitoring Site Drainage Areas and Majority Land Use

Monitoring Site	Map ID (on Figure 4)	Drainage Area (ac)	Predominant Land Use
Tor-S1	S1	155	Residential
Tor-S2	S2	248	Residential
Tor-S3	S3	2,115	Residential
Tor-S4	S4	852	Residential
Tor-S5	S5	797	Residential
Tor-S6, Tor-S7 and Tor-S9 drainage basin outside City of Torrance			

Table 3.3 Total Flow (gallons) and Total Mass (kg) of Nitrogen and Phosphorous During the Flow Monitoring Period - February and December of 2012

Monitoring Site	Total Annual Flow (Gallons)$^{(1)}$	Total Nitrogen (kg)	Total Phosphorous (kg)
Walteria Lake Pumping Event (May 29 through June 5, 2012)			
Tor-S3[3]	5,557,715	30.5	4
<u>Total Flow Leaving the City</u>			
Tor-S1	114,947	0.6	0.1
Tor-S2	1,530,700	8.3	1.8
Tor-S4	2,079,514	13	1.5
Tor-S5	79,603,481	3,610	553
TOTAL	**83,328,643**	**3,632**	**557**
<u>Total Flow Entering the City</u>			
Tor-S6	134,162	0.7	0.1
Tor-S7	7,480,023	57	4.8
Tor-S9	1,337,848	6.5	1.6
TOTAL	**8,952,033**	**63.99**	**6.5**
Flow Generated from TMDL Area	**68,818,895**	**3,533**	**546**

<u>Note:</u>
(1) Discharge from Walteria Lake During Pumping (March 7 and December 31, 2012).

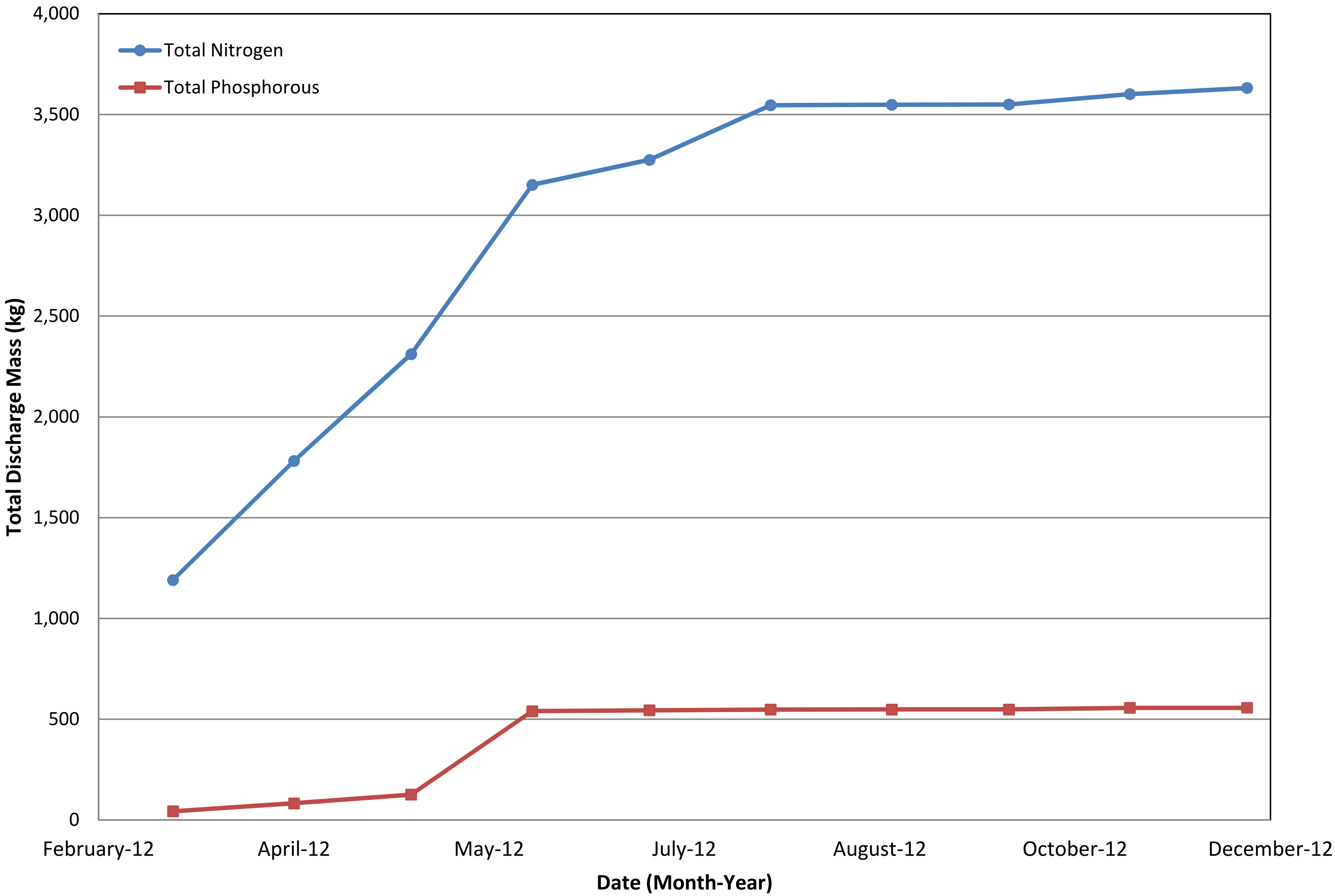


Figure 3.2 - Cumulative Nutrient Load Leaving City Boundary

Table 3.4 Typical Sources of Pollutants*

Pollutant Source	Pollutants: Bacteria	Nutrients	Metals	TSS	Trash	Key Reference (Appendix A 1-12)
NPDES Sources						
Residential land areas	●	●		●	●	1, 2, 3, 4, 5, 6
Agricultural activities (i.e., animal operations)	●	●		●		7, 8, 8
Construction activities			●			7, 9
Industrial/municipal activities	●		●	●	●	6, 10
POTW discharges			●			11
Landscaping, fertilizers		●				7, 9
Pet waste	●	●				9
Wildlife	●					7, 1
Native geology		●				7, 1
Land surface erosion				●		7
Detergents		●				9
Car washing				●		7, 9
Road Infrastructure						
Transportation sources (i.e., tire wear)						7, 9, 12, 13
Pavement erosion				●		7, 14
Atmospheric Deposition						
Construction activities			●			7, 9
Roofing			●			7
Resuspension of historic emissions in road dusts and soil particles			●			15
Land surface erosion		●				16
Sanitary Sewers SSOs						
Sewer leaks, sanitary sewer overflows (SSOs), illicit discharges, septic systems	●	●		●		7, 5, 17
POTW discharges		●	●			12

Note:
* City of San Diego and Caltrans 2012. Tecolote Watershed Comprehensive Load Reduction Plan. Final Report. San Diego, CA.

3.2.1 NPDES Sources

There are two categories of pollutants sources, point sources and non-point sources. Point source discharges are regulated through National Pollutant Discharge Elimination System (NPDES) permits. Point sources include stormwater and urban runoff through the MS4 and other NPDES discharges. Stormwater runoff in the Implementation Area is regulated through several types of permits including MS4 permits, a statewide stormwater permit for Caltrans; a statewide Construction General Permit (CGP); and a statewide Industrial General Permit (IGP). The NPDES IGP regulates stormwater discharges and authorized non-stormwater discharges from several specific categories of industrial facilities, including manufacturing facilities, landfills, and transportation facilities. Furthermore, the NPDES CGP regulates stormwater discharges from construction sites that result in land disturbances equal to or greater than one acre. Point source discharges from IGP, CGP, residential, commercial and transportation activities can be a significant source of pollutant loads.

Non-point sources, by definition, include pollutants that reach waters from a number of land uses and are not regulated through NPDES permits. Non-point sources include existing contaminated sediments within the watershed and direct air deposition to the waterbody surface. These sources can enter the MS4 and contribute pollutants through it to receiving waterbodies.

The following provides additional discussion regarding the presence of pollutants in stormwater runoff within the Implementation Area.

3.2.1.1 Copper and Lead

While the available Annual Reports do not indicate a clear source of lead in this subwatershed, the Regional Board Final Staff Report for the TMDL for Metals in Ballona Creek states that urban runoff, or the wash-off of pollutant loads accumulated on the land surface, is likely a substantial source of metals during both wet and dry weather (Regional Board, 2005). Indirect atmospheric deposition was estimated to account for 19 percent of the typical annual load for lead in the Ballona Creek Watershed (LARWQCB, 2005). Wet weather EMCs for lead, based on the Los Angeles County EMC dataset, show that the highest concentrations are expected from agricultural land uses, followed in order by industrial, commercial, high density single family residential, and transportation, multi-family residential, educational, and open space land uses (Geosyntec Consultants Wright Water Engineers, 2012). Other Los Angeles region land use studies have found that high density single family residential has the highest EMCs, followed by industrial and commercial land uses (Stein et al., 2007). These potential sources were evaluated for BMP implementation as part of the RAA.

3.2.1.2 Bacteria

Fecal coliform is listed in the 303d list for Dominguez Channel. Fecal Coliforms are used as indicator of possible sewage contamination because they are commonly found in human and animal feces. Although they are generally not harmful themselves, they indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoans that also live in human and animal digestive systems. Therefore, their presence in streams suggests that pathogenic microorganisms might also be present and that swimming and eating shellfish might be a health risk. Since it is difficult, time-consuming, and expensive to test directly for the presence of a large variety of pathogens, water is usually tested for coliforms and fecal streptococci instead. Antroponic sources of fecal contamination to surface waters include wastewater treatment plants, on-site septic systems, domestic and wild animal manure, and storm runoff. Non-antropogenic sources of fecal coliform include soils, (sediments), vegetation, decaying organic material, biofilms/regrowth, and atmospheric deposition.

3.2.1.3 Nutrient

Excessive input of nutrients (such as nitrogen and phosphorus) is the primary cause of eutrophication of surface waters, in which excess nutrients stimulate algal growth which leads to increased turbidity, decreased levels of oxygen, and odor problems. Possible sources of nutrients include runoff from residential and commercial areas due to landscaping activities and use of fertilizer for lawns and gardens. Activities such as washing cars can contribute nutrients to the watershed since many of the detergents used contain phosphorus. Other sources of nutrients include food wastes and domestic animal waste. These pollutants build up and are then washed into the waterways through the storm drain system when it rains. These kinds of loads are typically highest during the first major storm flush and even after extended periods of dry weather when pollutants have accumulated. Other major categories of nutrients sources include:

- Manure - Within the Implementation Area equestrian activities are not very common within private and public stables, and residential areas. Horse manure, if improperly managed, has the potential to pose a significant source of nutrients in runoff.
- Golf courses – golf courses are a major source of nutrients since fertilization activities and watering rates are generally much greater than in residential and commercial areas. The excess nutrients accumulated in the soils can be transported to waterways through excessive irrigation or stormwater runoff.
- Air deposition of nitrogen due to air pollution, the predominate species being NHO_3 (nitric acid), NO_2 (nitrogen dioxide) and NH_3 (ammonia).
- Agricultural land use is limited in the Implementation Area and therefore is not a significant source of nutrients.

3.2.1.4 Toxics

The most significant toxic pollutants including legacy pollutants are PAH compounds, PCBs, DDT, chlordane, and dieldrin. Non-point sources of toxics may include leaking motor oil, tire wear, and vehicular exhaust. Polychlorinated biphenyls (PCBs) are mixtures of synthetic organic chemicals that were commonly used for various applications from approximately 1929 until 1979 when the U.S. banned PCB manufacturing, processing, distribution, and use. PCBs are a ubiquitous environmental contaminant and, like DDT, they have persisted in the aquatic environment and continue to accumulate in fish tissue even though production of PCBs was banned 25 years ago. PCBs may also still exist in products made before 1977 such as transformers, old fluorescent lighting fixtures, household caulking, paints, and waxes (USEPA).

3.3 Reasonable Assurance Analysis Approach

A key element of the EWMP is the Reasonable Assurance Analysis (RAA), which is prescribed by the Permit as a process to demonstrate “that the activities and control measures will achieve applicable WQBELs and/or RWLs with compliance deadlines during the Permit term” (Permit Section C.5.b.iv.(5), page 63). While the Permit prescribes the RAA as a quantitative demonstration that identified watershed control measures will be effective, the RAA also promotes a modeling process to support the EWMP Group with selection of control measures. In particular, the RAA was used to evaluate the many different scenarios/combinations of institutional, distributed, and regional control measures that could potentially be used to comply with the RWLs and WQBELs of the Permit, and was then used to select the control measures specified in the EWMP Implementation Plan.

This section describes key elements of the RAA including the following:

- Modeling system used for the RAA
- Baseline critical conditions and required pollutant reductions
  - Baseline model calibration
  - Water quality targets
  - Critical conditions for wet weather and dry weather
  - Selection of limiting pollutants
  - Required interim and final pollutant reduction
- Representation of control measures in RAA
- Approach for selecting control measures for the EWMP Implementation Plan

The purpose of the RAA is to demonstrate that the implementation scenarios proposed in the EWMP will meet the MS4 Permit effluent and receiving water limits for priority pollutants of concern within the Implementation Area. This is done by demonstrating load reductions for the 85th Percentile, 24-hour storm and the 90th percentile load. Load reductions are used instead of concentrations. This is necessary for two reasons: first, the entire watershed is not participating as part of the this EWMP and the approaches they are taking may be different than Torrance; second, capture and infiltration systems will reduce the loads delivered, but may not change concentrations of flows that reach the regulated water bodies. Total loads in the water bodies will be tied to contributions from all entities within the watershed. For these reasons, load reductions are considered a better metric for analysis.

3.3.1 RAA Modeling System Used

The City developed a Stormwater Quality Master Plan (SQMP) in 2011 to address increasingly stringent regulatory requirements and stormwater related issues caused by continued development pressure. As part of the SQMP, the portion of the Machado Lake Watershed within the City was modeled utilizing a tool referred to as the PLAT, a module linking a number of publicly available models including: USEPA's PLOAD, the Program for Predicting Pollution Particle Passage thru Pits, Puddles, & Ponds (P8), USEPA's SWMM 5.0, and USEPA's SUSTAIN. WMMS and N-SPECT model (Nonpoint Source Pollution and Erosion Comparison Tool) were used to validate PLAT model results. The general concept of PLAT is illustrated on Figure 3.3.

Even though PLAT was developed before the guidelines (RWQCB, 2014) for developing a RAA was published, only few enhancements were made to meet RAA modeling requirements. The enhancements include converting the original XP-SWMM model (a proprietary software) to EPA SWMM 5.0 model. PLAT methodology is comprised of three main evaluations:

1. Model Calibration/verification – In the absence of field data specific to Torrance, LA County WMMS and N-SPECT models were used to calibrate/validate some modules of PLAT.
2. Annual load estimation and initial BMP Screening. – impervious cover information derived from satellite imagery, EMC and PLOAD model were used to compute annual pollutant load, characterize pollutant hotspots, and perform initial BMP screening analysis to select BMPs for detailed evaluation.
3. Detailed Load and BMP Evaluation – Uses EPA SWMM 5, P8, and SUSTAIN models for comprehensive water quality modeling to identify priority subbasins based on BMP need, BMP sizing and optimization, and evaluation of management alternatives.
4. The USEPA SWMM 5.0 and P8 models are the two main components of PLAT used to develop this RAA. SWMM and P8 models are described in more details below.

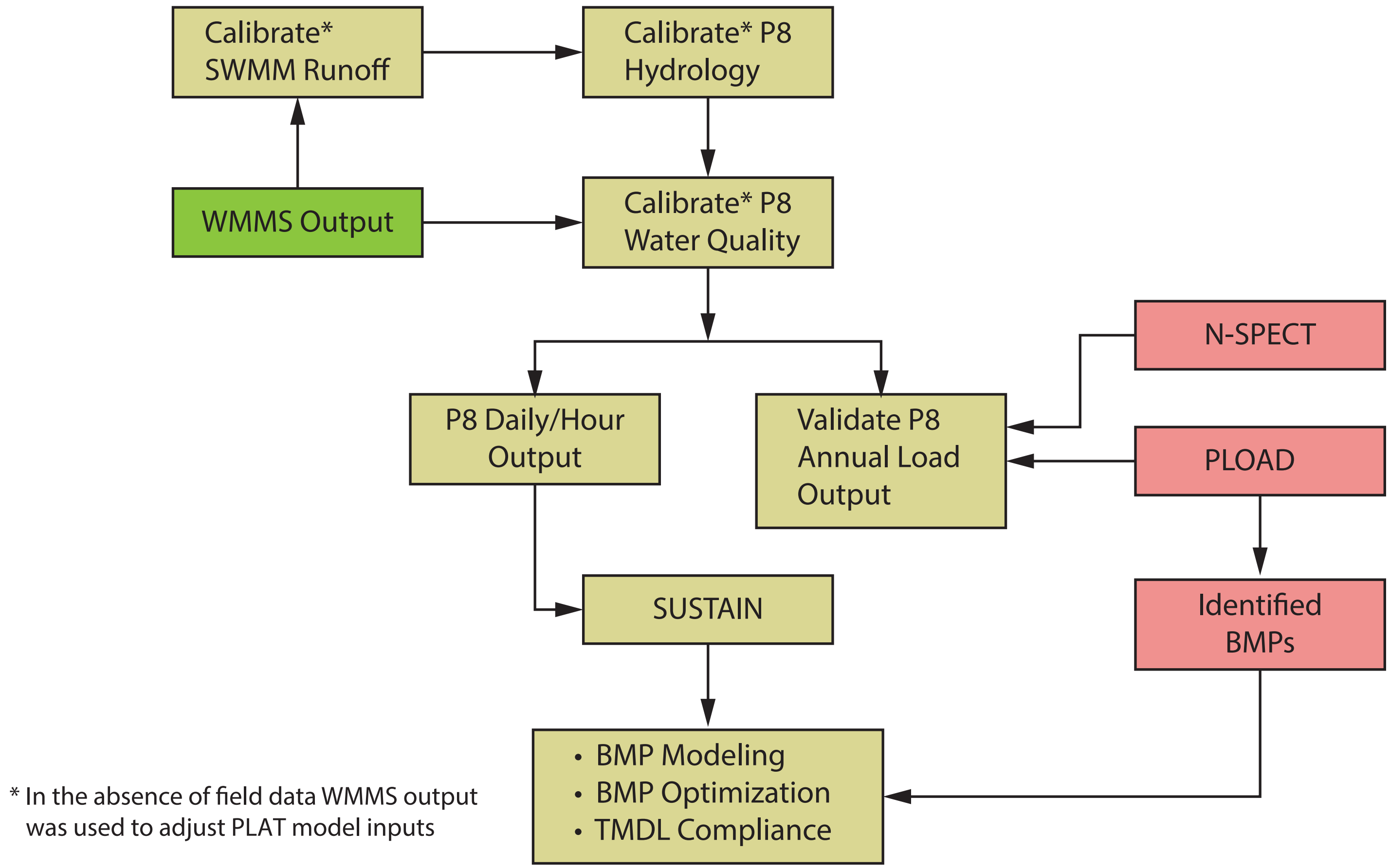


Figure 3.3 General Concept of PLAT Analysis

3.3.1.1 Watershed Model - EPA SWMM 5.0

EPA's Storm Water Management Model (SWMM) is used throughout the world for planning, analysis, and design related to stormwater runoff, combined and sanitary sewers, and other drainage systems in urban areas. There are many applications for drainage systems in non-urban areas as well.

SWMM is a dynamic hydrology-hydraulic water quality simulation model. It is used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component operates on a collection of sub catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators.

SWMM tracks the quantity and quality of runoff made within each sub catchment. It tracks the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period made up of multiple time steps. SWMM 5 has recently been extended to model the hydrologic performance of specific types of low impact development (LID) controls.

3.3.1.2 BMP Selection and Performance Model - P8 Model

'P8' abbreviates "Program for Predicting Polluting Particle Passage Through Pits, Puddles, and Ponds," which more or less captures the basic features and functions of the model. It has been developed for use by engineers and planners in designing and evaluating runoff treatment schemes for existing or proposed urban developments. Design objectives are typically expressed in terms of percentage reduction in suspended solids or other water quality component.

P8 has been used by state and local regulatory agencies as a consistent framework for evaluating proposed developments. Depending on applications, other models could be either too simple (easily used, but ignoring important factors) or too complex (requiring considerable site-specific data and/or user expertise). P8 attempts to strike a balance to between those extremes.

Predicted water quality components include total suspended solids (sum of the individual particle fractions), total phosphorus, total Kjeldahl nitrogen, copper, lead, zinc, and total hydrocarbons. Simulated BMP types include detention ponds (wet, dry, extended), infiltration basins, swales, buffer strips, or other devices with user-specified stage/discharge curves and infiltration rates. A simple water budget algorithm can be used to estimate groundwater storage and stream base flow in watershed-scale applications.

3.3.2 Baseline Critical Conditions and Required Pollutant Reductions

The following subsections describe the application of the SWMM and P8 models to simulate current conditions, identify critical conditions, and calculate required pollutant reductions. The calculated required reductions drive the extent of the control measures to be implemented under the EWMP.

3.3.2.1 Baseline Model Development and Calibration/Verification

A fundamental element of the RAA is simulating baseline/existing conditions in the watershed prior to implementation of control measures. For the Implementation Area RAA, baseline conditions were simulated using the SWMM and P8 watershed models in PLAT, including predictions of flow rate and pollutant concentrations over a 10-year period, as follows:

- The simulation period is October 1, 2001 to September 30, 2011.
- Simulated pollutants include total suspended solids, fecal coliform, total copper, total lead, total nitrogen, and total phosphorous. Toxics loads were estimated from total suspended solids load output.
- An hourly time step was used to simulate the flow rate and pollutant concentration at each of the 107 subbasins outlets shown in Figure 3.4 and the resultant downstream conveyance system.
- The model explicitly accounts for effects of major hydraulic structures in the Implementation Area including impoundments such as Walteria Lake.

There was no significant flow and water quality data for the Implementation Area during the development of PLAT. Recently calibrated WMMS' LSPC's output was therefore used to adjust PLAT input parameters. This process is referred to as calibration/verification in this EWMP. These calibrated WMMS parameters included in Appendix C were used without any adjustments in LSPC to perform a 10-year simulation. The LSPC output was summarized by sub area. For planning purposes the Implementation Area was subdivided into five sub areas as shown on Figure 3.5. The characteristics of the sub areas are summarized in Table 3.5.

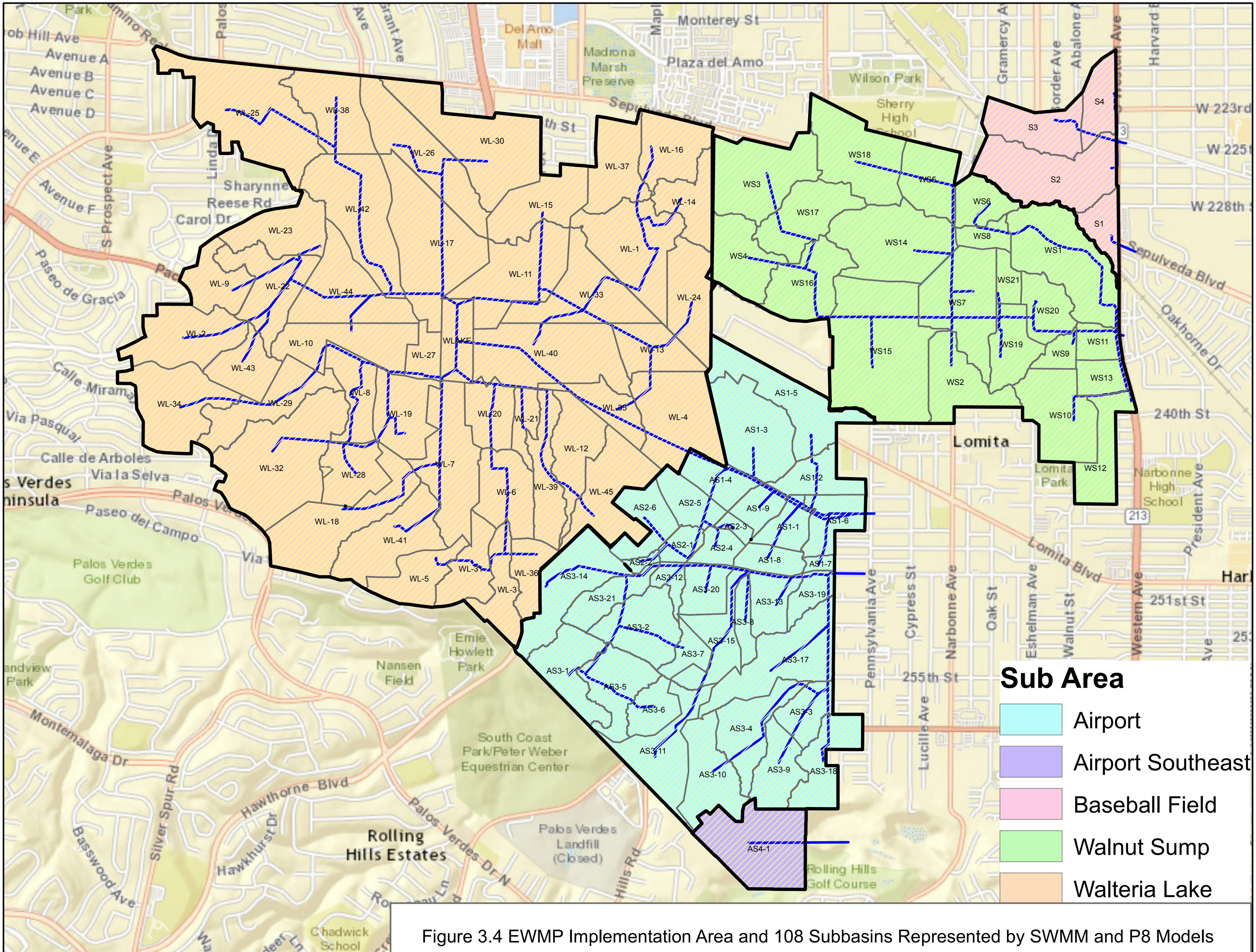


Figure 3.4 EWMP Implementation Area and 108 Subbasins Represented by SWMM and P8 Models

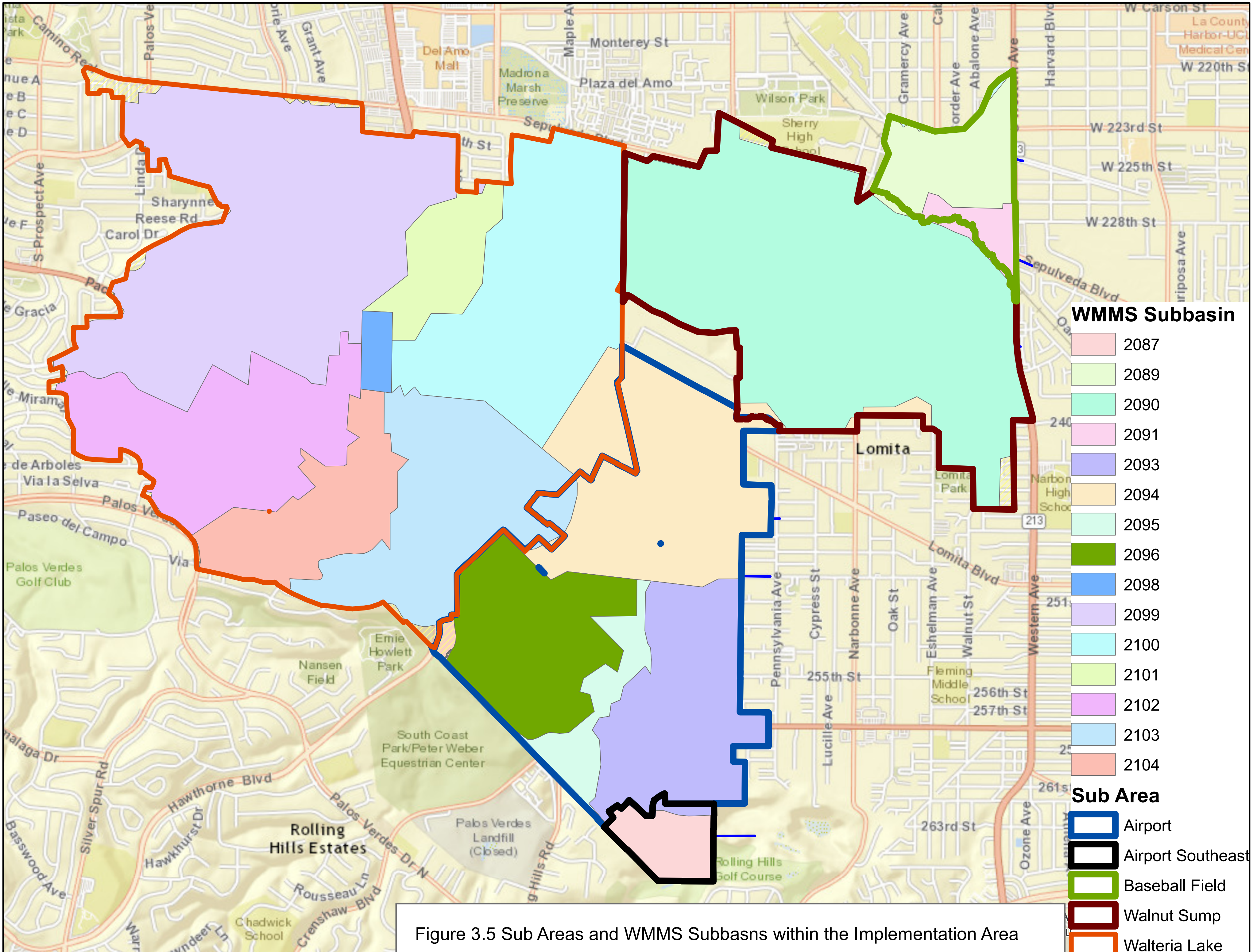


Figure 3.5 Sub Areas and WMMS Subbasns within the Implementation Area

Table 3.5 Summary of Sub Areas in the Implementation Area

Sub Area	Area (ac)	WMMS Subbasins	No. of SWMM Subbasins
Airport	975	2093, 2094, 2095 and 2096	35
Airport Southeast	70	2087	1
Walnut Sump	923	2090	21
Baseball Field	155	2089 and 2091	4
Walteria Lake	2,118	2090, 2098, 2099, 2100, 2102, 2103 and 2104	46

It was assumed that the calibrated WMMS model meets the RAA calibration standards and therefore provides a reasonable approach to validate SWMM in the absence of significant field data specific to the Implementation Area. As field data for the Implementation Area becomes available in the near future through sampling efforts by the City, SWMM will be recalibrated to the observed values. The comparison of the calibrated hydrology model to the RAA Guidelines is shown in Table 3.6. The annual volume values were obtained by summing the daily flow output from SWMM. The baseline SWMM model performs quite well for representing existing hydrologic and water quality conditions. Details of the baseline model development and calibration are presented in Appendix C.

Table 3.6 Summary of Hydrology Calibration Performance by Baseline SWMM Model

Sub Area	Drainage Area (ac)	Model Period	Hydrology Parameter	SWMM vs. WMMS
Airport	975	10/01/2001 - 09/30/2011	Annual Volume	9.20%
Airport Southeast	70	10/01/2001 - 09/30/2011	Annual Volume	-10.62%
Walnut Sump	923	10/01/2001 - 09/30/2011	Annual Volume	12.41%
Baseball Field	155	10/01/2001 - 09/30/2011	Annual Volume	11.72%
Walteria Lake	2,118	10/01/2001 - 09/30/2011	Annual Volume	9.47%

3.3.2.2 Current/Baseline Loading

A baseline analysis was performed as part of the RAA which represents the current watershed condition with the currently implemented stormwater programs. Stormwater runoff was simulated based on the time series record of rainfall between October 2001 and September 2011. This period represents the most recent 10 years of record as required by the MS4 Permit. The water quality constituent mass loading is estimated by multiplying the stormwater runoff volume by the water quality constituent concentration.

The baseline hydrology and simulated constituent loading serves as the basis for compliance. Watershed control measures, including structural and non-structural BMPs, will be implemented over time to meet the required load reductions. The load reductions represent the difference between the baseline conditions and the water quality objectives. The 85th Percentile, 24-hour rainfall event baseline simulation is based on the LACFCD 85th Percentile rainfall isohyets and unit hyetograph, consistent with the Standard Urban Stormwater Mitigation Plan (SUSMP) and Low Impact Development (LID) methods used within the County.

Table 3.7 summarizes the results of the SWMM and P8 simulations for the water years beginning the first day of October and ending the final day of September from 2001 to 2011 for each sub area. The sub areas are shown on Figure 3.5. The table compares the major water quality constituents with adopted TMDLs and identifies the annual load and corresponding volume for each year analyzed. The average annual loads are also provided for the simulation period. Table 3.7A lists the annual flow volumes and loads by sub area and Table 3,7B summarizes the average annual load by sub area for the ten years evaluated. In Table 3.7C, a summary of toxics baseline loads are provided by sub area. The toxics loads are assumed to be directly related to the simulated TSS load. Thus, toxics loads were computed as follows:

$$Toxic\ Load\ \left(\frac{g}{yr}\right) = TSS\ load\ \left(\frac{kg}{yr}\right) \times measured\ toxics\ concentration\left(\frac{\mu g}{kg}\right) \times 10^{-6}$$

Table 3.7A Summary of Annual Loads and Volume by Sub Area(1)

Period	Year	Volume(2) acre-ft	TSS kg	TP kg	TN kg	TCu kg	TPb kg	Bacteria #
Airport Sub Area								
10/1/01 - 9/30/02	2001	141.08	53,118.93	69.76	538.88	4.01	5.20	1.63E+15
10/1/02 - 9/30/03	2002	684.17	355,819.63	338.28	2613.24	19.43	16.01	5.84E+15
10/1/03 - 9/30/04	2003	300.17	101,879.02	148.42	1146.51	8.53	22.83	3.40E+15
10/1/04 - 9/30/05	2004	1448.33	765,083.32	716.12	5532.04	41.14	20.40	7.61E+15
10/1/05 - 9/30/06	2005	361.58	113,695.65	178.78	1381.10	10.27	5.40	4.19E+15
10/1/06 - 9/30/07	2006	110.33	66,236.10	54.55	421.43	3.13	7.75	1.07E+15
10/1/07 - 9/30/08	2007	514.50	98,556.55	254.39	1965.18	14.61	5.93	5.94E+15
10/1/08 - 9/30/09	2008	358.58	115,321.32	177.30	1369.64	10.19	6.14	4.41E+15
10/1/09 - 9/30/10	2009	755.17	227,188.09	373.39	2884.43	21.45	9.60	8.09E+15
10/1/10 - 9/30/11	2010	698.33	135,642.26	345.29	2667.35	19.84	7.84	8.14E+15
Average		**537.23**	**203,254.09**	**265.63**	**2051.98**	**15.26**	**10.71**	**5.03E+15**
Airport Southeast Sub Area								
10/1/01 - 9/30/02	2001	6.95	2,347.40	7.56	55.94	0.35	0.21	8.59E+14
10/1/02 - 9/30/03	2002	36.00	12,159.21	39.16	289.78	1.83	1.11	3.86E+15
10/1/03 - 9/30/04	2003	20.67	6,980.29	22.48	166.36	1.05	0.64	1.69E+15
10/1/04 - 9/30/05	2004	74.17	25,050.22	80.68	597.01	3.77	2.28	7.33E+14
10/1/05 - 9/30/06	2005	23.33	7,880.97	25.38	187.82	1.18	0.72	2.12E+15
10/1/06 - 9/30/07	2006	7.66	2,586.65	8.33	61.65	0.39	0.24	6.39E+14
10/1/07 - 9/30/08	2007	32.08	10,836.33	34.90	258.26	1.63	0.99	3.01E+15
10/1/08 - 9/30/09	2008	23.25	7,852.82	25.29	187.15	1.18	0.71	2.27E+15
10/1/09 - 9/30/10	2009	45.50	15,367.89	49.49	366.26	2.31	1.40	4.09E+15
10/1/10 - 9/30/11	2010	42.32	14,292.14	46.03	340.62	2.15	1.30	4.04E+15
Average		**31.19**	**10,535.39**	**33.93**	**251.09**	**1.58**	**0.96**	**2.33E+15**

Table 3.7A Summary of Annual Loads and Volume by Sub Area(1)

Period	Year	Volume(2) acre-ft	TSS kg	TP kg	TN kg	TCu kg	TPb kg	Bacteria #
Baseball Field Sub Area								
10/1/01 - 9/30/02	2001	19.29	8412.87	20.99	155.29	0.92	13.94	1.85E+14
10/1/02 - 9/30/03	2002	99.83	44299.65	108.60	803.62	4.78	2.22	9.44E+14
10/1/03 - 9/30/04	2003	65.80	13107.01	71.58	529.66	3.15	0.87	5.69E+14
10/1/04 - 9/30/05	2004	196.00	48313.03	213.20	1577.72	9.38	2.12	1.92E+15
10/1/05 - 9/30/06	2005	65.25	18410.77	70.98	525.23	3.12	23.77	6.32E+14
10/1/06 - 9/30/07	2006	21.44	14427.87	23.32	172.60	1.03	1.60	2.09E+14
10/1/07 - 9/30/08	2007	90.83	17364.24	98.81	731.17	4.35	1.00	8.92E+14
10/1/08 - 9/30/09	2008	64.67	27148.77	70.34	520.54	3.09	1.45	6.20E+14
10/1/09 - 9/30/10	2009	127.08	28388.35	138.24	1022.97	6.08	1.56	1.23E+15
10/1/10 - 9/30/11	2010	142.58	31436.49	155.10	1147.74	6.82	1.64	1.38E+15
Average		**89.28**	**25130.90**	**97.12**	**718.65**	**4.27**	**5.02**	**8.58E+14**
Walnut Sump Sub Area								
10/1/01 - 9/30/02	2001	140.00	52,224.81	69.22	512.25	4.97	5.73	7.49E+14
10/1/02 - 9/30/03	2002	670.83	335,295.48	331.69	2454.51	23.83	15.91	3.37E+15
10/1/03 - 9/30/04	2003	284.17	97,743.71	140.50	1039.74	10.10	6.86	1.47E+15
10/1/04 - 9/30/05	2004	1408.33	732,569.82	696.34	5152.95	50.03	29.14	6.40E+15
10/1/05 - 9/30/06	2005	347.50	108,717.02	171.82	1271.47	12.35	8.95	1.85E+15
10/1/06 - 9/30/07	2006	105.00	62,385.28	51.92	384.18	3.73	7.82	5.57E+14
10/1/07 - 9/30/08	2007	495.83	94,492.36	245.16	1814.20	17.61	5.77	2.63E+15
10/1/08 - 9/30/09	2008	376.67	105,668.88	186.24	1378.18	13.38	6.45	1.98E+15
10/1/09 - 9/30/10	2009	725.83	216,417.99	358.89	2655.75	25.79	11.36	3.57E+15
10/1/10 - 9/30/11	2010	674.17	133,102.15	333.34	2466.71	23.95	9.14	3.56E+15
Average		**522.83**	**193,861.75**	**568.73**	**1912.99**	**18.57**	**10.71**	**2.61E+15**

Table 3.7A Summary of Annual Loads and Volume

Period	Year	Volume acre-ft	TSS kg	TP kg	TN kg	TCu kg	TPb kg	Bacteria #
Walteria Lake Sub Area								
10/1/01 - 9/30/02	2001	353.85	133,533.15	174.96	1272.83	8.18	12.59	4.21E+15
10/1/02 - 9/30/03	2002	1677.24	759,920.79	829.31	6033.20	38.77	34.26	1.90E+16
10/1/03 - 9/30/04	2003	1129.13	232,246.68	558.29	4061.57	26.10	14.70	8.38E+15
10/1/04 - 9/30/05	2004	2406.40	1,555,872.63	1189.83	8656.04	55.62	58.39	3.62E+16
10/1/05 - 9/30/06	2005	892.50	270,553.17	441.29	3210.42	20.63	19.63	1.05E+16
10/1/06 - 9/30/07	2006	271.49	162,914.28	134.24	976.58	6.28	17.24	3.18E+15
10/1/07 - 9/30/08	2007	1266.40	239,860.33	626.17	4555.37	29.27	12.76	1.49E+16
10/1/08 - 9/30/09	2008	960.45	281,024.15	474.89	3454.84	22.20	16.68	1.12E+16
10/1/09 - 9/30/10	2009	1826.47	505,257.78	903.09	6569.97	42.22	24.46	2.03E+16
10/1/10 - 9/30/11	2010	1743.16	355,323.80	861.90	6270.31	40.29	20.66	2.03E+16
Average		**1252.71**	**449,650.68**	**619.40**	**4506.11**	**28.96**	**23.14**	**1.48E+16**

Notes:
(1) Sub areas listed in the table covers the entire Implementation Area
(2) Volume obtained by summing the daily flow values for entire year.

Table 3.7B Average Annual Load and Volume Summary from Implementation Area

Sub Area	Area ac	Volume ac-ft	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Copper (kg/yr)	Lead (kg/yr)	Bacteria #
Baseball Field	155	89.28	25,130.90	97.12	718.65	4.27	5.02	8.58E+14
Walnut Sump	923	522.83	193,861.75	568.73	1912.99	18.57	10.71	2.61E+15
Walteria Lake	2,118	1252.71	449,650.68	619.4	4506.11	28.96	23.14	1.48E+16
Airport	975	537.23	203,254.09	266	2051.98	15.26	10.71	5.03E+15
Airport Southeast	70	31.19	10,535.39	33.93	251.09	1.58	0.96	2.33E+15
Total(3)	**2,123**	**1,181**	**432,782**	**965**	**4,935**	**40**	**27**	**1.08E+16**
	Walteria Lake serves as a BMP for Walteria Lake Sub Area and therefore total load generated from the Implementation Area excludes Walteria Lake Sub Area load							

Table 3.7C Average Annual Load and Volume Summary from Implementation Area - Toxics

Sub Area	Area (ac)	Volume (ac-ft)	Total PCB (g/yr)(1)(2)	DDT (g/yr)(1)(2)	Dieldrin (g/yr)(1(2))	Chlordan (g/yr)(1)(2)
Baseball Field	155	89.28	2.47	1.68	0.48	1.45
Walnut Sump	923	522.83	19.07	12.99	3.72	11.15
Walteria Lake(3)	2,118	1252.71	44.24	30.12	8.63	25.87
Airport	975	537.23	20.00	13.62	3.90	11.70
Airport Southeast	70	31.19	1.04	0.71	0.20	0.61
Total(4)	**2,123**	**1,181**	**43**	**29**	**8**	**25**
	Walteria Lake serves as a BMP for Walteria Lake Sub Area and therefore total load generated from the Implementation Area excludes Walteria Lake Sub Area load					

Notes:
(1) Annual load for toxics is the concentration of each constituent multiplied by TSS load.
(2) Average toxic constituent concentrations in µg/kg used are: total PCB = 98.38, Chlordane - 57.54 and total DDT - 66.99. Source: Regional Board Machado Lake Pesticides and PCBs TMDL, June 2010, page 27 of the TMDL Staff Report. Average of all 5 lake samples taken in August 2003 (Table 7). Dieldrin - 19.2 µg/kg value was obtained from Machado Lake Nutrient and Toxics TMDL Water Quality Management Plan, May 2014, page 2-15.
(3) Load entering Walteria Lake.
(4) Total does not include Walteria Lake Sub Area
(5) Sub Areas listed in the table covers the entire Implementation Area

3.4 Estimated Required Pollutant Load Reduction

The Implementation Area RAA examines the average annual load, 85th percentile, 24-hour storm event volume and the 90th percentile constituent load to estimate the limiting pollutant and the corresponding volumes of required treatment. The limiting pollutant is the constituent with the highest mass load associated with a relevant TMDL. This subsection discusses the limiting pollutant evaluation, 85th percentile, 24-hour storm volume, and the 90th percentile, 24-hour storm load. These factors establish the control measure implementation requirements. Evaluation of the limiting pollutant requires estimating the volumes and loads associated with the average annual load, 85th percentile, 24-hour runoff volume and the 90th percentile load for baseline conditions and multiple pollutants. Once these values are estimated, the limiting pollutant can be evaluated. The limiting pollutant is that pollutant for which the greatest amount of volume control is required to achieve the 90th percentile load reduction.

3.4.1 Nutrient and Toxics Load Reduction

In order to perform the RAA for nutrients and toxics, the annual results listed in Table 3.7a were compared to the average annual results in Table 3.7b. Water years with annual TP results comparable to the average annual TP results were selected. The RAA simulation periods listed in Table 3.8 for TP, TN, and toxics were used for all the sub areas in the Implementation Area. Thus, the selected period represents the average year conditions.

Table 3.8 Baseline Constituent Load for TP, TN, and TSS(1) - Implementation Area

Constituent	Simulation Period	Volume (ac-ft)	Load (kg/yr)
TP	10/01/09 - 9/30/10	1,653.58	920.01
TN	10/01/09 - 9/30/10	1,653.58	6,929.41
TSS	10/01/09 - 9/30/10	1,653.58	487,362.3

Note:
(1) Toxics loads were based on simulated TSS results.

The average annual loads summarized in Table 3.8 for TN, TP and toxics (TSS load) were compared with the Machado Lake TMDL allocations. A summary of the pollutant loadings from the Implementation Area, the Final TMDL allocations and ultimate required reductions for TN, TP and toxics are presented in Table 3.9. The annual nutrient loadings (TN and TP) from the Implementation Area listed in the table currently comply with the interim limit of total nitrogen, 7,370 kg/yr and total phosphorus of 3,760 kg/yr. Final nutrient WLAs are supposed to be attained by September 11, 2018.

According to the Table 3.9, 67 percent of total phosphorus load and 57 percent of total nitrogen load must be removed by the City to meet the final nutrient WLAs.

Table 3.9 Baseline Loading Rates From Implementation Area to Machado Lake

Constituent	Baseline Load(1) (kg/yr)	Allowable Load(2) (kg/yr)	Required Reduction (kg/yr)	Required Reduction(3) (%)
Total Nitrogen	6,929	3,008	3,921	56.6
Total Phosphorus	920	301	664	67.3
		Toxic Constituent (g/yr)		
Total PCBs	47.93	9.88	38.05	79.4
Total DDT	28.04	0.87	27.17	96.9
Dieldrin	9.36	0.54	8.82	94.2
Chlordane	32.65	0.31	32.34	99.1

Notes:
(1) The annual nutrient baseline loadings from the TMDL Implementation Area listed in the table comply with the interim limit of total nitrogen, 7,370 kg/yr and total phosphorus of 3,760 kg/yr.
(2) Concentration based WLAs are met under the approved flow condition of 8.45 hm^3/yr.
(3) Percent of pollutant amount that is required to be removed.

3.4.2 Metal and Fecal Coliform Load Reduction

Using the 90th percentile load days for metals and fecal coliform, the required pollutant reductions were calculated for attainment of final limitations. Selection of the storms utilizing this process provides a sound criterion for compliance by evaluating the range in volumes, concentrations, and loads to provide a treatment volume that has the potential to meet the criteria for the 85th percentile, 24-hour event, and 90th percentile load reduction. The variability in the data shows that selecting a storm is an important step in the analysis process. By selecting the appropriate storm, flows that exceed the capture volume will mainly have pollutant concentrations below the TMDL concentration limits due to dilution of remaining pollutants. The details of the selection process are provided in the following paragraphs. The results of the analysis are provided later to demonstrate compliance and the reasonableness of the approach.

The 90th percentile load related to entire Implementation Area was estimated using PLAT. The 90th percentile constituent loads represent the daily constituent loads that are greater than 89 percent and less than 10 percent of all simulated loads at the output station. The method for estimating the 90th percentile load was to sort all flow days under wet weather conditions from the calibrated hydrology simulation model for the time series beginning on October 1, 2001 and ending on September 30, 2011.

The hourly and daily mass loads were the product of the simulated storm volume and the simulated hourly constituent concentration for the Implementation Area flows. The 90th percentile load was estimated from the simulated daily load. The volume capture for the 90th percentile load was estimated on the day of the actual event.

Baseline simulations were run with no storm runoff volume reduction. Table 3.10 summarizes the water quality constituents and the date of the 90th percentile event derived from the simulated model results following the criteria previously outlined in the preceding paragraph. The volume associated with the 90th percentile load is shown along with the expected (modeled) and objective concentrations and loads.

Table 3.10 90th Percentile Constituent Load - Implementation Area

Constituent	Date	Volume (ac-ft)	Concentration (µg/L) and MPN/100mL		Load (kg) and MPN		Reduction (%)
			Expected	Objective	Expected	Objective	
Airport Sub Area							
Copper	2/18/2005	61.8	88.94	9.7	6.79	0.74	89.1
Lead	2/15/2002	8.9	46.58	42.7	0.51	0.47	7.8
Bacteria	2/21/2011	24.7	8.89E+05	400	2.71E+14	1.22E+11	99.95
Airport Southeast Sub Area							
Copper	2/18/2005	0.48	15.9	9.7	0.01	0.006	40.0
Lead	4/12/2010	1.63	7.26	42.7	0.01	0.09	100
Bacteria	2/17/2011	1.80	3.83E+05	400	8.50E+12	8.80E+09	99.90
Baseball Field Sub Area							
Copper	2/19/2007	5.7	17.5	9.7	0.12	0.07	41.7
Lead	12/9/2006	1.8	38.4	42.7	0.09	0.10	100
Bacteria	2/16/2011	10.2	6.54E+05	400	8.23E+13	5.03E+10	99.99
Walnut Sump Sub Area							
Copper	2/18/2005	64.3	23.84	9.7	1.89	0.77	59.3
Lead	6/10/2010	27.8	31.00	42.7	1.07	1.47	100
Bacteria	2/14/2011	24.1	1.40E+05	400	4.16E+13	1.19E+11	99.70

3.5 Pollutant Source Prioritization

To help develop implementation strategies, a prioritization of pollutant loading by sub area and potential sources was developed. The effort is concentrated on wet weather loading, with the assumption that BMPs targeted for the watershed would be designed to treat both wet and dry weather flows that drain to the BMP.

Wet weather loads generated from the TMDL Implementation Area were converted to area loads (e.g., pounds per acre per year [lb/ac/yr]) for use in the pollutant source prioritization. This provides a normalized view for targeting management in that it shows where the rates are highest. Area loads for each constituent were then ranked with a score 1 through 4 by sub area. Values were assigned quartiles as follows:

- A score of 1 for the lowest 25th quartile[1],
- A score of 2 for values between the 25th and 50th quartile,
- A score of 3 for values between the 50th and 75th quartile, and
- A score of 4 for the highest quartile.

The final rankings for wet weather area-based loads are shown in Table 3.11.

Table 3.11 Wet Weather Load Ranking by TMDL Implementation Area (Area Loads)

TMDL Implementation Area	Parameter Score			Total Score	Priority Rank
	TSS	TN	TP		
Airport	4	4	4	12	1
Walnut Sump	4	2	3	9	2
Baseball Field	3	3	3	9	2
Airport Southeast	1	2	2	5	3
Walteria Lake	2	1	1	4	4

Rank: 1 – Highest Priority 4 – Lowest Priority

3.6 Volume and Load Reduction Strategies

Various load reduction strategies were used to achieve compliance through the RAA including institutional (non-structural) and structural BMPs. Control measures are implemented strategically throughout the compliance period at specific time steps so that the interim and final WQOs are met. The three types of control measures that are the focus of the volume and load reduction strategy are institutional BMPs (MCMs and LID ordinances), regional projects, and distributed projects (green streets). Details can be found in Sections 4 and 5. The schedule of implementation is discussed in Section 8 and represents a feasible implementation timeline considering regional BMP implementation will take a long time while MCMs and distributed BMPs may be implemented with less planning, engineering, and design effort.

3.6.1 85th Percentile Basin Identification

Wherever feasible, the City wants to capture and retain all non-stormwater runoff and all stormwater runoff from the 85th percentile, 24-hour storm event generated from the

[1] A quartile is one of the 4 subdivisions that have been grouped into four equal sized sets based on their statistical rank.

Implementation Area. However, it is not feasible to identify a single site within the Implementation Area to install a regional BMP to capture and retain the 85th Percentile, 24-hour design storm volume. The sub areas were therefore delineated into several subcatchments for BMP implementation purposes. Based on the proposed BMP capacities (detailed in Section 5.3.1) the subcatchments were classified into two:

- 85th Percentile Basin
- Non-85th Percentile Basin

The applicability of the BMPs serving these subcatchments to capture and retain the 85th percentile, 24-hour runoff volume was investigated. Calculations were performed to determine the approximate size required to capture the 85th-percentile, 24-hour storm volume for the subcatchments. The 85th-percentile, 24-hour storm volume was determined using SWMM modeling and the County of Los Angeles Modified Rational Method which uses drainage area, runoff coefficient, and the 85th Percentile, 24-hour storm depth as input. The 85th percentile, 24-hour storm event represents the rainfall event that is greater than 85 percent of all rainfall events over 0.1 inches in a 24-hour period. The 85th percentile, 24-hour isohyetal map developed by LACDPW was used to estimate the appropriate rainfall value of 0.85 in for the Implementation Area. This design storm is identified in the RAA Guidelines as an acceptable critical condition, and capture of design storm volumes by BMPs is a specified compliance metric in the Permits for TMDLs.

The stormwater volume from the 85th Percentile, 24-hour storm event calculated for each subcatchment is listed in Table 3.12 and Figure 3.6 shows the 85th Percentile subcatchment classification.

Table 3.12 Subcatchment Classification

Sub Area	Subcatchment	Drainage Area (ac)	85th Percentile 24-hr Volume (ac-ft)	85th Percentile 24-hr Storm Volume Captured
Airport Sub Area	AS1	249	10.4	No
	AS2	86	3.6	Yes
	AS3	640	27.2	Yes
Walteria Lake	NA	2,287	97.2	Yes
Walnut Sump	WS-1	144	6.2	No
	WS-2	722	31.2	Yes
	WS-3	56	2.4	Yes
Baseball Filed	BB-S1	19	0.88	No
	BB-S2	73	3.41	No
	BB-S3	39	1.82	Yes
	BB-S4	24	1.12	No

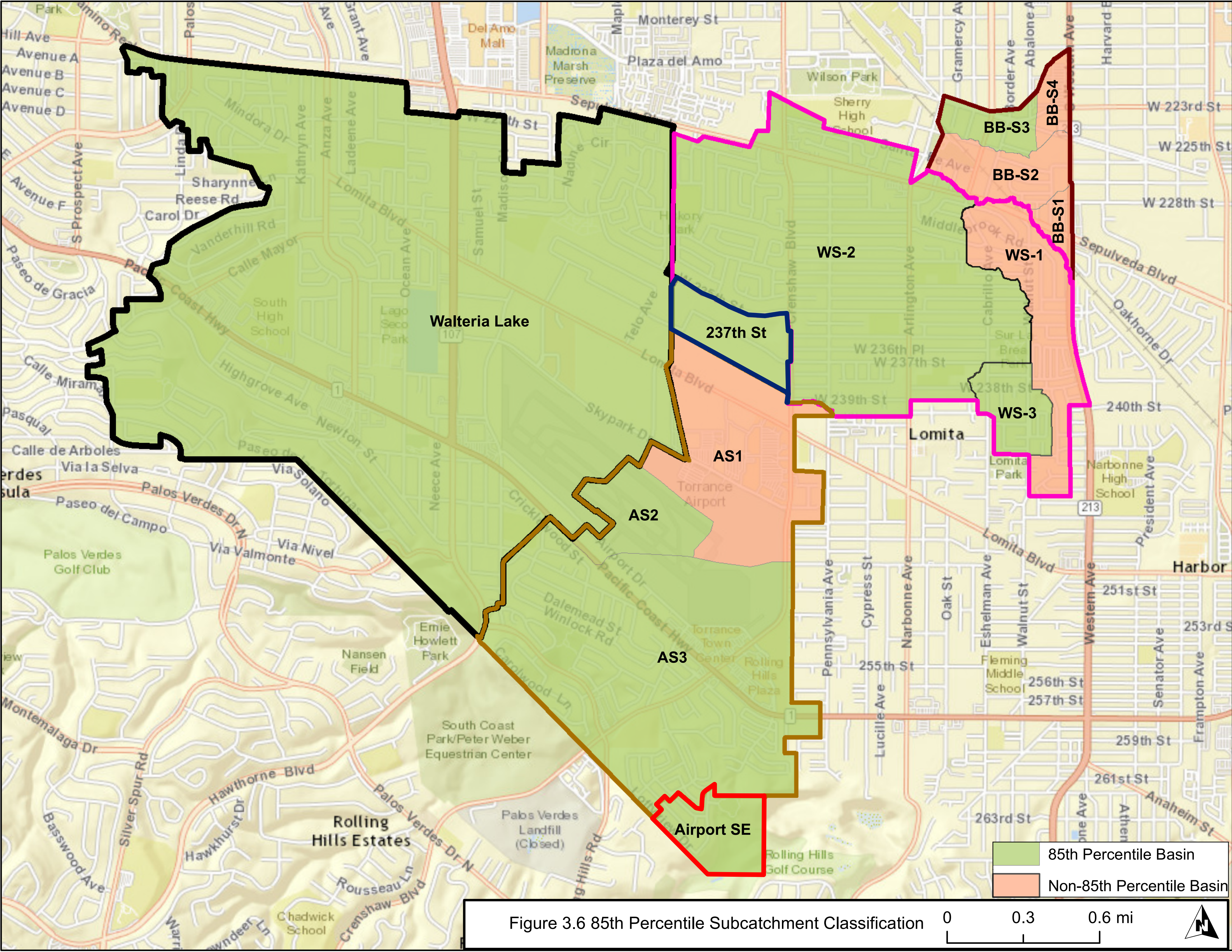


Figure 3.6 85th Percentile Subcatchment Classification

4.0 DEVELOPMENT OF INSTITUTIONAL SOLUTIONS

As part of the development of the EWMP, the Permit specifies that watershed control measures (or BMPs) shall be identified to:

1. Ensure that stormwater discharges meet receiving water and effluent limits as established in the Permit.
2. Reduce overall impacts to receiving waters from stormwater and non-stormwater runoff.

BMPs are grouped into two broad categories, structural and institutional. Structural BMPs are physically constructed control measures that alter the hydrology or water quality of stormwater or non-stormwater. Institutional (nonstructural) BMPs are source control measures that prevent the release of flow/pollutants or transport of pollutants, but do not involve construction of physical facilities. Minimum control measures (MCMs), such as street sweeping, are a subset of institutional BMPs. This section summarizes MCMs measures which reduce the current pollutant load to meet past and future compliance requirements.

A comprehensive program has been developed and ready to be implemented to reduce or eliminate the amount of pollutants in stormwater and urban runoff. This program meets a variety of regulatory requirements, including those of the LARWQCB adopted Order R4-2007-0042 for municipal stormwater and urban runoff discharges within the County (LARWQCB 2007b). An evaluation was conducted to identify opportunities for improvements to existing programs and new programs that would help meet TMDL WLAs and to determine the level of success in implementing these programs. Existing institutional BMPs are described in Section 4.1.1 and new institutional BMPs are proposed in Section 4.1.2. Considered holistically, these existing, improved, and new programs are expected to contribute to the reduction of TMDL pollutant loads and contribute to meeting WLAs.

4.1 MCMs/Institutional BMPs

In general, institutional solutions include pollution prevention actions and source control activities that prevent or minimize the amount of pollution entering urban runoff. Pollution prevention actions seek to control constituents of concern before their release to the environment. Typical pollution prevention actions include conservation and reuse activities. Source control activities target pollutants from specific sources to reduce or eliminate the concentrations of those pollutants entering the municipal separate storm sewer systems (MS4). Typical source control activities include, but are not limited to:

- Issuance of local ordinances
- Street sweeping
- Product bans by either the State or Federal government

For pollution prevention and source control measures to be effective, the parties involved need to be educated about the measures, incentives should be provided to use the measures, and enforcement should be available to ensure the measures are implemented. Both pollution prevention and source control measures are proposed as complementary components of non-structural solutions, which may provide more effective treatment at a lower cost than many structural solutions. The City will implement existing and proposed MCMs as written in the LA County MS4 Permit.

4.1.1 Summary of Existing MCMs/Institutional BMPs

The following provides a summary of existing Institutional BMPs that were evaluated to determine if enhancements could be made to specifically support TMDL implementation. A summary of the City's existing institutional BMPs relevant to nutrients, toxics, bacteria and sediment reduction and flow reductions are presented in Table 4.1. The description provides an overview of relevant programs that could directly support stormwater pollution control.

Table 4.1 Existing MCMs/Institutional Solutions Conducted by City of Torrance

MCM	BMP Type	Description
Public Information and Participation Program	Education	Encompasses several outreach campaigns. Those that most directly address nutrients are the Smart Gardening Program, pet waste outreach, and fats, oils and grease outreach.
Industrial/ Commercial Facilities Control Program	Enforcement	Tracks, inspects, and ensures compliance with permits for industrial and commercial facilities. Controls pollutant transport.
Development Planning	Source Control	Focuses on mitigating the long-term hydrologic and pollutant effects of the built environment and changes in land use. Includes establishing requirements for post-construction BMPs, reviewing plans to ensure that proposed drainage plans meet water quality and hydrologic performance standards, and ensuring long-term operation and maintenance of post-construction BMPs.
Development Construction Program	Enforcement	Addresses runoff from public and private construction projects through the use of stormwater pollution prevention plans (SWPPPs), training of staff engaged in construction activities, and compliance inspections. Through runoff prevention, controls the transport of nutrients and toxics.

Table 4.1 Existing MCMs/Institutional Solutions Conducted by City of Torrance

MCM	BMP Type	Description
Public Agency Activities Program	Source Control	Applies BMPs to infrastructure and facility operation and maintenance activities of Public Agencies to reduce pollutant sources. This includes sewer system maintenance, corporation yard, and recreational facility management.
Illicit Connections/Illicit Discharge Program	Enforcement	IC/ID removal prevents the discharge of a variety of pollutants including nutrients and toxics from entering the storm drain system.
Catch basin filter Clean Out	Source Control	Catch basin filters are cleaned at least annually, with higher priority catch basin filters cleaned semi-annually or quarterly. For industrial catch basin filters, the optimal cleaning frequency appears to be between quarterly and semiannual; for residential catch basin filters, the optimal frequency appears to be annual. For commercial catch basin filters, the optimal frequency is semiannual.
Catch basin filter(1)	Source Control	In an effort to reduce trash as part of the Machado Lake Trash TMDL, catch basin filter could be installed in portions of watershed. Catch basin filter proposed with Machado Lake Trash TMDL Project.
Street Sweeping	Source Control	Curbed streets are swept weekly with vacuum sweepers in the city. Much of Torrance is not signed for street sweeping. This will be corrected with Machado Lake Trash TMDL Project.
Impervious Cover Disconnection	Source Control	Employ rooftop disconnection techniques.
County Ordinance No. 2008-000S2U	Enforcement	Prohibits wash down of paved surfaces, irrigation runoff, and requires car washing BMPs.
Restaurant Training	Education	An education program that includes restaurant BMP guidelines, a watershed model showing the potential for oil and grease to affect the watershed, a PowerPoint presentation, and collateral material for restaurant owners, including posters, buckets with BMPs printed on them, and brochures. Torrance does this as part of Clean Bay Certification Program.
County Ordinance Title 10 Animals, Chapter 10.40.060, B.	Enforcement	Requires pet owners to pick up and properly dispose of their pet's waste.

Notes:
(1) Although normally considered structural BMPs, for the purposes of the model, catch basin filter were accounted for as a nonstructural BMP.
(2) Torrance has ban on smoking in Public Parks and Torrance Beach.

Enhancements to the existing institutional BMPs and additional institutional BMPs can be considered and are discussed in the following section.

4.1.2 Enhanced Institutional BMPs

Enhanced institutional BMPs may include new non-structural solutions and enhancements of existing institutional solutions. Specific sources of nutrients and toxics and their associated institutional solutions are listed in Table 4.2. The institutional solutions listed in Table 4.2 are detailed in Table 4.3. Sanitary sewer maintenance is covered in other areas of the Implementation Plan. Note that the costs presented in Table 4.3 are per year, and total implementation costs include an estimated rate of inflation of 3 percent over the life of the program.

Table 4.2 Potential Institutional Solutions by Pollutant Source

Pollutant Source	Associated Potential Nonstructural Solution(s)
Irrigation overflow	• Smart Gardening Program, with evapotranspiration controller irrigation enhancement • Public Agency Activities Program – landscape and recreational facilities management focus
Landscape fertilizer	• Smart Gardening Program • Public Agency Activities Program – landscape and recreational facilities • management focus • Development Planning – post construction BMPs
Catch basin(1)	• Development Planning – post construction BMPs • Catch basin(1) • Catch basin clean outs – increased frequency • Catch basin inserts – install inserts where other structural BMP retrofits options are infeasible due to ownership/space constraints. Inserts should be selected that are capable of removing nutrients.
Streets and parking lots	• Street and parking lot sweeping – more efficient sweepers and increased frequency
IC/ID	• More aggressive identification and removal of illicit connections • Add stencils and re-stencil storm drains, as needed
Sewage	• Public Agency Activities Program – sewer systems maintenance, overflow, and spill prevention focus • Public Information and Participation Program – fats, oils, and grease outreach • Recreation Vehicle Sewage Disposal Sites – Public Information
Horse manure	• Public outreach
Pet waste	• Public outreach, providing bags and receptacles at parks, etc.
Green waste	• Public outreach
Sediment	• Industrial/Commercial Facilities Control Program • Development Planning • Public Agency Activities Program – materials storage facilities/corporation yards management focus

Note:
(1) Although normally considered structural BMPs, for the purposes of the model, catch basin filter were accounted for as a nonstructural BMP

Table 4.3 Proposed New and Enhanced Institutional BMP Descriptions

Institutional BMP	Description	New/Enhanced Program	Targeted Pollutant	Annual Cost
Add stencils and re-stencil storm drains, as needed	Audit storm drains to determine where stencils are not present or are faded. Efforts should initially be focused in Island 1 where field investigations noted faded or missing storm drain labels	Enhanced: Public Agency Activities Program	Nutrients and toxics	$5K per year
Catch basin clean outs	Modify program to use more aggressive techniques and increase frequency to clean 60% of catch basin filters monthly and 40% of catch basin filters semi-annually.	Enhanced: Public Agency Activities Program	Nutrients and toxics	$100K per year
Catch basin inserts(1)	Expand installation of trash catch basin inserts to cover more areas in the city; catch basin inserts should be capable of removing trash, nutrients, and toxics. As an example, Kristar's FloGard Perk Filter has been approved by Washington Dept. of Ecology's TAPE program 5 as "basic treatment" meaning that third party monitoring data has validated its ability to remove at least 80% TSS and 50% TP. Regular maintenance is necessary to retain pollutant removal performance	Enhanced: TMDL Implementation	Nutrients and toxics	$20K (includes yearly O&M)
Downspout disconnection program	Establish a downspout disconnection program to incentivize the disconnection of residential rooftop downspouts. See Section on Integrated Water Resource Considerations for additional information, page 36	New	Nutrients and toxics	$50K/ year
Fats, oils, and grease outreach	Target restaurants and residents in the TMDL Implementation Area for additional FOG outreach to educate them about the potential of sewage overflows caused by FOG blockages	Enhanced: PIPP	Nutrients	$5K/ year
Green waste outreach	Target residents and institutional land uses in TMDL Implementation Area for additional proper management of green waste.	New	Nutrients	$5K/ year
Horse manure outreach	Target residents for outreach about horse manure management.	New	Nutrients	$5K/ year
Illicit connection removal	Enhance program so that 40% of the system is surveyed and 20% of identified IC is removed	Enhanced: ID/IC Program	Nutrients and toxics	$75K $2,500/illicit connection removal[2]

Table 4.3 Proposed New and Enhanced Institutional BMP Descriptions

Institutional BMP	Description	New/Enhanced Program	Targeted Pollutant	Annual Cost
Industrial/ Commercial Facilities Control Program	Enhancement may include more in-depth training for inspectors and staff that addresses nutrient and toxics specific BMPs. Strengthening partnerships with enforcing agencies may also improve enforcement escalation procedures	Enhanced: Industrial Commercial Facilities Program	Nutrients and toxics	$5K/ year
Landscape and recreational facilities management	Enhancements are similar to the Smart Gardening Program, with application to landscape and recreational facilities managed by the City. The enhancements include switching to non-phosphorus organic fertilizers or using no fertilizer, adding soil amendments to lawns, converting a goal of 25% of lawn to native vegetation and using ET controllers. Outreach may include trainings for City staff that manage or maintain landscape and recreational facilities	Enhanced: Public Agency Activities Program	Nutrients and toxics	$10K/ year
Materials storage facilities/ corporation yards management	Training for City staff in charge of materials storage facilities and corporation yards with focus on activities and materials that may contribute to nutrient and toxic pollution to storm drain	Enhanced: Public Agency Activities Program	Nutrients and toxics	$5K/ year
Oil pump ESC outreach	Work with oil pump parcels located throughout the TMDL Implementation Area to ensure that sediment does not leave the site during the wet season.	New	Nutrients and toxics	$10K/ year
Pet waste outreach	Target residents, pet stores, and animal shelters in TMDL Implementation Area for additional pet waste outreach	Enhanced: PIPP	Nutrients	$50K/ year
Post construction requirements for new development and redevelopment	This program may be enhanced with additional training for Development Planning Staff. The focus would be education in planning for and maintaining post-construction BMPs that are effective in reducing nutrients toxics, and runoff	Existing: Development Planning Program	Nutrients and toxics	$25K
Sewer system maintenance, overflow, and spill prevention	Enhance sewer system maintenance and target staff working in the TMDL Implementation Area for SSO response and spill prevention training.	Enhanced: Public Agency Activities Program	Nutrients	$20K • $1,700/mi to clean sewer pipe

Table 4.3 Proposed New and Enhanced Institutional BMP Descriptions

Institutional BMP	Description	New/Enhanced Program	Targeted Pollutant	Annual Cost
Smart Gardening Program	This program includes outreach to reduce inputs (fertilizers, pesticides, water, etc.) to landscape, controlling nutrient sources and irrigation runoff. Field investigations showed evidence of lawn irrigation runoff in the majority of residential neighborhoods in all three Islands. This program should aggressively target the population within the TMDL Implementation areas. This program may be additionally enhanced to include evapotranspiration (ET) controllers to further reduce irrigation runoff. It may also encourage residents to change to non-phosphorus organic fertilizers or use no fertilizer, add soil amendments to lawns, and convert lawn to natural vegetation.	Enhanced: Public Agency Activities Program	Nutrients and toxics	$60K/ year
Street and parking lot sweeping	Increase frequency of sweeping to 2x/weekly	Enhanced: Public Agency Activities Program	Nutrients and toxics	$80K/ year(4)

Notes:
(1) Although normally considered structural BMPs, for the purposes of the model, catch basin filter were accounted for as a nonstructural BMP.
(2) Source: Marcoux, 2004 and Brown et al., 2004
(3) Source: WERF, 1997
(4) Source: Modified from Ramsey-Washington Metro Watershed District, 2005.
(5) Source: Washington State Department of Ecology's Technology Assessment Protocol - Ecology (TAPE) program reviews performance evaluation reports on new stormwater treatment technologies and determines whether or not the technologies meet Ecology's performance standards. http://www.ecy.wa.gov/programs/wq/stormwater/newtech/

4.2 Public Information and Participation Program

The County of Los Angeles Department of Public Works' Countywide Stormwater/Urban Runoff Public Education, Used Motor Oil and Used Oil Filter Recycling, Household Hazardous Waste/Electronic Waste Collection, and Smart Gardening programs help achieve the Public Information and Participation Program (PIPP), public outreach mandates and address nutrients and toxics pollution. Public community events, paid media campaigns, media relations efforts, and distribution of collateral materials are part of the standard public outreach practices for the above-mentioned environmental education programs. Visit www.CleanLA.com for information about these programs.

The Smart Gardening Program consists of learning centers and workshops that educate homeowners about conservation (of fertilizers, pesticides, water, etc.) when gardening and landscaping, which reduces the amount nutrients and toxics in the environment. The Smart Gardening Program could be enhanced to help facilitate TMDL implementation by identifying learning centers and/or holding workshops in the Implementation Area.

Tip cards with Smart Gardening Program information could be tailored to address specific concerns (discontinuing irrigation overspray as a pollutant transport mechanism, controlling excess nutrients from fertilizer, pesticide alternatives, etc.) and sent to residences within the Implementation Area.

4.3 Institutional BMPs Recommendations

As a result of the review of the existing programs that address the TMDL pollutants, the following are recommended enhancements and additional BMPs that would offer additional water quality benefits and contribute to TMDL implementation:

- **Enhancing the Smart Gardening Program** so it would extend the reach of the water conservation and pollution-prevention messages to the Machado Lake watershed.
- **Conducting TMDL-specific stormwater training** that emphasizes activities and BMPs that can cause or mitigate the TMDL pollutants of concern.
- **Enhancing commercial and industrial facility inspections** to avoid that activities associated with these businesses become new sources of pollutants.
- **Improving enforcement escalation procedures** to more effectively address known sources of pollution.
- **Improving street sweeping technology** to more effectively reduce sediment-bound pollutants from road surfaces.
- **Reducing irrigation return flow** through a variety of water conservation initiatives.

The remainder of the discussion and analysis pertaining to non-structural solutions focuses on those seven recommended BMPs, which are expected to contribute substantially to reductions in pollutant loads. Table 4.4 shows the extent to which each BMP enhancement or new BMP addresses the TMDLs. All the proposed BMPs address nutrients and toxics; TMDL-Specific Stormwater Training addresses trash.

Table 4.4 Summary of Recommended Institutional BMPs

Institutional BMP	Condition: Wet Weather	Condition: Dry Weather	TMDL Pollutant Addressed: Nutrient	TMDL Pollutant Addressed: Trash	TMDL Pollutant Addressed: Toxics
Enhancements to Existing BMPs					
Smart Gardening Program Enhancements	√	√	◗	○	◗
TMDL-Specific Stormwater Training	√	√	◗	◗	◗
Enhancement of Commercial and Industrial Facility Inspections	√	√	◗	○	◗
Enforcement Escalation Procedures	√	√	◗	○	◗
Improved Street Sweeping Technology	√	√	◗	○	◗
New BMP					
Reduction of Irrigation Return Flow	√	√	●	○	◗

√ - applicable; ◗ - about half as effective, ○ - effective

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5.0 DEVELOPMENT OF STRUCTURAL SOLUTIONS

Meeting WLAs for the nutrient and toxics TMDLs, and Category 2 and 3 pollutants targets in the Implementation Area will take advantage of the institutional BMPs, but structural solutions will provide the majority of the necessary load reductions required. However, structural BMPs are also the most costly, so careful consideration was made in identifying opportunities for structural BMPs and collecting appropriate information to make cost-effective decisions regarding implementation.

Identification and assessment of opportunities for structural BMPs were focused on publicly owned land in the Implementation Area. Both distributed and centralized structural BMPs were considered. Distributed structural BMPs refer to those practices that provide the control and/or treatment of stormwater runoff at the site level. Typical BMPs in this category include, but are not limited to the following:

- Porous pavement
- Grassed swales
- Bioretention
- Water-harvesting systems
- Catch basin filters
- Practices that can be implemented on individual parcels or in the parkway to store, infiltrate, and treat runoff from that parcel.

Centralized BMPs refer to stormwater treatment, storage, or infiltration facilities that provide benefits on a larger scale (e.g., regional). Such projects can include neighborhood-scale or larger-scale facilities such as:

- Spreading grounds
- Flood control facilities
- Park space that provides treatment/infiltration of runoff from nearby areas.

The BMPs presented above are all not equally suitable to all site conditions and performance goals across watersheds. Consequently, several important site specific factors were considered when identifying those BMPs to include in the project analysis.

The following sections describe the process used to assess opportunities for implementing structural BMPs; both distributed and centralized. Section 6 describes the evaluation of BMP alternatives using an optimization process.

5.1 Summary of Structural Solutions

A phased approach is necessary for implementing structural solutions. The first priority was given to approaches that do not require obtaining land tenure, which may be projects within publicly owned right-of-ways or programs that encourage private owners to implement structural BMPs within their own properties. The next phase will involve public acquisition of property on which structural solutions can be implemented. The creation of public-private partnerships to implement structural solutions will also be considered. A summary of the pollutant removal mechanisms and capabilities of structural BMPs is provided in Table 5.1.

Table 5.1 Pollutant Removal Mechanisms and Capabilities of Structural BMPs

Structural BMP	Pollutant Removal Mechanism	Total Nitrogen	Total Phosphorus	Toxics(1)	Metals	Bacteria
Infiltration Basin	Infiltration	H	H	H	H	H
Detention Basin	Settling	M	M	M	M	M
Constructed Wetland	Biological Uptake, Settling	M	H	H	M	H
Catch basin filter	Settling, Filtration	L	M	M	M	L/M
Bioretention	Adsorption, Settling, Biological Uptake, Infiltration	M	H	H	H	H
Porous Pavement	Infiltration	M	H	H	H	H

Notes:
H: high; M: medium; L: low
Scoring modified from International BMP Database, 2010.
(1) Performance data is not widely available for this pollutant class; assumed that removal efficiency would be similar to sediments since these pollutants are largely associated particulates.
(2) Phosphorus index of fill soils in bioretention areas will cause a high total phosphorus outflow; high TP removal efficiency is dependent on the fill soils having a low P-index.
Nitrogen removal by bioretention areas can be increased using a design variation that creates an anaerobic zone below the drainpipe.

5.2 Assessment of Opportunities for Distributed Structural BMPs

It was not feasible within the Implementation Plan to identify and size each distributed structural BMP in the Implementation Area. Rather, within specific classifications of land characteristics (e.g., impervious roads, land use, soil type), general assumptions were established that provide insight regarding the types and benefits of distributed BMPs that can be implemented at a larger scale. That resulted in identifying key distributed structural BMP projects that could be considered for TMDL implementation planning.

Two major categories of distributed structural BMPs were identified, which were based on site characteristics and the types of BMPs determined feasible: 1) catch basin filter distributed BMPs and 2) other distributed BMPs on public land. The following provides detailed discussions for these categories and the proposed projects for TMDL implementation.

5.2.1 Catch Basin Filter Distributed BMPs

Storm drain systems in developed areas typically begin with inlets at the street level. Stormwater inlets have a variety of names, and there are regional differences in terminology. In California, storm drain inlets are routinely called catch basin.

As discussed in Section 3, roads represent a major source of TMDL pollutant loads, and therefore treating road runoff is considered a key strategy for multi-pollutant TMDL implementation. Because of the number and spatial distribution of catch basin in the Implementation Area, they represent an excellent opportunity for treating pollutants in addition to trash. Appendix G provides performance data for the catch basin filters proposed for the Implementation Area.

5.2.1.1 Catch Basin Filter

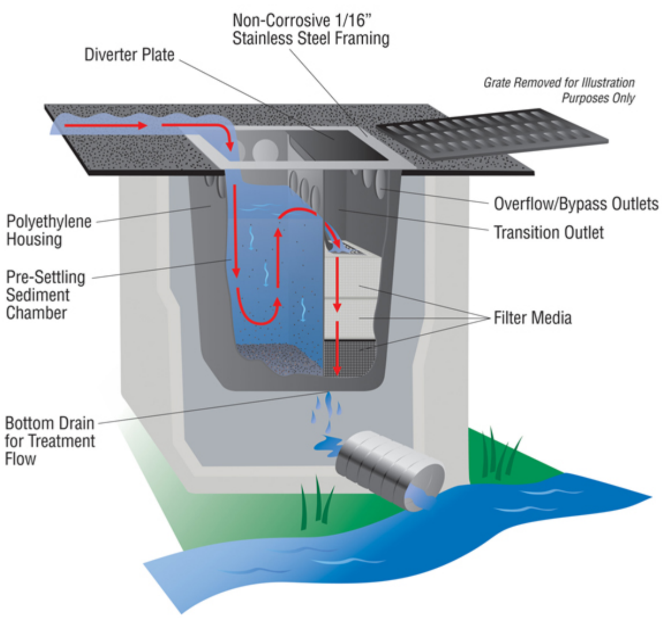


Figure 5.1 Example of Catch Basin Filter

Catch basin filters, as illustrated on Figure 5.1, are devices designed specifically to capture trash, oil/grease, other floatables, sediment, organics, and other pollutants—can offer additional pollutant removal benefits. On the basis of a synthesis of available studies, catch basin filters are expected to treat and remove a significant fraction of sediment (and associated metals and toxics) with treatment focused on runoff from the transportation network. The treatment efficiency of catch basin filters for bacteria is poorly studied and unknown but is likely to be very low unless the insert has a design element targeting bacteria. Such devices tend to have a 1- to 3-year warranty and would need maintenance or replacement after that. Catch basin filter can replace full capture devices upon installation depending on whether the space they occupy is compatible with the full capture device. Some devices (such as the Abtech Smart Sponge™) can be installed in tandem with existing full capture devices.

Implementing catch basin filters throughout the Implementation Area is highly applicable because of the high density of catch basins. The Implementation Area includes almost 811 catch basins, which equates to approximately 1 catch basin every 200 to 300 lineal feet of storm drain. The distribution of catch basins within the Implementation Area is summarized in Table 5.2.

Table 5.2 Summary of Catch Basins by Sub Area

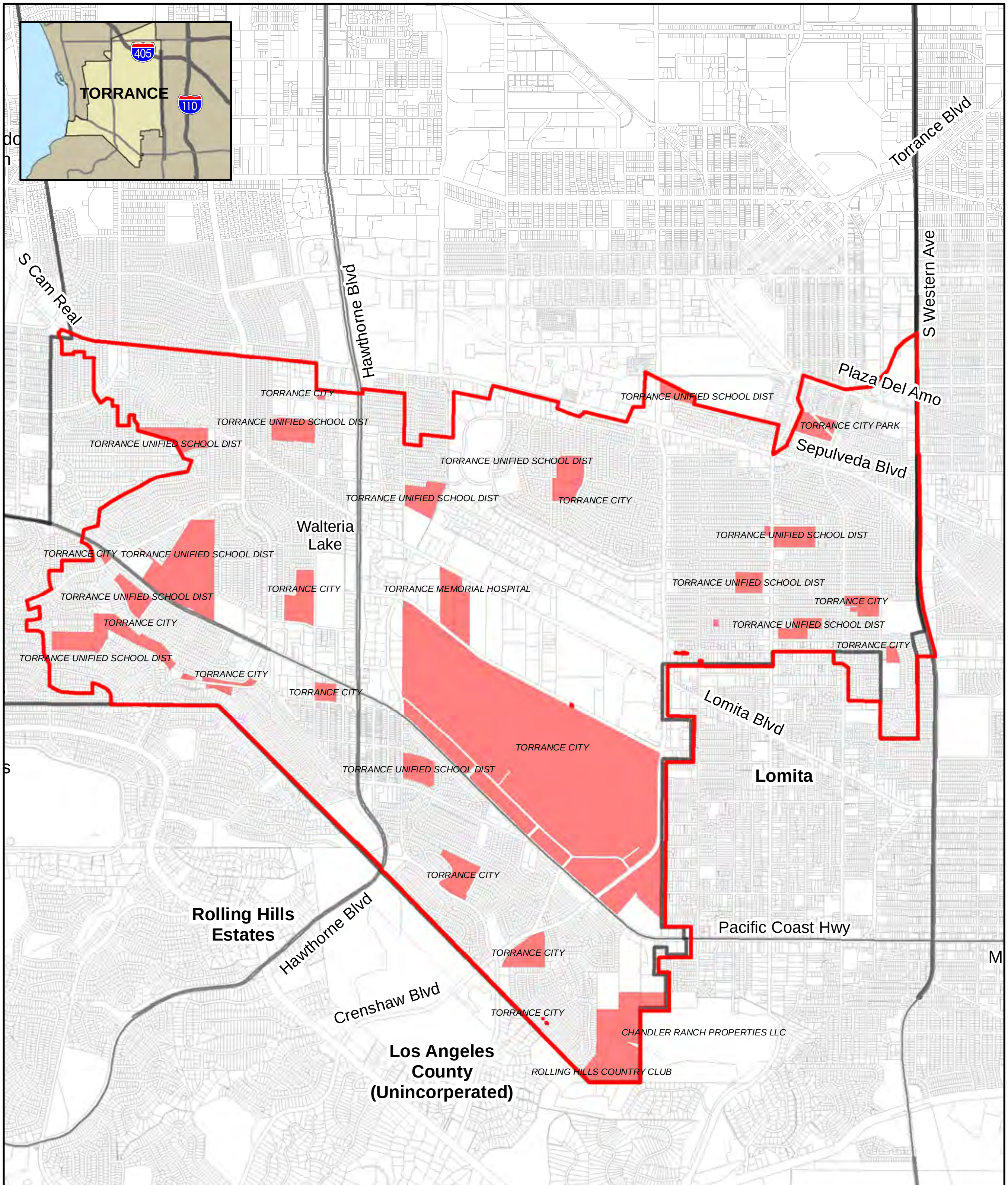
Sub Area	Storm Drain Length (mi)	Number of Catch Basin	Catch Basin Density (CB/mi)
Walteria Lake	25	373	15
Airport and Airport Southeast	14	173	12
Walnut Sump	9	242	27
Baseball Field	1.4	23	17
Total	**50**	**811**	**16**

Note:
(1) Based on count from City's storm drainage atlas maps

The City is currently in the process of installation of full capture devices for compliance with the trash TMDL. Implementing catch basin filters would require retrofitting or replacing the full capture devices that have been installed. For the TMDL Implementation Plan, implementing catch basin filters is assumed to focus on replacing existing full capture devices with catch basin filters, which is a more resource intensive, conservative approach. The catch basin filters the City proposes to use will have design elements targeting bacteria. During actual implementation, other more cost-effective approaches for full capture device retrofit could be employed. The schedule for implementing catch basin filters in the Implementation Area considers maximizing the operational period of installed full capture devices, thus improving the return on the investment. Implementing catch basin filters would involve internal planning, conducting a pilot study to gain approval from the LARWQCB for attaining the trash TMDL requirements (for cases where full capture devices are being retrofitted or replaced), installing the devices, and maintaining the sediment-removal insert as part of the existing catch basin filter maintenance activities.

5.2.1.2 Other Distributed BMPs on Public Land

Before stormwater enters the storm drain systems, opportunities are available for the storage, infiltration, and treatment of runoff within publicly owned right-of-ways or parcels. Such areas include road right-of-ways or other properties owned by public agencies for various purposes (e.g., parks, schools, storage, and utilities). Figure 5.2 shows the publicly owned parcels within the Implementation Area. In combination with road right-of-ways, these areas represent a significant opportunity for on-site stormwater treatment.



Legend

- Publicly Owned Parcels
- Project Area
- City Boundary
- Freeway
- Major Roads
- Parcels

0 0.5 1 Miles

Figure 5.2
Publicly Owned Parcels
in TMDL Implementation Area
BMP Implementation Plan
City of Torrance

5.2.2 Low Impact Development

The County of Los Angeles adopted a low impact development (LID) ordinance on January 1, 2009, which directly influences the selection and use of structural BMPs. New development and future redevelopment within the City are subject to LID requirements. The requirements are intended to result in runoff quantities and quality that mimic the runoff from undeveloped areas, up to and including runoff from a 50-year design storm event.

Development projects with four or fewer residential units are required to implement two LID BMP alternatives as specified in the County LID Standards Manual. LID BMP alternatives include, but are not limited to the following measures:

- Disconnecting impervious areas
- Installing porous pavement
- Dry wells
- Conforming to landscaping and irrigation requirements
- Installing green roofs

Developments with five or more units or nonresidential developments are required to provide infiltration for excess runoff volume. Runoff from these developments that mimics the natural hydrograph must meet treatment requirements. Redevelopment projects where at least 50 percent of the impervious surfaces are altered must mitigate the entire project area. Redevelopment projects that alter less than 50 percent of the impervious area only need to mitigate the alteration.

Implementation of LID BMPs within the Implementation Area provides an opportunity to reduce the loading of pollutants by reducing concentrations of pollutants in runoff and reducing the volume of runoff.

Both development and redevelopment are largely driven by the strength of the economy. Currently, the rate of development is near a historic low and as a result, estimates for gains from LID and the schedule for those gains are difficult to quantify. As part of the adaptive management implementation, the effects of implementing LID BMPs through development and redevelopment will be tracked though the monitoring and reporting program. Increased levels of development or redevelopment should result in decreases in pollutant loading from the Implementation Area, reducing the need for additional structural controls. Stagnation of development in the Implementation Area may lead to an extended schedule or require additional structural controls to attain TMDL WLA levels.

5.3 Assessment of Opportunities for Centralized Structural BMPs

To identify, evaluate, and ultimately select the optimal combination of centralized structural BMPs to address pollutant load reductions for the Implementation Area, key information was required. Investigations were performed to identify and assess potential sites for placing centralized structural BMPs on public land. Priority locations of centralized structural BMPs were publicly owned properties to reduce the need for land acquisition. Additional consideration was made regarding the necessity for implementing centralized structural BMPs on private land. Results of this assessment provided information necessary to support TMDL implementation planning.

5.3.1 Site-Screening Methodology

An initial analysis was conducted to identify all publicly owned parcels in the Implementation Area. That initial screening resulted in approximately 24 parcel groups as shown on Figure 5.2. The 24 parcel groups included any publicly owned land with no analysis of the suitability for a centralized BMP. Most of the sites provide adequate space for a centralized BMP. They are not too steep, or are within a feasible distance of a stormwater drainage system.

Additional screening was performed to further narrow potential sites for additional investigation. Additional field investigations were performed for identified locations to assess site and drainage area characteristics and identify the ideal BMP that could be constructed at the site.

Subsequently, GIS analysis was performed of land ownership parcels and site characteristics to identify potential sites for centralized BMP placement on publicly owned parcels. Considerations in the analysis included the following:

- **Land cost**—Land costs were minimized by identifying publicly owned parcels.
- **Percent impervious**—Areas with higher percent imperviousness would produce more runoff during typical rain events. Higher impervious areas were targeted for greater potential volume reduction and water quality improvements.
- **Space requirements**—Sites were evaluated to determine if space is available to implement an appropriately sized BMP.
- **Watershed treatment area**—The size of the drainage area for each site was evaluated on the basis of available storm drain or Digital Elevation Model (DEM) data. Sites were identified that provide sufficient space for BMPs to adequately treat/store/infiltrate runoff from their respective drainage areas.

- **Soil type**—Soil type was evaluated as an initial estimate of the infiltration rate and capacity of the soils. Sites with infiltration rates suitable for infiltration BMPs were further investigated.

- **Slope**—Slopes of sites were considered on the basis of DEM or other available topography data sets. Sites with moderate slopes (less than 10 percent for GIS purposes) were considered for centralized BMPs. Slope was verified in the field investigation, and sites where the slope is inappropriate for a centralized BMP were eliminated.

- **Multi-benefit use**—Sites were identified that could serve multiple purposes. For instance, some stormwater practices, such as infiltration basins or grassed swales, could serve a dual purpose of stormwater management and community park space. Several parks could be altered to provided stormwater treatment and storage.

Those criteria were evaluated to identify sites where centralized BMPs would be feasible. Sites that could provide enough space to effectively treat the drainage area associated with the site, that have soils suitable for infiltration, and that are publicly owned (to reduce land acquisition costs) were preferred. Sites that could provide a multi-benefit use, such as parks or parking lots where belowground storage could be used, were considered ideal. From the GIS screening analysis, a list of potential locations for centralized BMPs was developed to address stormwater runoff from the Implementation Area.

This GIS screening and additional field investigations narrowed the sites to the following five sites (which are also depicted on Figure 5.3):

- Airport 1 – A1
- Airport 2 – A2
- Airport 3 - A3
- Walnut Sump
- Baseball Field

Details regarding the proposed structural BMP improvements are presented in subsequent subsections, while general observations and strategies used to develop these BMP concepts are described below.

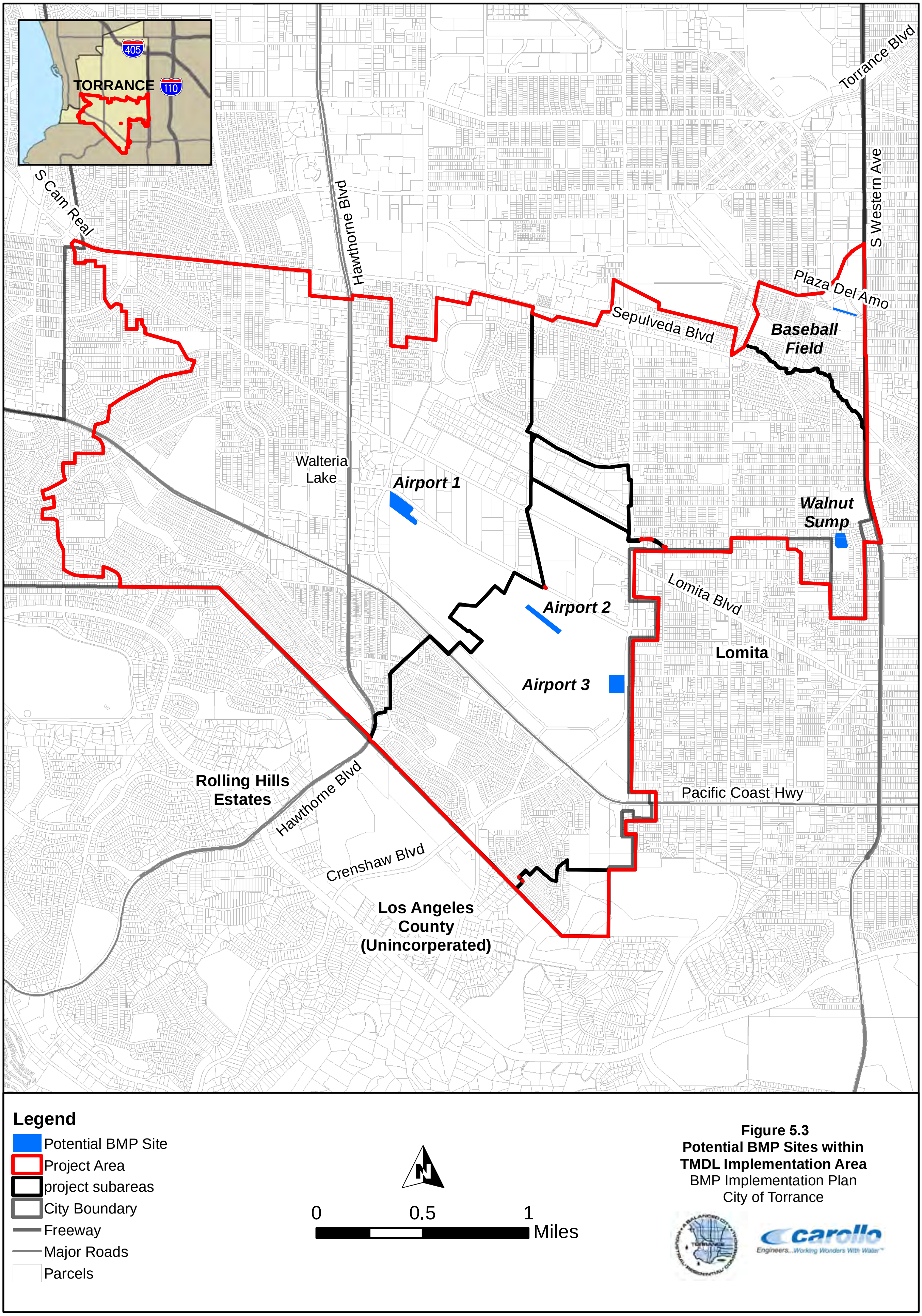


Figure 5.3
Potential BMP Sites within
TMDL Implementation Area
BMP Implementation Plan
City of Torrance

carollo
Engineers...Working Wonders With Water

Because existing site layouts and features can have an effect on where and what type of BMPs can be installed on a site, site layouts and on-site structures were photographed and documented to support evaluation of the site for centralized BMPs. The considerations included the following:

- **Effects on surrounding areas—**Any nearby structures, including storm drains and utilities, were documented. Any effects that could occur to surrounding structures because of settlement issues were noted.
- **Maintenance/accessibility—**Every BMP must be maintained at some level for the BMP to continue to function as it was designed. BMPs were considered that maximize access for maintenance purposes.
- **Research potential—**Research of stormwater BMPs is ongoing and necessary to fill existing data gaps and to continue to support the City in developing BMP standards. Monitoring protocol would be considered and incorporated into the design of each BMP that is implemented.

The individual site characteristics and summary of field investigations and BMP recommendations are described below. The description includes results of field tests to evaluate infiltration rate, water table depth and soil quality; more detailed maps of potential BMP sites; and photographs of the watershed treatment area and available BMP area for each site. Centralized structural BMP options for the sites were narrowed down to specific BMP types and sizes during the process of evaluating nonstructural and structural solutions.

The watershed treatment areas for each of the five identified sites, unless otherwise noted, are residential with concentrated or dispersed density configurations. Residential areas are known to generate high levels of nutrients, such as nitrogen and phosphorus, typically from over fertilization and excess irrigation. Detergents used to wash cars in residential areas can contain high levels of phosphorus. Residential areas are also a source for metals and bacteria. While the largest portion of the watershed treatment areas are residential, there are also institutional and commercial areas in many of the watersheds. Institutional and commercial areas are typically a source of metals, nutrients, and PAHs. Additional pollutant source discussion is included in each site discussion where additional detail is required.

On the basis of observed conditions at all the potential BMP sites, two types of centralized BMPs can be implemented in the open space at the five sites: underground storage/infiltration basins and extended dry detention/infiltration basin. Three of the potential BMP sites, A1, A2, and A3 are located at the Torrance Airport, one at Walnut Sump and the last site is located under the road near Torrance Baseball Field. The sites were also selected to eliminate or minimize the need for pump stations. Each centralized BMP is suitable for treating nutrients, bacteria, toxics, metals, and other pollutants typically delivered with suspended sediment (e.g., organic pesticides, PAHs) in stormwater.

Infiltration basins require high infiltration rates and are not designed to store water for extended periods. Underground storage/infiltration systems are suitable in areas with hydrologic soil group (HSG) C soils and soils in the lower range of HSG B where infiltration is possible but could take longer.

The five sites investigated do not have hard surface areas such as tennis courts, basketball courts, playgrounds, skateboard parks, and parking areas. These identified sites do not require a structural foundation and therefore could be used for belowground storage and treatment. Storm chambers installed below these surfaces would provide additional treatment while still allowing the areas to be used for recreation and parking.

The type and size of the BMP were determined through further optimization analysis and reported in Section 6. The BMPs are planned to infiltrate water within a few days, reducing possible public health risks from stagnant water such as mosquitoes and drowning. An infiltration basin could still be used for recreation and open space activities between storm events and during the dry season. Belowground BMPs could have overlying space available for recreation or parking regardless of the weather.

Each of the investigated centralized BMP sites has ample open space to provide access for maintenance. Observed maintenance at each site includes regular mowing similar to the required maintenance for an aboveground-centralized BMP. To maintain infiltration functionality, sediment would need to be removed when infiltration rates are reduced twenty-five to fifty percent from the design infiltration rate. Infiltration rates can be restored by removing accumulated sediment and disking or aerating the surface. Sediment from belowground BMPs would have to be removed annually or as needed.

Considering current usage, ample space would be available for construction activities at each investigated site. While the focus of each of the potential centralized BMPs is TMDL compliance, implementing such BMPs also aligns with several integrated water resources planning objectives. In addition to the intended BMP objective of water quality improvement, a centralized BMP at each of the proposed site would contribute to flood protection, water conservation, groundwater replenishment, and improved aesthetics.

5.3.2 Utility Search

Prior to recommending a BMP site, a utility search was conducted. Known utilities companies contacted for utility information regarding the project area include:

- Sempra – Gas utility
- Southern California Edison – Electric utility
- Metropolitan Water District of Southern California (MWDSC)

Utility information obtained from the companies was included in the database created for this project. Analysis of the utility information indicates that there appears to no potential conflict with the proposed projects. The utility information is included in Appendix D.

5.3.3 Geotechnical Investigation

Accurately identifying the HSG of the existing soils is also an important first design step in computing BMP design treatment volume and appropriate runoff reduction credit. The initial screening of the on-site soils was conducted to identify basic soil characteristics related to stormwater management, such as the HSG and other features relevant to construction activities (e.g., erosion and sediment control). Also, through the initial screening areas where more detailed soil investigation and field determinations may be needed to refine the limits of the different HSGs as defined in the soil survey were identified. The initial screening also included the identification of locations deemed suitable for infiltration BMPs and therefore further detailed geotechnical investigations.

Due to concern regarding infiltration rates at the Torrance Airport, a geotechnical investigation of this site was conducted using three soil borings. Details of this subsurface investigations are summarized in Appendix E. In summary, it can be concluded that the boring logs indicate that the top layer below surface at the Airport consists of a thin layer of silty sand followed by sandy clay, alluvium, and clay deposits. At depths ranging from 25 to 45 feet below surface, a sand layer is present. This layer would be most suitable for infiltration of stormwater. Hence, substantial excavation would be required to install the underground infiltration galleries at this site, which results in higher cost and difficult access for maintenance. More details regarding this BMP site is provided later in this section.

5.4 Sub Area Volume and Load Reduction Evaluation

Using the values extracted from other EWMPs and published articles the average removal efficiency for each pollutant was estimated. The results are presented in Table 5.3.

Part VI.C.4.c.i.(1) of the MS4 Permit requires Permittees to develop and implement LID ordinances applicable to new and re-development projects meeting specified thresholds of disturbance. Average annual re-development rates released by the City of Los Angeles (LAR UR2 WMA, 2015) were used to project the area within the Implementation Area that is expected to be developed between the modeled milestone dates. It can be assumed that the new and re-development projects will implement BMPs as required by the MS4 Permit, thus providing a load reduction based on the 85th percentile rainfall. Table 5.4 summarizes the percent of area re-developed at each of the milestone dates.

Using the land use information summarized in Table 2.1 and Table 5.4 the percent of area re-developed and expected volume reduction at each of the milestone dates were estimated.

Areas being re-developed, as a result of the LID ordinances enforced within the Implementation Area, were modeled using volume reduction BMPs sized for the 85th percentile storm depth. Table 5.5 summarizes the volume reduction associated with the re-developed area within each sub area in the Implementation Area.

Table 5.3 Average Pollutant per Constituent

	Non-modeled BMP Removal Efficiency (%)		
Constituent	**MCMs**	**Private Redevelopment and LID Incentives**	**Catch Basin Filter**
Sediment	5	30	45
Total Phosphorus	5	15	41
Total Nitrogen	5	15	28
Total Copper(1)	5	8.5	30
Total Lead	5	8.5	30
Bacteria	5	20	45

Note:
(1) Copper brake pad efficiency of 40%

Table 5.4 Re-Development Rates by Land Use

		Percent of Area to be Developed by Milestone Year			
Land Use	**Annual Dev. Rate**	**2018 Nutrient (100)**	**2019 Toxics (100%)**	**2032 Metal (100%)**	**2040 Bacteria (100%)**
Residential	0.18	0.54	0.72	3.06	4.5
Commercial	0.15	0.45	0.60	2.55	3.75
Industrial	0.34	1.02	1.36	5.78	8.5
Transportation	2.7	8.10	10.8	45.9	70.2

Table 5.5 Volume Reduction Based on Re-Development by Sub Area

Sub Area	Land Use Re-Development Area (ac)				Total Area (ac)	Volume Reduction (ac-ft)
	Residential	Commercial	Industrial	Transportation		
Nutrient						
Airport	2.31	0.44	0.60	18.16	21.46	10.38
Airport Southeast	0.16	0.03	0.04	1.54	1.30	0.75
Walnut Sump	2.14	0.41	0.56	17.18	20.3	9.81
Baseball Field	0.36	0.07	0.09	2.89	3.41	1.81
Toxics						
Airport	3.02	0.59	0.80	24.22	28.62	15.22
Airport Southeast	0.22	0.04	0.06	1.74	2.05	1.09
Walnut Sump	2.85	0.55	0.75	22.90	27.06	14.39
Baseball Field	0.48	0.09	0.13	3.85	4.55	2.42
Copper and Lead						
Airport	12.83	2.49	3.38	102.93	121.63	5.69
Airport Southeast	0.92	0.18	0.24	7.39	8.73	0.41
Walnut Sump	12.13	2.35	3.20	97.34	115.02	5.38
Baseball Field	2.04	0.40	0.54	16.36	19.34	0.90
Bacteria						
Airport	18.87	3.66	4.97	157.42	184.92	8.64
Airport Southeast	1.35	0.26	0.36	11.30	13.28	0.62
Walnut Sump	17.84	3.46	4.70	148.87	174.87	8.18
Baseball Field	3.00	0.58	0.79	25.03	29.4	1.37

5.4.1 Walteria Lake Sub Area

The Walteria Lake Sub Area is served by Walteria Lake, which acts as an extended wet detention basin. The lake is located west of Hawthorne Boulevard, between 234th Street and 238th Street. It has a surface area of about 26 acres with tributary area of nearly 2,287 acres. The total capacity of Walteria Lake is approximately 1,005 ac-ft, which is about ten times larger than the 85th Percentile 24-hour storm volume.

Stormwater is pumped from the lake through a 54-inch diameter force main. During big storms and/or pumping conditions, there is a high potential for sediment resuspension. This may lead to high pollutant discharge into Machado Lake. To prevent pollutant discharge into Machado Lake and thereby meet WLAs, discharge from Walteria Lake during pumping periods would be diverted at two locations to proposed BMP sites A1 and A2 as shown on Figure 5.4. However, A1 and A2 are designed based on Torrance watershed only. Additional capacity to treat flow volume pumped from Walteria Lake is not part of this report. A1 could be expanded with financial participation from the LACFCD.

5.4.2 Airport Sub Area

The Airport Sub Area is about 60 percent impervious with a concentrated impervious configuration and moderate road density. There are three proposed BMP sites all located at Torrance Airport (A1, A2, and A3). These are open areas and are well maintained, suggesting the use of fertilizers that have high levels of nutrients and some metals, such as copper, adding another source of nutrients and metals to the stormwater runoff from the area.

For the purposes of BMP implementation, the Airport Sub Area was subdivided into three subcatchments, AS1, AS2 and AS3 as shown on Figure 5.4. The subcatchments were delineated based on drainage characteristics and storm drain layout. Based on site characteristics and storm drain layout, only runoff generated from AS2 and AS3 can cost-effectively be diverted to the three proposed sites. Therefore, only distributed BMPs (catch basin filters) were considered for AS1.

Several scenarios of diverting runoff from AS2 and AS3 to the proposed BMP sites were investigated. The scenarios analyzed can be summarized as follows:

1. Divert runoff from AS2 and AS3 individually to the BMP sites:
    a. divert runoff from AS3 to A3 and
    b. runoff from AS2 to A2
2. Divert combined runoff from AS2 and AS3 to A1-A2. A1-A2 is the combination of sites A1 and A2.
3. Divert combined runoff from AS2 and AS3 to A3

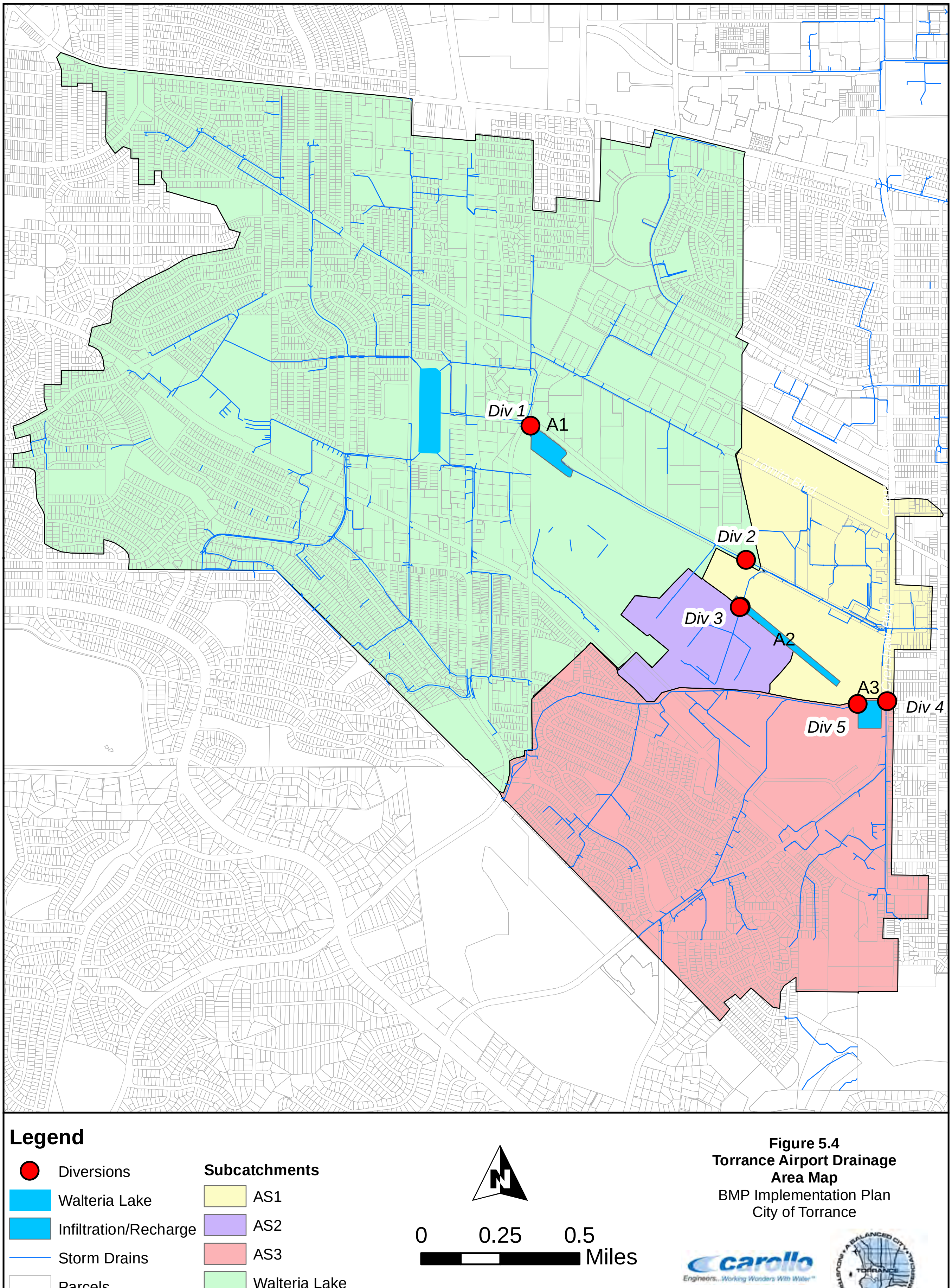


Figure 5.4
Torrance Airport Drainage Area Map
BMP Implementation Plan
City of Torrance

Based on the results of the analysis, the scenario where runoff is diverted individually to the BMP sites was eliminated.

The applicability of BMP sites A1-A2 and A3 to capture and retain the 85th percentile, 24-hour runoff volume from both AS2 and AS3 was investigated. Calculations were performed to determine the approximate BMP size required to capture the 85th-percentile, 24-hour storm volume from the subcatchments. Table 3.12 summarizes the 85th Percentile, 24-hour runoff volume generated from each subcatchment. The total surface area and volume requirements for each proposed BMP site are also summarized in Table 5.6. As shown in the table, the proposed BMP sites A1-A2 and A3 have adequate capacities to implement underground storage/infiltration systems to retain and infiltrate stormwater generated from AS2 and AS3. The total depth of the proposed underground storage/infiltration system will range between 4 and 8 feet.

The proposed BMP sites A1-A2 and A3 were also evaluated to determine if the soils at the sites meet infiltration requirements. Based on geotechnical evaluation, BMP site A3 is the least feasible site to implement underground storage/infiltration due to the presence of a thick clay layer. The clay layer can excavated and replaced with engineered soils. The combined capacity of A1-A2 is approximately 34.4 ac-ft. Thus, A1-A2 has enough capacity to capture and infiltrate the 85th percentile runoff from subcatchments AS2 and AS3. The BMP site A3 also has enough capacity to capture and retain the 85th Percentile, 24-hour storm volume. Subcatmments AS2 and AS3 can therefore be designated as 85th Percentile Basins. All the runoff captured at A1-A2 and A3 will be discharged through infiltration. The Airport Sub Area subcatchments scenarios are depicted on Figure 5.5.

Table 5.6 Summary of BMP Requirements for Airport Sub Area

Subcatchment Treated	Proposed BMP Site	Drainage Area Treated (ac)	Percent Imperviousness	85th Percentile 24-hr Volume (ac-ft)(3)	Proposed BMP Capacity (ac-ft)(1)
AS2 and AS3	A1(2)-A2(4)	726	59	30.8	34.4
AS2 and AS3	A3(5)	726	59	30.8	32.8

Notes:

(1) Proposed BMP capacity is based on minimum depth of 4 feet
(2) Discharge from Walteria Lake Sub Area could be diverted to A1. Surface area of A1 = 5.6 ac
(3) The 85th percentile 24-hour storm depth = 0.85 in.
(4) Surface area of A2 = 3 ac
(5) Surface area of A3 = 8.2 ac
(6) Drainage area within Torrance. Total tributary area is about 2,290 ac.
(7) Walteria Lake is an existing BMP

Legend

- Diversions
- New Conveyance
- Inflitration/Recharge
- Storm Drains

0 1,000 2,000 Feet

Figure 5.5
Conceptual Layout of Torrance Airport Underground Storage/Infiltration BMP
Stormwater Recharge Project
City of Torrance

5.4.2.1 Airport Sub Area Treatment and Volume Reduction Scenarios

Tables 5.7 and 5.8 show pollutant loads generated from subcatchments AS1, AS2, and AS3. These three subcatchments represent approximately 46 percent of the Implementation Area excluding Walteria Lake Sub Area and generate about 47 percent of the TSS load from the Implementation Area (excluding Walteria Lake). Therefore, for the City to meet the TMDL requirements, stormwater generated from these subcatchments must be managed using watershed-based strategies that combine structural and institutional or non-structural BMPs.

Table 5.7 Airport Sub Area Nutrient and Toxics Baseline Load Summary - 10/01/2009 - 09/30/2010

		Pollutant Load (kg/yr)		
Subcatchment	**Volume (ac-ft)**	**TSS**	**TP**	**TN**
AS1	191.7	58,020	72.1	556.6
AS2	67.2	20,038	17.5	134.2
AS3	496.3	149,130	176.4	1,361.2

		Pollutant Load (g/yr)			
Subcatchment	**Volume (ac-ft)**	**Total PCB**	**Total DDT**	**Dieldrin**	**Chlordane**
AS1	191.7	5.71	3.89	1.11	3.34
AS2	67.2	1.97	1.34	0.38	1.15
AS3	496.3	14.67	9.99	2.86	8.58

Table 5.8 Airport Sub Area Metals and Bacteria Critical Baseline Load Summary

	Total Copper(1)		Total Lead(2)		Bacteria(3)	
Subcatchment	**Volume (ac-ft)**	**Load (kg/day)**	**Volume (ac-ft)**	**Load (kg/day)**	**Volume (ac-ft)**	**Load (#/day)**
AS1	15.8	1.74	2.3	0.13	6.2	1.8E+10
AS2	5.5	0.60	0.8	0.05	2.1	6.2E+09
AS3	40.5	4.45	5.8	0.33	15.9	4.6E+10

Notes:
(1) Based on 02/18/2005 simulation
(2) Based on 04/12/2010 simulation
(3) Based on 02/21/2011 simulation
(4) Concentrations shown in Table 3.10

Subcatchment AS1

AS1 is a treatment subcatchment. That is, runoff volume reduction is minimal. Stormwater generated from AS1 will be treated solely with distributed and institutional BMPs. The distributed and institutional BMPs recommended for implementation in AS1 include:

- Street sweeping – toxics and other pollutants released to the urban environment during dry weather conditions are likely to adsorb on street sediments, which provide mechanism for metals to reach downstream waterbodies. Street sweeping removes sediment, debris, and other pollutants from road and parking lots surfaces.
- Catch Basin Filter/Cleanouts – continuation of catch basin filter cleaning programs will contribute to removal of sediments prior to entering the storm drains. The pollutant removal mechanisms of catch basin filters are: screening, sedimentation, flotation, and absorption. Debris and large particles are removed by screening; smaller particles and sediment along with associated hydrocarbons, metals, nutrients, toxics and pathogens are removed by settling; and hydrocarbons that are not associated with sediment are removed by absorption.

Through extensive research review this EWMP uses the pollutant removal efficiencies summarized in Table 5.3. Toxics removal is assumed to be directly related to sediment removal efficiency. The assumptions underlying the modeling efforts are discussed in Section 6.

Subcatchment AS1 has a total drainage area of about 249 acres with average imperviousness of about 60 percent. All of the stormwater runoff from AS1 will be treated by a total of 57 catch basin filters. All the 57 catch basins will be retrofitted to allow the installation of full capture filters. Table 5.9 presents the expected outcome after implementation of distributed and institutional BMPs in subcatchment AS1. Some of the catch basin filters considered have reported bacteria removal capabilities as shown in Appendix G. Since catch basin filters generally have moderate bacteria removal efficiency conservative removal efficiency was applied as shown in Table 5.9. The proposed catch basin filters will have design elements targeting bacteria.

The City will evaluate the existing street sweeping program (e.g., method, frequency, and equipment) to determine potential to modify the program to further reduce bacteria on street surfaces. Where opportunities exist, changes will be made to the program. If it is determined that a change in equipment can provide water quality benefits, the City will work to explore funding opportunities to upgrade/replace equipment.

Table 5.9 Subcatchment AS1 (Airport Sub Area) Volume and Load Reduction Summary

Control Measure Implementation	Volume (ac-ft)	Load Reduction (kg/yr)		
		TSS	TP	TN
Enhance MCMs(1)	0	2,901	3.61	27.83
Re-development and LID incentives	2.65	17,406	10.82	83.49
Catch Basin Filter(2)	0	26109	29.60	155.85
Total Reduction(3)	**2.65**	**46,416**	**44.03**	**267.17**
Critical Baseline Volume/Load	**191.7**	**58,020**	**72.10**	**556.6**
% Reduction	**1.4**	**80**	**61**	**48**

Control Measure Implementation	Volume (ac-ft)	Pollutant Load (g/yr)			
		Total PCB	Total DDT	Dieldrin	Chlordane
Enhance MCMs(1)	0	0.29	0.19	0.06	0.17
Re-development and LID incentives	3.89	1.71	1.17	0.33	1.00
Catch Basin Filter(2)	0	2.57	1.75	0.50	1.50
Total Reduction(3)	**3.89**	**4.57**	**3.11**	**0.89**	**2.67**
Critical Baseline Load	**191.7**	**5.71**	**3.89**	**1.11**	**3.34**
% Reduction	**2**	**80**	**80**	**80**	**80**

Control Measure Implementation	Load Reduction			
	Volume (ac-ft)	Total Copper (kg/day)	Total Lead (kg/day)	Bacteria (#/day)
Enhance MCMs(1)	0	0.09	0.01	3.46E+12
Re-development and LID incentives	1.45	0.15	0.01	1.38E+13
Copper Brake Pad Reduction(3)	0	0.78	0	0
Catch Basin Filter(2)	0	0.52	0.04	3.11E+13
Total Reduction	**1.45**	**1.54**	**0.06**	**4.84E+13**
Critical Baseline Volume/Load	**15.78**	**1.74**	**0.13**	**6.92E+13**
% Reduction	**9**	**89**	**46**	**70**

Note:
(1) MCMs efficiencies adopted from EWMP for Dominguez Channel Watershed Management Area Group
(2) Removal efficiencies; TSS - 45%, TP - 41%, TN - 24%, 48% and bacteria - 55%
(3) Load reduction by combined non-structural BMPs and distributed BMPs
(4) No volume reduction
(5) Removal efficiency - 45%

Subcatchments AS2 and AS3 - 85th Percentile Basins

Both institutional and structural BMPs are recommended for subcatchements AS2 and AS3. Enhanced MCMs including street sweeping and underground storage/infiltration system will be implemented to capture and retain runoff generated from these subcatchments.

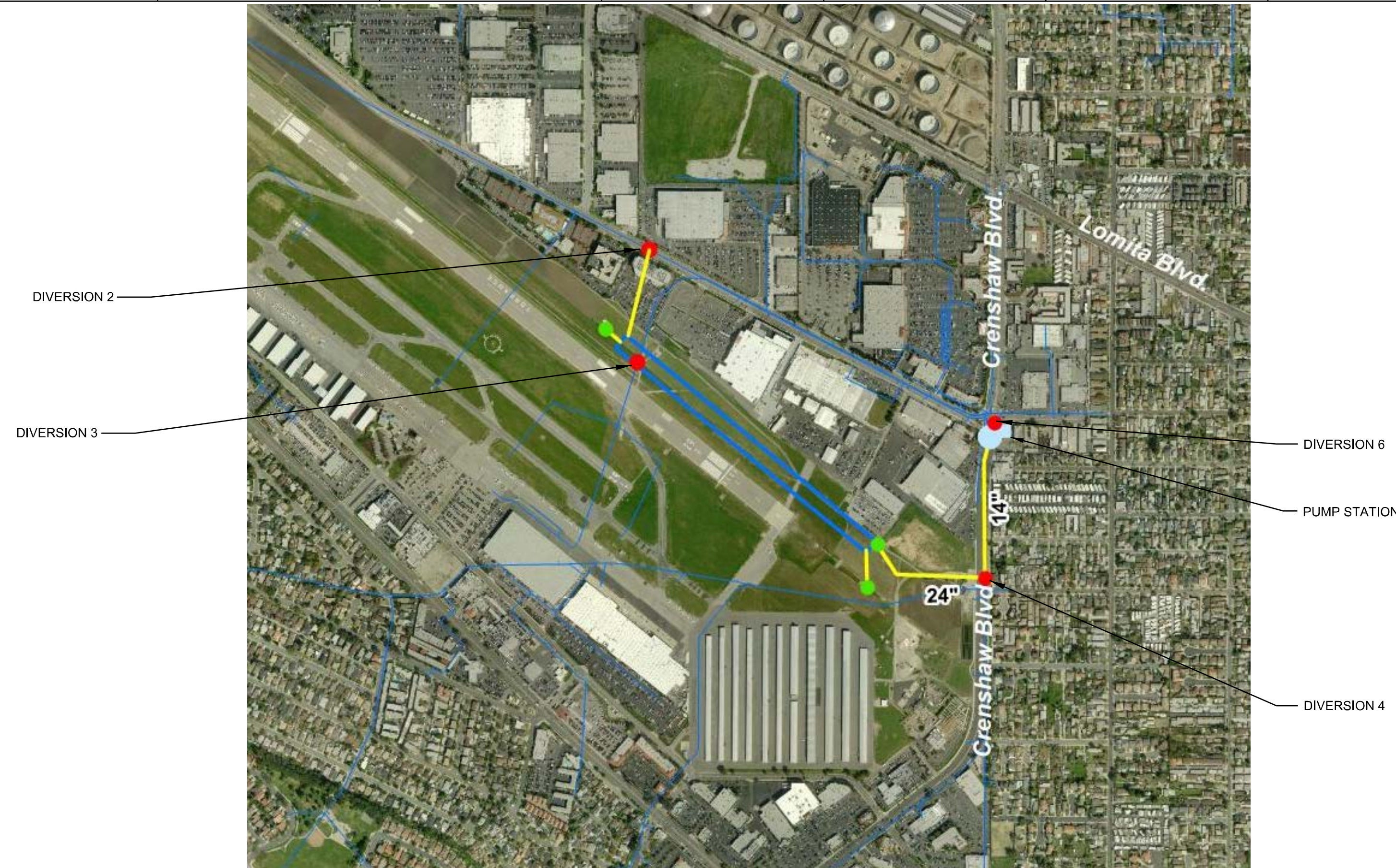
Two options listed below were evaluated regarding the underground storage/infiltration system.

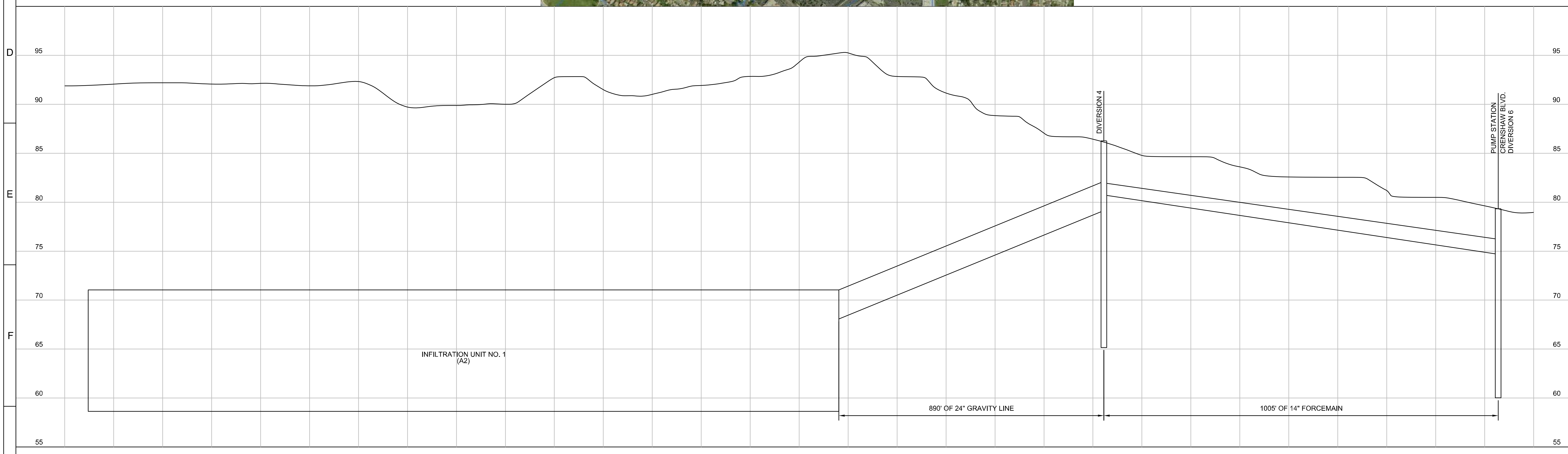
1. **Option 1 -** Divert the combined runoff from AS2 and AS3 generated from storms less or equal to the 85th Percentile, 24-hour event to BMP site A1-A2.
2. **Option 2 -** Divert the combined runoff from AS2 and AS3 generated from storms less or equal to the 85th Percentile, 24-hour event to BMP site A3.

Option 1: In this option, the underground storage/infiltration system will be implemented at BMP sites A1 and A2. The combined volume of the proposed BMPs at A1 and A2 is approximately 34.4 ac-ft. The total runoff volume generated from the 85th percentile 24 hour storm is about 30 ac-ft. Thus, the proposed BMP sites have enough capacity to handle this storm event. However, the underground storage/infiltration system will be implemented in two phases. In phase 1, a 4 feet deep underground storage/infiltration system will be implemented at Site A2. The EWMP calls for an integrated, adaptive management approach to utilize available resources effectively and efficiently. If through continued study of drainage patterns, diagnosis of problem sources, and new technologies for dry and wet weather treatment, it is realized that more treatment is needed in the Airport treatment area, BMP site A1 will be considered for implementation of additional storage/infiltration system in Phase 2. Thus, the implementation of underground storage/infiltration system in Phase 2 will depend on the effectiveness of the Phase 1 BMP.

In Phase 1, runoff generated from subcatchments AS2 and AS3 will be diverted to Site A2 (12 acre-ft). Under this phase, two scenarios have been identified and illustrated on Figures 5.6 and 5.7. In scenario 1, stormwater runoff will be diverted from Crenshaw Blvd and Amsler Street, and pump through a 14-inch diameter forcemain to another diversion system at Crenshaw Blvd and 250th Street. From here, the stormwater will flow by gravity to the infiltration system at Site A2. To improve infiltration in this area, the infiltration system will be located at a depth not less than 40 feet from the ground surface.

In scenario 2, stormwater diverted from storm drains at Crenshaw Blvd and Amsler Street, and Crenshaw and 250th Street will flow by gravity into the infiltration system at Site A2. Stormwater from Crenshaw Blvd. and Amsler Street will be conveyed through a 21-inch pipe to Crenshaw and 250th Street. From here, the stormwater will be conveyed through a 24-inch pipe to the infiltration system for treatment.





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DATE APRIL 2013

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PLAN AND PROFILE OPTION 1

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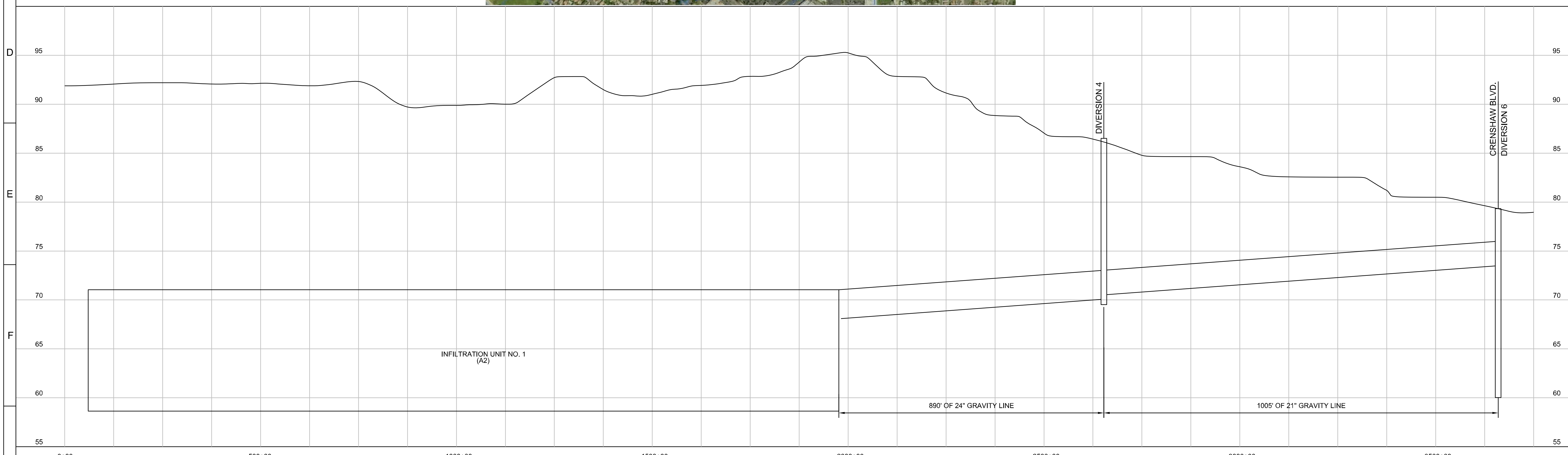

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Legend

- Diversions
- New Conveyance - Gravity Lines
- Inflitration/Recharge
- Storm Drains

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Figure 5.7
Recommended BMP
at Torrance Airport
Stormwater Recharge Project
City of Torrance

Option 2: This is the preferred option. In this option, stormwater diverted from storm drains at Crenshaw Blvd and Amsler Street, and Crenshaw and 250th Street will flow by gravity into the infiltration system at Site A3. Stormwater from Crenshaw Blvd. and Amsler Street will be conveyed through a 21-inch pipe to Crenshaw and 250th Street. From here, the stormwater will be conveyed through a 24-inch pipe to the infiltration system at Site A3.

Table 5.10 presents the expected outcome after implementation of institutional and structural BMPs to capture and retain stormwater runoff from subcatchments AS2 and AS3. The results are summarized for only Option 2, which is the recommended option. The load reductions in the table are based on both volume reduction and treatment by the MCMs. Table 5.10A summarizes the results for TSS, TP, TN, and toxics and Table 5.10B presents the results summary for metals and bacteria. As explained earlier TSS was used as a surrogate pollutant for toxics. The calculation for toxics load is based on the equation presented in Section 3.3.2.2.

Table 5.10A Subcatchments AS2 and AS3 (Airport Sub Area) Nutrient and Toxics Load Reduction Summary for Option 2 - Recommended Option(1).

Control Measure Implementation	Volume (ac-ft)	Load (kg/yr)		
		TSS	TP	TN
Enhanced MCMs				
1. AS2	0	1,002	0.88	6.71
2. AS3	0	7,457	8.82	68.06
Re-development and LID incentives (AS2 and AS3)	7.73	32,402	29.09	224.33
Storage/Infiltration AS2 and AS3	351.02	79,926	96.62	745.27
Total Reduction (2)	**358.75**	**120,787**	**135.41**	**1044.37**
Critical Baseline Volume/Load(3)	**563.50**	**169,168**	**193.9**	**1,495.5**
% Reduction	**64**	**71**	**70**	**70**

Control Measure Implementation	Volume (ac-ft)	Pollutant Load (g/yr)			
		Total PCB	Total DDT	Dieldrin	Chlordane
Enhanced MCMs					
1. AS2	0	0.10	0.07	0.02	0.06
2. AS3	0	0.73	0.50	0.14	0.43
Re-development and LID incentives (AS2 and AS3)	7.73	4.99	3.40	0.97	2.92
Storage/Infiltration AS2 and AS3	351.02	6.74	4.58	1.31	3.94
Total Reduction (2)	**358.75**	**12.56**	**8.55**	**2.44**	**7.35**
Critical Baseline Volume/Load(3)	**563.5**	**16.64**	**11.33**	**3.24**	**9.73**
% Reduction	**64**	**75**	**75**	**75**	**76**

Notes:
(1) Simulation period: 10/01/09 - 09/30/10
(2) Load reduction by combined non-structural BMPs and structural BMP
(3) Critical baseline volume/load for AS2 and AS3.

Table 5.10B Subcatchments AS2 and AS3 (Airport Sub Area) Metals and Bacteria Load Reduction Summary for Option 2 - Recommended Option.

Control Measure Implementation	Total Copper(1)		Total Lead(2)		Bacteria(3)	
	Volume (ac-ft)	Load(4) (kg/day)	Volume (ac-ft)	Load (kg/day)	Volume (ac-ft)	Load (#/day)
Enhanced MCMs						
1. AS2	0	0.09	0	0.01	0	1.20E+12
2. AS3	0	0.64	0	0.05	0	8.90E+12
Copper Brake Pad Reduction(3) (AS2 & AS3)	0	2.12	0	0	0	0
Re-development and LID incentives (AS2 & AS3)	5.69	0.40	5.69	0.03	8.64	4.04E+13
Storage/Infiltration (AS2 & AS3	30.9	0.98	30.9	0.29	30.9	1.52E+14
Total Reduction (1)	36.59	4.23	36.59	0.38	39.54	2.02E+14
Critical Baseline Volume/Load	**46**	**4.72**	**5.6**	**0.38**	**18.4**	**2.02E+14**
% Reduction	**80**	**90**	**100**	**100**	**100**	**100**

Notes:
(1) Based on 02/18/2005 simulation
(2) Based on 04/12/2010 simulation
(3) Based on 02/21/2011 simulation
(4) Concentrations shown in Table 3.10

The storage requirements summarized in Table 5.6 were incorporated into the water quality model to simulate the effectiveness of the BMPs. All assumptions used in the pre-BMP model scenario were retained. The simulations do not include non-structural BMPs such as street sweeping and catch basin filter. The nonstructural BMPs were evaluated separately.

5.4.2.2 Recommended BMP Implementation in Airport Sub Area

The Airport Sub Area subcatchments, AS1, AS2, and AS3 represent approximately 46 percent of the Implementation Area excluding Walteria Lake Sub Area. They generate about 47 percent of TSS load from the Implementation Area (excluding Walteria Lake Sub Area). The City has to implement BMPs to treat stormwater generated in this area in order to comply with the established TMDLs in the Machado Lake Watershed.

In addition to street sweeping, catch basin filters and other institutional BMPs discussed earlier, proposed site A3 is recommended for implementation of underground storage/infiltration system. The site was selected based on space availability, soil conditions, and cost effectiveness.

An eight feet deep underground storage/infiltration system will be installed at Site A3 to receive stormwater runoff through 21- and 24-inch diameter gravity pipes. Stormwater diverted from storm drains at Crenshaw Blvd and Amsler Street, and Crenshaw and 250th Street will flow by gravity into the infiltration system at Site A3. Stormwater from Crenshaw Blvd. and Amsler Street will be conveyed through a 21-inch to Crenshaw and 250th Street. From here, the stormwater will be conveyed through a 24-inch pipe to the infiltration system for treatment at A3.

The recommended BMP implementation in the Airport Sub Area can be summarized as follows:

1. Practice enhanced MCMs in subcatcments AS1, AS2 and AS3 as written in the LA County MS4 Permit.

2. Install 57 catch basin filters in subcatchment AS1. The proposed catch basin filters will capture runoff from the entire subcatchment AS1.

3. Divert up to the 85th Percentile, 24-hour stormwater runoff from AS2 and AS3 to the proposed BMP Site A3.

In addition to contributing to meeting the TMDL reduction requirement of improving water quality, a centralized BMP at the Torrance Airport would provide other water resources benefits. A centralized BMP at Torrance Airport would be designed to increase infiltration providing additional groundwater replenishment to the groundwater basin. Storage provided by the BMP would reduce potential flooding in the watershed treatment area. Further benefits could be determined during implementation.

5.4.2.2.1 <u>Potential Partnership with Peninsula Cities</u>

There is an opportunity for the Peninsula Cities to "financially partner" with the City of Torrance on the proposed Airport Project at BMP site A3. The cities include Rolling Hills Estate, Rancho Palos Verdes, Palos Verdes Estates, and Los Angeles County unincorporated. Table 5.11 shows the drainage areas tributary to the proposed BMP at Site A3.

As a result of the potential partnership, the capacity of the BMP at Site A3 will increase by about 100 percent and the total construction cost is estimated to increase from about $7,000,000 to about $14,000,000.

5.4.3 Airport Southeast Sub Area

The Airport Southeast Sub Area is designated an 85th Percentile Basin and is located in the Project No. 77/510 subbasin as shown on Figure 1.2. Tables 5.12 and 5.13 summarize the Airport Southeast Sub Area baseline loadings. Since runoff generated from storm events less or equal to the 85th Percentile, 24-hour storm event will be diverted to the stormwater facility being installed by a developer (Chandler's Sand and Gravel), no improvements is proposed in this EWMP for this sub area. The new stormwater facility will capture and retain the 85th Percentile, 24-hour runoff volume. The treatment facility under construction at the former Chandler Quarry Landfill, - which is being redeveloped as the Chandler Ranch/Rolling Hills Golf Course, is designed to capture and infiltrate runoff from storms up the 50 year return frequency storm event. The concept plan of this drainage facility is included as an appendix (Appendix H) to this report.

Table 5.11 Summary of Drainage Areas of Airport Project Partners

Partner	Drainage Area Acre	Drainage Area Square Miles	Share (%)
Torrance	726	1.13	24.34
Palos Verdes Estates	93	0.15	3.12
Rancho Palos Verdes	625	0.98	20.95
Rolling Hills Estates	1098	1.72	36.81
LA County Unincorporated	441	0.69	14.78
Total	**2983**	**4.66**	**100.00**

Table 5.12 Airport Southeast Sub Area Nutrient and Toxics Baseline Load Summary - 10/01/2009 - 09/30/2010

		Pollutant Load (kg/yr)		
Sub Area	**Volume (ac-ft)**	**TSS**	**TP**	**TN**
Airport Southeast	45.5	15,367	49.49	366

		Pollutant Load (g/yr)			
Sub Area	**Volume (ac-ft)**	**Total PCB**	**Total DDT**	**Dieldrin**	**Chlordane**
Airport Southeast	45.5	1.51	1.03	0.30	0.88

Table 5.13 Airport Southeast Sub Area Metals and Bacteria Critical Baseline Load Summary

	Total Copper(1)		Total Lead(2)		Bacteria(3)	
Sub Area	**Volume (ac-ft)**	**Load (4) (kg/day)**	**Volume (ac-ft)**	**Load (kg/day)**	**Volume (ac-ft)**	**Load (#/day)**
Airport Southeast	0.48	0.01	1.63	0.01	6.2	1.8E+10

Notes:
(1) Based on 02/18/2005 simulation
(2) Based on 04/12/2010 simulation
(3) Based on 02/21/2011 simulation
(4) Concentrations shown in Table 3.10

5.4.4 Walnut Sump Sub Area

The watershed treatment area that will be treated by the Walnut Sump is about 62 percent impervious with a concentrated impervious configuration and moderate road density. For BMP implementation purposes, this sub area was subdivided into three subcatchments, WS-1, WS-2 and WS-3 as shown on Figure 5.8.

Table 5.14 and Table 5.15 show pollutant load generated from subcatchments WS-1, WS-2, and WS-3. These three subcatchments represent approximately 43 percent of the Implementation Area excluding Walteria Lake Sub Area and generate about 59 percent of the TP load from the Implementation Area (excluding Walteria Lake). Therefore, for the City to meet the TMDL requirements, stormwater generated from these subcatchments must be managed using watershed-based strategies that combine structural and institutional or non-structural BMPs.

Table 5.14 Walnut Sump Sub Area Nutrient and Toxics Baseline Load Summary - 10/01/2009 - 09/30/2010

Subcatchment	Volume (ac-ft)	Pollutant Load (kg/yr)		
		TSS	TP	TN
WS-1	113.56	33,858.67	56.15	415.49
WS-2	568.16	169,406.02	280.93	2078.85
WS-3	44.11	13,153.30	21.81	161.41

Subcatchment	Volume (ac-ft)	Pollutant Load (kg/yr)			
		Total PCB	Total DDT	Dieldrin	Chlordane
WS-1	113.56	3.33	2.27	0.65	1.95
WS-2	568.16	16.67	11.35	3.25	9.75
WS-3	44.11	1.29	0.88	0.25	0.76

Table 5.15 Walnut Sump Sub Area Metals and Bacteria Critical Baseline Load Summary

Subcatchment	Total Copper(1)		Total Lead(2)		Bacteria(3)	
	Volume (ac-ft)	Load (kg/day)	Volume (ac-ft)	Load (kg/day)	Volume (ac-ft)	Load (#/day)
WS-1	10.06	0.30	4.35	0.17	3.77	6.51E+12
WS-2	50.33	1.48	21.76	0.83	18.86	3.26E+13
WS-3	3.91	0.12	1.69	0.06	1.46	2.53E+12

Notes:
(1) Based on 02/18/2005 simulation
(2) Based on 04/12/2010 simulation
(3) Based on 02/21/2011 simulation
(4) Concentrations shown in Table 3.10

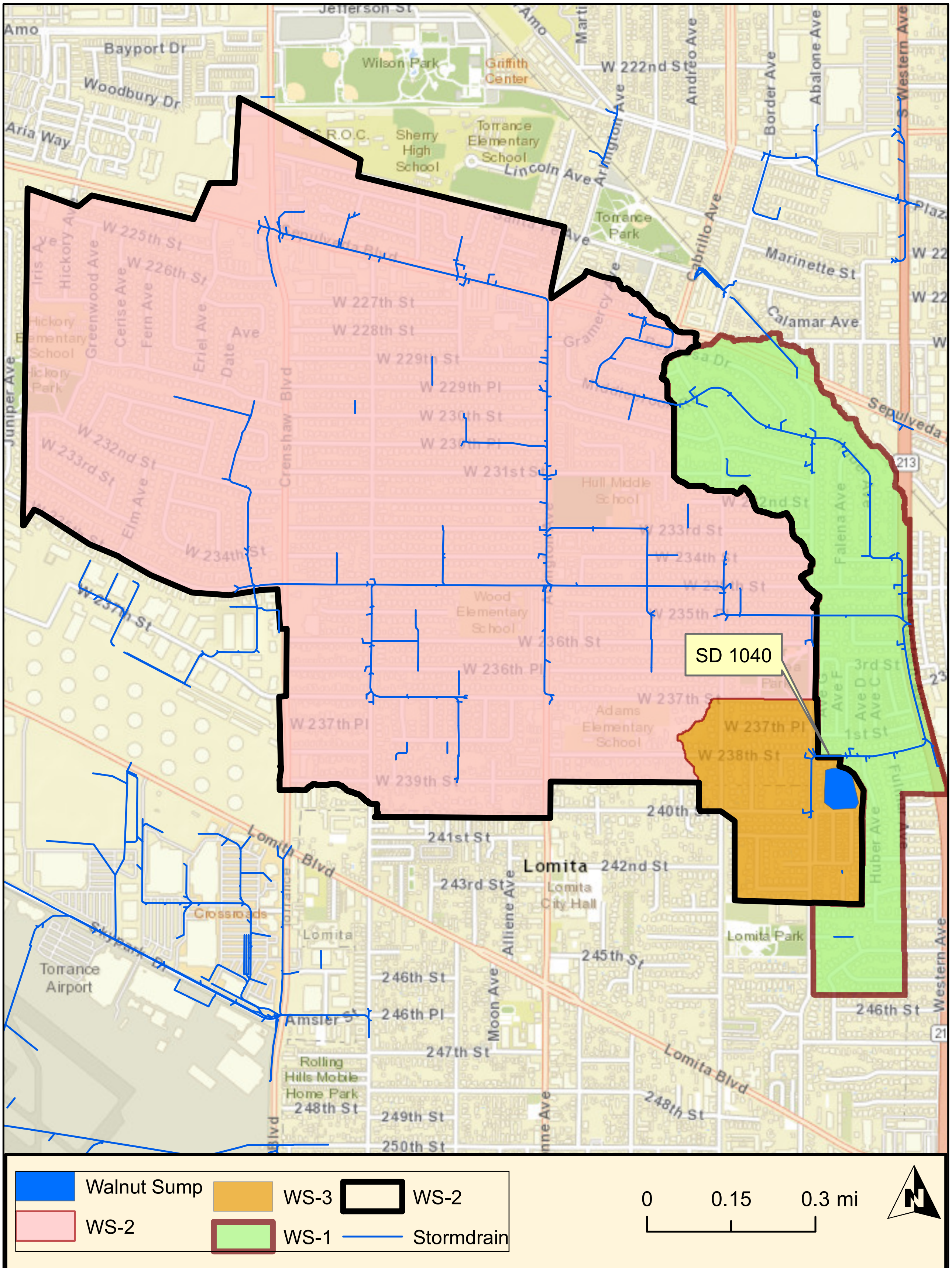

Figure 5.8 Walnut Sump Subcatchment Delineation

Two treatment options have been identified for this sub area. Both options include street sweeping. Option No. 1 will use the existing Walnut Sump to treat and infiltrate at least the 85th percentile storm runoff generated from subcatchments WS-2 and WS-3. If more treatment is needed in this sub area in order to achieve TMDL compliance Option No. 1 will be expanded to include 50 catch basin filter in WS-1. The catch basins will be retrofitted to allow the installation of full capture filter to capture fine sediments and other pollutants. Walnut Sump, which will receive stormwater from this sub area has adequate capacity to store and infiltrate the 85th percentile 24 hour runoff as shown in Table 5.16.

Table 5.16 Summary of BMP Requirements – Walnut Sump

Option	Drainage Area Treated (ac)	Percent Imperviousness	85th Percentile 24-hr Volume (ac-ft)(1)	Walnut Sump Capacity (ac-ft)	No. of Catch Basin Filter
Option No. 1	742	61	39.1	50	50
Option No. 2	922	62	-	-	150

Note:
(1) The 85th percentile 24-hour storm depth = 0.85 in.

In Option No. 1, stormwater runoff from WS-3 will be diverted to Walnut Sump in Phase I. In Phase II, stormwater from WS-2 will be diverted from the existing 9.2' x 11' RCB" storm drainpipe at 235th St. and Walnut St. through a new 60-inch diameter gravity pipe to a stormwater lift station to be located at 236th Street and Walnut Street. From the lift station, stormwater will be pumped through an 18-inch forcemain to Walnut Sump pre-treatment area for further removal of heavy sediments, oil, grease, and floatable wastes. Hydrodynamic Separator unit will be used for the pre-treatment. The pretreated stormwater runoff will then be conveyed to the Walnut Sump main storage area for storage and infiltration. If needed, 50 catch basin filters will be installed in WS-1 in Phase III.
Option No. 1 is the preferred option.

Option No. 2 consists of installing catch basin filters in WS-1, WS-2, and WS-3 to capture fine sediments and other pollutants as shown on Figure 5.9. Under this option, stormwater from WS-1, WS-2 and WS-3 will be treated by a total of 150 catch basin filters. The catch basins will be retrofitted to allow the installation of full capture screens.

Figure 5.9 shows the conceptual layout of Option No. 1 and Figure 5.10 shows detail design concept of Option No. 1. Figure 5.11 shows the details of the proposed Walnut Sump storage/infiltration system.

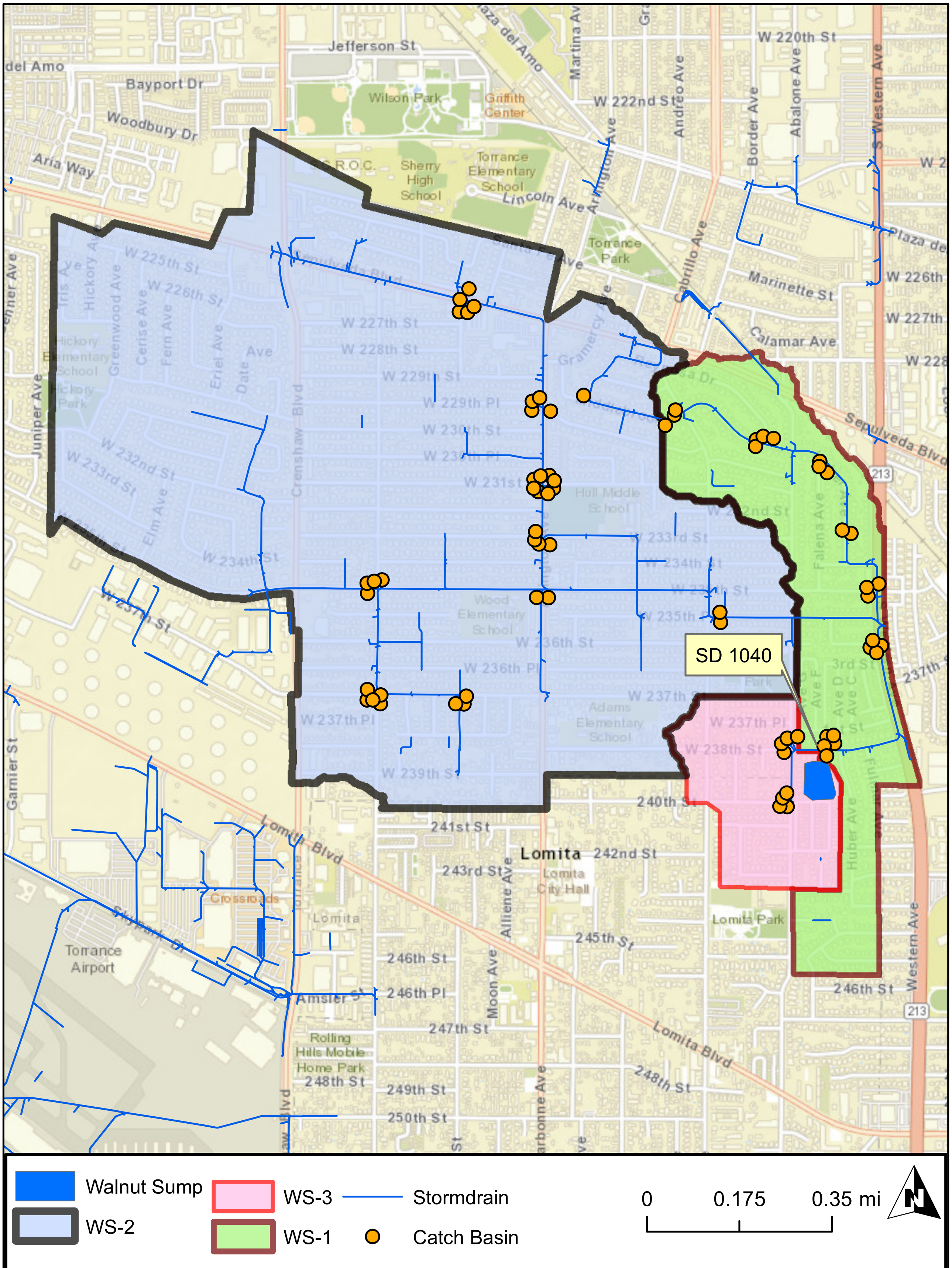

Figure 5.9 Drainage Map of Walnut Sump Treatment Area - Option 2

Legend

- Diversions
- Pump Station
- Conveyance
- Walnut Sump
- Storm Drains

0 200 400
Feet

Figure 5.10
Conceptual Layout of Walnut Sump
Aboveground Storage/Infiltration BMP
Stormwater Recharge Project
City of Torrance

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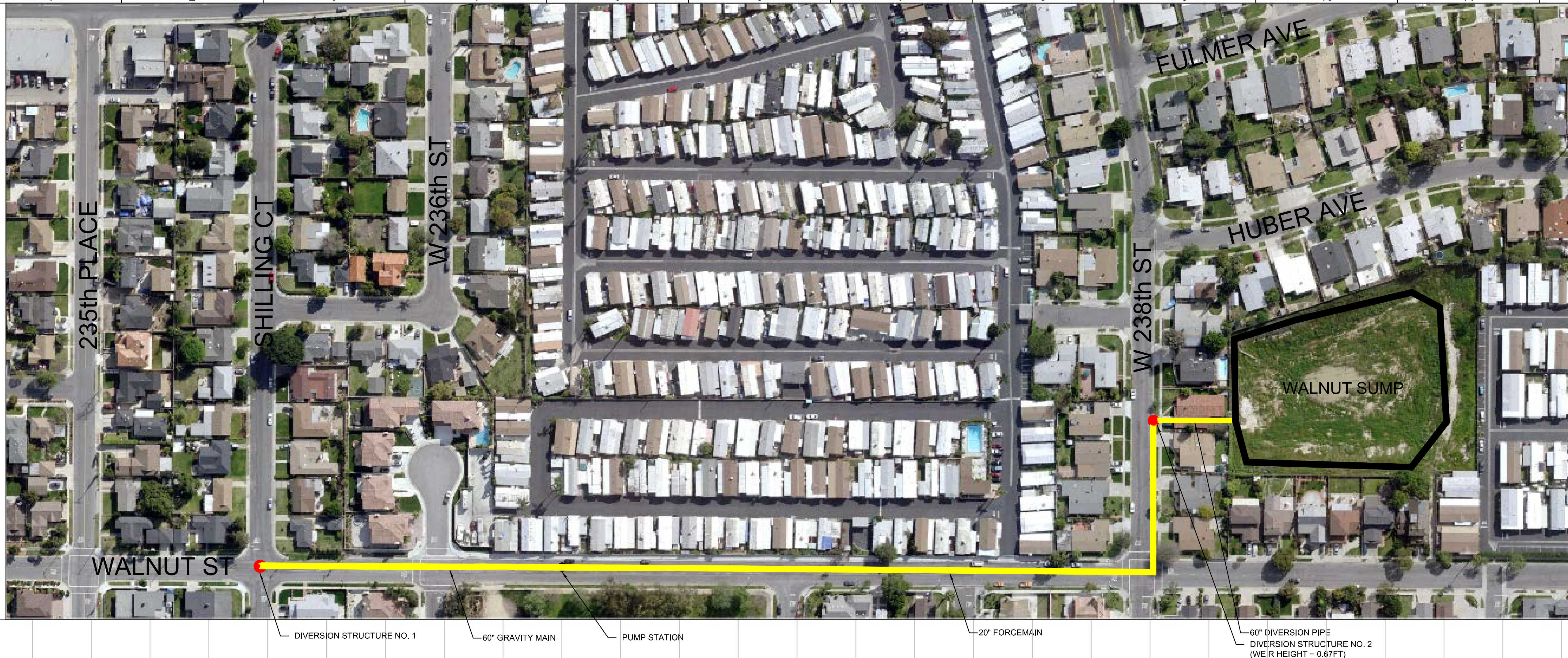

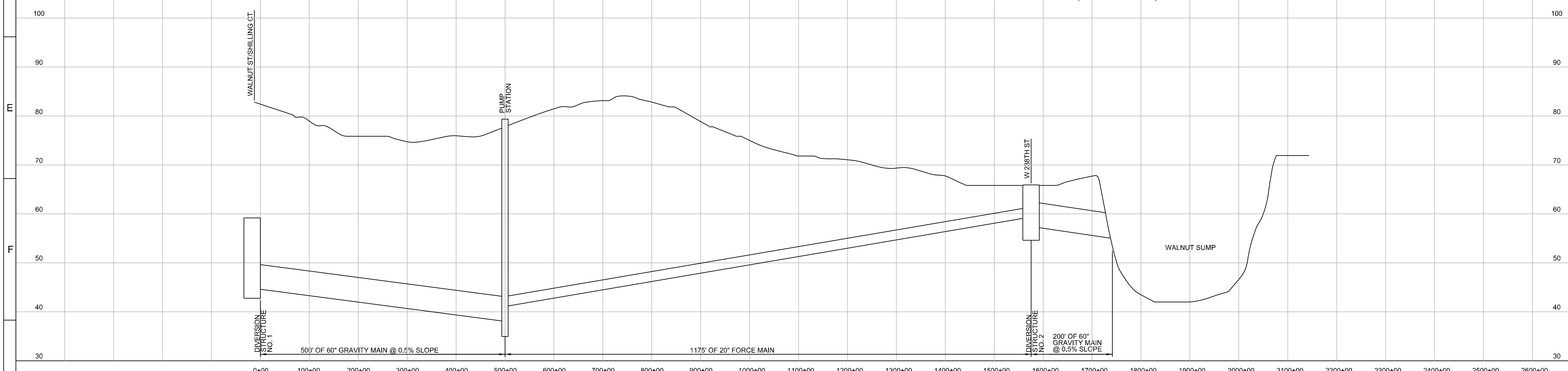

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PLAN AND PROFILE OF WALNUT SUMP TREATMENT SYSTEM

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The storage requirements summarized in Table 5.16 were incorporated into the water quality model to simulate the effectiveness of the BMPs. All assumptions used in the pre-BMP model scenario were retained. The simulations do not include non-structural BMPs such as street sweeping and catch basin filter. Table 5.17 presents the expected outcome after implementation of institutional and structural BMPs to treat stormwater runoff from subcatchments WS-1, WS-2, and WS-3. The results are summarized for only Option No. 1, which is the recommended option. The load reductions in the table are based on both volume reduction and treatment by the MCMs. Table 5.17A summarizes the results for TSS, TP, TN, and toxics and Table 5.17B presents the results for metals and bacteria.

Table 5.17A Walnut Sump Sub Area Nutrient and Toxics Volume/Load Reduction Summary for Option 1 - Recommended Option.

Control Measure Implementation	Volume (ac-ft)	Load (kg/yr)		
		TSS	TP	TN
Enhanced MCMs				
WS-1	0	1,693	2.81	20.77
WS-2	0	8,470	14.05	103.94
WS-3	0	658	1.09	8.07
Re-development and LID incentives (WS-1, WS-2 and WS-3)	9.81	64,925	53.84	398.37
Catch Basin Filter(1) WS-1	0	10,158	23.02	116.34
Storage/Infiltration				
WS-2	360.5	76,849	155.50	1,182.54
WS-3	28.0	5,969	12.08	91.85
Total Load Reduction (1)	**398.31**	**158,564**	**262.39**	**1,921.88**
Critical Baseline Load	**725.8**	**216,418**	**358.9**	**2,655.8**
% Load Reduction	**55**	**73**	**73**	**72**

Control Measure Implementation	Volume (ac-ft)	Pollutant Load (g/yr)			
		Total PCB	Total DDT	Dieldrin	Chlordane
Enhanced MCMs					
WS-1	0	0.17	0.11	0.03	0.10
WS-2	0	0.83	0.57	0.16	0.49
WS-3	0	0.06	0.04	0.01	0.04
Re-development and LID incentives (WS-1, WS-2 and WS-3)	9.81	6.39	4.35	1.25	3.74
Catch Basin Filter(1) WS-1	0	1.50	1.02	0.29	0.88
Storage/Infiltration					
WS-2	360.5	7.27	4.95	1.42	4.24
WS-3	28	0.49	0.38	0.11	0.33
Total Load Reduction (1)	384	**16.71**	**11.42**	**3.27**	**9.82**
Critical Baseline Load	**725.8**	**21.29**	**14.50**	**4.16**	**12.45**
% Load Reduction	**73.4**	**78**	**79**	**79**	**79**

Note:
(1) Removal efficiencies; TSS - 55%, TP - 41%, TN - 24%, 48% and bacteria - 55%

Table 5.17B Walnut Sump Sub Area Metals and Bacteria Load Reduction Summary for Option No.1 - Recommended Option.

	Total Copper		Total Lead		Bacteria	
Control Measure Implementation	**Volume (ac-ft)**	**Load (kg/day)**	**Volume (ac-ft)**	**Load (kg/day)**	**Volume (ac-ft)**	**Load (#/day)**
Enhanced MCMs 1. WS-1 2. WS-2 3. WS-3	 0 0 0	 0.02 0.07 0.01	 0 0 0	 0.01 0.04 0.00	 0 0 0	 3.26E+11 1.63E+12 1.27E+11
Copper Brake Pad Reduction(3) (WS-1, WS-2 & WS-3)	0	0.85	0	0	0	0
Catch Basin Filters (WS-1)	0	0.57	0	0.32	0	1.87E+13
Re-development and LID incentives (WS-1, WS-2 & WS-3)	5.38	0.16	5.38	0.09	8.18	0.83E+13
Storage/Infiltration 1. WS-2 2. WS-3	25.6 2.4	0.08 0.01	25.6 2.4	0.55 0.06	25.6 2.4	1.14E+13 1.07E+12
Total Volume/Load Reduction (1)	**33.4**	**1.77**	**33.4**	**1.07**	**36.18**	**4.16E+13**
Critical Baseline Volume/Load	**64.3**	**1.89**	**27.8**	**1.07**	**24.1**	**4.16E+13**
% Load Reduction	**52**	**94**	**100**	**100**	**100**	**100**

Note:
(1) Concentrations listed in Table 3.10

5.4.4.1 Recommended BMP Implementation at Walnut Sump

The overall objective of the Implementation Plan is compliance with the Machado Lake nutrients and toxics TMDLs. The primary objective for this project location, therefore, is to remove toxics and nutrients from the existing storm drains. These objectives may in general be met by implementing BMPs or a combination thereof. Option No. 1 which is discussed above is recommended for this sub area. In addition to street sweeping and other non-structural BMPs, the structural BMP (Option No. 1) proposed for the Walnut Sump drainage area includes the following elements:

- Stormwater lift station
- 60-inch gravity main
- 18-inch force main
- Flow diversion facility
- Hydrodynamic separator
- Above ground storage/infiltration area – Walnut Sump
- Overflow piping

The recommended plan (Option No. 1) for this sub area will be implemented in three phases as outlined below:

1. Phase 1 - Flow diversion from WS-3 and upgrades to Walnut Sump
2. Phase 2 - Flow diversion from WS-2 to Walnut Sump, new piping and pump station
3. Phase 3 - Installation of 50 catch basin filters in WS-1

In addition to contributing to meeting the TMDL reduction requirement of improving water quality, a centralized BMP at Walnut Sump would provide other water resources benefits. A centralized BMP at this location would be designed to increase infiltration providing additional groundwater replenishment to the groundwater basin. Storage provided by the BMP would reduce potential flooding in the watershed treatment area. Further benefits could be determined during implementation. For example, the actual BMP design could include additional vegetation that would enhance habitat area in the area and Public Education.

5.4.5 Baseball Field Sub Area

The watershed treatment area that will be treated by the Baseball Field underground storage/infiltration system is about 60 percent impervious with a concentrated impervious configuration and moderate road density. This treatment area has adequate surface area, about 0.73 acres to treat the 85th percentile 24-hour storm water quality volume generated from this sub area. For BMP implementation purposes, this sub area was subdivided into four subcatchments; BB-S1, BB-S2, BB-S3 and BB-S4. Table 5.18 and Table 5.19 show pollutant load generated from subcatchments BB-S1, BB-S2, BB-S3 and BB-S4.

Table 5.18 Baseball Field Sub Area Nutrient and Toxics Baseline Load Summary - 10/01/2009 - 09/30/2010

		Pollutant Load (kg/yr)		
Subcatchment	**Volume (ac-ft)**	**TSS**	**TP**	**TN**
BB-S1	15.92	3,557.46	17.32	128.19
BB-S2	59.38	13,265.46	64.60	478.02
BB-S3	31.87	7,118.59	34.66	256.52
BB-S4	19.91	4,446.83	21.65	160.24

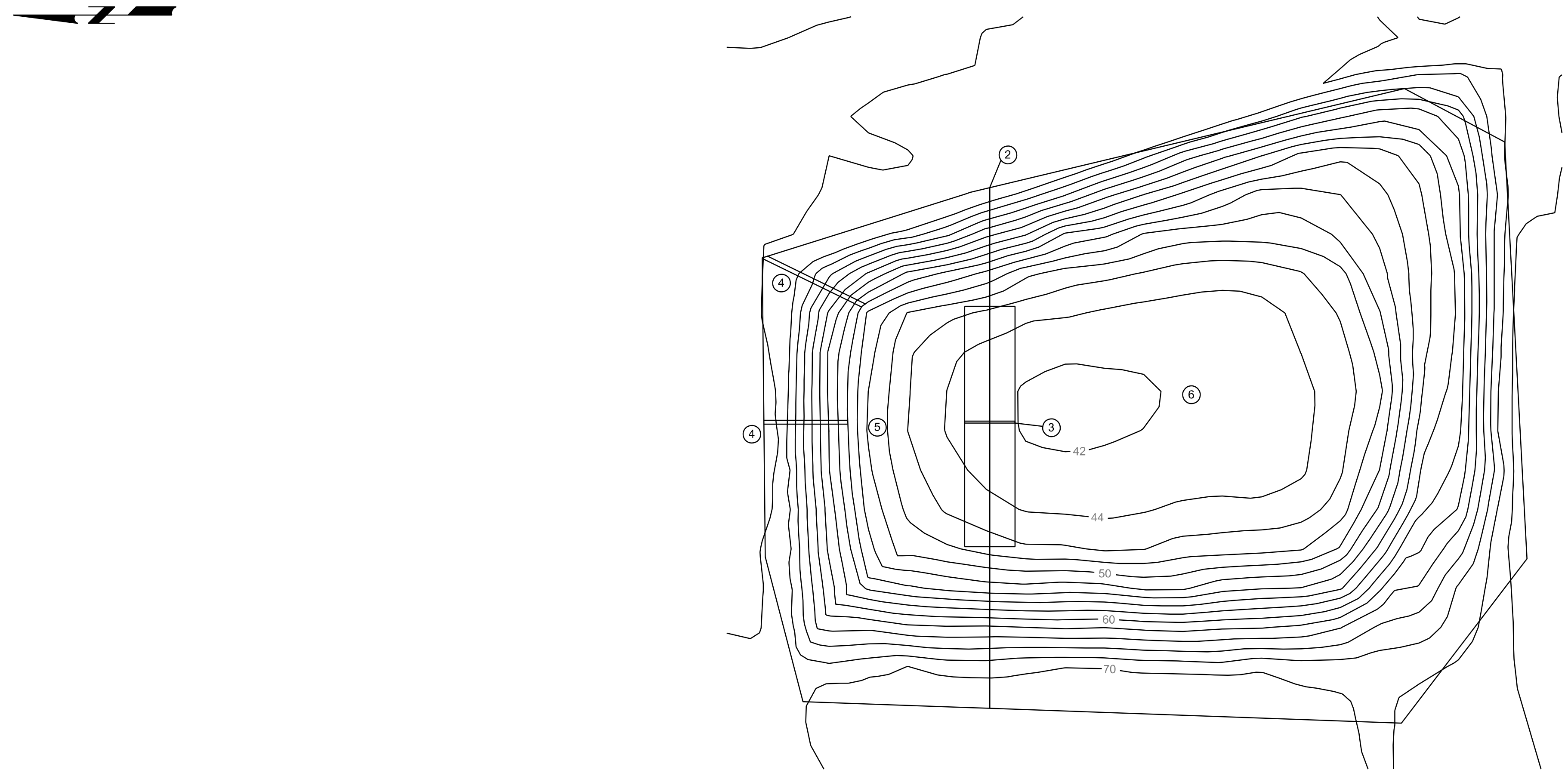
		Pollutant Load (g/yr)			
Subcatchment	**Volume (ac-ft)**	**Total PCB**	**Total DDT**	**Dieldrin**	**Chlordane**
BB-S1	15.92	0.35	0.24	0.07	0.20
BB-S2	59.38	1.31	0.89	0.25	0.76
BB-S3	31.87	0.70	0.48	0.14	0.41
BB-S4	19.91	0.44	0.30	0.09	0.26

Table 5.19 Baseball Field Sub Area Metals and Bacteria Critical Baseline Load Summary

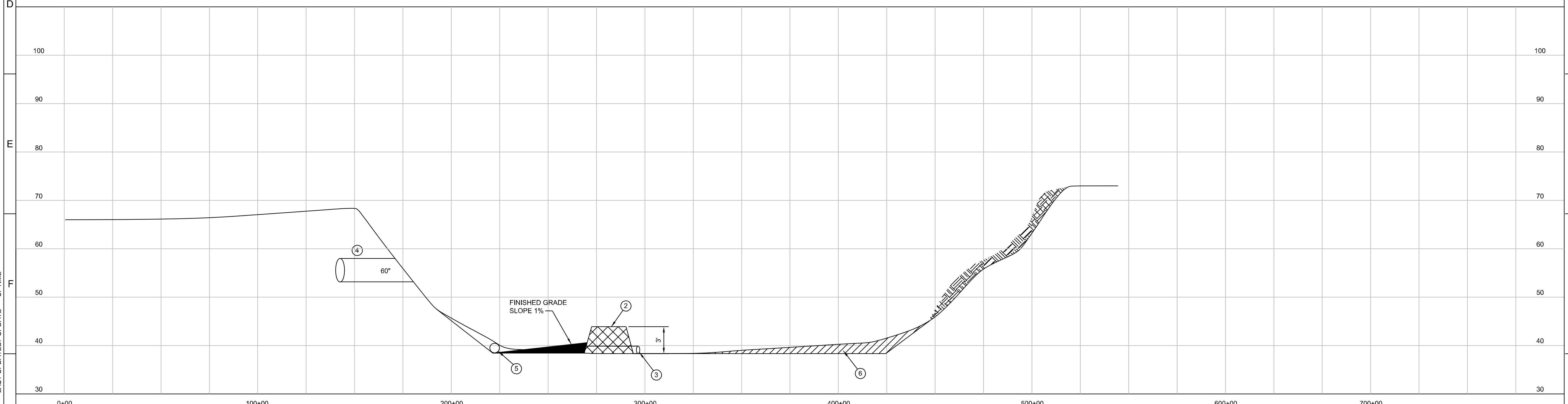
	Total Copper(1)		Total Lead(2)		Bacteria(3)	
Subcatchment	**Volume (ac-ft)**	**Load (kg/day)**	**Volume (ac-ft)**	**Load (kg/day)**	**Volume (ac-ft)**	**Load (#/day)**
BB-S1	0.71	0.02	0.23	0.01	1.28	1.03E+13
BB-S2	2.66	0.06	0.84	0.04	4.77	3.85E+13
BB-S3	1.43	0.03	0.45	0.02	2.56	2.06E+13
BB-S4	0.89	0.02	0.28	0.01	1.60	1.29E+13

Notes:
(1) Based on 02/18/2005 simulation
(2) Based on 04/12/2010 simulation
(3) Based on 02/21/2011 simulation
(4) Concentrations shown in Table 3.10

Two treatment options have been identified for this sub area. Option No. 1 will treat about 25 percent of the stormwater generated from the Baseball Field Sub Area (155 ac). Thus, under this option, only stormwater runoff from subcatchment BB-S3 shown on Figure 5.12 will be treated. Stormwater generated from the remaining subcatchments BB-S1, BB-S2, and BB-S4 will be captured by 19 catch basin filters. The catch basins will be retrofitted to allow full capture filters. These catch basin filters are of the same type as the ones proposed for the Airport and Walnut Sump sub areas and will cover the entire subcatchments.



1 RIPRAP APRON
2 EARTH BERM ACROSS ENTIRE WIDTH OF INFILTRATION BASIN
3 6" GRAVITY MAIN
4 INLET PIPE
5 UPSTREAM PRETREATMENT (INSTALL ARS UNIT)
6 DROUGHT TOLERANT VEGETATION



REV	DATE	BY	DESCRIPTION

DESIGNED SOD
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CHECKED
DATE APRIL 2013

PROJECT ENGINEER

PROJECT MANAGER

PRINCIPAL

carollo®

CITY OF TORRANCE, CALIFORNIA

DETAILS OF WALNUT SUMP STORAGE/INFILTRATION BMP
PLAN AND PROFILE

VERIFY SCALES
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JOB NO. 9115A.10
DRAWING NO. FIG 5.12
SHEET NO. XX OF XX

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Option No. 2 will treat the 85th percentile 24-hour storm water volume generated from the entire Baseball Field Sub Area, BB-S1, BB-S2, BB-S3, and BB-S4. Figure 5.12 shows the drainage map of this treatment area and Figure 5.13 is the conceptual layout of this treatment system.

In Option No. 1 (recommended option), stormwater will be diverted from the existing 36-inch diameter pipe at Plaza Del Amo and Western Avenue through a short diversion pipe into the BMP system. Option No. 2 will be considered for implementation when through monitoring and modeling it is found out that more treatment is needed in this subarea. Option No. 2 will capture stormwater runoff generated from BB-S1, BB-S2, BB-S3, and BB-S4. Stormwater runoff will be diverted from existing drain at Plaza Del Amo and Western Ave. to the infiltration unit located at the baseball field. This option also includes the installation of 23 full capture filter screens. Figure 5.13 shows conceptual layout and detail design concept of both options.

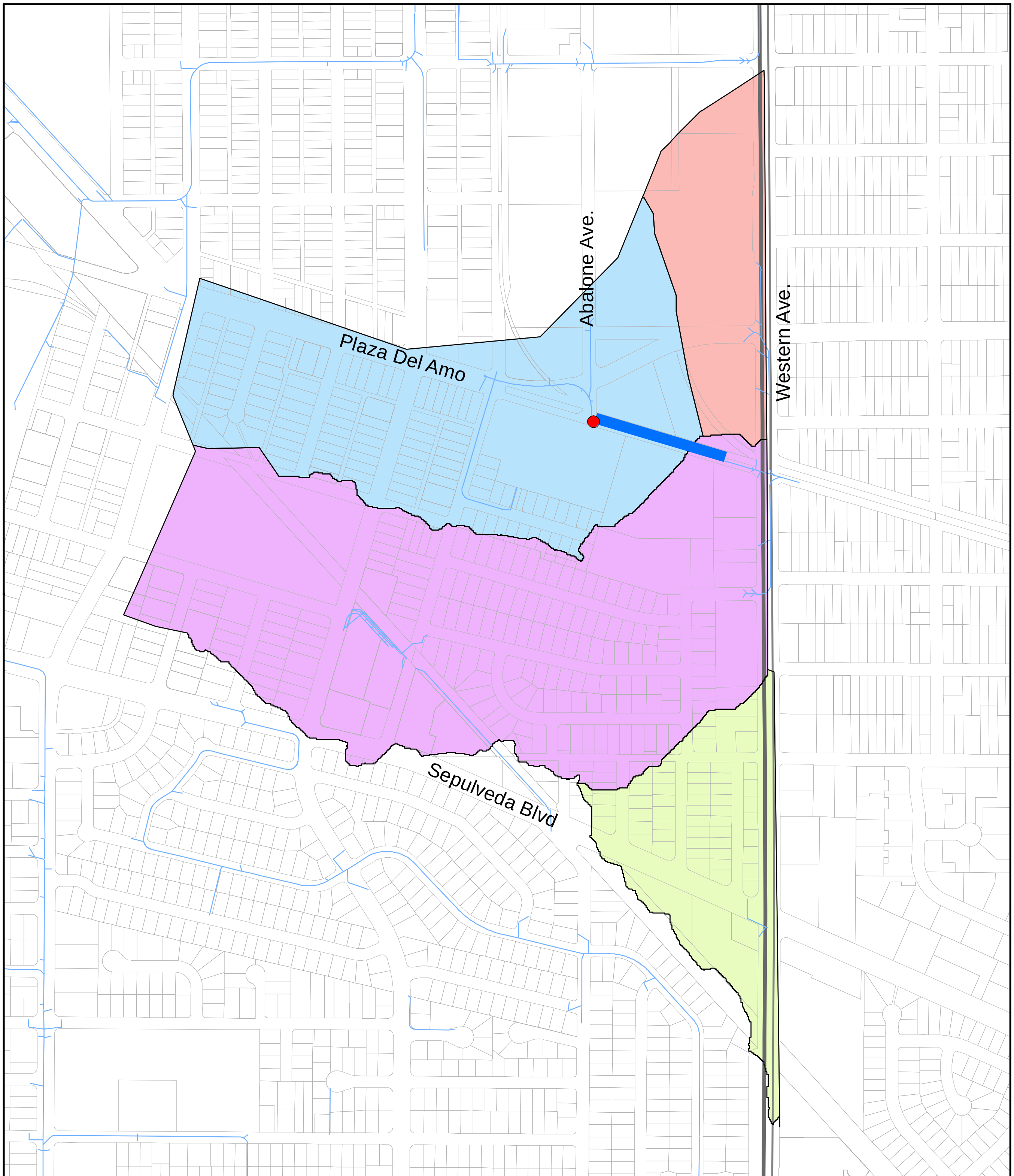
Table 5.20 summarizes the storage requirements for this treatment basin and Figure 5.14 presents the expected outcome after implementation of institutional and structural BMPs to treat stormwater runoff from the Baseball Field Sub Area. The results are summarized for only Option 1, which is the recommended option in Table 5.21. The load reductions in the table are based on both volume reduction and treatment by the MCMs. Table 5.21A summarizes the results for TSS, TP, TN, and toxics and Table 5.21B presents the results for metals and bacteria.

Figure 5.14 shows the plan and profile of the two options discussed above and Figure 5.15 is the detailed design concept.

Table 5.20 Summary of BMP Requirements – Baseball Field

Option	Area Treated (ac)	Percent Imperviousness	Treatability	24 hr 85th Percentile Volume (ac-ft)	BMP Capacity (ac-ft)
Option No. 1	39	63	26.3	2.6	2.9
Option No. 2	148	65	100	6.4	6.0

Note
(1) The 85th percentile 24-hour storm depth = 0.85 in.



Legend

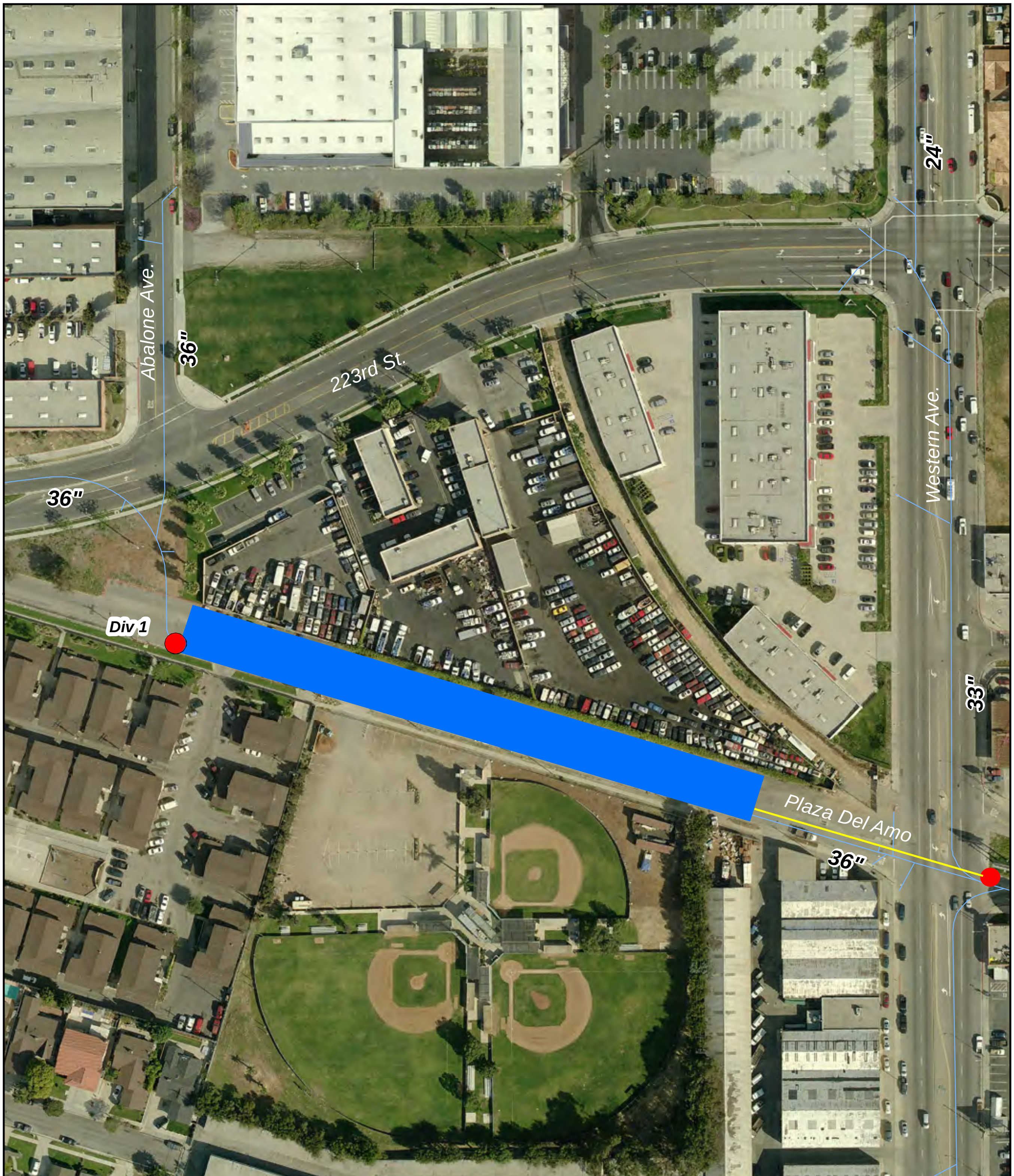
- Diversions
- Infiltration/Recharge
- Storm Drains

SUBCATCH

- BB-S1
- BB-S2
- BB-S3
- BB-S4

0 500 1,000 Feet

Figure 5.13
Drainage Map of Baseball Field Treatment Area
Stormwater Recharge Project
City of Torrance



Legend

- Diversions
- Storm Drains
- Infiltration/Recharge
- New Conveyance

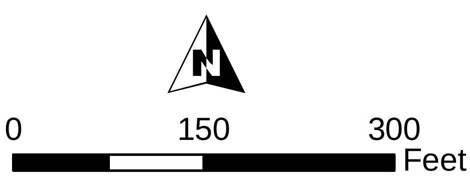


Figure 5.14
Conceptual Layout of Baseball Field Underground Storage/Infiltration BMP
Stormwater Recharge Project
City of Torrance

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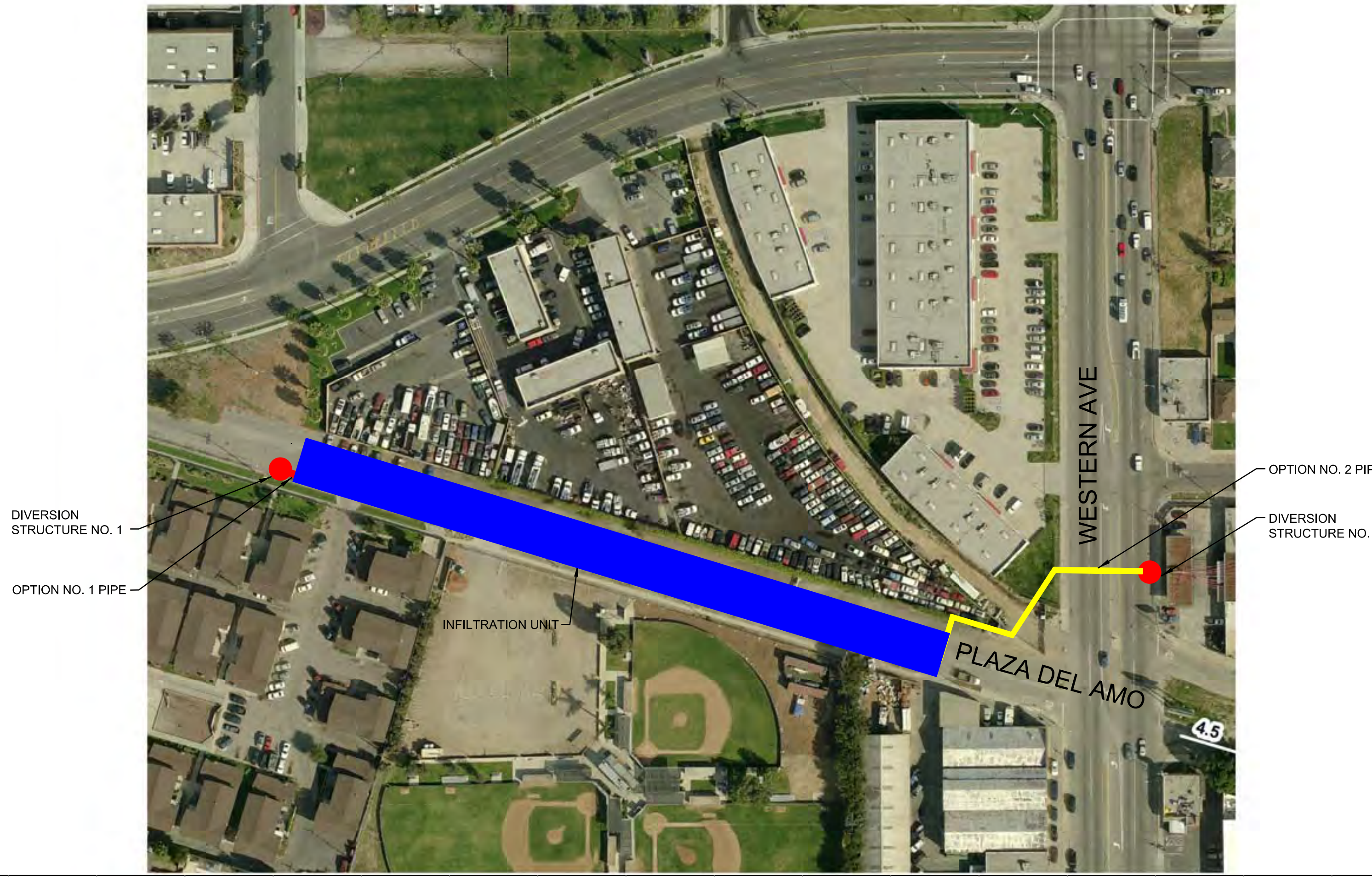

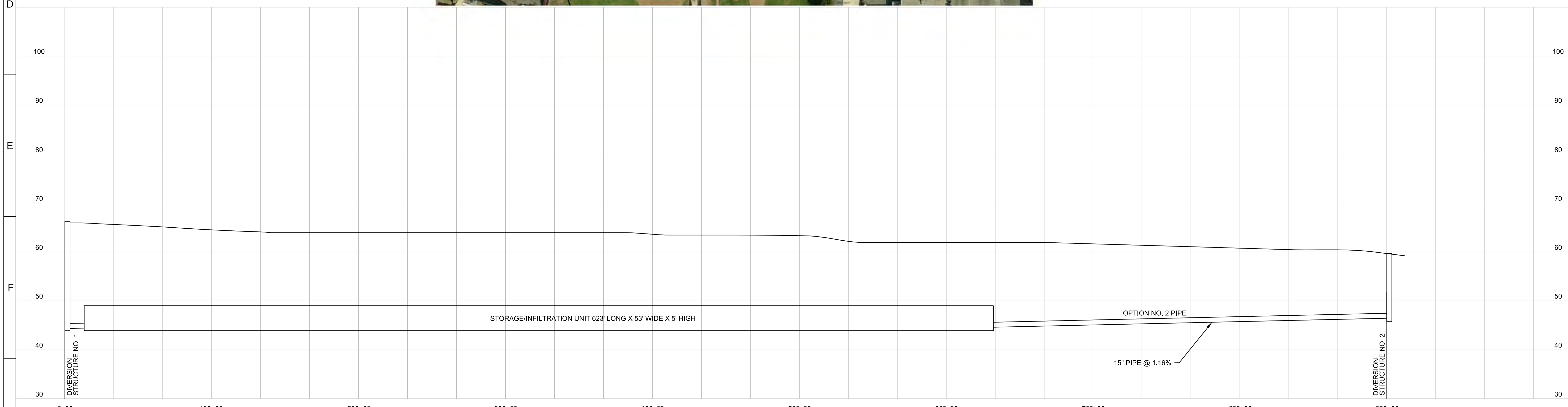

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DETAIL DESIGN CONCEPT OF BASEBALL FIELD
BMP TREATMENT SYSTEM

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Table 5.21A Walnut Sump Sub Area Nutrient and Toxics Volume/Load Reduction Summary for Option 1 - Recommended Option.

Control Measure Implementation	Volume (ac-ft)	Load (kg/yr) TSS	Load (kg/yr) TP	Load (kg/yr) TN
Enhanced MCMs				
BB-S1	0	178	0.87	6.41
BB-S2	0	663	3.23	23.90
BB-S3	0	356	1.73	12.83
BB-S4	0	222	1.08	8.01
Re-development and LID incentives (BB-S1, BB-S2, BB-S3 and BB-S4)	1.81	8,516	41	307
Catch Basin Filter(1) BB-S1, BB-S2	0	9,571	42.5	214.6
Storage/Infiltration BB-S3	19.4	1,356	7.3	68.7
Total Load Reduction (1)		**20,862**	**97.7**	**641.5**
Critical Baseline Load	**127.1**	**28,388**	**138**	**1,023**
% Load Reduction	**55**	**73**	**71**	**63**

Control Measure Implementation	Volume (ac-ft)	Pollutant Load (g/yr) Total PCB	Total DDT	Dieldrin	Chlordane
Enhanced MCMs					
BB-S1	0	0.02	0.01	0.00	0.00
BB-S2	0	0.07	0.04	0.01	0.04
BB-S3	0	0.04	0.02	0.01	0.02
BB-S4	0	0.02	0.02	0.00	0.01
Re-development and LID incentives (WS-1, WS-2 and WS-3)	1.81	0.84	0.57	0.17	0.49
Catch Basin Filter(1) WS-1	0	1.26	0.86	0.25	0.73
Storage/Infiltration BB-S3	19.4	0.08	0.06	0.02	0.05
Total Load Reduction (1)	384	**2.33**	**1.58**	**0.46**	**1.34**
Critical Baseline Load	**127.1**	**2.80**	**1.91**	**0.55**	**1.63**
% Load Reduction	**17**	**83**	**83**	**84**	**82**

Note:
(1) Removal efficiencies; TSS - 55%, TP - 41%, TN - 24%, 48% and bacteria - 55%

Table 5.21B Baseball Field Sub Area Metals and Bacteria Load Reduction Summary for Option No.1 - Recommended Option.

Control Measure Implementation	Total Copper Volume (ac-ft)	Total Copper Load (kg/day)	Total Lead Volume (ac-ft)	Total Lead Load (kg/day)	Bacteria Volume (ac-ft)	Bacteria Load (#/day)
Enhanced MCMs						
1. BB-S1	0	0.001	0	0.001	0	5.15E+11
2. BB-S2	0	0.003	0	0.002	0	1.93E+12
3. BB-S3	0	0.002	0	0.001	0	1.03E+12
4. BB-S4	0	0.001	0	0.001	0	6.45E+11
Copper Brake Pad Reduction(3) (BB-S1, BB-S2 BB-S3 & BB-S4)	0	0.05	0	0	0	0
Catch Basin Filters (BB-S1, BB-S2 & BB-S4)	0	0.04	0	0.03	0	3.70E+13
Re-development and LID incentives (BB-S1, BB-S2 BB-S3 & BB-S4)	0.90	0.01	0.90	0.01	1.37	1.65E+13
Storage/Infiltration						
1. BB-S3	1.82	0.01	1.82	0.08	1.82	0.51E+13
Total Volume/Load Reduction (1)	2.72	0.12	2.72	0.09	3.19	6.27E+13
Critical Baseline Volume/Load	5.7	0.12	1.8	0.09	10.2	8.23E+13
% Load Reduction	48	100	100	100	31	76

Note:
(1) Concentrations listed in Table 3.10

In addition to contributing to meeting the TMDL reduction requirement of improving water quality, a centralized BMP at Baseball Field would provide other water resources benefits. A centralized BMP at this location would be designed to increase infiltration providing additional groundwater replenishment to the groundwater basin. Storage provided by the BMP would reduce potential flooding in the watershed treatment area. Further benefits could be determined during implementation. This BMP could be constructed without interfering with baseball field.

5.5 Additional Structural Options for TMDL Implementation

Through additional monitoring, pollutant source characterizations, and site investigations throughout the duration of the TMDL implementation schedule, additional options for structural BMPs could be identified that can enhance or replace those BMPs identified in this plan. This is especially true for dry weather, when flows are highly variable throughout the storm drain system, and specific areas could require special methods treating storm drain flows before they discharge to receiving waters. For storm drains with particularly high dry weather flows and associated pollutant loads where other nonstructural or structural BMPs are not providing a remedy, specific mechanical BMPs can be implemented. Such BMPs could include diversions to wastewater treatment plants or on-site treatment facilities that provide ultraviolet disinfection or other forms of treatment.

Likewise, for wet weather, certain mechanical BMPs can be installed in problem storm drains where other nonstructural and structural BMPs are not providing a solution. Several stormwater BMPs are available for this purpose, which are based on a range of technologies that continue to evolve through continued research and development. This TMDL Implementation Plan is intended to be iterative and adaptive to allow for modifications as additional studies of the drainage system and diagnoses of problem sources are achieved and as new technologies for dry and wet weather treatment continue to emerge.

5.6 Regulatory Requirements and Environmental Permits

Consultation with regulatory agencies and the acquisition of permits is required before project components can be constructed. The following sections summarize regulatory permits and approvals relevant to the implementation of the Water Quality Enhancement Projects in the Machado Lake watershed.

5.6.1 Environmental Assessment

In accordance with the California Environmental Quality Act (CEQA), local agencies are required to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. Every development project that requires discretionary governmental approval will require at least some environmental review pursuant to CEQA, unless an exemption applies. The Water Quality Enhancement Projects discussed in the previous section will likely require the preparation of a Negative Declaration.

5.6.2 U.S. Army Corps of Engineers

Section 404 of the Federal Clean Water Act regulates the discharge of dredged, excavated, or fill material in wetlands, streams, rivers, and other waters of the United States. The U.S. Army Corps of Engineers (USACE) is the federal agency authorized to enforce Section 404 and issue permits for certain authorized activities conducted in these waters. Based on the proposed area for the projects, it is unlikely that a Section 404 permit will be required. If required and jurisdictional, Section 404 permitting could potentially be completed under the nationwide permit program. Coverage under the nationwide program can be authorized within three to four months from the time the permit application is deemed complete.

5.6.3 U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS), Department of the Interior, is responsible for administering the Federal Endangered Species Act, which prohibits activities affecting threatened and endangered species unless authorized by a permit from the USFWS. The Endangered Species Program is charged with issuing permits for activities that could potentially affect native endangered or threatened species, including Incidental Take Permits associated with Habitat Conservation plans. The USACE will consult with USFWS regarding endangered species issues as part of the Section 404 process. A biological resources report for the project site may be required as part of the permit application package to the USACE.

5.6.4 California Department of Fish and Game

The regulatory functions of the California Department of Fish and Wildlife (CDFW) include the review of CEQA documents as a responsible agency. In addition, CDFW issues streambed or lakebed alteration agreements for projects with impacts to waters of the State, issues permits for take of threatened and endangered species for authorized activities, approves and permits the take of birds, mammals, reptiles, amphibians, non-game fish, and plants for scientific or educational purposes, and the take of threatened, endangered, or candidate species for management purposes. The Water Quality Enhancement Projects may require a CDFW Code Section 1602 Streambed Alteration Agreement.

5.6.5 State Water Resources Control Board

Construction activities disturbing one or more acres must obtain coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges of Stormwater Associated with Construction Activity Water Quality Order No. 2009-0009-DWQ (Construction General Permit, or CGP). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation. To obtain coverage under the CGP, the City will designate a Legally Responsible Person to electronically file Permit Registration Documents (PRDs) with the State Water Resources Control Board (SWRCB). PRDs include a Notice of Intent, Risk Assessment, Site Map, Stormwater Pollution Prevention Plan (SWPPP), annual fee, and certification. A project-specific SWPPP will need to be developed and implemented to reduce polluted discharges from entering the storm drain system and local receiving waters during construction activities. The CGP requires all permitted dischargers to develop and implement a SWPPP that:

- Identifies all pollutant sources including sources of sediment that may affect the quality of stormwater discharges associated with construction activity from the construction site.
- Identifies and eliminates non-stormwater discharges.
- Specifies BMPs to reduce or eliminate pollutants in stormwater and authorized nonstormwater discharges from the site during construction.
- Incorporates BMP inspection and maintenance routines.
- Identifies a sampling and analysis strategy and sampling schedule for discharges that have been discovered through visual monitoring to be potentially contaminated by pollutants not visually detectable in runoff.

The City or construction contractor will need a Qualified SWPPP Developer to prepare the SWPPP, and then a Qualified SWPPP Practitioner will need to implement the plan during construction. The SWPPP must address the use of appropriately selected, correctly installed, and properly maintained pollution control BMPs.

5.6.6 Regional Water Quality Control Board, Los Angeles Region

Under Section 401 of the Clean Water Act, applicants for Section 404 Permits must first obtain a Water Quality Certification documenting that the proposed activity will comply with state water quality standards. If the project is determined to be under USACE jurisdiction, a Section 401 Water Quality Certification will be required for the project.

If the project is not under USACE jurisdiction, the LARWQCB may require coverage under Waste Discharge Requirements instead. Protection of beneficial uses during construction and operation are key issues. Construction dewatering may be necessary because of high groundwater. Dewatering activities will require coverage under the General NPDES Permit and Waste Discharge Requirements of Discharges from Construction and Project Dewatering to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties. To obtain permit coverage, a Report of Waste Discharge and application must be filed with LARWCQB at least 30 days prior to discharge.

Even though the installation of Water Quality Enhancement Projects is generally encouraged by the LARWQCB, concerns may be raised with the potential of projects using on-site infiltration of stormwater to affect the water quality of the underlying groundwater. Prior to implementing projects such as infiltration basins/trenches, flow through planters, porous pavement, etc., the City would need to conduct a technical analysis evaluating the possibility of groundwater impacts. The analysis will determine the depth to groundwater, its designated beneficial uses, and the historical uses of the site. There are cases where projects may be infeasible – if the depth to groundwater is less than 5 feet from the surface, if drinking water wells are present within 100 feet of the proposed infiltration site, or if the site is a brown field with potential pollutant mobilization through the soil, etc. Consultation with LARWQCB staff is recommended.

5.6.7 South Coast Air Quality Management District

Construction activities in the South Coast Air Basin are subject to South Coast Air Quality Management District's (SCAQMD) Rule 403. Rule 403 sets requirements to reasonably regulate operations that periodically may cause fugitive dust emissions into the atmosphere by requiring actions to prevent, reduce, or mitigate fugitive dust emissions. The construction contractor will need to implement dust control measures during project construction.

6.0 EVALUATION OF NONSTRUCTURAL AND STRUCTURAL SOLUTIONS

As shown in the previous sections, a number of nonstructural and structural BMP options were identified that can support TMDL implementation. An evaluation of those practices was performed, including optimizing the most cost-effective combination of BMPs to support meeting WLAs for the TMDL Implementation Area. The evaluation analysis for the Nutrient and Toxics TMDLs uses an integrated approach, considering reductions for both classes of pollutants. The evaluation analysis uses the identified suite of structural and nonstructural projects discussed in Sections 4 and 5 to determine the set of actions that will most likely be implemented in an effort to achieve the TMDL requirements. The analysis is a demonstration of how the identified projects may achieve compliance. As the implementation is an adaptive management process, the precise suite of actions and the timing may be changed to use resources more cost effectively. The adaptive management approach will allow changes in the type and quantity of structural and nonstructural BMPs to ensure cost effective measures are being implemented. Flexibility in the schedule and makeup of the Implementation Plan are key to adaptive management.

The quantification analysis is based on the reductions from both nonstructural and structural BMPs that work together to reduce the concentration and load of constituents. Generally nonstructural BMPs consist of pollution prevention activities and source control activities that reduce the amount of the constituent entering the MS4 system, ultimately reducing the concentration in stormwater. Nonstructural activities also encourage the effective use of water, aiming to reduce dry-weather flows. In this way, nonstructural activities reduce the constituent load entering structural BMPs located downstream of the sources.

Removal of suspended sediments by the proposed BMPs will be used a surrogate to assess compliance of Toxics. Toxics removal will be estimated as a fraction of suspended solids removed by the BMPs.

6.1 Evaluation of Structural Solutions

6.1.1 <u>Watershed Modeling and Optimized BMP Selection Approach</u>

Watershed modeling tools linked to a BMP simulation system were used to evaluate and optimize quantitative load reduction scenarios to address TMDL implementation efforts in the TMDL Implementation Area of the Machado Lake watershed. The watershed model is based on existing commonly used to simulate and evaluate BMPs Brief descriptions of the watershed model and BMP simulation model is provided below.

6.1.1.1 P8 - Hydrologic Modeling Using a Continuous Simulation Model

The P8 watershed modeling system utilizes a modeling approach that has been used to support numerous TMDL developments throughout the country. The P8 model is a continuous simulation model and generates runoff characteristics based on rainfall, soil characteristics and infiltration rates, evapo-transpiration, antecedent conditions, and land use specific pollutant loading characteristics. Meteorological data from 2005 to 2013 were used to calibrate the model. Existing meteorological data, hydraulic data, land use information, and monitoring data were used to calibrate each sub-watershed to most accurately simulate the runoff and pollutant load.

The P8 model simulates hydrology, sediment, and general water quality was combined with a stream fate and transport model. Wet-weather loading estimates are developed using the modeled constituents including TN, TP, TSS, and Toxics. Based on the model results from 2005 to 2013, a daily or average annual load was calculated for TSS, TN, TP and Toxics. Annual load results were compared with the WLAs to calculate the load reduction needed to meet those WLAs and presented in Table 3.7.

6.1.1.2 Optimization BMP Design Approach

The optimization BMP design approach uses GIS information and time-series data for watershed runoff flows and pollutant concentrations (generated by the watershed model), integrates a process-based BMP simulation, and applies optimization techniques for the most cost-effective BMP planning and selection.

Based on comprehensive site evaluation and financial analysis, the City selected five sites for centralized BMP Implementation. Optimization of BMP design approach was therefore not comprehensively performed.

6.1.1.3 BMP Simulation Process

The BMP simulation system uses process-based simulation for BMP function and removal efficiency and accepts flow and water quality time-series data generated internally by P8 as input data. Process-based simulation of BMPs provides a technique that is sensitive to local climate and rainfall patterns. BMP effectiveness can be evaluated and estimated over a wide range of storm conditions, site designs, and flow routing configurations.

The storage/infiltration BMPs used in the study included underground and aboveground storage/infiltration systems. The primary benefits of these BMPs are storage and infiltration, which enable runoff volume and rate reduction. These type BMPs also provide water quality benefits via filtration, settling of sediment, and pollutant decay.

The PLAT was used to estimate the average annual load of TN, TP, and TSS from the TMDL Implementation Area. The model-calculated annual loadings for these constituents are presented in Table 3.7. Additionally, the final WLA and the resulting required reduction for nutrients are included in Table 3.7. The model's estimate for current annual loading of nitrogen is less than the interim WLA, but would require a 30 percent reduction to meet the final WLA. The current loading of phosphorus estimated by the PLAT is also less the interim WLA, but would require a 54 percent reduction in average phosphorus loading by 2018. Load reductions of TSS are are used to estimate toxics removal.

6.2 Nonstructural Quantification Analysis

The Watershed Treatment Model (WTM) is used to assess the effectiveness of nonstructural BMPs on the dry weather and annual loading of nutrients and suspended solids from the TMDL Implementation Area. The WTM was developed by the Center for Watershed Protection with funding by the USEPA in June 2010. The WTM is a spreadsheet-based model that calculates annual pollutant loads and runoff volumes and accounts for the benefits of a full suite of stormwater treatment practices to determine reductions in pollutant loads. The WTM is used for the TMDL Implementation Area in the Machado Lake watershed to determine the accumulated effectiveness of implementing dry weather BMPs for the control of nutrients and suspended solids.

The WTM uses both environmental inputs (e.g., area of land use types, soil types, etc.) and inputs about BMPs. Environmental inputs are used to determine current loads and inputs about BMPs determine the percent reduction in loads.

6.2.1 Illicit Connection Removal

Illicit connections to storm drains are sources of a variety of pollutants including nutrients. This source control is applicable to residential and commercial areas in the TMDL Implementation Area. However, the load reduction impact of such program is dependent on the presence and extend of illicit connections in the TMDL Implementation Area. The costs of a field investigation, water sample analysis, and illicit connections trace or to confirm reconnection to the sewer system (via dye, video, or smoke testing) can be highly variable and depend on the extent and nature of the problem. Literature review indicates that the cost of removal of one illicit connection and its reconnection to the sewer system is roughly $2,500 (Marcoux, 2004 and Brown et al., 2004), which makes this is an expensive option. However, the City's NPDES Permit already requires inspection of the storm drain system for illicit connections and removal of the connections, and increased effort to identify illicit connections would enhance the City's illicit connection program. For the purposes of this evaluation, it was assumed that:

- 0 percent of residents have illicit connections. Previous audits by the City of all city storm drain found no illicit connections.
- 10 percent of businesses have illicit connections,
- 40 percent of the sanitary sewer is surveyed for illicit connections,
- 20 percent of illicit connections are corrected.

Assumptions were based on best professional judgment because the number of illicit connections varies depending on local habits, municipal outreach, and enforcement. The number of illicit connections identified and corrected would be dependent on the resources the City can allocate to this program.

6.2.2 Catch Basin Filter Cleanout

Regular catch basin filter cleanout prevents pollutants from flowing through and into the storm drain system. Sediment, debris, and gross particulate matter are the targeted pollutants with the cleanout of catch basin filters, but removal of particulate-bound pollutants, including nutrients and toxics, occurs through the physical removal of sediments. Catch basin filter cleanouts can be prioritized as follows:

- Priority A: These catch basin filters are cleaned quarterly.
- Priority B: These catch basin filters are cleaned semi-annually.
- Priority C: These catch basin filters are cleaned annually.

Review of the City's program showed that most catch basin filters were Priority C. However, the model only allows input of semi-annual or monthly cleanouts. Therefore, semi-annual cleanouts were selected. Other inputs were based on best professional judgment. The assumption of semiannual cleanouts may overestimate current load removal and therefore underestimate the percent reduction in loads that could be achieved from increased cleanout frequency.

For the purposes of this evaluation, it was assumed that:

- The impervious area drains to the catch basin filters,
- Catch basin filters are currently cleaned semi-annually,
- In the future, 60 percent of catch basin filters will be cleaned quarterly,
- In the future, 40 percent of catch basin filters will be cleaned semi-annually,

6.2.3 Street Sweeping

Street sweeping uses mechanical pavement cleaning practices to minimize pollutant transport to receiving water bodies. Sediment, debris, and gross particulate matter are the targeted pollutants, but removal of other particulate-bound pollutants, such as nutrients and toxics, can be accomplished simultaneously.

The City's Permit requires that the City prioritize street sweeping as follows:

- Priority A: These streets and/or street segments shall be swept at least two times per month.
- Priority B: Each street and/or street segments is swept at least once per month.
- Priority C: These streets and/or street segments shall be swept as necessary but in no case less than once per year.

For the purposes of this evaluation, it was assumed that:

- Publicly owned roads and parking lots are currently swept weekly.
- All roads in TMDL Implementation Area are currently swept with vacuum sweepers.
- The future program will use vacuum sweepers.

City roads are currently being swept weekly. However, the majority of streets lack proper no-parking signage to allow street sweeping trucks to effectively sweep along the curbs. The City is implementing a signage program to allow enforcement on non-parking days and increase the effectiveness of the current street sweeping program. The City uses both mechanical and the more effective vacuum sweepers. The street sweeping cost (including O&M) of vacuum street sweepers is $360/curb mile based on a monthly sweeping frequency (in 2005 dollars) (Shilling, 2005).

6.2.4 Residential Irrigation and Fertilizer Reduction

Over irrigation leads to runoff, increasing flows within the stormwater system. Additionally, urban irrigation runoff can be high in TSS and nutrients. The nutrients in urban irrigation runoff are typically from fertilizers, which are often overused. Effective outreach can teach residents not to overwater and to test the soil to determine the appropriate amount of fertilizer to apply. In addition, evapotranspiration (ET) controllers have been successfully used to reduce irrigation runoff. The cost of this outreach is highly dependent on the approach, which could vary from internet outreach sites to homeowner incentives to educational displays at retail stores.

For the purposes of this evaluation, it was assumed that:

- Half of runoff from the TMDL Implementation Area is dry weather flow.
- An irrigation reduction program would reduce irrigation flows by 20 percent.
- Enhanced outreach of television and radio spots would be necessary to reach and convey the message of controlling irrigation and using proper amounts of fertilizer.

6.2.5 Results of Watershed Treatment Model

The results of the above combined inputs to the WTM are listed in Table 6.1. The reductions are based on percent of dry weather load and the percent of annual runoff load (e.g., street sweeping has benefits in both wet and dry weather). These reductions are considered approximate estimates due to the environmental characterization assumptions made for the model and the assumptions listed in the previous sections.

Table 6.1 Estimated Reductions in Nutrients and TSS from Non-Structural BMPs

	Percent Reduction(1)			
Flow Condition	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Toxics**
Dry Weather Runoff	21%	15%	33%	33%
Annual Runoff	23%	10%	26%	26%

Note:
(1) Load reductions as predicted by the Watershed Treatment Model with inputs discussed in Section 6.2.

WTM requires a number of inputs to assess current conditions and the effectiveness of specific source controls. The WTM is the best available tool for modeling and estimating reductions because there is very little reliable literature about load reduction in stormwater through implementation of nonstructural BMPs. WTM results will need to be compared with and used in conjunction with stormwater quality and quantity data to evaluate the effectiveness of the nonstructural BMPs.

As shown in Table 6.1, the use of nonstructural BMPs is estimated to reduce TP loading by 10 percent on an annual basis. Therefore, the remaining 44 percent of the required 54 percent reduction will need to be through the use of structural BMPs. Similarly, structural BMPs need to remove the remaining 8 percent of the required 31 percent of TN removal as calculated with the models and assumptions stated in this report.

6.3 Structural Quantification Analysis

The PLAT calculates the distribution of structural BMPs to provide the required load reductions at the optimal cost. In setting the load reductions levels for structural BMPs in the PLAT, the anticipated reductions through implementation of non-structural BMPs are subtracted from the total load reductions necessary to achieve the TMDL WLAs. Structural BMPs considered in the PLAT include rainwater capture and reuse, bioretention, porous pavement, and centralized treatment. The initial recommendations for structural BMPs optimized by the PLAT are presented in Table 6.2.

Table 6.2 Optimized Sizing of Centralized BMPs from PLAT(1)

Sub Area	Total Area (ac)(1)	Impervious Area (%)	Centralized BMP Needed (ac-ft)		Total BMP Treatment Capacity (ac-ft)
			Aboveground	Underground	
Airport - AS2	86	45	N/A	1.5	12.0
Airport - AS3	640	59	N/A	28	32.8
Airport - Walteria	391	60	N/A	20.5	22.4
Walnut Sump	-	-	39.5	n/a	50
Baseball Field	-	-	N/A	1.0	2.9

Note:
(1) Overall removal load reduction percentages: TSS – 90%; TP – 68%, TN – 70%; Toxics – 90%.

The final mix of BMPs will depend on funding available for installation and the measured gains in nutrients and toxics reductions as projects are implemented. Refinements to the model based on Machado Lake watershed water quality and quantity monitoring may also change the amounts and relative distributions of BMPs in future reconsideration of the Nutrients TMDL.

6.3.1 Retrofit through Redevelopment

Additionally, the City will adopt an ordinance requiring LID components when greater than 50 percent of the impervious area is modified. Residential areas within the TMDL Implementation Area are generally established with low levels of redevelopment. The commercial and industrial areas may experience a moderate rate of redevelopment and would be subject to the City's LID ordinance.

For purposes of this evaluation, it is assumed that 15 percent of the 675 acres commercial, industrial, and institutional area in the area will experience redevelopment over the course of the Implementation Plan. In addition, the rate of redevelopment is assumed to be 2.5 percent per year between 2013 and 2018. This rate is based on the levels experienced in the TMDL Implementation Area of LA County over the past 20 years and is expected to be similar in the TMDL Implementation Area over the life of the Implementation Plan.

Future rate of redevelopment are largely a function of the economic health of the region as a whole and is outside the control of the City. In the future, if the levels of LID through redevelopment becomes more significant that assumed for this study, it could be possible, that less structural BMPs are required in the TMDL Implementation Area to meet the WLAs.

6.4 Quantification Analysis Results

A summary of the required BMP capacity volumes and identified volumes though City projects, redevelopment, and identified opportunities is presented in Table 6.2. The remaining BMP capacity (i.e., the BMP capacity not identified through retrofit of City lands, conceptual opportunities, or redevelopment) may be provided through private installation of BMPs or the installation of structural BMPs within leased properties or acquisition of land within the TMDL Implementation Area. Leasing land area will require negotiation with lessees on properties where leases will expire during the implementation period. Private installation of BMPs may occur through incentive programs, or ordinances. Stormwater fees may be developed to provide a funding mechanism for future BMPs and fund (not oversee) the programs discussed in the BMP Implementation Plan. To attain the WLAs, it may not be necessary for the City to acquire land outside the Implementation Area to implement BMPs. Successful implementation of the programs to attain WLAs will require the multi-departmental detailed planning which is beyond the scope of the BMP Implementation Plan. The BMP Implementation Plan is rooted in an adaptive management approach, allowing the City to assess the true effectiveness of non-structural BMPs, and monitoring to better refine the annual average load of the pollutants of concern. To attain WLA, City may need to work with LACFCD and Rolling Estates to expand Project A1 at the Torrance Airport.

6.5 Quantification Analysis Conclusions

Due to the reasonable amount of existing publicly owned land within the TMDL Implementation Area in the Machado Lake watershed, centralized structural BMPs can be implemented in areas currently owned by the City. This avoids lengthy negotiations between landowners and the City, incentive programs, City ordinances, and stormwater fees may need to be developed and instituted, and land acquisition may be necessary.

The monitoring program will provide stormwater sampling data to assess the site-specific level of nutrients associated with the sediment leaving TMDL Implementation Area. The measured pollutant levels from the monitoring program may provide more site-specific pollutant loading scenarios from the watershed, which would help reevaluate reductions required to meet the WLAs. Currently, TP is the limiting constituent driving the number of BMPs. Additionally, the Nutrients TMDL is due to be reevaluated by 2016, and the reevaluation will include the information from special studies and the results of monitoring programs. The Nutrients TMDL reevaluation may be used to refine the loading capacity of Machado Lake, ultimately changing the WLAs. If, through monitoring, the loadings from the TMDL Implementation Area reveal that nonstructural BMPs are more effective than assumed by the WTM, or the levels of constituents in the runoff from TMDL Implementation

Area are lower than currently thought to exist, BMP implementation will need to be adjusted accordingly.

6.6 Reasonable Assurance

The main objective of this implementation plan is capture 85th percentile runoff and infiltrate it, wherever possible. This is in addition to non-structural BMPs including enhanced street sweeping, public education and catch basin filter inserts. The City is already performing street sweeping and public education. The proposed BMPs have sufficient capacity to capture and infiltrate the 85th percentile runoff. The expected pollutant removal is summarized in Table 6.3.

The proposed BMPs have sufficient capacity to capture and infiltrate the 85th percentile, 24-hour volume from Subcatchments AS2, AS3, WS-2, WS-3, and BB-S3, while the remaining Subcatchments (including ASI, WS-1, BB-S1, BB-S2, and BB-S4) will be addressed through distributed BMPs and non-structural BMPs (such as catchbasin filters and street sweeping), and may be addressed through additional structural BMPs in the future.

The Walteria Lake which acts as a BMP serving the Walteria Lake Sub Area has sufficient capacity to capture and retain the 85th percentile, 24-hour volume from Walteria Lake Sub Area. The 85th percentile, 24-hour volume generated from the Airport Southeast Sub Area will be captured by an infiltration BMP being installed by a developer, and thus no more BMPs are proposed for this sub area.

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Table 6.3 Summary of Expected Phosphorus Removal

					BASELINE LOAD AND LOAD REDUCTION					COST ESTIMATES					
Project Location	Subcatchment	Drainage Area (ac)	Total No. of Catchbasins	Proposed No. of Catchbasins	Baseline Load for TP (kg/yr)	Load Reduction from Structural BMPs (kg/yr)	Load Reduction from Street Sweeping (kg/yr)	Load Reduction from Catch Basin Inserts (kg/yr)	Total Load Reduction (kg/yr)	Strucutual BMPs Captial Cost	Street Sweeping Captial Cost	Catch Basin Inserts Captial Cost	Total Capital Cost	$/kg removed	30
	AS1	391	57	57	167.8	6.7	5.0	5.1	16.8	$ 128,500	$ 138,293	$ 125,400	$ 392,193	$ 766	
Airport	AS2	86	0	0	40.8	27.6	2.9	0.0	30.5	$ 7,031,000	$ 30,417	$ -	$ 7,061,417	172328.431	
	AS3	640	0	0	410.5	278.9	28.7	0.0	307.6		$ 226,362	$ -	$ 226,362	$ -	
	Subtotal	***1,045***	***173***	***57***	***619.1***	***313.2***	***36.6***	***5.1***	***354.9***	***$ 7,159,500***	***$ 369,606***	***$ 125,400***	***$ 7,679,972***	***$ 173,094***	***$ -***
Walnut Sump	WS-1	742	50	50	17.7	0	1.2	1.3	2.5	$ 125,000	$ 262,438	$ 110,000	$ 497,438		
	WS-2	181	192	0	4.3	12.9	0.3	0	13.2	$ 3,488,000	$ 64,018	$ -	$ 3,552,018		
	Subtotal	***923***	***242***	***50***	***22.0***	***12.9***	***1.5***	***1.3***	***15.7***	***$ 3,613,000***	***$ 326,456***	***$ 110,000***	***$ 4,049,456***	***$ -***	***$ -***
Baseball Field	BB-S1	16	5	5	0.4	0	0.03	0.1	0.13		$ 5,659	$ 11,000	$ 16,659	$ -	
	BB-S2	50	9	9	1.3	0	0.09	0.2	0.28		$ 17,685	$ 19,800	$ 37,485		
	BB-S3	39	4	0	1.0	2.1	0.07	0.0	2.19	$ 500,000	$ 13,794	$ -			
	BB-S4	50	5	5	1.3	0	0.09	0.1	0.20		$ 17,685	$ 11,000	$ 28,685		
	Subtotal	***155***	***23***	***19***	***4.0***	***2.1***	***0.3***	***0.4***	***2.8***	***$ 500,000***	***$ 54,822***	***$ 41,800***	***$ 82,828***	***$ -***	***$ -***
Walteria Lake	WL	***2,118***	***0***	***0***	***7.0***	***0***	***0.5***	***0***	***0.5***	***0***	***$ 749,116***	***$ -***	***$ 749,116***		
Totals		**4,241**	**438**	**126**	**652**	**328**	**39**	**6.8**	**374**	**11,272,500**	**1,500,000**	**277,200**	**12,561,372**	**173,094**	**0**

7.0 MULTI-BENEFITS ANALYSIS

This BMP Implementation Plan outlines the management actions that may be needed to ultimately attain the WLAs of the Machado Lake Nutrient TMDL (LARWQCB, 2009) in the City's TMDL Implementation Area of the Machado Lake watershed. Although the primary intention of the proposed structural and nonstructural BMPs is to reduce nutrients load to Machado Lake, the ancillary benefits include water supply improvement, community enhancement, and sediment reductions. This section describes the additional benefits that may be achieved as the management actions are implemented. It should be noted that they do not necessarily benefit the City directly.

7.1 Water Supply

7.1.1 Irrigation Reduction

Irrigation reduction is a proposed nonstructural BMP. Irrigation reduction has the direct water supply benefit of reducing the amount of potable water used for irrigation. Irrigation reductions could be achieved through outreach to residents and implementation of evapotranspiration controllers. Irrigation reductions will be aided by Ordinance No. 2008- 0052U, which prohibits runoff from lawns and landscaping on to hardscape (streets, sidewalks). This ordinance also limits fertilizer running onto the street, thus reducing nutrient loads to stormwater. Field monitoring data show that irrigation runoff is insignificant and therefore the City may continue to monitor this in the future.

7.2 Community Enhancement Benefits

Water quality improvements benefit the community at large. These benefits include aesthetics, increases in property value, enhanced recreation opportunities, enhanced water supply, and lower costs for landscape maintenance. Ecosystem benefits are also realized from the improvements. Runoff reduction contributes to water conservation, provides habitat benefits through the reduction of the artificial dry weather flows, and reduces the cost of landscape maintenance. Improvements in Machado Lake water quality will provide the community with enhanced recreational opportunities. Water quality improvements are likely to improve wildlife viewing and fishing opportunities at the lake. Enhancements in habitat directly benefit the wildlife and provide habitat refuge in a highly urbanized area.

7.3 Toxics TMDL and Reduced Sediment to Machado Lake

Best management practices proposed to reduce nutrients in the Machado Lake BMP Implementation Plan include practices that will reduce sediment loads, especially as the WLAs for Toxics were assigned as a fraction of the suspended sediment loading to Machado Lake. Current sediment loading to the lake is estimated at 38,400 kg/yr. Reduction of sediment loading will provide for improved water quality in the lake, and will reduce future needs to dredge the lake.

Structural and nonstructural BMPs capture and remove sediment (TSS) from the watershed. Street sweeping and catch basin filter cleanouts are nonstructural practices that directly remove sediment loads from the watershed and manage them for proper disposal. Nonstructural practices also address the sources of sediment in the watershed, the public outreach, development construction, new development, and public works elements of the City's stormwater management program play a role in encouraging erosion control and reducing sediment inputs to the storm drainage system. Underground storage/infiltration systems are structural BMPs that prevent conversion of pervious areas to impervious cover during development. These practices reduce the quantity and rate of runoff from developed areas, thereby reducing the demand on the storm drain system. The expected reductions in sediment loading for dry and annual weather flows are listed in Table 7.1.

Table 7.1 Estimated Reductions in Stormwater TSS Loads

Flow Condition	Percent Reduction in TSS[1]
Dry Weather Flow	31%
Wet Weather Flow	90%

Note:
(1) Reductions based on nonstructural removal estimates and PLAT results within the TMDL Implementation Area.

7.4 Multi-Benefit Summary

Precise benefit quantification is difficult given the absence of site-specific information and uncertainty about BMP performance and efficiencies. A summary of the ancillary benefits to the proposed structural and nonstructural BMPs within the Machado Lake Watershed are listed in Table 7.2.

Table 7.2 Summary of Multi-Benefits of the Implementation Plan BMP Strategies

BMP	Aesthetics	Capture and Reuse	Flood Protection	Groundwater Recharge	Habitat	Property Value	Water Conservation	TSS Reduction
Under Storage/Infiltration			✓	✓	✓		✓	✓
Aboveground Storage/Infiltration	✓		✓	✓	✓	✓		✓
Irrigation Reduction					✓		✓	
Street Sweeping	✓							✓
Pet Waste Management	✓				✓			
Illicit Connection Removal	✓				✓		✓	
Catch Basin Filter Clean Out			✓					✓
Catch Basin Filter								✓

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8.0 IMPLEMENTATION SCHEDULES

The estimated implementation schedules for the nonstructural and structural projects proposed as possible solutions to comply with WLAs from the TMDLs are discussed below. The schedules presented herein are sufficient for long-term planning. Through adaptive management and based on the future monitoring results and response of Lake Machado, the implementation schedules may be modified to reflect the increased knowledge of the watershed. Actual schedule for Implementation of BMPs will occur as funding becomes available.

8.1 TMDL Schedule

The nutrient TMDL implementation schedule consists of a phased approach, with interim WLAs to be met by March 11, 2014 and full compliance by September 11, 2018. The schedules for required actions for both the Nutrient TMDL are outlined in Table 8.1. The full compliance of the Machado Lake toxics TMDL will be achieved by September 30, 2019. As stated earlier in this report and in Appendix B, the interim WLAs for total phosphorus and total nitrogen have been met.

Table 8.1 Schedule or Work Plan Elements

ID	Work Plan Element	Schedule
1	Effective Date	March 11, 2009
2	Submit Monitoring Plan	September 12, 2011
3	Begin Monitoring and Implementation	60-days from approval
4	Information Item to LARWQCB on Implementation Progress	March 11, 2013
5	Interim Limits Apply	March 11, 2014
6	LARWQCB to Reconsider TMDL	September 11, 2016
7	Final WLA applicable	September 11, 2018

8.2 Load Reduction Schedule

The Nutrient TMDL contains a phased compliance schedule, with interim limits effective in the first quarter of 2014 and final allocations effective the third quarter of 2018.

8.3 Nonstructural Schedules

An estimated schedule for the nonstructural BMPs described in Section 4 Nonstructural Solutions is summarized in Table 8.2. The schedule accounts for the planning and design of the nonstructural BMP programs and the long-term implementation of the programs.

8.4 Structural Schedules

An estimated schedule for completing the structural BMPs described in Section 5 is presented in Table 8.3. The schedule includes meeting planning and permitting requirements, preparing engineering design documents, bidding and constructing the BMPs and ongoing operations. The timeframe for funding has not been included in this schedule. In addition to the projects noted in the Table, the schedule accounts for the ongoing redevelopment activities that are expected to occur in the TMDL Implementation Area. The schedule also accounts for the ongoing opportunities to retrofit BMPs whether they are on public right-of-ways or private properties.

As discussed in Section 5.3.3., a geotechnical investigation was conducted at the Torrance Airport due to concern regarding infiltration rates at this BMP site. Details of this subsurface investigation are summarized in Appendix E. In summary, it can be concluded that the boring logs indicate that the top layer below surface is not suitable for infiltration and that substantial excavation (25-24 feet below surface) will be required to reach a sand layer that would typically yield higher percolation rates.

To verify if the proposed underground infiltration would work properly at this location, it is recommended that the City take a phased approach. First, it is recommended that the City conduct some percolation testing at the depth of the sand layer. If results are acceptable, it is then recommended that the City implement the project at Site A1 first, where the sandy layer is closest to ground surface (25 below ground surface) and then monitor the performance over multiple years. If the project meets expectations or if design alternations can overcome any identified issues, it is recommended that the City implement projects A2 and A3, where the sandy layer starts at 40 and 45 feet below surface, respectively.

.

Table 8.2 Proposed Implementation Schedule for Nonstructural Solutions

Structural Project	Duration (months)	Timeline					
		2013	2014	2015	2016	2017	2018
Catch Basin Filter Cleanouts							
Purchase Advanced cleaning Technology (steam cleaning), as needed							
Focus on Problem Areas	3 - 6						
Increase Frequency of Cleanouts	Ongoing						
Catch basin filter							
Install Catch basin filter in Implementation Area	Ongoing						
Downspout Disconnection Program							
Planning & Assessment	Ongoing						
Implementation	36						
Fats, Oils and Grease Outreach							
Focus on Residents in TMDL Implementation Area	8 - 12						
Continuation of Existing FOG Outreach	Ongoing						
Green Waste Outreach							
Planning & Assessment	8 - 12						
Implementation	24						

Table 8.2 Proposed Implementation Schedule for Nonstructural Solutions

Structural Project	Duration (months)	Timeline					
		2013	2014	2015	2016	2017	2018
Illicit Connection Removal							
Survey System in TMDL Implementation Area	24						
Implementation	24 - 36						
Impervious Cover Reduction							
Assess Feasibility of Reducing Existing Impervious cover	8 - 12						
Implementation, if appropriate	24						
Industrial/Commercial Facilities Control Program							
Nutrients and Toxics Specific Training	3 - 6						
Outreach to Facilities to Improve Onsite Source Control Activities	8 - 12						
Continuation of Existing I/C Facilities Program	Ongoing						
Pet Waste Outreach							
Planning & Assessment	8 - 12						
Implementation of Pet Waste Bag Dispenser Stations in TMDL Implementation Area	8 – 12						
Focus on TMDL Implementation Area Resident Outreach	24						
Continuation of Existing Pet waste Outreach	Ongoing						

Table 8.2 Proposed Implementation Schedule for Nonstructural Solutions

Structural Project	Duration (months)	Timeline					
		2013	2014	2015	2016	2017	2018
Post Construction Requirements							
Specialized Nutrient, Toxics and Runoff Reduction Training for Staff	3 - 6						
Require Implementation of BMPs that Effectively Remove Nutrients and Toxics for Redevelopment Projects in County Islands	Ongoing						
Sewer System Maintenance							
Specialized Training for Staff	3 - 6						
Focus maintenance in County Islands	8 - 12						
Smart Gardening Program							
Planning & Assessment	8 - 12						
Implementation	Ongoing						
Street and Parking Lot Sweeping							
Planning & Assessment	8 - 12						
Upgrade/Purchase More Effective Street Sweepers, as needed	3 - 6						
Conduct Residential Outreach	8 - 12						
Increase Frequency of Sweeping	ongoing						

Table 8.3 Implementation Schedule for Structural Projects

<table>
<tr><th rowspan="2">Structural Project</th><th rowspan="2">Duration (months)</th><th colspan="6">Timeline</th></tr>
<tr><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th></tr>
<tr><td colspan="8">Torrance Airport</td></tr>
<tr><td>Planning and Permitting</td><td>38 -48</td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td><td></td></tr>
<tr><td>Engineering Design Documents</td><td>24 - 36</td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td><td></td></tr>
<tr><td>Bid/Construct</td><td>12 - 24</td><td></td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td></tr>
<tr><td>Operations</td><td></td><td></td><td></td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td></tr>
<tr><td colspan="8">Walnut Sump</td></tr>
<tr><td>Planning and Permitting</td><td>24 -36</td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td><td></td></tr>
<tr><td>Engineering Design Documents</td><td>15 - 24</td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td><td></td></tr>
<tr><td>Bid/Construct</td><td>6 - 12</td><td></td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td></tr>
<tr><td>Operations</td><td></td><td></td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td></tr>
<tr><td colspan="8">Baseball Field</td></tr>
<tr><td>Planning and Permitting</td><td>12 - 24</td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td><td></td></tr>
<tr><td>Engineering Design Documents</td><td>12 -24</td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td><td></td></tr>
<tr><td>Bid/Construct</td><td>15 - 24</td><td></td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td></td></tr>
<tr><td>Operations</td><td></td><td></td><td></td><td></td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td></tr>
<tr><td colspan="8">Redevelopment(1)</td></tr>
<tr><td>Private Development</td><td>Continuous</td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td></tr>
<tr><td colspan="8">Retrofit</td></tr>
<tr><td>BMPs on Public Lands</td><td>As needed</td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td></tr>
<tr><td>BMP on private Property by Land Owner through Incentive Program(2)</td><td>As needed</td><td></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td><td style="background-color:#92D050"></td></tr>
</table>

Notes:
(1) Redevelopment of property is assumed to continue at a moderate pace comparable to the last 20 years and redevelopment will be in accordance with the LID ordinance and SUSMP requirements.
(2) Requires Public – Private partnership

9.0 COST ESTIMATES

The cost estimates for the proposed actions outlined in the Implementation Plan are presented in this section. At the planning level, the costs provided will allow an order of magnitude effort necessary to implement structural and nonstructural BMPs in the Machado Lake Watershed to meet the WLAs of both the Nutrient and Toxics TMDLs using the current information on the loading from the TMDL Implementation Area and effectiveness of implementing BMPs. Changes to the TMDLs, the model estimated loads through watershed specific monitoring, or assumed effectiveness of identified BMPs will result in a change in the required BMPs and their associated costs. Cost estimates presented are at the level of detail necessary for planning and strategic decision-making. The BMPs are to be distributed uniformly across the TMDL Implementation Area, and site-specific issues that may result in excessive costs are likely to occur in a portion of the installations. Costs presented in here cannot consider site-specific issues and are likely to underestimate the final costs for applying the identified BMPs throughout the TMDL Implementation Area.

9.1 Best Management Practices Cost Estimates

The nonstructural costs estimates are presented in Table 9.1. An assumed 3 percent rate of inflation is used in the cost estimates to determine the cost estimates. Of the BMPs discussed in Section 4, the impervious cover reduction and sanitary sewer maintenance are not included in Table 8.3, as the impervious cover reduction ultimately is a component of the structural BMP program, and the sanitary sewer maintenance is required under the collection system permit.

Table 9.1 Nonstructural Best Management Practice Cost Estimates.

Program	Cost ($)(1)
Catch basin filter Cleanouts	1,500,000
Catch basin filter(2)	2,200,000
Downspout Disconnection Program	200,000
Fats, Oils and Grease Outreach	100,000
Green Waste Outreach	100,000
Illicit Connection Removal	200,000
Industrial/ Commercial Facilities Control Program	100,000
Pet Waste Outreach	500,000
Post Construction Requirements	50,000
Sewer System Maintenance	500,000
Smart Gardening Program	500,000
Street and Parking Lot Sweeping	1,500,000
Total	**7,450,000**

<u>Note:</u>
(1)Program costs through 2018 using 3% rate of inflation

Structural cost estimates are listed in Table 9.2. Implementation costs for the conceptual projects do not include engineering design, permitting, construction, building materials, or O&M. Information on these can be found in Appendix F. The details of the five conceptual designs are presented in Section 5. As per the quantification analysis, structural BMPs are required in addition to the conceptual projects and projects situated on County lands. Typical costs for the additional projects are used to estimate the cost of projects on leased or private parcels. The costs do not reflect the costs of negotiation with landowners or the cost of land acquisition. The costs for additional projects are subject to change to reflect the specific site conditions. Detailed cost estimates can be found in Appendix F.

Table 9.2 Program Cost Estimates of Structural Best Management Practices

Structural Best Management Practice	Cost ($)
Conceptual Projects	
Walnut Sump	2,500,000
Baseball Field	500,000
Torrance Airport	
1. BMP at Site A1	5,007,000
2. BMP at Site A2	2,000,000
3. BMP at Site A3 (Recommended Option)	7,000,000
TOTAL(1)	**10,000,000**

Note:
(1) Total cost does not include BMP costs at A1 and A2.

9.2 Cost Schedule

The schedule for implementation to achieve the TMDL WLA, requiring 54 percent reduction in phosphorus load, is summarized in Table 8.3. The schedules for nonstructural, structural, redevelopment, and leased property projects were used to distribute the implementation costs over time, ending in 2018, the compliance point for the Nutrients TMDL. The implementation path represented by Table 8.3 is a method of compliance with the Nutrients TMDLs. As the adaptive management and reevaluation of the Nutrient TMDL progresses, the required levels of pollutant loading and the compliance timeline may change. The actual costs and timing of implementation will depend on the specific site characteristics, special studies, and actual effectiveness of installed BMPs.

9.3 Financial Strategy

Financing the implementation of the Torrance EWMP is the greatest challenge confronting the City. In the absence of stormwater utility fees (aside from those specified for maintenance), the City has no dedicated revenue stream to pay for implementation of the EWMP. The City's annual budget for catch basin cleaning is about $140,000 and the annual budget for street sweeping is approximately $1,3000,000.

In addition to current uncertainties associated with costs and funding, there are multiple uncertainties associated with future risks. There will be many deadlines that must be met despite limited resources. The City will need to set priorities and seek funding in order to meet the various compliance deadlines. Therefore, to address the Water Quality Priorities (WQPs), the City is going to pursue a multi-faceted financial strategy. In addition, the City has coordinated the proposed compliance schedule (see Section 5) with the financial strategy.

The latest Los Angeles MS4 Permit has greatly magnified the financial challenges associated with managing stormwater. The absence of a stable stormwater funding mechanism not tied to municipal General Funds is becoming ever more critical. For that reason, the City Manager Committees of the California Contract Cities Association and the League of California Cities, Los Angeles Division, formed a City Managers' Working Group (Working Group) to review stormwater funding options after the LA County proposed Clean Water, Clean Beaches funding initiative did not move forward. The result was a Stormwater Funding Report 3 that notes, "the Los Angeles region faces critical, very costly, and seriously underfunded stormwater and urban runoff water quality challenges." The Report found that funding stormwater programs is so complex and dynamic, and the water quality improvement measures so costly, that Permittees cannot depend on a single funding option at this time. The City Managers' report includes a variety of recommendations, including: organizational recommendations; education and outreach program recommendations; recommendations for legislation, such as State Facilities, Stormwater Capture, and Use; Source Control or Fee Legislation; Clean Water, Clean Beaches recommendations; local funding options; and recommendations for the Regional Water Board.

A summary of funding options identified in the Stormwater Funding Report can be found below.

9.3.1 <u>Grant and Loans</u>

As described in this EWMP, the projects being envisioned represent new infrastructure or revisions to existing infrastructure that will be expected to operate in perpetuity. This new infrastructure or increased costs associated with revising existing infrastructure were never envisioned when the City of Torrance and the potential partners (Peninsula Cities) were developing their revenue and budgeting models. Therefore, the City and the Peninsula Cities do not currently have revenue sources allocated specifically to this new infrastructure. New revenue sources need to be identified, or revenue sources currently allocated to other programs need to be used to fund the implementation of this EWMP.

Flexibility in identifying potential funding opportunities will be important for successful financing of EWMP implementation. The financial strategy presented in this EWMP outlines a set of multiple approaches that allows City and the Peninsula Cities to select those strategies that best fit their specific circumstances. The financial strategies available to the City and the Peninsula Cities associated with grants and low interest loans are summarized below:

- Apply for grants through the recently passed Prop 1 – 2014 Water Bond. Over $400M is available for stormwater capture, IRWMP and urban creek restoration projects.
- Apply for other grants (state and federal) for stormwater improvement, beach water quality improvement, and green infrastructure projects. (e.g. Prop. 84, CBI, etc.)

The City's strategy for funding the proposed projects is to fund pre-design and use the pre-design to apply for grants. If grant is obtained then the City will fund the Matching Funds from General Fund, deferring Capital Projects, or the Water or Sewer Enterprise Fund Balance. The City will decide where and how to fund the Matching Funds when grant funds confirmation is obtained.

Table 9.3 lists grant and low interest loan programs that the City and the Peninsula Cities will investigate for EWMP projects. They programs range from Federal to State and can apply to transportation, waters supply, water quality, habitat enhancement, recreation, or a range of potential project benefits. Table 9.3 shows which project benefit criteria apply most to the different grant programs. As projects are developed and concept planned, incorporating the benefits that position them for grants and low interest loans can be beneficial in improving odds at successfully obtaining such funds.

The State of California needs to address the laws that hamper or prevent Cities from adopting fees to fund EWMP projects, or adopt statewide funding source. Also the County of Los Angeles could adopt a county wide fee that could have revenue for the Cities, like they tried to do before. The City of Torrance would support these types of efforts.

The City of Torrance in partnership with the Peninsula Cities was awarded $500,000 toward the planning, design and environmental clearance for an underground infiltration basin at the Torrance Municipal Airport. This grant is administered by the Department of Water Resources for the Prop. 1 Storm Water Grant Program. The partners committed to local matching funds in the amount of $620,000 toward the total estimated design/environmental costs of $1,120,000.

The City of Torrance has a pending application for the Walnut Storm Water Capture and Groundwater Infiltration Project. The request amount is $450,000 toward a $900,000 project to begin utilizing a storm water basin to capture storm water that is currently routed to Machado Lake. This grant is administered by the Department of Water Resources for the Prop. 1 Storm Water Grant Program.

9.3.2 Organizational

As recommended in the Stormwater Funding Report, the City will consider forming a core group of elected officials to form a committee, including members from the environmental community, the business community, and other stakeholders to improve communication and to reach consensus on fee issues. Additionally, the City plans to engage with other agencies to discuss future partnerships in stormwater programs.

9.3.3 Education and Outreach

The City plans to implement public outreach on a watershed-based level. With these efforts the Participating Agencies will have direct communications with the Governor and the Legislature on the funding needs.

9.3.3.1 Legislation

The City has considered pursuing legislation in the following areas:

- Schools and Public Facilities (i.e., environmental liability waivers; state architect guidance on schools, etc.)
- Stormwater Capture and Reuse (i.e., provide a clear path to monetize the capture and use of stormwater)
- Source Control or Fee Legislation (i.e., pursue reduction of zinc in tires and/or a per-tire zinc reduction fee)
- Special Assessment Districts (i.e., explore the special assessment district concept for funding stormwater projects)

9.3.3.2 Clean Water

The Participating Agencies will consider a property owner/voter sentiment survey based on new factors and changed circumstances, including a list of specific projects, optional fee amounts and an "opt out" provision. Additionally, the Participating Agencies will explore the formation of the Urban Water Conservation District under the 1931 Act by determining the governance structure under 1931 Act. If it is Board of Supervisors governance, a protest hearing may be considered to vote for a stormwater capture and infiltration fee to fund other program aspects not covered under the 1931 Act Water Conservation District.

9.3.4 Local Funding Options

Local funding options include:

- Adopting local fees.

- Street sweeping contracts to provide NPDES trash controls.
- Adoption of water conservation fees to provide funding for reducing irrigated runoff to conserve water and reduce dry weather discharges.
- Stormwater impact fees.
- Local, statewide, or regional fees on car rentals to contribute to copper and zinc cleanup costs and incorporate stormwater quality features into street and highway projects funded by bonds and other street funds.

9.3.4.1 Transportation

Another consideration is future transportation bonds. This can be pursued by encouraging the Metropolitan Transportation Authority (MTA) to include funding stormwater quality features, such as Green Streets, in future bonds and encourage Council of Governments to develop strategic transportation plans that include mitigations designed to address water quality issues from transportation projects.

9.4 Assessment and Adaptive Management Framework

Adaptive management is a key component to the successful implementation, assessment, and refinement of the Machado Lake EWMP. Adaptive management is the process by which data are continually assessed in the context of improving and adapting programs to ensure the most effective strategies are implemented. In accordance with the MS4 Permit, every two years from the date of EWMP approval an adaptive management process will be implemented. The process will include consideration of the progress for the following elements as described in Part V1.C.8 of the MS4 Permit:

1. “Progress toward achieving interim and/or final WQBELS or RW limitations according to established schedules;
2. Progress toward achieving improved water quality in MS4 discharges and achieving RW limitations through implementation of the watershed control measures based on an evaluation of outfall based monitoring data and RW monitoring data;
3. Achievement of interim milestones;
4. Re-evaluation of the water quality priorities identified for the area based on more recent water quality data for discharges from the MS4 and the receiving water(s) and a reassessment of sources of pollutants in MS4 discharges;
5. Availability of new information and data from sources other than the Permittees’ monitoring program(s) within the area that informs the effectiveness of the actions implemented by the Permittees;
6. Regional Water Board recommendations; and

7. Recommendations for modifications to the Watershed Management Program solicited through a public participation process."

As additional data become available through CIMP monitoring, BMP effectiveness studies, special studies such as the Toxics TMDL required Stressor ID Study, and other scientific studies, they will be integrated and assessed to determine whether programs in the EWMP should be altered to enable compliance in the most efficient manner.

The adaptive management framework will allow the EWMP Agencies to develop an overall program consisting of efficient solutions based on evolving watershed priorities.

Table 9.3 Grant and Loan Programs and Project Criteria

Funding Source	Priority Project Elements								
	Increase Local water Supply	Conservation Program	Water Quality	Pollution Reduction	Flood Management Programs	Drinking Water Protection	Ecosystem Protection	Restoration	Public Health/ Environmental Impact
EPA Section 319			X	X					
Proposition 1:									
Regional Water Security		X	X				X	X	
Flood Management		X	X				X	X	
Clean, Safe, Reliable Drinking Water		X	X			X	X	X	
Ecosystem and Watershed Protection		X	X				X	X	
Groundwater Sustainability		X	X				X	X	X
Water Storage Capacity		X	X				X	X	
Clean Beaches Initiatives			X	X			X	X	
Supplemental Environmental Project Funds:			X						
Federal			X	X					X
State			X	X					

(1) Transportation projects that are coordinated with interdisciplinary factors including stormwater and infrastructure investments.

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APPENDIX A – REFERENCES

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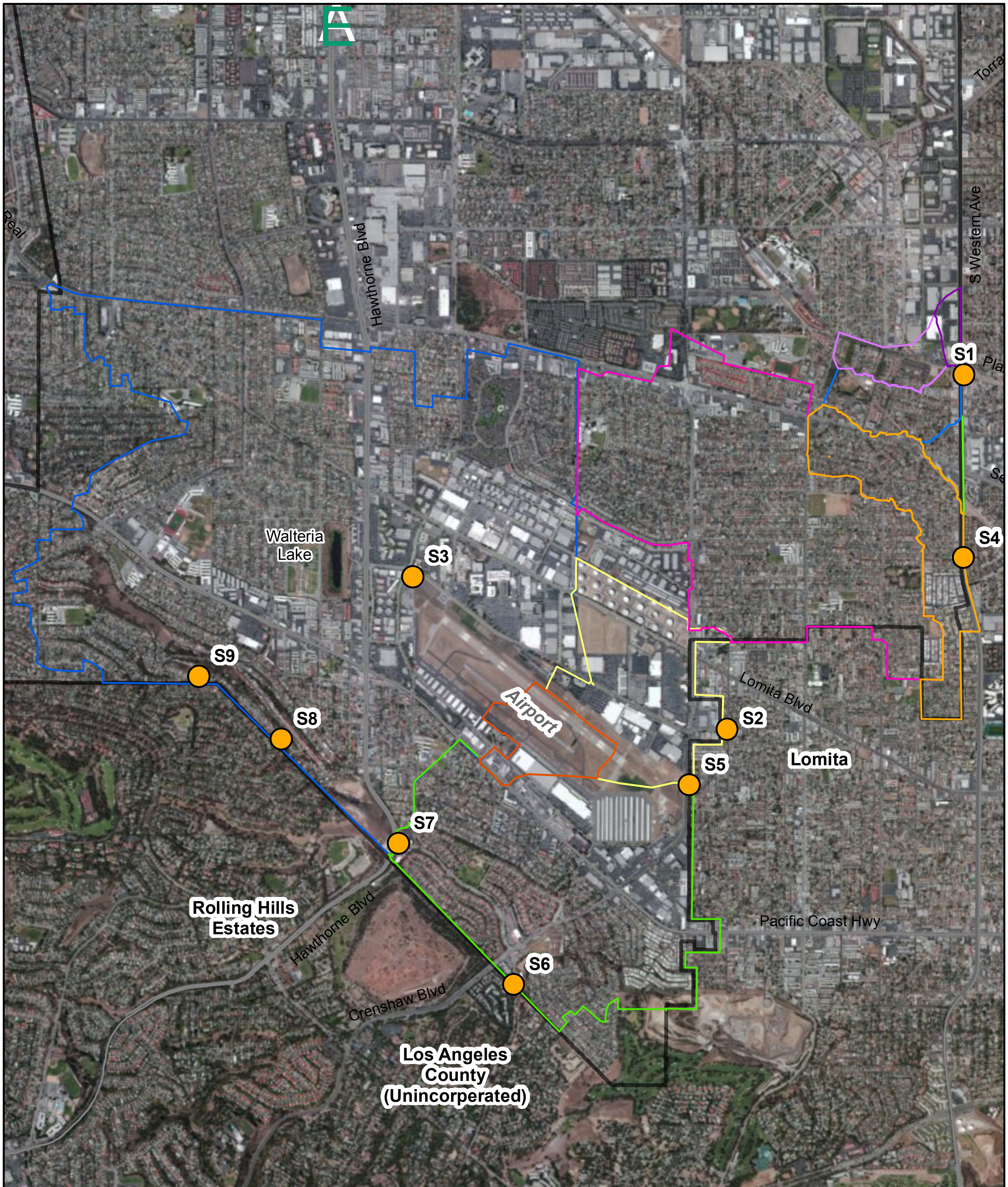
APPENDIX B – DETAILED MAPS OF SAMPLING LOCATIONS



Legend

Sampling Location
City Boundary
Freeway
Major Roads

Walnut Sump Subcatchments
Subcatchments
WS-1
WS-2

Baseball Subcatchments
SUBCATCH
BB-S1
BB-S2
BB-S3
BB-S4

Airport Subcatchments
NAME
AS1
AS2
AS3
Walteria Lake

0 0.5 1 Miles

Figure 4
Special Study Sampling Locations
BMP Implementation Plan
City of Torrance

Engineers...Working Wonders With Water™

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TABLE 1
Interim TMDL WLA Attainment Status

Month	Sample Location	Sample Date	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Nitrate/Nitrite as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Sum of Nitrogen Values (1) (mg/l)	Monthly Average Nitrogen (mg/l)	Total Phosphorus (mg/l)	Monthly Average Phosphorus (mg/l)
August	RHE City Hall	8/2/2011	0.77	< 0.15	0.77	0.75	1.52	0.57	0.15	0.08
	Valmonte		0.15	< 0.75	0.15	0.59	0.74		0.16	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
September	RHE City Hall	9/8/2011	0.51	< 0.15	0.51	0.48	0.99	0.43	0.13	0.17
	Valmonte		0.14	< 0.15	0.14	0.57	0.71		0.54	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
October	RHE City Hall	10/3/2011	0.91	< 0.15	0.91	0.55	1.46	0.63	0.17	0.19
	Valmonte		0.37	< 0.15	0.37	0.70	1.07		0.59	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
November	RHE City Hall	11/3/2011	0.79	< 0.30	0.79	11	11.79	2.08	0.20	0.12
	Valmonte		< 0.55	< 0.75	< 0.75	0.59	0.59		0.41	
	Solano		No Flow				0.00		0.00	
	Blackwater Cyn		No Flow				0.00		0.00	
	RHE City Hall	11/15/2011	0.62	< 0.75	0.62	< 0.50	0.62		0.071	
	RHE City Hall	11/22/2011	1.0	< 0.15	1.0	< 0.50	1.0		0.12	
	RHE City Hall	11/28/2011	0.58	< 0.30	0.58	< 0.50	0.58		0.058	
December	RHE City Hall	12/9/2011	1.9	< 0.15	1.9	1.2	3.10	0.92	0.083	0.13
	Valmonte		< 0.22	< 0.30	< 0.30	0.56	0.56		0.43	
	Solano		No Flow				0.00		0.00	
	Blackwater Cyn		No Flow				0.00		0.00	
January	RHE City Hall	1/6/2012	0.68	< 0.30	0.68	< 0.50	0.68	0.32	< 0.050	0.11
	Valmonte		< 0.55	< 0.75	<0.75	0.58	0.58		0.42	
	Solano		No Flow				0.00		0.00	
	Blackwater Cyn		No Flow				0.00		0.00	
February	RHE City Hall	2/6/2012	0.91	< 0.75	0.91	0.63	1.54	0.56	< 0.050	0.12
	Valmonte		< 0.55	< 0.75	<0.75	0.70	0.70		0.49	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	

TABLE 1
Interim TMDL WLA Attainment Status

Month	Sample Location	Sample Date	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Nitrate/Nitrite as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Sum of Nitrogen Values (1) (mg/l)	Monthly Average Nitrogen (mg/l)	Total Phosphorus (mg/l)	Monthly Average Phosphorus (mg/l)
March	RHE City Hall	3/2/2012	0.35	< 0.15	0.35	< 0.50	0.35	2.04	< 0.050	0.65
	Valmonte		< 0.11	< 0.15	<0.15	0.62	0.62		0.19	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
	RHE City Hall	3/17/2012 (Wet Weather Sample)	1.2	0.27	1.47	1.3	2.77		0.17	
	Valmonte		0.31	<0.15	0.31	0.72	1.03		0.51	
	Solano		0.75	< 0.15	0.75	4.7	5.45		1.40	
	Lariat		3.0	0.30	3.3	4.8	8.1		3.6	
	Lariat	3/28/2012	No Flow				0.00		0.00	
April	RHE City Hall	4/2/2012	0.75	< 1.5	0.75	< 0.50	0.75	1.05	< 0.050	0.16
	Valmonte		0.37	< 1.5	0.37	0.77	1.14		0.35	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
	RHE City Hall	4/11/2012 (Wet Weather Sample)	0.78	< 0.15	0.78	0.79	1.57		0.11	
	Valmonte		0.64	<0.30	0.64	3.0	3.64		0.39	
	Solano		0.48	< 0.15	0.48	0.79	1.27		0.40	
	Lariat		No Flow				0		0.00	
May	RHE City Hall	5/8/2012	< 0.22	< 0.30	<0.30	< 0.50	0.00	0.20	0.056	0.25
	Valmonte		0.26	< 0.30	0.26	0.55	0.81		0.96	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
June	RHE City Hall	6/5/2012	0.87	<0.30	0.87	0.52	1.39	0.65	0.084	0.26
	Valmonte		0.55	<0.75	0.55	0.65	1.20		0.95	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
July	RHE City Hall	7/3/2012	<0.10	<0.10	<0.10	0.224	0.224	0.16	<0.050	0.11
	Valmonte		<0.10	<0.10	<0.10	0.398	0.398		0.45	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
August	RHE City Hall	8/3/2012	<0.10	<0.10	<0.10	0.411	0.411	0.25	<0.050	0.15
	Valmonte		<0.10	<0.10	<0.10	0.579	0.579		0.60	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
September	RHE City Hall	9/11/2012	<0.10	<0.10	<0.10	0.616	0.616	0.35	0.19	0.15
	Valmonte		<0.10	<0.10	<0.10	0.802	0.802		0.40	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	

TABLE 1
Interim TMDL WLA Attainment Status

Month	Sample Location	Sample Date	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Nitrate/Nitrite as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Sum of Nitrogen Values (1) (mg/l)	Monthly Average Nitrogen (mg/l)	Total Phosphorus (mg/l)	Monthly Average Phosphorus (mg/l)
October	RHE City Hall	10/1/2012	0.100	<0.10	0.100	0.594	0.694	0.41	0.27	0.73
	Valmonte		<0.10	<0.10	<0.10	0.756	0.756		1.2 Q*	
	Solano		No Flow				0.000		0.00	
	Lariat		No Flow				0.000		0.00	
	Valmonte	10/15/2012	<0.100	<0.100	<0.100	0.587	0.587		2.2 Q*	
November	RHE City Hall	11/2/2012	<0.100	0.100	0.100	0.481	0.581	0.29	<0.050	0.019
	Valmonte		<0.100	<0.100	<0.100	0.588	0.588		0.075	
	Solano		No Flow				0.000		0.00	
	Lariat		No Flow				0.000		0.00	
December	RHE City Hall	12/7/2012	0.820	<0.100	0.820	0.192 B	1.012	0.25	0.05	0.07
	Valmonte		<0.100	<0.500	<0.500	0.301 B	0.301		0.43	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
	RHE City Hall	12/13/2012 (Wet Weather Sample)	0.120 Q*	<0.100	0.12	0.237	0.357		0.05	
	Valmonte		<0.100	<0.100	<0.100	0.342	0.342		<0.050	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
January	RHE City Hall	12/13/2012	0.340	<0.100	0.340	0.337 B	0.677	0.34	<0.050	0.11
	Valmonte		<0.100	<0.100	<0.100	0.680 B	0.680		0.45	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
February	RHE City Hall	2/5/2013	0.470	<0.100	0.470	0.236 Q*	0.706 Q*	0.28	<0.050	0.13
	Valmonte		<0.100	<0.100	<0.100	0.428	0.428		0.52	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
March	RHE City Hall	3/1/2013	0.350 O-04	<0.100 O-04	0.35 O-04	0.495 B N O-04	0.845 B N O-04	1.30	<0.050 O-04	0.26
	Valmonte		<0.100 O-04	<0.100 O-04	<0.100 O-04	0.707 B N O-04	0.707 B N O-04		0.78 O-04	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
	RHE City Hall	3/8/2013 (Wet Weather Sample)	1.02	<0.100	1.020	1.23	2.250		0.31	
	Valmonte		4.90	<0.100	4.900	0.588	5.488		0.63	
	Solano		0.41	<0.100	0.410	0.687	1.097		0.38	
	Lariat		No Flow				0.00		0.00	
April	RHE City Hall	4/1/2013	<0.100	<0.100	<0.100	0.594	0.594	0.32	<0.050	0.16
	Valmonte		<0.100	<0.100	<0.100	0.68	0.680		0.65	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	

TABLE 1
Interim TMDL WLA Attainment Status

Month	Sample Location	Sample Date	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Nitrate/Nitrite as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Sum of Nitrogen Values (1) (mg/l)	Monthly Average Nitrogen (mg/l)	Total Phosphorus (mg/l)	Monthly Average Phosphorus (mg/l)
May	RHE City Hall	5/13/2013	0.150	<0.500	0.150	0.416	0.566	0.25	<0.050	0.19
	Valmonte		<0.050	<0.500	<0.500	0.419	0.419		0.75	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
June	RHE City Hall	6/5/2013	0.230	<0.10	0.230	0.584	0.814	0.36	0.20	0.15
	Valmonte		0.130 Q*	<0.10	0.130 Q*	0.505 Q*	0.635 Q*		0.39 Q*	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
July	RHE City Hall	7/1/2013	<0.100	<0.100	<0.100	<0.400	<0.400	0.12	<0.050	0.15
	Valmonte		<0.100	<0.100	<0.100	0.474	0.474		0.59	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
August	RHE City Hall	8/14/2013	<0.100	<0.100	<0.100	0.632	0.632	0.37	0.24	0.23
	Valmonte		<0.100	<0.100	<0.100	0.834	0.834		0.68	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
September	RHE City Hall	9/26/2013	<0.100	<0.100	<0.100	0.804	0.80	0.20	0.59	0.15
	Valmonte		No Flow				0.00		0.00	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
October	RHE City Hall	10/2/2013	0.24	<0.100	0.24	0.346	0.59	0.47	0.00	0.04
	Valmonte		0.33	<0.100	0.33	0.95	1.280		0.15	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
November	RHE City Hall	11/5/2013	1.16	<0.400	1.16	0.212	1.37	0.48	0.00	0.02
	Valmonte		<0.100	<0.100	<0.100	0.558	0.558		0.07	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
December	RHE City Hall	12/13/2013	0.52	<0.100	0.52	0.053	0.57	0.22	0.085	0.13
	Valmonte		<0.100	<0.100	<0.100	0.322	0.322		0.45	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
January	RHE City Hall	1/10/2014	0.74	<0.200	0.74	0.277 N	1.02	0.34	0.056	0.18
	Valmonte		<0.100	<0.100	<0.100	0.353 N	0.353		0.66	
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
	RHE City Hall		0.75	<0.10	0.75	0.494 N	1.24		0.130	

TABLE 1
Interim TMDL WLA Attainment Status

Month	Sample Location	Sample Date	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Nitrate/Nitrite as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Sum of Nitrogen Values (1) (mg/l)	Monthly Average Nitrogen (mg/l)	Total Phosphorus (mg/l)	Monthly Average Phosphorus (mg/l)
February	Valmonte	2/3/2014	<0.10	<0.10	<0.10	0.545 N	0.545	1.78	0.56	0.97
	Solano		No Flow				0.00		0.00	
	Lariat		No Flow				0.00		0.00	
February	RHE City Hall	2/28/2014 (Wet Weather Sample)	0.64	<0.10	0.64	0.316 N	0.96		0.440	
	Valmonte		2.1 O-04	<0.10	2.1	0.872 N	2.972		0.72	
	Solano		0.33	<0.10	0.33	0.57 N	0.90		0.53	
	Lariat		0.27	<0.10	0.27	0.234 N	0.50		1.50	
March	RHE City Hall	3/19/2014	<0.100	<0.100	<0.100	0.255	0.26	0.20	<0.050	0.12
	Valmonte		<0.100	<0.100	<0.100	0.527	0.527		0.470	
	Solano		No Flow						No Flow	
	Lariat		No Flow						No Flow	
April	RHE City Hall	4/16/2014	<0.100	<0.100	<0.100	0.159	0.159	0.11	0.058	0.14
	Valmonte		<0.100	<0.100	<0.100	0.263 Q*	0.263		0.520	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
May	RHE City Hall	5/9/2014	<0.100	<0.100	<0.100	0.480	0.480	0.27	0.140	0.19
	Valmonte		0.31 O-04	<0.100	0.310	0.592	0.592		0.600	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
June	RHE City Hall	6/18/2014	<0.100	<0.100	<0.100	0.338 Q*	0.338	0.19	0.074	0.11
	Valmonte		<0.100	<0.100	<0.100	0.436	0.436		0.360	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
July	RHE City Hall	7/18/2014	<0.100	<0.100	<0.100	0.115	0.115	0.20	<0.050	0.15
	Valmonte		<0.100	<0.100	<0.100	0.682	0.682		0.580	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
August	RHE City Hall	8/7/2014	0.170	<0.100	<0.100	0.398	0.568	0.27	0.099	0.21
	Valmonte		<0.100	<0.100	<0.100	0.512	0.512		0.730	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
September	RHE City Hall	9/16/2014	0.10	<0.100	0.10	0.467	0.567	0.28	0.077	0.23
	Valmonte		<0.100	<0.100	<0.100	0.567	0.567		0.830	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
	RHE City Hall		0.240	<0.100	0.24	0.366	0.606		<0.050	

TABLE 1
Interim TMDL WLA Attainment Status

Month	Sample Location	Sample Date	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Nitrate/Nitrite as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Sum of Nitrogen Values (1) (mg/l)	Monthly Average Nitrogen (mg/l)	Total Phosphorus (mg/l)	Monthly Average Phosphorus (mg/l)
October	Valmonte	10/15/2014	<0.100	<0.100	<0.100	0.331	0.331	0.23	0.770	0.19
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
November	RHE City Hall	11/11/2014	<0.100	<0.100	<0.100	0.262	0.262	0.17	<0.050	0.23
	Valmonte		<0.100	<0.100	<0.100	0.42	0.420		0.900	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
December	RHE City Hall	12/2/2014 (Wet Weather Sample)	0.900	<0.100	0.900	0.655	1.555	1.69	0.410	0.41
	Valmonte		0.450	<0.100	0.450	0.805	1.255		0.500	
	Solano		3.43	0.480	3.91	8.20	12.11		1.600	
	Lariat		0.180	<0.100	0.180	0.902	1.08		0.660	
	RHE City Hall	12/10/2014	0.240	<0.100	0.240	0.476	0.716		<0.050	
	Valmonte		0.140	<0.100	0.140	0.666	0.806		0.350	
	Solano		No Flow				0.00		No Flow	
	Lariat		No Flow				0.00		No Flow	
	RHE City Hall	12/12/2014 (Wet Weather Sample)	0.370	<0.100	0.370	0.472	0.842		0.300	
	Valmonte		<0.100	<0.100	<0.100	0.784	0.784		0.320	
	Solano		0.160	<0.100	0.160	0.726	0.886		0.490	
	Lariat		<0.100	<0.100	<0.100	0.283	0.28		0.320	
January	RHE City Hall	1/8/2015	0.062	<0.100	0.062	0.261	0.323	0.24	<0.050	0.10
	Valmonte		<0.100	<0.100	<0.100	0.642	0.642		0.400	
	Solano		No Flow						No Flow	
	Lariat		No Flow						No Flow	
February	RHE City Hall	2/9/2015	<0.100	<0.100	<0.100	0.304	0.304	0.20	<0.050	0.14
	Valmonte		<0.100	<0.100	<0.100	0.509	0.509		0.560	
	Solano		No Flow						No Flow	
	Lariat		No Flow						No Flow	
March	RHE City Hall	3/11/2015	0.340	<0.100	0.340	0.389	0.729	0.32	0.050	0.14
	Valmonte		<0.100	<0.100	<0.100	0.541	0.541		0.510	
	Solano		No Flow						No Flow	
	Lariat		No Flow						No Flow	
April	RHE City Hall	4/7/2015	0.260	<0.100	0.260	0.201	0.461	0.21	<0.05	0.18
	Valmonte		<0.100	<0.100	<0.100	0.367	0.367		0.710	
	Solano		No Flow						No Flow	
	Lariat		No Flow						No Flow	
	RHE City Hall	5/4/2015	<0.100	<0.100	<0.100	0.215	0.215		<0.05	
	Valmonte		<0.100	<0.100	<0.100	0.437	0.437		0.360	

TABLE 1
Interim TMDL WLA Attainment Status

Month	Sample Location	Sample Date	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Nitrate/Nitrite as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Sum of Nitrogen Values (1) (mg/l)	Monthly Average Nitrogen (mg/l)	Total Phosphorus (mg/l)	Monthly Average Phosphorus (mg/l)
May	Solano	5/4/2015	No Flow					0.57	No Flow	0.28
	Lariat		No Flow						No Flow	
	RHE City Hall	5/15/2015 (Wet Weather Sample)	0.500	<0.100	0.500	1.14	1.640		<0.05	
	Valmonte		<0.100	<0.100	<0.100	0.422	0.422		0.600	
	Solano		0.660	<0.100	0.660	1.180	1.840		1.300	
	Lariat		No Flow						No Flow	
June	RHE City Hall	6/3/2015	<0.100	<0.100	<0.100	0.261	0.261	0.09	<0.050	0.17
	Valmonte		<0.100	<0.100	<0.100	0.095	0.095		0.680	
	Solano		No Flow						No Flow	
	Lariat		No Flow						No Flow	
						Interim WLA (3/11/2009)		3.50		1.25
						Interim WLA (3/11/2014)		2.45		1.25
						Final WLA (9/11/2018)		1.00		0.10

Notes:

Table 2-9
Summary of Machado Lake Sediment Data Sets

Source	Sample Data
City of Los Angeles, Machado Lake Watershed Management Plan	May 14 & 15, 2001
SWAMP	August 4, 2003
City of Los Angeles	October 22, 2008
Regional Board	January 14, 2009

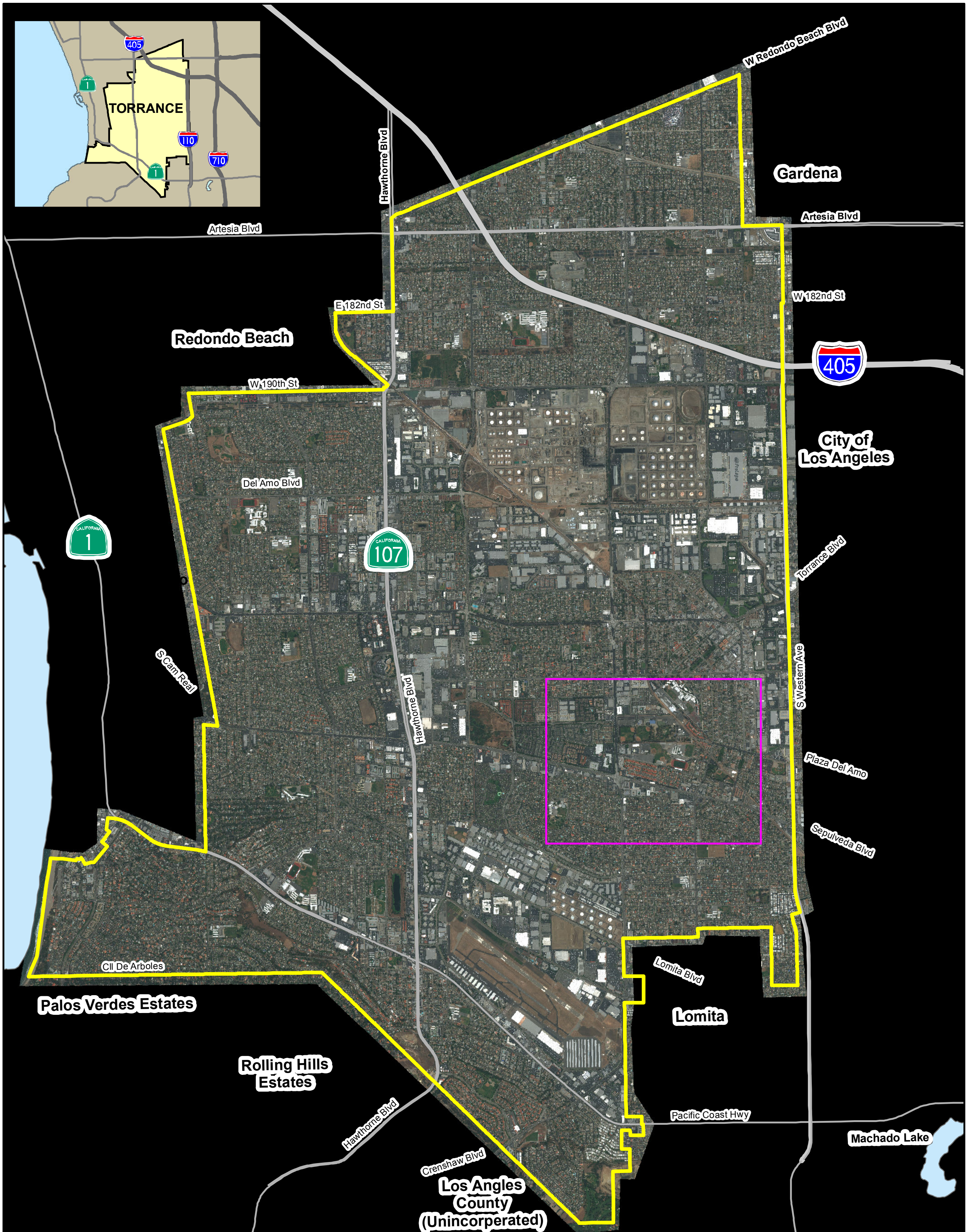
Source: Regional Board Machado Lake Pesticides and PCBs TMDL.

Table 2-10
Machado Lake Water Sediment Toxics Data

Lake Region	Sample Date	Sample Depth (cm)	Constituents of Concern (µg/kg)			
			Total Chlordane	Total DDT	Dieldrin	PCBs
North Lake	May 14-15 2001	20- composite	5.8	5.8	ND	No data
Mid North Lake	May 14-15 2001	20- composite	1.4	4.4	ND	No data
Mid Lake	May 14-15 2001	20- composite	2	2	ND	No data
Mid Lake South	May 14-15 2001	20- composite	7	ND	ND	No data
South Lake	May 14-15 2001	20- composite	3	2	ND	No data
North Lake	August 4, 2003	2	39.75	64.22	ND	94.1
Mid North Lake	August 4, 2003	2	60.73	76.13	ND	115.8
Mid Lake	August 4, 2003	2	40.93	57.13	ND	119.3
Mid Lake South	August 4, 2003	2	82.29	80.14	1.54	87.5
South Lake	August 4, 2003	2	64.01	57.35	1.1	75.2
North Lake	October 22, 2008	15	No data	4.69	No data	No data
North Lake	October 22, 2008	76	No data	8.38	No data	No data
Mid Lake (west side)	October 22, 2008	15	No data	10.04	No data	No data
Mid Lake (west side)	October 22, 2008	76	No data	8.7	No data	No data
North Lake	January 14, 2009	2	98.5	ND	ND	16.6
Mid Lake	January 14, 2009	2	56.4	34.8	ND	35.2
South Lake	January 14, 2009	2	60.7	19.8	ND	22.7
South Lake	January 14, 2009	2	67.1	51.9	ND	68.6

Notes:
ND = Non Detect
Detection limit is 1 µg/dry kg
Source: Regional Board *Machado Lake Pesticides and PCBs TMDL*

APPENDIX C – SATELLITE IMAGE OF CITY OF TORRANCE AND WMMS CALIBRATED PARAMETERS



Legend

City Boundary
Bodies of Water
Comparison Area

0 0.25 0.5 1 Miles

Satellite Imagery from WorldView for July 10, 2010

Appendix C
Satellite Image
BMP Implementation Plan
City of Torrance

WMMS Parameters														
defid	dwqid	deluid	sqo	potfw	potfs	potfc	acqop	sqolim	wsqop	soqc	ioqc	aoqc	addc	awdc
1	3	1	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	2	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	3	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	4	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	5	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	6	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	7	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	8	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	9	0	72.9725	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	10	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	11	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	12	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	13	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	14	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	15	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	16	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	17	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	18	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	19	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	20	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	3	21	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	1	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	2	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	3	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	4	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	5	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	6	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	7	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	8	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	9	0	72.9725	0.129194	0	0	0.000001	1.64	0.01	0	0	0	0
1	7	10	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	11	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0

WMMS Parameters														
defid	dwqid	deluid	sqo	potfw	potfs	potfc	acqop	sqolim	wsqop	soqc	ioqc	aoqc	addc	awdc
1	7	12	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	13	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	14	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	15	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	16	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	17	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	18	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	19	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	20	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	7	21	0	21.70456	0.129194	0	0	0.000001	1.64	0	0	0	0	0
1	11	1	0	1.072	0.8	0	0	0.000001	1.64	0	0	0	0	0
1	11	2	0	0.804	0.6	0	0	0.000001	1.64	0	0	0	0	0
1	11	3	0	0.804	0.6	0	0	0.000001	1.64	0	0	0	0	0
1	11	4	0	1.072	0.8	0	0	0.000001	1.64	0	0	0	0	0
1	11	5	0	1.528	1.14	0	0	0.000001	1.64	0	0	0	0	0
1	11	6	0	0.536	0.4	0	0	0.000001	1.64	0	0	0	0	0
1	11	7	0	0.536	0.4	0	0	0.000001	1.64	0	0	0	0	0
1	11	8	0	1.072	0.8	0	0	0.000001	1.64	0	0	0	0	0
1	11	9	0	1.072	0.8	0	0	0.000001	1.64	0	0	0	0	0
1	11	10	0	0.804	0.6	0	0	0.000001	1.64	0	0	0	0	0
1	11	11	0	0.804	0.6	0	0	0.000001	1.64	0	0	0	0	0
1	11	12	0	0.402	0.3	0	0	0.000001	1.64	0	0	0	0	0
1	11	13	0	0.402	0.3	0	0	0.000001	1.64	0	0	0	0	0
1	11	14	0	0.016	0.012	0	0	0.000001	1.64	0	0	0	0	0
1	11	15	0	0.016	0.012	0	0	0.000001	1.64	0	0	0	0	0
1	11	16	0	0.016	0.012	0	0	0.000001	1.64	0	0	0	0	0
1	11	17	0	0.016	0.012	0	0	0.000001	1.64	0	0	0	0	0
1	11	18	0	0.016	0.012	0	0	0.000001	1.64	0	0	0	0	0
1	11	19	0	0.016	0.012	0	0	0.000001	1.64	0	0	0	0	0
1	11	20	0	0	0	0	0	0.000001	1.64	0	0	0	0	0
1	11	21	0	0.804	0.6	0	0	0.000001	1.64	0	0	0	0	0
1	12	1	0	0.313	0.8	0	0	0.000001	1.64	0	0	0	0	0

WMMS Parameters														
defid	dwqid	deluid	sqo	potfw	potfs	potfc	acqop	sqolim	wsqop	soqc	ioqc	aoqc	addc	awdc
1	12	2	0	0.078	0.2	0	0	0.000001	1.64	0	0	0	0	0
1	12	3	0	0.078	0.2	0	0	0.000001	1.64	0	0	0	0	0
1	12	4	0	0.313	0.8	0	0	0.000001	1.64	0	0	0	0	0
1	12	5	0	0.391	1	0	0	0.000001	1.64	0	0	0	0	0
1	12	6	0	0.07	0.18	0	0	0.000001	1.64	0	0	0	0	0
1	12	7	0	0.07	0.18	0	0	0.000001	1.64	0	0	0	0	0
1	12	8	0	0.313	0.8	0	0	0.000001	1.64	0	0	0	0	0
1	12	9	0	0.313	0.8	0	0	0.000001	1.64	0	0	0	0	0
1	12	10	0	0.078	0.2	0	0	0.000001	1.64	0	0	0	0	0
1	12	11	0	0.078	0.2	0	0	0.000001	1.64	0	0	0	0	0
1	12	12	0	0.039	0.1	0	0	0.000001	1.64	0	0	0	0	0
1	12	13	0	0.039	0.1	0	0	0.000001	1.64	0	0	0	0	0
1	12	14	0	0.001	0.002	0	0	0.000001	1.64	0	0	0	0	0
1	12	15	0	0.001	0.002	0	0	0.000001	1.64	0	0	0	0	0
1	12	16	0	0.001	0.002	0	0	0.000001	1.64	0	0	0	0	0
1	12	17	0	0.001	0.002	0	0	0.000001	1.64	0	0	0	0	0
1	12	18	0	0.001	0.002	0	0	0.000001	1.64	0	0	0	0	0
1	12	19	0	0.001	0.002	0	0	0.000001	1.64	0	0	0	0	0
1	12	20	0	0	0	0	0	0.000001	1.64	0	0	0	0	0
1	12	21	0	0.078	0.2	0	0	0.000001	1.64	0	0	0	0	0
1	14	1	0	4.484	7.5	0	0	0.000001	1.64	0	0	0	0	0
1	14	2	0	0.717	1.2	0	0	0.000001	1.64	0	0	0	0	0
1	14	3	0	0.717	1.2	0	0	0.000001	1.64	0	0	0	0	0
1	14	4	0	4.484	7.5	0	0	0.000001	1.64	0	0	0	0	0
1	14	5	0	6.098	10.2	0	0	0.000001	1.64	0	0	0	0	0
1	14	6	0	3.037	5.08	0	0	0.000001	1.64	0	0	0	0	0
1	14	7	0	3.037	5.08	0	0	0.000001	1.64	0	0	0	0	0
1	14	8	0	4.484	7.5	0	0	0.000001	1.64	0	0	0	0	0
1	14	9	0	4.484	7.5	0	0	0.000001	1.64	0	0	0	0	0
1	14	10	0	0.717	1.2	0	0	0.000001	1.64	0	0	0	0	0
1	14	11	0	0.717	1.2	0	0	0.000001	1.64	0	0	0	0	0
1	14	12	0	1.495	2.5	0	0	0.000001	1.64	0	0	0	0	0

WMMS Parameters														
defid	dwqid	deluid	sqo	potfw	potfs	potfc	acqop	sqolim	wsqop	soqc	ioqc	aoqc	addc	awdc
1	14	13	0	1.495	2.5	0	0	0.000001	1.64	0	0	0	0	0
1	14	14	0	0.03	0.05	0	0	0.000001	1.64	0	0	0	0	0
1	14	15	0	0.03	0.05	0	0	0.000001	1.64	0	0	0	0	0
1	14	16	0	0.03	0.05	0	0	0.000001	1.64	0	0	0	0	0
1	14	17	0	0.03	0.05	0	0	0.000001	1.64	0	0	0	0	0
1	14	18	0	0.03	0.05	0	0	0.000001	1.64	0	0	0	0	0
1	14	19	0	0.03	0.05	0	0	0.000001	1.64	0	0	0	0	0
1	14	20	0	0	0	0	0	0.000001	1.64	0	0	0	0	0
1	14	21	0	0.717	1.2	0	0	0.000001	1.64	0	0	0	0	0
1	16	1	0	0	0	0	0	0.000001	1.64	31100	31100	0	0	0
1	16	2	0	0	0	0	0	0.000001	1.64	31100	31100	0	0	0
1	16	3	0	0	0	0	0	0.000001	1.64	31100	31100	0	0	0
1	16	4	0	0	0	0	0	0.000001	1.64	762000	762000	0	0	0
1	16	5	0	0	0	0	0	0.000001	1.64	1.74E+06	1.74E+06	0	0	0
1	16	6	0	0	0	0	0	0.000001	1.64	1.73E+06	1.73E+06	0	0	0
1	16	7	0	0	0	0	0	0.000001	1.64	3.19E+06	3.19E+06	0	0	0
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1	16	16	0	0	0	0	0	0.000001	1.64	6310	6310	0	0	0
1	16	17	0	0	0	0	0	0.000001	1.64	6310	6310	0	0	0
1	16	18	0	0	0	0	0	0.000001	1.64	6310	6310	0	0	0
1	16	19	0	0	0	0	0	0.000001	1.64	6310	6310	0	0	0
1	16	20	0	0	0	0	0	0.000001	1.64	0	0	0	0	0
1	16	21	0	0	0	0	0	0.000001	1.64	3500	3500	0	0	0

APPENDIX D – UTILITY SEARCH INFORMATION

October 21, 2013

Carollo Engineers
199 S. Los Robles Ave., Suite 530
Pasadena, CA 91101

Attention: John Meyerhofer,

Subject: 3 potential stormwater recharge project sites in the City of Torrance
Project No. 43-2013-10-00001
Please refer to the above Job ID Number in all future correspondence.

Enclosed is a copy of our Atlas Sheet/s with the approximate locations of our gas mains for you to post to your proposed project plans. The dimensions and locations of the mains are believed to be reasonably correct but are not guaranteed.

The depths of our facilities vary and can only be confirmed by pot holing, or some other acceptable method of taking elevations.

It is extremely important that you furnish us with "signed" final plans, before construction, including profiles and subsequent plan revisions as soon as they are available. A minimum of twelve (12) weeks is needed to analyze the plans and design alterations for any conflicting facilities. Depending on the magnitude of the work involved, additional time may be required to clear the conflict.

Underground Service Alert (USA), (800) 442-4133 or (800) 227-2600, must be notified 48 hours prior to commencing work. Please keep us informed of construction schedules, pre-construction meetings, etc., so that we can schedule our work accordingly. If no action is taken on this project within 24 months, plans will be discarded. Please call Paul Blood at (310) 687-2011 for further assistance.

Thank you,

Gale Etherly for Paul Blood
Cc: file: Job ID# 43-2013-10-00001
Enclosure: TOR 17 (Plaza Del Amo), C 501-W (Walnut St.), C 570-W (Skypark), TOR 26 (Skypark Dr., Garnier St.), C 508-W (Crenshaw Blvd.)
5atlas.doc

enclosure
atlas.doc

Map Title:
Printed By: CORP\CORP-TPGYE
Printed Date: 10/21/2013

Southern California Gas Company
Sempra Energy utility

Map Title:
Printed By: CORP\CORP-TPGYE
Printed Date: 10/21/2013

Southern California Gas Company
Sempra Energy utility

Map Title:

Printed By: CORP\CORP-TPGYE

Printed Date: 10/21/2013

Southern California Gas Company
Sempra Energy utility

Map Title:
Printed By: CORP\CORP-TPGYE
Printed Date: 10/21/2013

Map Title:
Printed By: CORP\CORP-TPGVE
Printed Date: 10/21/2013

SOUTHERN CALIFORNIA
EDISON
An *EDISON INTERNATIONAL* Company

September 12, 2013

Attn: John Meyerhofer
Carollo Engineers
199 S Los Robles Ave Ste 530
Pasadena, CA 91101

RE: Torrance

Enclosed are copies of the existing Southern California Edison overhead and/or underground facilities inventory maps covering the area of your proposed project.

Southern California Edison Company believes this information is correct for purposes intended by the Company and assumes no liability for its accuracy.

Should you need to contact an SCE service planner for review of preliminary or final plans, or to establish a service point, please contact:

SCE PLANNING SUPERVISOR
505 Maple Ave
Torrance, CA 90503
(310) 783-9356

When contacting the SCE service planner, please include copies of the facilities inventory maps that are being provided to you. **SENDING YOUR PLANS TO ANY ADDRESS OTHER THAN THE ONE LISTED WILL CAUSE A DELAYED RESPONSE.**

Thank you, and if you have any further questions, please call me at (714) 796-9932.

Kim Gurule
Facilities Mapping
Power Distribution

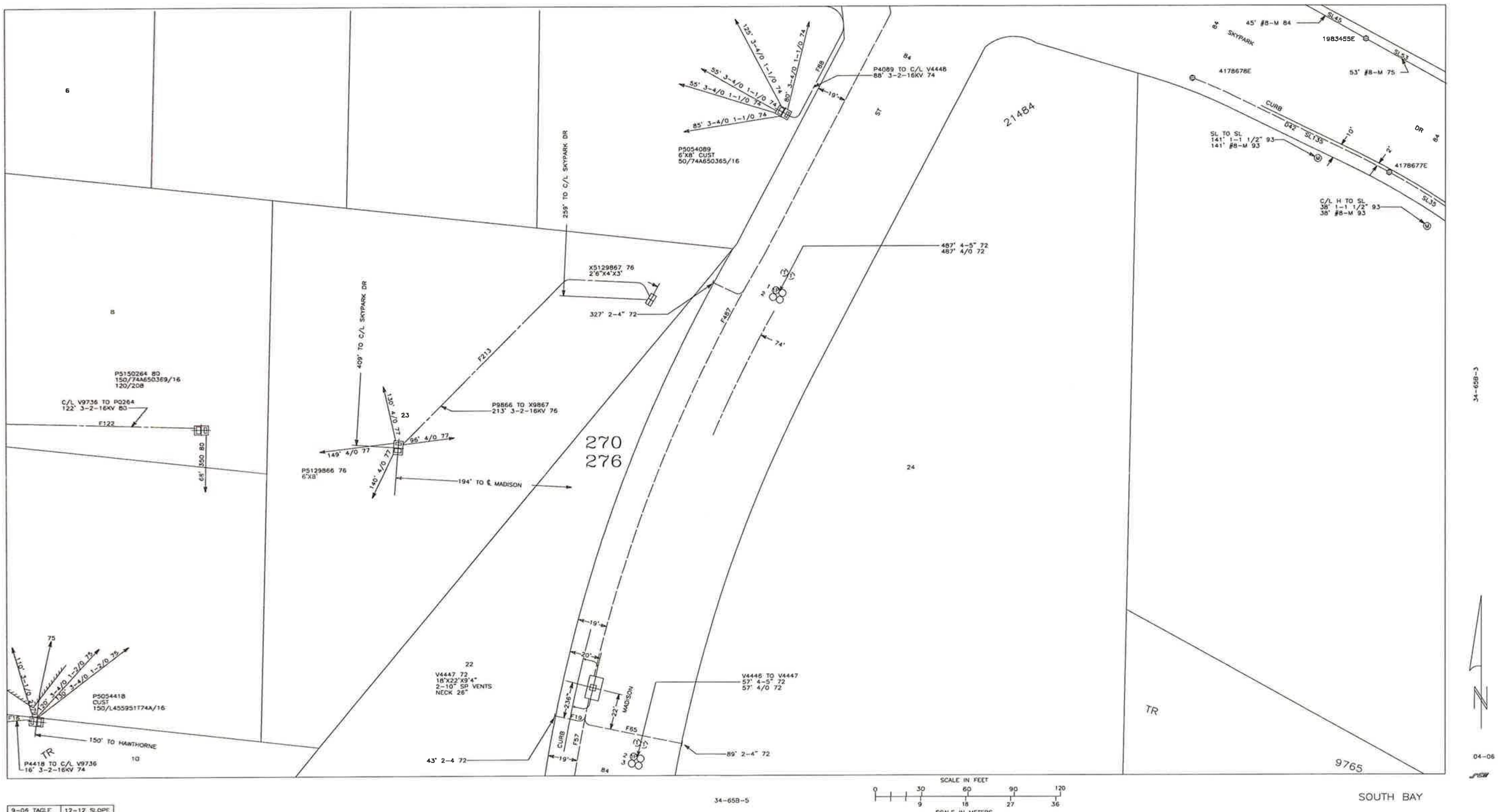
Enclosures

Bldg D
P.O. Box 11982
Santa Ana, Ca 92711-1982

35-65D-8

TORRANCE

LOS ANGELES CO. 34-65B-2



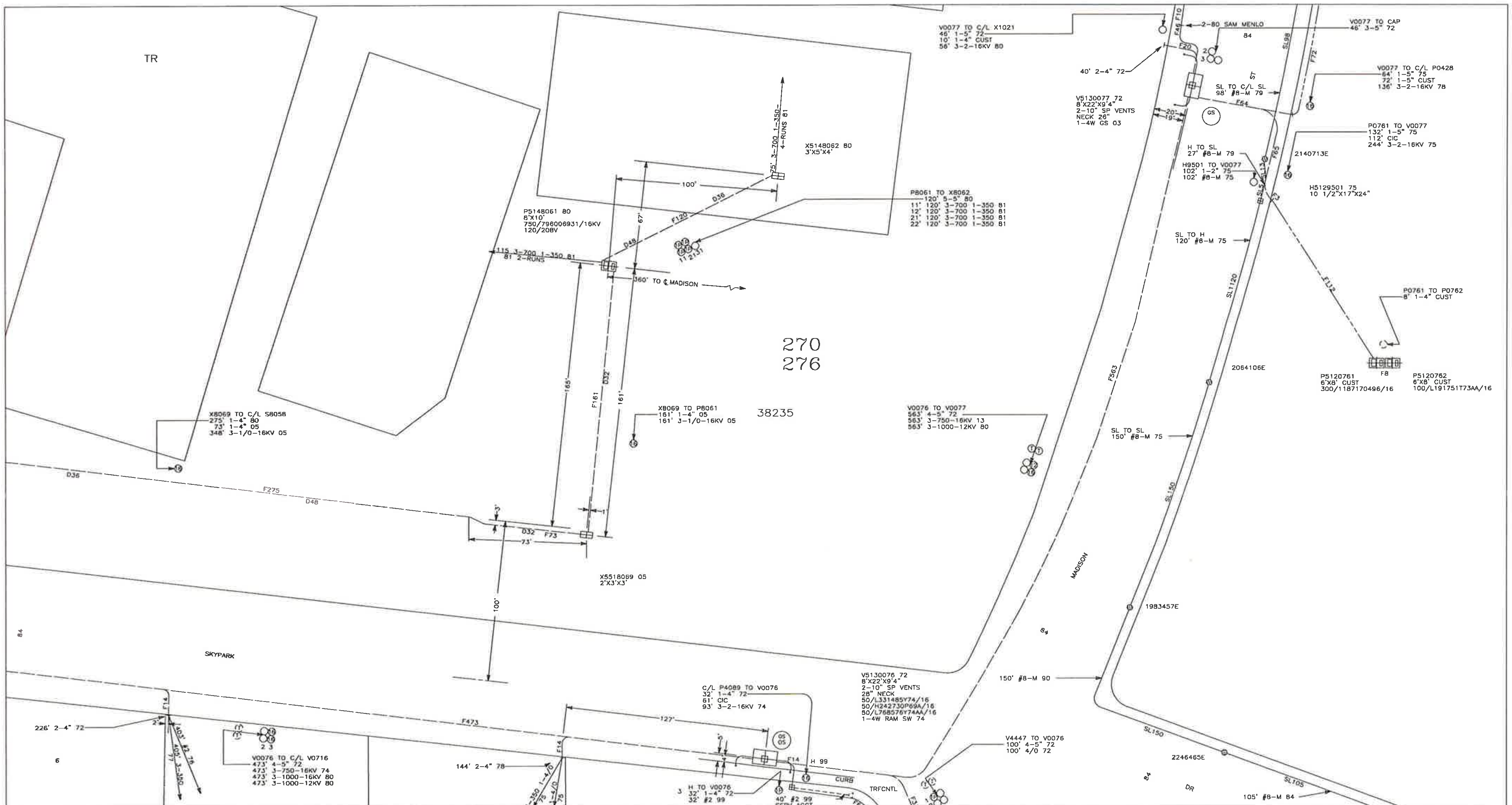
34-65B-5

SOUTH BAY

9-06 TAGLE	12-12 SLOPE
	6-06 D4006

35-65D-5 TORRANCE

LOS ANGELES CO. 35-65D-8



35-65D-7 35-65D-9

34-65B-2

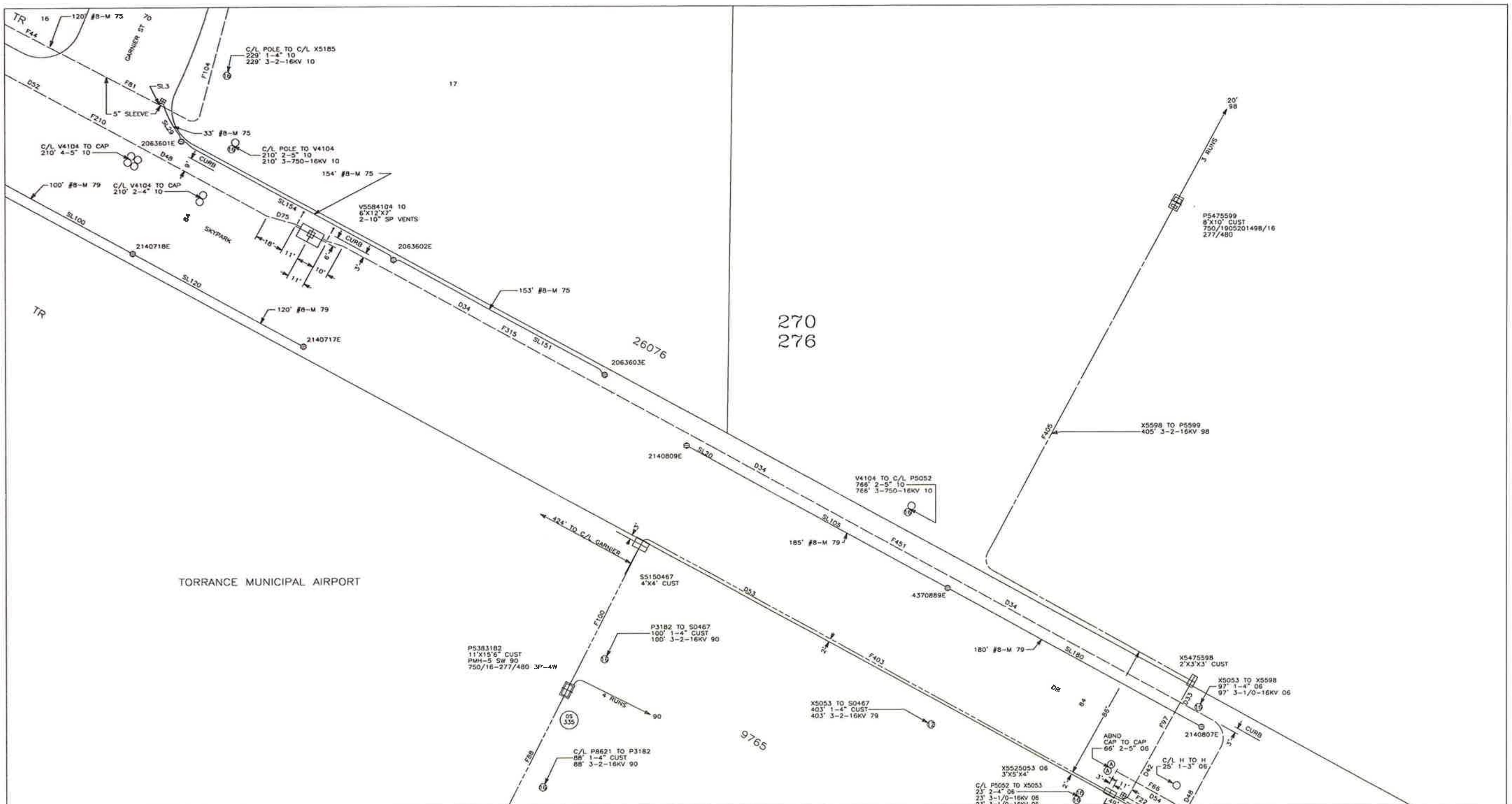
SCALE IN FEET
0 30 60 90 120
9 18 27 36
SCALE IN METERS

SOUTH BAY

04-06

8-05 AMEND	12-12 SLOPE
7-13 JJSTU	6-06 D4006

34-66C-5



34-66C-9

SCALE IN FEET 0 30 60 90 120
SCALE IN METERS 9 18 27 36

SOUTH BAY

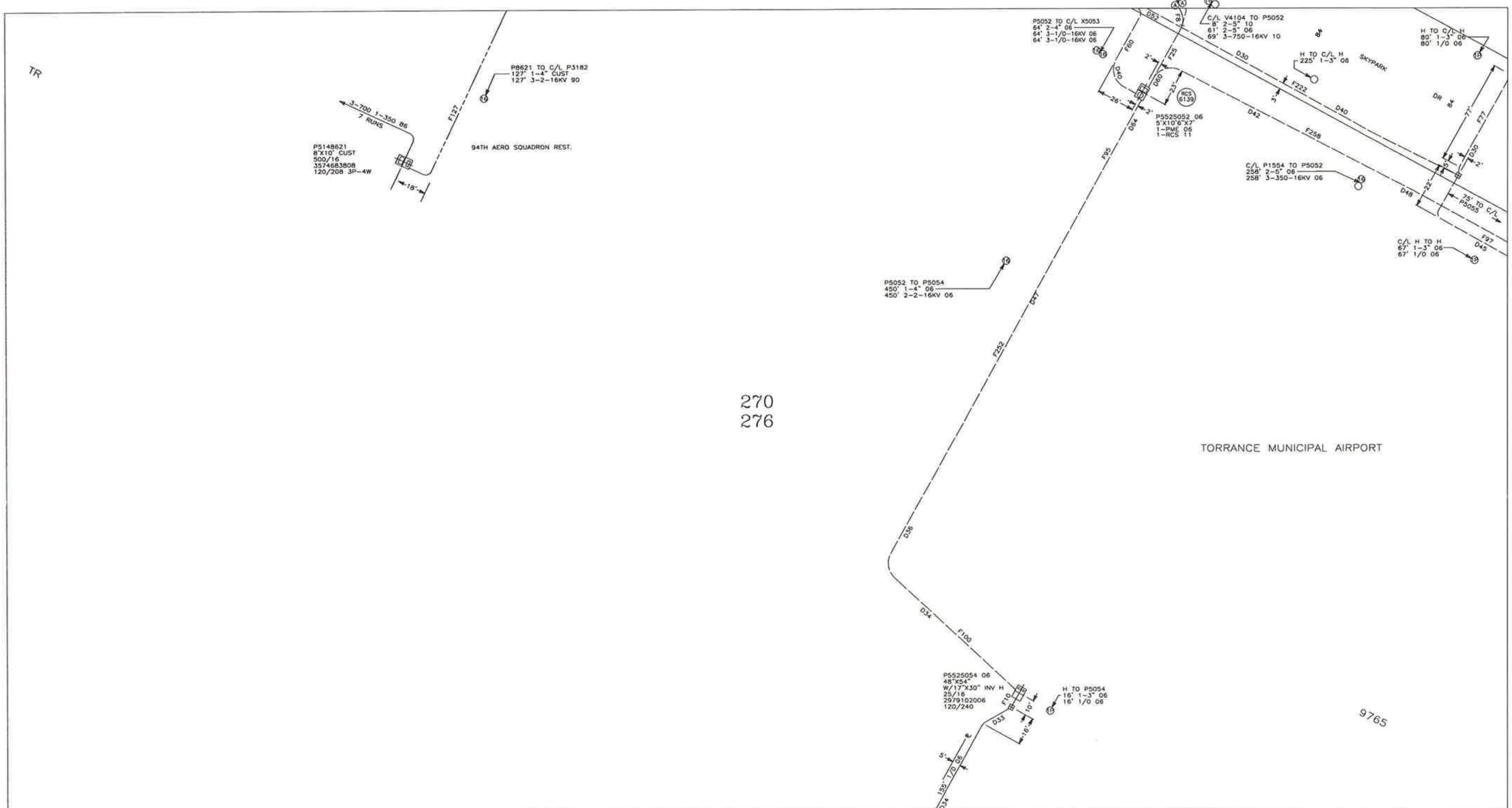
04-06

12-10 SLOPE	1-13 STEXA
3-10 KSARE	3-10 AMEND

LOS ANGELES CO. 34-66C-9

34-66C-6

TORRANCE



34-66D-7

8-05

33-66A-3

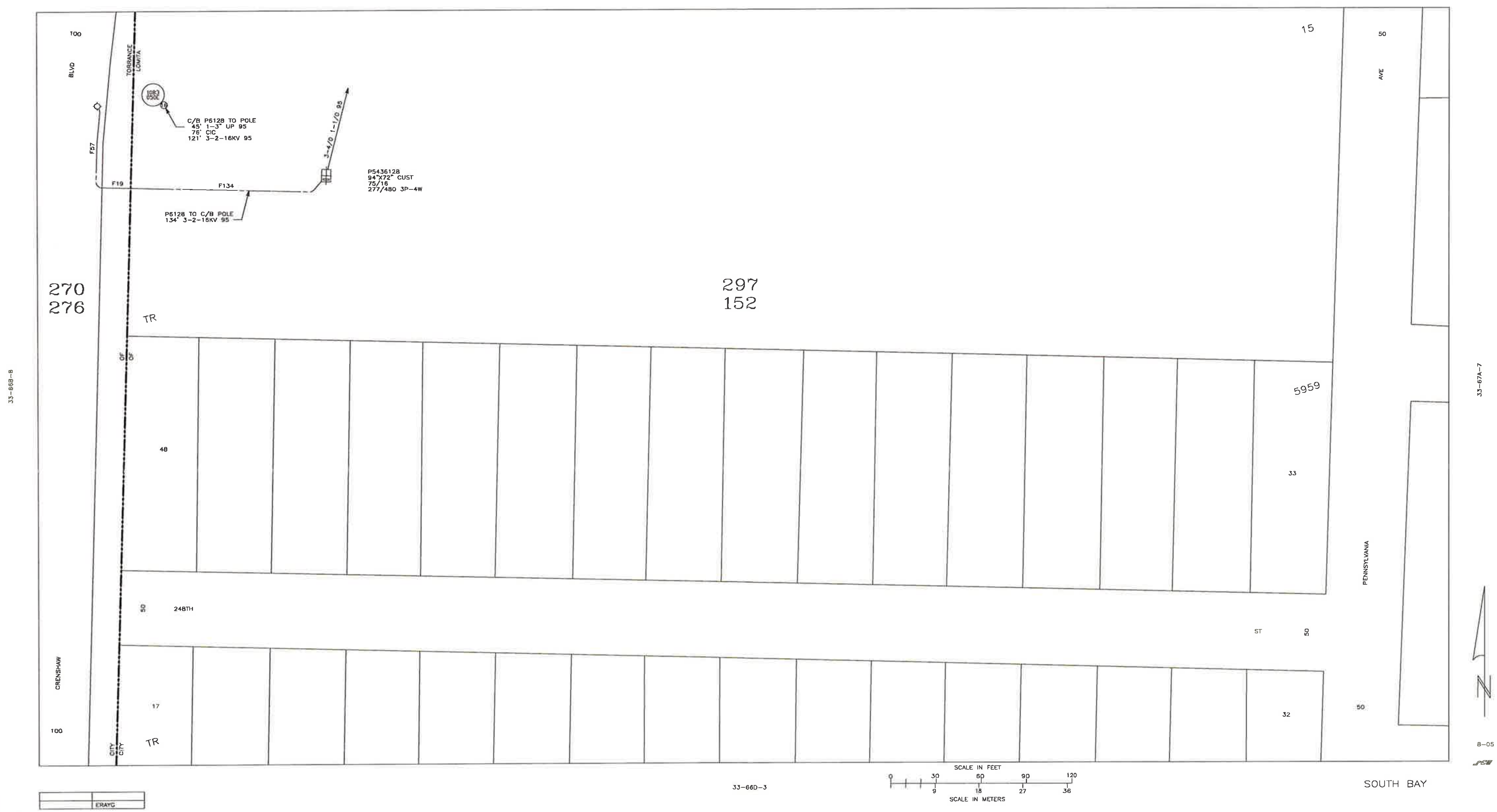
SCALE IN FEET
0 30 60 90 120
9 18 27 36
SCALE IN METERS

SOUTH BAY

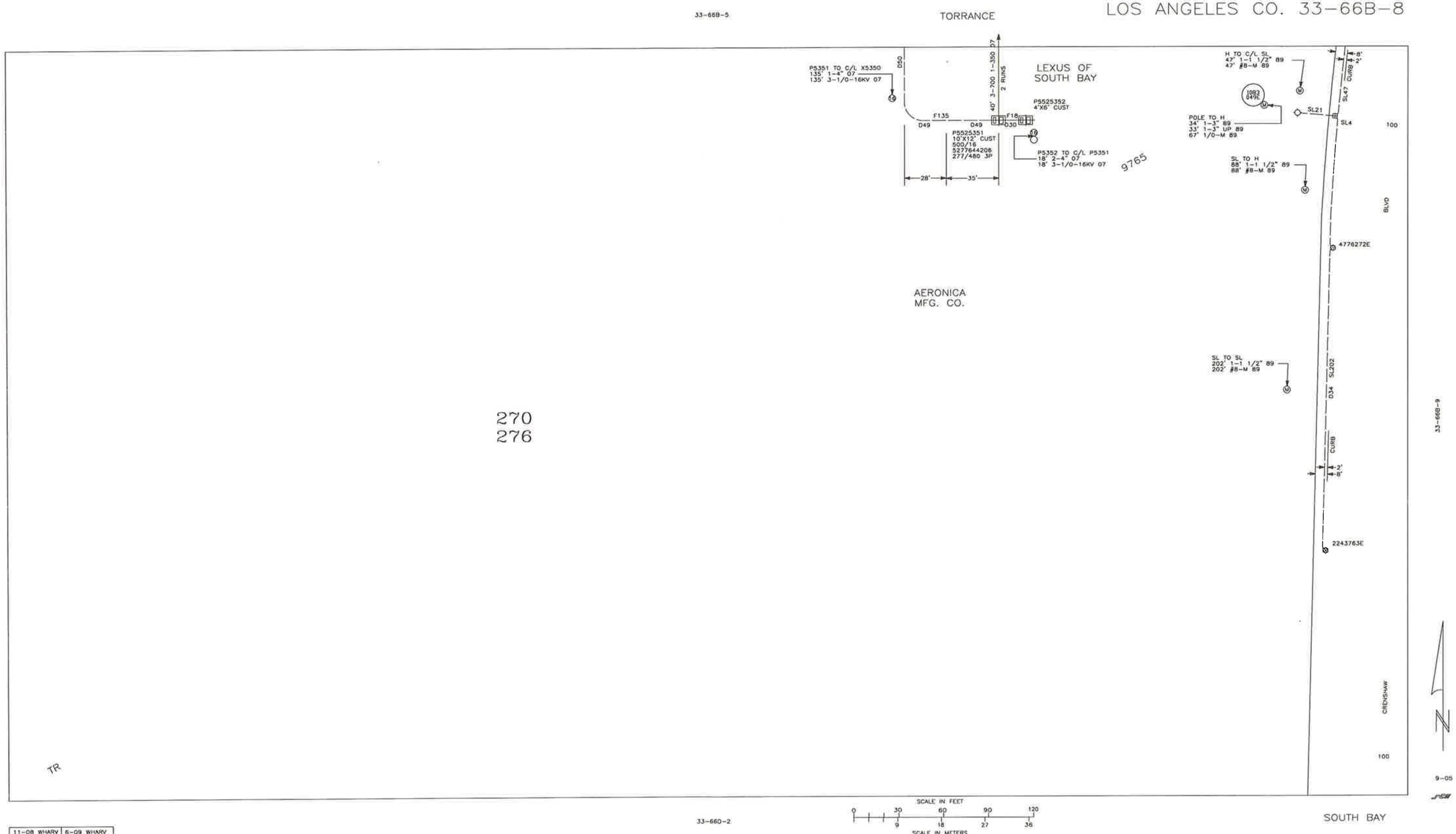
9-11 TAQLE	1-13 STEXA
5-09 MSTOC	12-10 SLOPE

33-66B-6 LOMITA TORRANCE

LOS ANGELES CO. 33-66B-9



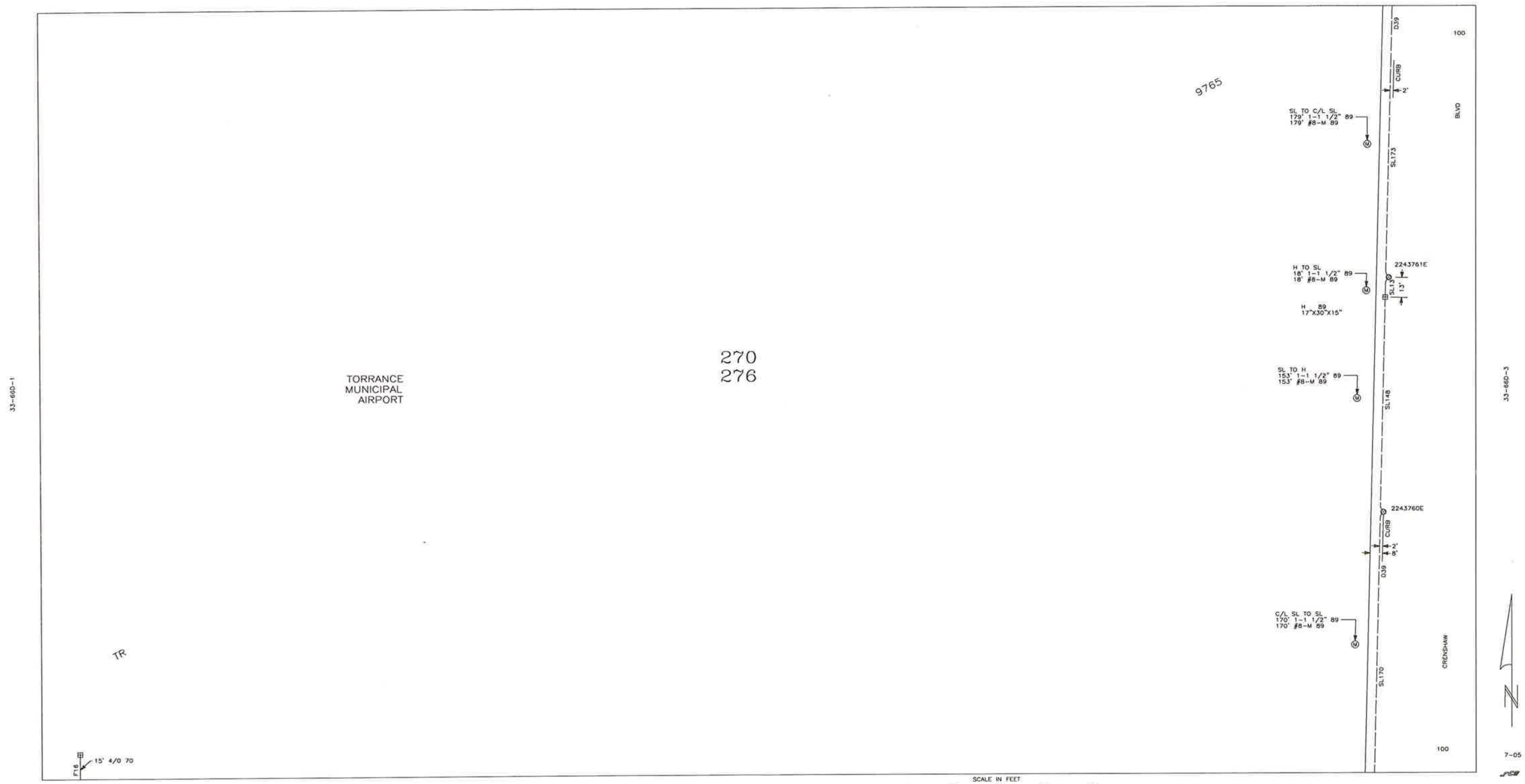
LOS ANGELES CO. 33-66B-8



11-08 WHARV	6-09 WHARV
8-10 CPDBL	6-13 MWILL

33-66B-8 TORRANCE

LOS ANGELES CO. 33-66D-2



33-66D-5

SCALE IN FEET 0 30 60 90 120
SCALE IN METERS 9 18 27 36

SOUTH BAY

12-12 CPOBL	
	SCEJD

LOS ANGELES CO. 33-66D-3

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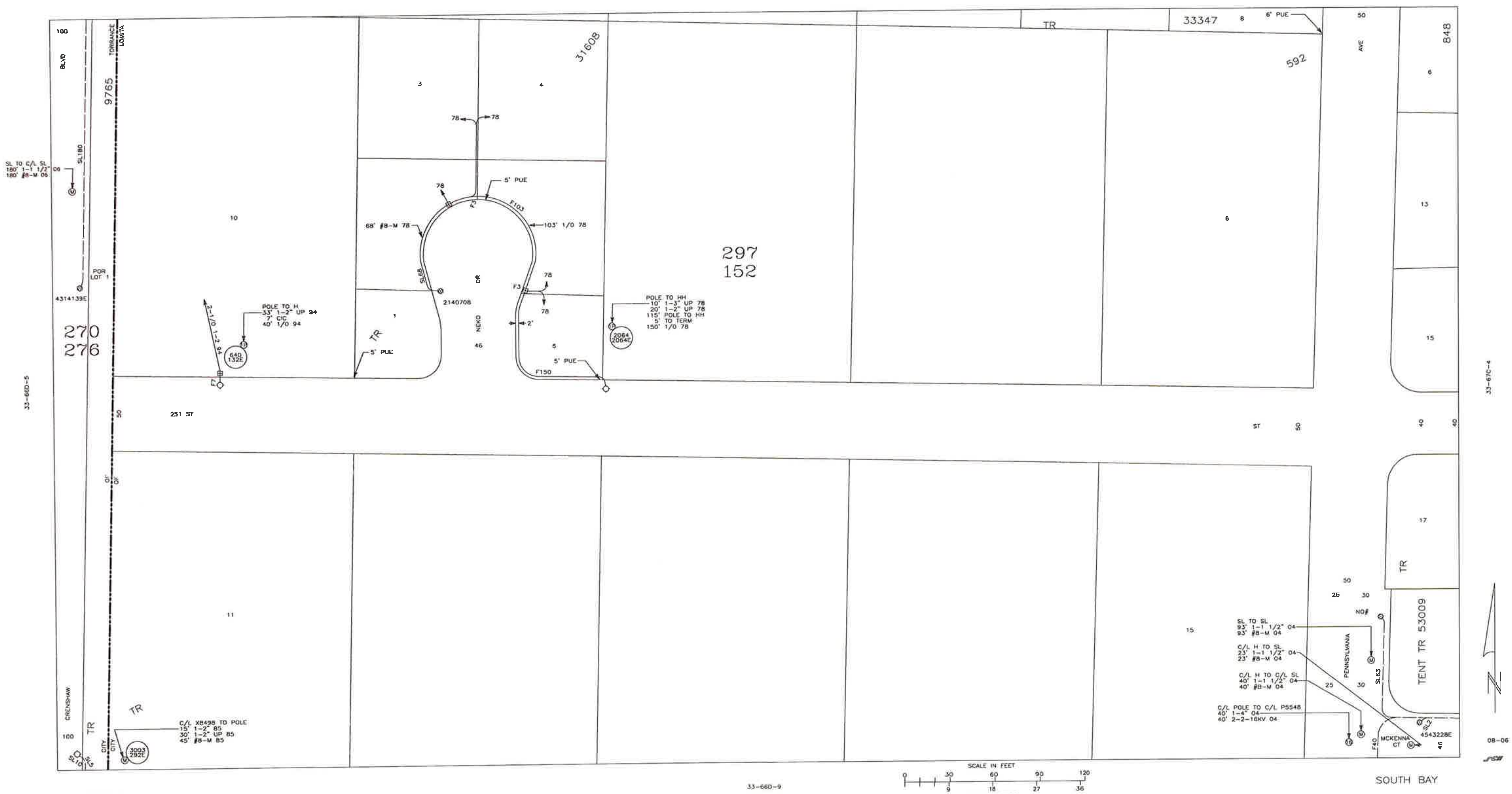
FOR REFERENCE ONLY This map has been created to SCE standards to be used by SCE personnel only and is not intended to be a legal representation of real property. Please don't forget to call Dig Alert: 1-800-227-2600

33-66D-3 LOMITA TORRANCE

LOS ANGELES CO. 33-66D-6



10-08 STEXA	7-07 CPOBL
5-11 STEXA	D4688

33-66D-2 TORRANCE LOS ANGELES CO. 33-66D-5

33-66D-4

33-66D-6

7-05

5-11 STEXA	
	SCEJO

33-66D-8 SOUTH BAY

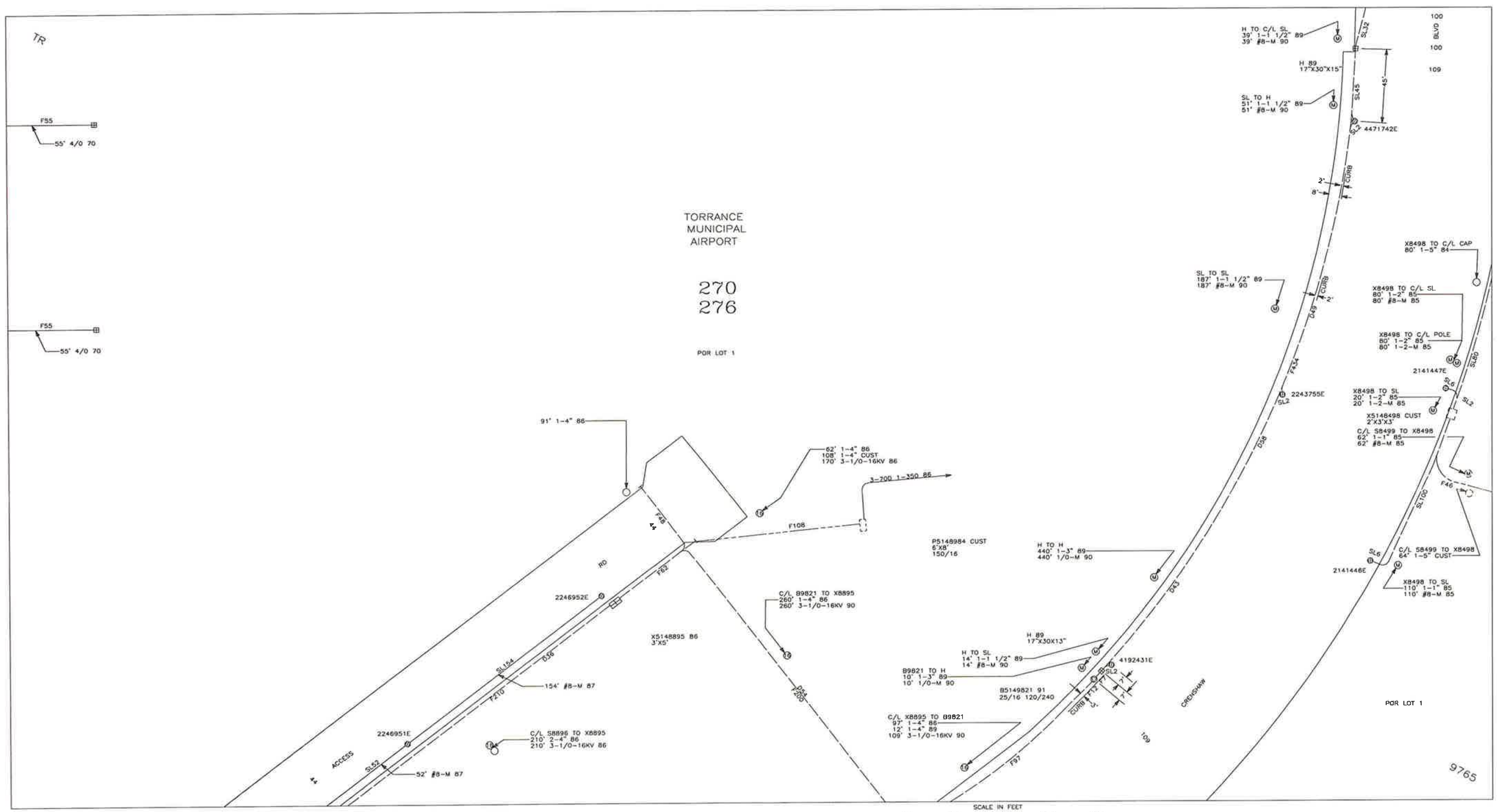
LOS ANGELES CO. 33-66D-8

33-66D-5

TORRANCE

33-66D-7

33-66D-9



32-66B-2

SCALE IN FEET
0 30 60 90 120
9 18 27 36
SCALE IN METERS

SOUTH BAY

08-06

10-06 STEXA	5-11 STEXA
	04089

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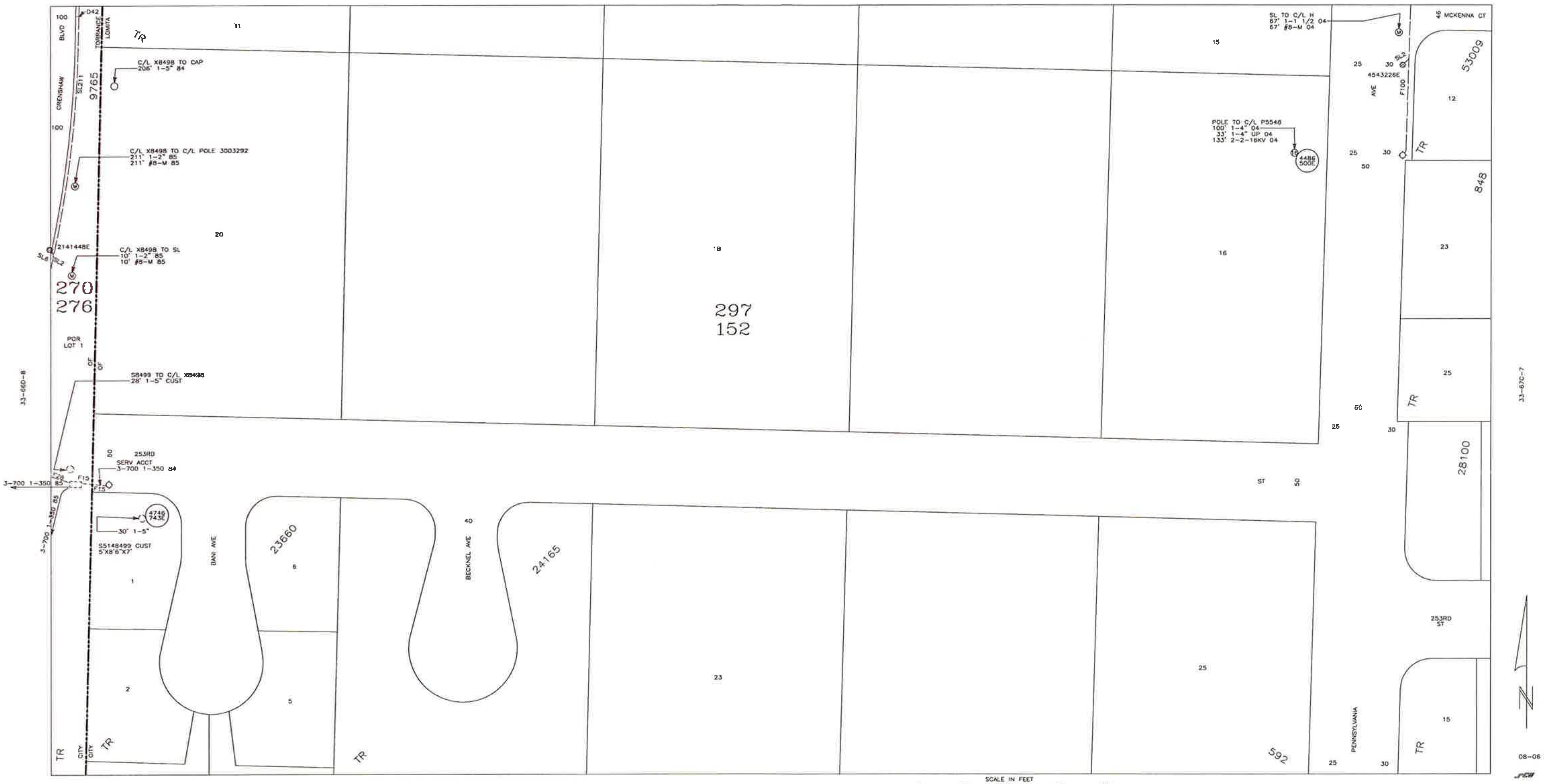

10-06 STEXA	3-08 GMEDI
5-11 STEXA	D4685

08-06

CONFIDENTIAL: CRITICAL ENERGY INFRASTRUCTURE
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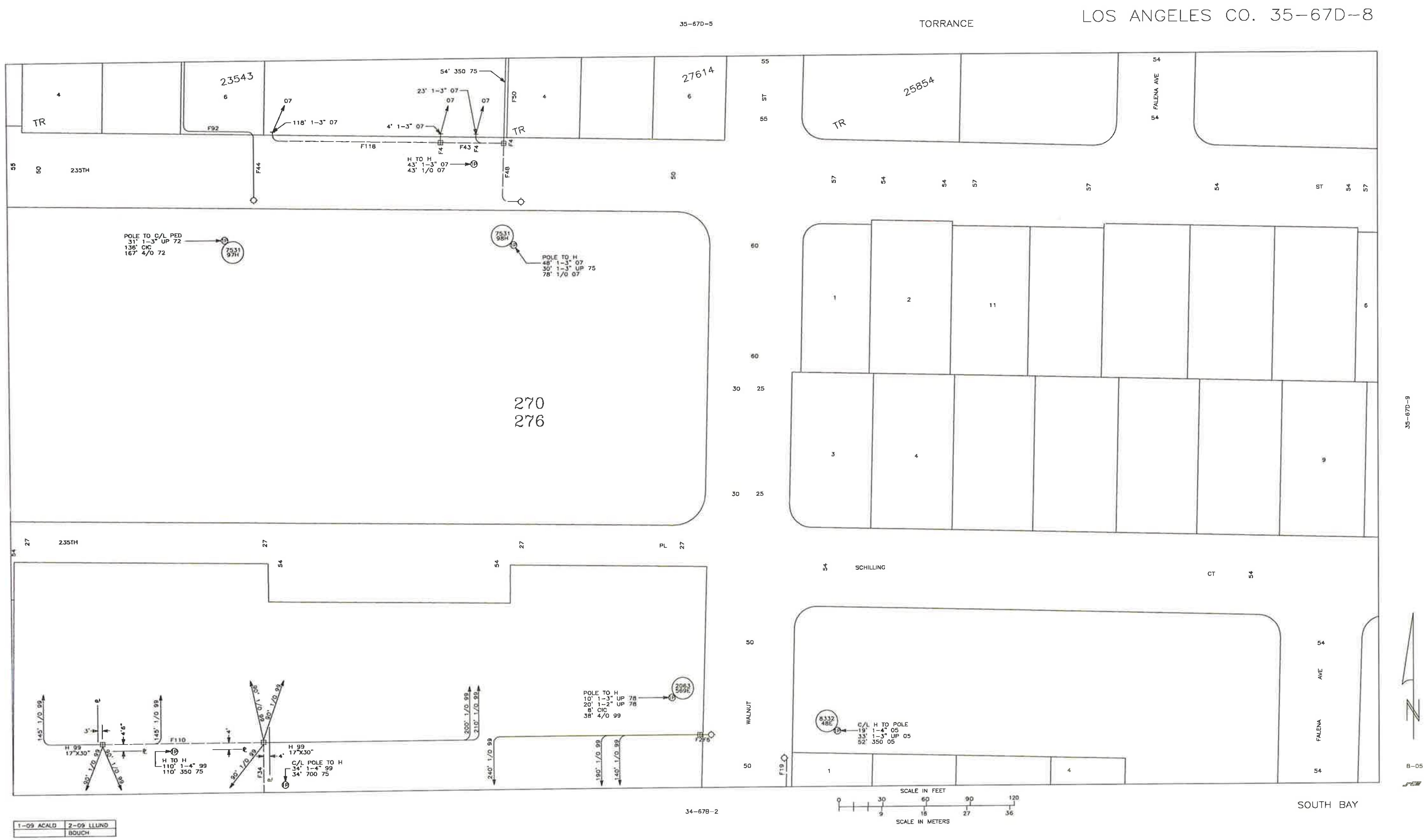
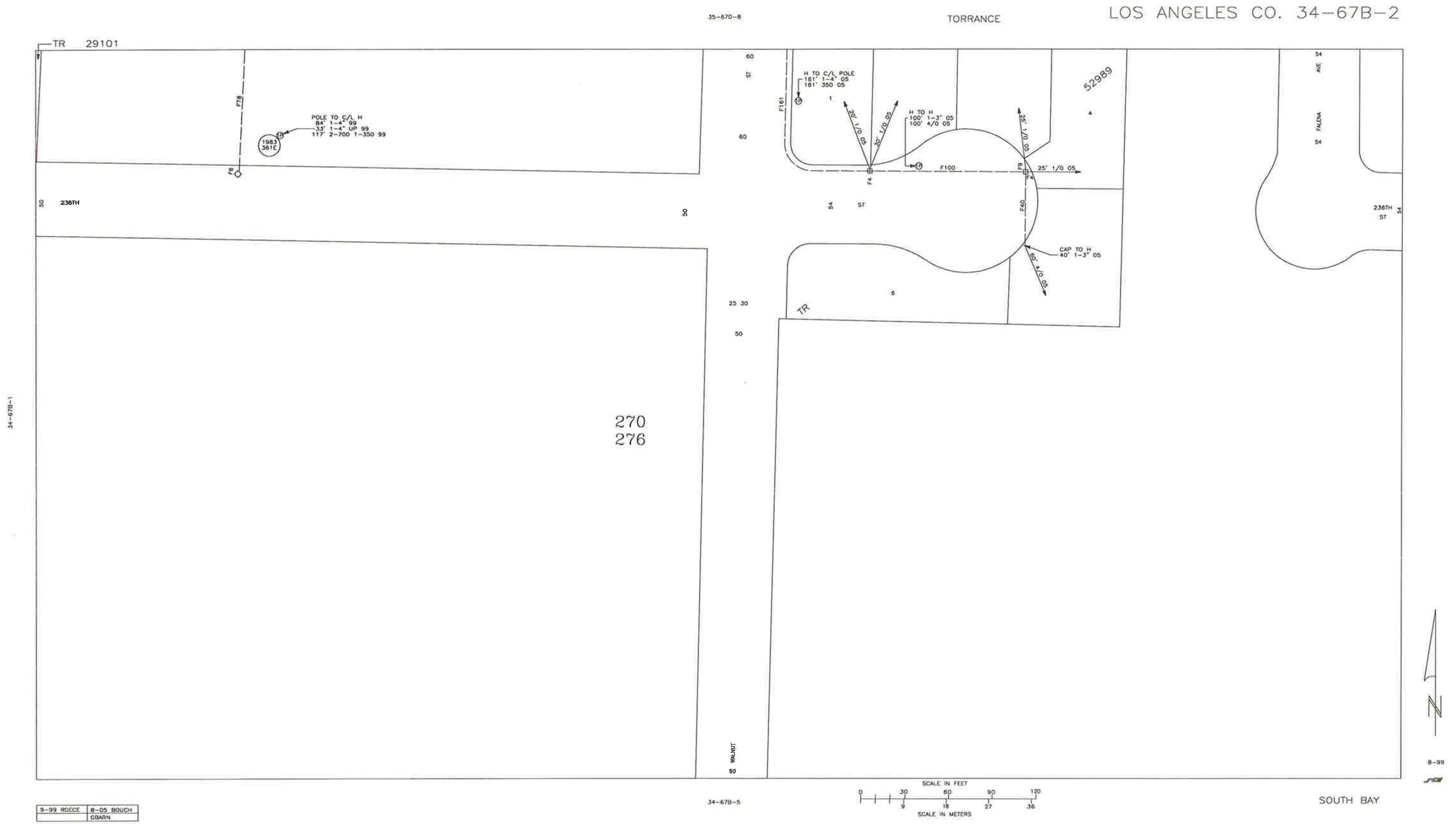
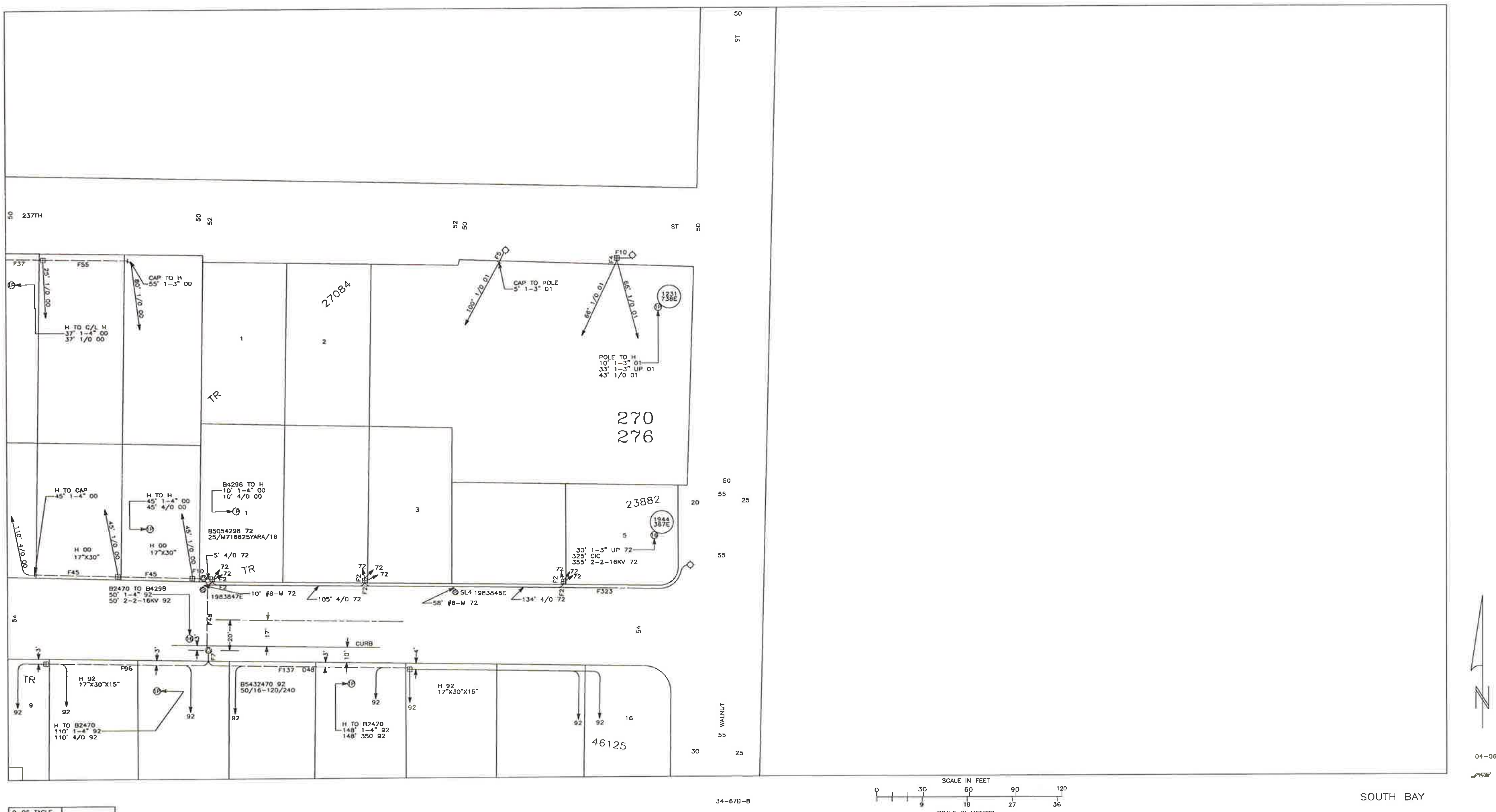


1-09 ACALO	2-09 LLUND
	BOUCH


LOS ANGELES CO. 34-67B-2
TORRANCE
35-67D-8
TR 29101
POLE TO C/L H
84' 1-4" 99
33' 1-4" UP 99
117' 2-700 1-350 99
1983
361E
236TH
H TO C/L POLE
161' 1-4" 05
161' 350 05
H TO H
100' 1-3" 05
100' 4/0 05
F100
25' 1/0 05
52989
CAP TO H
40' 1-3" 05
236TH ST
FALENA AVE
TR
270
276
WALNUT
34-67B-1
34-67B-5
SCALE IN FEET
SCALE IN METERS
SOUTH BAY
9-99 RDECE
8-05 BOUCH
CBARN

34-67B-2 TORRANCE LOS ANGELES CO. 34-67B-5



34-67B-4

34-67B-8

04-06

SOUTH BAY

9-06 TAGLE	
	6-06 04007

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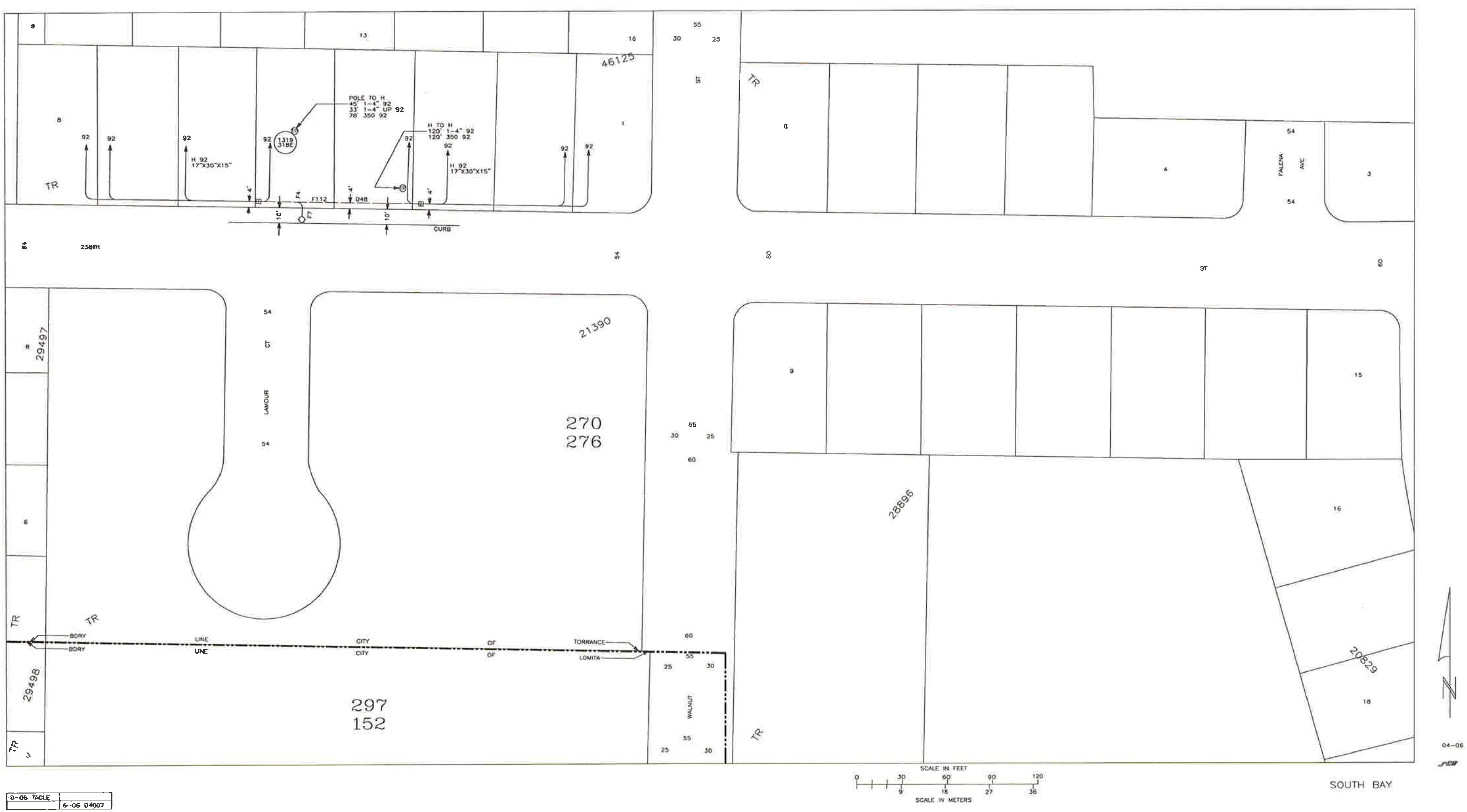
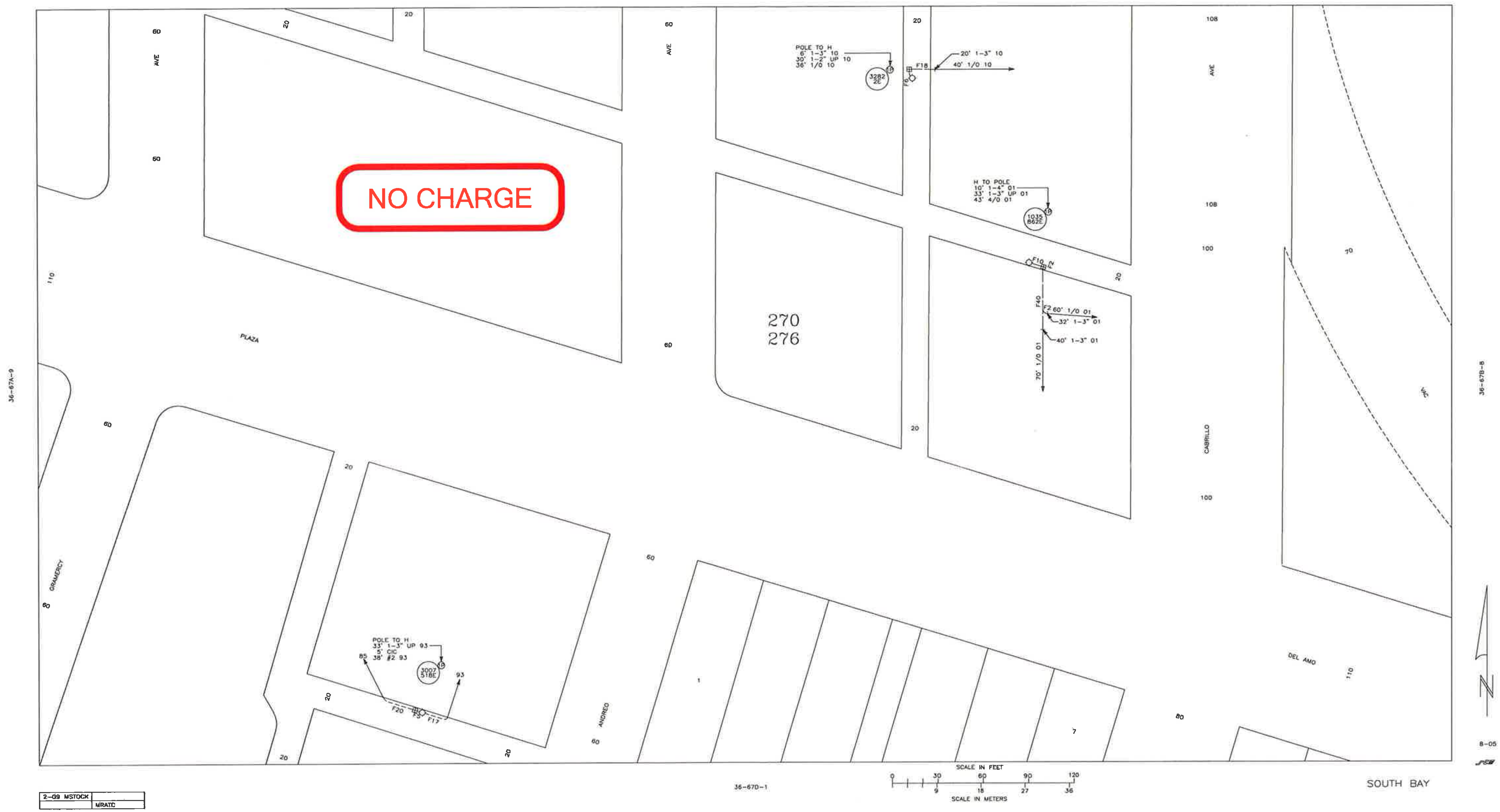
34-67B-5 LOMITA TORRENCE

LOS ANGELES CO. 34-67B-8



36-67B-4 TORRANCE

LOS ANGELES CO. 36-67B-7

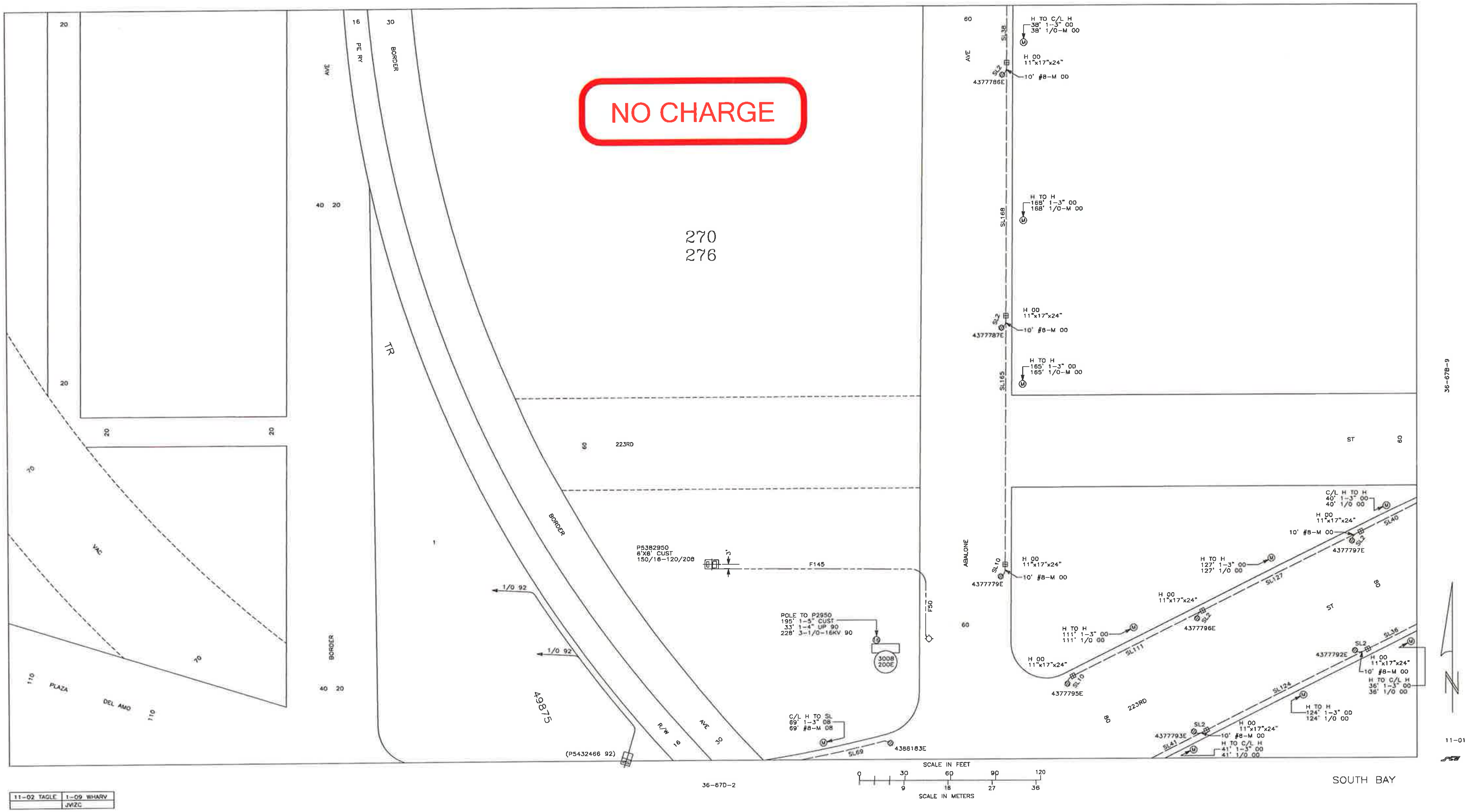


SOUTH BAY

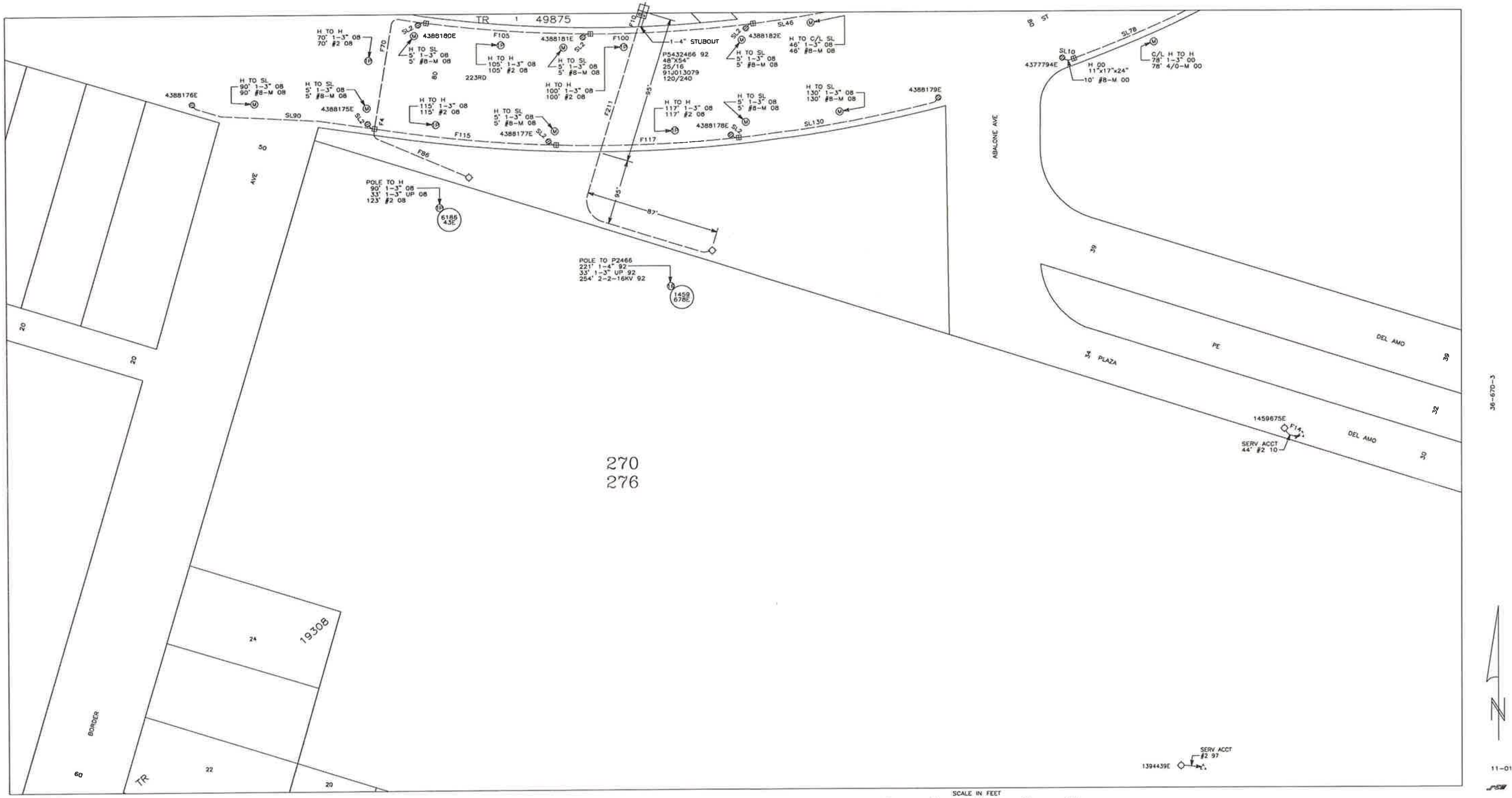
2-09 MSTOCK
MRATC

LOS ANGELES CO. 36-67B-8

TORRANCE



36-67B-8 TORRANCE LOS ANGELES CO. 36-67D-2



SOUTH BAY

4-12 CMORI	1-04
1-09 WHARV	2-09 MSTOCK

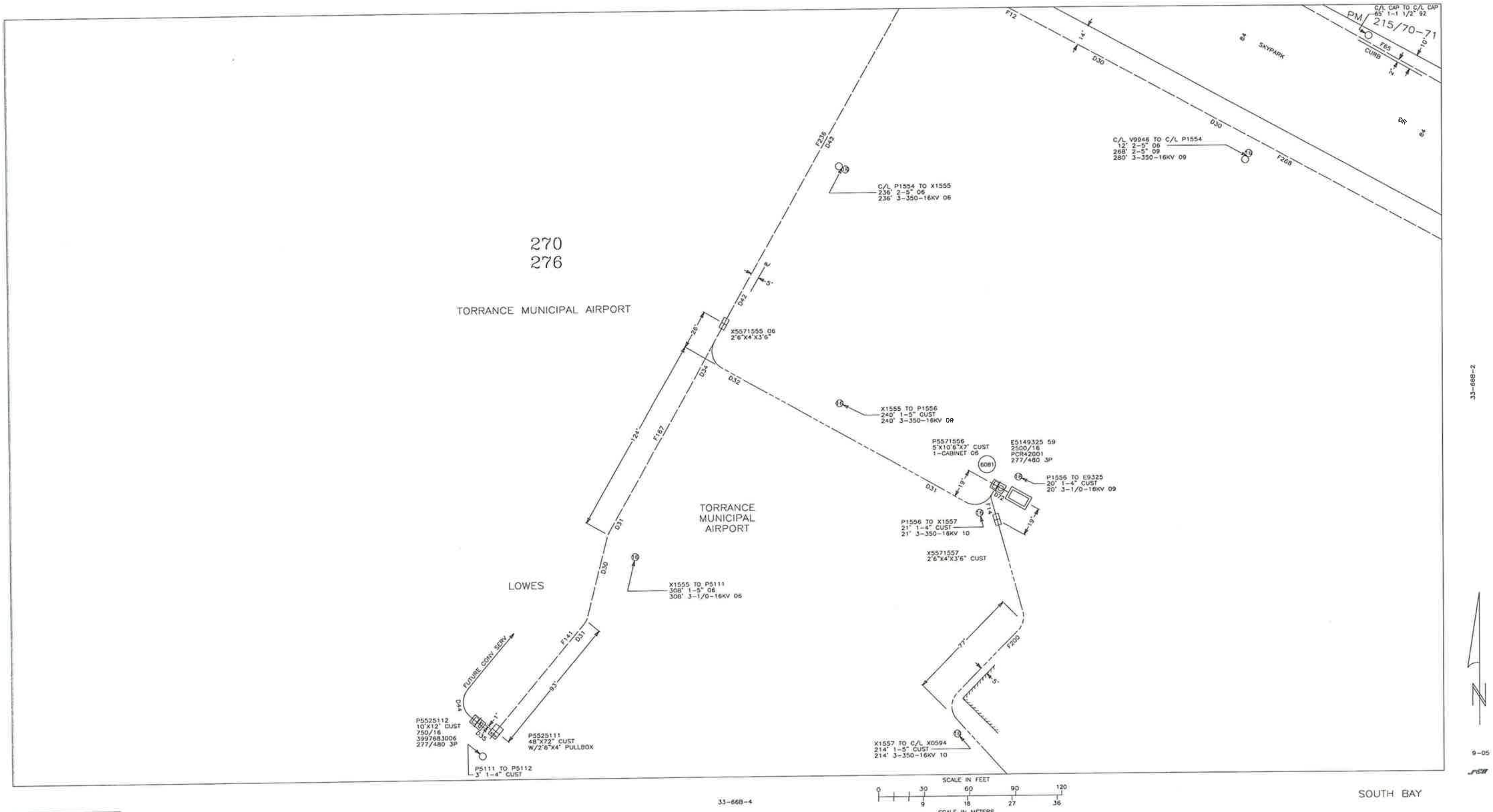
34-66D-7

TORRANCE

LOS ANGELES CO. 33-66B-1

33-66A-3

33-66B-2

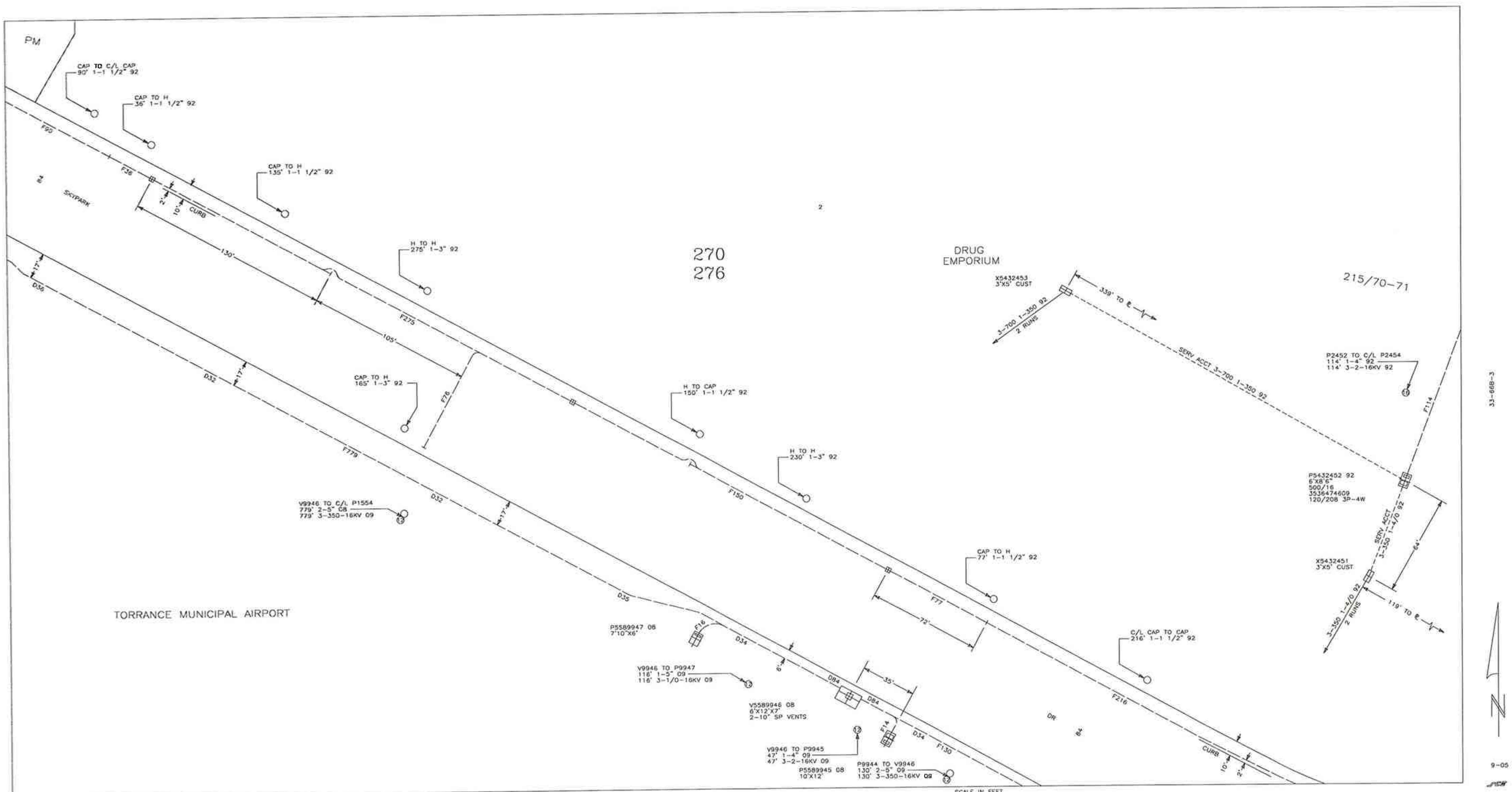


33-66B-4

SOUTH BAY

1-07 FVENE	3-10 AMEND
7-10 MROSE	1-13 STEXA

34-66D-8 TORRANCE LOS ANGELES CO. 33-66B-2

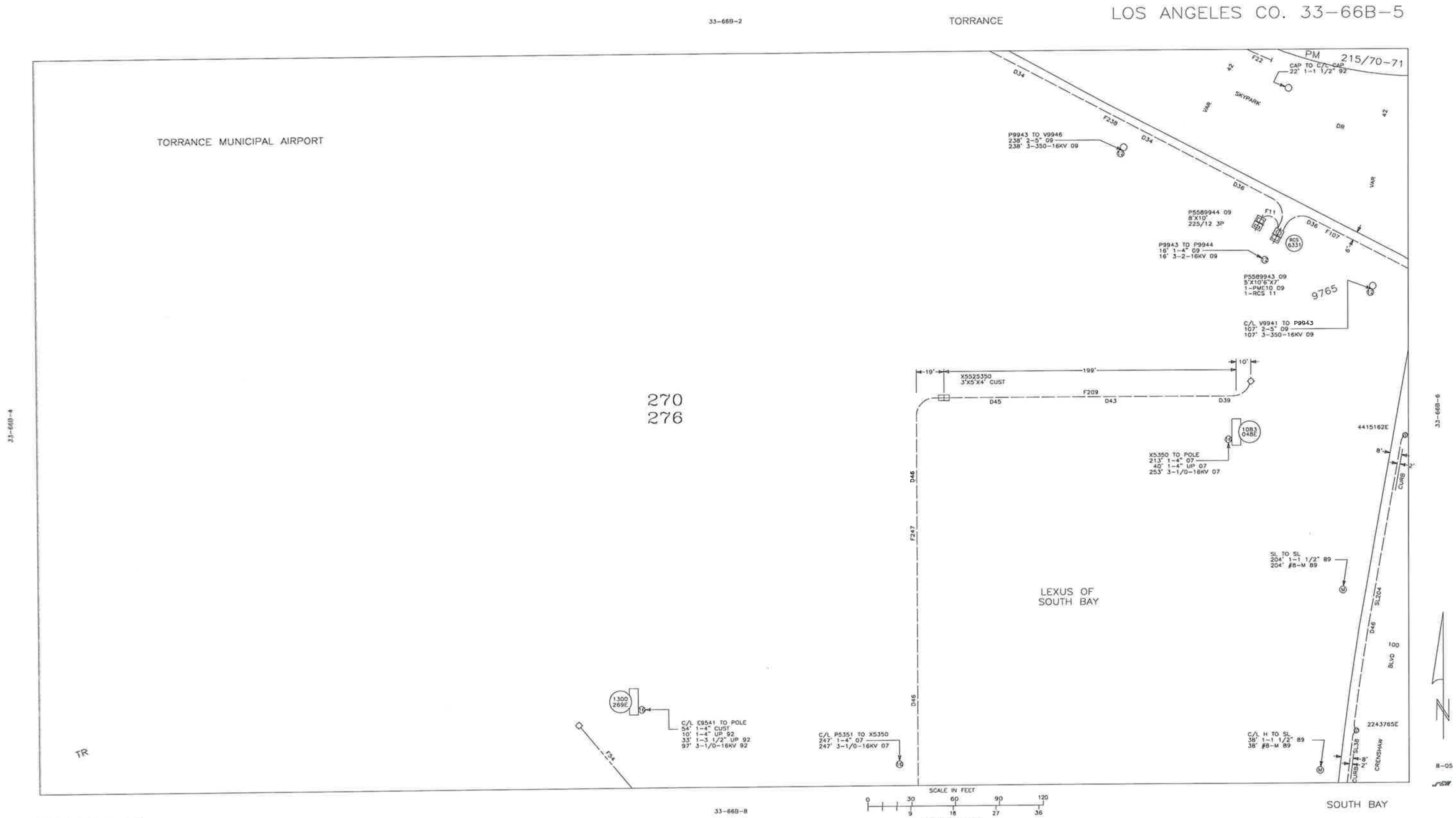


33-66B-5

SCALE IN FEET 0 30 60 90 120
SCALE IN METERS 9 18 27 36

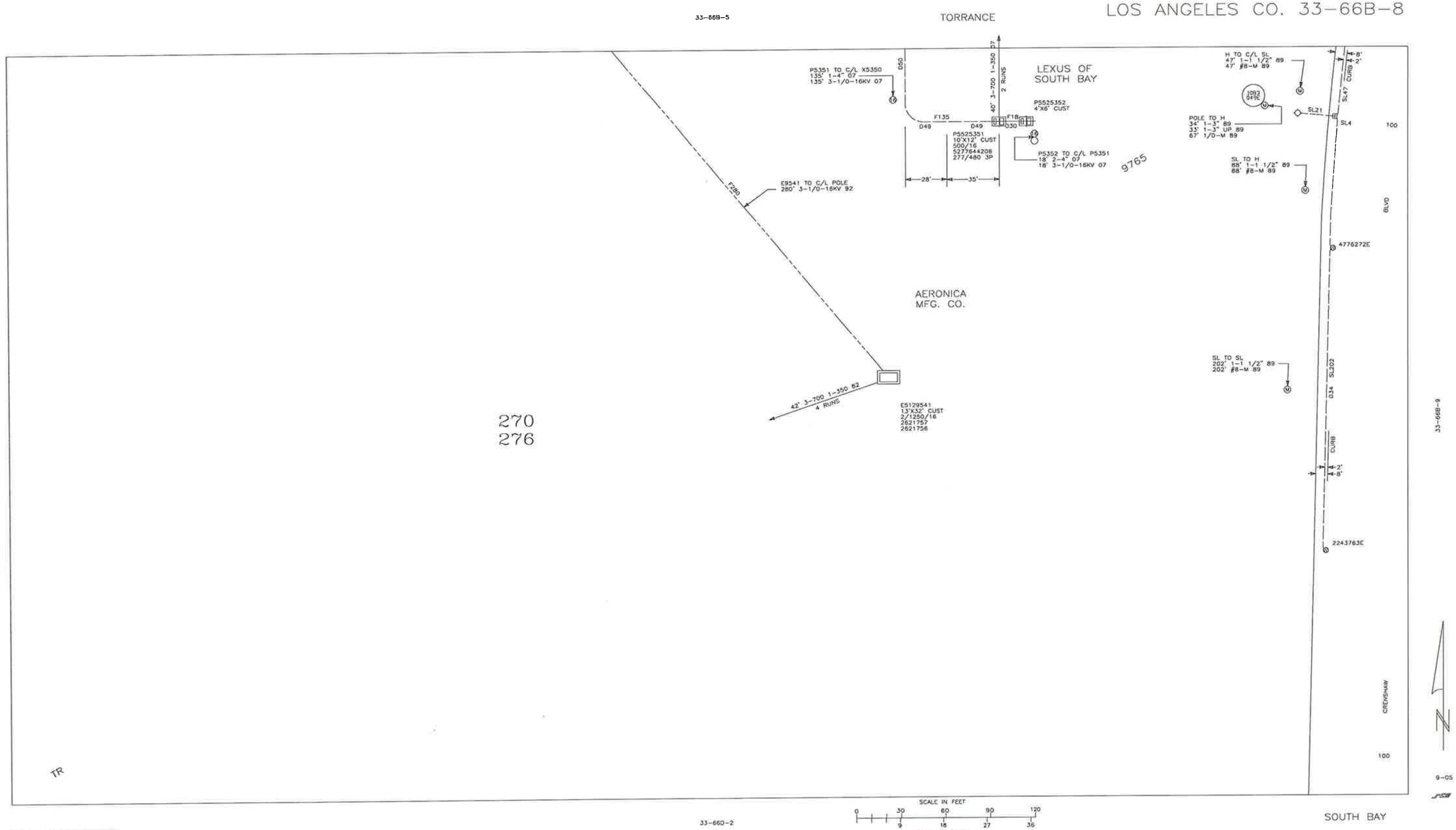
SOUTH BAY

1-07 FVENE	3-10 AMEND
11-11 SSARE	1-13 STEKA



8-10 CPOBL	1-13 STEXA
11-08 WHARV	3-10 AMEND

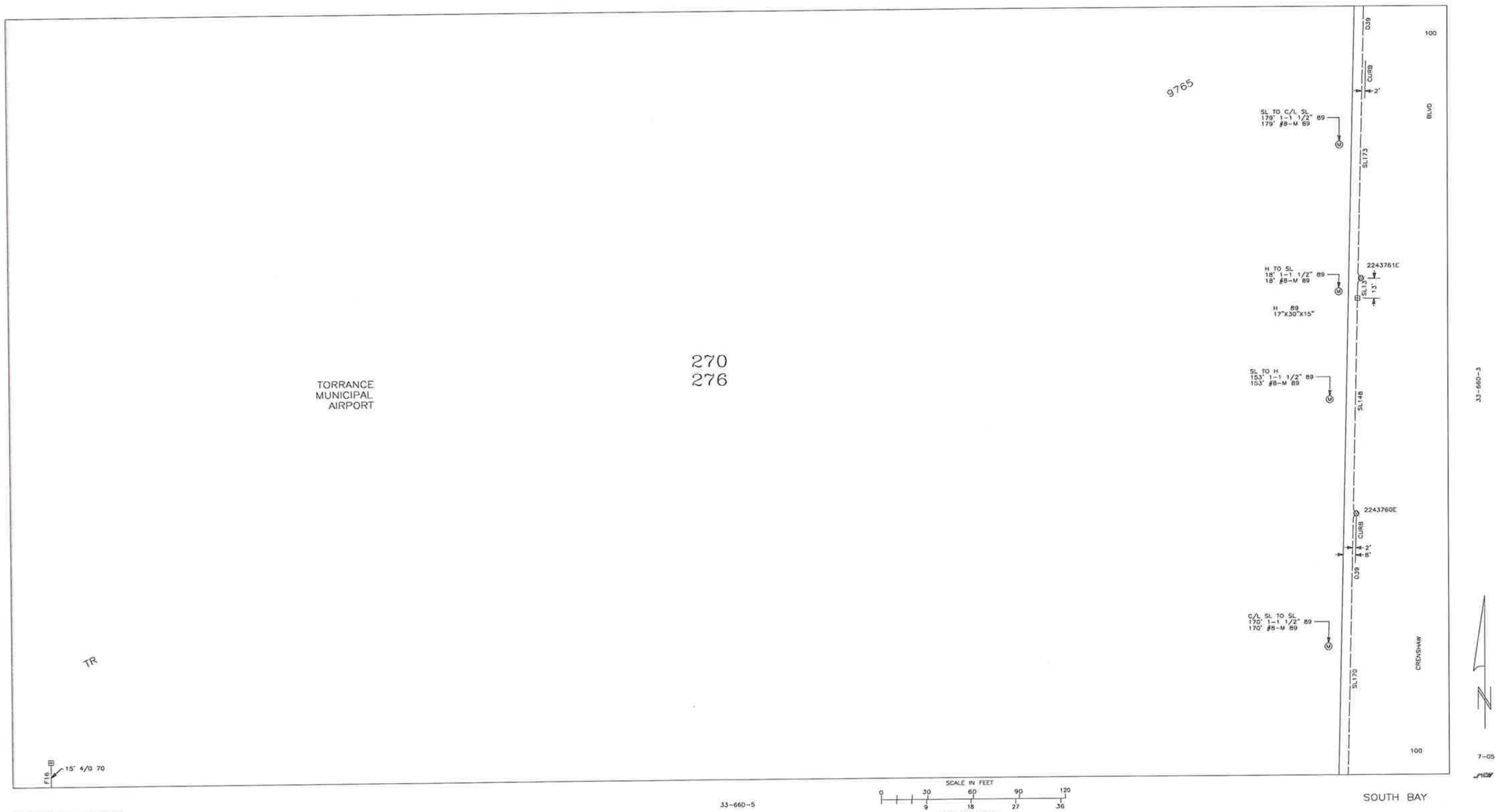
LOS ANGELES CO. 33-66B-8



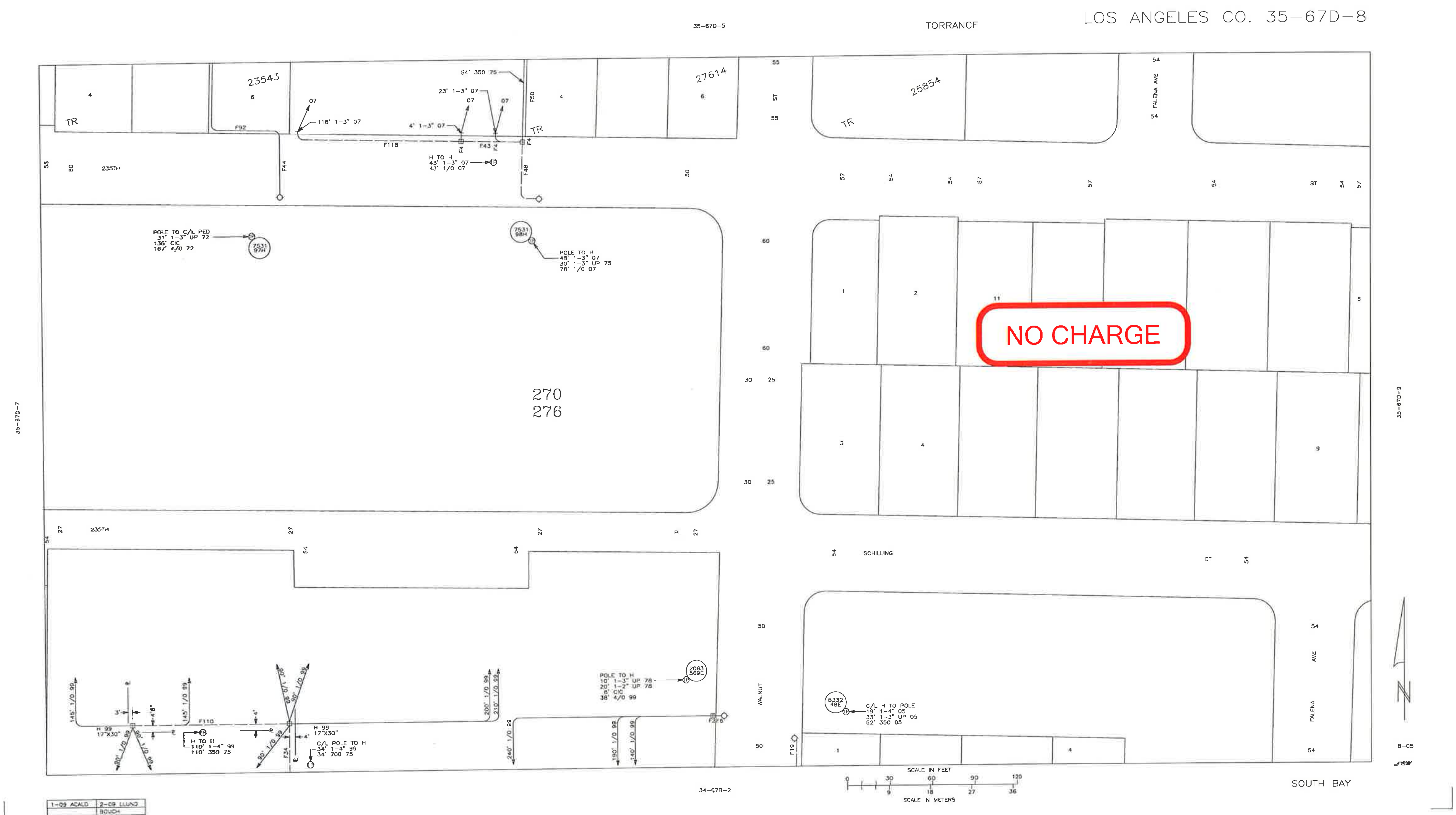
11-08 WHARV	6-09 WHARV
8-10 CPOBL	ERAYG

LOS ANGELES CO. 33-66D-2

33-66D-6 TORRANCE

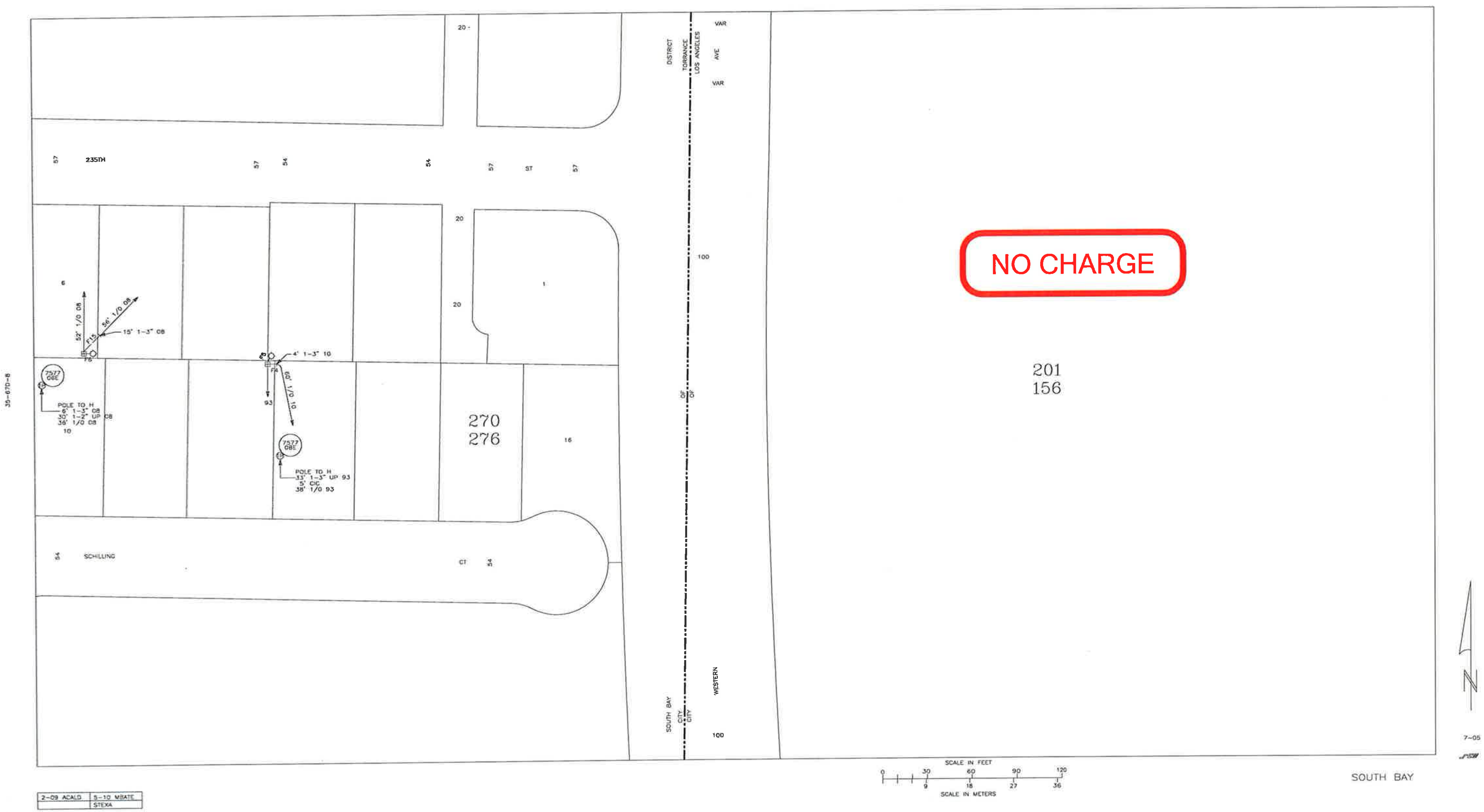


12-12 CPO8L
SCEJO

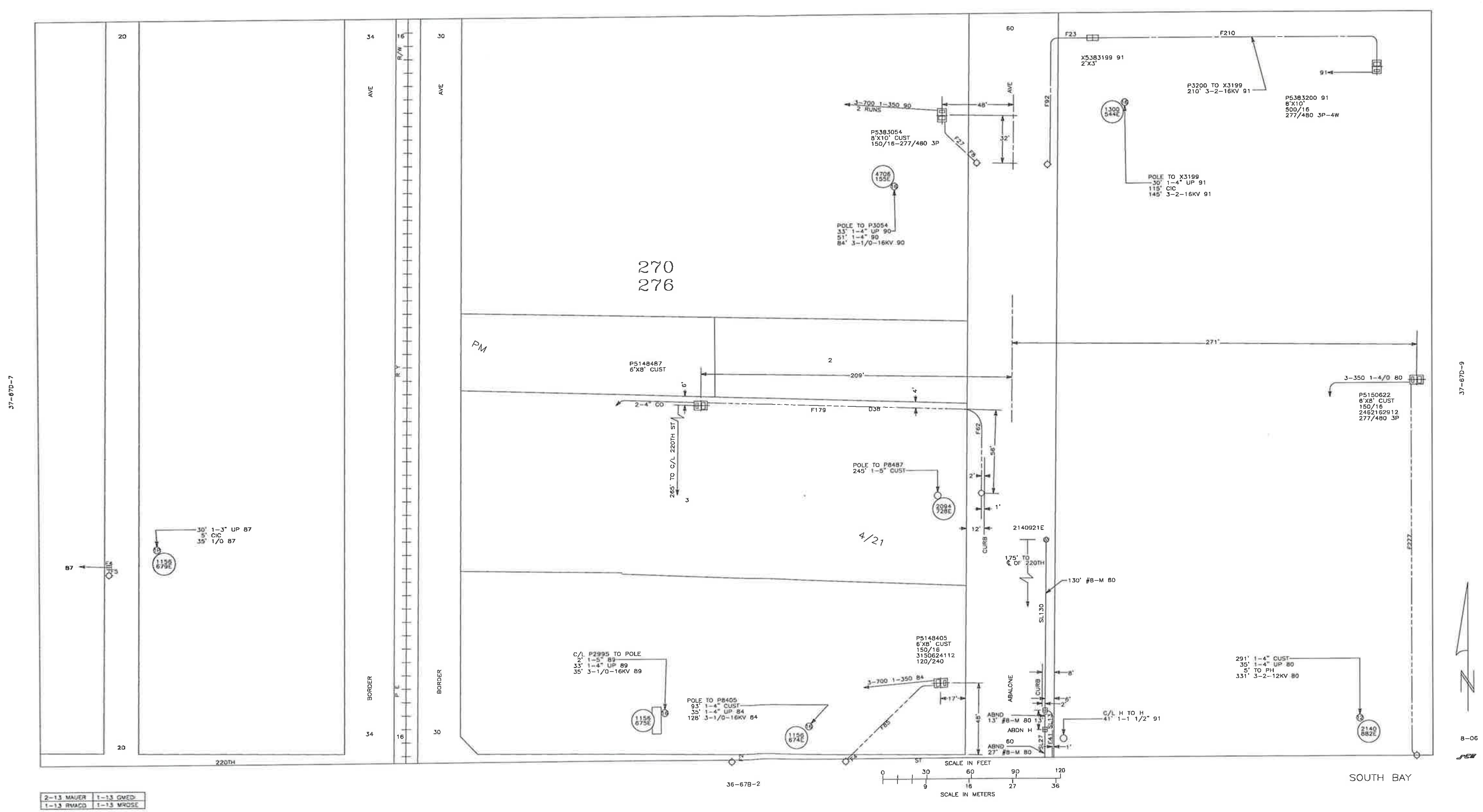

LOS ANGELES CO. 35-67D-8
TORRANCE
35-67D-5
23543
27614
25854
TR
235TH
ST
FALENA AVE
270
276
NO CHARGE
235TH PL
SCHILLING CT
WALNUT
FALENA AVE
SCALE IN FEET
SCALE IN METERS
34-67B-2
SOUTH BAY
35-67D-7
35-67D-9
8-05
1-09 ACALD
2-09 LLUND
BOUCH

35-67D-6 TORRANCE LOS ANGELES

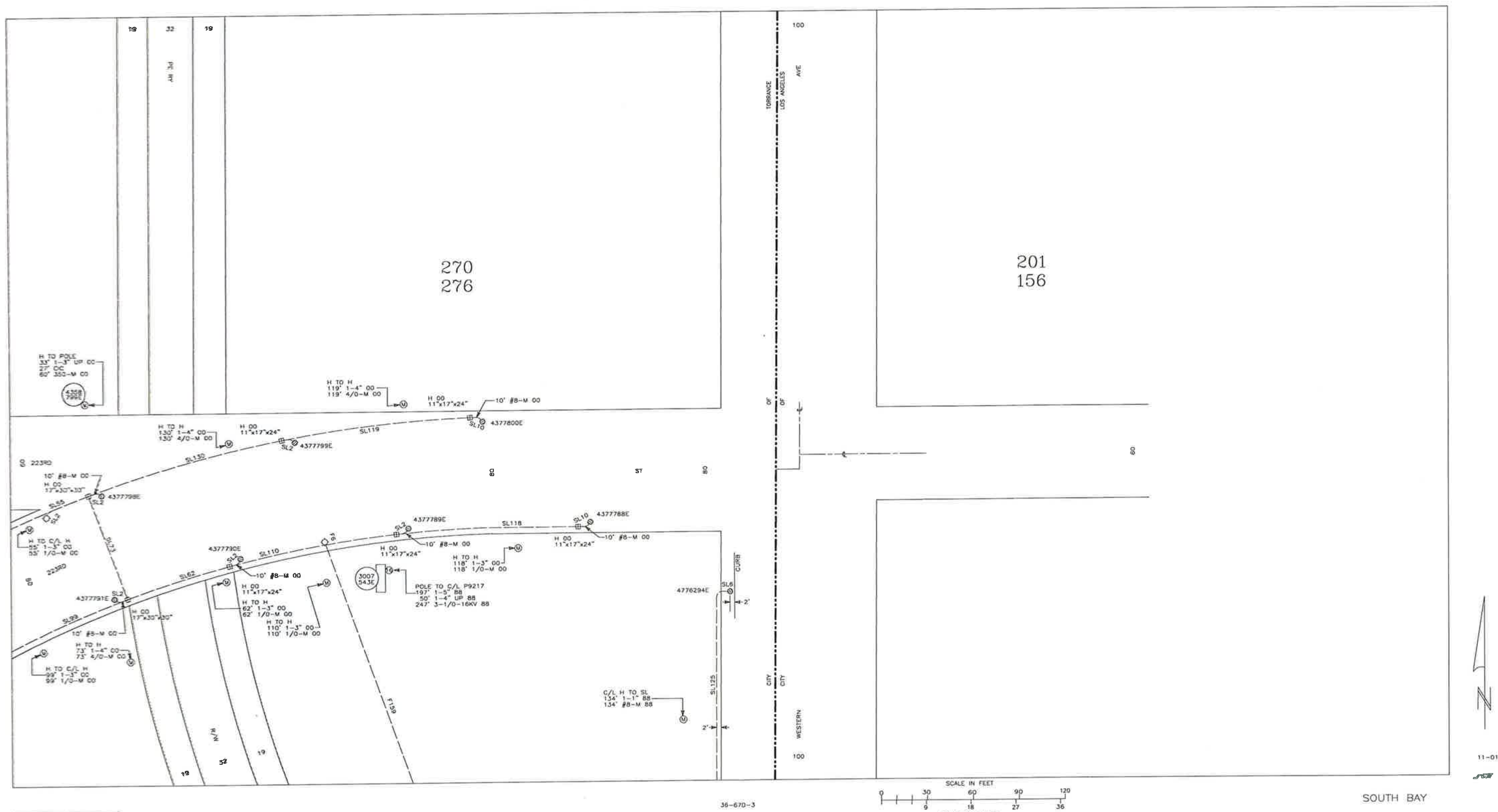
LOS ANGELES CO. 35-67D-9



LOS ANGELES CO. 37-67D-8



LOS ANGELES CO. 36-67B-9



SOUTH BAY

11-02 TADLE	2-10 AMEND
12-12 SLOPE	JMZC

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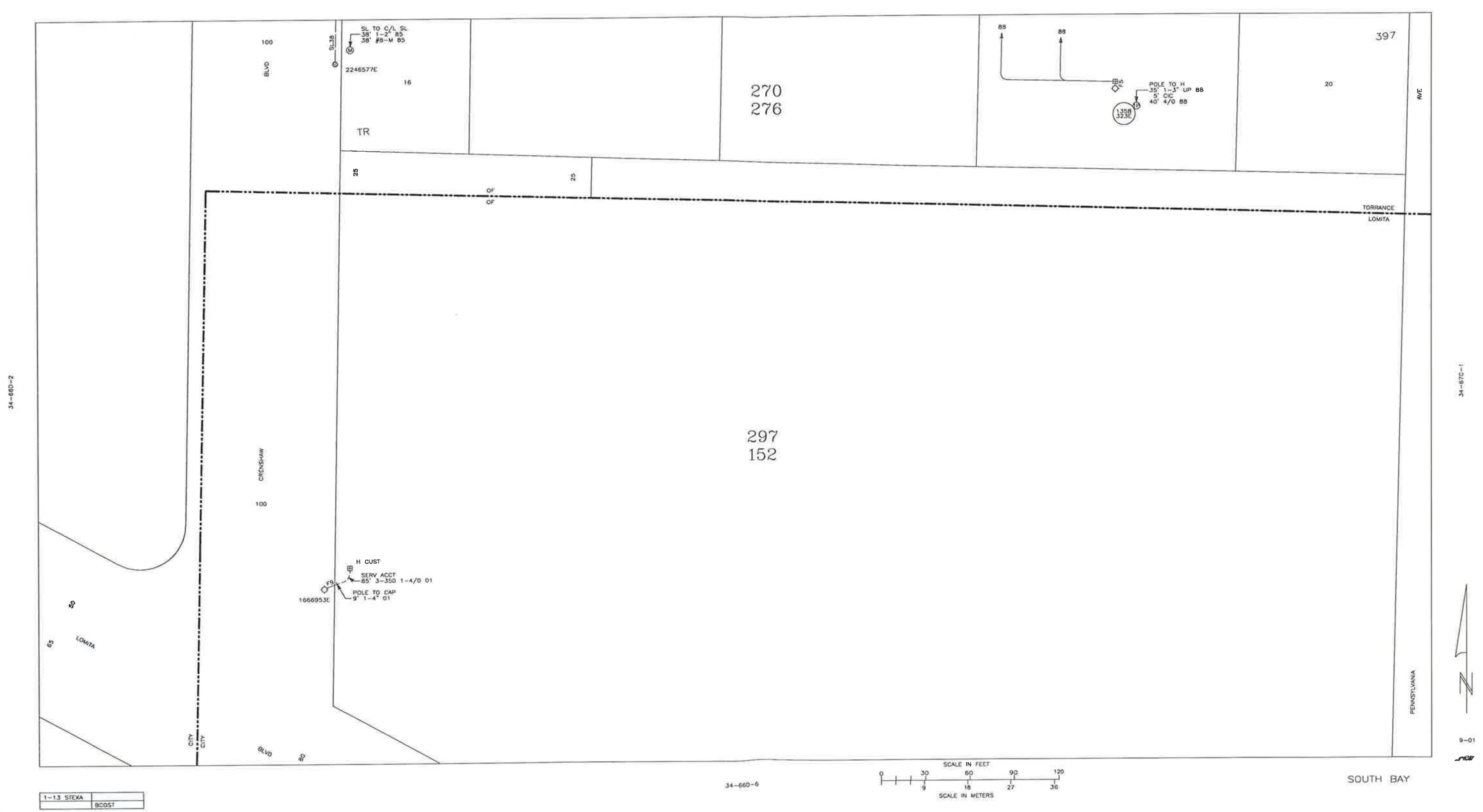
LOS ANGELES CO. 34-66D-3



THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

Office of the General Manager

MWD Second Lower Feeder
Sta. 1853+00 to 1957+00
MWD Palos Verdes Feeder
Sta. 1504+00 to 1573+00
MWD Sepulveda Feeder
Sta. 2268+00 to 2273+28
Substr. Job No. 4033-13-013

May 16, 2013

Mr. John Meyerhofer
Carollo Engineers
Suite 530
199 South Los Robles Avenue
Pasadena, CA 91101

Dear Mr. Meyerhofer:

Utility Information Request — Storm Water Projects

Thank you for your email dated May 2, 2013, requesting Metropolitan's utility information in the areas of your proposed storm drain improvements project located in various streets in the city of Torrance.

As shown on the enclosed maps, our 78-inch-inside-diameter prestressed-concrete Second Lower Feeder pipeline and appurtenant manhole structures are located along 220th Street and along Western Avenue, our 51-inch-inside-diameter welded-steel Palos Verdes Feeder pipeline and appurtenant manhole structures traverses in a northeasterly and southwesterly direction which also crosses Western Avenue, and our 84-inch-inside-diameter prestressed-concrete Sepulveda Feeder pipeline and appurtenant manhole structure are located along Western Avenue within your proposed project limits.

We are transmitting a copy of our "Guidelines for Developments in the Area of Facilities, Fee Properties, and/or Easements of The Metropolitan Water District of Southern

California," and a prints of our Drawings B-22797 through B-22805, B-23305 through B-23310 and B-54584, for your information and use.

We request that our facilities be fully shown and identified as Metropolitan's on your project plans and that prints of the preliminary plans be submitted for our review and written approval as they pertain to our facilities. We also request that all applicable portions of the enclosed guidelines be incorporated in your plans.

We also request that new storm drain lines and manhole structure proposed to cross over or located within 10 feet from the edges of our pipelines must include secondary containment, which consists of either a continuous steel casing or HDPE pipe with fusion-welded joints. Alternatively, we will allow a storm drain line without double containment if HDPE pipe with fusion-welded joints is used.

We also request that a stipulation be added to your plans or specifications to notify Samuel Teare of our Water System Operations Group, telephone (323) 276-7623, at least two working days prior to starting any work in the vicinity of our facilities.

For any further correspondence with Metropolitan relating to this project, please make reference to the Substructures Job Number shown in the upper right-hand corner of the first page of this letter. Should you require any additional information, please contact Ken Chung, telephone (213) 217-7670.

Very truly yours,

Kieran M. Callanan, P.E.
Manager, Substructures Team

KC/km
DOC#: 4033-13-013

Enclosures (19)

From: Metropolitan Water District MAY 0 6 2013
Substructures Team

Re: Your Project Stormwater Project - Torrance

Your Project No. ______

MWD Substructures Job No. 4033-13-013

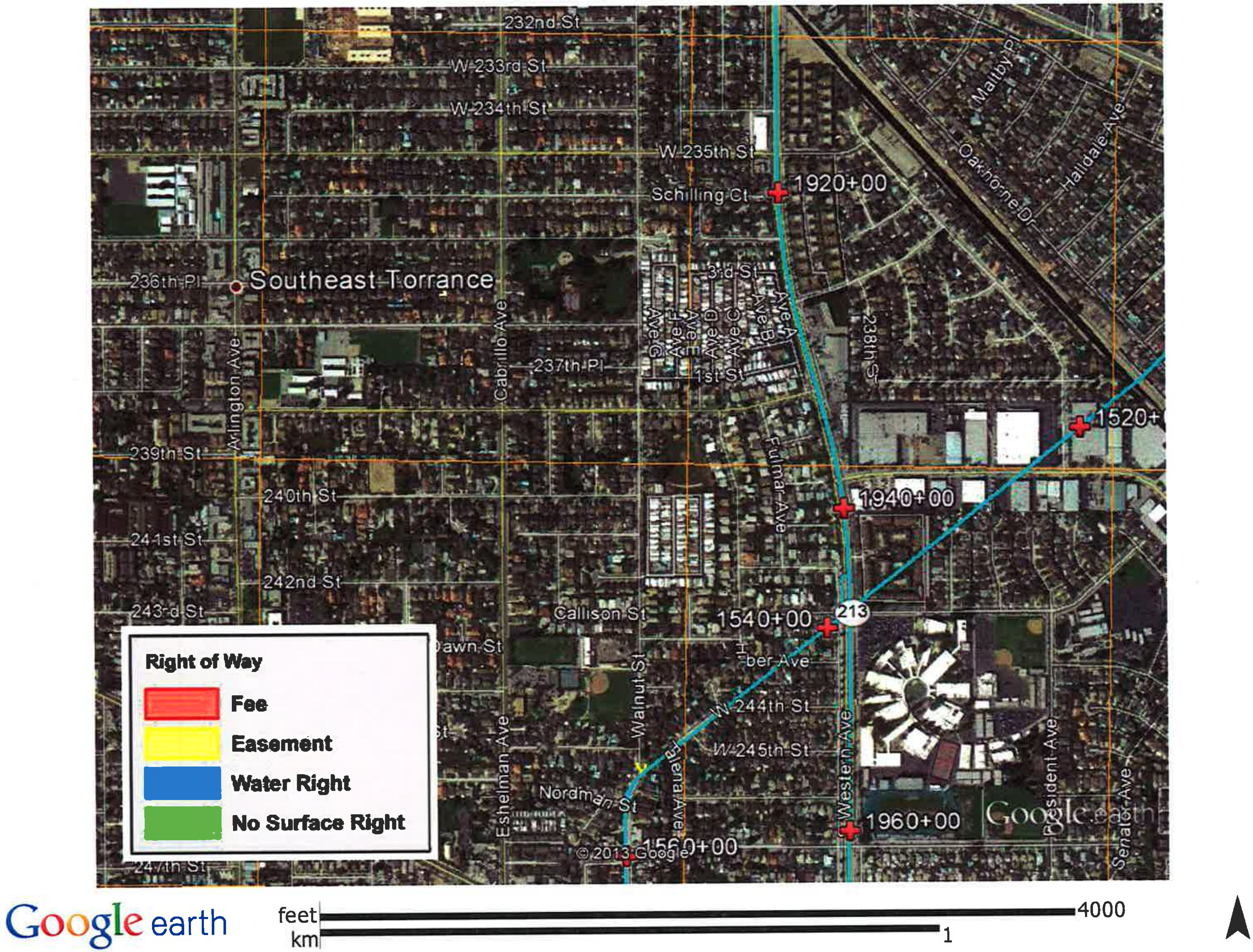
We received your above-referenced project submittal on 5/2/13
We will review your project proposal as it affects our facilities and rights-of-way and transmit our comments to you by written correspondence.

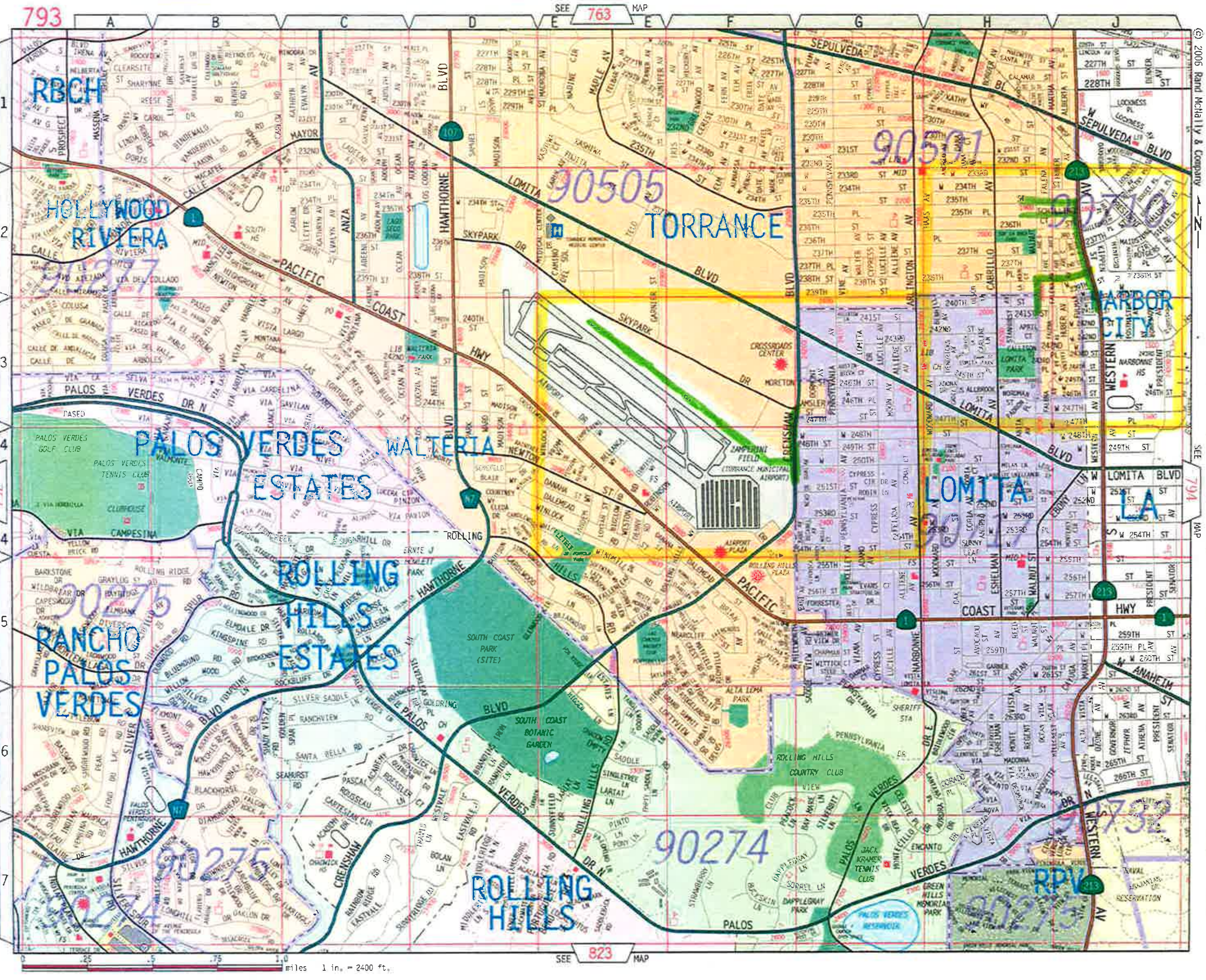
We typically respond within 30 days of receipt of the project submittal.

Your project has been assigned to Ken Chung
Telephone: (213) 217- 7670.

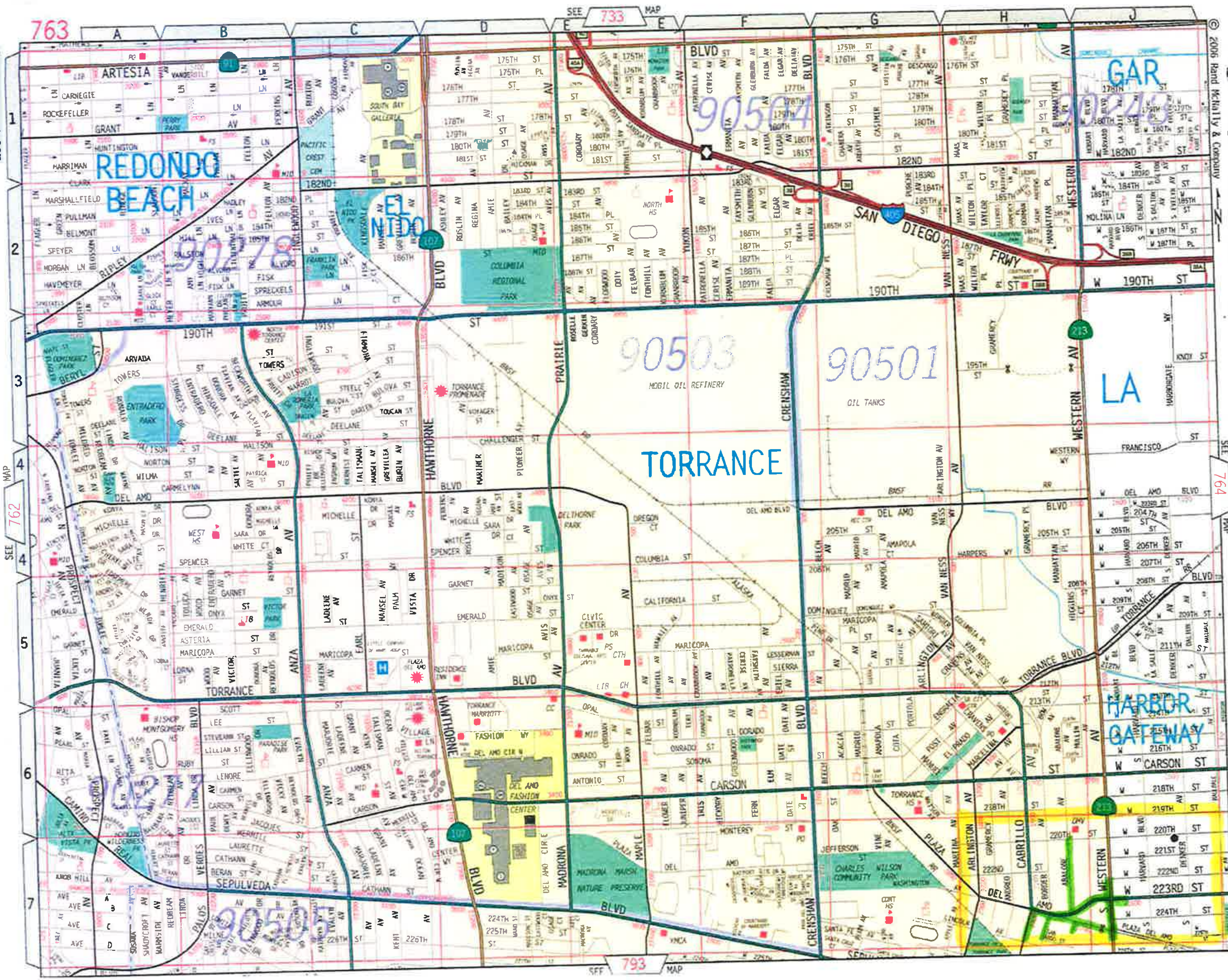
Please contact this Substructures Team coordinator if you have any questions.

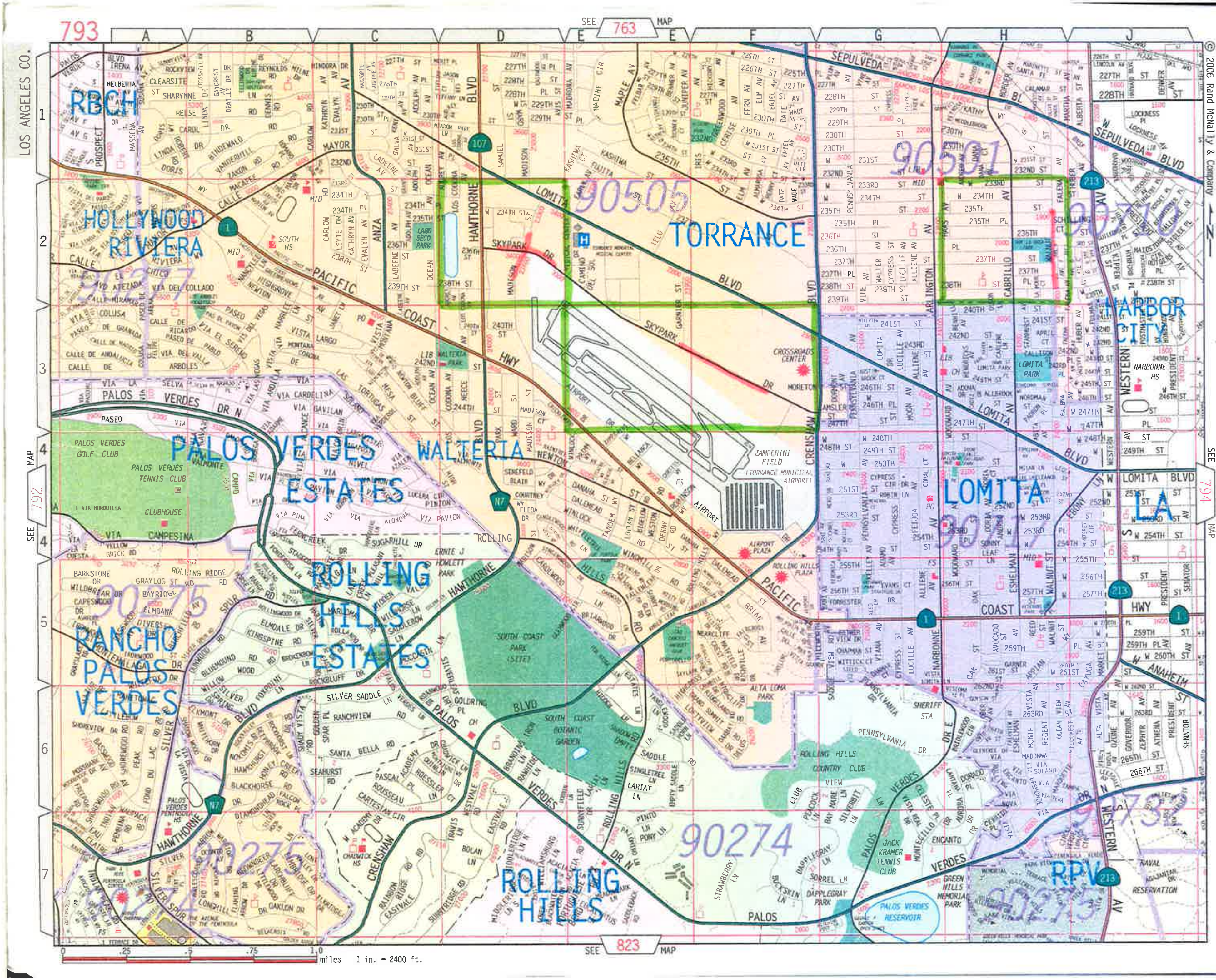
Thank you.

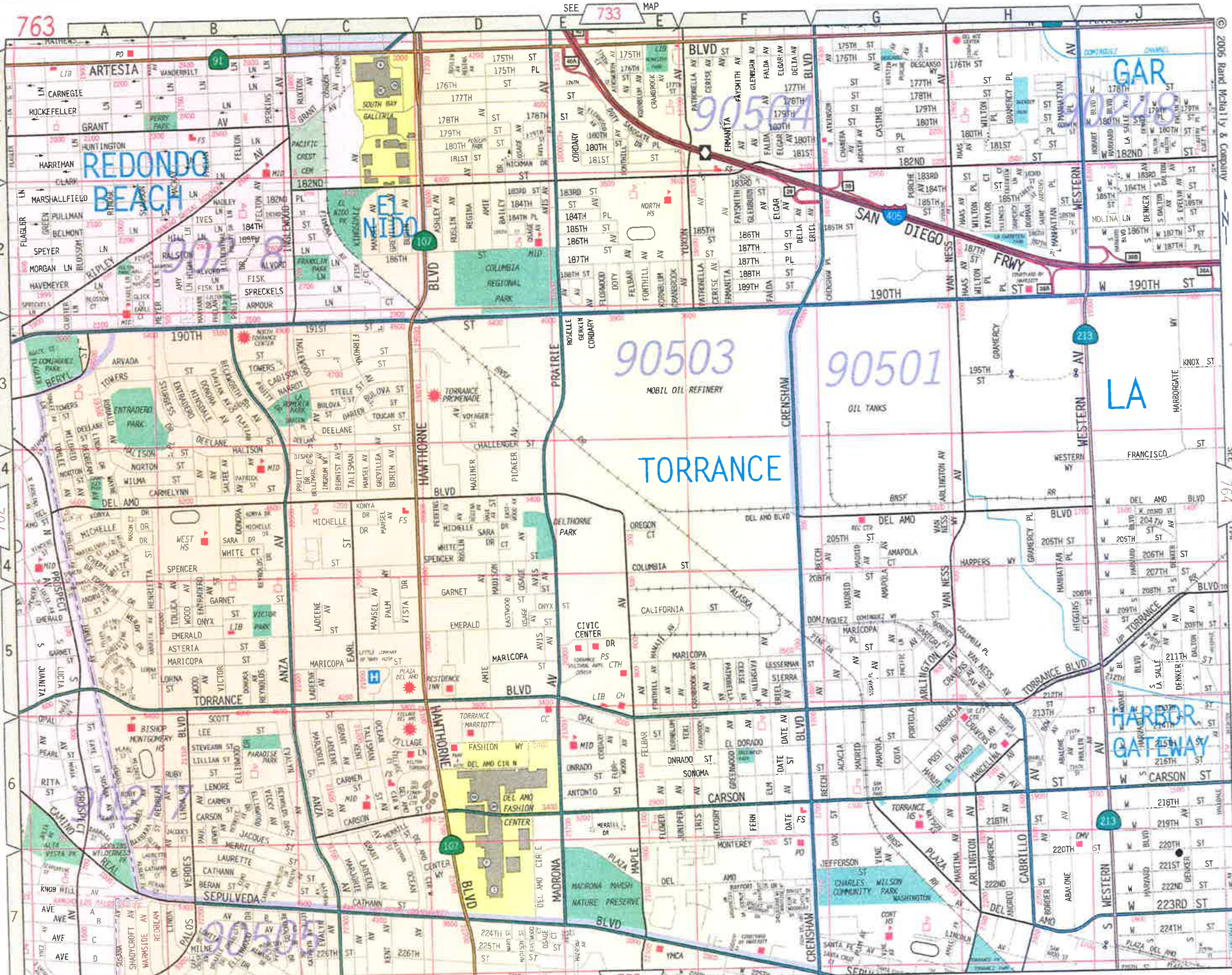

232nd St
W 233rd St
W 234th St
W 235th St
Schilling Ct
1920+00
Maltby Pl
Oakhorne Dr
Halldale Ave
236th Pl
Southeast Torrance
3rd St
Ave A
Ave B
Ave C
Ave D
Ave E
Ave F
Ave G
1st St
238th St
237th Pl
Cabrillo Ave
Arlington Ave
1520+
239th St
Fulmar Ave
1940+00
240th St
241st St
242nd St
243rd St
Callison St
1540+00
213
Dawn St
Walnut St
W 244th St
W 245th St
Western Ave
Eshelman Ave
Nordman St
Galena Ave
President Ave
Senator Ave
1960+00
1560+00
© 2013 Google
247th St
Right of Way
Fee
Easement
Water Right
No Surface Right
Google earth
feet
4000
km
1


SEE 763 MAP
SEE 794 MAP
SEE 823 MAP
SEE 792 MAP
LOS ANGELES CO.
© 2006 Rand McNally & Company
RBCH
HOLLYWOOD RIVIERA
90277
TORRANCE
90505
90501
90710
HARBOR CITY
LOMITA
90717
LA
PALOS VERDES ESTATES
WALTERIA
ROLLING HILLS ESTATES
RANCHO PALOS VERDES
90275
90274
ROLLING HILLS
90732
RPV
PACIFIC COAST HWY
HAWTHORNE BLVD
CRENSHAW BLVD
SEPULVEDA BLVD
LOMITA BLVD
WESTERN AV
ZAMPERINI FIELD (TORRANCE MUNICIPAL AIRPORT)
CROSSROADS CENTER
SOUTH COAST PARK (SITE)
SOUTH COAST BOTANIC GARDEN
ROLLING HILLS COUNTRY CLUB
PALOS VERDES GOLF CLUB
PALOS VERDES RESERVOIR
miles 1 in. = 2400 ft.

LOS ANGELES CO.




793
SEE 763 MAP
SEE 794 MAP
SEE 823 MAP
SEE 792 MAP
LOS ANGELES CO.
© 2006 Rand McNally & Company
RBCH
HOLLYWOOD RIVIERA
TORRANCE
90505
90501
90710
HARBOR CITY
LOMITA
90717
LA
PALOS VERDES ESTATES
WALTERIA
ROLLING HILLS ESTATES
RANCHO PALOS VERDES
90275
90274
ROLLING HILLS
RPV
90732
ZAMPERINI FIELD (TORRANCE MUNICIPAL AIRPORT)
PALOS VERDES GOLF CLUB
SOUTH COAST BOTANIC GARDEN
ROLLING HILLS COUNTRY CLUB
PALOS VERDES RESERVOIR
PACIFIC COAST HWY
HAWTHORNE BLVD
CRENSHAW BLVD
SEPULVEDA BLVD
WESTERN AV
miles 1 in. = 2400 ft.


SEE 733 MAP
SEE 762 MAP
SEE 764 MAP
SEE 793 MAP
REDONDO BEACH
EL NIDO
TORRANCE
LA
GAR
HARBOR GATEWAY
90503
90501
90504
90248
90277
90505
MOBIL OIL REFINERY
OIL TANKS
SAN DIEGO FRWY
ARTESIA
HAWTHORNE BLVD
CRENSHAW BLVD
PRAIRIE AV
WESTERN AV
DEL AMO BLVD
TORRANCE BLVD
SEPULVEDA BLVD
CARSON ST
190TH ST
COLUMBIA REGIONAL PARK
SOUTH BAY GALLERIA
DEL AMO FASHION CENTER
MADRONA MARSH NATURE PRESERVE
CIVIC CENTER
DELTHORNE PARK
ENTRADERO PARK
CHARLES WILSON COMMUNITY PARK
NORTH HS
WEST HS
TORRANCE HS
BISHOP MONTGOMERY HS
TORRANCE PROMENADE
0 .25 .5 .75 1.0 miles 1 in. = 2400 ft.

SPECIFICATIONS No. 283 SHEET No.

METROPOLITAN WATER DISTRICT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE SUBSTRUCTURE INFORMATION HEREIN PROVIDED. THE USER ASSUMES RESPONSIBILITY FOR VERIFYING SUBSTRUCTURE LOCATION BEFORE EXCAVATING AND ASSUMES ALL LIABILITY FOR DAMAGE TO METROPOLITAN'S FACILITIES AS A RESULT OF SUCH EXCAVATION. CALL UNDERGROUND SERVICE ALERT AND THE RELEVANT REPRESENTATIVE FROM METROPOLITAN AT LEAST 2 WORKING DAYS BEFORE EXCAVATING.

NO.	DATE	DWN.	CKD.	REVISION	REC.	APP.
2	10-29-92	Y.E.C.		ADDED CATHODIC PROTECTION		
1	5-21-71	F.U.D.		Added relief structure and storm drain		

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

COLORADO RIVER AQUEDUCT

PALOS VERDES FEEDER

190th ST. TO PALOS VERDES RESERVOIR

STA 1561+00 TO STA 1573+00

PLAN AND PROFILE

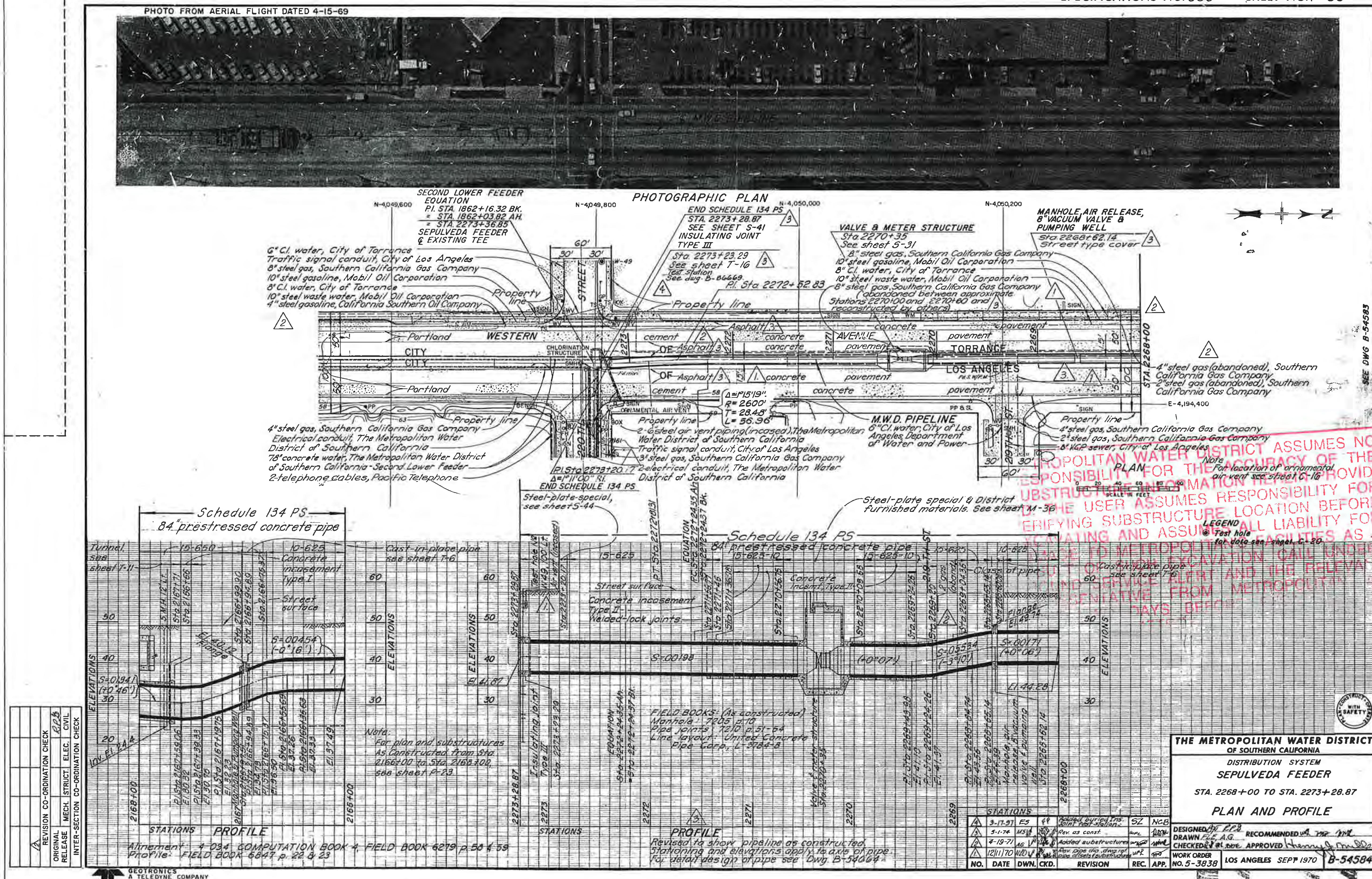
DRAWN / TRACED / CHECKED / RECOMMENDED / APPROVED

LOS ANGELES 1966 B-23310

POLARIS MICROFILMED JUN 28 1974 ELECTRONIC FILE JUN 09 1997

0-11-203-228

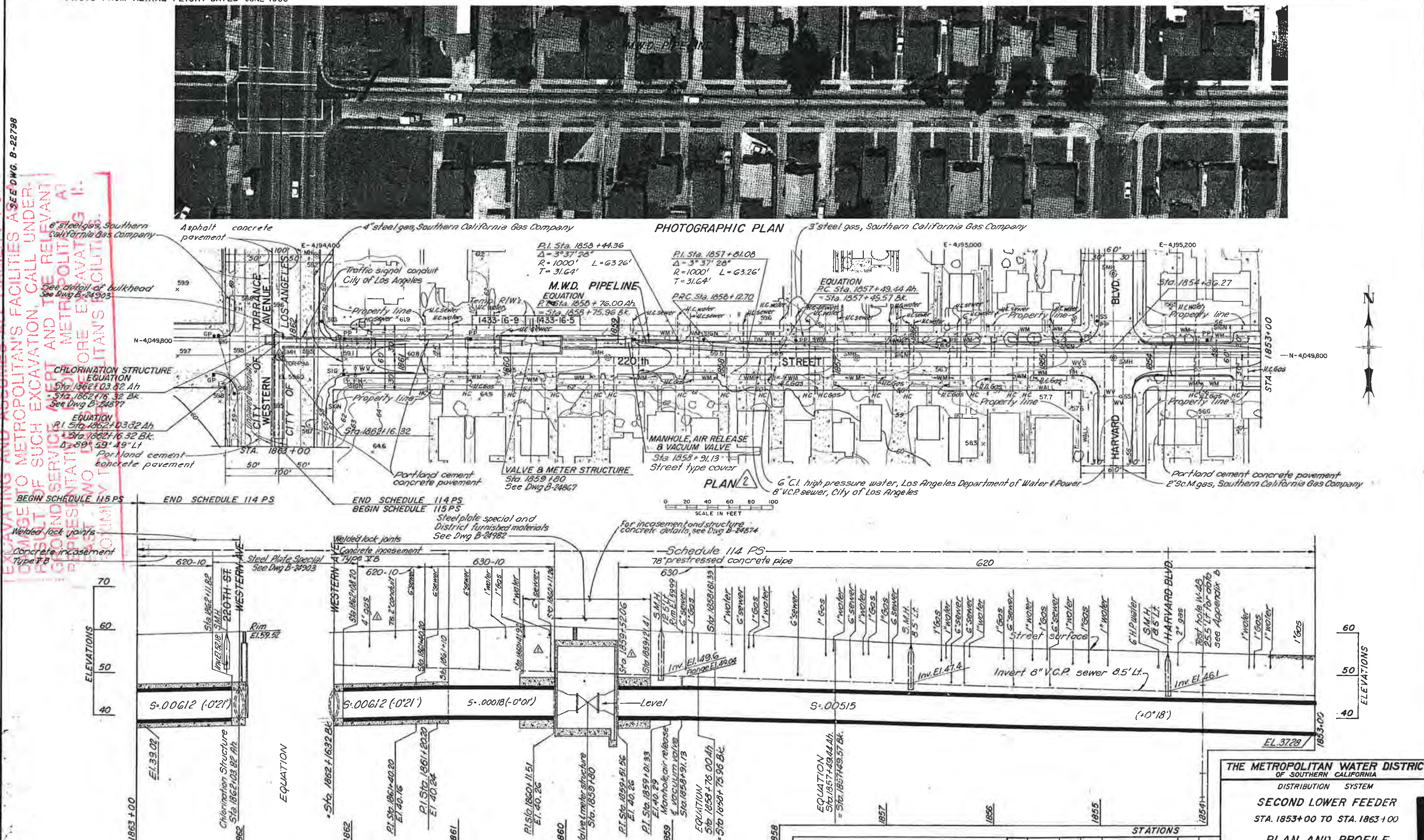
SPECIFICATIONS NO. 883 SHEET NO. P-33



SEP 05 1997

SPECIFICATIONS No. 762 SHEET No. P-

PHOTO FROM AERIAL FLIGHT DATED JUNE 1966



THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

DISTRIBUTION SYSTEM

SECOND LOWER FEEDER

STA. 1853+00 TO STA. 1863+00

PLAN AND PROFILE

M. A. NISHKIAN & CO. CONSULTING ENGINEERS LONG BEACH — LOS ANGELES

REGISTERED CIVIL ENGINEER No. 5777

No.	DATE	DWN.	CKD.	REVISION	REC.	APP.
2	5-28-73			Rev. as const.		
1	3/20/68	MS		Added 4" gas & revised pipe and stations		

DRAWN M.A.N. RECOMMENDED

TRACED M.A.N.

CHECKED APPROVED

W.O.-3638 LOS ANGELES OCT 1967 B-22797

FIELD BOOKS
Alinement: 5529 p 263
Profile: 6161 p 122, 6213 p 64 & 65
Test Hole: 6173 p 29 & 30

FIELD BOOKS (As constructed)
Manholes 6283 p 22
Pipe joints 6815 p 27-31
Line layout (U.C.P.)
Dwg No. L-3470-15,16

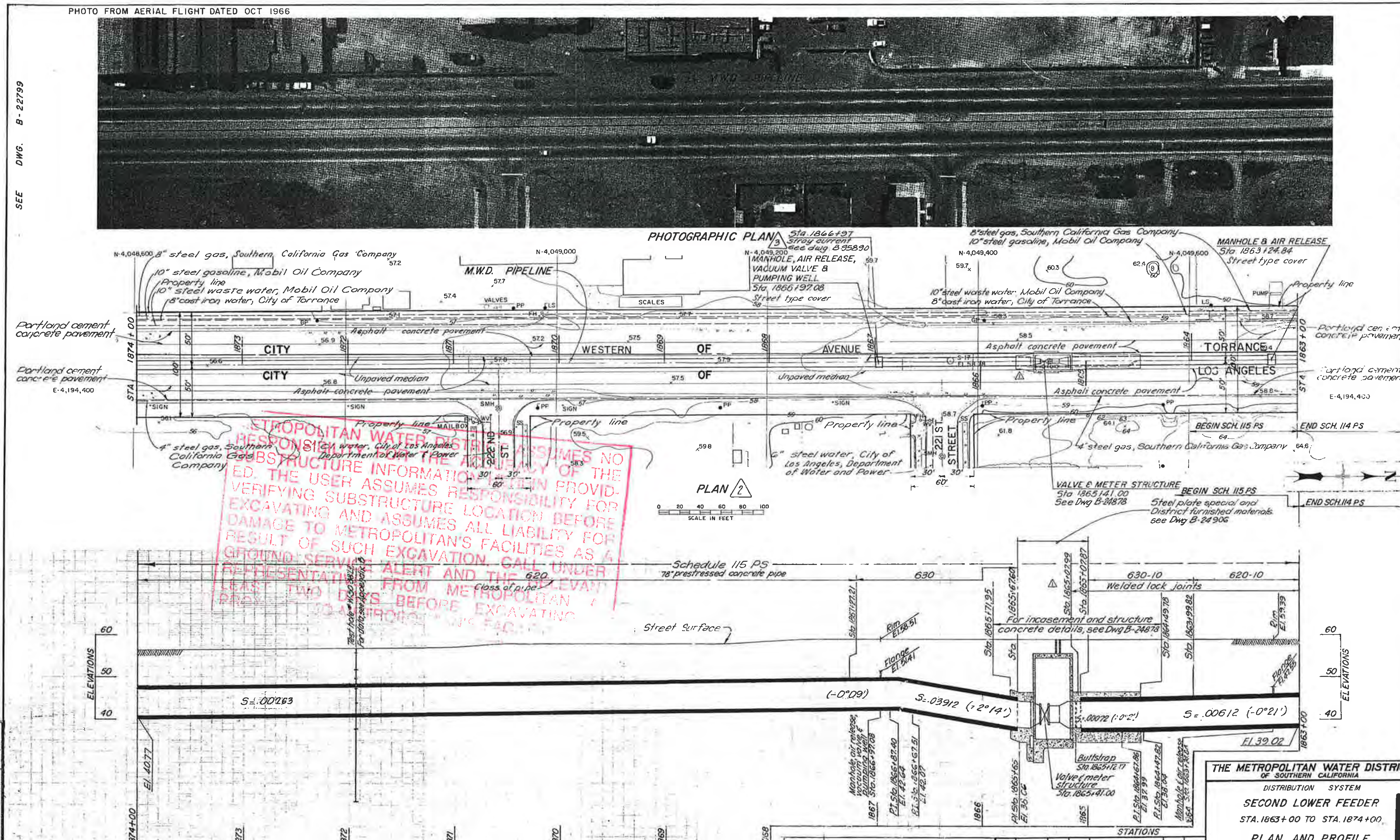
Revised to show pipeline as constructed
Stationing and elevations apply to invert of pipe
For detail design of pipe see Dwgs B-24943, B-24946

REVISION CO-ORDINATION CHECK		
ORIGINAL	RELEASE	INTER-SECTION CO-ORDINATION CHECK
MECH.	STRUCT.	ELEC.	CIVIL

SPECIFICATIONS No. 762 SHEET No P

SEE DWG. B-22799

PHOTO FROM AERIAL FLIGHT DATED OCT 1966



FIELD BOOKS:
Alinement: 5529 p.22
Profile: 6161 p.8
Test Hole: 6173 p. 34 & 35

FIELD BOOKS (As constructed)
Manholes 6283 p.23
Pipe joints 6815 p. 31-36
Line layout (UCP)
Dwg No. L-3470-16

Revised to show pipeline as constructed
Stationing and elevations apply to invert of pipe
For detail design of pipe see Dwgs B-24943, B-24946

M. A. NISHKIAN & CO.
CONSULTING ENGINEERS
LONG BEACH — LOS ANGELES
REGISTERED CIVIL ENGINEER No. 5777

Nº	DATE	DWN.	CKD.	REVISION	REC.	APP.
3	2-22-00	ES	SZ	Added stray current @ Sta. 1866+97	SZ	NCB
2	6-28-73			Rev. as const.		
1	3/20/68	MS		Rev. pipe and sta's		

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
DISTRIBUTION SYSTEM
SECOND LOWER FEEDER
STA. 1863+00 TO STA. 1874+00
PLAN AND PROFILE

DRAWN M.A.N. RECOMMENDED
TRACED M.A.N.
CHECKED APPROVED

W.O.-3639 | LOS ANGELES OCT. 1967 | B-227?

ORIGINAL RELEASE | REVISION CO-ORDINATION CHECK | MECH. | STRUCT. | ELEC. | CIVIL | INTER-SECTION CO-ORDINATION CHECK

PACIFIC AIR INDUSTRIES, INC.

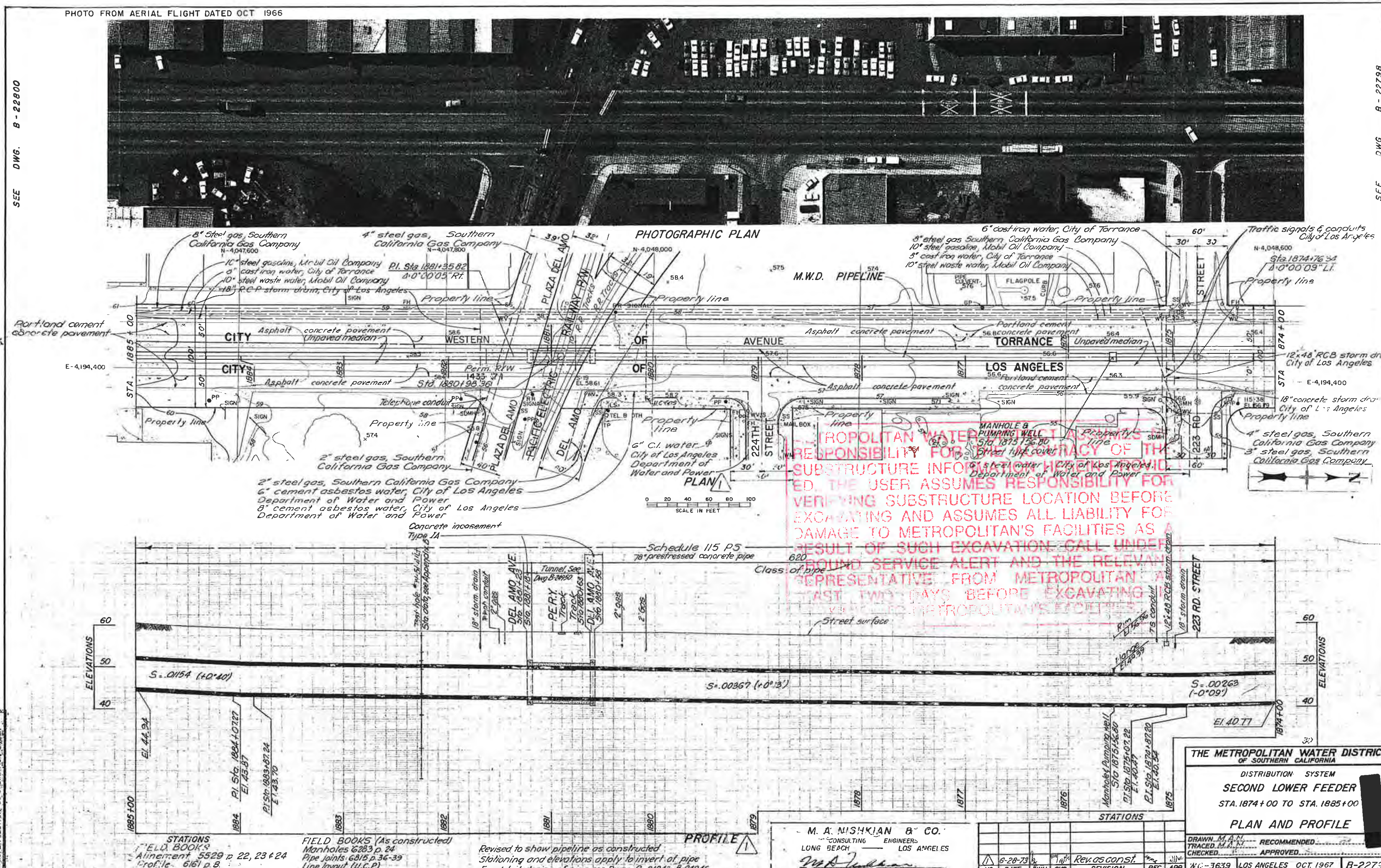
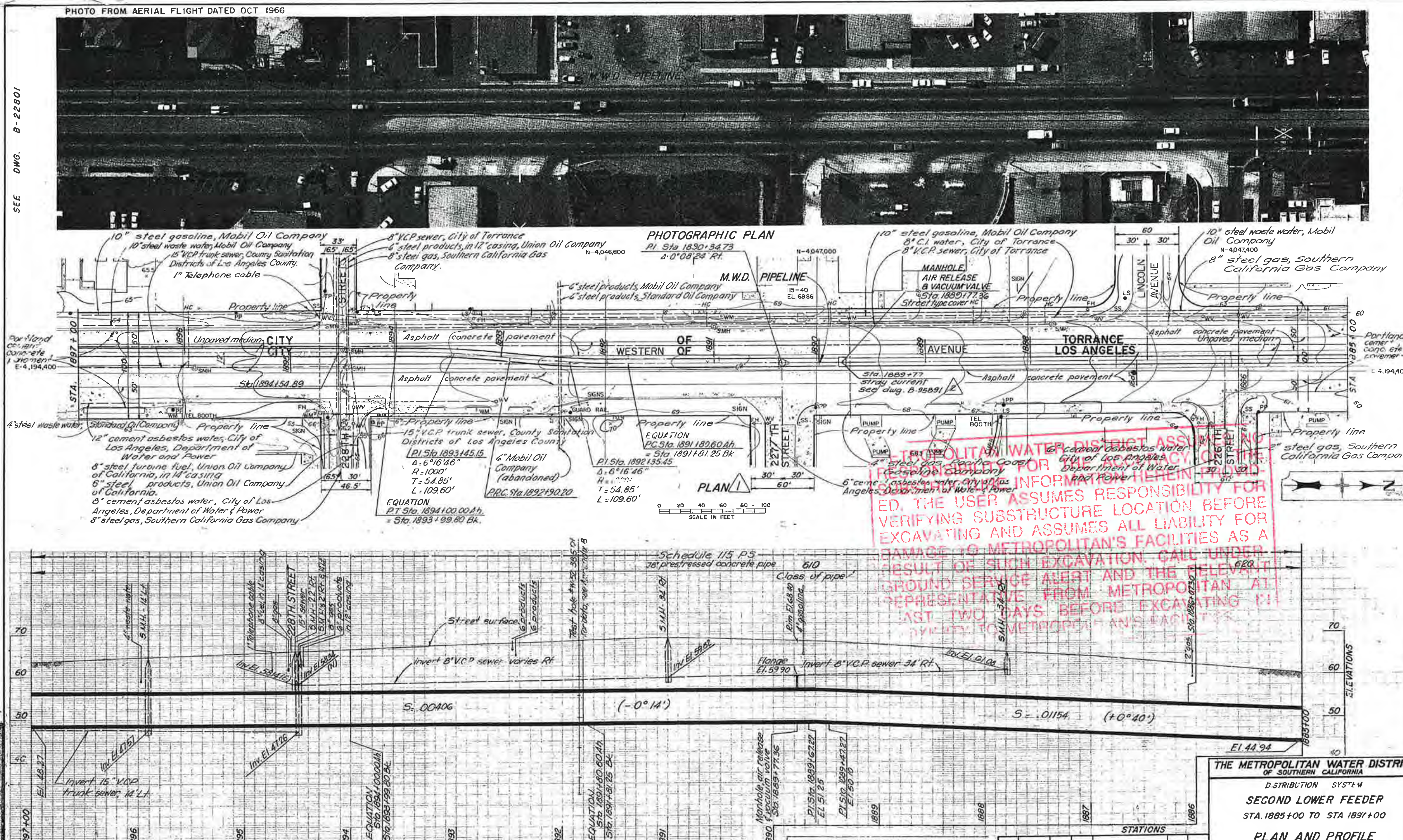


PHOTO FROM AERIAL FLIGHT DATED OCT 1966
SEE DWG. B-22800
SEE DWG B-22798
PHOTOGRAPHIC PLAN
M.W.D. PIPELINE
CITY OF TORRANCE
CITY OF LOS ANGELES
WESTERN AVENUE
PLAZA DEL AMO
PACIFIC ELECTRIC RAILWAY
224TH STREET
223 RD. STREET
PLAN
SCALE IN FEET
Schedule 115 PS
78" prestressed concrete pipe
Class of pipe
Concrete incasement Type IA
Street surface
S=.0154 (+0°40')
S=.00367 (+0°13')
S=.00263 (-0°09')
ELEVATIONS
STATIONS
PROFILE
FIELD BOOKS
Alinement 5529 p. 22, 23 & 24
Profile 6161 p. 8
Test Hole 6173 p. 36 & 37
FIELD BOOKS (As constructed)
Manholes 6283 p. 24
Pipe joints 6815 p. 36-39
Line layout (U.C.P.)
Dwg No. L-3470-16,17
Revised to show pipeline as constructed
Stationing and elevations apply to invert of pipe
For detail design of pipe see Dwgs B-24943, B-24946
METROPOLITAN WATER DISTRICT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE SUBSTRUCTURE INFORMATION HEREIN PROVIDED. THE USER ASSUMES RESPONSIBILITY FOR VERIFYING SUBSTRUCTURE LOCATION BEFORE EXCAVATING AND ASSUMES ALL LIABILITY FOR DAMAGE TO METROPOLITAN'S FACILITIES AS A RESULT OF SUCH EXCAVATION. CALL UNDERGROUND SERVICE ALERT AND THE RELEVANT REPRESENTATIVE FROM METROPOLITAN AT LEAST TWO DAYS BEFORE EXCAVATING IN VICINITY TO METROPOLITAN'S FACILITIES.
M. A. NISHKIAN & CO.
CONSULTING ENGINEERS
LONG BEACH — LOS ANGELES
REGISTERED CIVIL ENGINEER
6-28-73 Rev. as const.
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
DISTRIBUTION SYSTEM
SECOND LOWER FEEDER
STA. 1874+00 TO STA. 1885+00
PLAN AND PROFILE
[redacted]
W.O.-3639
LOS ANGELES OCT. 1967
B-22799
PACIFIC AIR INDUSTRIES, INC.



STATIONS
FIELD BOOKS
Alinement : 5529 p 23, 24+25
Profile : 5161 p 8+9
Test Hole : 5173 p 38+39

FIELD BOOKS (As constructed)
Manholes 6283 p 25
Pipe joints 6815 p 34-44
Line layout (U.C.P.)
Dwg No. L-3470-17

Revised to show pipeline as constructed
Stationing and elevations apply to invert of pipe
For detail of design of pipe see Dwgs B-24943, B-24946

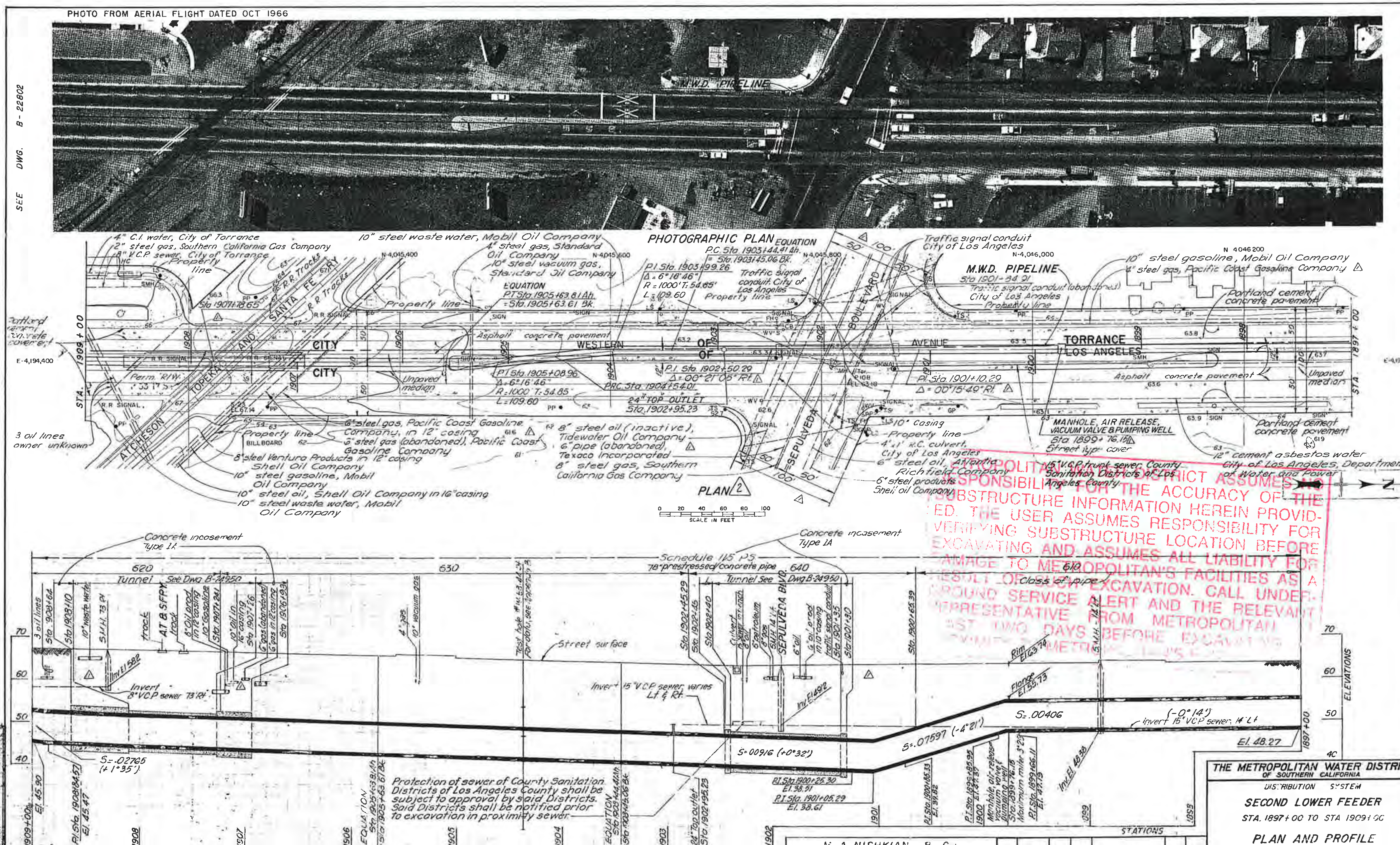
M. A. NISHKIAN & CO.
CONSULTING ENGINEERS
LONG BEACH — LOS ANGELES
REGISTERED CIVIL ENGINEER No. 5777

No	DATE	DWN.	CKD.	REVISION	REC.	APR.
2	2-22-08	ES	SZ	Added stray current @ Sta. 1889+77	SZ	NCB
1	6-28-73			Rev. as const.		

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
DISTRIBUTION SYSTEM
SECOND LOWER FEEDER
STA. 1885+00 TO STA 1897+00
PLAN AND PROFILE

DRAWN M.A.N. RECOMMENDED
TRACED M.A.N. APPROVED
CHECKED
WO-3639 LOS ANGELES OCT 6 B-22800

SPECIFICATIONS No. 752 SHEET No P-



METROPOLITAN WATER DISTRICT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE SUBSTRUCTURE INFORMATION HEREIN PROVIDED. THE USER ASSUMES RESPONSIBILITY FOR VERIFYING SUBSTRUCTURE LOCATION BEFORE EXCAVATING AND ASSUMES ALL LIABILITY FOR DAMAGE TO METROPOLITAN'S FACILITIES AS A RESULT OF SUCH EXCAVATION. CALL UNDERGROUND SERVICE ALERT AND THE RELEVANT REPRESENTATIVE FROM METROPOLITAN AT LEAST TWO DAYS BEFORE EXCAVATING

STATIONS
FIELD BOOKS
Alinement 5529 p. 24, 25 & 26
Profile: 6161 p. 9-12
Test holes: 6173 p. 40 & 41

FIELD BOOKS (As constructed)
Manholes 6283 p. 26
Pipe joints 6815 p. 44, 45
Line layout (U.C.P.)
Dwg No 3410-18, 19

Revised to show pipeline as constructed
Stationing and elevations apply to invert of pipe
For detail design of pipe see Dwgs B-24943, B-24946

M. A. NISHKIAN & CO
CONSULTING ENGINEERS
LONG BEACH — LOS ANGELES
REGISTERED CIVIL ENGINEER No. 5717

№	DATE	DWN.	CKD.	REVISION	REC.	APP.
2	5-28-73			Rev. as const.		
1	10-3-68	F.L.E.				

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
DISTRIBUTION SYSTEM
SECOND LOWER FEEDER
STA. 1897+00 TO STA 1909+00
PLAN AND PROFILE

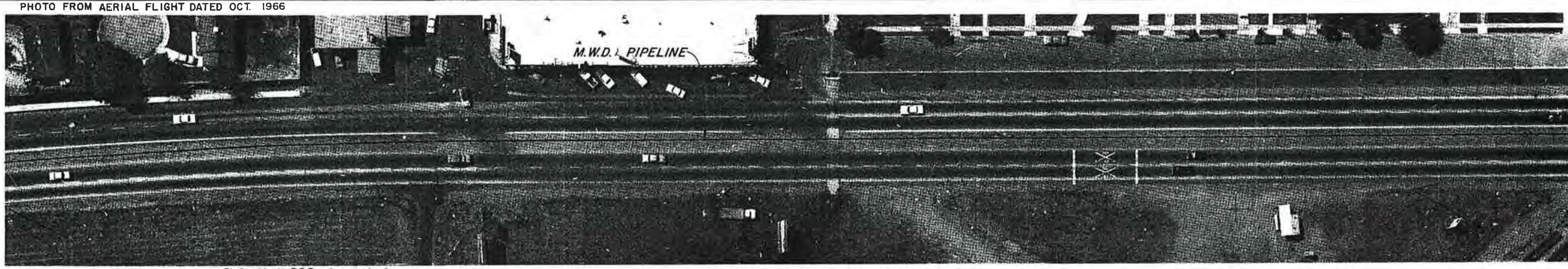
DRAWN M.A.N. RECOMMENDED
TRACED M.A.N.
CHECKED APPROVED
W.O. 3639 LOS ANGELES OCT 1967 B-2280

PACIFIC AIR INDUSTRIES, INC.

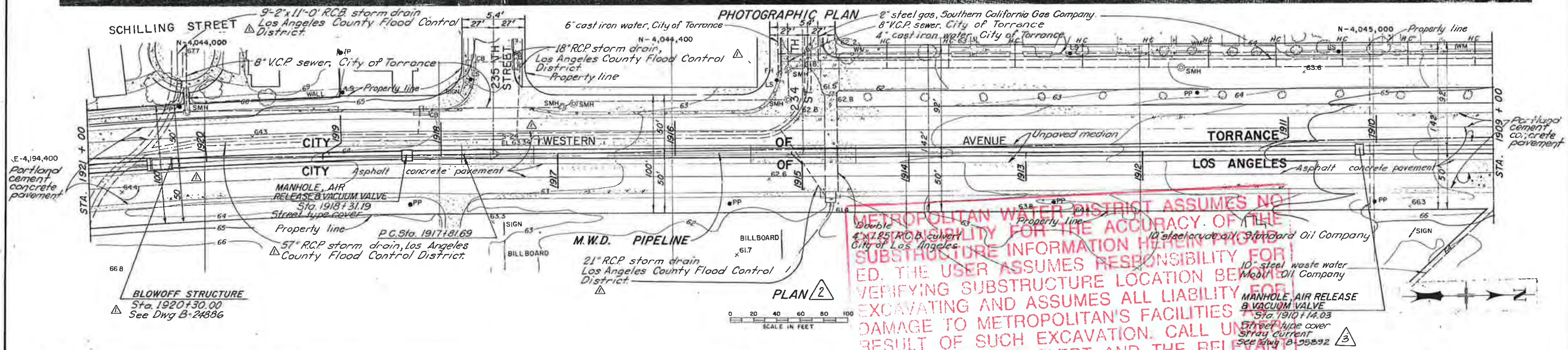
PHOTO FROM AERIAL FLIGHT DATED OCT. 1966

SEE DWG. B-22803

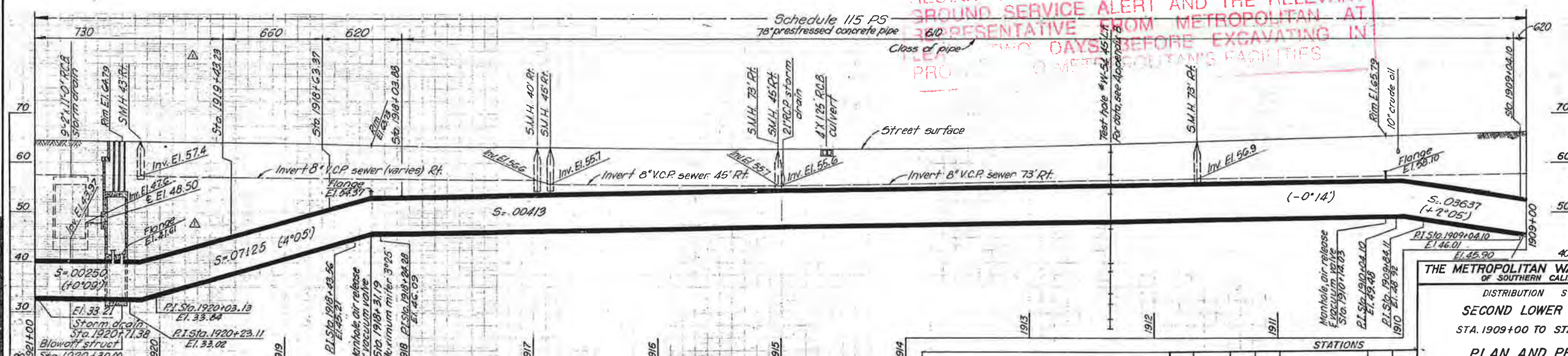
SEE DWG. B-22801



PHOTOGRAPHIC PLAN



PLAN 2



PROFILE 2

FIELD BOOKS
Alinement: 5239 p. 25, 26 & 27
Profile: 6161 p. 12, 13 & 14
Test Hole: 6173 p. 42 & 43

FIELD BOOKS (As constructed)
Manholes 6283 p. 27, 28
Pipe joints: 633 p. 45-48, 51
Line layout (U.C.P.) Dwg No. L-3470-18, 19

Revised to show pipeline as constructed
Stationing and elevations apply to invert of pipe
For detail design of pipe see Dwgs B-24943, B-24946

M. A. NISHKIAN & CO.
CONSULTING ENGINEERS
LONG BEACH — LOS ANGELES
REGISTERED CIVIL ENGINEER No. 5777

NO	DATE	DWN.	CKD.	REVISION	REC.	APP.
3	2-22-00	ES	SZ	Added stray current to Sta. 1910+14	SZ	NCB
2	6-28-73			Rev. as const.		
1	3/20/68	MS		Rev. blowoff, pipe classes, storm drain & pipe grades		

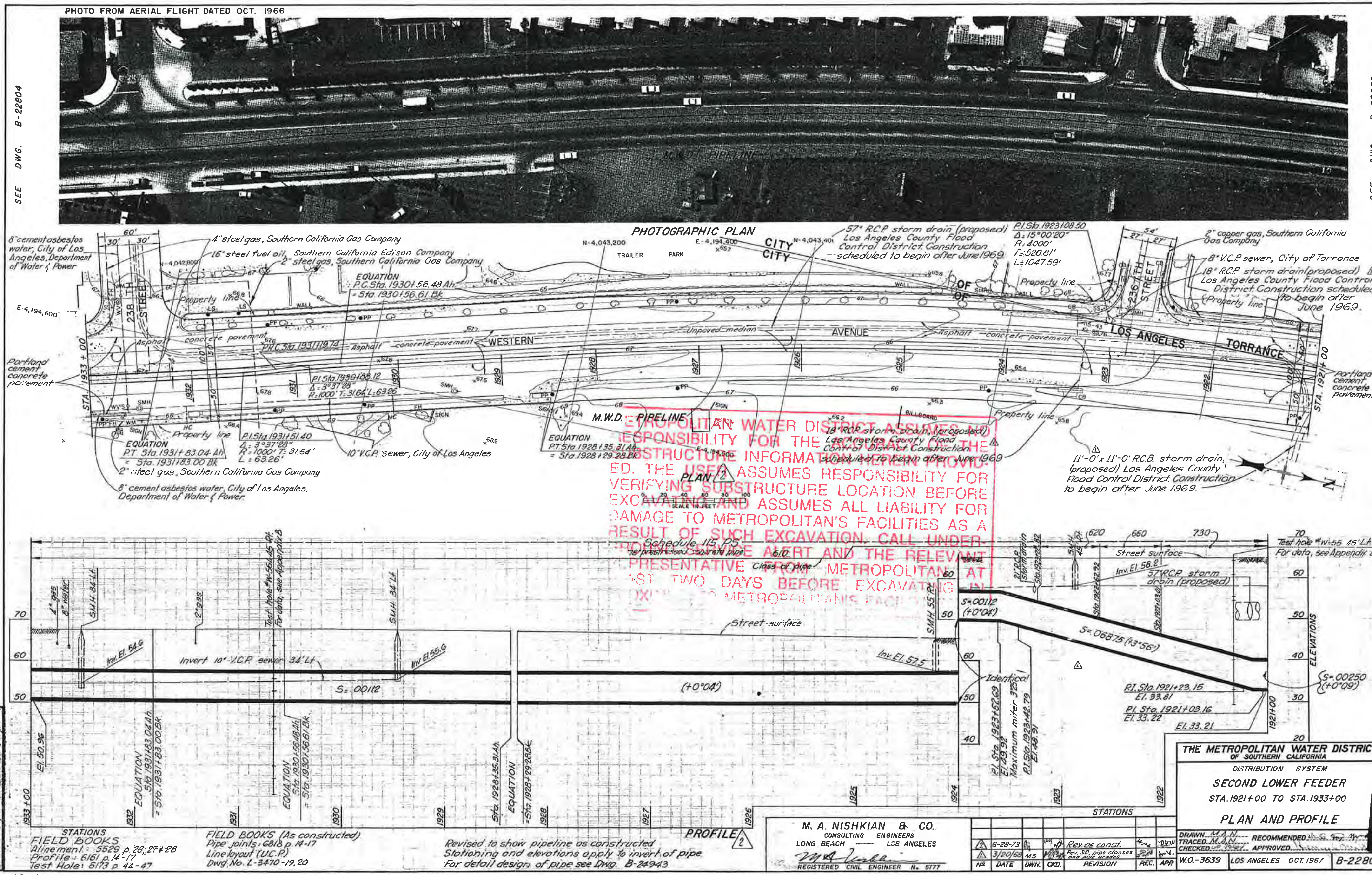
REVISION	ORIGINAL	RELEASE
CO-ORDINATION CHECK	MECH.	STRUCT.	ELEC.	CIVIL
INTER-SECTION CO-ORDINATION CHECK		

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
DISTRIBUTION SYSTEM
SECOND LOWER FEEDER
STA. 1909+00 TO STA. 1921+00
PLAN AND PROFILE

DRAWN M.A.N. RECOMMENDED
TRACED M.A.N. APPROVED
CHECKED
W.O.-3639 LOS ANGELES OCT. 1967 B-22802

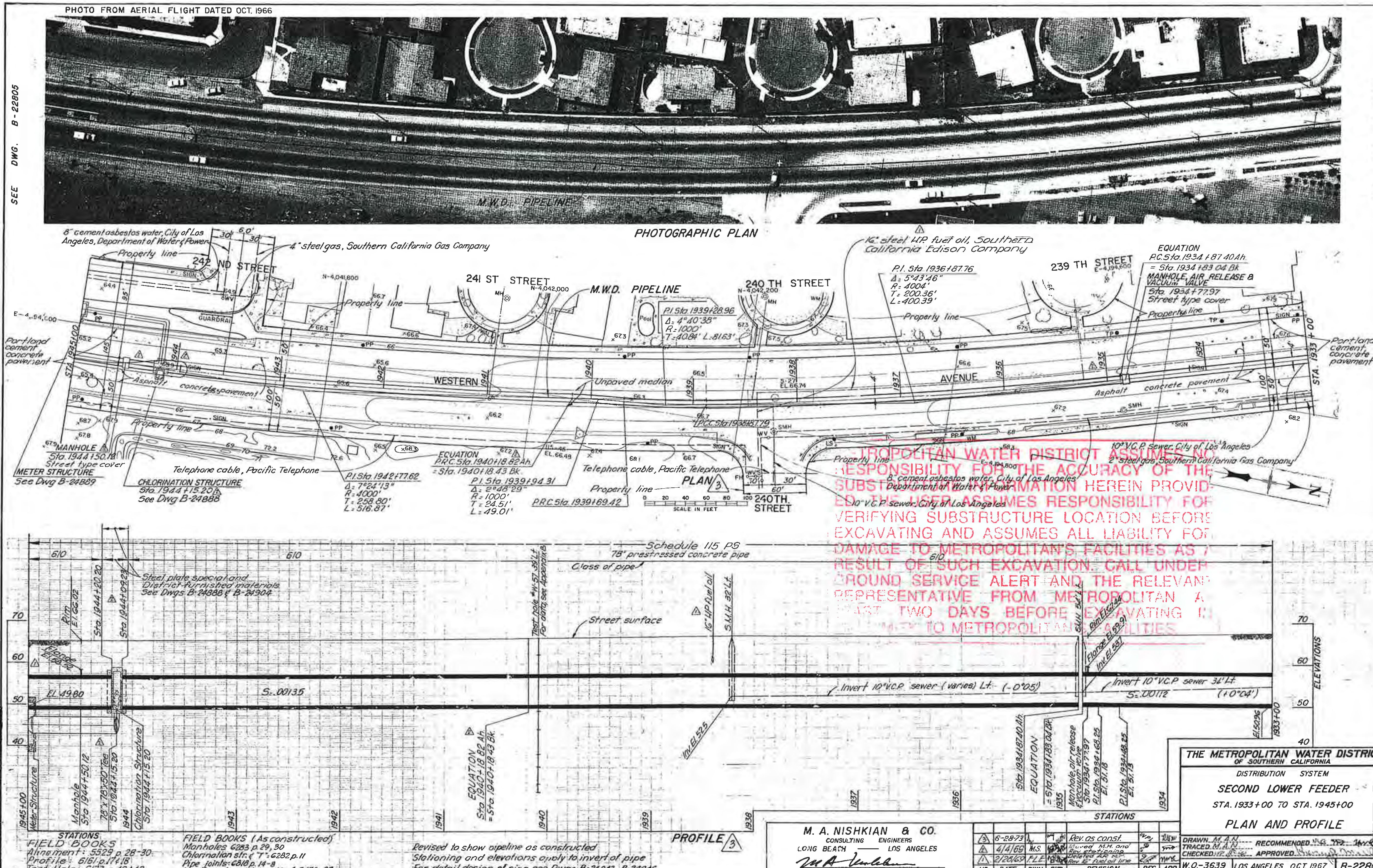
PACIFIC AIR INDUSTRIES, INC.

SPECIFICATIONS No. 762 SHEET No. P-2



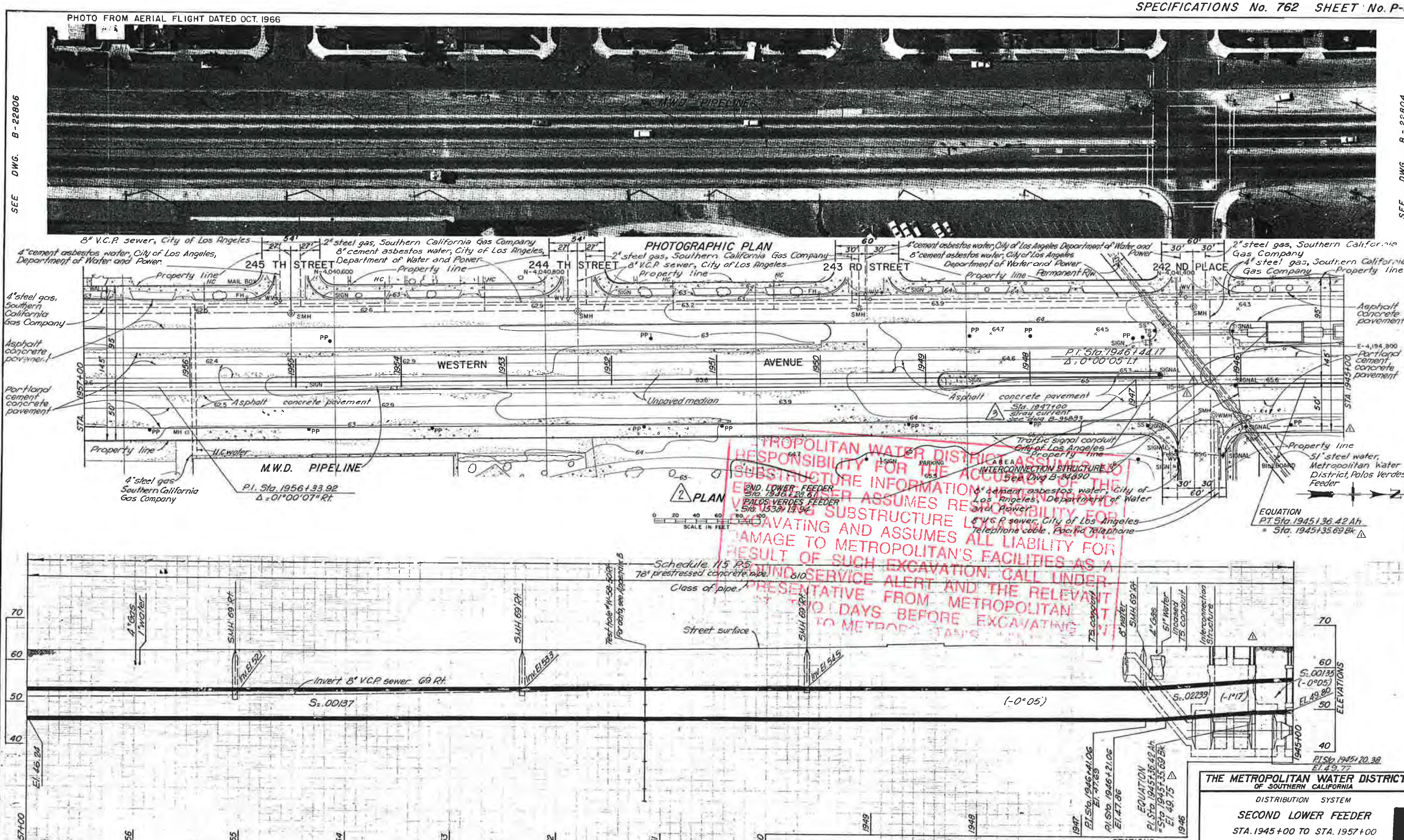
PACIFIC AIR INDUSTRIES, INC.

SPECIFICATIONS No. 762 SHEET No. P-3



SPECIFICATIONS No. 762 SHEET No. P-31

[redacted]



METROPOLITAN WATER DISTRICT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE SUBSTRUCTURE INFORMATION SHOWN. THE ENGINEER ASSUMES RESPONSIBILITY FOR VERIFYING SUBSTRUCTURE LOCATIONS BEFORE EXCAVATING AND ASSUMES ALL LIABILITY FOR DAMAGE TO METROPOLITAN'S FACILITIES AS A RESULT OF SUCH EXCAVATION. CALL UNDERGROUND SERVICE ALERT AND THE RELEVANT REPRESENTATIVE FROM METROPOLITAN AT TWO DAYS BEFORE EXCAVATING ... METROPOLITAN'S ...

STATIONS

FIELD BOOKS
Alinement: 5529 p. 31, 32 & 33
Profile: 6161 p. 18-21
Test Hole: 6173 p. 50 & 51

FIELD BOOKS (As constructed)
Pipe joints: 6818 p. 8-5
Line layout (U.C.P.)
Dwg No. L-3470-20,21

Revised to show pipeline as constructed
Stationing and elevations apply to invert of pipe
For detail design of pipe see Dwg. B-24943

No.	DATE	DWN.	CKD.	REVISION	REC.	APP.
3	2-22-00	ES	SZ	Added stray current @ Sta 1947+00	SZ	NGB
2	6-28-73			Rev. as const.		
1	4/4/69	MS		Revised stations and added control points		

M. A. NISHKIAN & CO.
CONSULTING ENGINEERS
LONG BEACH — LOS ANGELES
REGISTERED CIVIL ENGINEER No. 5777

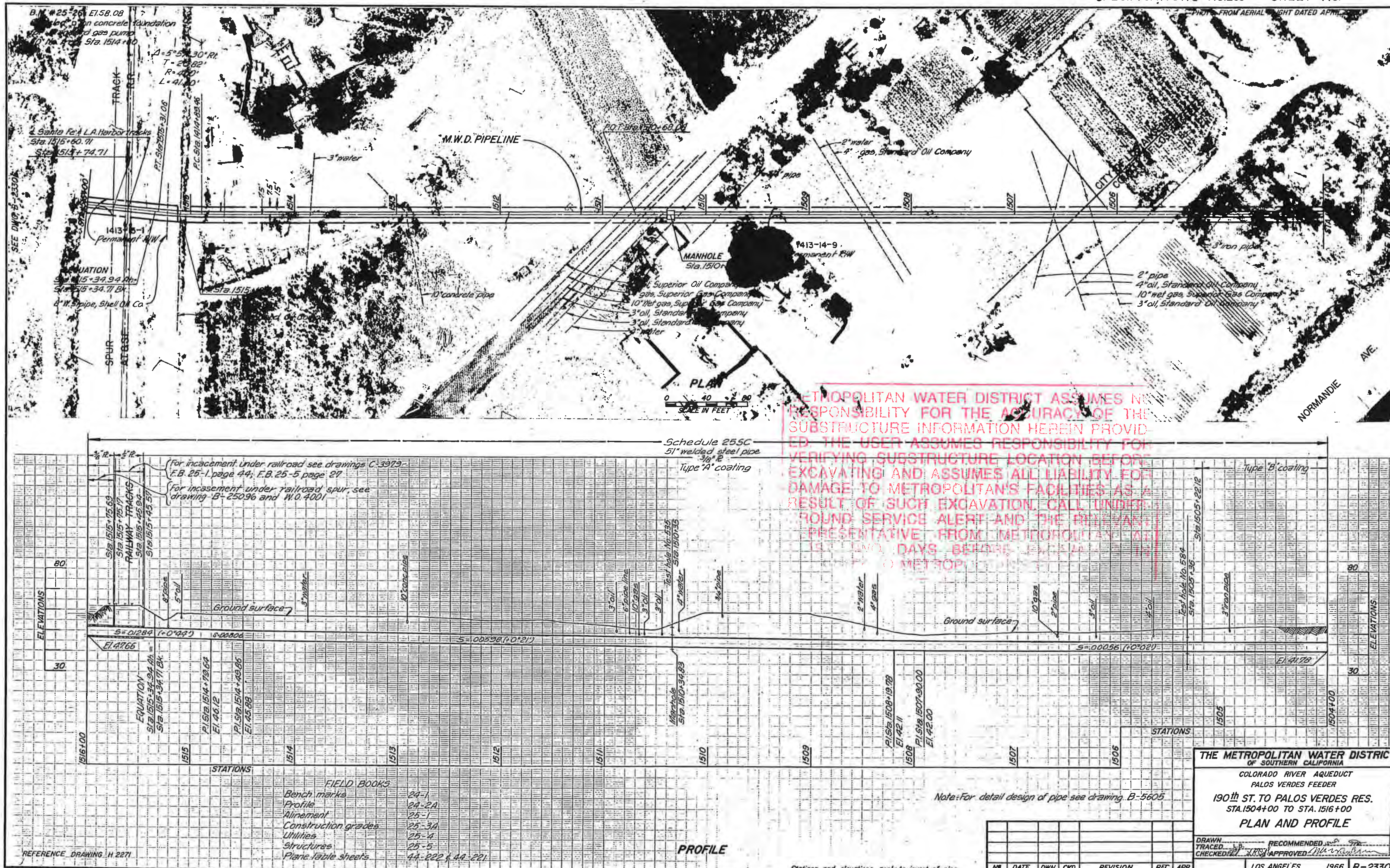
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
DISTRIBUTION SYSTEM
SECOND LOWER FEEDER
STA. 1945+00 TO STA. 1957+00
PLAN AND PROFILE

DRAWN M.A.N.
TRACED M.A.N.
CHECKED
RECOMMENDED
APPROVED
W.O.-3639 LOS ANGELES OCT. 1967 B-22805

REVISION CO-ORDINATION CHECK | ORIGINAL | RELEASE | MECH. | STRUCT. | ELEC. | CIVIL | INTER-SECTION CO-ORDINATION CHECK

PACIFIC AIR INDUSTRIES, INC.

SPECIFICATIONS No.283 SHEET No.



METROPOLITAN WATER DISTRICT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE SUBSTRUCTURE INFORMATION HEREIN PROVIDED. THE USER ASSUMES RESPONSIBILITY FOR VERIFYING SUBSTRUCTURE LOCATION BEFORE EXCAVATING AND ASSUMES ALL LIABILITY FOR DAMAGE TO METROPOLITAN'S FACILITIES AS A RESULT OF SUCH EXCAVATION. CALL UNDERGROUND SERVICE ALERT AND THE RELEVANT REPRESENTATIVE FROM METROPOLITAN AT ... DAYS BEFORE ... METROPOLITAN ...

Nº	DATE	DWN.	CKD.	REVISION	REC.	APP.

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

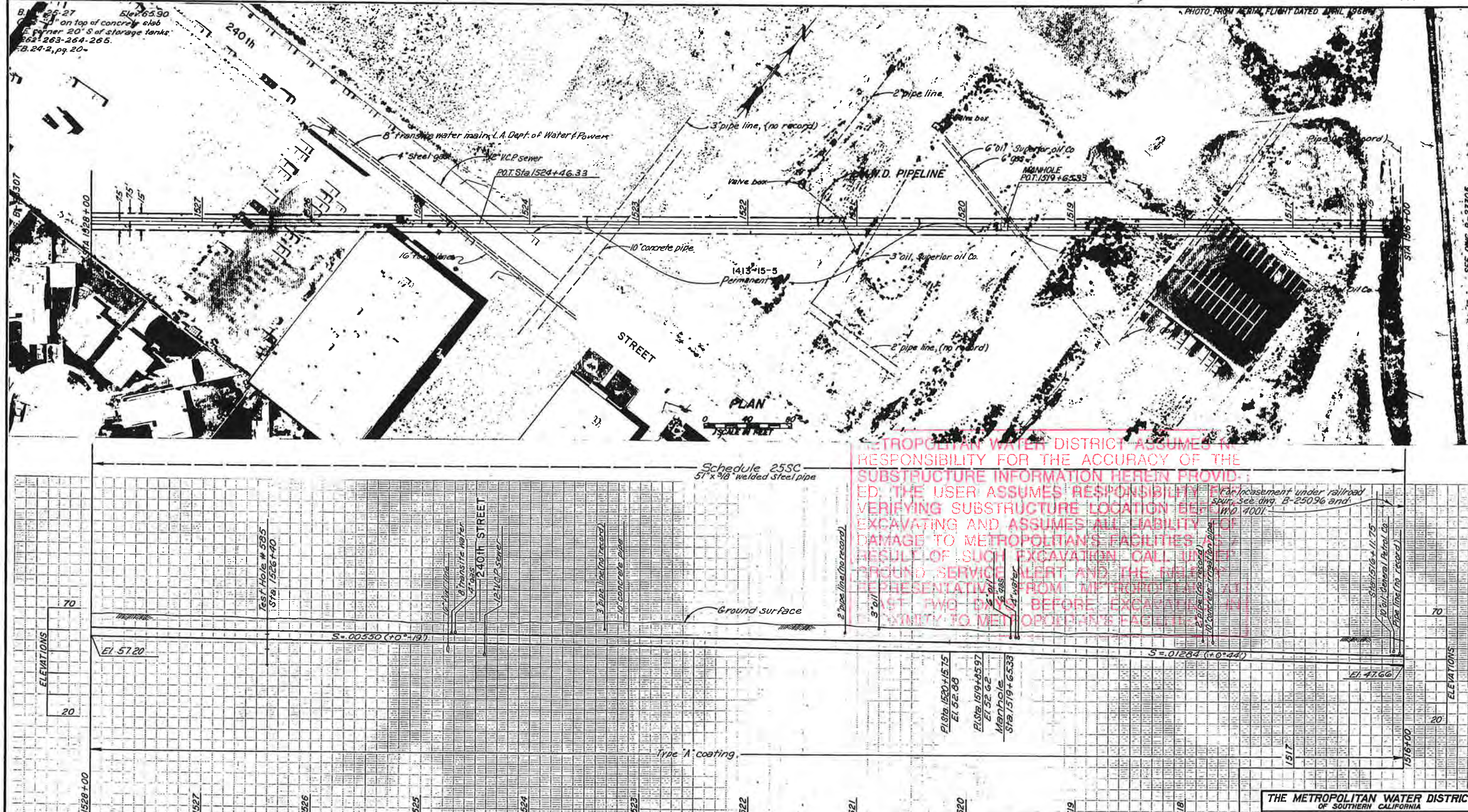
COLORADO RIVER AQUEDUCT
PALOS VERDES FEEDER
190th ST. TO PALOS VERDES RES.
STA.1504+00 TO STA.1516+00

PLAN AND PROFILE

DRAWN
TRACED L.B.
CHECKED
RECOMMENDED
APPROVED

LOS ANGELES 1966 B-23305

SPECIFICATIONS No. 283 SHEET No.



FIELD BOOKS	
Geology	25
Profile	25-2
Alinement	25-1
Bench marks	24-2
Construction grades	25-3A
Utilities	25-4
Structures	25-5
Plane table sheets	44-222 & 44-223

REFERENCE DRAWINGS H-2271 & H-2272

PROFILE

Note: For detail design of pipe see dwg. B-5605

Stations and elevations apply to invert of pipe

Nº	DATE	DWN.	CKD.	REVISION	REC.	APP.

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

COLORADO RIVER AQUEDUCT

PALOS VERDES FEEDER

190th ST. TO PALOS VERDES RESERVOIR

STA 1516+00 TO STA 1528+00

PLAN AND PROFILE

DRAWN
TRACED
CHECKED
RECOMMENDED
APPROVED

LOS ANGELES 1966 B-23306

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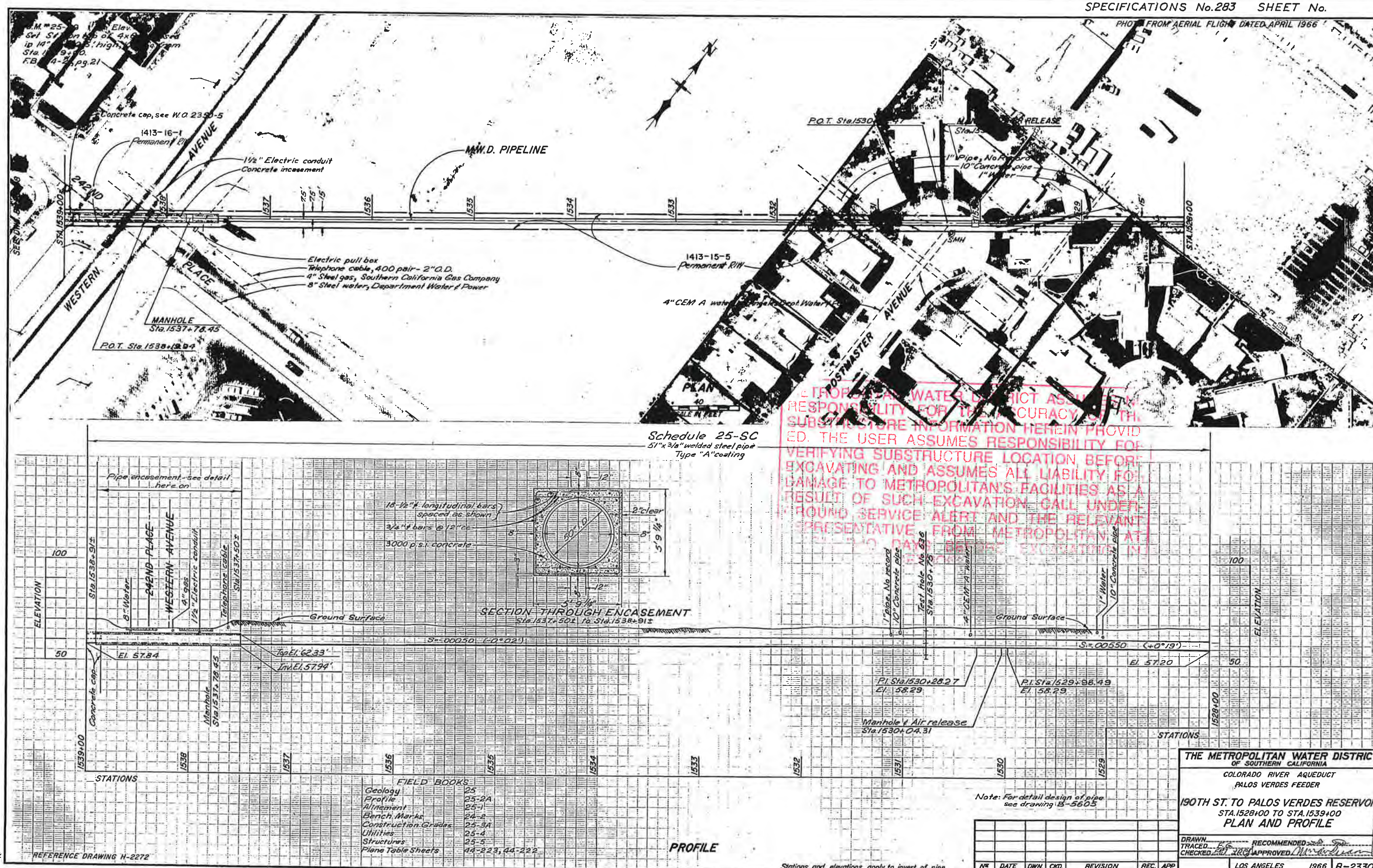
PHOTO FROM AERIAL FLIGHT DATED APRIL 1966
Concrete cap, see W.O. 2350-5
1413-16-1
Permanent R/W
242ND
AVENUE
WESTERN
PLACE
1½" Electric conduit
Concrete incasement
M.W.D. PIPELINE
STA.1539+00
1538
1537
1536
1535
1534
1533
1532
1529
STA.1528+00
Electric pull box
Telephone cable, 400 pair - 2" O.D.
4" Steel gas, Southern California Gas Company
8" Steel water, Department Water & Power
MANHOLE
Sta.1537+78.45
P.O.T. Sta.1538+19.94
1413-15-5
Permanent R/W
P.O.T. Sta.1530
RELEASE
1" Pipe, No Record
10" Concrete pipe
1" Water
SMH
4" CEM A water
POSTMASTER
AVENUE
PLAN
SCALE IN FEET
Schedule 25-SC
51" x 3/8" welded steel pipe
Type "A" coating
Pipe encasement - see detail here on
15-1/2" ø longitudinal bars spaced as shown
3/4" ø bars @ 12" c-c
3000 p.s.i. concrete
2" clear
5'-9¼"
SECTION THROUGH ENCASEMENT
Sta.1537+50± To Sta.1538+91±
Sta.1538+91±
8" Water
242ND PLACE
WESTERN AVENUE
4" gas
1½" Electric conduit
Telephone cable
Sta.1537+50±
Ground Surface
1" pipe, No record
10" Concrete pipe
Test hole No. 536
Sta.1530+75
4" CEM A Water
1" Water
10" Concrete pipe
ELEVATION
100
50
S=-.00050 (-0°02')
S=.00550 (+0°19')
El. 57.84
Top El. 62.33'
Inv. El. 57.94'
El. 57.20
Concrete cap
Manhole
Sta.1537+78.45
P.I. Sta.1530+28.27
El. 58.29
P.I. Sta.1529+98.49
El. 58.29
Manhole & Air release
Sta.1530+04.31
STATIONS
1539+00
1538
1537
1536
1535
1534
1533
1532
1531
1530
1529
1528+00
FIELD BOOKS
Geology 25
Profile 25-2A
Alinement 25-1
Bench Marks 24-2
Construction Grades 25-3A
Utilities 25-4
Structures 25-5
Plane Table Sheets 44-223, 44-222
PROFILE
REFERENCE DRAWING H-2272
Note: For detail design of pipe see drawing B-5605
Stations and elevations apply to invert of pipe
Nº DATE DWN. CKD. REVISION REC. APP.
THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA
COLORADO RIVER AQUEDUCT
PALOS VERDES FEEDER
190TH ST. TO PALOS VERDES RESERVOIR
STA.1528+00 TO STA.1539+00
PLAN AND PROFILE
DRAWN
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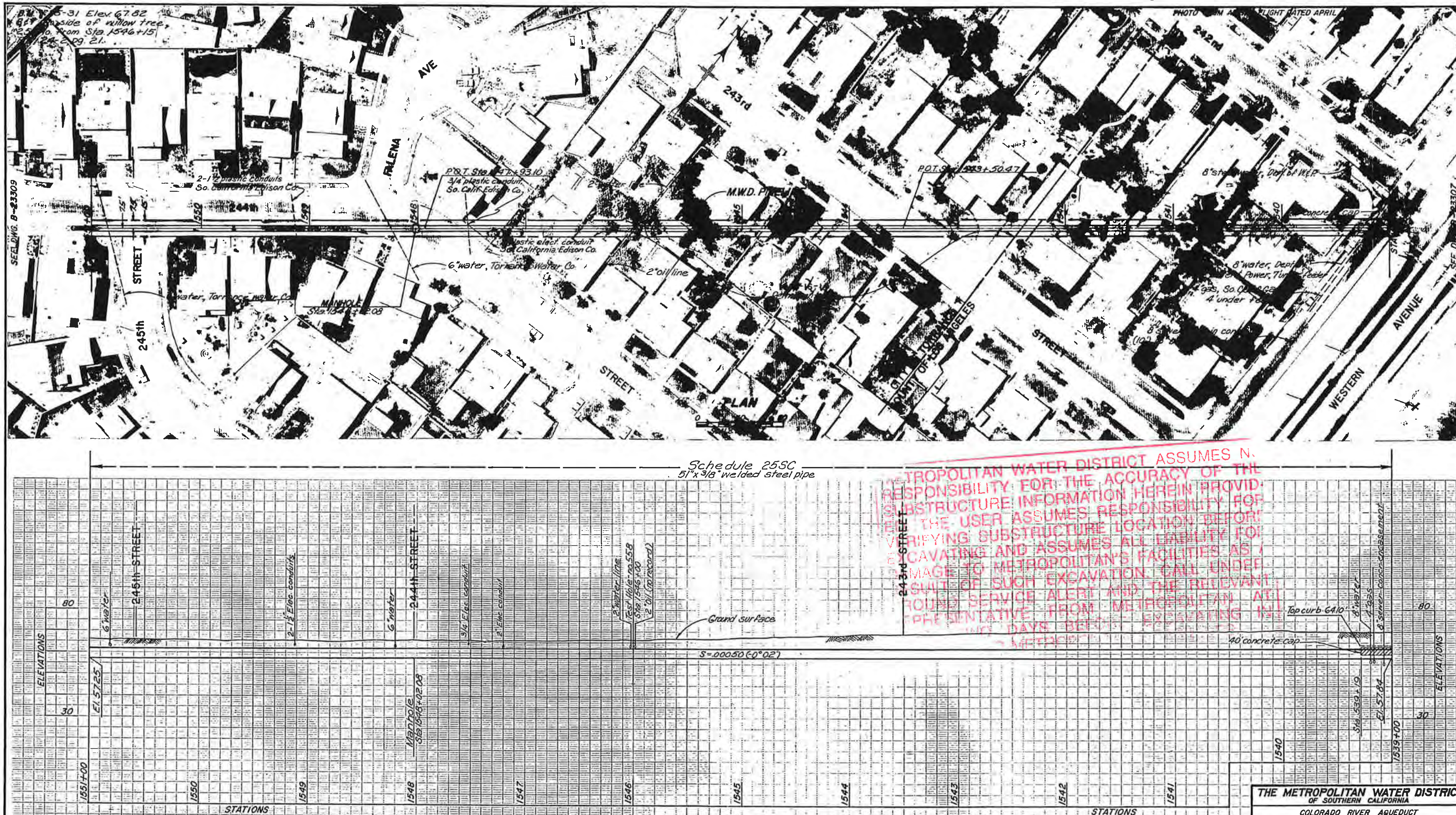
RECOMMENDED
APPROVED
LOS ANGELES 1966 B-23307



FIELD BOOKS
Bench marks — 25
Construction grades — 25-3A
Utilities — 25-4
Structures — 25-5
Geology — 25
Profile — 25-2A
Alinement — 25-1
Plane table sheets 44-223 & 44-224 see H-2278

REFERENCE DRAWINGS H-2272 & H-2273

Note: For detail design of pipe see dwg. B-5605

PROFILE

Stations and elevations apply to invert of pipe

METROPOLITAN WATER DISTRICT ASSUMES N... RESPONSIBILITY FOR THE ACCURACY OF THE SUBSTRUCTURE INFORMATION HEREIN PROVID... THE USER ASSUMES RESPONSIBILITY FOR VERIFYING SUBSTRUCTURE LOCATION BEFORE EXCAVATING AND ASSUMES ALL LIABILITY FOR DAMAGE TO METROPOLITAN'S FACILITIES AS A RESULT OF SUCH EXCAVATION. CALL UNDERGROUND SERVICE ALERT AND THE RELEVANT REPRESENTATIVE FROM METROPOLITAN AT ... WORKING DAYS BEFORE EXCAVATING ...

Nº	DATE	DWN.	CKD.	REVISION	REC.	APP.

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA
COLORADO RIVER AQUEDUCT
PALOS VERDES FEEDER
190TH ST. TO PALOS VERDES RESERVOIR
STA 1539+00 TO STA 1551+00
PLAN AND PROFILE

DRAWN
TRACED
CHECKED
RECOMMENDED
APPROVED

LOS ANGELES 1966 B-23308

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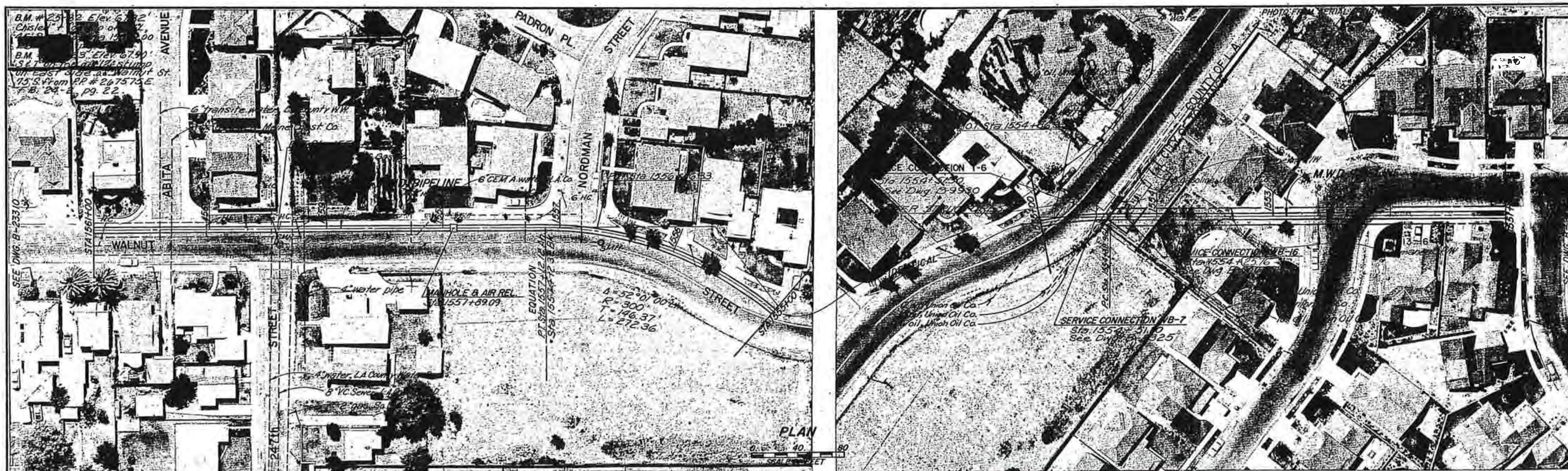
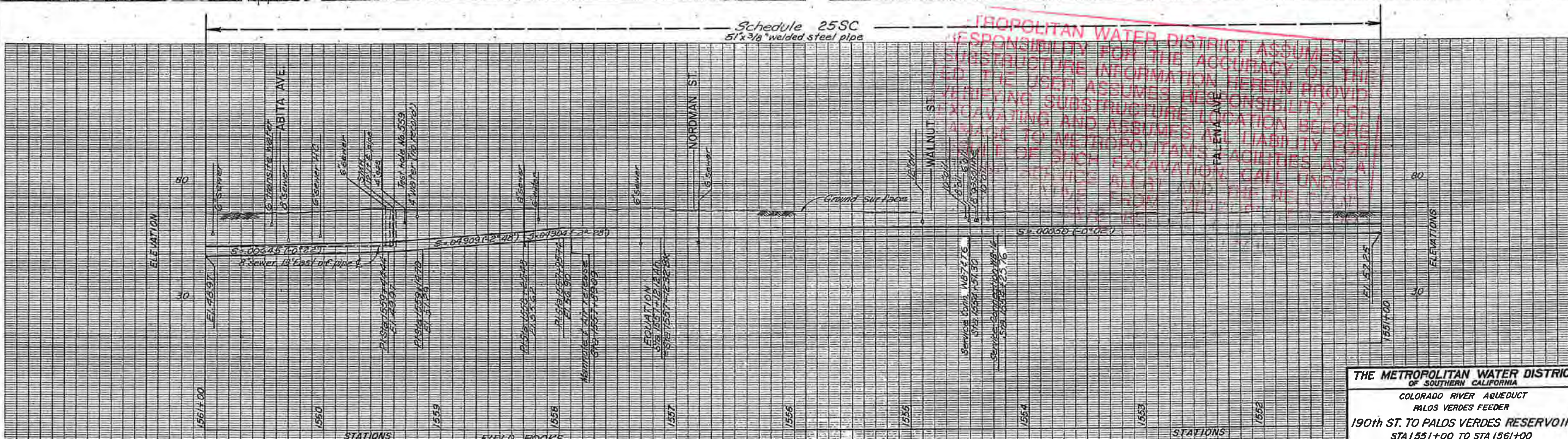
SPECIFICATIONS No. 283 SHEET No.



Schedule 25SC
51" x 3/8" welded steel pipe



METROPOLITAN WATER DISTRICT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE SUBSTRUCTURE INFORMATION HEREIN PROVIDED. THE USER ASSUMES RESPONSIBILITY FOR VERIFYING SUBSTRUCTURE LOCATION BEFORE EXCAVATING AND ASSUMES ALL LIABILITY FOR DAMAGE TO METROPOLITAN'S FACILITIES AS A RESULT OF SUCH EXCAVATION. CALL UNDERGROUND SERVICE ALERT AND THE REGION...

FIELD BOOKS

Bench marks	20-2
Alinement	25-1-1 Plane table sheets 44-223 & 44-224
Construction grades	25-3A
Utilities	25-7
Structures	25-5
Geology	25
Profile	25-2A

Note: For detail design of pipe see dwg. B-5605

Stations and elevations apply to invert of pipe

PROFILE

REFERENCE DRAWING H-2273

Nº	DATE	DWN.	CKD.	REVISION	REC.	APP.

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

COLORADO RIVER AQUEDUCT
PALOS VERDES FEEDER

190th ST. TO PALOS VERDES RESERVOIR
STA 1551+00 TO STA 1561+00

PLAN AND PROFILE

DRAWN ... RECOMMENDED ...
TRACED ...
CHECKED ... APPROVED ...

LOS ANGELES 1966 B-23309

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APPENDIX E – GEOTECHNICAL STUDY REPORT

Converse Consultants
Geotechnical Engineering, Environmental & Groundwater Science, Inspection & Testing Services

GEOTECHNICAL STUDY REPORT
Proposed Torrance Airport Infiltration Galleries Project
3301 Airport Drive
Torrance, California

Converse Project No. 13-31-225-01

September 27, 2013

PREPARED FOR
Corollo Engineers, Inc.
199 South Los Robles Ave. Suite 530
Pasadena, CA 91101

222 East Huntington Drive, Suite 211, Monrovia, California 91016-3500
Telephone: (626) 930-1200 ♦ Facsimile: (626) 930-1212 ♦ e-mail: converse@converseconsultants.com

Converse Consultants

Geotechnical Engineering, Environmental & Groundwater Science, Inspection & Testing Services

September 27, 2013

Mr. Bijan Sadeghi, P.E.
Carollo Engineers, Inc.
199 South Los Robles Avenue, Suite 530
Pasadena, CA 91101

Subject: **GEOTECHNICAL STUDY REPORT**
Proposed Torrance Airport Infiltration Galleries Project
3301 Airport Drive
Torrance, California
Converse Project No. 13-31-225-01

Dear Mr. Sadeghi:

Converse Consultants (Converse) is pleased to present this Geotechnical Study Report for the design of Torrance Airport Infiltration Galleries Project in Torrance, California. Our services were performed in accordance with our proposal dated June 27, 2013.

Based on our field exploration, laboratory testing, geologic evaluation and geotechnical analysis, the site is suitable from a geotechnical standpoint for the proposed project, provided our conclusions and recommendations are implemented during design and construction.

We appreciate the opportunity to be of service to Carollo Engineers, Inc. If you should have any questions, please do not hesitate to contact us at (626) 930-1200.

CONVERSE CONSULTANTS

William H. Chu, P.E., G.E.
Senior Vice President/Principal Engineer

Dist: 4/Addressee

MM/SCL/WHC/amm

222 East Huntington Drive, Suite 211, Monrovia, California 91016-3500
Telephone: (626) 930-1200 ♦ Facsimile: (626) 930-1212 ♦ e-mail: converse@converseconsultants.com

PROFESSIONAL CERTIFICATION

This report for the proposed Torrance Airport Infiltration Galleries Project located at 3301 Airport Drive in the City of Torrance, California has been prepared by the staff of Converse under the professional supervision of the individuals whose seals and signatures appear hereon.

The findings, recommendations, specifications or professional opinions contained in this report were prepared in accordance with generally accepted professional engineering and engineering geologic principles and practice in this area of Southern California. There is no warranty, either expressed or implied.

In the event that changes to the property occur, or additional, relevant information about the property is brought to our attention, the conclusions contained in this report may not be valid unless these changes and additional relevant information are reviewed and the recommendations of this report are modified or verified in writing.

Mohammad-Saad Malim, E.I.T
Staff Engineer

William H. Chu, G.E.
Principal Engineer, Senior Vice President

REGISTERED PROFESSIONAL ENGINEER
CHU HSUEH-HSIN WILLIAM
No. 2482
Exp 6/30/14
GEOTECHNICAL
STATE OF CALIFORNIA

EXECUTIVE SUMMARY

The following is the summary of our geotechnical study, findings, conclusions, and recommendations, as presented in the body of this report. Please refer to the appropriate sections of the report for complete conclusions and recommendations. In the event of a conflict between this summary and the report, or an omission in the summary, the report shall prevail.

- The project site is located at 3301 Airport Drive in the City of Torrance, California
- Three (3) exploratory borings (BH-1 through BH-3) were drilled within the project site on September 3, 2013. The borings were advanced using a truck mounted 8-inch diameter hollow stem auger drill rig to depths of 51.5 feet below the existing ground surface (bgs). Every boring was visually logged by a Converse engineer and sampled at regular intervals and at changes in subsurface soils.
- The earth materials encountered during our investigation consist of existing fill soils placed during previous site grading operations and natural alluvial soils. The fill soils encountered to depths of f feet below ground surface (bgs) are described as silty sand and sandy clay. Deeper fills may be present at the other areas at the site based on our field observations of existing on-site structures. The alluvial soils below the fill primarily consist of clay and sand to a maximum depth of 51.5 feet below ground surface (bgs).
- Groundwater was not encountered in our exploratory borings drilled to a maximum depth of 51.5 feet below the ground surface. Review of LA County Department of Public Works groundwater monitoring well number 769 and 271N indicate the historical highest groundwater level is reportedly deeper than 80 feet below the ground surface. Groundwater is not anticipated during construction and will not need to be considered in design.
- The site is not located within a mapped Seismic Hazard Zone for liquefaction potential. Based on the results of our subsurface exploration, including the absence of groundwater within 50 feet, and our experience on similar projects, the site is not considered susceptible to liquefaction and seismically-induced settlement is negligible.
- Results of our study indicate that the site is suitable from a geotechnical standpoint for the proposed development, provided that the recommendations contained in this report are incorporated into the design and construction of the project.
- The proposed buildings can be supported on conventional shallow foundations embedded into compacted fill.
- Soil can be excavated with conventional heavy-duty earthmoving equipments.

- The near surface site soils have a high expansion potential. Mitigation measures for expansive soil are anticipated. We recommend that two feet of suitable, non-expansive, sandy import materials approved by Converse be placed under planned footings and slabs.
- Based on the soil corrosivity test results, the near surface sols is not considered corrosive to concrete, However, the minimum saturated resistivity testing result indicates the onsite soil is considered corrosive to ferrous metal. Protections of underground metal pipe should be considered.
- Based on our field exploration, surficial clayey soils encountered up to 40 feet deep are not considered effective for planned infiltration systems. Sandy soils encountered below the clayey soil layers are relatively dense and also might not be conducive to good percolation rates. It is recommended that a specific percolation testing program be performed for any planned infiltration system to determine percolation rates at specific depths.

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TABLES

DRAWINGS

APPENDICES

1.0 INTRODUCTION

This report contains the findings and recommendations of our geotechnical study performed for the proposed Torrance Airport Infiltration Galleries Project located at 3301 Airport Drive in the City of Torrance, California as shown on Drawing No. 1, *Site Location Map*.

The purpose of this work was to evaluate the subsurface soil conditions, specifically the depths of clays and other impermeable layers, and provide geotechnical recommendations and design recommendations for the proposed project, including current standard of practice seismic and geotechnical engineering interpretations.

This report for geologic and geotechnical design parameters for the project described herein and is intended for use solely by Carollo Engineers, Inc and the City of Torrance. This report should not be used as a bidding document but may be made available to the potential contractors for information on faculty data only. For bidding purposes, the contractors should be responsible for making their own interpretation of the data contained in this report.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Description

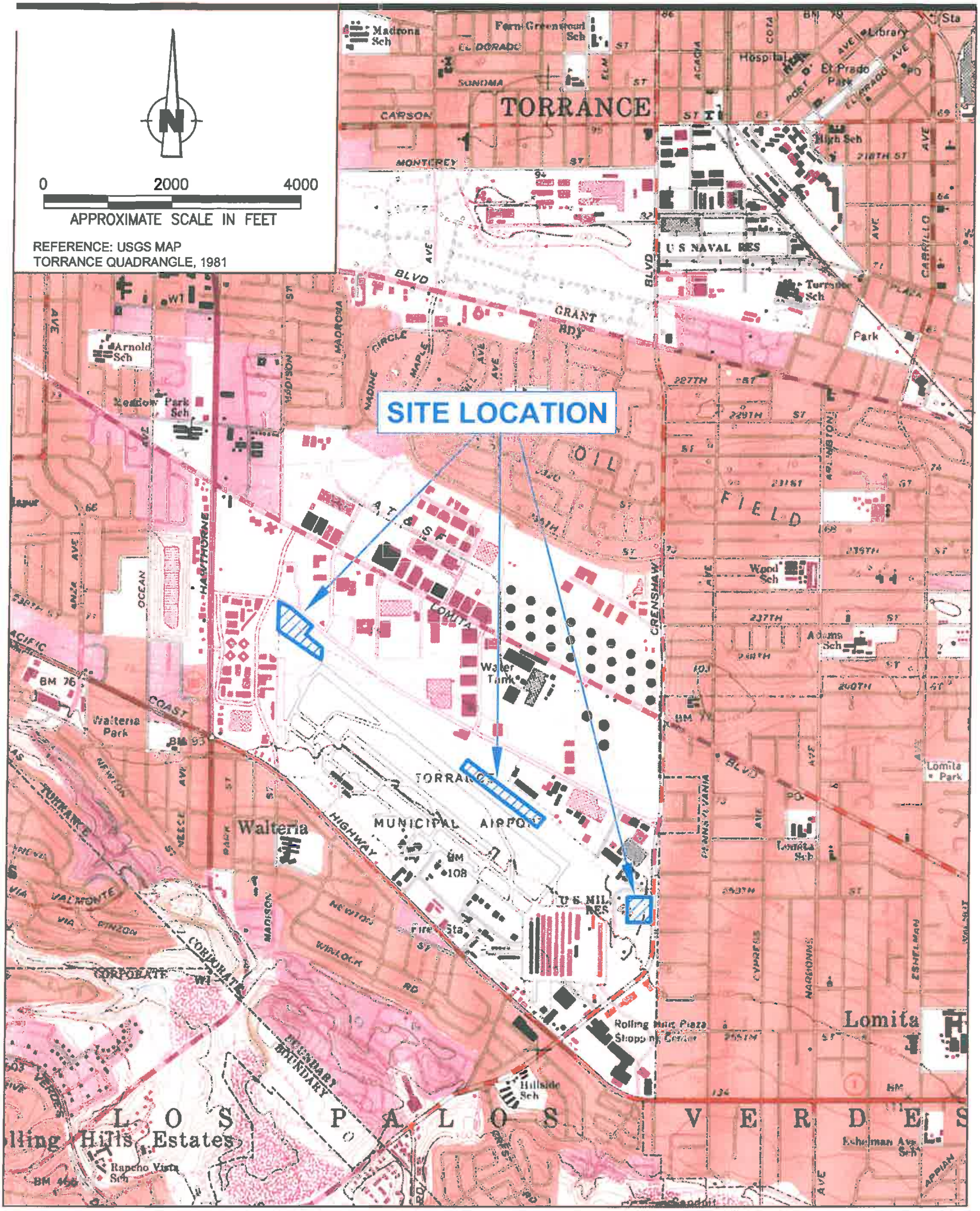
The project site is located at 3301 Airport Drive in the City of Torrance, California. The site currently consists of open fields adjacent to the Torrance Airport runway. The site is gently sloping towards the northwest and the ground elevation is about 90 feet above Mean Sea Level (MSL). The coordinates for the project site are: North latitude: 33.8017 degrees and West longitude: 118.3346 degrees. The project site is shown on Drawing No. 2, *Site Plan and Boring Locations*.

2.2 Project Description

The proposed project consists of the construction of three (3) potential infiltration galleries at Area 1 (approximately 246,400 square feet), Area 2 (approximately 105,000 square feet), and Area 3 (165,000 square feet) within Torrance Airport as shown on Drawing No. 2, *Site Plan and Boring Locations.* The proposed infiltration galleries are planned to divert flow from Machado Lake.

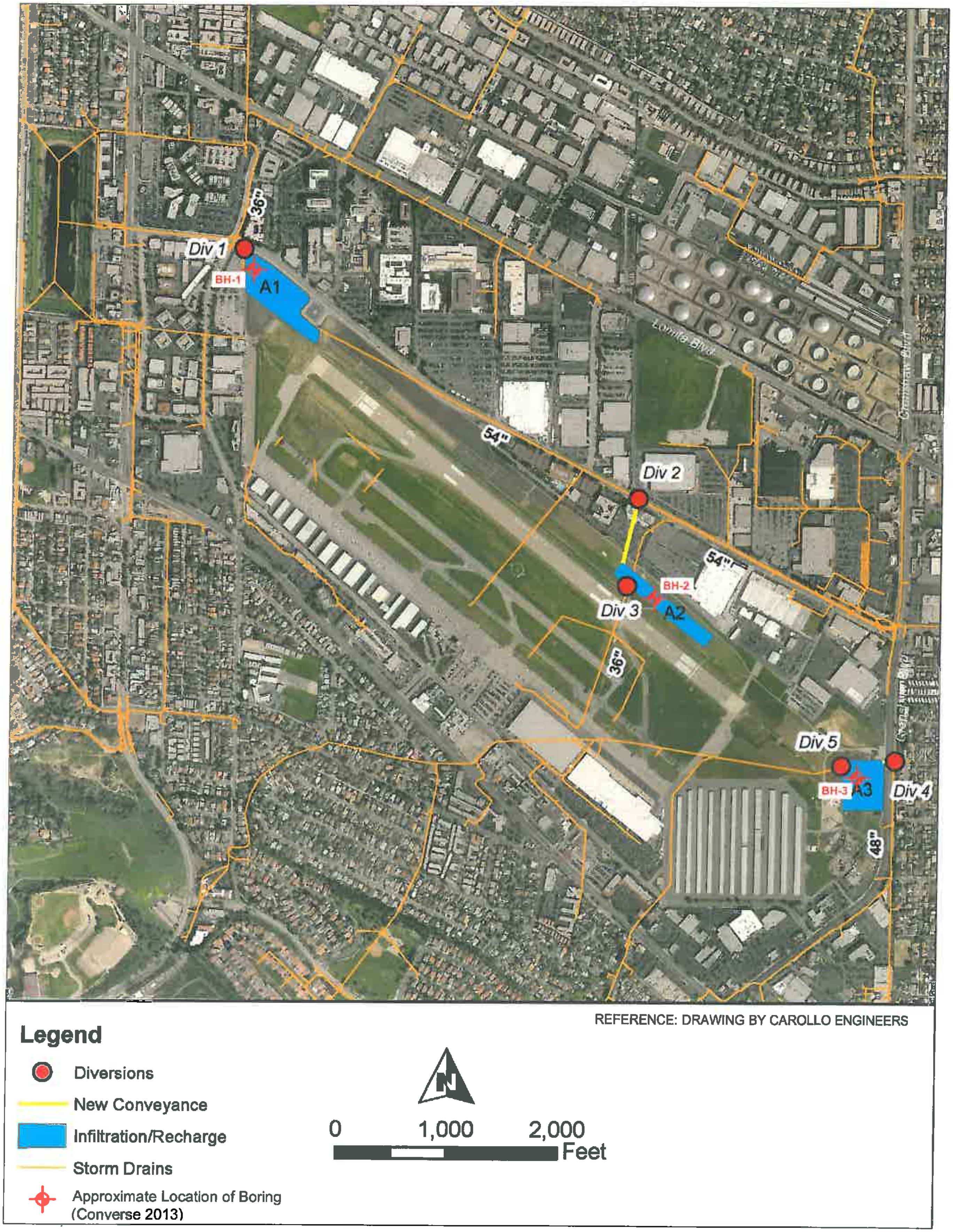
3.0 SCOPE OF WORK

The scope of our present study includes a review of the existing site plan, site reconnaissance, subsurface exploration, soil sampling, laboratory testing, preliminary



SITE LOCATION MAP

Converse Consultants	TORRANCE AIRPORT INFILTRATION GALLERIES TORRANCE, CALIFORNIA	Project No. 13-31-225-01	Drawing No. 1



SITE PLAN AND BORING LOCATIONS

Converse Consultants

TORRANCE AIRPORT INFILTRATION GALLERIES
TORRANCE, CALIFORNIA

Project No.	Drawing No.
13-31-225-01	2

engineering analysis, and preparation of this report. Details of the tasks are addressed in the following sections:

3.1 Site Reconnaissance

As a part of our project set-up task, available published geotechnical and geologic data were reviewed for the project area to ascertain regional geologic and groundwater conditions, and to screen for potential geologic hazards.

Converse representatives also visited the site prior to drilling to assess the site accessibility for drilling equipment, and to mark the boring locations on August 29, 2013. Underground Service Alert of Southern California was notified at least 48 hours prior to the field exploration.

3.2 Subsurface Exploration

Three (3) exploratory borings (BH-1 through BH-3) were drilled within the project site on September 3, 2013. The borings were advanced using a truck mounted 8-inch diameter hollow stem auger drill rig to depths 51.5 feet below the existing ground surface (bgs). Every boring was visually logged by a Converse engineer and sampled at regular intervals and at changes in subsurface soils. Detailed descriptions of the field exploration and sampling program are presented in Appendix A, *Field Exploration*.

California Modified Sampler (Ring samples), Standard Penetration Test samples, and bulk soil samples were obtained for laboratory testing. Standard Penetration Tests (SPTs) were performed in selected borings at selected intervals using a standard (1.4 inches inside diameter and 2.0 inches outside diameter) split-barrel sampler. The bore holes were backfilled and compacted with soil cuttings and cement by reverse spinning of the auger following the completion of drilling. Borings within paved areas were patched with asphalt cold-patch, with the patch thickness matching the surrounding pavement section.

The approximate locations of the exploratory borings are shown in Drawing No. 2, *Site Plan and Boring Locations.* The detailed description of the field exploration and sampling program are presented in Appendix A, *Field Exploration*.

3.3 Laboratory Testing

Representative samples of the site soils were tested in the laboratory to aid in the classification and to evaluate relevant engineering properties. The tests performed included:

- *In situ* moisture contents and dry densities (ASTM Standard D2216)

- Maximum dry density and optimum-moisture content relationship (ASTM Standard D1557)
- Percent Finer than Sieve No. 200 (ASTM D1140)
- Direct shear (ASTM Standard D3080)
- Consolidation (ASTM Standard D2435)
- Expansion Index (ASTM D4829)
- Atterburg Limits (ASTM D4318)
- Soil corrosivity tests (Caltrans 643, 422, 417 and 532)

The detailed description of the laboratory test methods and test results are presented in Appendix B, *Laboratory Testing Program*.

3.4 Analyses and Report

Data obtained from the exploratory fieldwork and laboratory-testing program were analyzed and evaluated with respect to the planned construction. This report was prepared to provide the findings, conclusions and recommendations developed during our study and evaluation.

4.0 SUBSURFACE CONDITIONS

4.1 Regional Geologic Setting

The project site is located within the west coast portion of the Los Angeles Basin and underlain by alluvial soils as shown on Drawing No. 3, *Regional Geologic Map*.

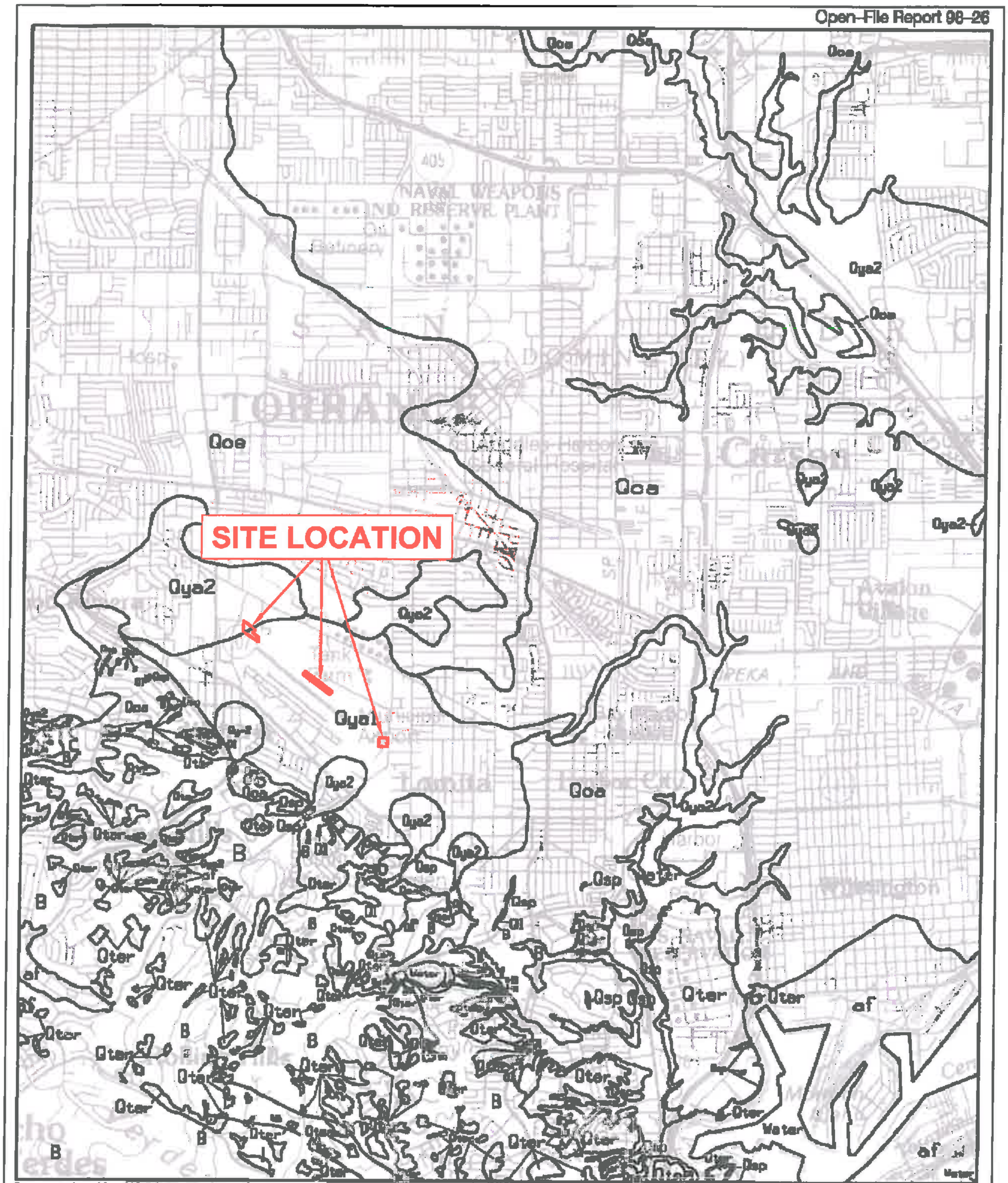
4.2 Subsurface Soil Profile of Project Site

The earth materials encountered during our investigation consist of existing fill soils placed during previous site grading operations and natural alluvial soils. Based on our field exploration, undocumented fill up to a maximum observed depth of five (5) feet were encountered in the borings. The fill soils encountered are described as silty sand and sandy clay. Deeper fills may be present at the other areas at the site based on our field observations of existing on-site structures. The alluvial soils below the fill primarily consist of clay and sand to a maximum depth of 51.5 feet below ground surface (bgs).

The detailed description of the materials encountered in each boring is presented in Appendix A, *Field Exploration*.

4.3 Groundwater

Groundwater was not encountered in our exploratory borings drilled to a maximum depth of 51.5 feet below the ground surface. Review of LA County Department of Public



Base map enlarged from U.S.G.S. 30 x 60-minute series

Plate 1.1 Quaternary Geologic Map of the Torrance Quadrangle.
See Geologic Conditions section in report for descriptions of the units.
B = Pre-Quaternary bedrock.

ONE MILE

SCALE

REGIONAL GEOLOGIC MAP

Converse Consultants

TORRANCE AIRPORT INFILTRATION GALLERIES
TORRANCE, CALIFORNIA

Project No.	Drawing No.
13-31-225-01	3

Works groundwater monitoring wells number 769 and 271N indicate the historical highest groundwater level is reportedly deeper than 80 feet below the ground surface. Groundwater is not anticipated during construction and will not need to be considered in design.

4.4 Subsurface Variations

Based on results of the subsurface exploration and our experience, some variations in the continuity and nature of subsurface conditions within the project site should be anticipated. Because of the uncertainties involved in the nature and geologic characteristics of the earth material at the site, care should be exercised in interpolating or extrapolating subsurface conditions between or beyond the boring locations. If during construction, subsurface conditions differ significantly from those presented in this report; this office should be notified immediately so that recommendations can be modified, if necessary.

5.0 FAULTING AND GEOLOGIC HAZARDS

Geologic hazards are defined as geologically related conditions that may present a potential danger to life and property. Typical geologic hazards in Southern California include earthquake ground shaking, fault surface rupture, landslides, and liquefaction.

5.1 Fault Surface Rupture and Active Faults

The project site is not located within a currently designated State of California Earthquake Fault Zone (formerly Alquist-Priolo Special Studies Zones) for surface fault rupture. No surface faults are known to project through or towards the site. The closest known fault to the project site is the Palos Verdes Hills Fault Zone located at approximately 1.2 km to the south-west.

5.2 Liquefaction

Liquefaction is the sudden decrease in the strength of cohesionless soils due to dynamic or cyclic shaking. Saturated soils behave temporarily as a viscous fluid (liquefaction) and, consequently, lose their capacity to support the structures founded on them. The potential for liquefaction decreases with increasing clay and gravel content, but increases as the ground acceleration and duration of shaking increase. Liquefaction potential has been found to be the greatest where the groundwater level and loose sands occur within 50 feet of the ground surface. The site is not located within a mapped Seismic Hazard Zone for liquefaction (CDMG, 1998) as shown in Drawing No. 4, *Seismic Hazard Zones Map*.

Based on the results of our subsurface exploration, including the absence of shallow groundwater, high SPT blow counts, and our experience on similar projects we anticipate liquefaction potential to be very low and seismically-induced settlement to be negligible.

5.3 Landslides

The site is not located within a Seismic Hazard Zone for required investigation for earthquake-induced landsliding (CDMG, 1999). The project site is relatively flat and not located near any hillside terrain. In the absence of significant ground slopes, the potential for seismically induced landslides to affect the proposed site is considered to be nil.

6.0 SEISMIC ANALYSIS

6.1 CBC Seismic Design Parameters

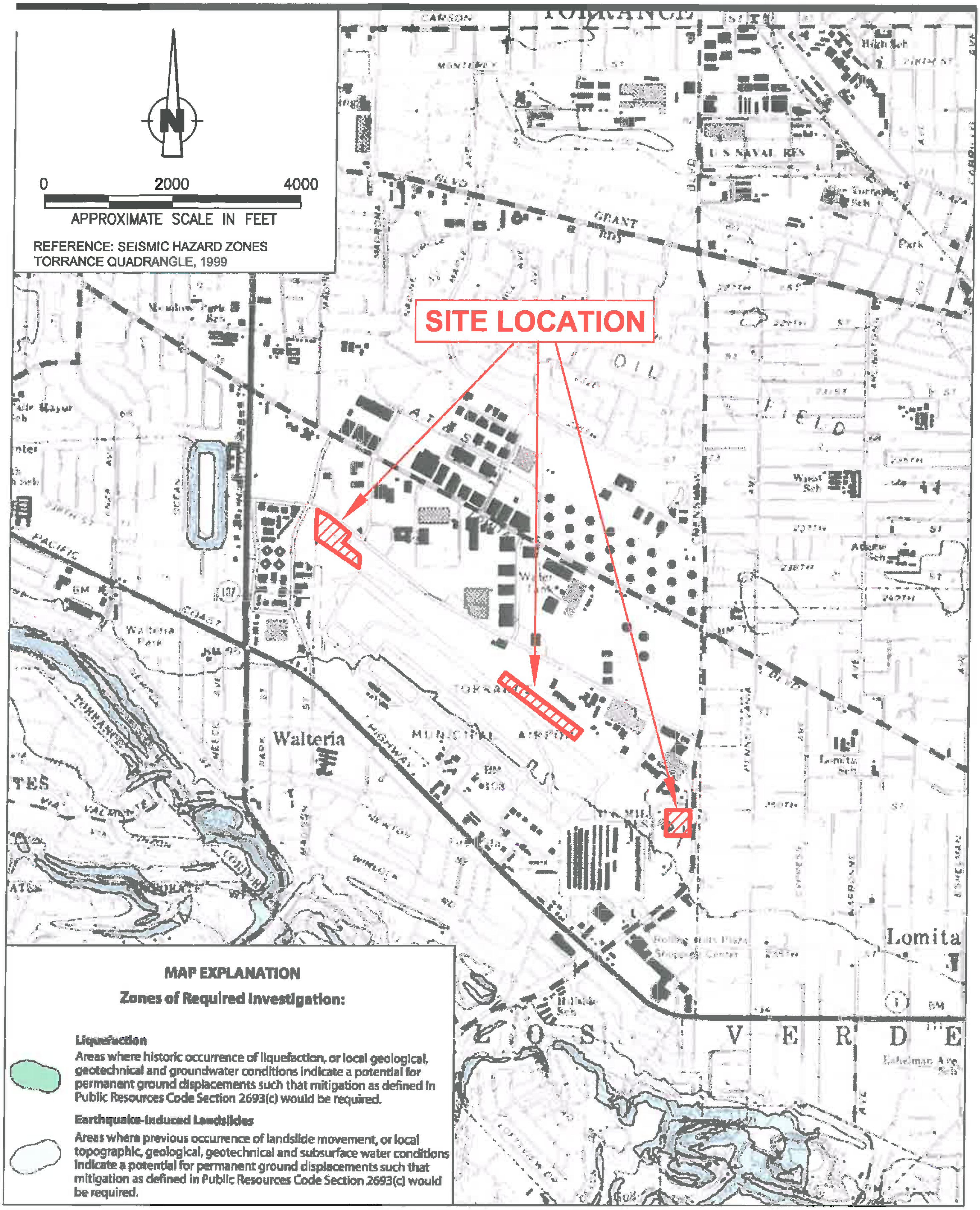
Seismic parameters based on the 2010 and 2013 California Building Code are calculated using the United States Geological Survey *U.S. Seismic Design Maps* website application. The seismic parameters are presented below.

Table No. 1, 2010 and 2013 CBC Seismic Parameters

Seismic Parameters	2010 CBC	2013 CBC
Site Class	D	D
Mapped Short period (0.2-sec) Spectral Response Acceleration, S_S	2.096 g	1.715 g
Mapped 1-second Spectral Response Acceleration, S_1	0.872 g	0.665 g
Site Coefficient (from Table 1613.5.3(1)), F_a	1.0	1.0
Site Coefficient (from Table 1613.5.3(2)), F_v	1.5	1.5
MCE 0.2-sec period Spectral Response Acceleration, S_{MS}	2.096 g	1.715 g
MCE 1-second period Spectral Response Acceleration, S_{M1}	1.308 g	0.997 g
Design Spectral Response Acceleration for short period, S_{DS}	1.397 g	1.143 g
Design Spectral Response Acceleration for 1-second period, S_{D1}	0.872 g	0.665 g
Seismic Design Category	D	D

6.2 Deaggregated Seismic Source Parameters

Based on our analyses utilizing the USGS 2008 NSHMP PSHA Interactive Deaggregation web site, the mean and modal earthquake magnitudes for a return time of 2475 years is calculated to be 6.92 and 7.19, respectively. The earthquake magnitude of 7.19 should be considered for seismic design at the project site.



SEISMIC HAZARD ZONES MAP

Converse Consultants	TORRANCE AIRPORT INFILTRATION GALLERIES TORRANCE, CALIFORNIA	Project No. 13-31-225-01	Drawing No. 4

7.0 DESIGN RECOMMENDATIONS

7.1 General Evaluation

Based on the results of our literature review, subsurface exploration, laboratory testing, geotechnical analyses, and understanding of the planned site improvements, it is our opinion that the proposed project is feasible from a geotechnical standpoint, provided the following conclusions and recommendations are incorporated into the project plans, specifications, and are followed during site construction. The following geotechnical findings should be considered for the planned projects:

- Groundwater was not encountered in our exploratory borings to a maximum depth of 51.5 feet. Groundwater is not anticipated during construction and will not need to be considered in design.
- It is our opinion that the proposed structures can be supported on conventional shallow foundations embedded into compacted fill.
- Due to existing surficial undocumented fill, we recommend over-excavation and re-compaction to be at least 5-feet from the existing ground surface, or 2-feet below bottom of footings, whichever is deeper at the structure area. Lateral over-excavation limits should extend at least 5 feet beyond edge of footings, where the space is available. For pavement and flatwork area, we recommend 2 feet over-excavation and re-compaction.
- Laboratory testing indicates the site soils have a high expansion potential. Mitigation measures for expansive soil are anticipated. We recommend that two feet of suitable, non-expansive, sandy import materials approved by Converse be placed under planned footings and slabs.
- The on-site soil is not considered corrosive to concrete. However, the minimum saturated resistivity testing result indicates the onsite soil is considered corrosive to ferrous metal. Protections of underground metal pipe should be considered.
- Soil can be excavated with conventional heavy-duty earthmoving equipments.
- Based on our field exploration, surficial clayey soils encountered up to 40 feet deep are not considered effective for planned infiltration systems. Sandy soils encountered below the clayey soil layers are relatively dense and also might not be conducive to good percolation rates. It is recommended that a specific percolation testing program be performed for any planned infiltration system to determine percolation rates at specific depths.

7.2 Shallow Foundations

7.2.1 Vertical Capacity

We recommend the bottoms of continuous and square footings be founded at least 18 inches below lowest adjacent final grade on compacted fills. A minimum footing width of 24 inches is recommended for square footings and 15 inches for continuous footings. The allowable bearing value for footings with above minimum sizes is 2,000 psf for dead plus live load. The net allowable bearing pressure can be increase by 150 psf for each additional foot of excavation depth and by 150 psf for each additional foot of excavation width up to a maximum value of 3,000 psf.

The net allowable bearing values indicated above are for the dead loads and frequently applied live loads and are obtained by applying a factor of safety of 3.0 to the net ultimate bearing capacity.

7.2.2 Lateral Capacity

Resistance to lateral loads can be provided by friction acting at the base of the foundation and by passive earth pressure. A coefficient of friction of 0.3 may be assumed with normal dead load forces. An allowable passive earth pressure of 300 psf per foot of depth up to a maximum of 3,000 psf may be used for footings poured against properly compacted fill. The values of coefficient of friction and allowable passive earth pressure include a factor of safety of 1.5.

7.2.3 Settlement

The static settlement of structures supported on continuous and/or spread footings founded on compacted fill will depend on the actual footing dimensions and the imposed vertical loads. Most of the footing settlement at the project site is expected to occur immediately after the application of the load. Based on the maximum allowable net bearing pressures presented above, static settlement is anticipated to be less than 0.5 inch. Differential settlement is expected to be up to one-half of the total settlement over a 30-foot span.

7.2.4 Dynamic Increases

Bearing values indicated above are for total dead load and frequently applied live loads. The above vertical bearing may be increased by 33% for short durations of loading which will include the effect of wind or seismic forces. The allowable passive pressure may be increased by 33% for lateral loading due to wind or seismic forces.

7.3 Slabs-on-grade

Slabs-on-grade should be supported on compacted fill and have a minimum thickness of four inches nominal for support of normal ground-floor live loads. Minimum reinforcement for slabs-on-grade should be No. 3 reinforcing bars, spaced at 18 inches on-center each way. The thickness and reinforcement of more heavily-loaded slabs will be dependent upon the anticipated loads and should be designed by a structural engineer. A static modulus of subgrade reaction equal to 150 pounds per square inch per inch may be used in structural design of concrete slabs-on-grade.

It is critical that the exposed subgrade soils should not be allowed to desiccate prior to the slab pour. Care should be taken during concrete placement to avoid slab curling. Slabs should be designed and constructed as promulgated by the ACI and Portland Cement Association (PCA). Prior to the slab pour, all utility trenches should be properly backfilled and compacted.

In areas where a moisture-sensitive floor covering (such as vinyl tile or carpet) is used, a 10-mil-thick moisture retarder/barrier between the bottom of slab and subgrade that meets the performance criteria of ASTM E 1745 Class A material. Retarder/barrier sheets should be overlapped a minimum of six inches, and should be taped or otherwise sealed per the product specifications.

7.4 Earth Pressures for Retaining Structures

The following design values can be used for the retaining walls, if proposed. The earth pressure behind any retaining wall depends primarily on the allowable wall movement, type of soil behind the wall, backfill slopes, wall inclination, surcharges, and any hydrostatic pressure. The following earth pressures are recommended for vertical walls with no hydrostatic pressure.

Table No. 2, Lateral Earth Pressures for Retaining Wall Design

Backfill Slope (H:V)	Cantilever Wall Equivalent Fluid Pressure (pcf)	Restrained Wall (psf)
Level	30 (triangular pressure distribution)	23H (uniform pressure distribution)

The recommended lateral pressures assume that the walls are fully back-drained to prevent build-up of hydrostatic pressure. Adequate drainage could be provided by means of permeable drainage materials wrapped in filter fabric installed behind the walls. The drainage system should consist of perforated pipe surrounded by a minimum one (1) square feet per lineal feet of free draining, uniformly graded, ¾ -inch washed, crushed aggregate, and wrapped in filter fabric such as Mirafi 140N or equivalent. The filter fabric should overlap approximately 12 inches or more at the joints. The subdrain pipe should consist of perforated, four-inch diameter, rigid ABS (SDR-35) or PVC A-2000, or equivalent, with perforations placed down. Alternatively, a prefabricated drainage composite system such as the Miradrain G100N or equivalent can be used. The subdrain should be connected to solid pipe outlets, with a maximum outlet spacing of 100 feet.

Walls subjected to surcharge loads located within a distance equal to the height of the wall should be designed for an additional uniform lateral pressure equal to one-third or one-half the anticipated surcharge load for unrestrained or restrained walls, respectively. These values are applicable for backfill placed between the wall stem and an imaginary plane rising 45 degrees from below the edge (heel) of the wall footings.

Retaining walls greater than 12 feet should be designed to resist additional earth pressure caused by seismic ground shaking. A seismic earth pressure of 16H (psf), based on an inverted triangular distribution, can be used for design of wall.

7.5 Soil Corrosivity Evaluation

Based on our review of soil corrosivity test results (see Appendix B), the pH and chloride content are not in the corrosive range to ferrous metal. The soluble sulfate concentration is not in the corrosive range to concrete. However the minimum saturated resistivity is in the corrosive range to ferrous metal. Protections of underground metal pipe should be considered.

A corrosion engineer may be consulted for appropriate mitigation procedures and construction design, if needed. General considerations for corrosion mitigation measures may include the following:

- Steel and wire concrete reinforcement should have at least three inches of concrete cover where cast against soil, unformed.
- Below-grade ferrous metals should be given a high-quality protective coating, such as 18-mil plastic tape, extruded polyethylene, coal-tar enamel, or Portland cement mortar.
- Below-grade metals should be electrically insulated (isolated) from above-grade metals by means of dielectric fittings in ferrous utilities and/or exposed metal structures breaking grade.

7.6 *Percolation Testing*

Percolation testing was not part of the initial scope for this investigation. However, based on the findings of our field exploration, we recommend that a specific percolation testing program be performed for any planned infiltration systems in layers of permeable soils to determine definite percolation rates at the desired depths for infiltration system design.

7.7 Site Drainage

Adequate positive drainage should be provided away from the structure foundations to prevent ponding and to reduce percolation of water into the foundation soils. We recommend that any landscape areas immediately adjacent to the foundation shall be designed sloped away from the foundation with a minimum 2 percent slope gradient for at least 10 feet measured perpendicular to the face of the foundation. Impervious surfaces within 10 feet of the structure foundation shall be sloped a minimum of 1 percent away from the structure.

8.0 SITE GRADING AND EARTHWORK RECOMMENDATIONS

8.1 General

Based on our review of soil boring and laboratory data, the upper five (5) feet of soils consisting of undocumented fills and loose to moderately dense native alluvial soils should be removed and recompacted to provide sufficient lateral resistance and a relatively uniform soil condition for the footings and slab. To help reduce the potential for differential settlement, variations in the soil type, degree of compaction, and thickness of the compacted fill placed underneath slab and/or footings should be kept uniform. Site grading recommendations provided in this report are based on our experience with similar projects in the area and our site-specific geotechnical evaluation.

The existing soils removed during over-excavation can be placed as compacted fill in structural areas after proper processing (free of vegetation, shrubs, roots and debris). Earthwork should be performed with suitable equipment and techniques to selectively screen/remove debris from soils placed as engineered fill. Following remedial grading, compacted fill soils are anticipated to have similar engineering characteristics with the underlying dense alluvial soils.

8.2 Over-Excavation/Removal

For infiltration galleries, we recommend over-excavation be at least five (5) feet below existing grade, or two (2) foot below bottom of footing, or to the depth of undocumented fill, whichever is deeper for slab and foundation support. Deeper removal will be needed if firm soil conditions are not exposed on the excavation bottom. The lateral limits of the over-excavation should extend at least five (5) feet beyond the footing and slab areas, where space is available.

For pavement and concrete flatwork, we recommend over-excavation be at least two (2) feet below existing grade and two (2) feet laterally beyond the footprints, where space is available.

The exposed bottom of the over-excavation area should be scarified at least six (6) inches; moisture conditioned as needed to near-optimum moisture content, and compacted to 90 percent relative compaction. Over-excavation should not undermine adjacent off-site improvements. Remedial grading should not extend within a projected 1:1 (horizontal to vertical) plane projected down from the outer edge of adjacent off-site improvements.

If loose, yielding soil conditions are encountered at the excavation bottom, the following options can be considered:

a. Over-excavate until reach firm bottom.
b. Scarify or over-excavate additional 18 inches deep, and then place at least 18-inch-thick compacted base material (CAB or equivalent) to bridge the soft bottom. Base should be compacted to 90% relative compaction.
c. Over-excavate additional 18 inches deep, and then place a layer of geofabric (i.e. Marifi HP570, X600 or equivalent), place 18-inch-thick compacted base material (CAB or equivalent) to bridge the soft bottom. Base should be compacted to 90% relative compaction. An additional layer of Geo-Fabric may be needed on top of base depending on the actual site conditions.

8.3 Engineered Fill

All engineered fill should be placed on competent, scarified and compacted bottom as evaluated by the geotechnical engineer and in accordance with the recommendations presented in this section. Excavated site soils, free of deleterious materials and rock particles larger than three (3) inches in the largest dimension, should be suitable for placement as compacted fill. Any proposed import fill should be evaluated and approved by Converse prior to import to the site. Import fill material should have an expansion index less than 20.

Prior to compaction, fill materials should be thoroughly mixed and moisture conditioned within three (3) percent above the optimum moisture content. Fill soils shall be evenly spread in maximum 8-inch lifts, watered or dried as necessary, mixed and compacted to at least the density specified below. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Engineer. Upper 12 inches below pavement subgrade should be compacted to at least 95 percent of the laboratory dry density in accordance with the ASTM Standard D1557 test method. All fill, if not specified otherwise elsewhere in this report, should be compacted to at least

90 percent of the laboratory dry density in accordance with the ASTM Standard D1557 test method.

8.4 Excavatability

Based on our field exploration, the earth materials at the site may be excavated with conventional heavy-duty earth moving and trenching equipment. The onsite materials will contain demolition debris, gravel, cobbles and/or boulders. Earthwork should be performed with suitable equipment and methods for removal of debris from the engineered fill.

8.5 Expansive Soil

The near surface soils have a "High" expansive potential. Mitigation measures for expansive soil are anticipated. We recommend that two (2) feet of suitable, non-expansive, sandy import materials approved by Converse be placed under planned footings and slabs.

8.6 Shrinkage and Subsidence

Soil shrinkage and/or bulking as a result of remedial grading depends on several factors including the depth of over-excavation, and the grading method and equipment utilized, and average relative compaction. For preliminary estimation, bulking and shrinkage factors for various units of earth material at the site may be taken as presented below:

- The approximate shrinkage factor for the undocumented fill soils is estimated to range from ten (10) to fifteen (15) percent.
- The approximate shrinkage factor for the native alluvial soils is estimated to range from ten (10) to fifteen (15) percent.
- For estimation purposes, ground subsidence may be taken as 0.1 feet as a result of remedial grading.

Although these values are only approximate, they represent our best estimates of the factors to be used to calculate lost volume that may occur during grading. If more accurate shrinkage and subsidence factors are needed, it is recommended that field-testing using the actual equipment and grading techniques be conducted.

9.0 CONSTRUCTION CONSIDERATIONS

9.1 Temporary Excavations

Based on the materials encountered in the exploratory borings, sloped temporary excavations may be constructed according to the slope ratios presented in the following table:

Table No. 3, Slope Ratios for Temporary Excavation

Maximum Depth of Cut (feet)	Maximum Slope Ratio* (horizontal: vertical)
0 – 4	vertical
4 – 8	1:1
>8	1.5:1

*Slope ratio assumed to be uniform from top to toe of slope.

Any loose utility trench backfill or other fill encountered in excavations will be less stable than the native soils. Temporary cuts encountering loose fill or loose dry sand should be constructed at a flatter gradient than presented in the table above. Surfaces exposed in slope excavations should be kept moist but not saturated to minimize raveling and sloughing during construction. Adequate provisions should be made to protect the slopes from erosion during periods of rainfall. Surcharge loads, including construction, should not be placed within five (5) feet of the unsupported excavation edge. Temporary excavations less than six (6) feet vertical may be proceeded with “A-B-C” slot cut method. The width of each slot should be less than eight (8) feet.

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act of 1987 and current amendments, and the Construction Safety Act should be met. The soils exposed in cuts should be observed during excavation by the project's geotechnical consultant. If potentially unstable soil conditions are encountered, modifications of slope ratios for temporary cuts may be required.

9.2 Geotechnical Services during Construction

This report has been prepared to aid in the foundation plans and specifications, and to assist the architect, civil and structural engineers in the design of the proposed structures. It is recommended that this office be provided an opportunity to review final design drawings and specifications to verify that the recommendations of this report have been properly implemented.

Recommendations presented herein are based upon the assumption that adequate earthwork monitoring will be provided by Converse. Footing excavations should be observed by Converse prior to placement of steel and concrete so that footings are founded on satisfactory materials and excavations are free of loose and disturbed materials. Trench backfill should be placed and compacted with observation and field density testing provided by this office.

During construction, the geotechnical engineer and/or their authorized representatives should be present at the site to provide a source of advice to the client regarding the geotechnical aspects of the project and to observe and test the earthwork performed. Their presence should not be construed as an acceptance of responsibility for the performance of the completed work, since it is the sole responsibility of the contractor performing the work to ensure that it complies with all applicable plans, specifications, ordinances, etc.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any recommended actions presented herein to be unsafe.

10.0 CLOSURE

The findings and recommendations of this report were prepared in accordance with generally accepted professional engineering and engineering geologic principles and practice. We make no other warranty, either expressed or implied. Our conclusions and recommendations are based on the results of the field and laboratory studies, combined with an interpolation and extrapolation of soil conditions between and beyond boring locations. If conditions encountered during construction appear to be different from those shown by the borings, this office should be notified.

Design recommendations given in this report are based on the assumption that the earthwork and site grading recommendations contained in this report are implemented. Additional consultation may be prudent to interpret Converse's findings for contractors, or to possibly refine these recommendations based upon the review of the final site grading and actual site conditions encountered during construction. If the scope of the project changes, if project completion is to be delayed, or if the report is to be used for another purpose, this office should be consulted.

This report was prepared for Carollo Engineers, Inc. for the subject project described herein. We are not responsible for technical interpretations made by others of our exploratory information. Specific questions or interpretations concerning our findings and conclusions may require a written clarification to avoid future misunderstandings.

11.0 REFERENCES

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APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Field exploration included a site reconnaissance and subsurface exploration program. During the site reconnaissance, the surface conditions were noted, and the approximate locations of the boring were determined. The exploratory borings were approximately located using existing boundary and other features as a guide and should be considered accurate only to the degree implied by the method used. The various field study methods performed are discussed below.

Exploratory Borings

Three (3) exploratory borings (BH-1 through BH-3) were drilled within the project site on September 3, 2013. The borings were advanced using a truck mounted 8-inch diameter hollow stem auger drill rig to depths of 51.5 feet below the existing ground surface (bgs). Encountered earth materials were continuously logged by a Converse professional staff and classified in the field by visual examination in accordance with the Unified Soil Classification System (USCS). Where appropriate, field descriptions and classifications have been modified to reflect laboratory test results.

Ring samples of the subsurface materials were obtained at frequent intervals in the exploratory borings using a drive sampler (2.4-inches inside diameter and 3.0-inches outside diameter) lined with sample rings. The steel ring sampler was driven into the bottom of the borehole with successive drops of a 140-pound driving weight falling 30 inches, using an automatic hammer. Samples are retained in brass rings (2.4-inches inside diameter and 1.0-inch in height). The central portion of the sample was retained and carefully sealed in waterproof plastic containers for shipment to the Converse laboratory. Blow counts for each sample interval are presented on the logs of borings. Bulk samples of typical soil types were also obtained.

Standard Penetration Tests (SPTs) were performed in selected borings at selected intervals using a standard (1.4 inches inside diameter and 2.0 inches outside diameter) split-barrel sampler. The bore holes were backfilled and compacted with soil cuttings by reverse spinning of the auger following the completion of drilling and patched with asphalt.

It should be noted that the exact depths at which material changes occur cannot always be established accurately. Changes in material conditions that occur between driven samples are indicated in the logs at the top of the next drive sample. A key to soil symbols and terms is presented as Drawing No. A-1, *Soil Classification Chart*. The log of the exploratory boring is presented in Drawing Nos. A-2a through A-4b, *Log of Borings*.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BORING LOG SYMBOLS

SAMPLE TYPE

STANDARD PENETRATION TEST
Split barrel sampler in accordance with ASTM D-1586-84 Standard Test Method

DRIVE SAMPLE 2.42" I.D. sampler.

DRIVE SAMPLE No recovery

BULK SAMPLE

GROUNDWATER WHILE DRILLING

GROUNDWATER AFTER DRILLING

LABORATORY TESTING ABBREVIATIONS

TEST TYPE
(Results shown in Appendix B)

CLASSIFICATION

Plasticity	pi
Grain Size Analysis	ma
Passing No. 200 Sieve	wa
Sand Equivalent	se
Expansion Index	ei
Compaction Curve	max
Hydrometer	h

STRENGTH

Pocket Penetrometer	p
Direct Shear	ds
Direct Shear (single point)	ds*
Unconfined Compression	uc
Triaxial Compression	tx
Vane Shear	vs
Consolidation	c
Collapse Test	col
Resistance (R) Value	r
Chemical Analysis	ca
Electrical Resistivity	er

UNIFIED SOIL CLASSIFICATION AND KEY TO BORING LOG SYMBOLS

Converse Consultants

Project Name
TORRANCE AIRPORT
INFILTRATION GALLERIES

Project No.
13-31-225-01

Drawing No.
A-1

Log of Boring No. BH-1

Dates Drilled: 9/3/2013 | Logged by: MM | Checked By: SCL

Equipment: 8" HOLLOW STEM AUGER | Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): N/A | Depth to Water (ft): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FT	MOISTURE (%)	DRY UNIT WT. (pcf)	
0		**FILL (Af):** **SILTY SAND (SM):** fine to medium-grained, with gravels up to 0.5" in maximum dimension, with few clays, brown.		X				ei
		SANDY CLAY (CL): fine to medium-grained sand, brown.		X				
5		**ALLUVIUM (Qa):** **CLAY (CL):** trace of fine-grained sand and silt, light brown.	X		10/13/17	19	97	c
10			X		6/13/25	21	101	
15		-trace of fine-grained sand, dark brown	X		5/11/16	26	92	
20			X		3/5/8			
25		**SAND (SP):** fine to medium-grained, orange brown.	X		4/20/28	7	102	
30			X		9/13/17			

Converse Consultants

Project Name: TORRANCE AIRPORT INFILTRATION GALLERIES

Project No. 13-31-225-01

Drawing No. A-2a

Log of Boring No. BH-1

Dates Drilled: 9/3/2013 Logged by: MM Checked By: SCL

Equipment: 8" HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): N/A Depth to Water (ft): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FT	MOISTURE (%)	DRY UNIT WT. (pcf)	
		SAND (SP): fine to medium-grained, light brown.			21/50(5")	6	85	
40					14/25/40			
45					16/50(6")	4	96	
50					14/36/50(5")			
		End of boring at 51.5 feet. Groundwater not encountered during drilling. Borehole backfilled with soil cuttings and portland cement on 9-3-13.						

Converse Consultants

Project Name: TORRANCE AIRPORT INFILTRATION GALLERIES

Project No.: 13-31-225-01

Drawing No.: A-2b

Log of Boring No. BH-2

Dates Drilled: 9/3/2013 Logged by: MM Checked By: SCL

Equipment: 8" HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): N/A Depth to Water (ft): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FT	MOISTURE (%)	DRY UNIT WT. (pcf)	
		FILL (Af): **SILTY SAND (SM):** fine to medium-grained, with gravels up to 0.5" in maximum dimension, few clays, brown. **SANDY CLAY (CL):** fine to medium-grained sand, brown.		X				max,ds
5		**ALLUVIUM (Qa):** **CLAY (CL):** trace of fine-grained sand, dark brown.	X		7/8/13	15	86	
10		**Fat CLAY (CH):** trace of fine-grained sand, dark brown.	X		10/19/25	19	100	pi
15		-trace of fine to medium-grained sand, brown	X		5/11/24	19	103	wa (fc=81%)
20		**CLAY (CL):** trace of fine to medium-grained sand, light brown.	X		14/26/35	20	104	pi
25			X		6/10/16			wa (fc=88%)
30		**Fat CLAY (CH):** trace of fine-grained sand, light brown.	X		6/18/31	22	98	pi

Converse Consultants

Project Name: TORRANCE AIRPORT INFILTRATION GALLERIES

Project No. 13-31-225-01

Drawing No. A-3a

Log of Boring No. BH-2

Dates Drilled: 9/3/2013 Logged by: MM Checked By: SCL

Equipment: 8" HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): N/A Depth to Water (ft): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FT	MOISTURE (%)	DRY UNIT WT. (pcf)	
		Fat CLAY (CH): trace of fine to medium-grained sand, brown.			6/10/15			wa (fc=75%)
40		**SAND (SP):** fine-grained, yellow brown.			7/36/50	6	106	
45					11/20/35			wa (fc=7%)
50		-light brown			10/24/50(3")	5	95	
		End of boring at 51.5 feet. Groundwater not encountered during drilling. Borehole backfilled with soil cuttings and portland cement on 9-3-13.						

Converse Consultants

Project Name: TORRANCE AIRPORT INFILTRATION GALLERIES

Project No. 13-31-225-01

Drawing No. A-3b

Log of Boring No. BH-3

Dates Drilled: 9/3/2013 Logged by: MM Checked By: SCL

Equipment: 8" HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): N/A Depth to Water (ft): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FT	MOISTURE (%)	DRY UNIT WT. (pcf)	
		FILL (Af): **SILTY SAND (SM):** fine to medium-grained, with gravels up to 1" in maximum dimension, brown. **SANDY CLAY (CL):** fine to medium-grained sand, brown.		X				ca,er
5		**ALLUVIUM (Qa):** **CLAY (CL):** trace of fine-grained sand, with gravels up to 1.5" in maximum dimension, dark brown.	■		15/24/20	18	101	
10		-with few gravels up to 1" in maximum dimension, dark brown	■		9/8/15	19	103	
15		-trace of fine-grained sand, orange brown/brown	■		14/32/42	17	106	
20		-trace of fine to medium-grained sand, with gravels up to 0.5" in maximum dimension	X		7/3/7			
25			■		8/18/32	24	100	
30		-trace of silt, light brown	X		6/10/15			

Converse Consultants

Project Name: TORRANCE AIRPORT INFILTRATION GALLERIES

Project No.: 13-31-225-01

Drawing No.: A-4a

Log of Boring No. BH-3

Dates Drilled: 9/3/2013 Logged by: MM Checked By: SCL

Equipment: 8" HOLLOW STEM AUGER Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): N/A Depth to Water (ft): NOT ENCOUNTERED

Depth (ft)	Graphic Log	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FT	MOISTURE (%)	DRY UNIT WT. (pcf)	
		CLAY (CL): trace of fine-grained sand and silt, light brown.			6/16/25	11	112	
40		**CLAYEY SAND (SC):** fine-grained, light brown.			10/19/24			
45		**SAND (SP):** fine-grained with silt, light brown.			7/28/34	19	108	
50		-fine to medium-grained, with few gravels up to 0.5" in maximum dimension, light brown			9/20/20			
		End of boring at 51.5 feet. Groundwater not encountered during drilling. Borehole backfilled with soil cuttings and portland cement on 9-3-13.						

Converse Consultants

Project Name: TORRANCE AIRPORT INFILTRATION GALLERIES

Project No.: 13-31-225-01

Drawing No.: A-4b

APPENDIX B

LABORATORY TESTING PROGRAM

APPENDIX B

LABORATORY TESTING PROGRAM

Tests were conducted in our laboratory on representative soil samples for the purpose of classification and evaluation of their relevant physical characteristics and engineering properties. The amount and selection of tests were based on the geotechnical requirements of the project. Test results are presented herein and on the Logs of Borings in Appendix A, *Field Exploration*. The following is a summary of the laboratory tests conducted for this project.

Moisture Content and Dry Density

Results of moisture content and dry density tests, performed on relatively undisturbed ring samples were used to aid in the classification of the soils and to provide quantitative measure of the *in situ* dry density. Data obtained from this test provides qualitative information on strength and compressibility characteristics of site soils. For test results, see the Logs of Borings in Appendix A, *Field Exploration*.

Percent Finer than Sieve No. 200

The percent finer than sieve No. 200 tests were performed on four (4) representative soil samples to aid in the classification of the on-site soils and to estimate other engineering parameters. Testing was performed in general accordance with the ASTM Standard D1140 test method. Test results are presented in the Logs of Borings in Appendix A, *Field Exploration*.

Atterberg Limits

Atterberg limits test were performed on three (3) representative samples to assist the classification of the soil and fill materials according to ASTM Standard D4318 test method. The test results are presented in the following table and on Drawing No. B-1, *Atterburg Limits Results*.

Table No. B-1 Atterberg Limit Test Results

Boring No.	Depth (feet)	Soil Classification	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)
BH-2	10	Fat Clay (CH)	63	20	43
BH-2	20	Clay (CL)	49	15	34
BH-2	30	Fat Clay (CH)	60	19	41

Maximum Density Test

One (1) representative bulk sample was tested in the laboratory to determine the maximum dry density and optimum moisture content. The tests were conducted in accordance with the ASTM Standard D1557 laboratory procedure. The test results are presented in Drawing No. B-2, *Moisture-Density Relationship Results*.

Direct Shear

Direct shear tests were performed on one (1) sample remolded to 90% relative compaction. For each test, three brass sampler rings were placed, one at a time, directly into the test apparatus and subjected to a range of normal loads appropriate for the anticipated conditions. The sample was then sheared at a constant strain rate of 0.01 inch/minute. Shear deformation was recorded until a maximum of about 0.25-inch shear displacement was achieved. Ultimate strength was selected from the shear-stress deformation data and plotted to determine the shear strength parameters. For test data, including sample density and moisture content, see Drawing No. B-2, *Direct Shear Test Results.*

Table No. B-2, Direct Shear Test Results

Boring No.	Depth (feet)	Soil Classification	Ultimate Strength Parameters	
			Friction Angle (degrees)	Cohesion (psf)
BH-2	0 – 5*	Sandy Clay (CL)	31	450

Note: Sample remolded to 90% relative compaction

Consolidation

Consolidation test was performed on one (1) relatively undisturbed in-situ sample. Data obtained from this test procedure was used to evaluate the settlement characteristics of the foundation soils under load. Preparation for this test involved trimming the sample and placing the one-inch high brass ring into the test apparatus, which contained porous stones, both top and bottom, to accommodate drainage during testing. Normal axial loads were applied to one end of the sample through the porous stones, and the resulting deflections were recorded at various time periods. The load was increased after the sample reached a reasonable state equilibrium. Normal loads were applied at a constant load-increment ratio, successive loads being generally twice the preceding load. The sample was tested at field and submerged conditions. The test results, including sample density and moisture content, are presented in Drawing No. B-4, *Consolidation Test Results*.

Expansion Index

One (1) representative bulk samples were tested to evaluate the expansion potential of material encountered at the site. The test results are presented in the following table:

Table No. B-3, Expansion Index Test Results

Sample Location	Depth (ft)	Soil Description	Expansion Index	Expansion Potential
BH-1	0-5	Sandy Clay (CL)	94	High

Soil Corrosivity

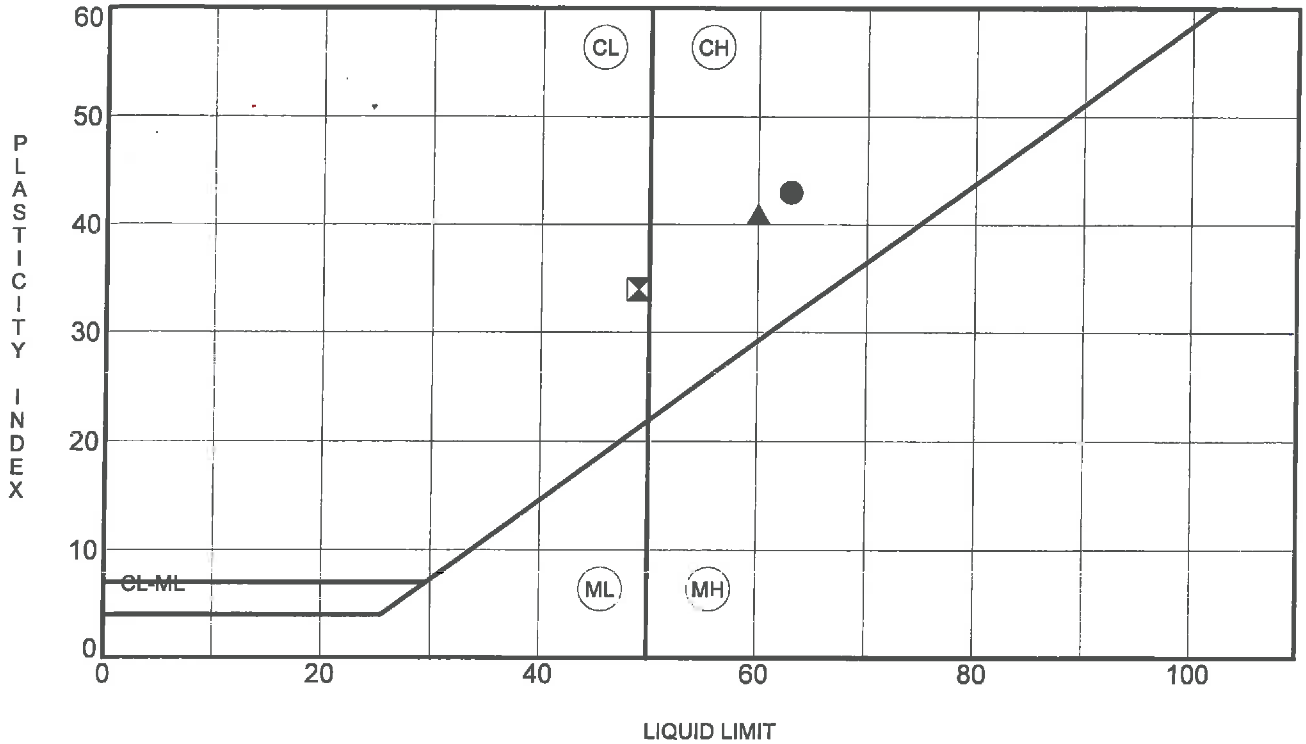
One (1) representative soil samples were tested to evaluate minimum electrical resistivity, pH, and chemical content, including soluble sulfate and chloride concentrations. The purpose of these tests is to determine the corrosion potential of site soils when placed in contact with common construction materials. These tests were performed by Environmental Geotechnology Laboratory, Inc. (EGL), located in Arcadia, California. The test results received from EGL are included in the following table:

Table No. B-4, Corrosivity Test Results

Boring No.	Sample Depth (feet)	pH (Caltrans 643)	Soluble Chlorides (Caltrans 422) ppm	Soluble Sulfate (Caltrans 417) (%)	Saturated Resistivity (Caltrans 643) Ohm-cm
BH-3	0 – 5	7.75	120	0.034	540

Sample Storage

Soil samples presently stored in our laboratory will be discarded 30 days after the date of this report, unless this office receives a specific request to retain the samples for a longer period.

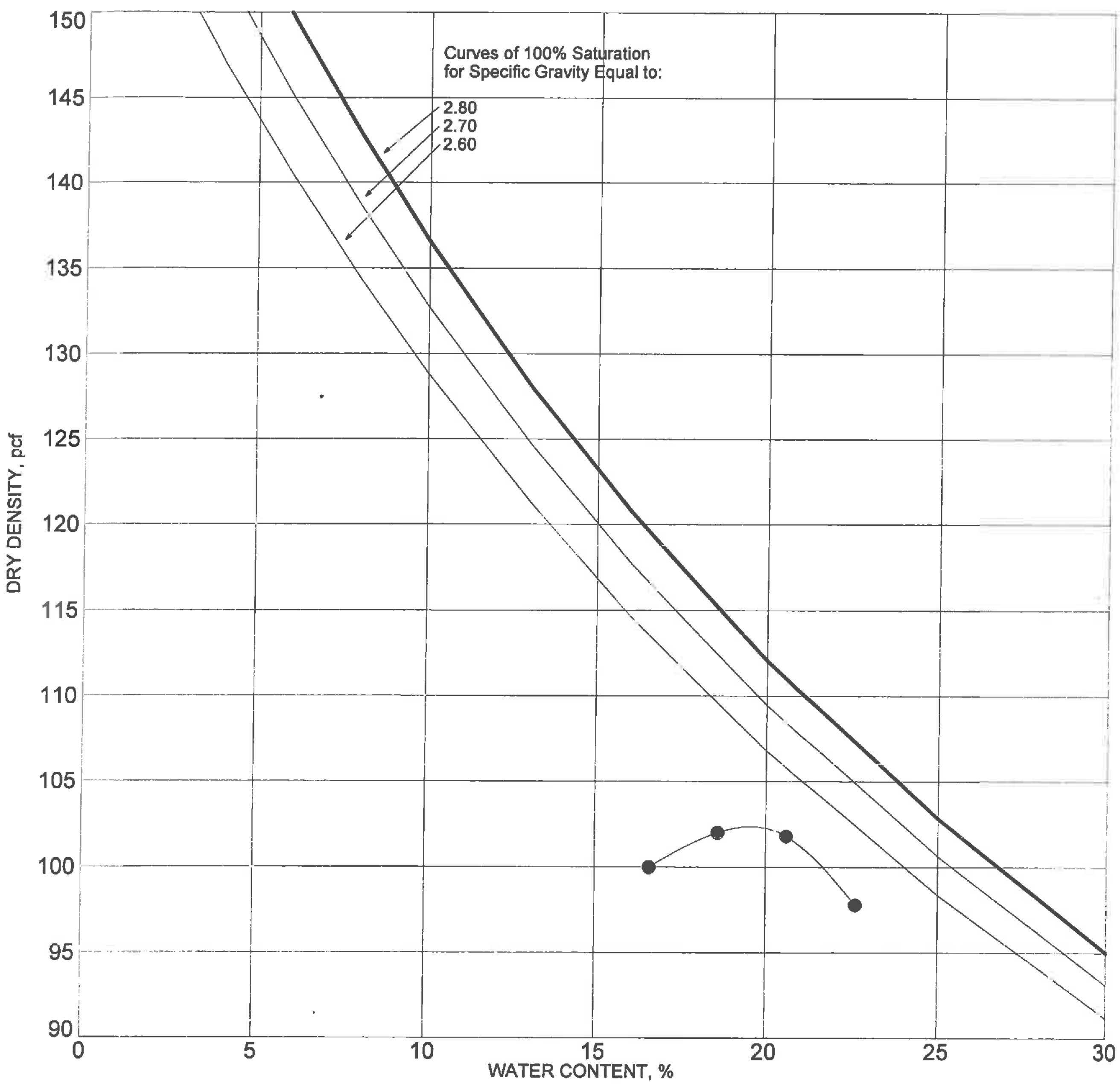


Symbol	Boring No.	Depth (ft)	LL (%)	PL (%)	PI (%)	Description
●	BH-2	10	63	20	43	Fat CLAY (CH)
⧗	BH-2	20	49	15	34	CLAY (CL)
▲	BH-2	30	60	19	41	Fat CLAY (CH)

ATTERBERG LIMITS RESULTS

Converse Consultants

Project Name	Project No.	Drawing No.
TORRANCE AIRPORT INFILTRATION GALLERIES	13-31-225-01	B-1



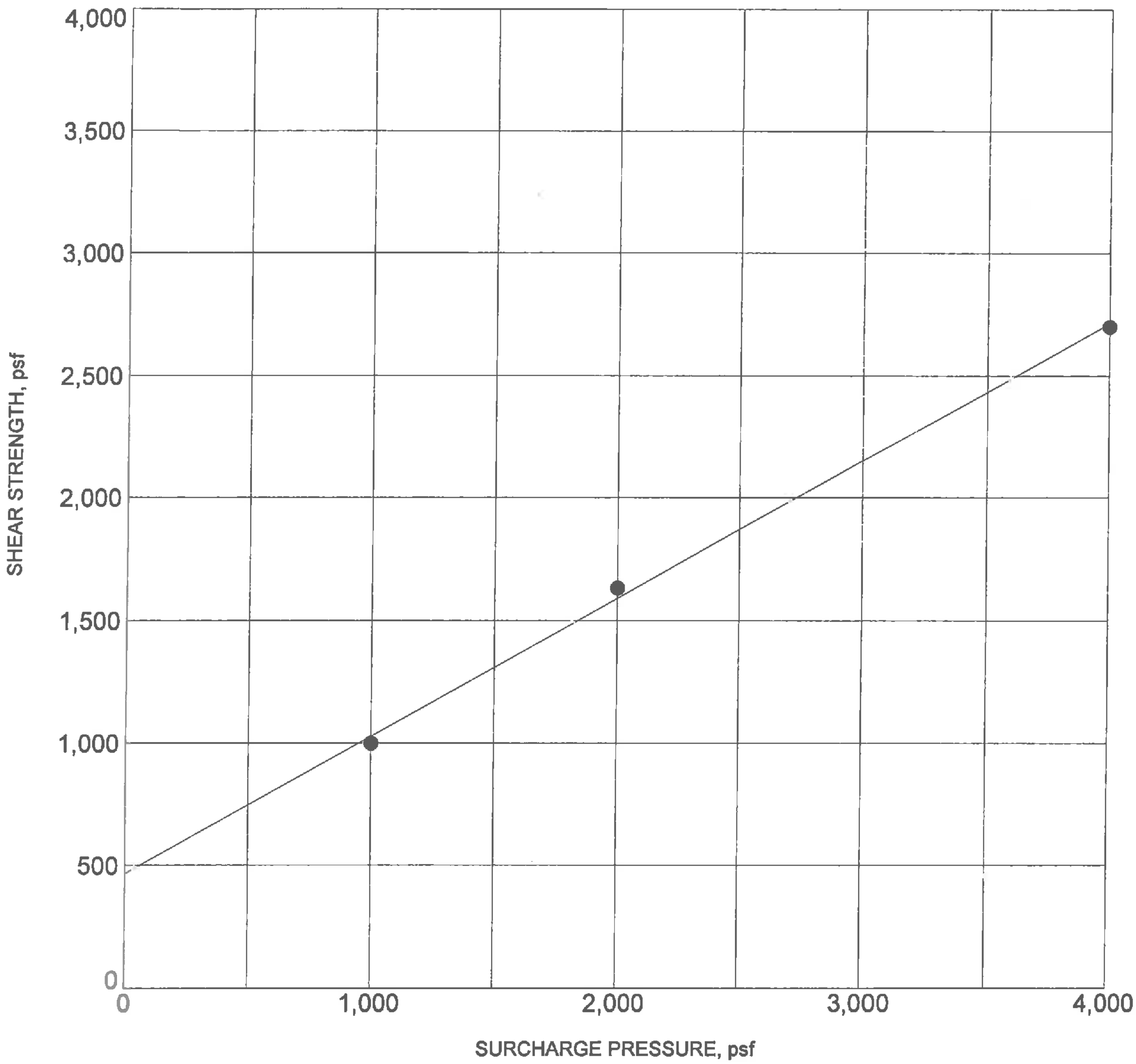
SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	ASTM TEST METHOD	OPTIMUM WATER, %	MAXIMUM DRY DENSITY, pcf
●	BH-2	0-5	SANDY CLAY (CL)	D1557 Method B	19.8	103

NOTE:

MOISTURE-DENSITY RELATIONSHIP RESULTS

Converse Consultants

Project Name	Project No.	Drawing No.
TORRANCE AIRPORT INFILTRATION GALLERIES	13-31-225-01	B-2



BORING NO. :	BH-2	DEPTH (ft) :	0-5
DESCRIPTION :	SANDY CLAY (CL)		
COHESION (psf) :	450	FRICTION ANGLE (degrees)	31
MOISTURE CONTENT (%) :	93.3	DRY DENSITY (pcf) :	18.8

NOTE: Ultimate Strength, sample remolded to 90% relative compaction.

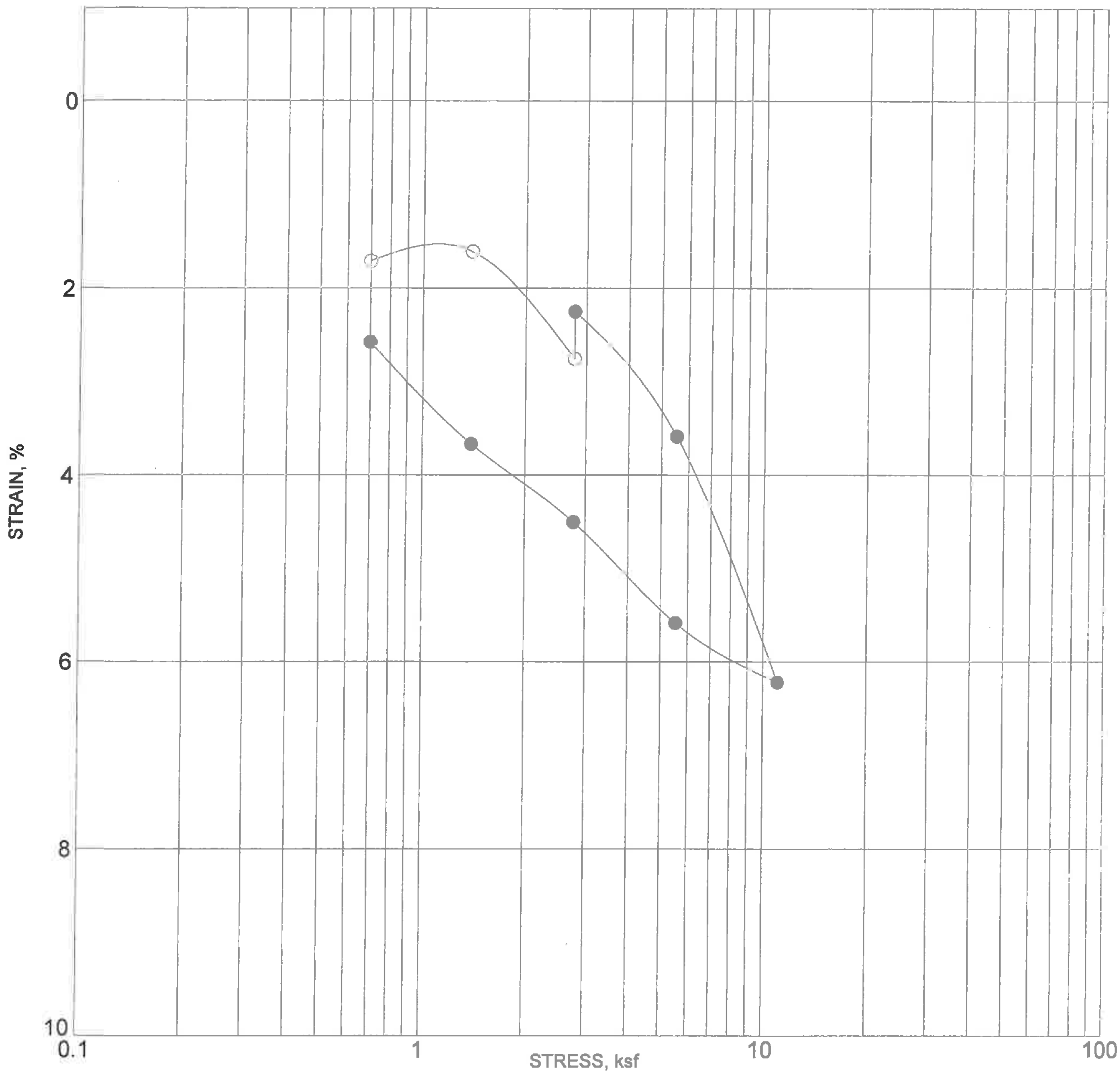
DIRECT SHEAR TEST RESULTS

Converse Consultants

Project Name
TORRANCE AIRPORT
INFILTRATION GALLERIES

Project No. 13-31-225-01

Drawing No. B-3



BORING NO. :	BH-1	DEPTH (ft) :	5
DESCRIPTION :	CLAY (CL)		

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	23.5	96.3		
FINAL	18.1	98.3		

NOTE: SOLID CIRCLES INDICATE READINGS AFTER ADDITION OF WATER

CONSOLIDATION TEST RESULTS

Converse Consultants

Project Name
TORRANCE AIRPORT
INFILTRATION GALLERIES

Project No. **13-31-225-01**

Drawing No. **B-4**

APPENDIX F – DETAILED BMP COST ESTIMATES

TORRANCE AIRPORT - Phase 1: BMP at SITE A1

Airport Infiltration System - Site A1: Diversion, Gravity Main, and Infiltration Sytem

Water Quality Benefits Construction Cost Estimate

Description	Unit	Quantity	Unit Cost	Cost ($)
Diversion structure	EA	4	$50,000	$200,000
Infiltration System - StormChamber (12 ac-ft)	LS	1	$1,968,343	$1,968,343
Instalation Cost - 50% to 100% Material	LS	60%		$1,181,006
Gravity main - 100 feet of 24" Pipe	LF	300	$350	$105,000
Power/Electrical cabinets	LS	1	$100,000	$100,000
Subtotal (1)				***$3,554,348***
Mobilization - 0% to 7% of Subtotal (1)		5%		$177,717
Permits - 2% to 5% of Subtotal (1)		3%		$106,630
Subtotal (2)				***$3,838,696***
Estimating contingency - 10% to 25% of Subtotal (2)		15%		$575,804
Subtotal (3)				***$4,414,500***
Escalation - 5% to 10% per year of subtotal (3)		3%		$132,435
Subtotal (4)				**$4,546,935**
Construction contingency - 10% to 20% of subtotal (4)		10%		$454,694
Total Estimated Project Construction Cost				**$5,001,629**

TORRANCE AIRPORT - Phase 2 - BMP at SITE A2

Airport Infiltration System - Site A1: Diversion, Gravity Main, and Infiltration Sytem

Water Quality Benefits Construction Cost Estimate

Description	Unit	Quantity	Unit Cost	Cost ($)
Diversion structure	EA	4	$50,000	$200,000
Infiltration System - StormChamber (12 ac-ft)	LS	1	$705,890	$705,890
Instalation Cost - 50% to 100% Material	LS	60%		$423,534
Gravity main - 100 feet of 15" Pipe	LF	50	$250	$12,500
Power/Electrical cabinets	LS	1	$100,000	$100,000
Subtotal (1)				**$1,441,924**
Mobilization - 0% to 7% of Subtotal (1)		5%		$72,096
Permits - 2% to 5% of Subtotal (1)		3%		$43,258
Subtotal (2)				**$1,557,278**
Estimating contingency - 10% to 25% of Subtotal (2)		15%		$233,592
Subtotal (3)				**$1,790,870**
Escalation - 5% to 10% per year of subtotal (3)		3%		$53,726
Subtotal (4)				**$1,844,596**
Construction contingency - 10% to 20% of subtotal (4)		10%		$184,460
Total Estimated Project Construction Cost				**$2,029,055**

TORRANCE AIRPORT - Phase 3

Installation of 57 Catch Basin Filters Subcatchment AS1

Water Quality Benefits Construction Cost Estimate

Description	Unit	Quantity	Rate	Cost ($)
Diversion structure	EA	0	$50,000	$0
Sump Preparation	LS	0	$250,000	$0
Earth Dam	LS	0	$350,000	$0
Catch Basin Filter Inserts	EA	57	$2,200	$28,500
Gravity Main 1000 ft of 24"	LF	0	$350	$0
Power/Electrical cabinets	LS			$100,000
Subtotal (1)				**$128,500**
Mobilization - 0% to 7% of Subtotal (1)		0%		$0
Permits - 2% to 5% of Subtotal (1)		0%		$0
Subtotal (2)				**$128,500**
Estimating contingency - 10% to 25% of Subtotal (2)		0%		$0
Subtotal (3)				**$128,500**
Escalation - 5% to 10% per year of subtotal (3)		0%		$0
Subtotal (4)				**$128,500**
Construction contingency - 10% to 20% of subtotal (3)		0%		$0
Total Estimated Project Construction Cost				**$128,500**

TORRANCE - WALNUT SUMP - PHASE 1

Water Quality Benefits Construction Cost Estimate

Description	Unit	Quantity	Rate	Cost ($)
Diversion structure	EA	1	$50,000	$50,000
Sump Preparation	LS	0	$250,000	$0
Earth Dam	LS	0	$350,000	$0
Gravity Main 500 ft of 24"	LF	500	$350	$250,000
Power/Electrical cabinets	LS			$100,000
Subtotal (1)				**$400,000**
Mobilization - 0% to 7% of Subtotal (1)		5%		$20,000
Permits - 2% to 5% of Subtotal (1)		3%		$12,000
Subtotal (2)				**$432,000**
Estimating contingency - 10% to 25% of Subtotal (2)		15%		$64,800
Subtotal (3)				**$496,800**
Escalation - 5% to 10% per year of subtotal (3)		3%		$14,904
Subtotal (4)				**$511,704**
Construction contingency - 10% to 20% of subtotal (3)		10%		$51,170
Total Estimated Project Construction Cost				**$562,874**

TORRANCE - WALNUT SUMP - PHASE 2

Water Quality Benefits Construction Cost Estimate

Description	Unit	Quantity	Rate	Cost ($)
Diversion structure	EA	0	$50,000	$0
Sump Preparation	LS	0	$250,000	$0
Earth Dam	LS	0	$350,000	$0
Catch Basin Filter Inserts	EA	50	$2,200	$25,000
Gravity Main 1000 ft of 24"	LF	0	$350	$0
Power/Electrical cabinets	LS			$100,000
Subtotal (1)				**$125,000**
Mobilization - 0% to 7% of Subtotal (1)		0%		$0
Permits - 2% to 5% of Subtotal (1)		0%		$0
Subtotal (2)				**$125,000**
Estimating contingency - 10% to 25% of Subtotal (2)		0%		$0
Subtotal (3)				**$125,000**
Escalation - 5% to 10% per year of subtotal (3)		0%		$0
Subtotal (4)				**$125,000**
Construction contingency - 10% to 20% of subtotal (3)		0%		$0
Total Estimated Project Construction Cost				**$125,000**

TORRANCE - WALNUT SUMP - PHASE 3

Water Quality Benefits Construction Cost Estimate

Description	Unit	Quantity	Rate	Cost ($)
Diversion structure	EA	2	$50,000	$100,000
Sump Preparation	LS	1	$250,000	$250,000
Earth Dam	LS	1	$350,000	$350,000
Stormwater Lift Station No. 2 - 20 MF Mixed Flow Pump	LS	3	140000	420,000
Gravity Main 500 ft of 60"	LF	500	$1,820	$250,000
Force Main 1175 ft of 24"	LF	1175	$348	$408,900
Pretreatment Unit	EA	1	$200,000	$200,000
Power/Electrical cabinets	LS			$100,000
Subtotal (1)				**$2,078,900**
Mobilization - 0% to 7% of Subtotal (1)		5%		$103,945
Permits - 2% to 5% of Subtotal (1)		3%		$62,367
Subtotal (2)				**$2,245,212**
Estimating contingency - 10% to 25% of Subtotal (2)		15%		$336,782
Subtotal (3)				**$2,581,994**
Escalation - 5% to 10% per year of subtotal (3)		3%		$77,460
Subtotal (4)				**$2,659,454**
Construction contingency - 10% to 20% of subtotal (3)		10%		$265,945
Total Estimated Project Construction Cost				**$2,925,399**

APPENDIX G – CATCH BASIN FILTER INFORMATION

UNIVERSAL
ENGINEERING SCIENCES
Consultants In: Geotechnical Engineering • Environmental Sciences
Construction Material Testing • Threshold Inspection

820 Brevard Avenue • Rockledge, Florida 32955
(321) 638-0808 Fax (321) 638-0978

November 7, 2007

Mr. Henry Happel
Suntree Technologies
798 Clearlake Road, Suite 2
Cocoa, FL 32922

Re: Suspended Soils Retention Testing for
Suntree Curb Inlet Basket and Grate Inlet Skimmer Box
Rockledge, FL
Universal Project No. 34184-004-01
Docs No. 622763

Dear Mr. Happel:

As requested, we have performed testing of a curb inlet and a skimmer box of your design at our laboratory in Rockledge, Florida. The purpose of the test was to determine the percentage of 100 micron grain size particles of OK90 sand that would be retained in the baskets of the devices following a 3 minute wash through the devices.

To perform the test, we recorded certain amounts of dry OK90 sand and washed it though each of the devices using an electric pump with a flow of approximately 1200 gallons per hour for 3 minutes. The sand that passed through the baskets and was retained on the reservoir was then dried and weighed. The percentage of sand that has a grain size larger than 100 microns was determined from the attached sieve analyses and used to calculate the removal efficiencies.

Based on the results of the testing, the Suntree Curb Inlet Basket had a removal efficiency of 93 percent for particle sizes of 100 microns or greater.

Based on the results of the testing, the Suntree Grate Inlet Skimmer Box had a removal efficiency of 86 percent for particle sizes of 100 microns or greater.

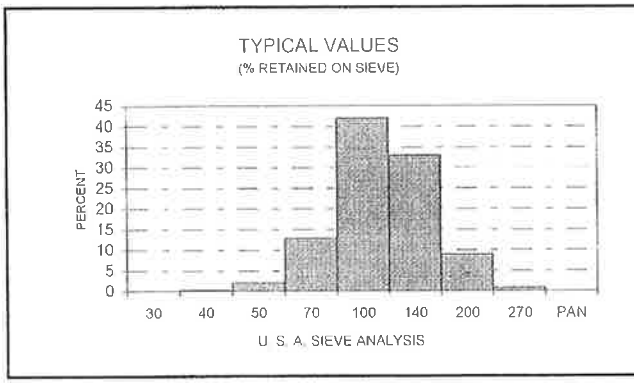
We trust that this information is sufficient. Please call if you need any further information.

Sincerely,

Universal Engineering Sciences, Inc.

Richard E. Hoaglin, P.E. 11/7/07
Branch Manager
FL Reg. no. 48796

PRODUCT DATA



INTERIM OK-90

UNGROUND SILICA

PLANT: MILL CREEK, OKLAHOMA

USA STD SIEVE SIZE		TYPICAL VALUES % RETAINED		% PASSING
MESH	MILLIMETERS	INDIVIDUAL	CUMULATIVE	CUMULATIVE
30	0.600	0.0	0.0	100.0
40	0.425	0.3	0.3	99.7
50	0.300	2.1	2.4	97.6
70	0.212	12.9	15.3	84.7
100	0.150	42.0	57.3	42.7
140	0.106	33.0	90.3	9.7
200	0.075	9.0	99.3	0.7
270	0.053	0.8	100.0	0.0
PAN		0.0	100.0	

TYPICAL PHYSICAL PROPERTIES

AFS[1] ACID DEMAND (@pH 7) 0.4
AFS[1] GRAIN FINENESS 84
COLOR .... WHITE
GRAIN SHAPE .... ROUND
HARDNESS (Mohs) 7

MELTING POINT (Degrees F) 3100
MINERAL .... QUARTZ
MOISTURE CONTENT (%) .... <0.5
pH 6.8
SPECIFIC GRAVITY 2.65

(1) AMERICAN FOUNDRYMEN'S SOCIETY

TYPICAL CHEMICAL ANALYSIS, %

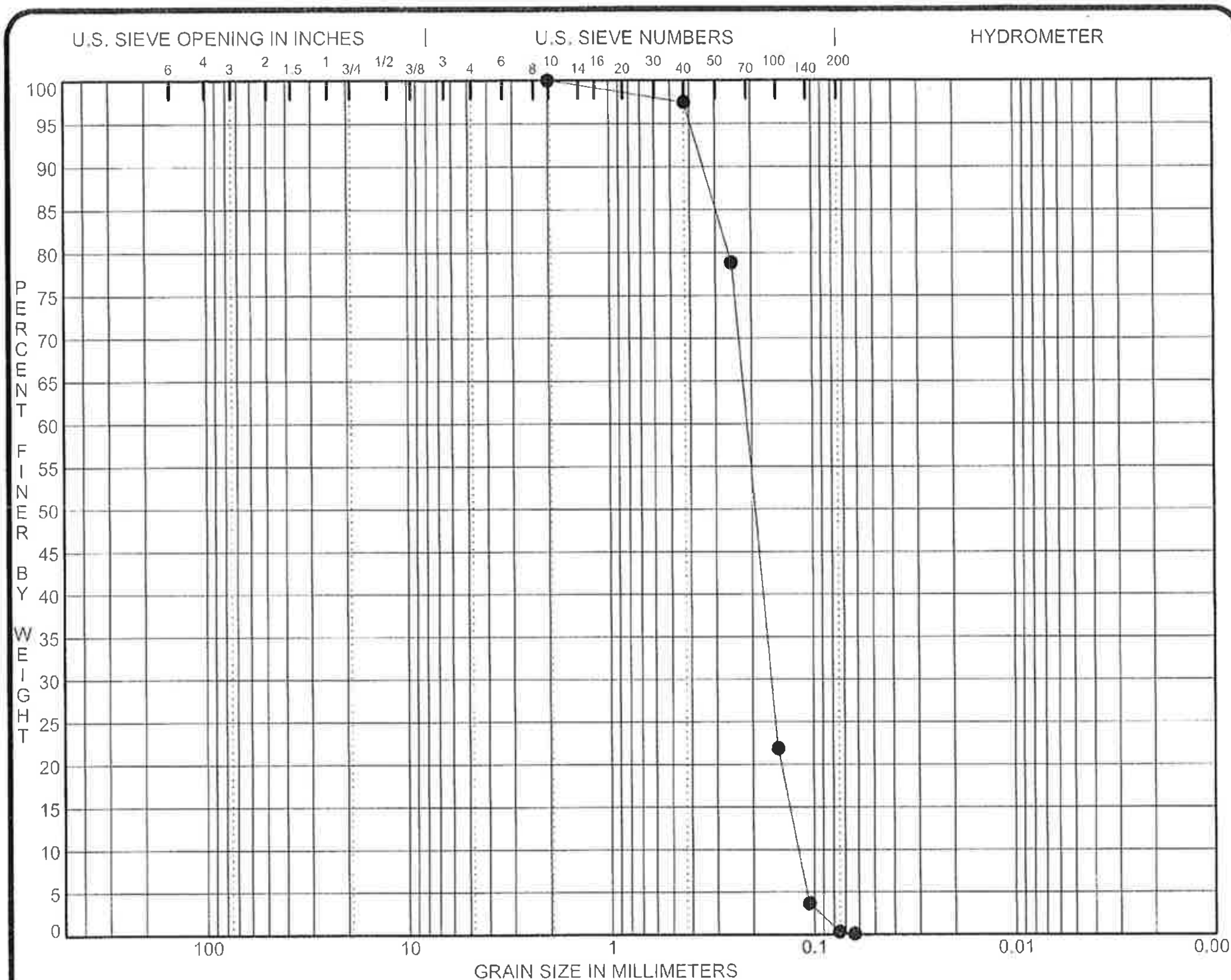
SiO_2 (Silicon Dioxide) 99.8
Fe_2O_3 (Iron Oxide) 0.015
Al_2O_3 (Aluminum Oxide) 0.05
TiO_2 (Titanium Dioxide) .... <0.01
CaO (Calcium Oxide) .... <0.01

MgO (Magnesium Oxide) .... <0.01
Na_2O (Sodium Oxide) .... <0.01
K_2O (Potassium Oxide) 0.02
LOI (Loss On Ignition) 0.1

February 1, 2007

WARNING: The product contains crystalline silica - quartz, which can cause silicosis (an occupational lung disease) and lung cancer. **For detailed information on the potential health effect of crystalline silica - quartz, see the U.S. Silica Company Material Safety Data Sheet.**

U.S. Silica Company P.O. Box 187, Berkeley Springs, WV 25411-0187 (800) 243-7500



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	P1	CURB INLET BASKET					1.03	1.8
	0							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P1	2.00	0.21	0.161	0.1196	0.0	99.6	0.4	

3/4"	3/8"	NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 200
			100.0	97.5	78.9	21.9	0.4

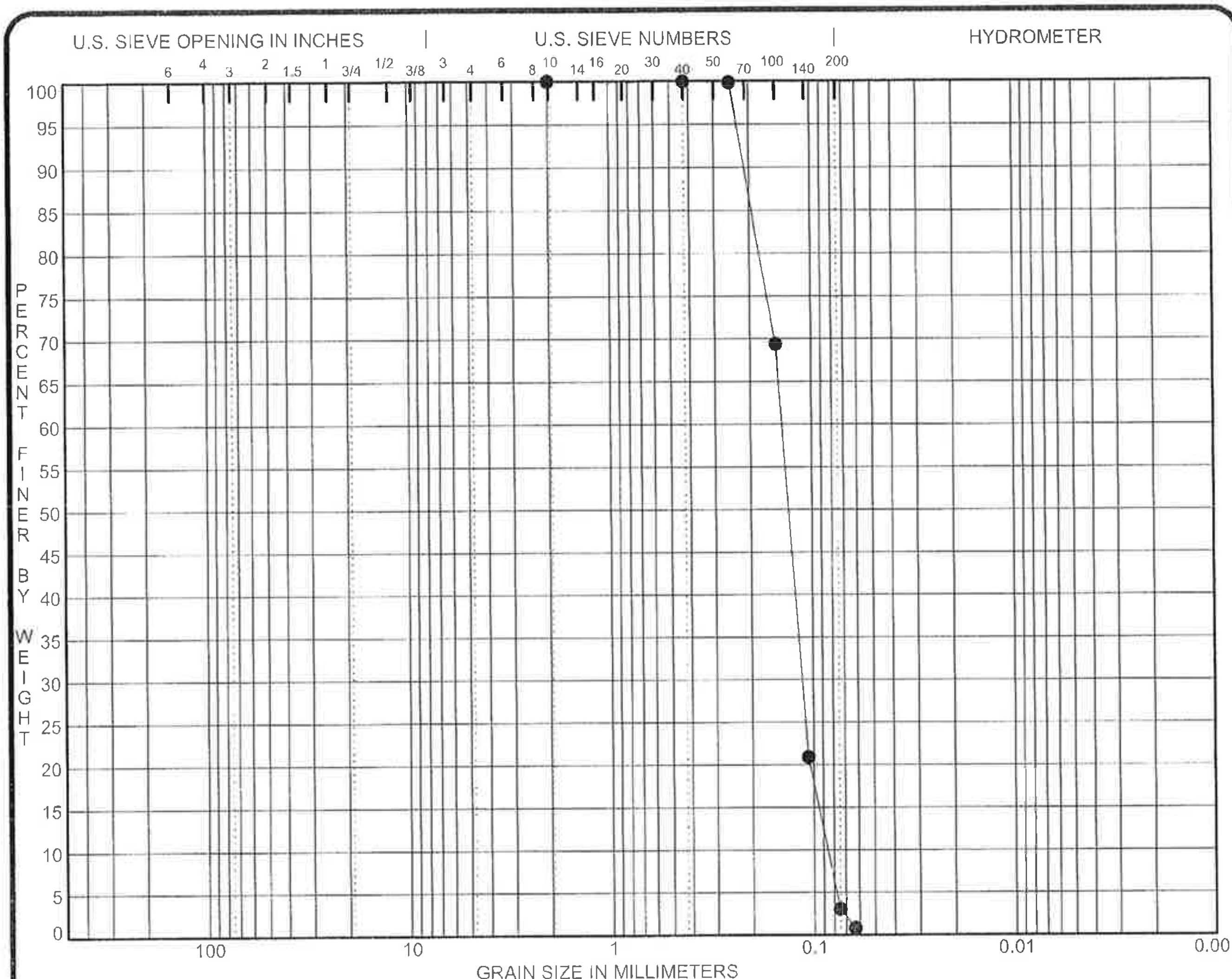
Client: SUNTREE TECHNOLOGIES
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

Client No: 34184-004-01
Report No: 1116
Date: 11/7/07

Project: SUSPENDED SOILS RETENTION TESTING FOR
GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

SOIL GRADATION CURVES

Universal Engineering Sciences, Inc.
ROCKLEDGE, FLORIDA



COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● P1	CURB INLET RESERVOIR					1.06	1.6
0							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P1	2.00	0.14	0.113	0.0858	0.0	97.0	3.0	

3/4"	3/8"	NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 200
			100.0	100.0	99.8	69.4	3.0

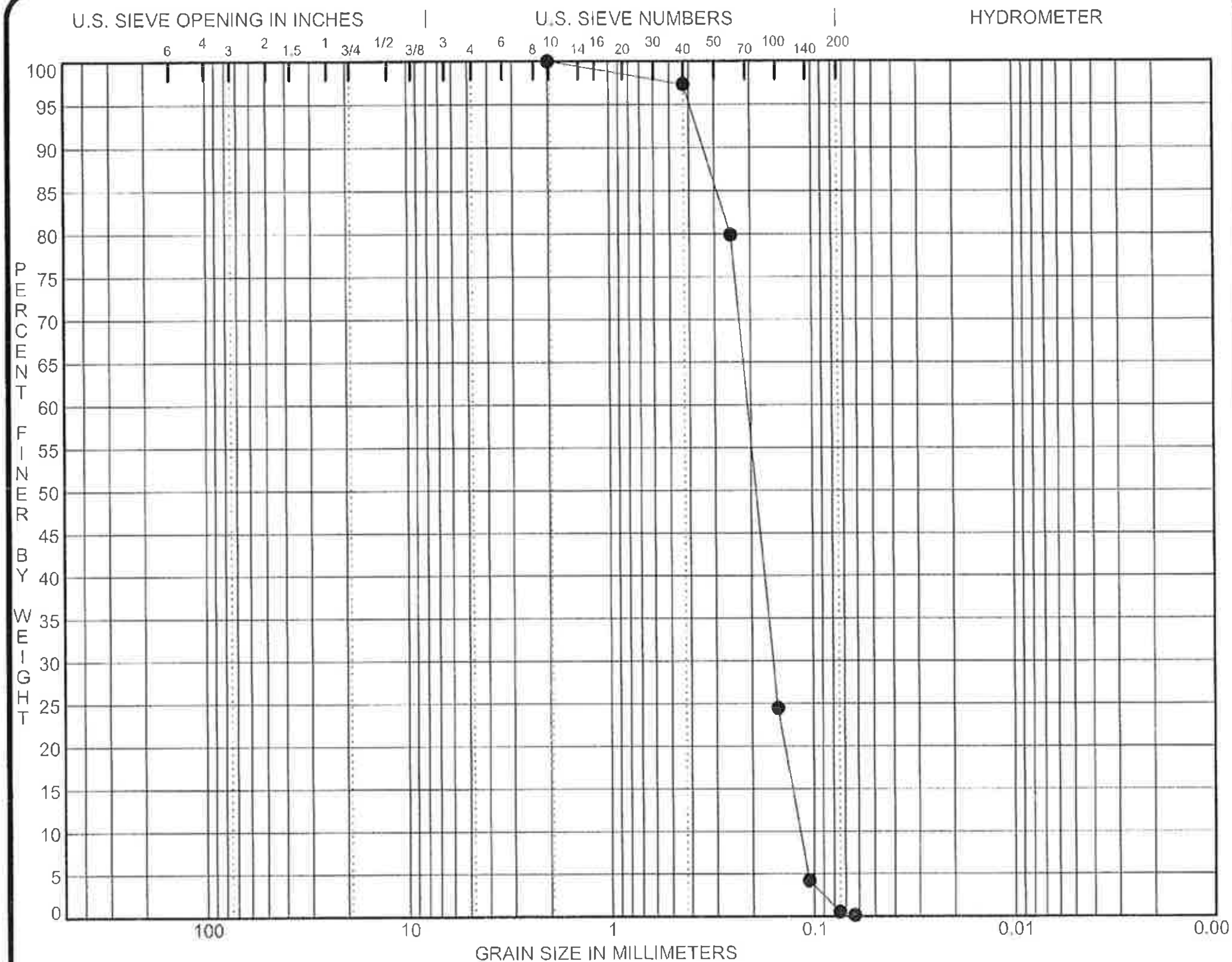
Client: SUNTREE TECHNOLOGIES
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

Client No: 34184-004-01
Report No: 1118
Date: 11/7/07

Project: SUSPENDED SOILS RETENTION TESTING FOR
GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

SOIL GRADATION CURVES

Universal Engineering Sciences, Inc.
ROCKLEDGE, FLORIDA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	P1	SKIMMER BOX BASKET					1.02	1.8
	0							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P1	2.00	0.21	0.158	0.1171	0.0	99.5	0.5	

3/4"	3/8"	NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 200
			100.0	97.3	79.9	24.4	0.5

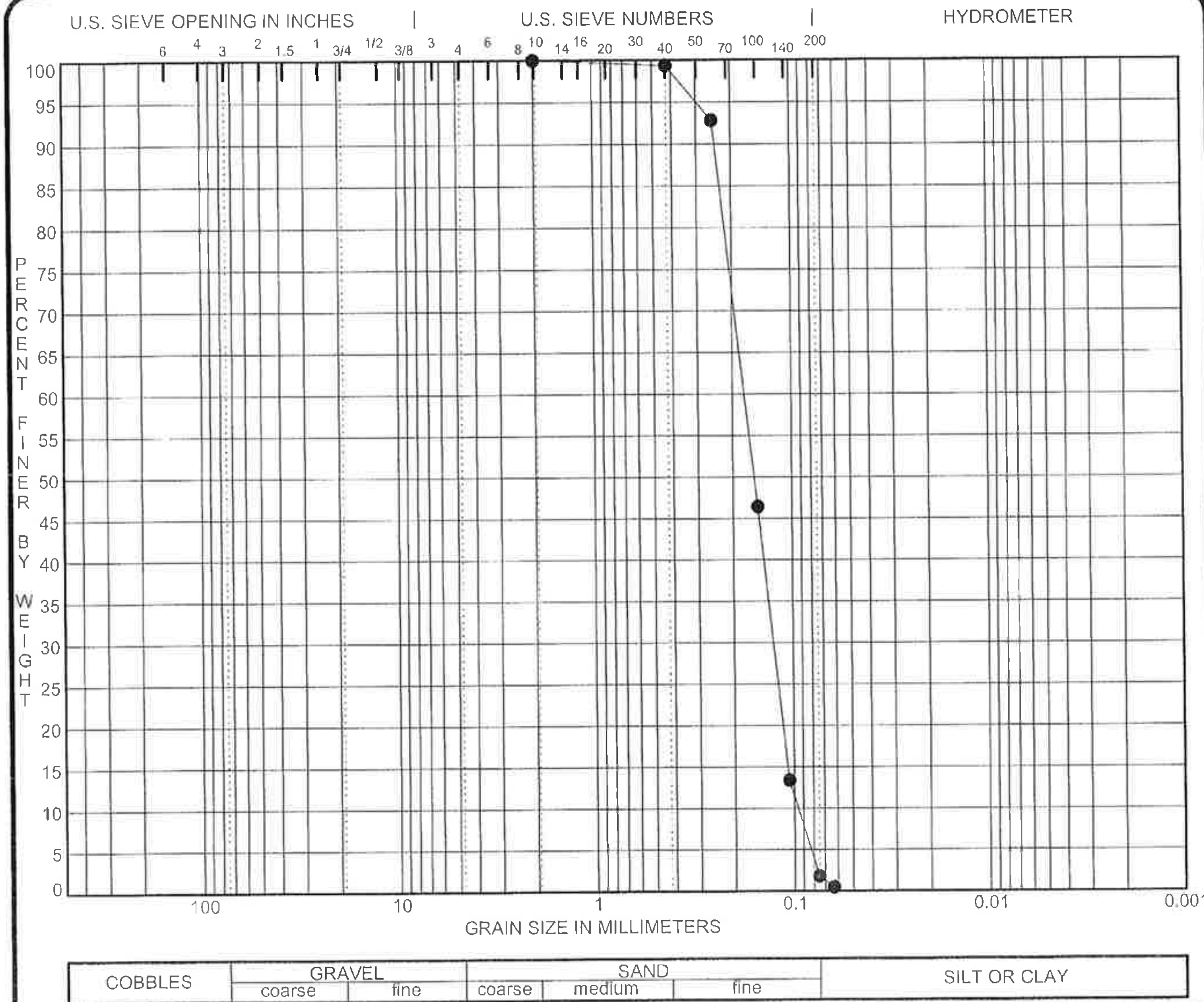
Client: SUNTREE TECHNOLOGIES
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

Client No: 34184-004-01
Report No: 1117
Date: 11/7/07

Project: SUSPENDED SOILS RETENTION TESTING FOR
GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

SOIL GRADATION CURVES

Universal Engineering Sciences, Inc.
ROCKLEDGE, FLORIDA



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**P1**	**SKIMMER BOX RESERVOIR**					**0.95**	**1.8**
	0							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P1**	**2.00**	**0.17**	**0.126**	**0.0958**	**0.0**	**98.2**	**1.8**	

3/4"	3/8"	NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 200
			100.0	**99.3**	**92.8**	**46.4**	**1.8**

Client: **SUNTREE TECHNOLOGIES**
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

Client No: **34184-004-01**
Report No: **1115**
Date: **11/7/07**

Project: **SUSPENDED SOILS RETENTION TESTING**
FOR GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

SOIL GRADATION CURVES

Universal Engineering Sciences, Inc.
ROCKLEDGE, FLORIDA

SITE EVALUATION OF SUNTREE TECHNOLOGIES, INC. GRATE INLET SKIMMER BOXES FOR DEBRIS, SEDIMENT, AND OIL & GREASE REMOVAL

Reedy Creek Improvement District
Planning & Engineering Department
Eddie Snell, Compliance Specialist

Stormwater is now recognized as the leading source of pollution to our remaining natural water bodies in the United States. Development and urbanization have removed most of the natural filtration and sediment trapping systems provided by the environment. Current development must address this need through the implementation of stormwater treatments systems in the project design. Most of these systems perform reasonably well, if properly designed, constructed, and maintained.

Retrofit of older urban areas lacking these modern stormwater systems is a continually expensive challenge. The Downtown Disney complex, formerly the Lake Buena Vista Shopping Village, has several drainage basins with 1970's stormwater systems. These older systems discharge directly into the adjacent drainage canal with no pollutant treatment. Over time the accumulation of sediments, nutrients, intensive development, and recreational/entertainment pressures are contributing to water quality degradation.

Whenever new development or redevelopment occurs, the stormwater system is brought to current code/permit requirements. In the interim, several areas are in need for rapid, effective, and economical improvement in the quality of its stormwater discharge.

Suntree Technologies Incorporated, located in Cape Canaveral, FL, manufactures stormwater grate inlet skimmer boxes. They are made of a high quality fiberglass frame, with stainless steel filter screens backed by heavy-duty aluminum grating. Each unit is custom made to accommodate various inlet sizes. A hydrocarbon absorption boom is attached to the top of the skimmer box for petroleum, oil, and grease removal.

These devices fit below the grate and catch sediment, debris, and petroleums, oils & greases. Clean-out, maintenance, and performance reporting is provided by Suntree on a scheduled basis.

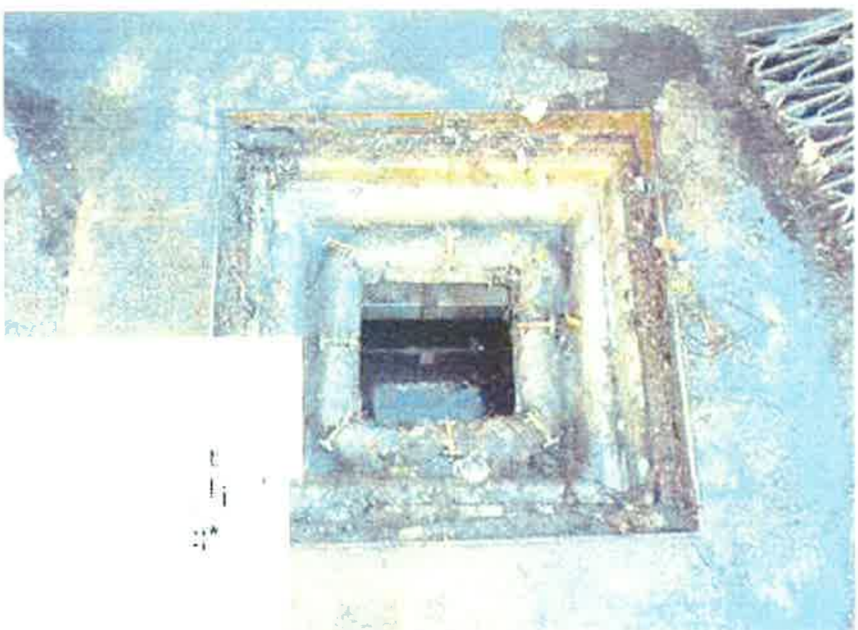
Picture of Grate Inlet Skimmer Box

The Reedy Creek Improvement District (RCID) selected six (6) test sites in the Lake Buena Vista area to evaluate the performance of these units. One unit was placed in a curb inlet along Hotel Plaza Boulevard to trap landscape leaf litter, sediment, and oil & grease from a high use roadway. Three (3) units were placed in the backstage service area of the Rain Forest Cafe. Two (2) units were placed in the backstage service area of the McDonald's restaurant and Legos merchandise shop.

After several field meetings, during which Suntree took extensive measurements, photos, and other documentation of each stormwater drain, the Grate Inlet Skimmer Boxes were manufactured and delivered for installation. All units were installed without mishap approximately two weeks before the 1999 Christmas holiday season. The target time period for particle catchment was one month. Mr. Henry and Tom Happel, Suntree Technologies, visited each site several times during the month to ensure that debris would not fill the units too soon.

On January 25,2000, Suntree serviced the six units. At each site, the material captured in the skimmer boxes was removed, measured, weighed, visually identified, photographed, and recorded. Some units were slightly field modified for optimum performance. All units performed as expected **removing, on average, 20 pounds of debris from each of the six sites.** The composition of debris varied considerably.

The Hotel Plaza (roadway) site was 90% leaf litter and 10% sediment. The Rain Forest Cafe sites ran in opposition as you got close to the lake. First inlet was about 50% leaf litter and cigarette butts and 50% sediment. The middle inlet was 60 % sediment and 30 % leaf litter (10% miscellaneous). The inlet closest to the lake was 95% sediment and 5% leaf litter. The two sites at the McDonalds/Legos area were similar to each other. The site closest to the lake was 95% sediment and 5% leaf litter. The site closest to the entrance gate was 98% litter sediment and 2% leaf litter.



This composition is indicative of the human activities and drainage flow patterns of that site. Backstage areas in the Walt Disney World Resort receive an artificial rain event each night during cleaning operations. This washes a continual flow over the impervious site, washing all materials into the stormwater system.

Municipalities in Brevard, Volusia and Dade counties have successfully used inlet skimmers in Florida. RCID partnered with Walt Disney Imagineering (WDI) Research and Development to coordinate some basic chemical sampling for pollutant removal efficiency determination. Mr. Craig Duxbury, WDI, provided technical support and guidance for this. An ingeniously simple device was fabricated by Suntree to allow sampling of the First Flush of water going into the units and ultimately coming out of the skimmer boxes.

Collected samples were processed and analyzed by the RCID Environmental Services Laboratory. Analysis parameter were:

Ammonia, Chemical Oxygen Demand, Fecal Coliform (MPN), Nitrite and Nitrate, Total Kjeldahl Nitrogen, Oil and Grease, Total Phosphate, Suspended Solids, and Metals.

Analysis results are presented in the following table:

ANALYSIS	LOCATION	LAB NO.	VALUE	UNITS	SAM-DATE	Pollutant Change	% Change
Ammonia, Salicylate	RF-IN	1646	0.38	mg/l	09-Feb-00	0.14	37 %
Ammonia, Salicylate	RF-OUT	1646	0.23	mg/l	09-Feb-00		
Ammonia, Salicylate	RF-OUT-I	1646	0.25	mg/l	09-Feb-00		
Chemical Oxygen Demand	RF-IN	1646	2670	mg/l	09-Feb-00	1035	
Chemical Oxygen Demand	RF-OUT	1646	1780	mg/l	09-Feb-00		
Chemical Oxygen Demand	RF-OUT-I	1646	1490	mg/l	09-Feb-00		
Coliform, Fecal MPN	RF-IN	1646	1600	#IOO ml	09-Feb-00	-93400	
Coliform, Fecal MPN	RF-OUT	1646	160,000	#IOO ml	09-Feb-00		
Coliform, Fecal MPN	RF-OUT-I	1646	30,000	#IOO ml	09-Feb-00		
Nitrate and Nitrite	RF-IN	1646	0.06	mg/l	09-Feb-00	0.035	
Nitrate and Nitrite	RF-OUT	1646	0.04	mg/l	09-Feb-00		
Nitrate and Nitrite	RF-OUT-I	1646	0.01	mg/l	09-Feb-00		
Nitrogen, Total Kjeldahl	RF-IN	1646	24.3	mg/l	09-Feb-00	13.55	
Nitrogen, Total Kjeldahl	RF-OUT	1646	10.4	mg/l	09-Feb-00		
Nitrogen, Total Kjeldahl	RF-OUT-I	1646	11.1	mg/l	09-Feb-00		
Oil and Grease	RF-IN	1646	526	mg/l	09-Feb-00	283	

Pollutant removal efficiencies averaged about 50% for all parameters tested. The minimal removal was 37% for Ammonia and the maximum removal was 74% for Suspended Solids.

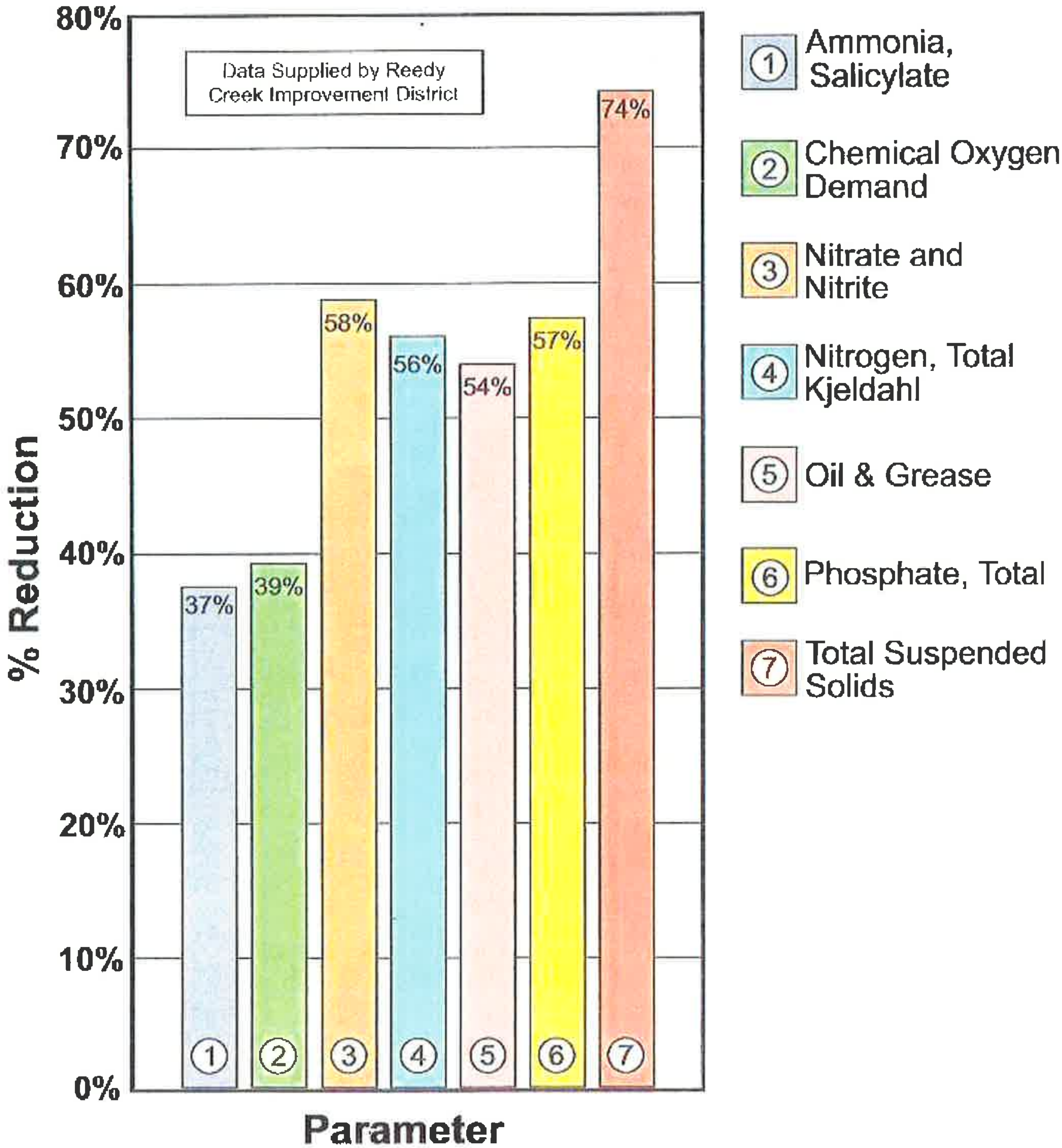
Coliform bacteria were not effectively removed by the skimmer boxes, although, they are not designed to provide water disinfection. Oil and Grease are a food source for bacteria and reduction of this pollutant should provide some effect on bacterial numbers.

Reedy Creek 24" x 24" Grate Inlet Skimmer Box

Pollutant Removal Efficiency

Grate Inlet Skimmer Box

Using Storm Boom #1 Type Absorbent



Grate Inlet Skimmer Box/Round Curb Inlet Basket - Removal Efficiencies

Numeric Reductions (mg/L)

	Total Suspended Solids mg/L			Total Phosphorus mg/L			Total Nitrogen mg/L		
Location	Inlet	Outlet	Removal Efficiency	Inlet	Outlet	Removal Efficiency	Inlet	Outlet	Removal Efficiency
Site Evaluation - Reedy Creek			74%			57%	24.3	10.4	57%
Creech Engineering Report			73%			79%			79%
Witman's Pond	978	329	66%	18.6	0.452	98%	48.08	9.86	79%
Universal Engineering - 2007 (100 Microns) LATEST REPORT			86%						

	Zinc mg/L			Lead mg/L			Copper mg/L		
Location	Inlet	Outlet	Removal Efficiency	Inlet	Outlet	Removal Efficiency	Inlet	Outlet	Removal Efficiency
UC Irvine						99%			
Longo Toyota	13.7	0.73	95%	1.5	0.2	87%	1.9	0.1	95%

	Ammonia, Salicylate mg/L			Fecal Coliform CFU/100 mL			Cadmium		
Location	Inlet	Outlet	Removal Efficiency	Inlet	Outlet	Removal Efficiency	Inlet	Outlet	Removal Efficiency
Site Evaluation - Reedy Creek	0.38	0.23	39%						
UC Irvine						33%			94%

	Hydrocarbons mg/L		
Location	Inlet	Outlet	Removal Efficiency
UC Irvine			90%
Longo Toyota	199	10.43	95%

Reedy Creek - Site Evaluation of a Grate Inlet Skimmer Box for Debris, Sediment, and Oil & Grease Removal - 1999 - Independent Test
Creech Engineering Report - Pollutant Removal Testing for a Grate Inlet Skimmer Box - 2001
Witman's Pond - Restoration Project - Massachusetts Dept of Environmental Management - 1998 -Independent Test
UC Irvine - Optimization of Stormwater Filtration at the Urban/Watershed Interface - Dept of Environmental Health - 2005 - Independent Test
Longo Toyota - Field Test - City of El Monte - 2002 - Independent Test
Universal Engineering Sciences - Suspended Soils Retention Study - 2007 -Independent Test

UNIVERSAL
ENGINEERING SCIENCES
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Construction Material Testing • Threshold Inspection

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(321) 638-0808 Fax (321) 638-0978

November 29, 2007

Henry Happel
President
Suntree Technologies, Inc.
798 Clearlake Road
Cocoa, Florida 32922

Reference: Suspended Solids Retention Testing
Curb Inlet Basket and Grate Inlet Skimmer Box
Universal Project No. 34184-004-01

Dear Mr. Happel:

Universal Engineering Sciences, Inc. (Universal) is pleased to submit this letter report to Suntree Technologies, Inc. including laboratory analysis and photo documentation of the testing procedures used, as described below.

SCOPE OF WORK

Universal measured the percentage (by dry weight) of OK-90 calibrated sand provided by the client that was retained in the Curb Inlet Basket and Grate Inlet Skimmer Box. In addition, gradation analyses were performed on the OK-90 sand before it was used in the testing beds and again after it had been used in the testing beds, on both the portions of sand retained in the skimmer box and curb basket, and the portions of sand that passed through the skimmer box and curb basket.

DESCRIPTION OF TESTING APPARATUS

On November 6, 2007 Suntree Technologies arrived at the Universal branch office located at 820 Brevard Avenue in Rockledge, FL with the Curb Inlet Basket test bed and Grate Inlet Skimmer Box test bed, as shown in **APPENDIX B**. Two 100 pound bags of U.S. Silica OK-90 Unground Silica Sand were previously delivered to the Universal laboratory in preparation for the Suspended Solids Testing.

Grate Inlet Skimmer Box

The Grate Inlet Skimmer Box test bed consisted of a two-tiered formed fiberglass table and water pumping apparatus designed to simulate a standard storm water catch basin that would typically be found in a parking lot. The dimensions of the Grate Inlet Skimmer Box test bed are approximately 64" by 45". The top tier is ringed with a 1-inch diameter PVC tube, perforated so as to form water jets at 2 inch intervals once pressurized water is pumped into the tubes. The surface of the top tier is sloped towards the center of the table so that water from the jets will flow towards the center of the top tier, where a 36" by 27" rectangular opening has been cut into the surface. The Grate Inlet Skimmer Box is placed into the opening. Water and/or debris are washed into the Skimmer Box. Debris is retained on the mesh sieves that line the bottom and sides of the Skimmer Box, while water drains freely through the sieves.

Once the water has passed through the Skimmer Box apparatus, it collects in the bottom tier of the table. The bottom tier is separated into two areas by a wall with large openings in it which allows water to pass freely between the two areas. The larger area acts as a reservoir for the recirculation pumps, which are located in the smaller area. A screen has been placed along the face of the wall to prevent debris which has passed through the Skimmer Box and into the reservoir from entering the pump intake area. The recirculation pumps supply water to the PVC tubes located on the top tier.

Curb Inlet Basket

The Curb Inlet Basket test bed consisted of a basin approximately 48" by 48" and approximately 36" deep. A shelf is located along one side of the basin approximately 15" wide that runs the length of the basin approximately two inches below the top edge of the basin (see photos in **APPENIDX B**). A one-inch diameter PVC tube similar to the one used for the Skimmer Box test bed runs the length of the shelf and is supplied by a single pump located in the reservoir of the test bed. Similarly to the Skimmer Box test bed, the Curb Inlet test bed has a reservoir divided by a wall with screened opening. The Curb Inlet Basket has two hooks on it which are hung through slots that have been cut into the edge of the shelf, which allows the shelf to simulate a standard "D.O.T. Type F" curb. The Basket is hung so that water flows off of the shelf and into the Basket (see photos in **APPENIDX B**).

OK-90 Unground Silica Sand

Two 100 pound bags of US Silica OK-90 sand were provided by Suntree Technologies to use for suspended solids testing. A gradation analysis (AASHTO T-88) was performed at the Universal office on a representative sample of each bag of the OK-90 sand provided by the client to determine the percentage of OK-90 sand that has a grain size larger than 100 microns for future calculations. The results of the sieve analysis are presented in **APPENDIX A** along with the sieve analysis provided by the manufacturer.

Approximately 60 pounds of the OK-90 sand obtained from Bag 1 was thoroughly mixed and air dried in preparation for the suspended solids testing.

SKIMMER BOX TESTING PROCEDURE

The testing bed reservoir was filled with water and the pump system was turned on to begin water circulation. Additional water was added to maintain a water level in the reservoir approximately 1.5 inches below the bottom of the Skimmer Box (see photos in **APPENDIX B**).

The Skimmer Box was removed and weighed wet to establish the container weight.

The Skimmer Box was placed back into the testing bed and a bead of RTV (Room Temperature Vulcanizing) silicon approximately ¼-inch wide was applied around the edge of the Skimmer Box to ensure a positive seal between the edge of the Skimmer Box and the test bed (for testing purposes only), preventing any sand from bypassing the Skimmer Box and washing directly into the reservoir (see photos in **APPENDIX B**). The silicon was then allowed to cure for approximately one hour before testing.

A 546 gram sample of the OK-90 sand was taken for moisture content determination (ASTM-D 2216), then a 25.09 pound (wet weight) sample of OK-90 sand was placed around the Skimmer Box in the top of the test bed over a period of six minutes, while the water jets washed the sand into the Skimmer Box, which resulted in a suspended solids introduction rate of approximately 4.2 pounds of sand per minute (see photos in **APPENDIX B**).

The pumps remained on and water was circulated through the test bed for a period of three minutes, washing all of the sand into the Skimmer Box (see photos in **APPENDIX B**).

The pumps were turned off and the Skimmer Box was removed and weighed wet again, with the sand retained inside.

20.88 pounds (dry weight) of the original 24.99 pound (dry weight) sample of sand was retained in the Skimmer Box. A grain size analysis sample was taken from the sand retained inside the Skimmer Box to determine the retained weight of OK-90 sand that was greater than 100 microns in diameter. The results of this test are presented in **APPENDIX A**.

The reservoir in the lower tier of the test bed was carefully drained, so that only a small amount of water and all of the sand that passed through the Skimmer Box was left in the bottom tier of the test bed. The sand that passed through the Skimmer Box was then washed into a container and a grain size analysis was performed on this sample (see photos in **APPENDIX B**). The results of this test are presented in **APPENDIX A**.

The laboratory worksheet results of the Suspended Solids Retention Testing for the Skimmer Box are presented in **APPENDIX A**.

CURB INLET TESTING PROCEDURE

The testing bed reservoir was filled with water and the pump system was turned on to begin water circulation. Additional water was added to maintain a water level in the reservoir approximately 1.5 inches below the bottom of the Curb Inlet (see photos in **APPENDIX B**).

The Curb Inlet was removed and weighed wet to establish the container weight.

A 12.77 pound (wet weight) sample of OK-90 sand was placed approximately midway along the length of the shelf of the Curb Inlet test bed over a period of three minutes, while the water jets washed the sand into the Curb Inlet, which resulted in a suspended solids introduction rate of approximately 4.3 pounds of sand per minute (see photos in **APPENDIX B**).

The pump remained on and water was circulated through the test bed for a period of three minutes, washing all of the sand into the Curb Inlet (see photos in **APPENDIX B**).

The pump was turned off and the Curb Inlet was removed and weighed wet again, with the sand retained inside.

11.70 pounds (dry weight) of the original 12.72 pound (dry weight) sample of sand was retained in the Curb Inlet. A grain size analysis sample was taken from the sand retained inside the Curb Inlet basket. The results of this test are presented in **APPENDIX A**.

The basin of the test bed was carefully drained, so that only a small amount of water and all of the sand that passed through the Curb Inlet was left in the bottom of the test bed. The sand that passed through the Curb Inlet was then washed into a container and a grain size analysis was performed on this sample to determine the retained weight of OK-90 sand that was greater than 100 microns in diameter (see photos in **APPENDIX B**). The results of this test are presented in **APPENDIX A**.

The laboratory worksheet results of the Suspended Solids Retention Testing for the Curb Inlet are presented in **APPENDIX A**.

SUMMARY

The Grate Inlet Skimmer Box by Suntree Technologies, Inc. retained a minimum of 84% of the portion of OK-90 sand in suspension with an average grain size greater than 100 microns (.100 mm).

The Curb Inlet Basket by Suntree Technologies, Inc. retained a minimum of 93% of the portion of OK-90 sand in suspension with an average grain size greater than 100 microns (.100 mm).

Universal appreciates this opportunity to provide testing services to you, and looks forward to working with you on future projects. Please do not hesitate to contact us if you have questions or require any additional information.

Sincerely,

UNIVERSAL ENGINEERING SCIENCES, INC.
Certificate of Authorization No. 549

Keith A. Ellis, E.I.
Project Engineer

Richard E. Hoaglin, P.E. 11/28/07
Branch Manager
Florida Registration No. 48796

2-Addressee

UES Project No. 34184-004-01
November 29, 2007
Page 1

Suspended Solids Testing Results

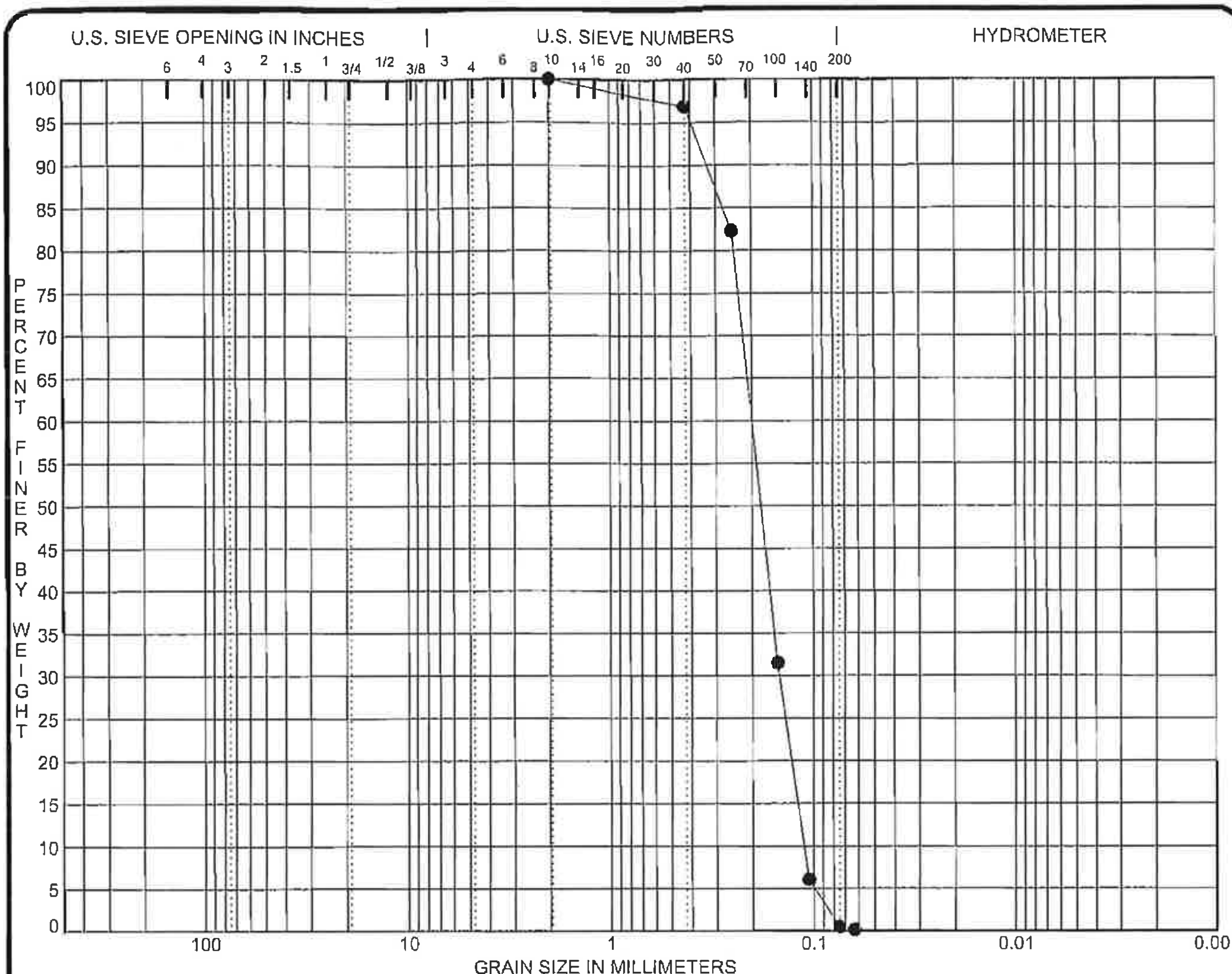
Curb Inlet Basket

A.)	Wet Weight of OK-90 Sand (pre test):	12.77 pounds
B.)	Moisture Content of Sand Prior to Testing:	0.40 % by mass
A/(1+(B/100)) = C.)	Dry Weight of OK-90 Sand (pre test):	12.72 pounds
D.)	Weight of Curb Inlet Basket:	19.40 pounds
E.)	Weight of Curb Inlet Basket and Sand:	33.92 pounds
E-D = F.)	Wet Weight of Sand Retained in Basket:	14.52 pounds
G.)	Moisture Content of Sand After Testing:	24.00 % by mass
F/(1+(G/100)) = H.)	Dry Weight of Sand Retained in Basket:	11.71 pounds
I.)	Dry Weight of Sand Passing Basket:	444.50 grams
I/453.6 = J.)		0.98 pounds
100*(1-(H+J)/C) = K.)	Loss of Sample:	0.23 % by mass
(from Soil Gradation, Bag #1) L.)	OK-90 Sand larger than 100 microns placed in Curb Inlet test bed:	95.00 % by mass
C*L = M.)	Mass of OK-90 sand placed in Curb Inlet test bed greater than 100 microns, based on initial gradation of Bag #1:	12.08 pounds
(from Soil Gradation, Curb Inlet Basket) N.)	OK-90 Sand larger than 100 microns retained in Curb Inlet basket:	96.50 % by mass
H*N = O.)	Mass of OK-90 sand retained in Curb Inlet Basket greater than 100 microns, based on post-test gradation:	11.30 pounds
100*(O/M) = P.)	Percentage of particles greater than 100 microns retained in Curb Inlet Basket:	93.54 % by mass

Suspended Solids Testing Results

Grate Inlet Skimmer Box

A.)	Wet Weight of OK-90 Sand (pre test):	25.09 pounds
B.)	Moisture Content of Sand Prior to Testing:	0.40 % by mass
A/(1+(B/100)) = C.)	Dry Weight of OK-90 Sand (pre test):	24.99 pounds
D.)	Weight of Skimmer Box:	48.14 pounds
E.)	Weight of Skimmer Box and Sand:	73.26 pounds
E-D = F.)	Wet Weight of Sand Retained in Box:	25.12 pounds
G.)	Moisture Content of Sand After Testing:	20.28 % by mass
F/(1+(G/100)) = H.)	Dry Weight of Sand Retained in Box:	20.88 pounds
I.)	Dry Weight of Sand Passing Skimmer Box:	1627.60 grams
I/453.6 = J.)		3.59 pounds
100*(1-(H+J)/C) = K.)	Loss of Sample:	2.08 % by mass
(from Soil Gradation, Bag #1) L.)	OK-90 Sand larger than 100 microns placed in Skimmer Box test bed:	95.00 % by mass
C*L = M.)	Mass of OK-90 sand placed in Skimmer Box test bed greater than 100 microns, based on initial gradation of Bag #1:	23.74 pounds
(from Soil Gradation, Skimmer Box Basket) N.)	OK-90 Sand larger than 100 microns retained in Skimmer Box basket:	96.00 % by mass
H*N = O.)	Mass of OK-90 sand retained in Skimmer Box greater than 100 microns, based on post-test gradation:	20.04 pounds
100*(O/M) = P.)	Percentage of particles greater than 100 microns retained in Skimmer Box:	84.41 % by mass



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **P1**	**OK-90 SAND BAG #1**					**0.97**	**1.8**
0' Depth							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P1**	**2.00**	**0.20**	**0.147**	**0.1119**	**0.0**	**99.5**	**0.5**	

NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 140	NO. 200	NO. 230
	100.0	**96.9**	**82.3**	**31.5**	**6.0**	**0.5**	**0.2**

Client: SUNTREE TECHNOLOGIES
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

Client No: 34184-004-01

Date: 11/21/07

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GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

SOIL GRADATION CURVES

Universal Engineering Sciences, Inc.
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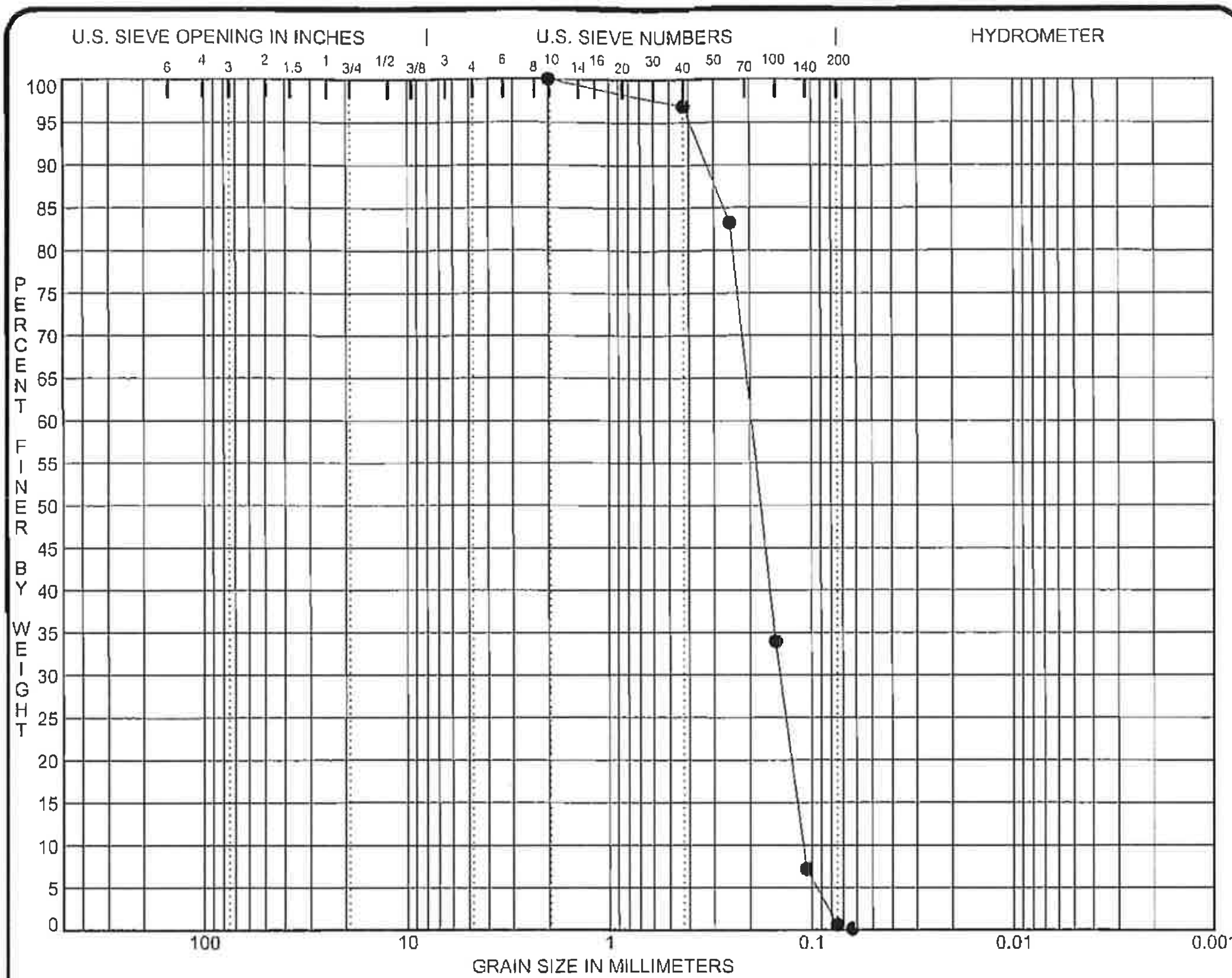

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**P1**	**OK-90 SAND BAG #2**					**0.94**	**1.8**
	0' Depth							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P1**	**2.00**	**0.20**	**0.142**	**0.1099**	**0.0**	**99.4**	**0.6**	

NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 140	NO. 200	NO. 230
	100.0	**96.9**	**83.3**	**34.0**	**7.2**	**0.6**	**0.1**

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SOIL GRADATION CURVES

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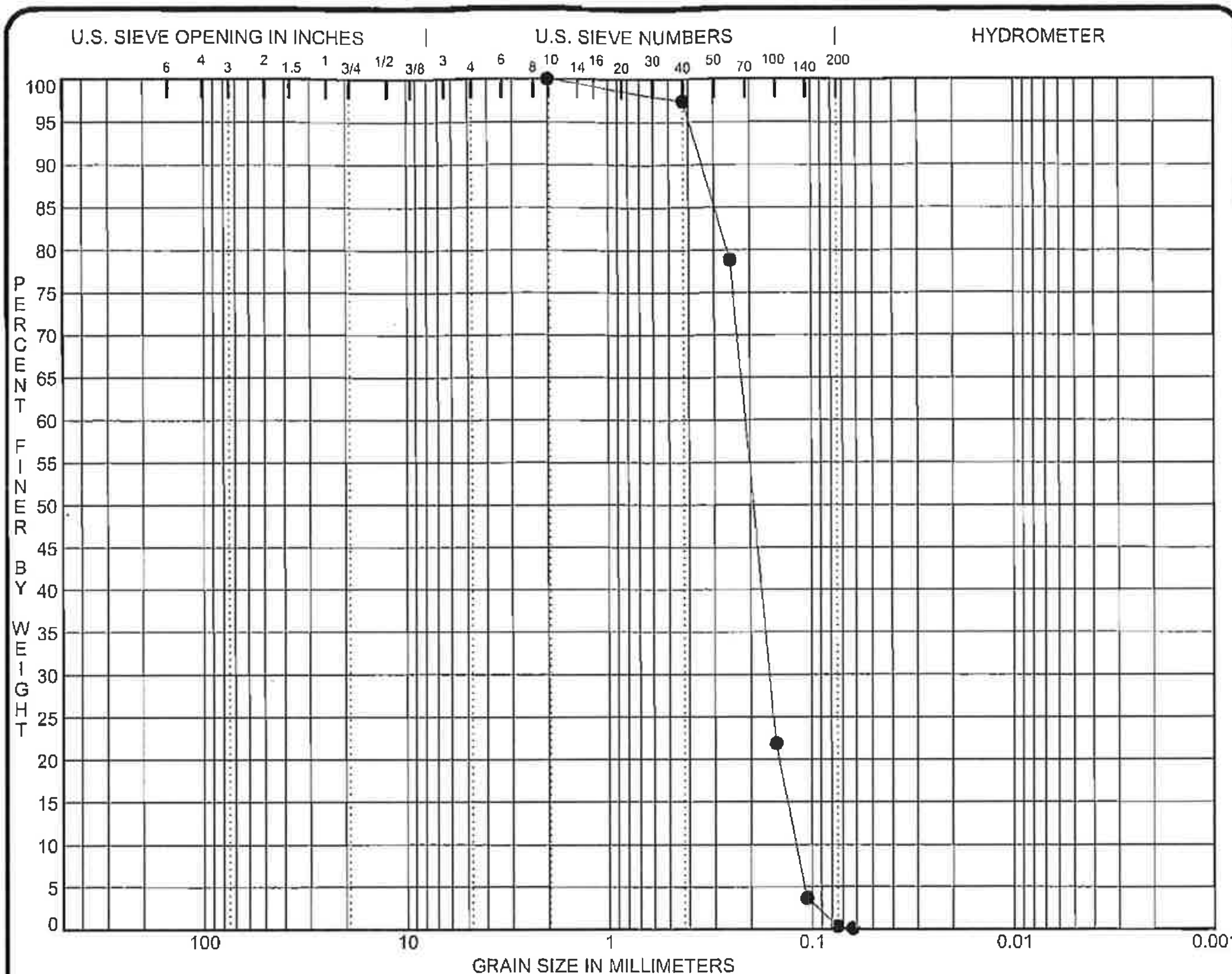

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	P1	**CURB INLET BASKET (Material retained in Curb Inlet)**					**1.03**	**1.8**
	0' Depth							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P1	**2.00**	**0.21**	**0.161**	**0.1196**	**0.0**	**99.6**	**0.4**	

NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 140	NO. 200	NO. 230
	100.0	**97.5**	**78.9**	**21.9**	**3.7**	**0.4**	**0.1**

Client: **SUNTREE TECHNOLOGIES**
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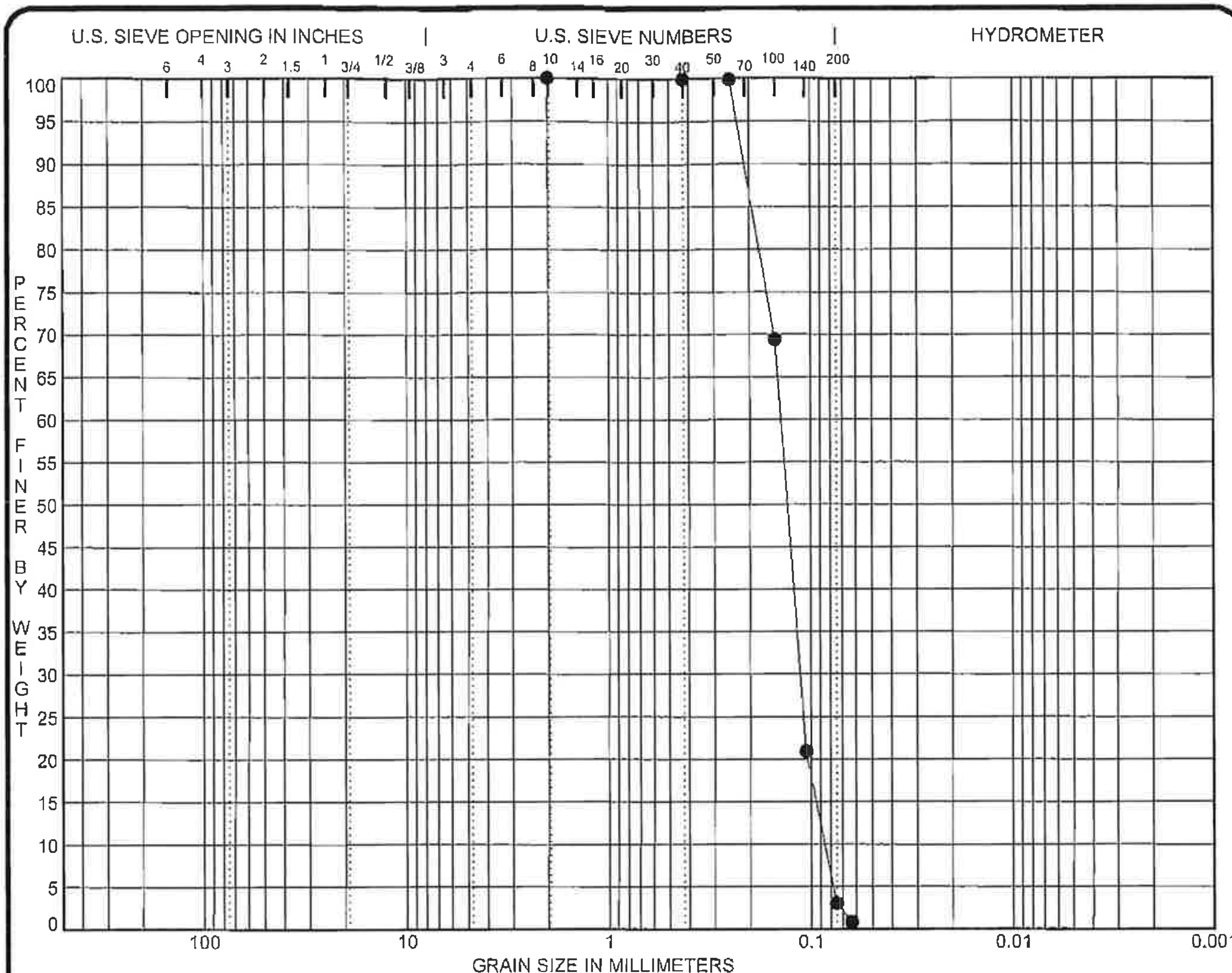
ROCKLEDGE, FLORIDA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **P1**	**CURB INLET RESERVOIR (Material passing Curb Inlet Basket)**					**1.06**	**1.6**
0' Depth							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P1**	**2.00**	**0.14**	**0.113**	**0.0858**	**0.0**	**97.0**	**3.0**	

NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 140	NO. 200	NO. 230
	100.0	**100.0**	**99.8**	**69.4**	**20.9**	**3.0**	**0.8**

Client: SUNTREE TECHNOLOGIES
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

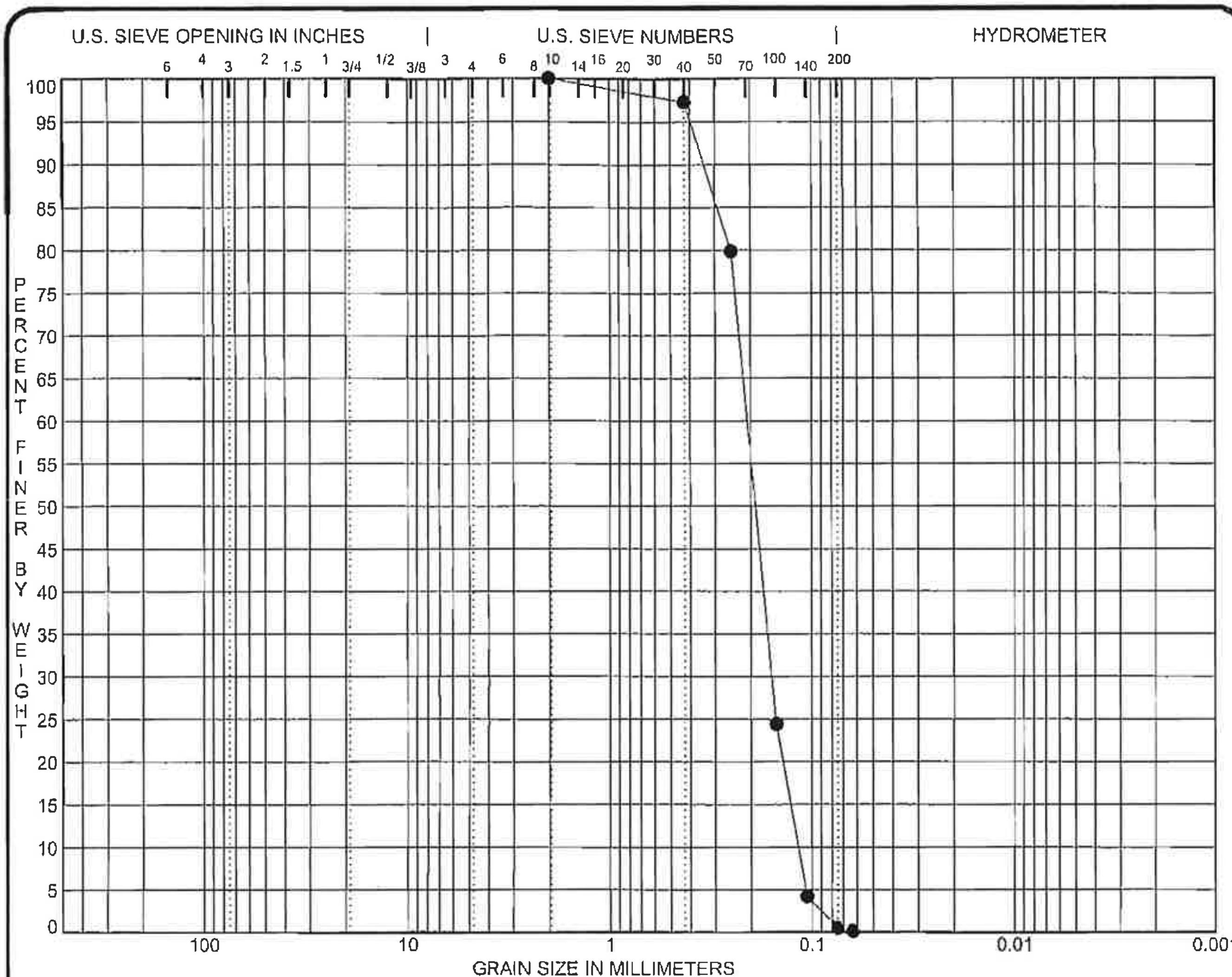
Client No: 34184-004-01

Date: 11/21/07

Project: SUSPENDED SOILS RETENTION TESTING FOR
GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

SOIL GRADATION CURVES

Universal Engineering Sciences, Inc.
ROCKLEDGE, FLORIDA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **P1**	**SKIMMER BOX BASKET (Material retained in Skimmer Box)**					**1.02**	**1.8**
0' Depth							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P1**	**2.00**	**0.21**	**0.158**	**0.1171**	**0.0**	**99.5**	**0.5**	

NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 140	NO. 200	NO. 230
	100.0	**97.3**	**79.9**	**24.4**	**4.2**	**0.5**	**0.1**

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GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

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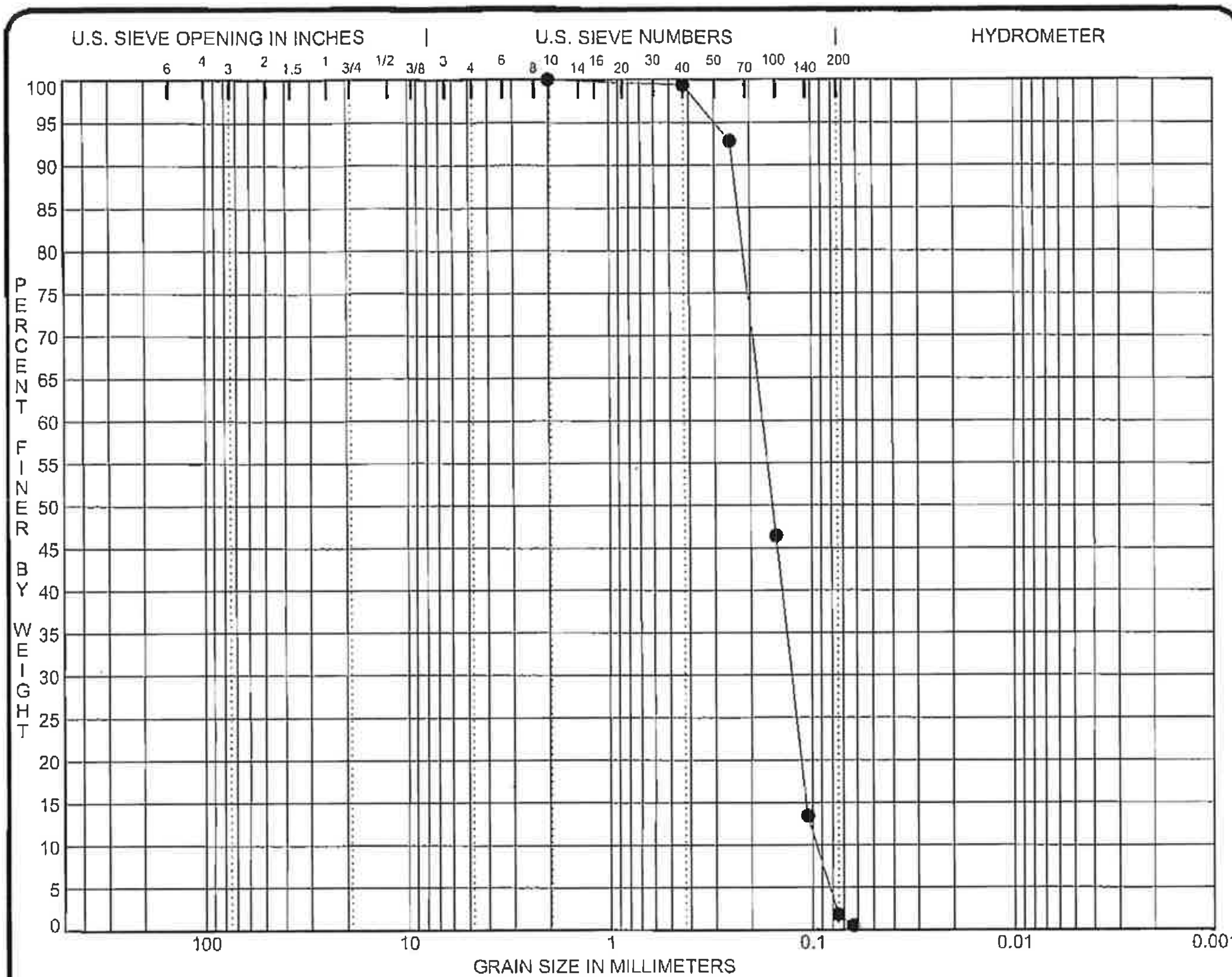

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● P1	SKIMMER BOX RESERVOIR (Material passing Skimmer Box Basket)					0.95	1.8
0' Depth							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P1	2.00	0.17	0.126	0.0958	0.0	98.2	1.8	

NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 140	NO. 200	NO. 230
	100.0	99.3	92.8	46.4	13.4	1.8	0.5

Client: SUNTREE TECHNOLOGIES
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

Client No: 34184-004-01

Date: 11/21/07

Project: SUSPENDED SOILS RETENTION TESTING
FOR GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

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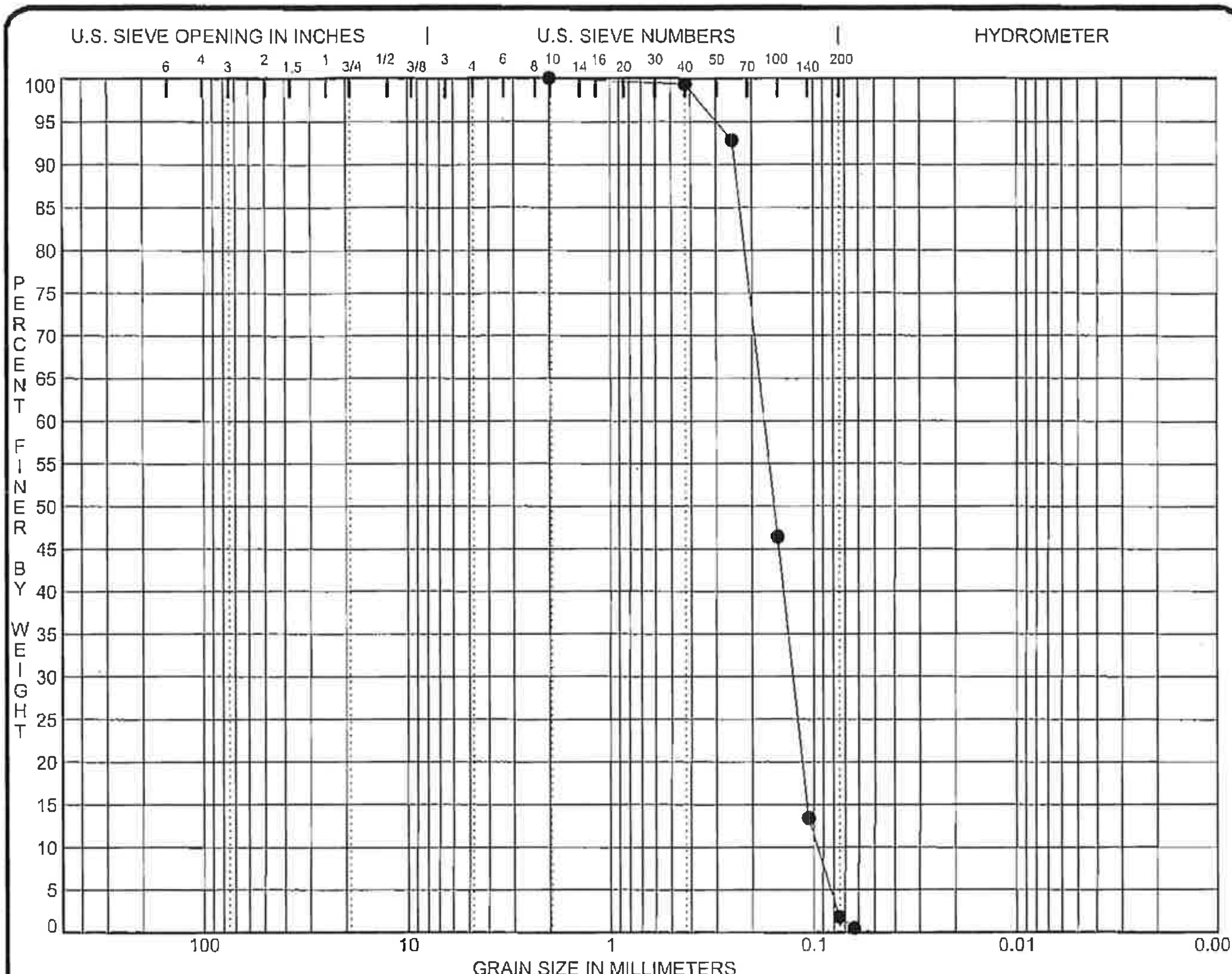
ROCKLEDGE, FLORIDA



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **P1**	**SKIMMER BOX RESERVOIR (Material passing Skimmer Box Basket)**					**0.95**	**1.8**
0' Depth							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P1**	**2.00**	**0.17**	**0.126**	**0.0958**	**0.0**	**98.2**	**1.8**	

NO. 4	NO. 10	NO. 40	NO. 60	NO. 100	NO. 140	NO. 200	NO. 230
	100.0	**99.3**	**92.8**	**46.4**	**13.4**	**1.8**	**0.5**

Client: **SUNTREE TECHNOLOGIES**
798 CLEARLAKE ROAD
COCOA FLORIDA 32922

Client No: **34184-004-01**

Date: **11/21/07**

Project: **SUSPENDED SOILS RETENTION TESTING**
FOR GRATE INLET SKIMMER BOX
ROCKLEDGE, FLORIDA

SOIL GRADATION CURVES

Universal Engineering Sciences, Inc.
ROCKLEDGE, FLORIDA

Photo No. 1: Curb Inlet Basket test bed

Photo No. 2: Grate Inlet Skimmer Box test bed, upper tier

Photo No. 3: Grate Inlet Skimmer Box test bed, lower tier

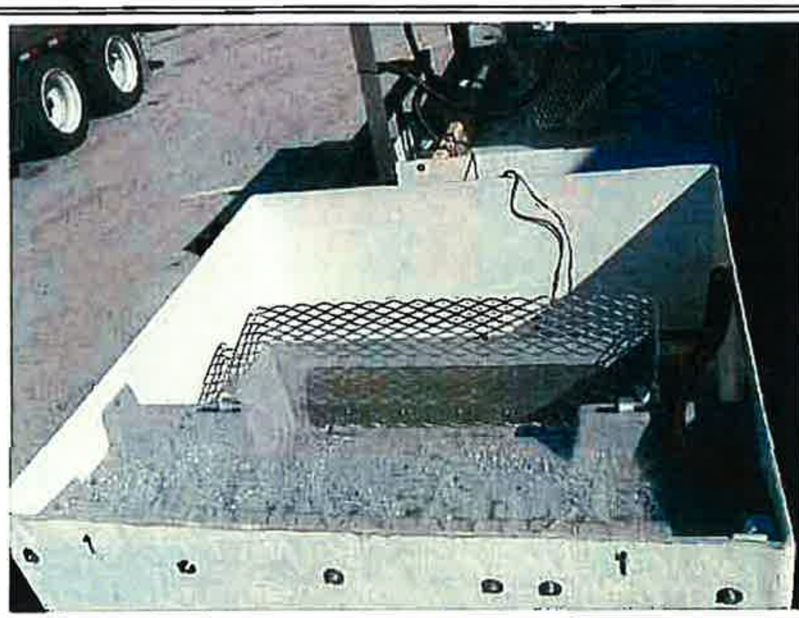


Photo No. 4: Water flowing into Curb Inlet

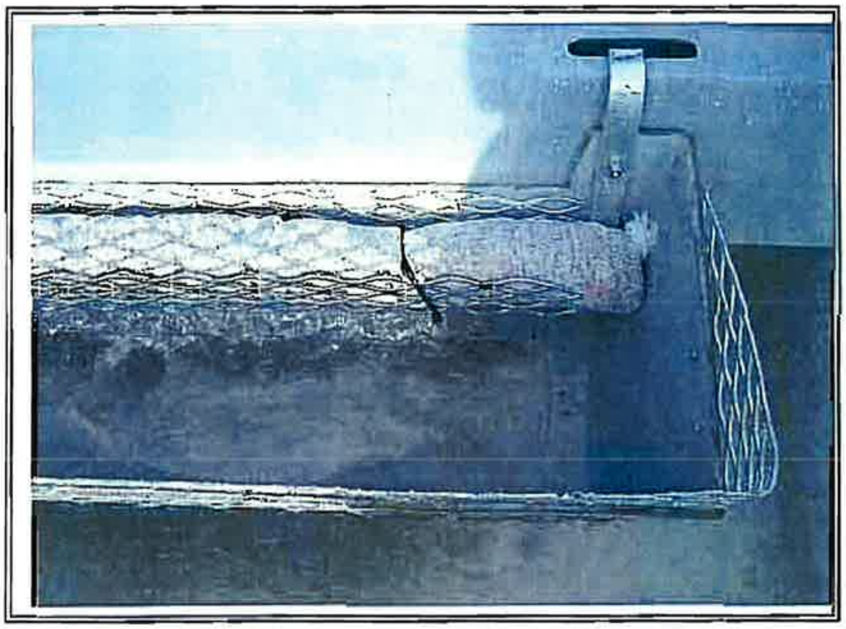


Photo No. 5: Curb Inlet hook hanging in slot on test bed

Photo No. 6: Blue RTV Silicon placed around edge of Skimmer Box

Photo No. 7: Silica sand being placed into top tier of Skimmer Box testing bed

Photo No. 8: Approximately one minute left until completion of Skimmer Box test

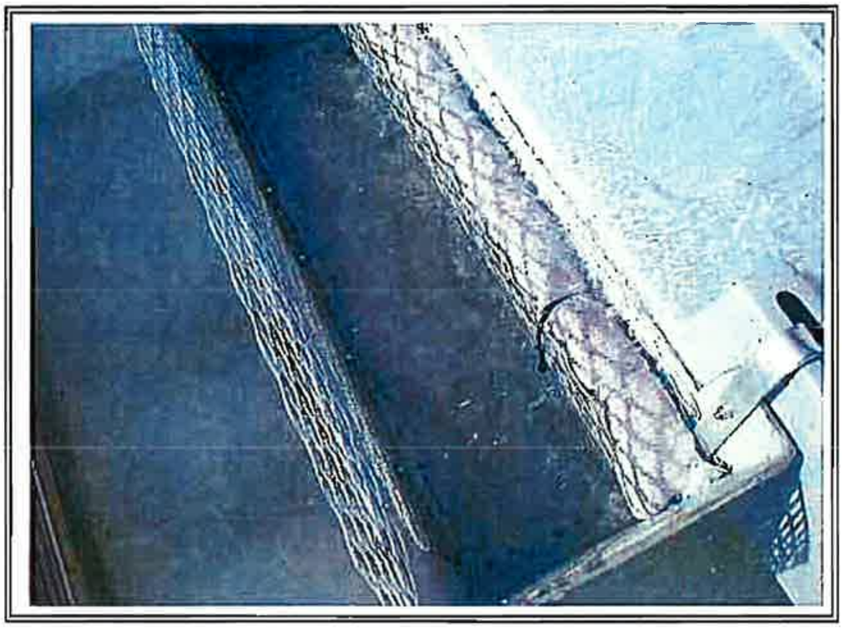


Photo No. 11: Curb Inlet Basket just prior to end of testing

Photo No. 12: Sand in the Curb Inlet testing bed reservoir being washed into a container prior sieve analysis

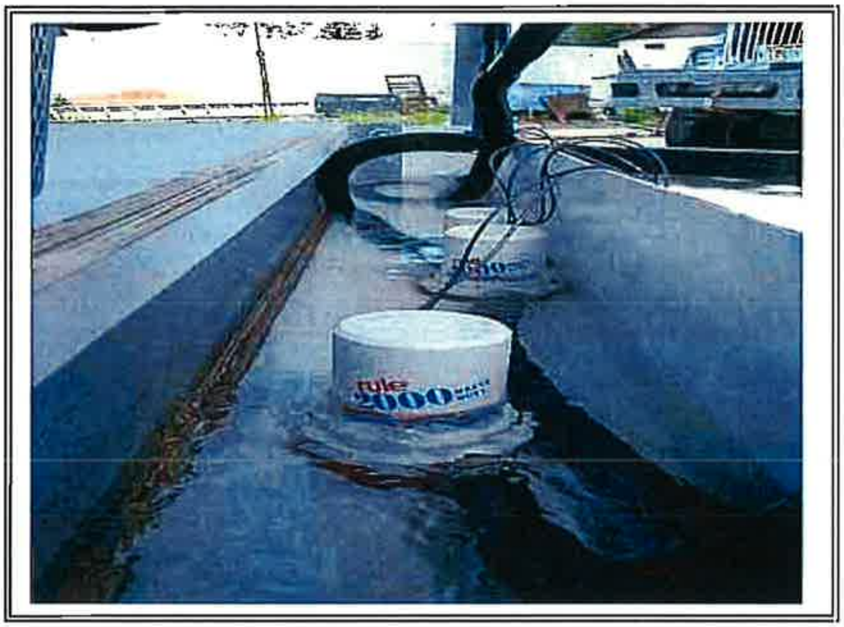


Photo No. 13: Pumps for Grate Inlet Skimmer Box test bed

Photo No. 14: Sand left in lower tier of Skimmer Box test bed being washed into a container for sieve analysis

Evaluation of the Performance of Four Catch Basin Inserts in Delaware Urban Applications

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Introduction

Catch basin inserts are becoming more widely used as stormwater best management practices (BMPs). A variety of commercial devices are available. Most are designed to remove trash, sediments and hydrocarbons to varying degrees from stormwater runoff that enters the catch basins. They are a relatively easy and inexpensive retrofit, particularly for older, existing drainage systems where end-of-pipe treatment technologies may be impractical or prohibitively expensive. However, until recently, few catch basin insert filters have had performance data collected under actual field conditions.

The Delaware Department of Transportation (DelDOT) is investigating the performance of four different types of inlet protection devices in urbanized areas of northern Delaware. We are evaluating and comparing the performance of these inserts with respect to their ability to remove sediment and hydrocarbons from stormwater runoff, as well as their maintenance requirements in different applications. Monitoring will continue year-round over a two- to three-year period, in order to incorporate data from varying seasonal and rainfall conditions.

Methods

The catch basin inserts being tested are

1. UltraDrainguard® Oil and Sediment Model (UltraTech International, Inc.) – an X-TEX geotextile sock and skirt that fits the size of the inlet opening.
2. HydroKleen® (Hydro Compliance Management, Inc.) – a two-chambered system consisting of a presettling sediment chamber and a filtration chamber containing one activated carbon and two cellulose filters.
3. DrainPac® (United Stormwater, Inc.) – an HDPE support basket and polypropylene filter liner custom-sized to fit the inlet.
4. Flo-Gard+Plus® (Kristar Enterprises, Inc.) – a support basket and removable polypropylene filter liner, plus a silicate oil-adsorbent filter medium in floatable bags.

The devices were installed in three different locations, with different land use types and varying pollutant loads. These include the service station drainage areas of a rest area on Interstate Rt. 95 near Newark; Drummond North, a residential subdivision in Newark; and a commercial parking area on the Wilmington Riverfront (Table 1). Photographs of each insert are included in Figure 1.

To determine the effectiveness of the catch basin inserts, we are comparing data from wet-weather samples collected at the outfalls of both protected and nearby unprotected (control) runs of inlets. Criteria for a qualifying storm event are a 72-hour dry period preceding and at least 0.1 inch of rainfall during the storm. First flush and flow-weighted composite stormwater samples are analyzed for the following water quality parameters: suspended and dissolved solids, pH, chemical and biological oxygen demand, nutrients, chloride, oil and grease, petroleum hydrocarbons, BTEX, phenolics, PAHs, heavy metals, and indicator bacteria. Only first flush samples are being collected for the Flo-Gard+Plus® inserts. In addition, we inspect all of the inserts on a regular basis; when cleaning or replacement occurs, the sediment and other solids collected in the filters are weighed, characterized as to content, and samples are taken for chemical analysis. This allows us to estimate the total sediment and nutrient load removed by the filters.

The inserts were installed at various times during the past year (Table 1). The drainage pipes and catch basins were cleaned before installation of the inserts.

Results

At the time of this writing, data were available from six wet weather events for the DrainPac® units and one event each for the HydroKleen® and Flo-Gard Plus® units.

HydroKleen®: The HydroKleen® catch basin inserts were selected for the service plaza site because of their multilayer filter design for removing hydrocarbons and other dissolved organics. Baseline monitoring data collected for the past year from the I-95 service plaza show that metals, petroleum hydrocarbons and PAHs are major stormwater contaminants there.

The single set of data from wet weather samples collected from the HydroKleen®-protected run of inlets do not show much protective effect for most of the parameters we measured (Table 2). However, we do not draw any conclusions from this single sampling event, because of the variability of the data. Additional samples collected during the next year or two may clarify this.

The filters were replaced immediately before water quality sampling began, after about nine months of service. The originally white cellulose filters were thoroughly blackened, indicating that the media was saturated with adsorbed hydrocarbons (Figure 2). Little sediment had accumulated in the sedimentation chambers of the inserts; even after nine months most of the chambers had less than an inch of sediment in them. It is not clear whether this is due primarily to a very low sediment and debris load coming from this part of the service plaza or to resuspension and failure to collect the sediment that does enter the units.

DrainPac®: The Drummond North subdivision in which the DrainPac® catch basin inserts were installed lies within the White Clay Creek watershed, an urban area facing TMDL restrictions for nutrients, bacteria, and biology and habitat. This is an older single-family home community, with numerous trees, so the inserts were expected to collect leaves and yard debris, especially during the fall months.

Wet weather data from the DrainPac®-protected catch basins have been highly variable (Table 2). Concentrations of most parameters measured in first flush samples collected from the protected run of inlets were frequently higher than in samples from the untreated control (Table 2). This difference, however, generally was not statistically significant (Wilcoxon signed rank test, $p>0.05$). Contaminant concentrations in composite samples also were not significantly different between treated and control runs. The lack of difference in this case may be explained by the observation that much of the water flowing into the catch basins appears to bypass the DrainPac® filters. The catch basins in this community, like many in Delaware, are grated curb inlets (Figure 3), and, because in our trial the

DrainPac® units do not extend under the curb opening, water that flows into the curb opening does not get treated. For this type of inlet it is clearly desirable to have a BMP that extends under this opening in order that most of the water is not bypassed.

The DrainPac® units, despite the relatively large size of the filter bag, filled up rapidly in this tree-lined community, particularly during the autumn leaf fall (Figure 4). They were cleaned at two-month intervals. However, in this case the units should probably be cleaned more often to prevent resuspension of the collected debris, which may also have contributed to the lack of observed difference in treated and untreated contaminant concentrations. Stenstrom (1999) also demonstrated that DrainPac inserts bypassed much flow once they had accumulated debris.

UltraDrainguard®: UltraDrainguard® inserts were installed in both the I-95 service plaza and the Drummond North subdivision (Table 1). These inserts are appealing because of their relatively low initial cost and ease of installation. However, the smaller bag size compared to other inserts may make their maintenance more burdensome in areas with heavy debris or sediment loads. At the service plaza, these units have collected primarily trash, sand (in winter), grass clippings (in summer), and some leaves. They have been able to go for a number of months between cleanings at this site. The UltraDrainguard® filters were not installed in the Drummond North community until mid-Winter 2004. At the time this paper was written, no wet weather data had yet been collected.

Flo-Gard Plus®: Flo-Gard® inserts also were not installed until late Winter 2004. Initial wet weather data suggest that sediment and oils are removed by the units (Table 2), although more storm events will need to be sampled to determine if this difference is significant.

Discussion and Conclusions

This study was designed to collect stormwater quality data from field installations of catch basin inserts. Thus, the water samples collected represent actual discharge to the stormwater system, including untreated bypass flow. The study will provide information not only on the effectiveness of various inlet protection devices in removing runoff pollutants, but also on their practicality in terms of maintenance issues and cost. Results will help DelDOT in its efforts to select BMPs that are appropriate for particular sites, land uses or stormwater quality problems in the state.

The limited data that we have collected so far on these catch basin inserts point out the variability in wet weather data, as well as in pollutant loads and the effectiveness of the inserts at removing those contaminants. Other studies have also demonstrated considerable variability in field results. DeMaria et al. (2003) have discussed the challenges in acquiring good field data in this type of study. A Navy Environmental Leadership Program study found a 17-95% range of removal efficiencies for DrainPac inserts (NELP, 2002). A study performed by the Interagency Catch Basin Insert Committee found that a variety of catch basin inserts showed little removal of suspended solids, partially due to scouring from relatively small storms (ICBIC, 1995). A recent CalTrans study of highway BMP retrofits included several types of drain inlet inserts. The inserts performed poorly compared to other BMP types, generally providing less than 10% reduction in the concentration of most constitutents. This study concluded that drain inlet inserts are best suited for gross solids removal (Currier et al., 2001; Taylor, 2002).

Lee (2000) and Taylor (2000) claim that storm drain inserts of all kinds generally perform poorly in field tests due to limited contact time between the water and sorptive media, resuspension of material removed by the filters, and requirements for close monitoring and frequent maintenance. They also conclude that inserts do little to remove dissolved contaminants and are bested suited for removing trash and other gross pollutants.

Catch basin inserts are attractive retrofits because of the relative ease and low cost of installation. Ultimately, however, their cost effectiveness is determined by the frequency with which they must be maintained. Our study and others have demonstrated that for many applications a very high frequency of cleaning is necessary to keep the inserts from clogging and bypassing stormwater flows, as well as resuspending captured material. Inserts may not be practical for large drainage areas or for areas with high levels of leaves or debris that can plug them.

Acknowledgements

We wish to thank the dedicated field staff of KCI Technologies for their hard work performing the wet weather monitoring and maintenance of the catch basin inserts. We also thank the vendors for their assistance and advice.

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Table 1. Summary of types of catch basin inserts evaluated in this study.

Insert Type	Location	Land Use Drained	Date Installed	No. of Units	Monitoring
HydroKleen®	I-95 Service Plaza	Gas station and vehicle (primarily truck) parking	July 2003	8	Wet weather and sediment
UltraDrainguard®	I-95 Service Plaza	Gas station and vehicle parking	Aug. 2003	19	Sediment only
	Drummond North subdivision	Residential	Dec. 2003	26	Wet weather and sediment
DrainPac®	Drummond North subdivision	Residential	June 2003	21	Wet weather and sediment
FloGard Plus®	Wilmington Riverfront	Commercial parking	Feb. 2004	7	Wet weather

Figure 1. Photographs of installed catch basin inserts. (a) HydroKleen units at the I-95 service plaza; (b) UltraDrainguard filters at the service plaza; (c) DrainPac inserts in Drummond North subdivision; (d) FloGard Plus units at the Wilmington Riverfront.

Table 2. Comparison of first flush (FF) and flow-weighted composite concentrations of selected chemical parameters in stormwater samples from control and insert-protected inlet runs. "ND" indicates a non-detect value.

	TSS, mg/L				Oil & Grease				TPH				COD			
	FF		Composite		FF		Composite		FF		Composite		FF		Composite	
Insert/Storm Event	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*
DrainPac																
9/22/2003	11	17	22	19	ND	ND	ND	ND	ND	ND	ND	ND	86	139	100	80
10/14/2003	161	222	112	51	ND	ND	ND	ND	ND	ND	ND	ND	103	313	60	36
11/19/2003	52	266	149	138	ND	7.4	5.3	8.7	ND	ND	ND	ND	89	189	79	64
11/24/2003	31	85	17	22	ND	ND	7.1	7.0	ND	ND	ND	7.0	117	445	54	59
2/3/2004	2140	476	150	151	ND	ND	ND	ND	ND	ND	ND	ND	64	294	118	97
3/16/2004	59	43	31	51	ND	ND	ND	ND	ND	ND	ND	ND	70	100	42	44
HydroKleen																
3/16/2004	132	188	31	57	ND	14.0	6.1	ND	ND	9.9	6.1	ND	313	674	82	132
Flo-Gard Plus																
3/5/2004	468	136			8.3	ND			ND	ND			287	220		

	TKN				NO2/NO3				Total P				Total Zinc			
	FF		Composite		FF		Composite		FF		Composite		FF		Composite	
Insert/Storm Event	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*
DrainPac																
9/22/2003	1.40	2.00	1.30	1.30	3.15	2.75	1.49	1.69	0.40	0.40	0.59	0.35	0.009	0.010	0.007	0.008
10/14/2003	1.46	3.93	1.29	0.89	2.26	2.29	1.05	0.63	0.37	0.80	0.35	0.23	0.016	0.029	0.008	0.008
11/19/2003	1.50	2.00	0.54	0.57	2.31	0.00	0.00	0.84	0.60	0.56	0.37	0.24	0.018	0.010	0.008	0.009
11/24/2003	1.16	2.40	1.11	1.43	0.25	0.32	0.19	0.21	0.18	0.96	0.27	0.20	0.007	0.071	0.008	0.011
2/3/2004	3.87	3.16	7.65	1.96	2.03	1.75	ND	ND	0.11	0.30	0.52	0.26	0.056	0.201	0.155	0.120
3/16/2004	0.67	1.93	1.09	0.93	2.49	2.24	1.17	1.07	0.18	0.19	0.16	0.11	0.048	0.053	0.047	0.043
HydroKleen																
3/16/2004	9.58	118	5.53	12.50	2.15	1.5	ND	ND	0.35	7.71	0.41	0.98	0.354	0.666	0.168	0.243
Flo-Gard Plus																
3/5/2004													0.262	0.325		

Figure 2. Used cellulose (front) and activated carbon (back) filters removed from HydroKleen inserts after nine months service.

Figure 3. UltraDrainguard-protected inlet showing water flow bypassing the filter and entering the curb opening.

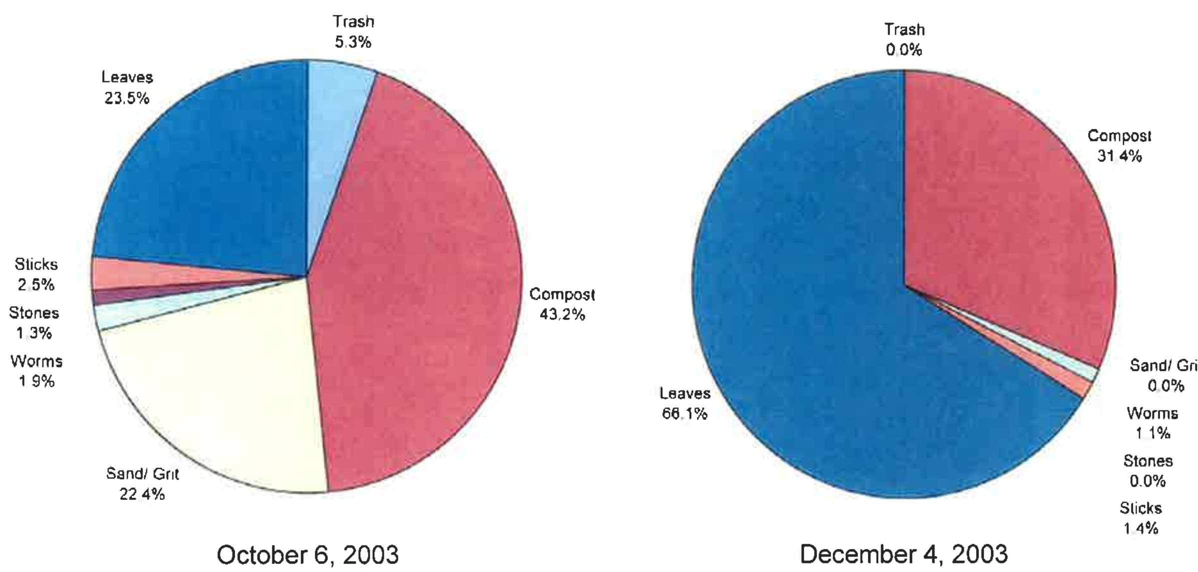


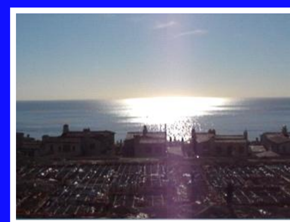
Figure 4. Mean percent volume of contents removed from DrainPac filter bags at two different times, showing the preponderance of leaves and other organic debris.

APPENDIX H – PRELIMINARY DRAINAGE CONCEPT AND STORM WATER QUALITY PLAN - CHANDLER RANCH/ROLLING HILLS CC

WATER QUALITY MITIGATION PLAN
AS

PRELIMINARY DRAINAGE CONCEPT AND STORM WATER QUALITY PLAN

For Compliance with The Standard Urban Stormwater Mitigation Plan



FOR

CHANDLER RANCH / ROLLING HILLS CC
TENTATIVE TRACT 61287

MIXED-USE GOLF & RESIDENTIAL DEVELOPMENT
COUNTY OF LOS ANGELES

Prepared for:

CHANDLER'S SAND AND GRAVEL
26311 Palos Verdes Drive
Rolling Hills CA 90274

Prepared by:

H&A

HUNSAKER AND ASSOCIATES IRVINE, INC.
Three Hughes
Irvine, CA 92618
(949) 583-1010

Date Prepared: June 16, 2010

WO # 2726-4

CONCEPT PLAN FOR STORM DRAINAGE AND SURFACE WATER QUALITY

FOR

TENTATIVE TRACT 61287 – CHANDLER RANCH

LOCATED IN THE CITY OF ROLLING HILLS ESTATES AND THE CITY OF TORRANCE

LOS ANGELES COUNTY

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June 16, 2010

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CONCEPT PLAN FOR STORM DRAINAGE AND SURFACE WATER QUALITY FOR TENTATIVE TRACT 61287 – CHANDLER RANCH LOCATED IN THE CITIES OF ROLLING HILLS ESTATES AND TORRANCE

TABLE OF CONTENTS

1. CONCEPT PLAN SUMMARY

The project site is comprised of approximately 225 acres located in the cities of Rolling Hills Estate and Torrance, in the County of Los Angeles. It includes the existing Rolling Hills County Club and Chandler's Sand and Gravel site. The proposed development project will include approximately 60 acres of single family housing, and expansion of the golf course facilities including a new clubhouse and parking areas.

The project is in the watershed tributary to Los Angeles County Department of Public Works' (LACDPW's) Bond Issue Project No 77. As shown in *Exhibit A-Drainage Area Map,* based on points of connection to Project 77, the project site is divided into two drainage areas, as follows:

Eastern Drainage Area: Approximately 45.3 acres of the project area fronting Palos Verdes Drive East (Area 1) is in the Eastern Drainage Area. It is comprised of approximately 230 acres tributary to LACDPW's Miscellaneous Transfer Drain (MTD) Project No. 742. The project sub-areas and other off-site sub-areas in Eastern Drainage Area drain directly to MTD 742.

MTD 742 is a lateral storm drain system tributary to Project 77 with a design capacity of 486 cfs at the downstream end of the drainage area. Peak design ($Q_{25/50}$) flows generated in this drainage area has been calculated at 244 cfs per Hydrology Analysis Report for Tract 61287. The proposed land use in this area remains substantially the same as its' present use as a golf course. Proposed improvements in Area 1 include two (2) Water Quality Basins and appurtenances; with one basin on each side of Palos Verdes Drive East conveying treated runoff to the existing storm drain system.

Western Drainage Area: The Western Drainage Area is comprised of approximately 707 acres tributary to the sand and gravel pit located at the upstream terminus of Project 77 along Pennsylvania Drive. Approximately 80% of the total project area, shown as Area 2 in Exhibit A, is located in the downstream end of the Western Drainage Area. The hydraulic capacity of Project 77 at the point of connection with Western Drainage Area is tabulated at 242 cfs. Runoff from this drainage area is significantly higher than the capacity of the downstream system. Peak design ($Q_{25/50}$) flows generated in the Western Drainage Area has been calculated at 723 cfs, Off-site flows from approximately 467 acre area in the southerly portion to the drainage area enter the project site In two watercourses with peak flow rates of 381 and 83 cfs.

As shown in *Exhibit B – Conceptual Drainage and Water Quality Plan* (included under Tab B) proposed facilities in the Western Drainage Area will include the following:

- **<u>Debris Basins:</u>** Two debris basins will be located in the southwest corner of the project site. These basins will intercept and remove debris from the storm runoffs in the two watercourses draining the off-site areas to the project site.

- **<u>Water Quality/Sediment Basin:</u>** All the low-flows and first-flush runoffs generated in the Western Drainage Area A will be diverted to a water quality/sediment basin (Basin #2). Outflow from the basin will be conveyed to a infiltration system.

- **<u>Storm Drain System:</u>** A storm drain collection and conveyance system that will deliver low flows to Basin #2; and carry overflows to a Flow Distribution Box and Flow-by Detention Basin located at in the vicinity of the existing terminus of Project 77.

- **<u>Flow Distribution Box and Flow-By Detention Basin:</u>** During major storm events, higher flows (flows higher than the flows diverted to Basin #2) will be conveyed to the Flow Distribution Box. As shown in *Exhibit C – Infiltration System Concept Plan* (included under Tab C), the Flow Distribution Box will be comprised of a reinforced concrete underground hydraulic structure with multiple chambers with the following controls:

- An orifice that will restrict downstream flows to 242 cfs, equals the available capacity of the existing downstream storm drain, LACDPW's Project 77;
- A weir wall that will divert flows that exceed 242 cfs to the detention basin; and
- An opening and flap-gate in the weir wall that will drain out the detention basin when the flows in the Flow Distribution Box start to recede.

- **Flow Infiltration System:** In addition to the drainage facilities outlined above, the project will include an infiltration system that will percolate all of the stormwater discharges exiting the orifice in the Flow Distribution Box, thus eliminating any storm runoff from exiting the Western Drainage Area, for up to a 50-year return frequency storm event.

  The infiltration system will be comprised of piping and appurtenances required to convey and spread pre-treated flows from the Flow Distribution Box and the Water Quality/Sediment Basin throughout a geo-fabric lined gravel bed (infiltration pad). A series of perforated piping will spread flow in the infiltration pad for infiltrating into the underlining ground. The size of the infiltration pad is based on the maximum flow (242 cfs) spreading throughout the infiltration pad and percolating into the underlining material through the bottom of the pad, at field tested percolation rates and safety factor greater than 2.0. It will be located directly on the highly pervious underlying San Pedro Formation material.

  The pipe conveying flows to the infiltration system will be connected at the downstream end of the orifice in the Flow Distribution Box, such that all flows exiting the orifice (restricted to a maximum of 242 cfs) will be first diverted to the infiltration system. If for any reason the capacity of the infiltration system is exceeded, flows will divert to the downstream storm drain Project 77.

2. WATER QUALITY

This analysis addresses, in general, (1) the potential environmental concerns related to the proposed project's discharges of storm water into recipient drainages, (2) the potential impacts of the proposed project on surface and ground water quality and (3) identification of the Best Management Practices (BMPs) proposed to be employed at the project site to prevent the pollution of surface and ground water during operation of the project.

The potential for the proposed project to impact pollutant loading on the downstream offsite Machado Lake shall be eliminated or reduced through engineering design techniques (primarily by installation of properly designed subsurface infiltration system, three manufactured wetlands water quality basins known as Natural Treatment Systems and upsizing of on-site drainage conduits to pass pollutant-laden flow from upstream areas into the proposed infiltration system), in a manner meeting the approval of the County of Los Angeles, and the cities of Rolling Hills Estates and Torrance, as applicable.

3. STANDARD REQUIREMENTS

Upon implementation of the Project Design Features and compliance with the conditions of the Standard Urban Stormwater Management Plan (SUSMP) of the Los Angeles County Municipal Stormwater Permit Order R4-2009-0130 of December 10, 2009 (MS-4), in addition to other applicable regulatory requirements, the proposed project would minimize the potential to degrade surface water quality during construction activities or post-construction operations. With incorporation of proposed water quality treatment and infiltration systems, the project would not exacerbate the impaired water quality of the Machado Lake and would not hinder public agency efforts to improve the water quality of the Machado Lake. Similarly, the potential impact of cumulative projects would be reduced to the Maximum Extent Practicable (MEP) with compliance to applicable regulatory requirements.

4. ANTICIPATED POTENTIAL POLLUTANTS GENERATED BY LAND USE

Per the *Exhibit E – Table of Land Use Summary* (enclosed under Tabs E), the following entire project development, as identified by land use/density areas, drains to the following project water quality basins:

1. **Basins #1A and #1B – Water Quality Natural Treatment System (Total of 2)**

3.3 Acres	Detached Residential Development
42.1 Acres	Golf Course
0.04 Acres	Streets (Portion of Palos Verdes Drive)

2. **Basin #2 – Pre-Infiltration Water Quality Sediment Basin (Modified NTS), Detention Basin and Infiltration System (1 each)**

56.6 Acres	Detached Residential Development
113.2 Acres	Golf Course
7.4 Acres	Club House with Restaurant (Commercial)
2.7 Acres	Parking Lot (at Clubhouse)

Accordingly, anticipated potential pollutants for the project are shown in the following tables:

Table 1: Potential Pollutants Generated by Land Use Type at Water Quality Basins #1A and 1B (Natural Treatment Systems)

(Excerpted, with minor revision, from the San Bernardino Water Quality Management Plan dated April 14, 2004 and the 9/2004 update to the CASQA Handbook)

Type of Development (Land Use)	Sediment/ Turbidity	Nutrients	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Bacteria & Viruses	Oil & Grease	Pesticides	Metals
Detached Residential Development	E	E	N	E	E	E	E	E	N
Attached Residential Development	E	E	N	E	P(1)	P	P(2)	E	N
Commercial/ Industrial Development	P(1)	P(1)	P(5)	E	P(1)	P(3)	E	P(1)	P
Automotive Repair Shops	N	N	E(4,5)	E	N	N	E	N	P
Restaurants	N	N	N	E	E	E	E	N	N
Hillside Development	E	E	N	E	E	E	E	E	N
Parking Lots	P(1)	P(1)	E(4)	E	P(1)	P(6)	E	P(1)	E
Streets, Highways & Freeways	E	P(1)	E(4)	E	P(1)	P(6)	E	P(1)	E

Abbreviations:
E= Expected (Anticipated) P=Potential N=Not Expected (Not Anticipated)

Notes:
(1) A potential pollutant if landscaping or open area exists on the Project site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves animal waste.
(4) Specifically, petroleum hydrocarbons.
(5) Specifically, solvents.
(6) Bacterial indicators are routinely detected in pavement runoff.

Table 2: Potential Pollutants Generated by Land Use Type at Water Quality Basin #2 (Infiltration Pit System)

(Excerpted, with minor revision, from the San Bernardino Water Quality Management Plan dated April 14, 2004 and the 9/2004 update to the CASQA Handbook)

Type of Development (Land Use)	Sediment/ Turbidity	Nutrients	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Bacteria & Viruses	Oil & Grease	Pesticides	Metals
Detached Residential Development	E	E	N	E	E	E	E	E	N
Attached Residential Development	E	E	N	E	P(1)	P	P(2)	E	N
Commercial/ Industrial Development	P(1)	P(1)	P(5)	E	P(1)	P(3)	E	P(1)	P
Automotive Repair Shops	N	N	E(4,5)	E	N	N	E	N	P
Restaurants	N	N	N	E	E	E	E	N	N
Hillside Development	E	E	N	E	E	E	E	E	N
Parking Lots	P(1)	P(1)	E(4)	E	P(1)	P(6)	E	P(1)	E
Streets, Highways & Freeways	E	P(1)	E(4)	E	P(1)	P(6)	E	P(1)	E

Abbreviations:
E= Expected (Anticipated)   P=Potential   N=Not Expected (Not Anticipated)

Notes:
(1) A potential pollutant if landscaping or open area exists on the Project site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves animal waste.
(4) Specifically, petroleum hydrocarbons.
(5) Specifically, solvents.
(6) Bacterial indicators are routinely detected in pavement runoff.

5. VOLUME-BASED AND FLOW-BASED BMP DESIGN AND EFFECTIVENESS

Runoff treatment BMPs are separated into the following two categories:

5.1 Volume-Based BMP Design

Volume-based BMP design standards apply to BMPs whose primary mode of pollutant removal depends on the volumetric capacity of the BMP. Examples of BMPs in this category include detention basins, natural treatment systems, extended dry detention basins, retention basins, and infiltration. Typically, a volume-based BMP design criteria call for the capture and infiltration or treatment of a certain percentage of the runoff from the project site, usually in the range of the 75th to 85th percentile average annual runoff volume. The 75th to 85th percentile capture range corresponds to the "knee of the curve" for many sites in California for sites whose composite runoff coefficient is in the 0.50 to 0.95 range. See Tables 4 and 5 following for confirmation of infiltration system to effectively treat the project's anticipated pollutants, if properly installed and maintained.

The following are the volume-based BMP design standards from current Standard Urban Stormwater Management Plan (SUSMP):

- The 85th percentile 24-hour runoff event determined as the maximized capture storm water volume for the area, from the formula recommended in Urban Runoff Quality Management, WEF Manual of Practice No. 23 /ASCE Manual of Practice No. 87, (1998);
- The volume of annual runoff based on unit basin storage water quality volume, to achieve 80 percent or more volume treatment by the method recommended in California Stormwater Best Management Practices Handbook – Industrial and Commercial (or New Development and Redevelopment), 2003;
- The volume of runoff produced from a 0.75 inch storm event, prior to its discharge to a storm water conveyance system; and
- The volume of runoff produced from a historical-record based reference 24-hour rainfall criterion for "treatment" (0.75 inch average for the Los Angeles County area) that achieves approximately the same reduction in pollutant loads achieved by the 85th percentile 24-hour runoff event.

5.2 Flow-Based BMP Design

Flow-based BMP design standards apply to BMPs whose primary mode pollutant removal is filtration and depends on the rate of flow of runoff through the BMP. The following are the flow-based BMP design standards from current Standard Urban Stormwater Management Plan (SUSMP):

- The flow of runoff produced from a rain event equal to at least 0.2 inches per hour intensity;
- The flow of runoff produced from a rain event equal to at least two times the 85th percentile hourly rainfall intensity for Los Angeles County; and
- The flow of runoff produced from a rain event that will result in treatment of the same portion of runoff as treated using volumetric standards previously discussed.

5.3 ***Project BMP Design***

This project proposes implementation of three (3) natural treatment system water quality basins and one (1) infiltration system for water quality purposes, as shown on the enclosed Exhibit A and Exhibit B. The volume-based BMP sizing methodology provided in the California Storm Water Best Management Practice Handbook (Stormwater Quality Task Force, 1993 and subsequent revisions thereafter) and referenced as an approved sizing methodology per the SUSMP Manual is the method selected for use in determining the sizing criteria of the project's volume-based BMPs.

The California Stormwater BMP Handbook approach is based on results of a continuous simulation model, the STORM model, developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers (COE-HEC 1977). The Storage, Treatment, Overflow, Runoff Model (STORM) was applied to long-term hourly rainfall data at numerous sites throughout California, with sites selected throughout the state representing a wide range of municipal stormwater permit areas, climatic areas, geography, and topography. STORM translates rainfall into runoff, then routes the runoff through detention storage. The volume-based BMP sizing curves resulting from the STORM model provide a range of options for choosing a BMP sizing curve appropriate to site in most areas of the state.

The California Stormwater BMP Handbook approach is simple to apply, and relies largely on commonly available information about this project. The following steps describe the use of the BMP sizing design parameters.

1. Identify the "BMP Drainage Area that drains to the proposed BMP. This includes all areas that will contribute runoff to the proposed BMP, including pervious areas, impervious areas, and off-site areas, whether or not they are directly or indirectly connected to the BMP.

2. Calculate the composite runoff coefficient "C: for the area identified in Step 1.

3. Select a capture curve representative of the site and the desired drain down time using. See Appendix D. Curves are presented for 24 hour and 48 hour draw down times. The 48 hour curve should be used in most areas of California. Use of the 24 hour curve should be limited to drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries. Draw down times in excess of 48 hours should be used with caution as vector breeding can be a problem after water has stood in excess of 72 hours.

4. Determine the applicable requirement for capture of runoff (Capture, % of Runoff).

5. Enter the capture curve selected in Step 3 on the vertical axis at the "Capture, % Runoff" value identified in Step 4. Move horizontally to the right across capture curve until the curve corresponding to the drainage area's composite runoff coefficient "C" determined in Step 2 is intercepted. Interpolation between curves may be necessary. Move vertically down from this point until the horizontal axis is intercepted. Read the "Unit Basin Storage Volume" along the horizontal axis. If a local requirement for capture of runoff is not specified, enter the vertical axis at the "knee of the curve" for the curve representing composite runoff coefficient "C." The "knee of the curve" is typically in the range of 75 to 85% capture.

6. Calculate the required capture volume of the BMP by multiplying the "BMP Drainage Area" from Step 1 by the "Unit Basin Storage Volume" from Step 5 to give the BMP volume. Due to the mixed units that result (e.g., ac-in., ac-ft) it is recommended that the

resulting volume be converted to cubic feet for use during design.

The County of Los Angeles, Rolling Hills Estates and Torrance City stormwater program managers for the jurisdictions processing this development project application shall review and approve the specific requirements applicable to this project.

Natural Treatment System (NTS) Performance

Geotechnical investigations indicate that the eastern project areas, shown as Area 1 in Exhibit A, have low porosity and are not conducive to high infiltration rates nor to the implementation of effective infiltration BMPs. Water quality flows from this area can be physically diverted to the western drainage area to the proposed water quality infiltration pit. However, such a diversion is not practical because of it is prohibited by Los Angeles County Flood Control District rules, guidelines, orders and directives.

In lieu of infiltration BMPs, the project proposes two manufactured wetlands (NTS) systems to treat water quality flow which drain Area 1 (See Tab B). An NTS System consists of an ecosystem-based, constructed water quality treatment (WQT) wetland for improving water quality. Constructed WQT wetlands are different from natural wetlands in that they are primarily designed to improve water quality. The NTS approach is considered the best strategy for addressing regional water quality treatment needs because:

- WQT wetlands are natural and effective technology. The NTS System expands on the experience and success of the existing constructed wetlands in Southern California.
- A WQT wetland can address pollutant sources from existing and future development, as well as pollutants from nonpoint sources.
- A WQT wetland can enhance habitat and natural resources in the watershed.

An NTS can include networking with other WQT wetlands distributed throughout the watershed. A NTS can be categorized into three general configurations:

I. A wetland adjacent to an existing stream channel (off-line facility)

II. A wetland established within an existing stream channel (in-line facility)

III. A wetland incorporated within an existing and planned flood control basin

An NTS facility will not be used to process recycled water. An NTS facility is only intended to improve the quality of water flowing in stream channels and waterways through the engineered application of natural treatment processes.

Plan Assessment. Planning-level water quality models were used by Irvine Ranch Water District (2000) to evaluate the performance of NTS and NTS Plan alternatives. An NTS system is assessed for ultimate watershed conditions, assuming the watershed was completely developed (i.e. build-out conditions). Table 3 summarizes the estimated water quality contributions of the particular NTS Plan used by IRWD in evaluating their use. The table is included in this report as an example of the potential benefits these systems provide.

Table 3: TMDL Summary and Estimated Annual Contribution of IRWD's NTS Plan.

TMDL Constituent	TMDL target and water quality ojective[1]	What the NTS Plan estimated to achieve
Nitrogen	TMDL for TN Load: Dry season = 153,861 lbs; Wet season = 144,364 lbs.	Dry Season: Ave TN removed = 127,300 lbs Load = 70,500 lbs Wet Season: Ave TN removed = 103,500 lbs Load = 129,200 lbs
Sediment	TMDL for sediment: 62,500 tons/year to watershed (trapped in sediment basins).	Annual sediment loads are variable, strongly associated on rainfall. Estimated removal in NTS facilities is about 800 tons/year from urban and open land sources for average rainfall year conditions.
Phosphorus	TMDL for TP (Load) 62,080 lbs/year	TP loads are strongly associated with sediment loads. Estimated removal is 4,300 lbs/year from urban and open land sources for average rainfall year conditions.
Pathogens	TMDL for fecal coliform in flows to watershed: Maximum = 400 MPN per 100 mL (with 10% exceedance in 30 days) 30-day average = 200 MPN per 100 mL	Fecal coliform concentration is variable, associated with rainfall. Average maximum fecal coliform concentrations are reduced by roughly 30 percent in dry weather low flows, and about 10 percent in storm flows.
Organochlorine compounds	Annual load limits to watershed Chlordance = 314.7 Dieldrin = 262 DDT = 432.6 PCBs = 282 Toxaphene = 8.9	Removals were not quantified due to lack of monitoring data and undermined sources. These legacy compounds are strongly associated with sediments. Sediment removal in NTS could provide minimal treatment of these compounds.
Heavy metals	Concentration based TMDLs expressed at four flow tiers. Concentrations are based on the CTR objectives using average hardness values of the associated flow tier.	Annual loads are variable, depending on rainfall. Total metal loads in storm runoff from urban and open land sources are reduced by about 13 percent for copper, 10 percent for lead, and 12 percent for zinc. Cadmium was not modeled. Removal from low flows was not quantified.

[1] TMDL target are subject to periodic review and revision. Toxics TMDLs issued by the USEPA are subject to review and adoption by the RWQCB.

Facility Design. A NTS facility shall include shallow pools between zero and two feet deep that can support the growth of emergent wetland plants, primarily cattails and bulrushes. Some of the proposed wetlands also have deeper open water areas about four to six feet deep that are designed to trap coarse sediments, help to maintain uniform flow through the marsh, and aid in pathogen removal. The typical residence time within a wetland is about 10-14 days during dry weather flows.

The project NTS shall be sized to capture and treat pollutants present in the design storm per SUSMP requirements. The outlet structures in these facilities are designed to detain storm runoff for treatment for a period of about 36-48 hours.

An important secondary aspect of the NTS system is habitat enhancement. The selection and planting of riparian vegetation between the WQT wetlands and the surrounding habitat enhances the habitat characteristics of the wetlands. Where feasible, native riparian vegetation will be selected to enhance habitat avian species.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. The average annual maintenance hours experienced were analyzed in a recent three-year study by the California Department of Transportation. Individual activities were compared plotted against the number of person-hours required for completion.

Of the 72 hours of maintenance performed annually, only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management and routine mowing. The largest absolute number of hours was associated with vector control because of mosquito that occurred in the stilling basins. Some activities such as major sediment removal were not performed during the study, but based on the amount of sediment accumulation, this could occur every year.

Infiltration System Performance

Geotechnical investigations conducted at the project site indicate that the western project areas, shown as Area 2 in Exhibit A, have significantly high percolation rate characteristics which are conducive to an effective, infiltration system and which is capable of handling large water quality flow volumes. The design of the project infiltration system is intended to be capable of large volume infiltrations, not only of on-site storm flows from a 25/50-year intensity storm, but also of the 25/50-year intensity storm flows which run onto the project from off-site, upstream areas. Normal, water quality storm flows for a typical infiltration BMP are in the range of a 2-year intensity storm.

Infiltration is considered the most effective means in reducing the pollutant load discharged to surface water as the runoff entering the system is captured, retained and allowed to percolate through underlying soils. When properly designed and maintained, they provide 100% reduction of all pollutants entering the BMP.

Extensive studies have been conducted on infiltration BMPs, with the majority of the studies showing high pollutant removal for most pollutant constituents. The following tables provide typical removal rates for these systems.

Table 4: Typical Removal Rates (Schueler, 1992)

Typical Percent Removal Rates	
Sediment	90
Total Phosphorus	60
Total Nitrogen	60
Metals	90
Bacteria	90
Organics	90
Biochemical Oxygen Demand	75

Table 5: Typical Removal Rates (Sansalone, 1999)

Typical Percent Removal Rates	
Dissolved Metals:	
- Zinc	>95
- Copper	>85
- Cadmium	>80
- Lead	70-95
Particulate-bound Metals:	
- Zinc	75-95
- Copper	85-95
- Cadmium	79-90
- Lead	85-95

The primary pollutant removal mechanism is filtering of runoff through the bottom of the basin and into the underlying soil matrix. Concerns have been raised regarding the potential for groundwater contamination. However, based on findings of the Water Augmentation Study conducted by the Los Angeles and San Gabriel Rivers Watershed Council (January 2010), the risk is relatively low.

Maintenance

Longevity can be increased by careful geotechnical evaluation prior to construction and by designing and implementing an inspection and maintenance plan. Additionally, pre-treatment of runoff for constituents that may clog and / or reduce infiltration rate should be included in the design of the BMP system. These include hydrocarbons and sediment.

Regular maintenance also includes post-storm inspections to ensure all runoff is infiltrated within the design time frame (e.g. 72 hours or less); and semi-annual inspections to identify potential problems such as erosion, excessive sediment accumulation, standing water, trash and debris accumulation.

Maintenance activities include removal accumulated trash, debris, sediment and other materials that may adversely affect infiltration, vegetation removal and prevention of woody vegetation establishment and re-grading of basin when sediment accumulation exceeds 10% of basin volume.

5.4 __Effectiveness Summary__

The following tables reflect a recap of an effective plan to control potential, anticipated project pollutants, as more thoroughly presented per the pre- and post- Project Pollutant Analysis included in Exhibit F.

Table 6: Treatment Control BMP Selection Matrix[1]
Areas Tributary to Basins #1A and #1B for Eastern Project Drainage Areas

(Excerpted, with minor revision, from the Orange County Water Quality Management Plan dated September 26, 2003 and the San Bernardino Water Quality Management Plan dated April 14, 2004)

Pollutant of Concern	Biofilters[2]	Detention Basins[2]	Infiltration BMPs[4]	Wet Ponds or Wetlands[5]	Filtration Systems[6]	Water Quality Inlets	Hydrodynamic Separator Systems[7]	Manufactured or Proprietary Devices[8]
Sediment/ Turbidity	H/M	H/M	H/M	H/M	H/M	L	H/M (L for Turbidity)	U
Nutrients	L	H/M	H/M	H/M	L/M	L	L	U
Organic Compounds	U	U	U	U	H/M	L	L	U
Trash & Debris	L	H/M	U	U	H/M	M	H/M	U
Oxygen Demanding Substances	L	H/M	H/M	H/M	HM	L	L	U
Bacteria & Viruses	U	U	H/M	U	H/M	L	L	U
Oil & Grease	H/M	H/M	U	U	H/M	M	L/M	U
Pesticides (non-soil bound)	U	U	U	U	U	L	L	U
Metals	H/M	M	H	H	H	L	L	U

<u>Abbreviations</u>:
L= Low removal efficiency
H/M=High or medium removal efficiency
U=Unknown removal efficiency

<u>Notes</u>:
(1) Periodic performance assessment and updating of the guidance provided by this table may be necessary.
(2) Includes grass swales, grass strips, wetland vegetation swales, and bioretention.
(3) Includes extended/dry detention basins with grass lining and extended/dry detention basins with impervious Effectiveness based upon minimum 36-48-hour drawdown time.
(4) Includes infiltration basins, infiltration trenches, and porous pavements.
(5) Includes permanent pool wet ponds and constructed wetlands.
(6) Includes sand filters and media filters.
(7) Also known as hydrodynamic devices, baffle boxes, swirl concentrators, or cyclone separators.
(8) Includes proprietary stormwater treatment devices as listed in the CASQA Stormwater Best Management Practices Handbooks, other stormwater treatment BMPs not specifically listed in this WQMP, or newly developed/emerging stormwater treatment technologies.

Table 7: Treatment Control BMP Selection Matrix(1)
Areas Tributary to Basin #2 for Western Project Drainage Area

(Excerpted, with minor revision, from the Orange County Water Quality Management Plan dated September 26, 2003 and the San Bernardino Water Quality Management Plan dated April 14, 2004)

Pollutant of Concern	Biofilters(2)	Detention Basins(2)	Infiltration BMPs(4)	Wet Ponds or Wetlands(5)	Filtration Systems(6)	Water Quality Inlets	Hydrodynamic Separator Systems(7)	Manufactured or Proprietary Devices(8)
Sediment/ Turbidity	H/M	H/M	H/M	H/M	H/M	L	H/M (L for Turbidity)	U
Nutrients	L	H/M	H/M	H/M	L/M	L	L	U
Organic Compounds	U	U	U	U	H/M	L	L	U
Trash & Debris	L	H/M	U	U	H/M	M	H/M	U
Oxygen Demanding Substances	L	H/M	H/M	H/M	HM	L	L	U
Bacteria & Viruses	U	U	H/M	U	H/M	L	L	U
Oil & Grease	H/M	H/M	U	U	H/M	M	L/M	U
Pesticides (non-soil bound)	U	U	U	U	U	L	L	U
Metals	H/M	M	H	H	H	L	L	U

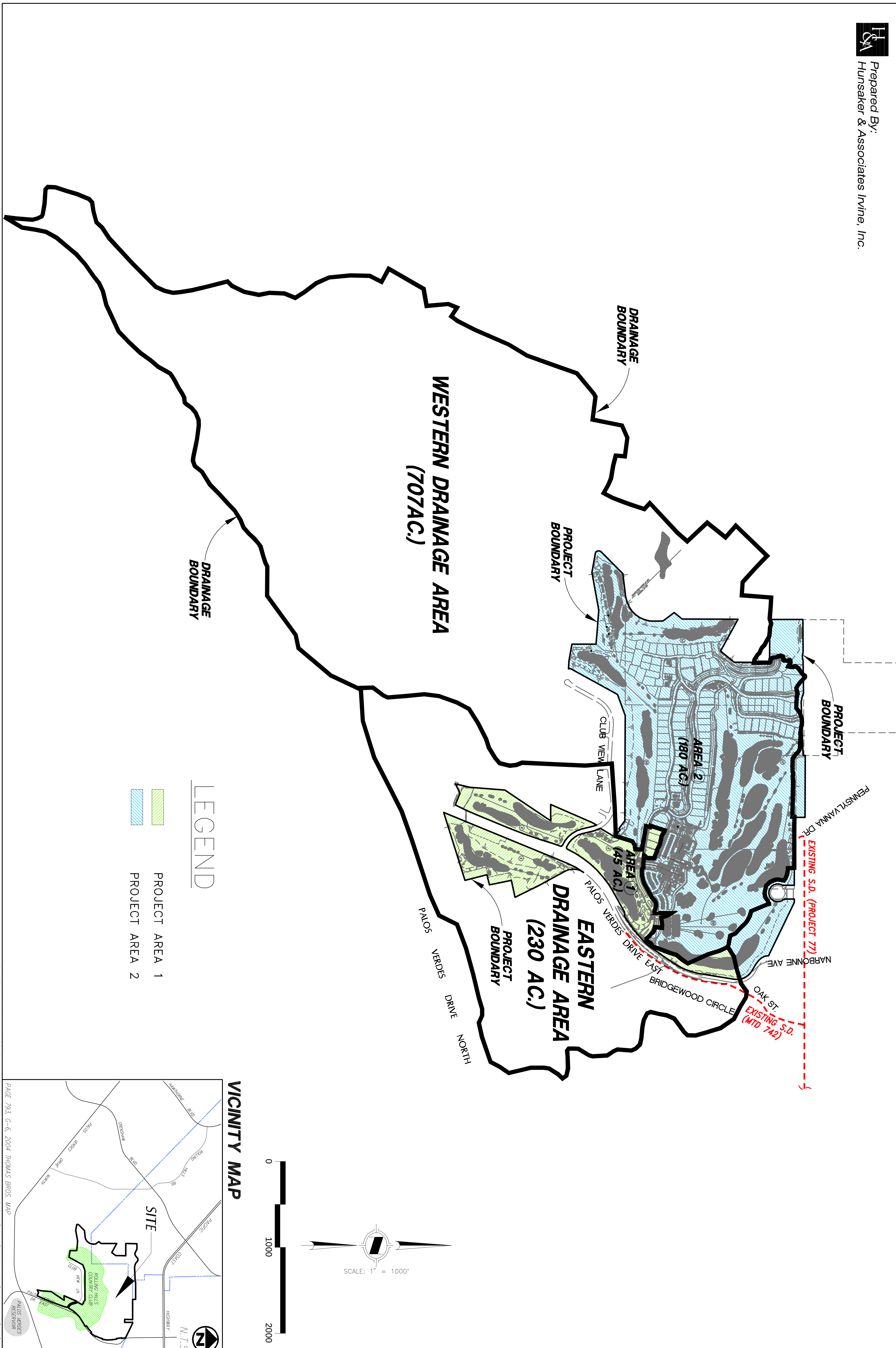
Abbreviations:
L= Low removal efficiency
H/M=High or medium removal efficiency
U=Unknown removal efficiency

Notes:
(1) Periodic performance assessment and updating of the guidance provided by this table may be necessary.
(2) Includes grass swales, grass strips, wetland vegetation swales, and bioretention.
(3) Includes extended/dry detention basins with grass lining and extended/dry detention basins with impervious Effectiveness based upon minimum 36-48-hour drawdown time.
(4) Includes infiltration basins, infiltration trenches, and porous pavements.
(5) Includes permanent pool wet ponds and constructed wetlands.
(6) Includes sand filters and media filters.
(7) Also known as hydrodynamic devices, baffle boxes, swirl concentrators, or cyclone separators.
(8) Includes proprietary stormwater treatment devices as listed in the CASQA Stormwater Best Management Practices Handbooks, other stormwater treatment BMPs not specifically listed in this WQMP, or newly developed/emerging stormwater treatment technologies.

6. COMPLIANCE WITH REQUIREMENTS

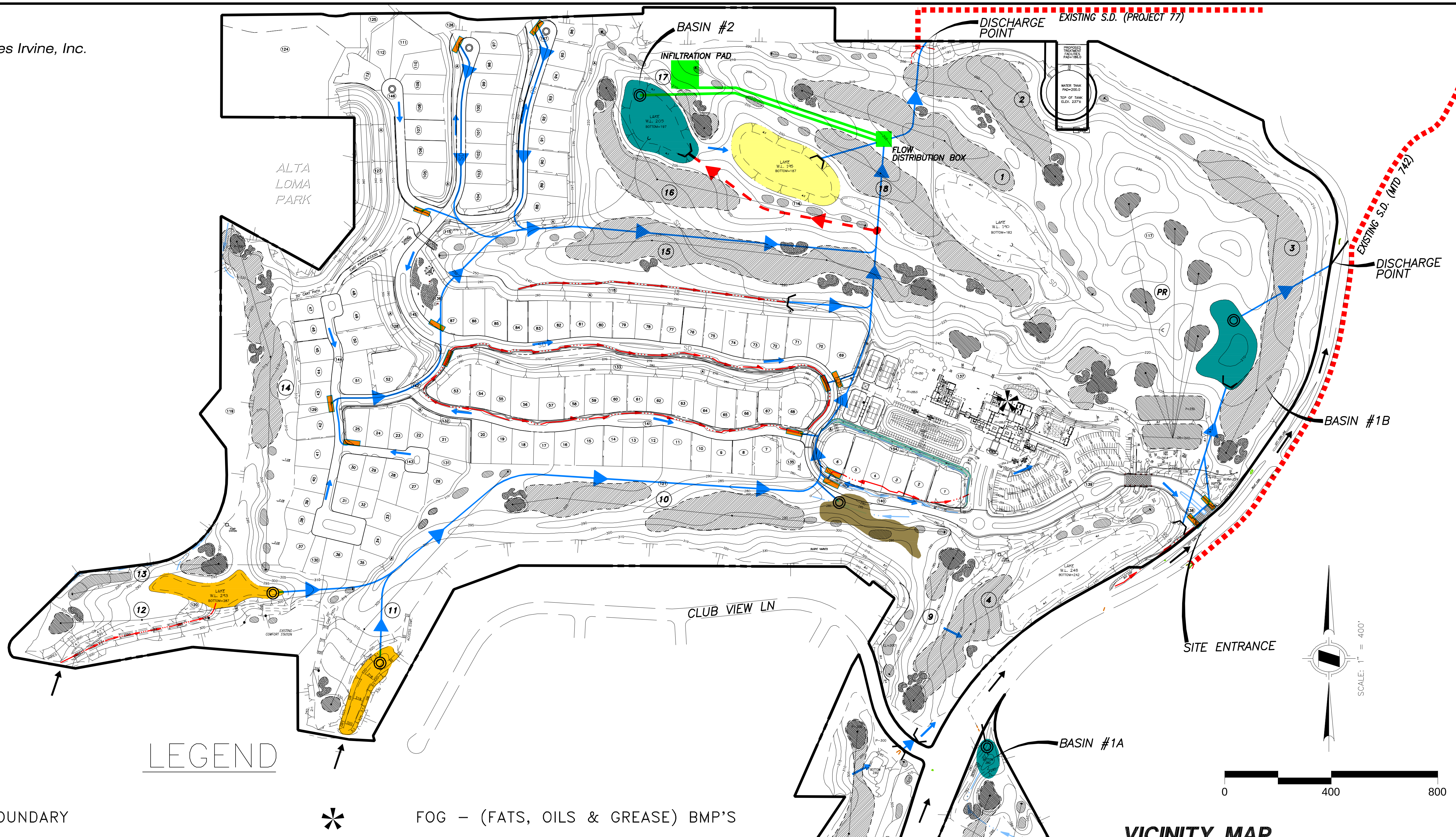
Upon implementation of the proposed water quality measures and compliance with the Standard, Federal, State, County and City Conditions, as applicable, potential water quality impacts would be minimized to the Maximum Extent Practicable (MEP). The concept of "Maximum Extent Practicable" (MEP) is the technology-based standard established by congress in CWA §402(p)(3)(B)(iii) that municipal dischargers of storm water must meet. Technology-based standards establish the level of pollutant reductions that dischargers must achieve. MEP is generally a result of emphasizing pollution prevention and source control BMPs as the first lines of defense in combination with structural and treatment methods, where appropriate, serving as additional lines of defense. The MEP approach is an ever evolving, flexible and advancing concept, which considers technical and economic feasibility. As knowledge about controlling urban runoff continues to evolve, so does that which constitutes MEP. The individual and collective activities elucidated in the Los Angeles County Stormwater Quality Management Plan (SQMP) become the proposal for reducing or eliminating pollutants in discharge to the MEP. The way in which MEP is met may vary between communities.

Consistent with EPA guidance, the MEP standard in California is applied so that a first-round storm water permit requires BMPs that will be expanded or better-tailored in subsequent permits. In choosing BMPs, the major focus is on technical feasibility, but cost effectiveness, and public acceptance are also relevant. If a Permittee employs all applicable BMPs except those that are not technically feasible in the locality, or whose cost exceeds any befit to be derived, it would meet the MEP standard. MEP requires Permittees to choose effective BMPs, and to reject applicable BMPs only where other effective BMPs will serve the same purpose, the BMPs are not technically feasible, or the cost is prohibitive.



DRAINAGE AREA MAP	DATE PREPARED: 06/16/2010 WO # 2726-4	CHANDLER RANCH/ROLLING HILLS COUNTRY CLUB TT NO. 61287 ROLLING HILLS, CALIFORNIA	EXHIBIT A

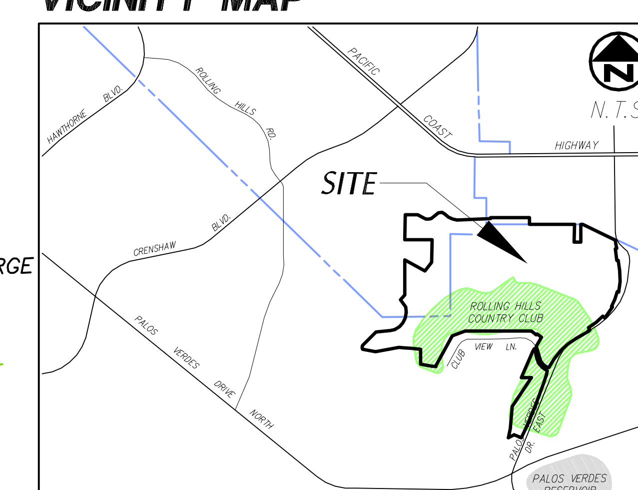
Prepared By:
Hunsaker & Associates Irvine, Inc.



LEGEND

	TRACT BOUNDARY
	DIRECTION OF ONSITE SURFACE FLOW
	DIRECTION OF OFFSITE SURFACE FLOW
	PROPOSED STORM DRAIN & FLOW DIRECTION
	INFILTRATION SYSTEM PIPING
	FIRST FLUSH & LOW FLOWS
	EXISTING DOWNSTREAM STORM DRAIN
	PROPOSED STORM DRAIN RISER
	OUTLET/INLET STRUCTURE
	LOW FLOW DIVERSION MH
	FOG – (FATS, OILS & GREASE) BMP'S
	FLOW DISTRIBUTION & INFILTRATION SYSTEM
	POND – GOLF COURSE WATER FEATURE ONLY
	CATCH BASIN/INLET STRUCTURE
	WATER QUALITY/SEDIMENT BASIN
	DEBRIS BASIN
	DETENTION BASIN
	IRRIGATION POND
	SWALE FLOWLINE

VICINITY MAP



PAGE 793, G-6, 2004 THOMAS BROS. MAP

DRAINAGE AND WATER QUALITY CONCEPT PLAN

DATE PREPARED: 06/16/2010

WO # 2726-4

CHANDLER RANCH/ROLLING HILLS COUNTRY CLUB
TT NO. 61287
ROLLING HILLS, CALIFORNIA

EXHIBIT B

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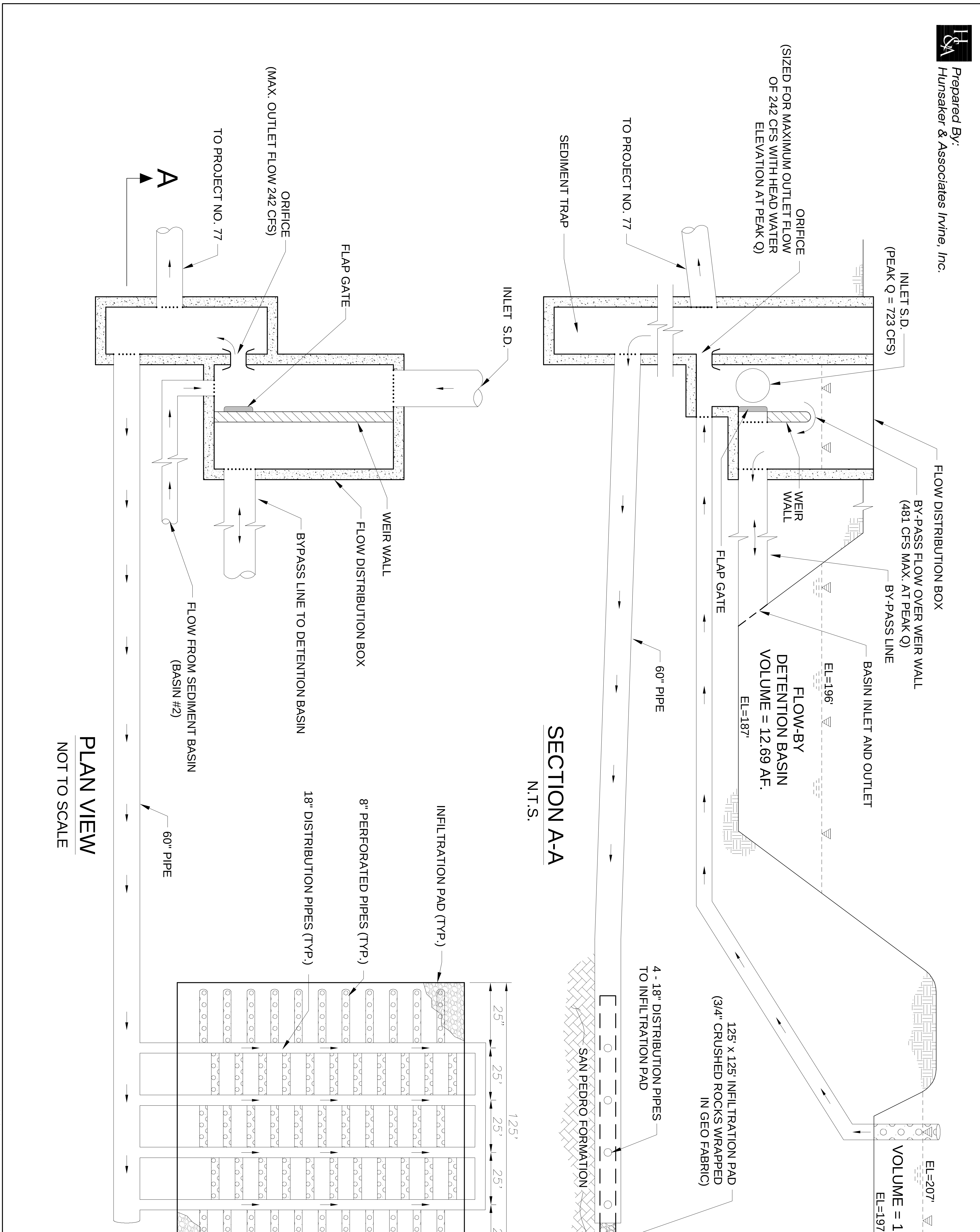
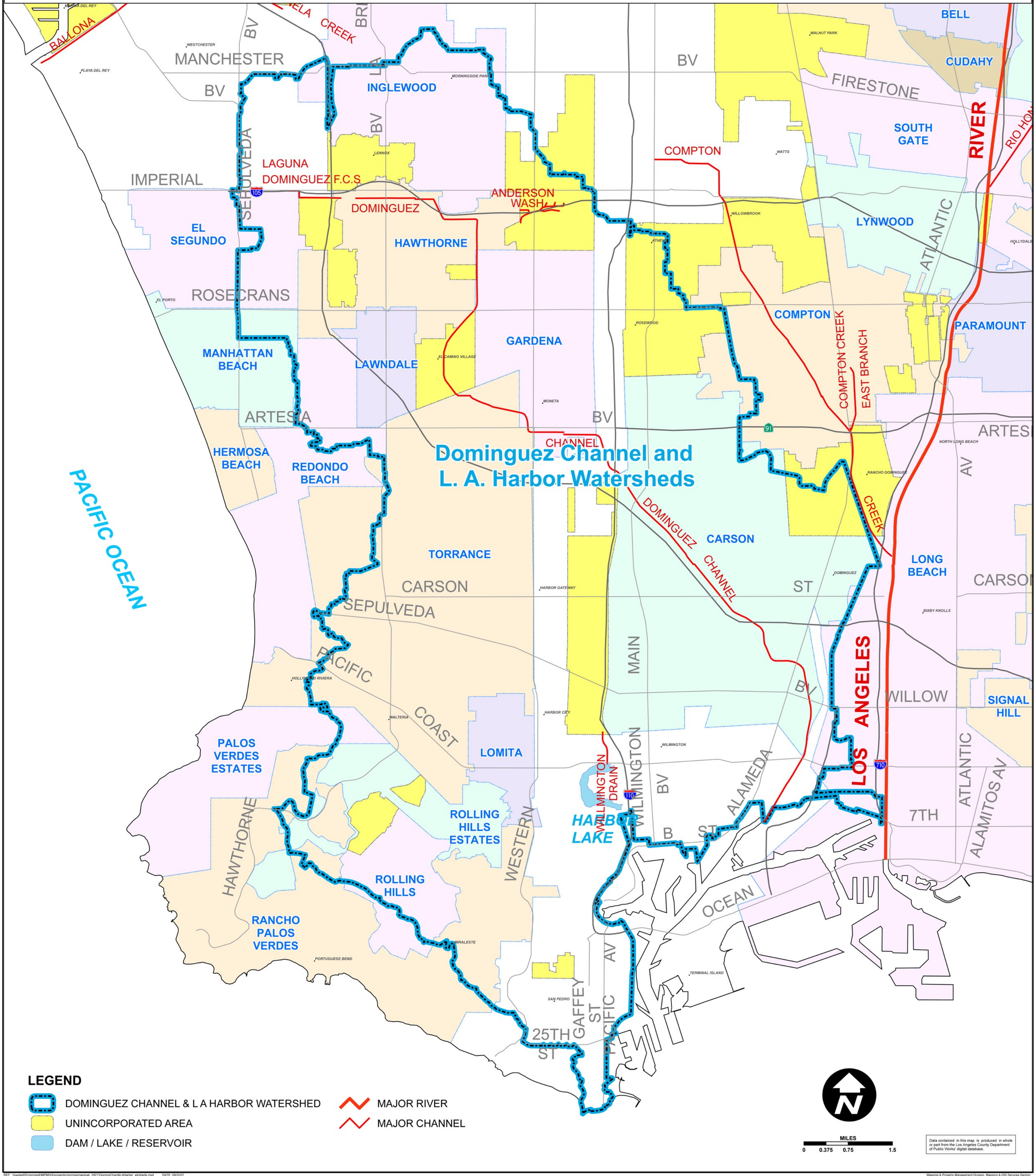


INFILTRATION SYSTEM CONCEPT PLAN	DATE PREPARED: 06/16/2010 WO # 2726-4	CHANDLER RANCH/ROLLING HILLS COUNTRY CLUB TT NO. 61287 ROLLING HILLS, CALIFORNIA	EXHIBIT C

COUNTY OF LOS ANGELES

DOMINGUEZ CHANNEL & LA HARBOR WATERSHEDS



Land Use Summary – TTM 61287 Rolling Hills Estates
Land Use Areas

Land Use	**Area 1 (Eastern Drainage Area)**	**Area 2 (Western Drainage Area)**
Detached Residential Development	3.3 Acres	56.6 Acres
Golf Course	42.1 Acres	113.2 Acres
Clubhouse	--	7.4 Acres
Parking Lots @ Clubhouse	--	2.7 Acres
Streets (Palos Verdes Drive)	0.04 Acres	--
Total	**45.4 Acres**	**179.9 Acres**

PRE- AND POST-PROJECT POLLUTANT ANALYSIS FOR CHANDLER RANCH / ROLLING HILLS COUNTRY CLUB PROJECT – TENTATIVE TRACT NO. 61287

CITY OF ROLLING HILLS ESTATES
COUNTY OF LOS ANGELES, CALIFORNIA

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June 16, 2010 (2726-4 D04r1.doc)

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1.0 Introduction

1.1 PURPOSE AND NEED

The objective of this report is to compare the water quality pollutant levels contributed downstream from the existing project area to the anticipated pollutants levels from project build out, with employment of selected treatment Best Management Practices (BMPs). Results of the study would be useful in determining the impacts proposed project would have on downstream receiving waters.

1.2 SITE DESCRIPTION

This project is located within the jurisdiction of the Los Angeles Regional Water Quality Control Board (RWQCB – Region 4) and within the Dominguez Channel and Los Angeles/Long Beach Harbors Management Area. Runoff from the site is tributary to Los Angeles County Department of Public Works (LACDPW) Bond Issue Project No. 77, which discharges to Machado Lake.

The project site consists of approximately 225 acres located in the Cities of Rolling Hills Estates and Torrance, in the County of Los Angeles. The site currently includes the existing Rolling Hills Country Club, the Chandler's Sand and Gravel Quarry site and surrounding undeveloped land.

1.3 PROJECT DESCRIPTION

The proposed project will include approximately 60 acres of single-family housing, including landscaping, slopes, streets and related improvements, open space, expansion and reconfiguration of the existing golf course facilities, including a new club house, parking areas and related improvements.

1.4 ANALYSIS COMPONENTS

The study considers the water quality impacts that existing improvements and proposed improvements (with incorporation of treatment BMPs) would have on downstream waters. Since storm water pollutant monitoring data is only available for the sub-watershed (Project 77/510) that the project site is tributary to, but not specifically for the proposed site (site-specific data monitored), the results from the Nationwide Urban Runoff Program (NURP)[1], the National Stormwater Quality Database (NSQD)[2] and other studies[3] were used to estimate the existing and anticipated pollutant concentrations to determine if project implementation would result in any significant water quality changes to Machado Lake.

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[1] *"Results of the Nationwide Urban Runoff Program". December 1983. U.S. Environmental Protection Agency. Water Planning Division, PB 84-185552, Washington D.C.*
[2] *"Research Progress Report – Findings from the National Stormwater Quality Database (NQSD)". January 2004. Pitt, Robert; et. al. University of Alabama and Center for Watershed Protection.*
[3] *"Fundamentals of Urban Runoff Management: Technical & Institutional Issues, Terrene Institute, Washington DC. Horner, R.R., Kupien, J.J., Livingston, E.H., and Shaver H.E. 1994.; Cave et al. 1994.*

In particularly, the analysis examines the following:

1. Estimated water quality for runoff discharging from existing site.
2. Estimated water quality for runoff discharging from proposed site.
3. Comparison of changes in pollutant load(s).

The pollutant constituents selected for assessment are limited to those anticipated to be present in runoff flows based on the land use of the site's tributary areas, and also causing impairments to the project's receiving water.

1.4.1 Discharge Limitations

Section 303(d) of the Federal Clean Water Act addresses waters that do not or are not expected to meet water quality standards necessary to maintain designated beneficial uses with implementation of technology-based controls. After a waterbody is placed on the 303(d) list of impaired waters, states are required to develop Total Maximum Daily Load (TMDL) requirements to address each pollutant causing impairment. The TMDL defines the amount of a pollutant a waterbody can accept while still meeting water quality standards. Table 1-4 provides the impairment status of the project's receiving water:

Table 1-4. Receiving Water Impairments

Receiving Water	303(d)	TMDL
Machado Lake	Algae, Ammonia, ChemA, Chlordane, DDT, Eutrophic, Odor, PCBs, Trash	Eutrophic (Nutrients (TP, TN, Ammonia, DO, Chlorophyll *a*), Trash and Toxics (under development)

2.0 Affected Environment

2.1 LOCAL CLIMATE AND PRECIPITATION

The watershed's climate is classified as Mediterranean, characterized by cool, dry summers and mild, wet winters. The major contributors to the climate are the Eastern Pacific High and the moderating effects of the Pacific Ocean. Most rainfall occurs during the winter season, from November through April. Rainfall in the project area averages approximately 12 inches annually. The peak monthly rainfall in the project vicinity generally occurs between January and February.

2.2 SITE DRAINAGE AND LAND USE

The site's watershed is divided into an Eastern Drainage Area and a Western Drainage Area. The Eastern Drainage Area consists of approximately 45.3 acres of project area fronting Palos Verdes Drive East. The Western Drainage Area consists of approximately 179.9 acres of onsite project area and 707 acres of offsite run-on from the west/southwest.

Table 2-2(1) provides existing land use details of the onsite watershed.

Table 2-2(1). Existing Land Use Summary

Land Use	Eastern Drainage	Western Drainage	% Total
Quarry Site	0 Acres	86.6 Acres	38.4 %
Golf Course	45.4 Acres	88.4 Acres	59.5 %
Open Space	0 Acres	4.9 Acres	2.1 %
Total	45.4 Acres	179.9 Acres	225.3 acres (100%)

As seen in Table 2-1, golf course use is the largest land use, encompassing approximately 60% of the onsite watershed.

Table 2-2(2) provides proposed land use details of the onsite watershed.

Table 2-2(2). Proposed Land Use Summary

Land Use	Eastern Drainage	Western Drainage	% Total
Residential Related Improvements (Including Streets)	3.3 Acres	52.61 Acres	24.8%
Golf Course	42.1 Acres	123.3 Acres (includes parking/clubhouse)	73.4%
Open Space	0.0	3.99	1.8%
Total	45.4 Acres	179.9 Acres	225.3 acres (100%)

In the developed condition, golf course use remains the largest land use.

2.3 URBAN RUNOFF INPUTS

Pollutants within the watershed's runoff can be anticipated to be similar as those found in the NURP and NSQD studies. These pollutants include pathogens (bacteria and virus), metals, nutrients, pesticides, organic compounds, sediments, trash and debris, oxygen demanding substances and oil and grease.

Of special concern are priority pollutants, which are pollutants causing impairments in Machado Lake (receiving water body) and also anticipated to be present in urban runoff. Since the sources of these pollutants are unknown, it is difficult to target or provide controls for these pollutants.

Potential sources of downstream pollutants such as derivatives of pesticides and nutrient related impairments (eutrophic conditions, algae, decreased clarity, low dissolved oxygen) within the watershed are mostly likely derived from households, park/open space landscape areas and other facilities requiring the upkeep of vegetative cover, such as golf courses.

Urban runoff is also a common source of metals, including copper, lead and zinc. These metals are present in background sources such as rainfall, tap water, soil, vegetation, paint, solar cells, automobile brakes and tires, concrete and other metal products. Other pollutants, such as trash, are often attributed to developments in general.

Other potential sources of these pollutants may include residual amounts from historical land uses.

2.4 ATMOSPHERIC INPUTS

Aerial deposition of pollutants can also impact water quality. However, it has been noted in *Attachment A to Resolution No. R08-006*[4] that direct aerially deposited sources of pollutants, such as nutrients, play very minor roles in Machado Lake due to the lake's small surface area (13.7 ha). Indirect deposition of pollutants was not addressed in the report because the amount of uptake by terrestrial biota within the watershed is not known. However, indirect deposition was accounted for in stormwater loading estimates.

[4] *"Amendment to the Water Quality Control Plan – Los Angeles Region to Incorporate the Total Maximum Daily Load for Eutrophic, Algae, Ammonia, Odors (Nutrient) in Machado Lake. Attachment A to Resolution No. R08-006.Adopted May 1, 2008.*

3.0 Assessment of Water Quality Impacts

In this analysis, the average concentration values for the priority pollutants of concern (POC), which may include various derivatives of nutrients, pesticides and metals (copper, lead and zinc), obtained are assumed to be consistent with the site's runoff. Trash is not included in this report since trash was not analyzed in these studies. However, it has been noted that trash is a priority pollutant of concern for the site. Some pollutants may not be analyzed due to the lack of data.

3.1 EVALUATION CRITERIA

The proposed project is evaluated herein to determine if it would substantially increase or decrease the amount of priority pollutants discharged to the receiving water. Additionally, the proposed project is evaluated herein to determine if it would substantially contribute to the exceedance of any adopted water quality standard or conflict with the objectives, plans, goals, policies, or implementation of the Basin Plan and any other applicable plans and policies.

3.2 EXISTING WATER QUALITY

Table 4-1 provides a summary of mean values for each of the project's pollutants of concern adapted from NURP, NSQD and other related studies based on land use. Although golf courses are the most intensively managed urban landscaping, there is currently no large scale study regarding their impacts on downstream waters. However, studies suggest that runoff inputs from golf courses (as it pertains to the care of turf grass) are similar to that of low-density residential developments with large areas of turf grass. Therefore, this assumption is observed in this study.

The pollutants and conditions that contribute to downstream impairments analyzed in this study are:

Table 3-2(1). EMC Values for Selected POCs[5]

Land Use Category	BOD (mg/L)	COD (mg/L)	TP (mg/L)	DP (mg/L)	TKN (mg/L)	NO_2 / NO_3 (mg/L)
Open Space	3	30.5	0.23	0.06	0.79	0.57
Industrial / Commercial	10.6	60	0.21	0.10	1.39	0.59
Golf Course*	38	124	0.52	0.27	3.32	1.83
Residential	10	64	0.34	0.16	1.7	0.67

* Large/Medium density residential data used.

BOD = Biochemical Oxygen Demand; COD = Chemical Oxygen Demand;

TP = Total Phosphorous; DP = Dissolved Phosphorous;

TKN = Total Kjeldahl Nitrogen; NO_2 / NO_3 = Nitrates / Nitrites

[5] *Average of EMC values from NURP and NSQD studies used. For values not available from NURP/NSQD, estimates from Horner et al. and Cave et. al used.*

Trash is not included in this report since trash was not analyzed in these studies. However, it has been noted that trash is a priority pollutant of concern for the site. Other pollutants, such as ammonia and various ChemA pesticides, were not analyzed due to the lack of data.

Based on the information provided in Table 3.2(1), the project site's existing pollutant loads (annual) for each watershed can be estimated using the Simple Method.[6]

Table 3-2(2). Estimated Pollutant Loads (Existing)

Drainage Area	Land Use Category	%I	Rv	Area (Ac)	L (Annual Pollutant Load in pounds)					
					BOD	COD	TP	DP	TKN	NO_2 / NO_3
Western Drainage Area	Open Space	0	0.05	4.9	1.8	18.5	0.2	0.04	0.5	0.4
	Commercial / Industrial	90	0.86	86.6	1,949	11,031	38.6	18.4	255.5	108.4
	Golf Course	10	0.14	88.5	1162	3,792	15.9	8.3	101.5	56.0
Eastern Drainage Area	Golf Course	10	0.14	45.3	595	1,941	8.1	4.2	42.0	28.6
Total (Produced)	--	--	--	225.3	3,708	16,782.5	62.8	30.94	399.5	193.4
Total (Discharged)	--	--	--	45.3	595	1,941	8.1	4.2	42.0	28.6

Since the existing runoff from the Western Drainage Area is conveyed to a sand and gravel pit with the capacity to retain and infiltrate runoff from the 25/50-year storm event, the annual pollutant contributed from this drainage area is assumed to be zero in this study.

[6] *Pollutant loading determined using the Simple Method: L = [P x Pj x Rv)/12] x C x A x (2.72); Rv = 0.05 + 0.009(I); where L = storm pollutant export (in pounds), P = annual rainfall (12.1 inches); Pj = factor correcting P for storms that produce no runoff (set to 0.9 for annual/seasonal estimates); Rv = fraction of rainfall that is converted into runoff; I = site impervious percentage; C = flow-weighted mean concentration (mg/L) in urban runoff from Table 3-2(1); A = area of subwatershed.*

3.3 ANTICIPATED WATER QUALITY AND POLLUTANT REMOVAL

This section estimates the anticipated water quality loads for the proposed project site without any treatment BMPs, as well as with the implementation of the project's proposed treatment BMPs. The estimated values are then compared to that of existing levels.

Table 3-3(1) provides estimates of annual pollutant load for the project's proposed condition in both drainage areas, with the removal of the industrial / commercial development and the addition of a residential element.

Table 3-3(1). Estimated Pollutant Loads (Proposed) Without BMPs

Drainage Area	Land Use Category	%I	Rv	Area (Ac)	L (Annual Pollutant Load in pounds)					
					BOD	COD	TP	DP	TKN	NO_2 / NO_3
Western Drainage Area	Open Space	0	0.05	3.99	2	15	0.1	0.03	0.4	0.3
	Residential (w/ streets)	65	0.64	52.61	818	5,234	27.8	13.1	139.0	54.8
	Golf Course	10	0.14	123.3	1,606	5,240	22	11.4	140.3	77.3
Eastern Drainage Area	Residential (w/ streets)	65	0.64	3.3	52	328	1.8	0.8	8.7	3.4
	Golf Course	10	0.14	42.1	548	1,790	7.5	3.9	47.9	26.4
Total	--	--	--	225.3	3,026	12,607	59.2	29.23	336.3	162.2

For the proposed condition, infiltration BMPs would treat project flows from the Western Drainage Area, while water quality treatment (WQT) wetlands would be employed to treat runoff from the Eastern Drainage Area.

The performance of the BMPs have been tested nationwide and have shown to provide effective treatment for most pollutants present in urban runoff.

Infiltration BMPs are 100% effective at removing pollutant constituents from runoff when the entire design volume is infiltrated and no water is discharged to surface waters.[7] Other studies have shown less removal efficiencies when discharge occurs from infiltration devices. However, removal rates still remain in excess of 70% for most constituents. Runoff entering the system will be pre-treated to remove trash, hydrocarbons, sediment and other fines that may prevent infiltration.

WQT wetlands have shown favorable results nationwide as well as in Southern California, in particularly the success the Irvine Ranch Water District (IRWD) has had with their Natural Treatment System (NTS) employed in various locations throughout the San Diego Creek Watershed. These systems are particularly effective at removing nutrients from runoff (ranging from 64% of dry weather loads and approximately 45% of wet weather loads) and retaining them within the system. It is anticipated that the

[7] *Caltrans BMP Retrofit Pilot Program – Final Report. Report ID CTSW-RT-01-060. January 2004*

systems would be effective in removing approximately 55% of the site's annual loads. Runoff entering the proposed facilities will also be pre-treated for trash, hydrocarbons, sediment and other runoff constituents that would reduce the efficacy of the proposed BMPs.

The following table depicts the predicted annual loads for site development and site development with employment of proposed treatment BMPs:

Table 3-3(2). Anticipated Reduction of Pollutant

Drainage Area	Annual Pollutant Load (lbs)					
	BOD	COD	TP	DP	TKN	NO_2 / NO_3
Eastern	600	2,118	9.3	4.7	56.6	29.8
Eastern with BMP	270	953.1	4.2	2.1	25.5	13.4
Western	2,426	10,489	49.9	24.53	279.7	132.4
Western with BMP	0	0	0	0	0	0

Since it is impossible for the non-infiltration type BMPs to contain and treat all runoff tributary to the system, a more conservative (lower) performance efficiency was used to derive the estimates provided in Table 3-3(2). Removal efficiencies of 100% and 55% were used for the infiltration BMP system and water quality basins with NTS features, respectively.

A comparison of the pre-project and post-project (with BMP) annual pollutant loads derived from this study is provided in the following table (Table 3-3(3)). The table shows, as expected, that the anticipated pollutant loads to be discharged from the Western Drainage Area remains unchanged from existing conditions. The table also shows an average pollutant load reduction of approximately 50% for the Eastern Drainage Area.

Table 3-3(3). Change in Pollutant Load: Pre- and Post-Project

Drainage Area	Annual Pollutant Load (lbs)																	
	BOD(EX)	BOD(PR)	% D	COD(EX)	COD(PR)	% D	TP(EX)	TP(PR)	% D	DP(EX)	DP(PR)	% D	TKN(EX)	TKN(PR)	% D	NO_2 / NO_3 (EX)	NO_2 / NO_3 (PR)	% D
Eastern	595	270	55	1,941	953.1	51	8.1	4.2	48	4.2	2.1	50	42.0	25.5	39	28.6	13.4	53
Western	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	595	270	55	1,941	953.1	51	8.1	4.2	48	4.2	2.1	50	42.0	25.5	39	28.6	13.4	53

4.0 SUMMARY

4.1 BASIS FOR FINDINGS

The results of this study have been evaluated by 1) examining the pollutants present within watershed runoff, 2) determining the pollutants of concern, 3) examining the pollutant removal capabilities and removal mechanism(s) of the proposed treatment BMPs, and 4) examining the anticipated pollutant removal capabilities and removal mechanism(s) of the proposed BMPs.

4.2 CONCLUSION OF WATER QUALITY CHANGES

In analyzing the elements described in previous sections of this report as well as the existing literature available on storm water runoff constituents and various treatment BMPs, it is concluded that while the actual pollutant levels in the site's existing condition are not known, the studies referenced in this analysis do provide a reasonable baseline for this report. It is also necessary to consider the benefits that the treatment BMPs proposed would have on Machado Lake, in particularly since there are currently no BMPs employed within the Eastern Drainage Area to the reduce the existing site's impacts.

On a regional scale, the proposed infiltration BMP within the Western Drainage Area would provide treatment of a large portion of the 707-acre storm water (and non-storm water) run-on from tributary areas to the south/southwest and ensure that no pollutants would be discharged offsite (up to the 25/50-year storm events), as in existing conditions.

The BMP system proposed within the Eastern Drainage Area would provide treatment to ensure that project implementation would not cause an increase in the site's pollutant loads to downstream receiving waters (e.g. Project 77/510 and specifically Machado Lake), but rather, a decrease from existing conditions since no BMPs are currently in place.

The average annual external nutrient load to Machado Lake is 38,772.7 lbs for TN and 7,187.1 lbs for TP. Approximately 1,979.8 lbs of TN and 66.1 lbs of TP are contributed by the Project 77/510 sub-watershed.[8] Based on the findings of this report, it is anticipated that with implementation of the proposed BMPs, the annual nutrient loads to Project 77/510 would be reduced by approximately 0.8% for TN and 5.9% for TP. The overall effect on Machado Lake would be a TN and TP reduction of 0.04% and 0.05%, respectively.

[8] *"Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL". CA RWQCB – Los Angels Region – April 2008.*