HAYNES GENERATING STATION UNITS 5 & 6 REPOWERING PROJECT

Draft
Environmental Impact Report (EIR)

(SCH#2005061111)

Technical Appendices (B through F)

Los Angeles Department of Water and Power
Environmental Services
111 North Hope Street, Room 1044
Los Angeles, CA 90012

With Technical Assistance By:

AECOM
2737 Campus Drive
Irvine, CA 92612

JANUARY 2010

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January 2010

Appendices

Appendix A Notice of Preparation, Initial Study, and Responses to Notice of Preparation, April 6, 2009 (Included with the Draft EIR)

Appendix B Air Quality Study for the Haynes Generating Station Simple Cycle Generating System (SCGS), AECOM Inc., July 2009

Appendix C Marine Biological Studies, Haynes Generating Station Units 5&6 Repower Project, MBC Applied Environmental Sciences, May 15, 2009

Appendix D Water Quality Analysis for CEQA Evaluation of the Haynes Generating Station Units 5 and 6 Repowering Project: Alamitos Bay, Haynes Intake Channel, and Lower San Gabriel River Flood Control Channel, Flow Science Incorporated, September 1, 2009

Appendix E Hynes Generating Station Units 5 & 6 Repowering Project Noise and Vibration Impact Report, Terry A. Hayes Associates LLC, January 21, 2010

Appendix F Traffic Study for the Haynes Generating Station Simple Cycle Generating System (SCGS) in the City of Long Beach, California, KOA Corporation, July 29, 2009

APPENDIX B

AIR QUALITY STUDY FOR THE HAYNES GENERATING STATION SIMPLE CYCLE GENERATING SYSTEM (SCGS)

AECOM, Inc.

July 2009

Prepared for:
EDAW
Irvine, CA 92614

Air Quality Study for the Haynes Generating Station Simple Cycle Generating System (SCGS)

LA DWP
LOS ANGELES DEPARTMENT OF WATER & POWER

AECOM, Inc.
July 2009
Document No.: 02450-051-01

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Prepared for:
EDAW
Irvine, CA 92614

Air Quality Study for the Haynes Generating Station Simple Cycle Generating System (SCGS)

Prepared by Charanya Varadarajan

Prepared By Sarah T. Sullivan

Reviewed By Gregory S. Wolffe

AECOM, Inc.

July 2009
Document No.: 02450-051-01

AECOM

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Abbreviations and Acronyms

$\mu g/m^3$	micrograms per cubic Meter
AQMD	Air Quality Management District
ARB	Air Resources Board
AVR	Automatic Voltage Regulator
BACT	Best Available Control Technology
bhp	brake horsepower
BPIP	Building Profile Input Program
CAAQS	California Ambient Air Quality Standards
CalEPA	California Environmental Protection Agency
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CT	Combustion Turbine
DEM	Digital Elevation Model
DPM	Diesel Particulate Matter
F	Fahrenheit
g/bhp-hr	grams per brake horsepower-hour
g/s	grams per second
GHG	Greenhouse Gas
gpm	gallons per minute
GRP	General Reporting Protocol
GWP	Global Warming Potential
HARP	Hot Spots Analysis Reporting Program
HI	Hazard Index
HnGS	Haynes Generating Station
HRA	Health Risk Assessment
ICE	Internal Combustion Engine
K	kelvin

kW	kilowatt
lb/hr	pound per hour
lb/Mgal	pound per million gallon
LHV	Lower Heating Value
LOS	Level of Service
m	meter
m/s	meter per second
MATES	Multiple Air Toxics Exposure Study
MDAB	Mojave Desert Air Basin
MEIR	Maximum Exposed Individual Resident
MEIW	Maximum Exposed Individual Worker
mg/kg-day	milligram per kilogram-day
MICR	Maximum Individual Cancer Risk
MMBtu	Million British Thermal Units
MMscf	Million Standard Cubic Feet
MT	Metric Tons
$MTCO_2e$	metric tons of carbon dioxide equivalent
MW	Megawatt
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAD	North America Datum
NO_2	Nitrogen dioxide
NOx	Nitrogen oxide
NTC	Non-tradeable credits
O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PM_{10}	Particulate matter, micron size 10
$PM_{2.5}$	Particulate matter, micorn size 2.5
psig	pound per square inch
PTC	Permit to Construct
PTO	Permit to Operate
PVMRM	Plume Volume Molar Ratio Method
RECLAIM	Regional Clean Air Incentives Market

REL	Reference Exposure Level
RTCs	Regional Trading Credits
SCAB	South Coast Air Basin
SCAQMD	South Coast Air Quality Management District
SCGS	Simple Cycle Generating System
SCR	Selective Catalytic Reduction
SF_6	Sulfur hexafluoride
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
SSAB	Salton Sea Air Basin
TAC	Toxic Air Contaminant
T-BACT	Toxic Best Available Control Technology
TPY	tons per year
USEPA	United States Environmental Protection Agency
USGS	United State Geological Survey
UTM	Universal Transverse Mercator
V/C	Volume to Capacity Ratio
VOC	Volatile Organic Compounds

1.0 Introduction

This study focuses on the potential air quality and public health impacts of the construction and operation of a proposed 616-megawatt (MW) gross, not to exceed 600 MW net, simple cycle generating system (SCGS) at the Haynes Generating Station (HnGS) in Long Beach, California. The SCGS is proposed by the Los Angeles Department of Water and Power (LADWP) and will include six natural gas-fired combustion turbines (CTs) at nearly 100 MW each, associated cooling and pollution control systems, and other ancillary facilities. The proposed project includes decommissioning of two existing steam boiler generators that have a total generation capacity of 600 MW.

Air pollution produced from the proposed project would occur both during construction and operation of the project. This study analyzes potential air quality impacts associated with the short-term construction and long-term operation of the proposed project and identifies potential mitigation to lessen and/or avoid significant adverse project related air quality impacts. The attachments to this report include detailed emission calculations and supporting modeling files for the air quality impact analysis and the human health risk assessment (HRA).

1.1 Project Location

HnGS is an electric power generating facility supplying power to the LADWP power distribution grid. It is located at 6801 2nd Street in the City of Long Beach, immediately south of State Highway 22 (Garden Grove Freeway) approximately one mile east of State Highway 1 (Pacific Coast Highway). Access to HnGS is provided from 2nd Street, which forms the southern property boundary. Seventh Street (State Route 22) serves as the northern site boundary and provides emergency access. The facility consists of approximately 122 acres, majority of which is located in the City of Long Beach, County of Los Angeles. Approximately 7.5 acres in the northeast corner of the facility is located in the City of Seal Beach, County of Orange. The proposed project is located in the northern portion of the HnGS property, entirely within the City of Long Beach and the County of Los Angeles. The proposed project is within the South Coast Air Basin (SCAB) and is under the jurisdiction of the South Coast Air Quality Management District (SCAQMD).

Land uses surrounding HnGS consist primarily of industrial, commercial, and residential uses including the Leisure World residential community along the entire eastern property boundary, light industrial facilities (including office, research and development, and manufacturing) in the Boeing Integrated Defense Systems Specific Plan Area to the southeast, the Island Village residential community to the south, vacant land to the southwest, the Alamitos Generating Station (an electrical generating station operated by the AES company) along the entire western boundary, across the San Gabriel River channel, residential areas to the northwest, and a community park and residential areas to the north. Most of the eastern station boundary is also the boundary between Los Angeles and Orange counties. A regional bike trail runs along the upper bank of the San Gabriel River, adjacent to HnGS.

1.2 Project Description

The proposed project would include six natural gas-fired 100 MW combustion turbines, one or two emergency standby generators producing up to 5 MW net, associated cooling and pollution control systems, and other ancillary facilities and equipments such as gas compressors, electrical transformers, switching equipment, and a water treatment system required to purify water for use in the SCGS. The new generation units would be designated as Units 11, 12, 13, 14, 15, and 16. Natural gas obtained through the site's existing gas supply lines will be combusted in the SCGS to produce thermal energy which will be converted into mechanical energy required to drive the turbines and generators to produce electricity. The net capacity of the proposed SCGS is 600 MW.

The proposed project also includes permanently decommissioning two existing steam boiler generators (Units 5 and 6) having a total generation capacity of 600 MW. The total net generating capacity of the HnGS facility after the completion of the proposed project would be 1619 MW, equal to the current capacity at the facility. Further, the proposed project would also result in the decommissioning of a portion of the plant's existing once-through cooling water circulation. This is the portion that is currently utilized for Units 5 and 6. However, no modifications to this system would occur within either the circulating water channel (located east of the existing generating units) or the San Gabriel River. The proposed SCGS would employ a dry cooling system which would require new cooling structures to be located north of the proposed SCGS instead of the once-through cooling.

Project Construction

Construction of the proposed project is scheduled to begin in the second quarter of 2010 and continue to completion by the end of 2012. Construction activities are anticipated to last approximately 26 months and would normally take place six days per week, Monday through Saturday. To ensure that construction activities stay on schedule, two shifts per day may be required at times during the construction period, and occasional Sunday shifts may also be required. A total of approximately 270 workers could be present at the site on the same day, in either one or two shifts, during the peak project construction period when simultaneous foundation and SCGS erection would be underway. This peak period is expected to occur for several months in 2011, during Phase II General Construction. In addition, truck trips may average approximately 26 loads per day during the peak construction materials delivery period of several months during Phase II (2011). During the balance of the project, truck trips are expected to generally average less than 10 loads per day, although approximately 15 loads per day may be necessary during some non-peak months. During the peak of construction activity, between 35 and 40 pieces of equipment would be operating on site. It has been assumed that the peak in construction workers (270), the peak in truck deliveries (26), and the peak in on-site equipment use (40) would occur simultaneously over several months during the middle of Phase II (2011).

Construction activity for the proposed project would include minor grading and site preparation; construction of access roads and equipment foundations, including the driving of piles for the SCGS; installation of the CT's (with control equipments and exhaust stacks), dry cooling towers, and associated ancillary equipment; and turbine commissioning (testing and calibration of SCGS prior to operations). All required construction staging, storage, and laydown areas related to project construction will be located within the existing HnGS boundaries. New generating equipment would be brought to the site on trucks, and oversize loads are anticipated. In addition, contractors would require temporary trailers onsite for construction planning and management activities.

Project Operation

Power Generating Equipment: The SCGS will include six natural gas-fired simple cycle combustion turbines. The equipment would be designed to provide a net base load capacity of 600 MW. The CTs would produce thermal energy through the combustion of the natural gas and the thermal energy would be converted into mechanical energy required to drive the turbines and generators that produce electricity. Natural gas would be obtained through the site's existing offsite and onsite gas supply lines. Air would be supplied to the CTs through an inlet air filter and evaporative coolers by an air inlet duct. Natural gas would be supplied at approximately 850 pounds per square inch gauge (psig) pressure by the gas compressors. This mixture of fuel and air would be ignited and burned, producing high-temperature pressurized gas to drive the turbines and electric generators.

The new CTs would use a combination of processes to control air pollutant emissions. The combustors in the CTs would use water injection to reduce nitrogen oxide (NO_x) emissions. A selective catalytic reduction (SCR) system also would be provided for the CTs that would use a catalyst to facilitate a reaction between NO_x and aqueous ammonia to reduce NO_x emissions. A carbon monoxide (CO) catalyst would also be installed to comply with the SCAQMD New Source Review and Best Available Control Technology (BACT) requirements.

Each CT would include a weatherproof, acoustic (i.e., sound-dampening) enclosure with separate compartments for the turbine, generator, and auxiliary equipment. Lighting as well as fire and gas detection equipment would be provided in each compartment.

There would be three step-up transformers. Two electric generators would share and feed a step-up transformer, which would be connected by pole-mounted electrical lines to a new switchyard. Power would be transmitted offsite through existing transmission lines. Wastewater generated by the operation of the SCGS would be transmitted to the settling basins in the southeast corner of HnGS, treated, and discharged with other plant treated wastewaters.

Cooling System: Each CT would have an intercooler in the compression section of the turbine in which warm air would be taken from the compressor section and sent to an air-to-water heat exchanger. The warm water from the heat exchanger would be sent to one of six dry cooling towers (one for each CT). The water would be cooled by fans that would blow cooler air over the tubes containing the warmer water, and the cooled water would then be pumped back to the heat exchangers. The once through cooling system currently used by Units 5 and 6 would be shut down as part of the retirement of those units and no ocean cooling would be used by this project. The proposed project would not require construction activity within either the cooling water channel or the San Gabriel River.

Ammonia Handling and Storage: Aqueous ammonia (ammonium hydroxide at 29.5 percent concentration by weight) is presently used in the SCR systems in existing HnGS Units 1, 2, 5, 6, 9, and 10 to reduce NO_x emissions. Aqueous ammonia would also be used in the proposed SCGS that would replace Units 5 and 6. The ammonia for the existing and new units would continue to be delivered to HnGS by truck and stored at the site's existing aqueous ammonia tank facility. The existing ammonia storage consists of six cylindrical aboveground storage tanks, with a total capacity of 225,000 gallons (37,500 gallons in each tank). No new ammonia storage or deliveries would be required for the proposed project since ammonia used for the SCGS would be generally offset by the removal from service of existing Units 5 and 6.

Removal from Service of Units 5 and 6: Within 90 days of completion of the commissioning of the proposed SCGS, LADWP would remove Units 5 and 6 from service by surrendering the operating permits pursuant to SCAQMD Rule 2012. Units 5 and 6 would be left in place but permanently disabled.

Operating Personnel Requirements: Once constructed, the proposed project would not require additional personnel beyond those currently employed at HnGS to support site operations. The facility would be capable of operating 24 hours per day, seven days per week.

Project Termination and Decommissioning: The estimated life of the new simple-cycle equipment at HnGS is expected to be more than 25 years. Equipment that is no longer effective may then be shut down and/or decommissioned, replaced, or modified in accordance with applicable regulations, market conditions, and technology prevailing at the time of termination. Decommissioning of the new units in the future may involve a combination of salvage or disposal in accordance with applicable federal, state, and local regulations.

2.0 Environmental Setting

2.1 Regional Climate

The regional climate significantly influences the air quality in the SCAB. Climatic variables including temperature, wind, humidity, precipitation, and even the amount of sunshine influence air quality of a region. In addition, the SCAB is frequently subjected to an inversion layer that traps air pollutants. Temperature has an important influence on SCAB wind flow, pollutant dispersion, vertical mixing, and photochemistry.

Annual average temperatures throughout the SCAB vary from the low to middle 60 degree Fahrenheit (ºF). However, due to decreased marine influence, the eastern portion of the SCAB shows greater variability in average annual minimum and maximum temperatures. January is the coldest month throughout the SCAB, with average minimum temperatures of 47ºF in downtown Los Angeles and 36ºF in San Bernardino. All portions of the SCAB have recorded maximum temperatures above 100ºF.

Although the climate of the SCAB can be characterized as semi-arid, the air near the land surface is quite moist on most days because of the presence of a marine layer. This shallow layer of sea air is an important modifier of the SCAB climate. Humidity restricts visibility in the SCAB, and the conversion of sulfur dioxide (SO_2) to sulfates is heightened in air with high relative humidity. The marine layer is an excellent environment for that conversion process, especially during the spring and summer months. The annual average relative humidity is 71 percent along the coast and 59 percent inland. Because the ocean effect is dominant, periods of heavy early morning fog are frequent, and low stratus clouds are a characteristic feature. These effects decrease with distance from the coast.

More than 90 percent of the rainfall in the SCAB occurs from November through April. Annual average rainfall varies from approximately nine inches in Riverside to fourteen inches in downtown Los Angeles. Monthly and yearly rainfall totals are extremely variable. Summer rainfall usually consists of widely scattered thundershowers near the coast and slightly heavier shower activity in the eastern portion of the region and near the mountains. Rainy days comprise five to ten percent of all days in the SCAB, with the frequency being higher near the coast. The influence of rainfall on the contaminant levels in the SCAB is minimal.

Although some wash-out of pollution would be expected with winter rains, air masses that bring precipitation of consequence are very unstable and provide excellent dispersion that masks wash-out effects. Summer thunderstorm activity affects pollution only to a limited degree. High contaminant levels can persist even in areas of light showers if the inversion is not broken by a major weather system. However, heavy clouds associated with summer storms minimize ozone production because of reduced sunshine and cooler temperatures.

HnGS is located less than one mile from the coast and is influenced by its proximity to the Pacific Ocean. Rainfall averages about 14.5 inches a year, falling almost entirely from late October to early April. The meteorological data (temperature and precipitation) from the Los Angeles International Airport are detailed in Table 2.1-1.

Table 2.1-1: Average Monthly Temperatures and Precipitation for Los Angeles International Airport, CA, 1961-1990			
Month	**Mean Daily Temperatures**		**Mean Monthly Precipitation (inches)**
	Max (°F)	**Min (°F)**	
January	65	47	2.40
February	66	49	2.51
March	65	50	1.98
April	68	53	0.72
May	69	56	0.14
June	72	60	0.03
July	75	63	0.01
August	76	64	0.15
September	76	63	0.31
November	71	52	1.76
December	66	48	1.66
Absolute Extreme Temperatures	110	23	12.01 (total)
Source: Local Climatological Data, Annual Summary with Comparative Data, Los Angeles, California, International Airport; www.wrcc.dri.edu			

The importance of wind to air pollution is considerable. The direction and speed of the wind determines the horizontal dispersion and transport of air pollutants. During the late autumn to early spring rainy season, the SCAB is subjected to wind flows associated with traveling storms moving through the region from the northwest. This period also brings five to 10 periods of strong, dry offshore winds, locally termed “Santa Anas” each year. During the dry season, which coincides with the months of maximum photochemical smog concentrations, the wind flow is bimodal, typified by a daytime onshore sea breeze and a nighttime offshore drainage wind.

Summer wind flows are created by the pressure differences between the relatively cold ocean and the unevenly heated and cooled land surfaces that modify the general northwesterly wind circulation over southern California. Nighttime drainage begins with the radiational cooling of the mountain slopes. Heavy, cool air descends the slopes and flows through the mountain passes and canyons as it follows the lowering terrain toward the ocean. Another characteristic wind regime in the SCAB is the “Catalina Eddy,” a low level cyclonic (counterclockwise) flow centered over Santa Catalina Island which results in an offshore flow to the southwest. On most spring and summer days, some indication of an eddy is apparent in coastal sections.

The vertical dispersion of air pollutants in the SCAB is frequently restricted by the presence of a persistent temperature inversion in the atmospheric layers near the earth’s surface. Normally, the temperature of the atmosphere decreases with altitude; however, when the temperature of the atmosphere increases with altitude, the phenomenon is termed an inversion. An inversion condition can exist at the surface or at any height above the ground. The bottom of the inversion, known as the mixing height, is the height of the base of the inversion.

In the SCAB, there are two distinct temperature inversion structures that control vertical mixing of air pollution. During the summer, warm, high-pressure descending (subsiding) air is undercut by a shallow layer of cool marine air. The boundary between these two layers of air is a persistent marine subsidence/inversion. This boundary prevents vertical mixing which effectively acts as an impervious lid to pollutants over the entire SCAB. The mixing height for this inversion structure is normally situated 1,000 to 1,500 feet above mean sea level.

A second inversion-type forms in conjunction with the drainage of cool air off the surrounding mountains at night followed by the seaward drift of this pool of cool air. The top of this layer forms a sharp boundary with the warmer air aloft and creates nocturnal radiation inversions. These inversions occur primarily in the winter, when nights are longer and onshore flow is weakest. They are typically only a few hundred feet above mean sea level. These inversions effectively trap pollutants, such as NO_x and CO from vehicles, as the pool of cool air drifts seaward. Winter is therefore a period of high levels of primary pollutants along the coastline.

In general, inversions in the SCAB are lower before sunrise than during the daylight hours. As the day progresses, the mixing height normally increases as the warming of the ground heats the surface air layer. As this heating continues, the temperature of the surface layer approaches the temperature of the base of the inversion layer. When these temperatures become equal, the inversion layer's lower edge begins to erode, and if enough warming occurs, the layer breaks up. The surface layers are gradually mixed upward, diluting the previously trapped pollutants. The breakup of inversion layers frequently occurs during mid- to late-afternoon on hot summer days. Winter inversions usually break up by mid-morning.

2.2 Existing Air Quality

Criteria Air Pollutants

The SCAQMD monitors levels of various pollutants at its 38 monitoring stations within the Basin. The closest ambient air quality monitoring station to the HnGS is the South Coastal Los Angeles County monitoring station. Background ambient air quality data from 2004 through 2007 for criteria pollutants measured at the South Coastal Los Angeles County monitoring station are presented in Table 2.2-1. Ambient air quality was compared to the most stringent of either the California Ambient Air Quality Standards (CAAQS) or the National Ambient Air Quality Standards (NAAQS). In all cases, CAAQS are the most stringent.

The air quality data indicates that the area is in compliance with both CAAQS and NAAQS for CO, nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Additionally, lead (Pb) and sulfate concentrations measured were below state and national standards. State ozone (O_3), particulate matter less than 10 microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) standards were exceeded on several days each year. The state 1-hour ozone standard was exceeded once in 2007; however, the federal 1-hour and 8-hour ozone standards were not exceeded. At this monitoring station, peak 24-hour PM_{10} concentrations ranged from 66 $\mu g/m^3$ in 2005, 78 $\mu g/m^3$ in 2006, and 75 $\mu g/m^3$ in 2007. The number of observed exceedances of the state 24-hour PM_{10} standard varied from five days in 2005 and 2007 to six days in 2006. The station recorded five exceedances of the 24-hour $PM_{2.5}$ standard in 2006 and 12 exceedances in 2007.

Table 2.2-1: Background Air Quality Data for the South Coastal Los Angeles County Station (2005 - 2007)					
Constituent	**Maximum Observed Concentration (No. of Standard Exceedances - most restrictive)**				
	State Standard	**Federal Standard**	**2005**	**2006**	**2007**
Carbon Monoxide					
1-hr	20.0 ppm	35.0 ppm	4.0 (0 days)	4.0 (0 days)	3.0 (0 days)
8-hr	9.0 ppm	9.5 ppm	3.5 (0 days)	3.4 (0 days)	2.6 (0 days)
Ozone					
1-hr	0.09 ppm	0.12 ppm	0.091 (0 days)	0.091 (0 days)	0.099 (1 day)
8-hr	0.07 ppm	0.08 ppm	0.068 (0 days)	0.068 (0 days)	0.073 (1 day)
NO_x					
1-hr	0.25 ppm		0.14 (0 days)	0.1 (0 days)	0.11 (0 days)
Annual	---	0.053 ppm	0.0241	0.0215	0.0207
SOx					
1-hr	0.25 ppm	---	0.04 (0 days)	.03 (0 days)	0.11 (0 days)
3-hr	---	0.5 ppm	---	---	---
24-hr	0.04 ppm	0.14 ppm	0.01 (0 days)	.010 (0 days)	0.011 (0 days)
Annual	---	0.03 ppm	---	---	0.0027 (0 days)
PM_{10}					
24-hr	50 µg/m3	150 µg/m3	66 (5 days)	78 (6 days)	75+ (5 days)
Annual	20 µg/m3	50 µg/m3	29.6	31.1	30.2+
$PM_{2.5}$					
24-hr	12 µg/m3	65 µg/m3	41.4 (0 days)	58.5 (5 days)	82.9 (12 days)
Annual	--	35 µg/m3	16.0	14.2	14.6
3 Year Nat'l. Avg	---	---	---	---	---
Lead					
30-day	1.5 µg/m3	---	0.01	0.01	0.02
Calendar Quarter	---	1.5 µg/m3	0.01	0.01	0.01
Sulfates					
24-hour	25	---	16.8 (0 days)	17.8 (0 days)	11.1 (0 days)
Source: SCAQMD Historical Data – Air Quality Data Table, South Coastal LA Monitoring Station					

The project site is located within the SCAB, which is currently designated "severe nonattainment" for the federal eight-hour ozone ambient air quality standard and has until 2024 to achieve the national standard. The Basin is also in nonattainment for $PM_{2.5}$ and has until 2010 to achieve the national standard, but will be filing a five-year extension to 2015 due to the severity of the $PM_{2.5}$ problem. The Basin is in attainment for NO_2. Table 2.2-2 below represents SCAB non-attainment designations from 2004-2006.

Table 2.2-2: SCAB Non-attainment Designation			
Constituent	**Non-attainment Designation**		
	2004	2005	2006
Carbon Monoxide	--	--	--

Table 2.2-2: SCAB Non-attainment Designation			
Constituent	Non-attainment Designation		
	2004	2005	2006
Nitrogen Oxide	--	--	--
Sulfur Dioxide	--	--	--
PM_{10}	--	Yes	Yes
$PM_{2.5}$	--	Yes	Yes
Ozone	--	Yes	Yes

Toxic Air Contaminants

Cancer Risk: One of the primary health risks of concern due to exposure to toxic air contaminants (TACs) is the risk of contracting cancer. The carcinogenic potential of TACs is a particular public health concern because it is currently believed by many scientists that there is no "safe" level of exposure to carcinogens, that is, any exposure to a carcinogen poses some risk of causing cancer. Health statistics show that one in four people will contract cancer over their lifetime, or 250,000 in a million, from all causes, including diet, genetic factors, and lifestyle choices.

Non-cancer Health Impacts: Unlike carcinogens, for most non-carcinogens it is believed that there is a threshold level of exposure to the compound below which it will not pose a health risk. The California Environmental Protection Agency (CalEPA) and California Office of Environmental Health Hazard Assessment (OEHHA) have developed reference exposure levels (RELs) for non-carcinogenic TACs that are health-conservative estimates of the levels of exposure at or below which health effects are not expected. The non-cancer health risk due to exposure to a TAC is assessed by comparing the estimated level of exposure to the REL. The comparison is expressed as the ratio of the estimated exposure level to the REL, called the hazard index (HI).

Multiple Air Toxics Exposure Study (MATES): The Multiple Air Toxics Exposure Study (MATES) is one of the most comprehensive urban air toxic studies conducted by the SCAQMD within the SCAB. The MATES III (2004-2006) is a monitoring and evaluation study conducted in the basin as a follow on to previous air toxics studies in the Basin (MATES II (1998-1999) and MATES I (1987)) and is part of the SCAQMD Governing Board Environmental Justice Initiative. MATES III consisted of several elements such as monitoring program, an updated emissions inventory of toxic air contaminants, and a modeling effort to characterize risk across the Basin. The study estimated the Basin-wide carcinogenic risk from air toxics at 1,200 cases per million. About 94 percent of this risk was attributed to emissions associated with mobile sources, with the remaining attributed to toxics emitted from stationary sources. The estimated population weighted risk across the Basin for the MATES III period showed an 8 percent decrease compared to the MATES II period. MATES III (2005 inventory) also noted an 11 percent decrease in the carcinogenic potency weighted emissions since MATES II (1998 emission inventory year). Emissions from on-road, point, and area source categories were estimated to have decreased 12 percent, 66 percent, and 42 percent, respectively, while off-road emissions were determined to be essentially unchanged (an increase of 1 percent) (SCAQMD 2008).

2.3 Regional Emissions Inventory

Criteria Pollutant Inventory

SCAQMD's current emissions inventory for the SCAB is summarized in Table 2.3-1. Anthropogenic sources of emissions include stationary sources, area-wide sources, and mobile sources (both on-road and off-road mobile sources). On-road mobile sources include light-duty passenger vehicles; light-, medium-, and heavy-duty trucks; motorcycles; and urban buses. Off-road mobile sources include off-road vehicles, trains, ships, aircraft, and mobile equipment. The SCAQMD emissions inventory only includes emissions in the SCAB for criteria air pollutants NO_x, CO, sulfur oxides (SO_x), PM_{10}, and volatile organic compounds (VOC) (a precursor of ozone). Since ozone is formed by photochemical reactions involving the precursors, VOC and NO_x, it is not inventoried.

Table 2.3-1: Sources of Criteria Pollutant Emissions (TPY)

Source Category	VOC	CO	NO_X	SO_X	PM_{10}
Stationary Sources	59.0	35.8	40.0	17.9	12.6
Area-wide Sources	85.3	43.8	15.3	0.4	103.2
Mobile Sources	252.5	2133.5	529.4	24.6	29.5
Natural Sources	34.3	65.0	1.9	0.6	6.6
TOTAL =	**431.1**	**2278.0**	**586.7**	**43.5**	**151.9**
Source: CARB Estimated Annual Average Emissions, SCAB Los Angeles					

As shown in Table 2.3-1, mobile sources are the major contributors to emissions in the SCAB, i.e., CO (93 percent), NO_x (90 percent), SO_x (43 percent), and VOC (58 percent). A significant percentage of fine PM_{10} in the atmosphere is attributable to mobile sources (19 percent), but as shown in the table, the majority of PM_{10} emissions (67 percent) are from area-wide sources in the SCAB.

TAC Inventory

Table 2.3-2 presents the TAC inventory as published by the SCAQMD in its MATESIII final report. The 2007 Air Quality Management Plan (AQMP) is the basis for the toxics emissions inventory developed for MATES III. The 2005 inventory used in the MATES III modeling analysis is projected from the 2002 baseline inventory in the 2007 AQMP. MATES III identified diesel particulate matter (DPM) to account for over 85 percent of the overall potency weighted emissions (emissions for carcinogenic chemicals from Table 2.3-2 weighted by a ratio of their cancer potency to the cancer potency of DPM). The other significant compounds (i.e., contributions >1 percent) included 1,3-butadiene, benzene, perchloroethylene, and hexavalent chromium. On-road and off-road mobile sources were identified to contribute nearly 93 percent of the potency weighted air toxics emissions, while stationary (i.e., point and area) sources contribute about seven percent of the potency weighted risk in the basin.

MATES III also noted an 11 percent decrease in the carcinogenic potency weighted emissions since MATES II (1998 emission inventory year). Emissions from on-road, point, and area source categories were estimated to have decreased 12, 66, and 42 percent, respectively, while off-road emissions were determined to be essentially unchanged (an increase of 1 percent).

Table 2.3-2: 2005 Annual Average Day Toxic Emissions for the SCAB					
Pollutant	Emissions (lbs/day)				
	On-road	Off-road	Point	Area	Total
Acetaldehyde*	4857.0	8622.4	125.8	505.1	14110.3
*Acetone***	4020.5	7189.1	552.4	28904.9	40666.9
Benzene	13244.8	7808.3	906.5	609.3	22568.9
1,3 Butadiene	2723.1	1755.6	537.1	108.7	5124.5
Carbon tetrachloride	0.0	0.0	11.2	0.0	11.2
Chloroform	0.0	0.0	206.9	0.0	206.9
1,1 Dichloroethane	0.0	0.0	0.5	0.0	0.5
1,4 Dioxane	0.0	0.0	0.8	0.7	1.5
Ethylene dibromide	0.0	0.0	2.2	0.0	2.2
Ethylene dichloride	0.0	0.0	67.2	0.0	67.2
Ethylene oxide	0.0	0.0	16.1	52.6	68.7
Formaldehyde*	12596.6	19889.0	1488.8	1302.0	35276.4
*Methyl ethyl ketone**	745.6	1366.0	1244.3	6466.7	9822.6
Methylene chloride	0.0	0.0	325.1	13548.3	13873.4
MTBE	0.0	4.4	89.6	0.0	93.9
Naphthalene	573.4	376.8	16.6	568.1	1534.9
p-Dichlorobenzene	0.0	0.0	115.4	5553.9	5669.3
Perchloroethylene	0.0	0.0	940.4	9685.3	10625.7
Propylene oxide	0.0	0.0	2.2	0.1	2.3
Styrene	681.7	326.3	1332.5	76.5	2417.0
Toluene	37707.9	15369.2	8724.3	21029.4	82830.8
Trichloroethylene	0.0	0.0	587.1	633.0	1220.1
Vinyl chloride	0.0	0.0	51.1	0.0	51.1
Arsenic	0.2	3.9	13.4	24.8	42.3
Cadmium	1.5	2.1	3.2	7.2	14.0
Chromium	21.1	9.2	49.2	77.3	156.8
Diesel particulate	22164.5	37406.2	489.5	618.3	60678.5
*Elemental carbon****	10498.2	9337.4	4850.4	14197.3	38883.3
Hexavalent chromium	1.1	0.6	0.6	0.5	2.8
Lead	2.4	4.8	13.7	180.9	201.8
Nickel	15.3	5.8	44.2	23.4	88.7
Organic carbon	19972.7	18073.3	371.0	69230.1	107647.1
Selenium	0.5	0.5	41.4	2.2	44.6
*Silicon***	838.7	136.5	1211.9	218527.2	220714.3
Italics represent *Not a known human carcinogen.*					
* Primarily emitted emissions. These materials are also formed in the atmosphere as a result of photochemical reactions.					
** Acetone and silicon are not toxic compounds. Their emissions are included here because they were measured in the sampling program and were subsequently modeled for the purpose of model evaluation.					
*** Includes elemental carbon from all sources (including diesel particulate).					

3.0 Regulatory Setting

The SCAQMD has jurisdiction over an area of approximately 10,743 square miles, consisting of the four-county SCAB, the Mojave Desert Air basin (MDAB) and the Riverside County portions of the Salton Sea Air Basin (SSAB). The SCAB, which is a sub-area of the SCAQMD jurisdiction, is bounded by the Pacific Ocean to the west and the San Gabriel, San Bernardino, and San Jacinto mountains to the north and east. It includes all of Orange County and the non-desert portions of Los Angeles, Riverside, and San Bernardino counties. HnGS lies within the SCAB. The current air quality settings in the vicinity of the HnGS are discussed below.

3.1 Regional Authority

In the Basin, the SCAQMD is the agency responsible for the administration of federal and state air quality laws, regulations, and policies. SCAQMD regulations require that any equipment that emits or controls air contaminants be permitted prior to construction, installation, or operation (Permit to Construct or Permit to Operate). The SCAQMD is responsible for review of applications and for the approval and issuance of these permits. In addition, the project must comply with the relevant federal air quality requirements.

3.2 Air Quality Regulations, Plans and Policies

Air quality is determined primarily by the type and amount of contaminants emitted into the atmosphere, the size and topography of the air basin, and the meteorological conditions. The SCAB has low mixing heights and light winds, which are conducive to the accumulation of air pollutants. Pollutants that impact air quality are generally divided into two categories: criteria pollutants (those for which health standards have been set) and toxic air contaminants (those that cause cancer or have adverse human health effects other than cancer).

It is the responsibility of the SCAQMD to ensure that state and federal ambient air quality standards are achieved and maintained in the SCAB. Health-based air quality standards have been established by California and the federal government for the following criteria air pollutants: ozone, CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, and lead. These standards were established to protect sensitive receptors from adverse health impacts due to exposure to air pollution. The CAAQS are more stringent than the federal standards. California has also established standards for sulfate, visibility, hydrogen sulfide, and vinyl chloride. Hydrogen sulfide and vinyl chloride are currently not monitored in the SCAB because these contaminants are not seen as a significant air quality problem. CAAQS and NAAQS for each of these pollutants and their effects on human health are summarized in Table 3.2-1.

Table 3.2-1: Ambient Air Quality Standards

Air Pollutant	Concentration/Averaging Time		Most Relevant Health Effects
	State Standard	Federal Primary Standard	
Ozone	0.09 ppm, 1-hr. avg.	0.12 ppm, 1-hr avg., 0.075 ppm, 8-hr avg.	(a) Short-term exposures: (1) Pulmonary function decrements and localized lung edema in humans and animals (2) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (b) Long-term exposures: Risk to public health implied by altered connective tissue metabolism and altered pulmonary morphology in

Table 3.2-1: Ambient Air Quality Standards			
Air Pollutant	Concentration/Averaging Time		Most Relevant Health Effects
	State Standard	Federal Primary Standard	
			animals after long-term exposures and pulmonary function decrements in chronically exposed humans; (c) Vegetation damage; (d) Property damage
Carbon Monoxide	9.0 ppm, 8-hr avg. 20 ppm, 1-hr avg.	9 ppm, 8-hr avg. 35 ppm, 1-hr avg.	(a) Aggravation of angina pectoris and other aspects of coronary heart disease; (b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease; (c) Impairment of central nervous system functions; (d) Possible increased risk to fetuses
Nitrogen Dioxide	0.030 ppm, 1-hr avg.	0.053 ppm, annual arithmetic mean	(a) Potential to aggravate chronic respiratory disease and respiratory symptoms in sensitive groups; (b) Risk to public health implied by pulmonary and extra-pulmonary biochemical and cellular changes and pulmonary structural changes; (c) Contribution to atmospheric discoloration
Sulfur Dioxide	0.04 ppm, 24-hr avg. 0.25 ppm, 1-hr. avg.	0.030 ppm, annual arithmetic mean 0.14 ppm, 24-hr avg.	(a) Bronchoconstriction accompanied by symptoms which may include wheezing, shortness of breath and chest tightness, during exercise or physical activity in persons with asthma
Suspended Particulate Matter (PM_{10})	50 µg/m3, 24-hr avg 20 µg/m3, annual arithmetic mean	150 µg/m3, 24-hr avg.	(a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease; (b) Excess seasonal declines in pulmonary function, especially in children
Fine Particulate Matter ($PM_{2.5}$)	12 µg/m3, annual arithmetic mean	35 µg/m3, 24-hr avg. 15 µg/ m3, annual arithmetic mean	(a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease; (b) Excess seasonal declines in pulmonary function, especially in children
Sulfates	25 µg/ m3, 24-hr avg.	None	(a) Decrease in ventilatory function; (b) Aggravation of asthmatic symptoms; (c) Aggravation of cardio-pulmonary disease;(d) Vegetation damage; (e) Degradation of visibility; (f) Property damage
Lead	1.5 µg/ m3, 30-day avg.	1.5 µg/ m3, calendar quarter	(a) Increased body burden; (b) Impairment of blood formation and nerve conduction
Visibility Reducing Particles	Insufficient amount to reduce the visual range to less than 10 miles at relative humidity less than 70%, 8-hour average	None	Visibility impairment on days when relative humidity is less than 70 percent

3.3 Significance Thresholds

Emissions that can adversely affect air quality originate from various activities. A project generates emissions both during the period of its construction and during ongoing daily operations. Project-related air quality impacts estimated in this environmental analysis would be considered significant if any of the applicable significance thresholds presented in Table 3.3-1 are exceeded. This table includes both emissions and concentration related significance thresholds. Construction and non-RECLAIM source emissions (i.e., indirect source emissions) are compared to pollutant specific emissions thresholds to determine if the impact is significant.

Additionally, operational NO_x or SO_x emissions from stationary sources regulated under the Regional Clean Air Incentives Market (RECLAIM) program (SCAQMD Regulation XX) would be considered significant if they exceed a facility specific RECLAIM threshold. It should be noted, however, since electric utilities are exempt from the SO_x RECLAIM program (Rule 2001(i)(2)(A)), this criteria would only apply to NOx emissions from this project. This RECLAIM threshold is calculated based on the project's Initial 1994 RECLAIM Allocation plus non-tradeable credits (NTCs), as listed in the RECLAIM Facility Permit. A project is considered significant if the project's operational emissions, plus the facility's Annual Allocation for the year the project becomes operational, including purchased RECLAIM trading credits (RTCs) for that year, are greater than this RECLAIM significance threshold. HnGS is a RECLAIM facility under the SCAQMD (Facility ID: 800074).

The SCAB is currently designated by United States Environmental Protection Agency (EPA) as a nonattainment area for PM_{10} and $PM_{2.5}$. As a result, localized impacts for PM_{10} and $PM_{2.5}$ would be considered significant if they exceed the localized significance thresholds listed in Table 3.3-1. The localized significance thresholds for these nonattainment pollutants are based on the significant change in air quality concentration levels as they appear in Rule 1303, Table A-2.

The SCAB has been designated attainment for the CAAQS and NAAQS for NO_2 and CO. For this reason, localized NO_x and CO air quality impacts would be significant if the project's NO_2 and CO impacts plus background are above the CAAQS and/or the NAAQS. Because the SCAB has been designated attainment for both the CAAQS and NAAQS for SO_2 since the early 1980s, no significant change in air quality concentration has ever been identified for this pollutant for the purposes of permitting new or modified equipment.

Table 3.3-1: Air Quality Significance Thresholds			
Pollutant	**Construction**	**Operation**	**RECLAIM Sources**[1]
Criteria Pollutants Mass Daily Thresholds			
NO_x	100 lbs/day	55 lbs/day	10,045 lbs/day
VOC	75 lbs/day	55 lbs/day	
PM_{10}	150 lbs/day	150 lbs/day	
PM2.5	55 lbs/day	55 lbs/day	
SO_x	150 lbs/day	150 lbs/day	Exempt
CO	550 lbs/day	550 lbs/day	
Lead	3 lbs/day	3 lbs/day	
TAC, AHM, and Odor Thresholds			
Toxic Air Contaminants (TACs)	Maximum Incremental Cancer Risk ≥ 10 in 1 million Hazard Index ≥ 1.0 (project increment)		
Odor	Project creates an odor nuisance pursuant to SCAQMD Rule 402		

Table 3.3-1: Air Quality Significance Thresholds	
Ambient Air Quality for Criteria Pollutants	
NO_2 1-hour average annual average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 0.18 ppm/339 µg/m^3 (state) 0.03 ppm/57 µg/m^3 (state)
PM_{10} 24-hour average annual geometric mean	10.4 µg/m^3 (construction) & 2.5 µg/m^3 (operation) 1.0 µg/m^3
$PM_{2.5}$ 24-hour average	10.4 µg/m^3 (construction) & 2.5 µg/m^3 (operation)
Sulfate 24-hour average	1 µg/m^3
CO 1-hour average 8-hour average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 20 ppm/23 mg/m^3 (state) 9.0 ppm/10 mg/m^3 (state/federal)
[1] The NO_x emissions significance threshold, in lbs/day, is based on the facility's Initial 1994 RECLAIM Allocation (3666443 lbs) divided by 365 days per year.	

4.0 Environmental Impacts

The construction and operation of the SCGS will result in emissions of criteria pollutants, TACs, and green house gas (GHG) emissions. This section provides a discussion on the air quality impacts associated with these emissions.

4.1 Project Construction

Construction of the proposed SCGS will result in emissions from a number of activities including site preparation and grading, pile driving and foundation construction, general construction including installation of new SCGS, dry cooling system, and transformers, and turbine commissioning.

Construction equipment, manpower requirements, and hours of operations required for completion of each construction phase were estimated and entered into URBEMIS. Additionally, assumptions on the duration of each construction phase were made based on the anticipated 26 month schedule provided by LADWP. Phases considered in this analysis are detailed below.

- Site Preparation and Foundation Construction: Grading requirements for the project would be minor as the site is already cleared and essentially flat. Mass site grading will occur to level existing berms. For conservative purposes it was assumed that grading would be conducted on the entire 16-acre area that will accommodate the SCGS and yard for the electrical switching equipment and transformers. Any excess soil from the grading or foundation excavation operations would be stockpiled in the northern end of the HnGS property, and would be stabilized or covered to limit dust.

Foundation piles are required to adequately support the SCGS components. It is estimated that approximately 3,000 piles driven to a depth of up to 80 feet would be required. The pile driving operation was assumed to last approximately 4 months in duration during the construction Months 4 through 8.

- Pile Driving and SCGS Installation: Once the site is prepared and the foundations are constructed, the SCGS would be erected and assembled. The major components for the LMS-100 turbine generator system would be delivered in a staged manner over an approximately 5-month period beginning about Month 14. The construction of the SCGS, from initial delivery of components to completion of the SCGS construction would require approximately 16 months in duration.
- Dry Cooling System: The dry cooling towers would consist of six banks of cooling equipment (one for each turbine) supported by a structural steel base. Each bank would have 11 bays of fans, with 3 fans in each bay. The bays come in one piece and weigh approximately 85,000 lbs each and would require 66 truck deliveries. Roughly 400,000 lbs to 450,000 lbs of structural steel would be needed for the base of each bank, generating about 60 additional truck loads.
- Transformers/Switchyard and Natural Gas Supply: A single step-up transformer would be installed for each pair of generator units of the SCGS. Trenching equipment will be used to construct a new natural gas supply line from the existing gas compressor station located just north of the proposed SCGS site. The construction of the transformers, switchyard, and natural gas supply system would occur concurrently with the erection of the proposed SCGS.
- Start Up and Commissioning: After the SCGS construction is complete but prior to producing electrical energy for distribution to the LADWP service area, the SCGS would undergo a comprehensive commissioning program to evaluate and calibrate the various systems. The commissioning phase of the proposed project would require approximately four months in duration.
- Decommissioning of Units 5 and 6: Within 90 days of completion of the commissioning of the proposed SCGS, LADWP would remove existing Units 5 and 6 from service.

The construction activities are anticipated to require approximately 26 months, including mobilization, component acquisition and fabrication, site preparation, SCGS erection, and system startup and commissioning. Construction-related activities are normally anticipated to occur six days per week, Monday through Saturday, from 7:00 a.m. to 3:30 p.m. To insure that construction activities stay on schedule, two shifts per day may be necessary at times during the construction period, and Sunday shifts may also be required at times. During the course of construction it may be necessary to conduct activities after hours. These activities will be limited to those that do not emit excessive noise or light. To provide conservative estimates for the operating schedule of construction equipment during each phase, it has been assumed that construction equipment will be operated 6 hours per day; and that on-site trucks including pick-up trucks, water trucks, service trucks, and fuel/lube trucks will be operated 4 hours per day.

4.1.1 Criteria Pollutant Emissions

Emissions from construction activities have been quantified using the URBEMIS (version 9.2.4) program. The URBan EMISsions - URBEMIS software model estimates air pollution emissions from a wide variety of land use projects and includes numerous factors associated with industrial projects, including site grading, paving, building construction, worker commute, and vender trips. URBEMIS is approved by CARB and is recommended for use by the SCAQMD in completing a California Environmental Quality Act (CEQA) impact analysis. URBEMIS output files are included in Attachment A.

Emissions associated with construction activities during the project would result from the following activities:

- Site preparation, grading, and related earthwork activities will be conducted over the entire 16-acre site to level existing berms in preparation for construction;
- Pile driving and foundation construction;
- General building construction and equipment installation;
- Commissioning of new equipment;

It is estimated that these activities will occur during the second quarter of 2010 and continue through July 2012. Some of the various tasks listed above may occur concurrently at different locations within the project site as construction of the six CT generators and associated facilities proceed. A conservative operating schedule, equipment list, and numbers of equipment has been used to represent overlapping construction activities. The approximate construction schedule and equipment lists are provided in Table 4.1-1 below. Equipment specifications including maximum brake-horsepower and load factor are provided as default values in URBEMIS. These specifications are provided in Attachment A.

Table 4.1-1: Construction Schedule and Equipment List

Type of Equipment	No. of Equipment	Max. Hrs. of Operation (Hours/day)	Total Hrs. of Operation (Hours/day)
Phase I –Site Preparation and Earthwork 6/1/2010 - 8/30/2010 (~ 3 months)			
Pick-Up Truck	4	4	16
Fuel/Lube Truck	1	4	4
Backhoe Loader	1	6	6
Trackloader	1	6	6
Skiploader	2	6	12
Push Pull Scrapers	2	6	12
Bottom Dump Trucks	2	6	12
Crawler Excavator	1	6	7
Motor Grader	2	6	12
Water Truck	2	4	8
Maximum No. of Equipment Operating (No. of equipment/day) =	18	**Off-site Emission Sources**	
Peak Daily Workers (workers/day) =		40	
Peak Daily Truck Deliveries (avg. deliveries/day) =		3.25	
Phase II – Pile Driving 9/1/2010 - 12/30/2010 (~ 4 months)			
Pick-Up Truck	4	6	24

Table 4.1-1: Construction Schedule and Equipment List			
Fuel Lube Truck	1	6	6
Hydraulic Crane (65-ton)	1	6	6
Dump Truck (30-ton)	2	6	12
48' Flat Bed Truck	3	6	18
Drilling Rig and Pile Hammer	2	6	12
Hydraulic Power Pack	1	6	6
Water Truck	2	4	8
Maximum No. of Equipment Operating (No. of equipment/day) =	16	**Off-site Emission Sources**	
Peak Daily Workers (workers/day) =		120	
Peak Daily Truck Deliveries (avg. deliveries/day) =		8.9	
Phase III – General Construction 1/1/2011 – 4/30/2012 (~ 16 months)			
Pick-Up Truck	1	4	4
1-Ton Flatbed Truck	1	4	4
Forklifts	2	6	12
Fuel/Lube Truck	1	4	4
Service Truck	1	4	4
Crawler Crane	1	6	6
Hydraulic Crane (65-ton)	1	6	6
Hydraulic Crane (45-ton)	1	6	6
Articulating Boom Manlift	2	6	12
Air Compressor	1	6	6
Backhoe Loader	2	6	12
Crawler Excavator	1	6	6
Vibratory Roller	1	6	6
Walk Behind Vibratory Roller	1	6	6
Dump Truck	1	6	6
Motor Grader	1	6	6
Jumping Jack Compactor	1	6	6
Vibratory Plate Compactor	2	6	12
Water Truck	1	4	4
Concrete Pump Truck	2	4	8
Concrete Truck	7	4	28

Table 4.1-1: Construction Schedule and Equipment List			
Welder	2	6	12
Light Plant	2	2	4
Maximum No. of Equipment Operating (No. of equipment/day) =	39	**Off-site Emission Sources**	
Peak Daily Workers (workers/day) =		**270**	
Peak Daily Truck Deliveries (avg. deliveries/ day) =		**25.8**	
Phase IV – Commissioning 5/1/2012 – 7/30/2012 (3 months)			
Pick-Up Truck	4	4	16
Forklift	1	6	6
Maximum No. of Equipment Operating (No. of equipment/day) =	5	**Off-site Emission Sources**	
Peak Daily Workers (workers/day) =		30	
Peak Daily Truck Deliveries (avg. deliveries/ day) =		0	

4.1.2 Criteria Pollutant Impact Analysis

The information in Table 4.1-1 was entered into URBEMIS to calculate peak daily unmitigated emissions. URBEMIS output details are presented in two formats – peak daily emissions by phase, and peak daily emissions by construction year. Estimated emission summaries are presented on Table 4.1-2. Detailed emission outputs are provided in Attachment A.

Table 4.1-2: Estimated Peak Daily Unmitigated Emissions

	VOCs (lbs/day)	NO_x (lbs/day)	CO (lbs/day)	SO_2 (lbs/day)	Total PM_{10} (lbs/day)	Total $PM_{2.5}$ (lbs/day)
Site Preparation and Earthwork (4/1/2010 - 7/30/2010)						
Onsite	10.38	90.87	38.39	--	84.28	20.64
Offsite	0.15	0.28	4.72	0.01	0.04	0.02
Total	10.52	91.15	43.61	0.01	84.32	20.66
Pile Driving and Foundation Building (8/1/2010 – 12/30/2010)						
Onsite	7.36	77.58	24.87	0.00	2.67	2.45
Offsite	0.16	0.68	4.36	0.01	0.06	0.04
Total	7.62	78.26	29.23	0.01	2.72	2.49
General Construction (1/1/2011 – 7/30/2012)						
Onsite	12.69	93.83	45.65	--	5.85	5.38

Table 4.1-2: Estimated Peak Daily Unmitigated Emissions						
	VOCs (lbs/day)	NO_x (lbs/day)	CO (lbs/day)	SO_2 (lbs/day)	Total PM_{10} (lbs/day)	Total $PM_{2.5}$ (lbs/day)
Offsite	1.08	4.75	28.23	0.04	0.41	0.26
Total	13.77	98.59	73.87	0.04	6.25	5.64
Commissioning (8/1/2012 – 10/30/2012)						
Onsite	0.98	10.36	3.69	--	0.38	0.35
Offsite	0.03	0.06	1.13	--	0.01	0.01
Total	1.02	10.42	4.82	--	0.39	0.36

Significance Criteria

SCAQMD has adopted significance criteria thresholds for both operation and construction, as presented in Table 3.3-1. Table 4.1-2 represents the estimated peak daily emissions per project year. The construction thresholds were used to determine the potential impacts from the proposed project.

Table 4.1-3: Peak Daily Unmitigated Emissions – CEQA Significance Threshold Comparison						
	VOCs (lbs/day)	NO_x (lbs/day)	CO (lbs/day)	SO_2 (lbs/day)	Total PM_{10} (lbs/day)	Total $PM_{2.5}$ (lbs/day)
2010 Totals						
Total (Onsite & Offsite)	10.52	91.15	43.61	0.01	84.32	20.66
2011 Totals						
Total (Onsite & Offsite)	13.77	98.59	73.87	0.04	6.25	5.64
2012 Totals						
Total (Onsite & Offsite)	13.01	91.89	70.74	0.04	5.82	5.24
CEQA Significance Threshold (lbs/day)	75	100	550	150	150	55
Exceeds Significance Threshold? (Yes/No)	No	No	No	No	No	No

As shown in Table 4.1-3, the proposed project would not exceed SCAQMD significance thresholds for any criteria pollutant.

Regulatory Control Measures

The SCAQMD has adopted specific regulations geared toward mitigating emissions of VOCs and particulate matter (fugitive dust) during construction activities. SCAQMD Rule 403 *Fugitive Dust,* states that any active operations including demolition, grading, and/or earthmoving activities shall include appropriate best control measures designed to control localized fugitive dust emissions. Best control measures shall include one of the following:

- Watering the site two-three times a day with a water track;
- Application of non-chemical soil stabilizers to unpaved roads or disturbed areas;
- Stabilizing equipment staging areas.

In order to maintain compliant operations during construction, best control measures for fugitive dust shall be implemented during relevant activities (i.e. demolition, grading, earth-moving).

4.1.3 Mitigation Measures

As shown in Table 4.1-3 above, emissions during individual construction phases are not anticipated to exceed the significance thresholds and would have a less than significant air quality impact. Mitigation measures during construction phases are not required.

4.1.4 Turbine Commissioning

The commissioning of the turbines will involve all of the steps from the first fire of the CT through the completion of the CT certification. A maximum of three CTs will be commissioned during a month but only two CTs will be commissioned simultaneously during a month. The CT commissioning schedule was developed by LADWP in support of the SCAQMD *Application for Permit to Construct and Operate Haynes Generation Station Units 11 through 16* (PTC/PTO) prepared for the proposed SCGS at HnGS (LADWP, 2009) through a review of manufacturer's information and CPV Sentinel Project commissioning schedule. Per this commissioning schedule, each CT will be commissioned in a total of 176 hours. The commissioning sequence consists of the following nine phases:

- First Fire of the Unit and then Shutdown to Check Leaks, etc. This phase will last 23 hours and is expected to be completed in one day. It is estimated that natural gas at a rate of 73.5 MMBtu/hr (LHV) will be used during this phase of commissioning.
- Synch and Check E-Stop. This phase will last 17 hours and is expected to be completed in one day. It is estimated that natural gas at a rate of 73.5 MMBtu/hr (LHV) will be used during this phase of commissioning.
- Additional Automatic Voltage Regulator (AVR) Commissioning. This phase will last 17 hours and is expected to be completed in one day. It is estimated that natural gas at a rate of 92.8 MMBtu/hr (LHV) will be used during this phase of commissioning. The CT will run at a power level of 5 percent.
- Break-in Run. This phase will last 12 hours and is expected to be completed in one day. It is estimated that natural gas at a rate of 92.8 MMBtu/hr (LHV) will be used during this phase of commissioning. The CT will run at a power level of 5 percent.
- Dynamic Commissioning of AVR and Commission Water. This phase will be carried out in 10 load steps (load steps 10 percent through 100 percent). Each load step will last for six hours and up to four load steps may be completed in one day. It is estimated that natural gas at rates varying between 166 MMBtu/hr and 798 MMBtu/hr will be used during various load steps of this phase.
- Base Load AVR Commissioning. This phase will last 23 hours and is expected to be completed in one day. It is estimated that natural gas at a rate of 798 MMBtu/hr (LHV) will be used during this phase of commissioning. The CT will run at a power level of 100 percent.

- SCR Testing. This phase will last 12 hours and is expected to be completed in one day. It is estimated that natural gas at a rate of 798 MMBtu/hr (LHV) will be used during this phase of commissioning. The CT will run at a power level of 100 percent.
- Stack/RATA Testing. This phase will last 12 hours and is expected to be completed in one day. It is estimated that natural gas at a rate of 798 MMBtu/hr (LHV) will be used during this phase of commissioning. The CT will run at a power level of 100 percent.

The commissioning emissions for CO, NO_x, and VOC were estimated by LADWP for the PTC/PTO application using the emission data provided by the equipment manufacturer. PM_{10} emissions were estimated using USEPA AP-42 emission factor of 0.6 lb/MMscf. SO_2 in the exhaust is converted to sulfur trioxide (SO_3) in the SCR/CO catalyst system. SO_3 then reacts with ammonia in the SCR system to become ammonium sulfate ($(NH_4)_2SO_4$), which is a particulate matter. This additional particulate matter emission was included in the total PM_{10} emission factor for estimating PM_{10} emissions, where applicable.

Table 4.1-4 presents the commissioning emissions calculated by LADWP for permitting purposes (LADWP, 2009a). Emissions of NOx are higher during commissioning than during normal operations due to the need to test and tune the CTs prior to installation of the SCR to control NO_x. Emissions of CO are also higher than during normal operations because combustor performance would not be optimized and the CO catalyst would not be installed.

Table 4.1-4: Commissioning Emission Rates Per CT

Pollutant	Maximum Hourly Emissions (lb/hr)
NO_x	80.33
CO	197.33
PM_{10}	6.65
VOC	12.00
SO_x	0.61

Table 4.1-5 presents a summary of the estimated maximum daily emissions of criteria pollutants anticipated from turbine commissioning in comparison with the SCAQMD significance criteria for construction. It should be noted that the peak daily emissions presented in the table are calculated assuming two turbines undergoing simultaneous commissioning with the maximum hourly emissions occurring continuously for 12 hours. As shown in the table, emissions during commissioning would exceed the SCAQMD CEQA significance levels for all pollutants except SOx; however it should be noted that the commissioning emissions are temporary short-term events that does not represent the normal operation of the project.

Table 4.1-5: Peak Daily Emissions during Turbine Commissioning

	NO_x	CO	PM_{10}	VOC	SO_x
Maximum Daily Emissions (lbs/day)	1,928	4,736	160	288	14.64
CEQA Significance Threshold	100	550	150	55	150
Significant?	Yes	Yes	Yes	Yes	No

Table 4.1-5: Peak Daily Emissions during Turbine Commissioning					
	NO_x	CO	PM_{10}	VOC	SO_x
Note: Maximum daily emissions calculated as maximum hourly emissions multiplied by 12 for a worst-case estimate. The emissions shown are for two turbines assuming simultaneous commissioning.					

Localized air quality dispersion modeling was performed to determine if emissions during commissioning result in exceedance of the short-term ambient air quality standards. USEPA regulatory model AERMOD (version 07026) was used to model the dispersion of the pollutant emissions. Detailed description of the model selection and other input parameters are discussed in Section 4.2, Project Operation. Detailed dispersion modeling of different commissioning scenarios was conducted by LADWP for short-term NO_x (1-hour) and CO (1-hour and 8-hour) in support of the PTC/PTO application to study the impact of turbine commissioning on local air quality. Table 4.1-6 presents the source parameters pertaining to the different commissioning phases. Based on a thorough review of the source parameters in Table 4.1-6, LADWP identified seven scenarios with the potential to result in high CO and NO_x emissions (phases 2, 5, 6.1, 6.7, 6.8, 6.9, and 6.10). Screening dispersion modeling analysis of these potential seven phases identified commissioning phases 2 and 4 to result in high 1-hour ground level CO and NO_x concentrations respectively.

Table 4.1-6: Source Parameters for Various Phases of Commissioning (1-hour)							
Commissioning Phase	**Number of Turbines**	**CO Emission Rate (g/s)**	**NO_x Emission Rate (g/s)**	**Release Height (m)**	**Stack Temperature (K)**	**Exhaust Velocity (m/s)**	**Stack Diameter (m)**
Commissioning, Phase 2	2	5.725	1.402	27.43	732.59	5.98	4.11
Commissioning, Phase 3	2	5.722	1.393	27.43	732.59	5.98	4.11
Commissioning, Phase 4	2	3.81	2.639	27.43	735.37	8.27	4.11
Commissioning, Phase 5	2	3.811	2.635	27.43	735.37	8.27	4.11
Commissioning, Phase 6.1	2	8.736	2.1	27.43	737.59	10.57	4.11
Commissioning, Phase 6.2	2	5.712	3.108	27.43	714.82	13.87	4.11
Commissioning, Phase 6.3	2	5.712	4.032	27.43	703.15	16.65	4.11
Commissioning, Phase 6.4	2	5.04	4.914	27.43	691.48	19.13	4.11
Commissioning, Phase 6.5	2	4.158	5.796	27.43	683.15	21.48	4.11
Commissioning, Phase 6.6	2	5.67	6.657	27.43	677.59	23.66	4.11
Commissioning, Phase 6.7	2	7.791	7.476	27.43	673.15	25.79	4.11
Commissioning, Phase 6.8	2	11.004	8.358	27.43	673.15	27.8	4.11
Commissioning, Phase 6.9	2	16.254	9.198	27.43	676.48	29.82	4.11
Commissioning, Phase 6.10	2	24.864	10.122	27.43	681.48	31.87	4.11
Commissioning, Phase 7	2	24.843	10.102	27.43	681.48	31.87	4.11
Commissioning, Phase 8	2	24.843	10.101	27.43	681.48	31.87	4.11
Commissioning, Phase 9	2	24.843	10.101	27.43	681.48	31.87	4.11
Table adapted from LADWP PTC/PTO Application to SCAQMD (LADWP 2009). Gas turbine exhaust parameters were based on fuel usage and other parameters provided by the manufacturer.							

Based on the results of the screening analysis, air quality impact analysis was conducted for phase 4 “1-hour” NO_x emissions and phase 2 “1-hour” and “8-hour” CO emissions. Table 4.1-7 shows the predicted concentrations from the dispersion modeling for the worst-case phases. The dispersion modeling results indicate that the worst-case scenario with two CTs operating in the same phase simultaneously do not result in exceedance of the short-term ambient air quality standards for CO and NO_x during the commissioning phase. Thus the commissioning of the CTs will not cause significant air quality impacts. Modeling files are provided in Attachment C.

Table 4.1-7: Commissioning Modeling Results						
Pollutant	**Averaging Period**	**Ambient Air Quality Thresholds[1] (µg/m³)**	**Background Conc.[2] (mg/m³)**	**Maximum Predicted Impact (mg/m³)**	**Total Conc. (mg/m³)**	**Significant?**
NO_2[3]	1-hour	339	263.00	72.65	335.65	No
CO[4]	1-hour	23,000	4600.00	470.98	5070.98	No
	8-hour	10,000	4025.00	262.23	4287.23	No

[1] Ambient Air Quality Thresholds for Criteria Air Pollutants. For attainment pollutants (NO_x, and CO), the predicted results are added to the background concentrations and compared against the stringent of CAAQS or NAAQS. CAAQS is generally either the same or more stringent than NAAQS.

[2] Background concentrations obtained for the Source Receptor Area 4, South Coastal LA County 1, District Station ID 072 (North Long Beach Monitoring Station).

[3] 1-hour NO_2 was modeled for two turbines simultaneously operating in Phase 4. Non-regulatory PVMRM option (NO_x to NO_2 conversion) in AERMOD was selected; 2004 meteorological data produced worst-case concentrations.

[4] 1-hour and 8-hour CO was modeled for two turbines simultaneously operating in Phase 2. Meteorological data for 2006 produced the worst-case results for 1-hour, and meteorological data for 2003 produced worst-case results for 8-hour.

4.2 Project Operation

4.2.1 Criteria Pollutant Emissions

The operation of the proposed SCGS will result in emissions of criteria pollutants and TACs. Potential emission sources of criteria pollutants include the six combustion turbines, the two standby power generators, the diesel fuel storage tanks and the oil and water separators (OWS). The following section details the criteria pollutant emissions from the operation of the SCGS. For the following discussions, the emissions of PM, PM_{10} and $PM_{2.5}$ are considered to be equivalent for the combustion equipment. This is a conservative assumption. Only PM_{10} is called out in the following discussion regarding operational emissions. The TAC emissions from the operation of these sources are presented in Section 4.2.2, TAC Emissions. Detailed emission calculations are presented in Attachment B.

Combustion Turbine

Emissions from the operation of the six proposed LMS100 CTs are affected by several factors, most important being the mode of operation and the ambient meteorological conditions. The emissions from the CTs for different modes of operation including start-up, normal, and shutdown are presented in the following sections.

Start-up Emissions

Start-up emissions begin with each turbine's initial firing and continue until each unit complies with the permitted emission concentration limits. The emissions during start-up are expected to be higher due to lower exhaust gas temperature that results due to the control systems (CO oxidation catalyst and SCR) being not fully functional at lower temperatures. The start-up duration for each of the CTs is about 20 minutes for a cold start and 17 minutes for a hot start as provided by LADWP.

The start-up emissions for CO and VOC were estimated using CPV Sentinel Project emission data as provided in the LADWP PTC/PTO application (LADWP, 2009). Revised NO_x start-up event emissions were estimated by LADWP using revised data from the manufacturer (General Electric (GE)). PM_{10} emissions were estimated using the USEPA AP-42 emission factor of 0.6 lb/MMscf as provided in the LADWP PTC/PTO application. Indirect PM_{10} in the form of ammonium sulfate that is formed as a reaction byproduct of the SO_3 in the exhaust with ammonia within the SCR/CO system is also added to determine the total PM_{10}. SO_x emissions were estimated using the data provided by the manufacturer for the normal operation of the CTs as provided in the LADWP PTC/PTO application. Table 4.2-1 presents the start-up emissions for one CT.

Table 4.2-1: Startup Emission Rates Per CT

Pollutant	Startup Emissions (lb/start)	Startup Emissions (lb/hr)
NO_x - Cold Start	21.01	26.41
NO_x - Hot Start	16.96	22.77
CO	17.82	25.69
PM10	2.96	7.49
VOC	5.17	6.48
SO_x	0.27	0.69

Note: Cold start-up lasts 20 minutes in duration and hot start-up lasts 17 minutes. NO_x event emissions for both cold and hot-starts were provided by LADWP. For all other pollutants, the start-up event emissions (lb/event) are as provided in the PTC/PTO application package (LADWP, 2009). Hourly emissions are calculated using the start-up event emissions for the start-up duration and emissions from normal operation for the remaining duration.

Normal Emissions

Following the startup of the CT, the CT will operate at various load conditions of 50 percent or higher during normal operation. Hourly and annual emissions were calculated at full load (100%) for different temperatures (25°F, 65°F, and 91°F), each temperature representing the minimum recorded temperature, ambient annual mean temperature, and maximum monthly average temperature, respectively (LADWP 2009). Based on this analysis, the worst-case highest hourly emission rates for all criteria pollutants were estimated for a base load operation at 65°F temperature scenario. Table 4.2-2 presents the hourly emissions of the criteria pollutants for the worst-case scenario. The emissions for NO_x, CO, VOC, and SO_x during normal operations were estimated using the emission data provided by the equipment manufacturer. PM_{10} emissions were estimated using the USEPA AP-42 emission factor of 0.6 lb/MMscf. Indirect PM_{10} in the form of ammonium sulfate that is formed as a reaction byproduct of the SO_3 in the exhaust with ammonia within the SCR/CO system is also added to determine the total PM_{10}.

Table 4.2-2: Normal Operation Emissions Per CT	
Pollutant	**Hourly Emissions (lb/hr)**
NO_x	8.1
CO	11.8
PM_{10}	6.8
VOC	1.96
SO_x	0.63

<u>Shutdown Emissions</u>

During the shutdown sequence the turbine will be ramped down from base load to a no fuel-flow condition. The CT will not be parked at intermediate loads during this ramp down process. Shutdown begins with the initiation of the turbine shutdown sequence and ends with the cessation of turbine firing. It is estimated that each shutdown will last approximately ten minutes (10.3 minutes). During the shutdown process, ammonia injection and water injection will be discontinued.

The shutdown emissions for CO and VOC were estimated using the CPV Sentinel Project emission data as provided in the LADWP PTC/PTO application (LADWP, 2009). Revised NO_x shutdown event emissions were estimated by LADWP using revised data from the manufacturer. PM_{10} emissions were estimated using USEPA AP-42 emission factor of 0.6 lb/MMscf and as provided in the LADWP PTC/PTO application. Indirect PM_{10} in the form of ammonium sulfate that is formed as a reaction byproduct of the SO_3 in the exhaust with ammonia within the SCR/CO system is also added to determine the total PM_{10}. SO_x emissions were estimated using the data provided by the equipment manufacturer for the normal operation of the CTs as provided in the LADWP PTC/PTO application. Table 4.2-3 presents the shutdown emissions for one CT.

Table 4.2-3: Shutdown Emission Rates Per CT		
Pollutant	**Shutdown Emissions (lb/shutdown)**	**Shutdown Emissions (lb/hr)**
NO_x	3.97	10.68
CO	35.0	44.77
PM_{10}	0.22	5.85
VOC	3.0	4.62
SO_x	0.02	0.54
Note: Each shutdown hour includes a shutdown event 10.3 minutes in duration and the remaining 49.7 minutes in normal operation.		

Emergency Standby Power Generators

Table 4.2-4 presents the estimated criteria pollutant emissions from the diesel fuel operated standby power generators. The emission data are based on the emission factors reported by SCAQMD for Certified Internal

Combustion Engines for a Caterpillar emergency generator of 3,622 brake horse power (bhp) rating (Model 3516C-DITA - 2,500kW) (SCAQMD, 2008). The LADWP will install either one or two emergency generators as determined by future studies. This analysis assumes that the project will install two 2.5 MW emergency generators. It is expected that the two diesel generators will be tested every month for one hour. The annual emission calculations are based on maximum of 50 hours per year for each generator for routine testing and maintenance operations.

Table 4.2-4: Diesel Fired Standby Generator Emissions

Pollutant	Emission Factor[1]	Emissions (lb/hr)[2]	Annual Emissions (lb/yr)[3]
NO_x	3.7 (g/bhp-hr)	29.55	1,477.3
CO	0.67 (g/bhp-hr)	5.35	267.5
PM_{10}	0.007 (g/bhp-hr)	0.06	2.8
VOC	0.25 (g/bhp-hr)	1.99	99.8
SO_x as SO_2[4]	0.2158 lb/Mgal	0.04	1.87

[1] Emission Factors as reported by SCAQMD for Certified Internal Combustion Engines (July 10, 2008) for a Caterpillar engine, Model 3516C-DITA, 2500 KW (3622 bhp). PM_{10} emission factor represents emission after installation of DPM filter with 90% control efficiency (LADWP, 2009).

[2] Calculated for one hour per month of testing for an engine rating of3622 bhp.

[3] Calculated for testing and maintenance of 50 hours per year.

[4] SO_2 emissions are calculated for a fuel use of 173.3 gal/hr.

Diesel Fuel Storage Tank

A diesel fuel storage tank of 15,000 gallons capacity will be used at the SCGS for storing diesel fuel for the standby power generators. VOC emissions from the diesel fuel storage tank were estimated using USEPA TANKS program (Version 4.0.9d) at 5.48 lb/yr (LADWP, 2009).

Oil/Water Separators

The OWSs will collect potentially oily wastewater from equipment area wash downs. The only potential oil contaminant is expected to be the lubricating oil associated with the CTs. Oil will collect in the OWS and will be removed by vacuum truck before to the oil collection section of OWS reaching capacity. Each OWS will have a capacity of 2,000 gallon per minute (gpm). VOC emissions from the OWS were estimated using USEPA TANKS program (Version 4.0.9d) at 5.27 as provided in the LADWP PTC/PTO application (LADWP, 2009).

4.2.2 Toxic Air Contaminant Emissions

TACs will be emitted during the short-term construction phase and the long-term operational phase of the SCGS from the combustion of fuel in construction equipments, combustion sources, and the release of fugitive emissions from fuel storage tanks. TAC emissions emitted from the construction equipment during construction of the project are not quantified or evaluated due to the short-term nature of construction activities. However, operation of facility will emit numerous TACs which may have a long term impact on the public, and therefore the operational TAC emissions are quantified and evaluated in a HRA.

Potential operational sources of TAC emissions at the HnGS will include six CTs, two standby diesel-fueled power generators, and the diesel fuel storage tank. No TACs are expected to be emitted from the oil/water separators because TACs are not normally present in the products which may drain to the oil/water separator. The TAC emissions were estimated by LADWP for the PTC/PTO application in support of the PTC/PTO application to the SCAQMD (LADWP, 2009).

Combustion Turbines

TAC emissions from the CTs were estimated using emission factors from USEPA AP-42 (Table 3.1-3) for all TACs except formaldehyde, benzene, acrolein, and polycyclic aromatic hydrocarbons (PAHs). Formaldehyde, benzene, and acrolein emission factors are from the Section 3.1 of the Background Document for AP-42. PAH emission factor (speciated TACs) were obtained from the California Air Toxic Emissions Factors (CATEF) (emission factors developed by CARB) database for natural gas-fired combustion turbines with CO/SCR catalysts.

Annual TAC emissions are conservatively based on 8,760 hours of operation (24 hours/day and 365 days/year) of the combustion turbines at annual average temperature of 65°F to vastly overestimate the potential health risk. Fuel consumption will be the highest at this temperature; thus, the estimate TAC emissions are expected to be the maximum. Table 4.2-5 presents the TAC emissions for one CT during normal operations. The fuel usage during most of the commissioning scenario and start-up or shutdown scenario would be lower than during normal operation. Thus, TAC emissions during commissioning, startup or shutdown operations are not presented or evaluated in the HRA.

Table 4.2-5: TAC Emissions Per CT During Normal Operations

TAC	CAS Number	Emission Factor (lb/MMscf)	Emission Factor (lb/MMBtu)	Max. Hourly Emissions (lb/hr)	Annual Emissions[1] (lb/yr)
Ammonia[2]	7664417	NA	NA	6.00E+00	5.26E+04
1,3-Butadiene	106990	4.32E-04	4.30E-07	4.00E-04	3.50E+00
Acetaldehyde	75070	4.02E-02	4.00E-05	3.63E-02	3.18E+02
Acrolein	107028	3.63E-03	3.62E-06	3.30E-03	2.89E+01
Benzene	71432	3.27E-03	3.26E-06	3.00E-03	2.63E+01
Ethylbenzene	100414	3.21E-02	3.20E-05	2.90E-02	2.54E+02
Formaldehyde	50000	3.6IE-01	3.60E-04	3.26E-01	2.86E+03
Propylene Oxide	75569	2.9IE-02	2.90E-05	2.63E-02	2.30E+02
Toluene	108883	1.31E-01	1.30E-04	1.18E-01	1.03E+03
Xylene	1330207	6.43E-02	6.40E-05	5.80E-02	5.08E+02
PAH	1151				

Table 4.2-5: TAC Emissions Per CT During Normal Operations					
TAC	CAS Number	Emission Factor (lb/MMscf)	Emission Factor (lb/MMBtu)	Max. Hourly Emissions (lb/hr)	Annual Emissions[1] (lb/yr)
Benzo(a)anthracene	56556	2.26E-05	2.25E-08	2.04E-05	1.79E-01
Benzo(a)pyrene	50328	1.39E-05	1.38E-08	1.26E-05	1.10E-01
Benzo(b)fluoranthene	205992	1.13E-05	1.I3E-08	1.02E-05	8.94E-02
Benzo(k)fluoranthene	207089	1.I0E-05	1.I0E-08	9.93E-06	8.70E-02
Chrysene	218019	2.52E-05	2.51E-08	2.28E-05	1.99E-01
Diebenz(a,h)anthracene	53703	2.35E-05	2.34E-08	2.12E-05	1.86E-01
Indeno(I,2,3-cd)pyrene	193395	2.35E-05	2.34E-08	2.12E-05	1.86E-01
Napthalene	91203	1.66E-03	1.65E-06	1.50E-03	1.31E+01
Note: Ammonia emissions calculated for exhaust ammonia limit of 5 ppm (LADWP, 2009). Annual emissions are based on 8760 hours of operation.					

Emergency Standby Power Generators

The project proposes to install two emergency standby diesel Compression Ignition (CI) engines (3622 bhp each). Each engine will be operated approximately one hour per month for routine testing and maintenance. SCAQMD Rule 1470 (Requirements for Stationary Diesel Fueled Internal Combustion and Other Compression Ignition Engines), limits the non-emergency operation of new stationary emergency standby diesel fueled CI engines greater than 50 bhp to 50 hours per year. Table 4.2-6 presents the estimated TAC emissions for one diesel-driven Tier-2 standby power generator. For HRA purposes, the annual DPM emissions are estimated for the rule limit of 50 hours per year to overestimate the DPM emissions and consequently the health risk.

Table 4.2-6: DPM Emissions Per Diesel Fired Standby Generator			
Pollutant	Emission Factor (g/bhp-hr)[1]	Emissions/Test (lb/hr)	Annual Emissions (lb/yr)
DPM (PM10)	0.007	0.056	2.79
[1] Emission factor obtained from SCAQMD for Certified Internal Combustion Engines (July 10, 2008) for a Caterpillar engine, Model 3516C-DITA, 2500 KW (3622 bhp) and revised to reflect a control efficiency of 90% from the installation of the diesel particulate filter.			

Diesel Fuel Storage Tanks

The TACs present in the VOC emissions from the diesel fuel storage tank were calculated by LADWP for the PTC/PTO Application (LADWP, 2009). The TACs were calculated using the weight percentage of specific TACs in diesel fuel vapor (IERA, 1999) and the total VOC emissions estimated from the TANKS 4.09d. Table 4.2-7 presents the estimated TAC emissions from the diesel fuel storage tanks.

Table 4.2-7: TAC Emissions from Diesel Fuel Storage Tank			
Toxic Air Contaminant	**CAS Number**	**Emissions (lbs/yr)**	**Emissions (lb/hr)**
Benzene	71432	3.95E-01	4.52E-05
Ethylbenzene	100414	3.84E-02	4.40E-06
Hexane (n-hexane)	110543	1.26E-01	1.44E-05
Naphthalene	91203	5.50E-03	6.30E-07
Toluene	108883	2.25E-01	2.57E-05
Xvlene (mixed isomers)	1330207	1.37E-01	1.56E-05

4.2.3 Criteria Pollutant Operational Impacts

The emissions from the operation of the six turbines and the two engines were estimated and compared against daily mass thresholds and ambient air quality criteria as listed in Table 3.3-1. Maximum daily emissions from the operation of the proposed project were calculated for comparison against the daily mass emissions thresholds for operation. Maximum 1-hour, 8-hour, 24-hour, and annual average emissions were estimated for dispersion modeling to assess localized operational impacts against the ambient air quality thresholds. The following sections present the impacts of the project criteria pollutant emissions.

Daily Mass Emissions

Peak daily emissions were estimated by assuming that the maximum emissions would occur on a day when all six CTs and both standby generators are operated. Though the two diesel generators will not be routine tested on the same day, the analysis assumes both the diesel engines to operate for one-hour on the same day for conservative daily emissions. A reasonable worst-case day was defined by the LADWP as one with a total of 16 startups and shutdowns for the six combustion turbines, one CT with 6 startups (1 cold + 5 hot) and 6 shut downs, and the other 5 CTs with 2 startups (1 cold + 1 hot) and 2 shut downs. Tables 4.2-8 and 4.2-9 present the detailed 24-hour operational scenario for the turbines and corresponding pollutant emissions.

A summary of the resulting net daily mass emissions associated with the project, including shutdown of Units 5 and 6, is shown in Table 4.4-10. This table presents a comparison of the emissions associated with a projected worst-case daily operation of the SCGS versus a worst-case daily operation of Units 5 and 6. Because Units 5 and 6 will be decommissioned and will no longer be operational, there is a net emissions reduction associated with the implementation of the proposed project. The table also compares the net daily mass operational emissions to the SCAQMD criteria pollutant significance thresholds listed in Table 3.3-1. Based on this comparison, the proposed project during a projected worst-case 24-hour operation would result in a reduction in emissions versus a worst-case 24-hour operation of Units 5 and 6 and thus will not result in significant criteria pollutant operational impact.

A summary of operational RECLAIM pollutant emissions (NO_x) is shown in Table 4.4-11. As discussed previously, the significance determination is based on whether direct NO_x emissions, when added to the RECLAIM Annual Allocation (2013) including purchased RECLAIM Trading Credits (RTCs) are greater than the Initial 1994 RECLAIM Allocation plus the non-tradeable credits. Based on this comparison too, the direct NOx emissions from the installation of the CTs would not result in significant NO_x emissions impact**.**

Table 4.2-8: Hourly Operating Profile for One CT and Emissions						
Time	**Unit Output MW**	**NO_x Lb/hr**	**CO Lb/hr**	**PM_{10} Lb/hr**	**VOC Lb/hr**	**SO_2 Lb/hr**
Midnight	0	0.0	0.0	0.0	0.0	0.0
1	0	0.0	0.0	0.0	0.0	0.0
2	0	0.0	0.0	0.0	0.0	0.0
3	0	0.0	0.0	0.0	0.0	0.0
4	0	0.0	0.0	0.0	0.0	0.0
5	Cold Start	26.4	25.7	7.5	6.5	0.7
6	100	8.1	11.8	6.8	2.0	0.6
7	75	6.1	8.9	5.1	1.5	0.5
8	Shut Down	10.7	23.0	5.9	1.8	0.5
9	0	0.0	0.0	0.0	0.0	0.0
10	0	0.0	0.0	0.0	0.0	0.0
11	0	0.0	0.0	0.0	0.0	0.0
12	Hot Start	22.8	25.7	7.5	6.5	0.7
13	100	8.1	11.8	6.8	2.0	0.6
14	100	8.1	11.8	6.8	2.0	0.6
15	100	8.1	11.8	6.8	2.0	0.6
16	100	8.1	11.8	6.8	2.0	0.6
17	100	8.1	11.8	6.8	2.0	0.6
18	100	8.1	11.8	6.8	2.0	0.6
19	80	6.5	9.4	5.4	1.6	0.5
20	70	5.7	8.3	4.8	1.4	0.4
21	60	4.9	7.1	4.1	1.2	0.4
22	60	4.9	7.1	4.1	1.2	0.4
23	60	4.9	7.1	4.1	1.2	0.4
24	Shut Down	10.7	23.0	5.9	1.8	0.5
Daily Emissions per CT (lb/day)		**160.0**	**227.7**	**101.8**	**38.3**	**9.4**

Table 4.2-9: Hourly Operating Profile for 5 CTs and Emissions						
Time	**Unit Output MW**	**NO_x Lb/hr**	**CO Lb/hr**	**PM_{10} Lb/hr**	**VOC Lb/hr**	**SO_2 Lb/hr**
Midnight	Cold Start	26.4	25.7	7.5	6.5	0.7
1	100	8.1	11.8	6.8	2.0	0.6
2	Shut Down	10.7	23.0	5.9	1.8	0.5
3	0	0.0	0.0	0.0	0.0	0.0
4	Hot Start	22.8	25.7	7.5	6.5	0.7
5	100	8.1	11.8	6.8	2.0	0.6
6	Shut Down	10.7	23.0	5.9	1.8	0.5
7	0	0.0	0.0	0.0	0.0	0.0
8	Hot Start	22.8	25.7	7.5	6.5	0.7
9	100	8.1	11.8	6.8	2.0	0.6
10	Shut Down	10.7	23.0	5.9	1.8	0.5
11	0	0.0	0.0	0.0	0.0	0.0
12	Hot Start	22.8	25.7	7.5	6.5	0.7
13	100	8.1	11.8	6.8	2.0	0.6
14	Shut Down	10.7	23.0	5.9	1.8	0.5
15	0	0.0	0.0	0.0	0.0	0.0
16	Hot Start	22.8	25.7	7.5	6.5	0.7
17	100	8.1	11.8	6.8	2.0	0.6
18	Shut Down	10.7	23.0	5.9	1.8	0.5
19	0	0.0	0.0	0.0	0.0	0.0
20	Hot Start	22.8	25.7	7.5	6.5	0.7
21	100	8.1	11.8	6.8	2.0	0.6
22	100	8.1	11.8	6.8	2.0	0.6
23	100	8.1	11.8	6.8	2.0	0.6
24	Shut Down	10.7	23.0	5.9	1.8	0.5
Daily Emissions per CT (lb/day)		**269.1**	**386.4**	**134.5**	**65.5**	**12.4**

Table 4.2-10: Net Overall Daily Operational Emissions					
Source	**Daily Mass Emissions (lbs/day)**				
	NO_x	**CO**	**PM_{10}**	**VOC**	**SO_x**
Combustion Turbine (6 CTs)[1]	1069.31	1873.73	643.64	301.57	59.59
IC Engines[2]	59.09	10.70	0.11	3.99	0.07
Decrease due to shutdown of Unit 5[3]	(779.74)	(6505.82)	(588.62)	(425.98)	(46.47)
Decrease due to shutdown of Unit 6[3]	(449.40)	(5040.00)	(456.00)	(330.00)	(36.00)
Total Decrease due to Units 5 & 6	***(1229.14)***	***(11545.82)***	***(1044.62)***	***(755.98)***	***(82.47)***
Net Total[4]	**(100.75)**	**(9661.39)**	**(400.87)**	**(450.41)**	**(22.81)**
CEQA Significance Threshold	*55*	*550*	*150*	*55*	*150*
RECLAIM Significance Threshold[5]	*10,045*	--	--	--	--
Significant? (Yes/No)	**No**	**No**	**No**	**No**	**No**

[1] Emissions are based on LADWP provided worst-case day operation including a total of 16 startups and shutdowns for all six CTs. One CT is assumed to have 6 startups (1 cold start and 1 hot start) and 6 shutdowns. The other 5 CTs are assumed to have 2 startups (1 cold start and 1 hot start) and 2 shutdowns each. The normal operation load is detailed in Tables 4.2-8 and 4.2-9. For all pollutants except NO_x, cold start-up emissions are used. For NO_x, both cold start and hot start emissions as shown in Table 4.2-1 are used.

[2] Emissions from the operation of 2 diesel engines. One hour operation per engine per day.

[3] CO, PM_{10}, VOC and SO_x daily emissions are based on USEPA AP-42 emission factors. Peak daily emissions are calculated based on a 24-hour period for a maximum permitted fuel use of 3240 MMBtu/hr for Unit 5, and 2510 MMBtu/hr for Unit 6. NO_x emissions are based on CEMS data as provided by LADWP for units 5 and 6.

[4] NO_x threshold based on the original 1994 RTCs allocated to the facility (10,045 lbs/day).

Table 4.2-11: Project RECLAIM NO_x Peak Daily Emissions	
Criteria	**Emissions**
RECLAIM NO_x Emissions (lbs/day)[1]	1,104
2024 RECLAIM NO_x Allocation (lbs/day)[2]	2,378
Total (lbs/day)	3,482
Significance Threshold (lbs/day)[3]	10,045
Significant? (Yes/No)	**No**

[1] Maximum worst-case day emissions from the proposed Project as shown in Table 4.2-8.

[2] The 2013 facility Allocation for NO_x includes purchased RTCs and is converted to pounds per day by dividing by 365 days per year. This value was taken from the Facility Permit to Operate for each site. The value from the column headed NO_x RTC Initially Allocated and NO_x RTC holding were selected.

[3] The significance threshold is based on the original 1994 RTCs allocated to the facility (10,045 lbs/day).

Localized Ambient Air Quality Impact

Criteria pollutant atmospheric modeling was performed to analyze potential localized ambient air quality impacts associated with the proposed project. The results of the dispersion modeling were compared against the Ambient Air Quality Thresholds presented in Table 3.3-1 and as discussed in Section 3.3. Since the SCAB is in attainment for VOC and SOx, modeling for these pollutants is not required. All modeling files are provided in Attachment C.

Dispersion Modeling

The USEPA regulatory dispersion model AERMOD (version 07026) was used to model NO_x, PM_{10}, and CO emission impacts from the proposed project. The methodology used to perform the modeling is in accordance with the generally accepted modeling practices and guidelines of both the USEPA and the SCAQMD. The model was run in the urban mode with the regulatory default options and building downwash for 1-hour and 8-hour averaging periods for CO; 24-hour and annual averaging periods for PM_{10}; and annual averaging period for NO_x. Maximum 1-hour NO_x was modeled under the non-regulatory options using NO_x to NO_2 conversion through the Plume Volume Molar Ratio Method (PVMRM).

Meteorological Data

Five years (2003 through 2007) of meteorological data (surface meteorological data from Long Beach Airport and upper air soundings from San Diego Miramar Naval Air Station) that was used by LADWP for modeling in support of the SCAQMD PTC/PTO application (LADWP, 2009) was also used here. The worst-case years for the different pollutants and their averaging periods were identified by LADWP through a screening dispersion modeling analysis for all five years of meteorological data and a unit emission rate. Based on the results of this analysis presented in PTC/PTO application (LADWP, 2009), the worst-case years for the pollutants were identified and used in the modeling. Table 4.2-10 lists the meteorological years that produced the maximum ground level concentrations for the various averaging periods (compiled from LADWP 2009). The meteorological data selection used in the dispersion modeling was based on Table 4.2-12.

Table 4.2-12: Worst-case Meteorological Year

Pollutant	Averaging Period	Worst-Case Met Year
NO_2	1-hour	2004
	Annual	2006
CO	1-hour	2006
	8-hour	2003
PM_{10}	24-hour	2006
	Annual	2006

Receptors

The network of nested grid receptors that was used in the dispersion modeling is presented below:

- receptors along the perimeter of the HnGS with a spacing of approximately 50 meters,
- receptors spaced 100 meters apart extending from the previous receptors to approximately three kilometers from the property line, and

- receptors spaced 500 meters apart from the previous receptors to approximately two kilometers.

Thus, receptors up to about five kilometers from the facility boundary were selected for the localized impact modeling. No receptors were placed within the HnGS property. All coordinates for sources and receptors were specified in North American Datum (NAD) 83, Universal Transverse Mercator (UTM) Zone 11.

Terrain

Terrain heights for all the receptors were determined from commercially available digital terrain elevations developed by the U.S. Geological Survey (USGS) by using its Digital Elevation Model (DEM). The DEM data provides terrain elevations with 1-meter vertical resolution and 30-meters horizontal resolution based on a UTM coordinate system.

Building Downwash

USEPA's guidance was followed to address the potential influence of structures (located near point emission sources) on the resulting ambient concentrations. The latest building downwash program (BPIP Version 04274) was used to identify the structures required to be included in the AERMOD model and it was used to address the building downwash effect. This building downwash program was also used to estimate the direction-specific building dimensions, which are required as inputs by the AERMOD dispersion model, to address the influence of nearby structures on the ambient concentrations.

Sources

The NOx, CO, and PM_{10} emissions from the operation of the six combustion turbines and the two diesel standby generators were modeled for short-term and annual impacts. Table 4.2-13 shows the emission sources and worst case scenarios modeled for the air quality impact analysis.

Table 4.2-13: Modeled Sources and Scenarios

Pollutant	Averaging Period	Emission Sources Considered for Dispersion Modeling	Worst-case Conditions Considered for Dispersion Modeling
NO_X	1-hr	6 CTs and 2 Diesel ICEs	CTs: Start-up hour (20 minute startup emissions + 40 minutes normal operation emissions)
			ICEs: 1-hour operation of each diesel ICE
NO_X	Annual	6 CTs and 2 Diesel ICEs	CTs: 1476 cold start-up hours and 1476 shutdown hours and the remaining hours in normal operation for each CT (for a total of 8760 hours of annual operation)
			ICEs: 50 hour operation for each ICE.
CO	1-hr	6 CTs and 2 Diesel ICEs	CTs: Shutdown hour (10 minutes shutdown emissions + 50 minutes normal operation emissions)
			ICEs: 1-hour operation of each diesel ICEs
CO	8-hr	6 CTs and 2 Diesel ICEs	CTs: 3 start-up hours, 2 shutdown hours, and 3 normal operation hours
			ICEs: 1-hour operation of each diesel ICEs
PM_{10}	24-hr	6 CTs and 2 Diesel ICEs	CTs: 8 start-up hours, 8 shutdown hours, and 8 normal operation hours
			ICEs: 1-hour operation of each diesel ICEs

Table 4.2-13: Modeled Sources and Scenarios			
Pollutant	**Averaging Period**	**Emission Sources Considered for Dispersion Modeling**	**Worst-case Conditions Considered for Dispersion Modeling**
PM_{10}	Annual	6 CTs and 2 Diesel ICEs	CTs: 1476 cold start-up hours and 1476 shutdown hours and the remaining hours in normal operation for each CT (for a total of 8760 hours of annual operation)
			ICEs: 1-hour operation of each diesel ICEs

Table 4.2-14 shows the modeled emission rates for the combustion turbines and diesel engines. The worst-case 1-hour emission for NO_x occurs during the start-up hour, while the worst-case 1-hour emission for CO occurs during the shutdown scenario (see Tables 4.2-2, 4.2-3, and 4.2-4). The worst-case 8-hour CO emissions were calculated for an 8-hour period with 3 start-up hours, 2 shutdown hours, and the remaining 3 hours in normal operations. The worst-case 24-hour PM_{10} emissions were calculated for a 24-hour period with one startup and the remaining in normal operations. For a worst-case analysis, the two diesel ICEs were assumed to operate concurrently. In reality, the two diesel engines may not be tested simultaneously and their operation could be avoided during the turbine start-up or shut-down hour. As mentioned earlier, for each modeling period, simultaneous operation of all six CTs was assumed to overestimate the impacts.

Table 4.2-14: Short-term Emission Rates for Modeling						
	Emission Rate Per CT (g/s)			**Emission Rate Per Engine (g/s)**		
	1-hr	**8-hr**	**24-hr**	**1-hr**	**8-hr**	**24-hr**
NO_x	3.33	--	--	3.72	--	--
CO	5.64	3.18	--	0.67	0.08	--
PM_{10}	--	--	0.86	--	--	2.93E-04

For the annual NO_x and PM_{10} modeling, for a worst-case analysis, the turbines were each assumed to operate 8760 hours per year, with 1476 start-up hours, 1476 shutdown hours and the remaining in normal operation. This represents an extremely conservative operating scenario as the turbines are not expected to operate continuously for a full year. The diesel engines were assumed to operate a maximum of 50 hours per year each, though they will only be run 12-hours per year for routine testing and operation. Therefore, the predicted impacts from this modeling exercise are conservative; the impacts from actual operation of the SCGS will be lower than the predicted impact results presented here. Table 4.2-15 summarizes the modeled emission rates for the combustion turbine. Modeled stack parameters are presented in Table 4.2-16.

Table 4.2-15: Modeled Emission Rates for the SCGS			
Pollutant	Averaging Period	Emission Rate (g/s)	
		Per CT	Per Engine
NO_2	1-hour	3.33	3.723
	Annual	1.46	0.021
CO	1-hour	5.64	0.674
	8-hour	3.18	0.084
PM_{10}	24-hour	0.86	2.93E-04
	Annual	0.75	4.02E-05

Table 4.2-16: Modeled Stack Parameters				
Source	Stack Height (m)	Stack Diameter (m)	Stack Temp. (K)	Stack Velocity (m/s)
CTs	27.43	4.11	626.9/683.2/667	21.45/32.55/23.05
ICE	22.9	0.51	452.6	5.9
For the CTs the stack temperature and exit velocity are presented for start-up, normal, and shutdown operations.				

Modeling Results

Table 4.2-17 presents the results of the air quality impact analysis. For attainment pollutants NO_x and CO, the maximum predicted impacts due to the operation of the SCGS were added to a representative background concentration for comparison against the CAAQS. For non-attainment pollutant PM_{10}, the modeled concentrations were compared against the significant change threshold as discussed in Section 3.3 and Table 3.3-1. As can be seen from the table below, the emissions due to the operation of the proposed project will not cause or contribute to an exceedance of the AAQS or adopted thresholds.

Table 4.2-17: Air Quality Impact Modeling Results							
Pollutant	Averaging Period	California Ambient Air Quality Thresholds[2] (μg/m^3)	SCAQMD Significant Change Thresholds[3] (μg/m^3)	Background Conc.[1] (μg/m^3)	Maximum Predicted Impact (μg/m^3)	Total Conc. (μg/m^3)	Significant?
NO_2	1-hour[3]	339	-	37.00	197.64	234.64	No
	Annual[4]	57	-	45.20	0.51	45.71	No
CO	1-hour	23,000	-	4600.00	147.39	4747.40	No
	8-hour	10,000	-	4025.00	10.91	4035.91	No
PM_{10}[5]	24-hour	50	2.5	78.00	0.95	-	No

Table 4.2-17: Air Quality Impact Modeling Results							
Pollutant	Averaging Period	California Ambient Air Quality Thresholds[2] ($\mu g/m^3$)	SCAQMD Significant Change Thresholds[3] ($\mu g/m^3$)	Background Conc.[1] ($\mu g/m^3$)	Maximum Predicted Impact ($\mu g/m^3$)	Total Conc. ($\mu g/m^3$)	Significant?
	Annual	20	1	31.10	0.23	-	No

[1] Ambient Air Quality Thresholds for Criteria Air Pollutants. For attainment pollutants (NOx, and CO), the predicted results are added to the background concentrations and compared against the CAAQS; for non-attainment pollutants (PM_{10}), the predicted concentration is compared against the localized SCAQMD significance threshold. PM_{10} significance threshold of 2.5 ug/m^3 is for operations, not be exceeded at any receptor.

[2] Background concentrations obtained for the Source Receptor Area 4, South Coastal LA County 1, District Station ID 072 (North Long Beach Monitoring Station). The background concentration for 1-hr NO_x was taken for the worst-case day and hour for 1-hr predicted NO_x concentration of 114.29 (October 31, 2004 at 10 am).

[3] 1-hour NO_2 was modeled using the PVMRM option in AERMOD. The IC engine emissions were assigned full emission rate for hours between 8.00 am and 5.00 pm, with the remaining of the hours at zero emissions.

[4] The annual NO_x modeling was conducted without PVMRM option. The model predicted maximum annual NO_x concentration (0.65 ug/m^3) was multiplied by USEPA's ambient Ratio method factor of 0.75, to obtain the maximum ground level NO_2 concentration of 0.51 ug/m^3.

[5] The background PM_{10} concentration exceeds CAAQS. The modeled 24-hr PM_{10} concentrations do not exceed SCAQMD localized significant change in air quality concentration of 2.5 ug/m^3 (operation) for 24-hr and 1 ug/m^3 for annual averaging period.

4.2.4 TAC Emissions Impact - Health Risk Assessment

This section presents the results of a refined health risk assessment performed to assess potential public health impacts associated with emissions of TACs from the proposed operation of the SCGS. The HRA is a multi-pathway risk analysis performed using the Hot Spots Analysis Reporting Program (HARP) software package (Version 1.4a) developed by CARB for conducting health risk assessments in California under the Air Toxics Hot Spots Program. The HARP modeling system is a comprehensive health risk assessment tool that contains air emissions, dispersion, and risk analysis modules. The methods used to assess potential human health risks are consistent with those prepared by The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments (OEHHA, 2003) which describes algorithms, exposure methods, and cancer and non-cancer health values needed to perform a HRA under AB2588. This Guidance Manual is generally considered the best available reference for conducting human health risk assessments in California. The HARP software includes the USEPA Industrial Source Complex (ISCST3 version 99155) dispersion model and the latest OEHHA toxicity values.

Risk Definitions and Significance

<u>Cancer Risk</u>

Cancer risk is the probability or chance of contracting cancer over a human life span, which is assumed to be 70 years. Carcinogens are not assumed to have a threshold below which there would be no human health impact. In other words, any exposure to a carcinogen is assumed to have some probability of causing cancer; the lower the exposure, the lower the cancer risk (i.e., a linear, no-threshold model). In assessing public health impacts, cancer risk is the expected incremental increase in cancer cases based on an equally exposed population of individuals, typically expressed as excess cancer cases per million exposed individuals.

State and local regulations have developed cancer risk levels above which a project is considered to have a potential significant impact on public health. California's AB2588 Air Toxic Hot Spots Program and California's Proposition 65, for example, have developed a significance level for incremental cancer risk of 10-in-one-million as the public notification level for TAC emissions from existing sources. The SCAQMD has also established cancer risk significance thresholds for permitting new stationary sources. SCAQMD Rule 1401 allows for an incremental risk of between one-in-one-million (1×10^{-6}) and 10-in-one-million (1×10^{-5}), provided T-BACT is employed. For carcinogenic health impacts, the SCAQMD considers impacts to be significant if the incremental maximum individual cancer risk (MICR) is greater than or equal to 10-in-one-million. The MICR is the highest of either the maximum exposed individual resident (MEIR) or the maximum exposed individual worker (MEIW). Occupational exposures are calculated utilizing shorter exposure assumptions (40 versus 70 years).

<u>Non-Cancer Health Hazard</u>

Non-cancer health effects are characterized as either chronic or acute. In determining potential non-cancer health risks from TAC emissions, it is assumed that there is a dose of the chemical of concern below which there would be no impact on human health. The air concentration corresponding to this dose is called the reference exposure level. Non-cancer health risks are measured in terms of a hazard index (HI), which is the calculated exposure of each contaminant divided by its REL. HIs for those pollutants affecting the same target organ are typically summed, with the resulting totals expressed as HIs for each organ system.

Similar to cancer risk, non-cancer impacts also have determined significance thresholds based on the estimated HI for the project. RELs used in the HI calculations were those published in the California Air Pollution Control Officers Association (CAPCOA) AB2588 Risk Assessment Guidelines (CAPCOA, 1993), and as updated by the OEHHA in the Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values (OEHHA, 2009).

Chronic toxicity is defined as adverse health effects from prolonged chemical exposure. Chronic exposure is one which occurs over a period exceeding 12 percent of a 70-year lifetime. Because chemical accumulation to toxic levels typically occurs slowly, symptoms of chronic effects usually do not appear until long after exposure commences. The lowest no-effect chronic exposure level for a non-cancer TAC is the chronic REL. Below this threshold, the body is capable of eliminating or detoxifying the chemical rapidly enough to prevent its accumulation.

Acute toxicity is defined as adverse health effects caused by a short-term chemical exposure of less than or equal to one hour. For most chemicals, the multi-pathway exposure required to produce acute effects is higher than levels required to cause chronic effects because of the shorter exposure period. Because acute toxicity is predominantly manifested in the upper respiratory system at threshold exposures, all hazard indices are typically summed to calculate the total acute HI.

State and local regulations have developed chronic and acute risk levels above which a project is considered to have a potential significant impact on public health. For non-carcinogenic health impacts, the SCAQMD considers impacts to be significant if incremental HI is greater than or equal to one.

4.2.4.1 Health Risk Assessment Methodology

The HRA contains three quantitative determinations: emission estimation, air dispersion analysis, and health risk characterization. Source emissions of TACs from the proposed SCGS are presented in Section 4.2.2, Toxic Air Contaminant Emissions. Exposure calculations were performed using air dispersion modeling analysis to predict ground-level air concentrations by source. Results of the air modeling exposure predictions were applied to emission estimates along with the respective cancer health risk factors, and chronic and acute non-cancer reference exposure levels for each toxic substance, a health risk characterization was performed to quantify individual health risks associated with predicted levels of exposure. The section pertaining to the dispersion and health risk characterization is presented below.

<u>Health Risk Factors</u>

Chemical substance were evaluated in this analysis using health values that have been approved by OEHHA and ARB for use in facility HRAs conducted for the AB2588 Air Toxics Hot Spots Program (OEHHA, 2003). The chemical substances of concern that are addressed in this HRA are listed in Table 4.2-18, along with their respective published OEHHA health effect values. The table lists the OEHHA-adopted inhalation and oral cancer slope factors, non-cancer acute RELs, and inhalation and oral non-cancer chronic RELs. The cancer potency factors and RELs used are consistent with the current values as determined by OEHHA.

Table 4.2-18: Risk Assessment Health Values for TAC of Concern

Compound		Cancer Risk		Non-cancer Effects	
	Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$	Inhalation Cancer Potency Factor $(mg/kg\text{-}day)^{-1}$	Oral Slope Factor $(\mu g/m^3)^{-1}$	Chronic Inhalation REL $(\mu g/m^3)$	Acute Inhalation REL $(\mu g/m^3)$
Acetaldehyde	2.7E-06	1.0E-02	--	1.4E+02	4.7E+02
Acrolein	--	--	--	3.5E-01	2.5E+00
Ammonia	--	--	--	2.0E+02	3.2E+03
Benzene	2.90E-05	1.0E-01	--	6.0E+01	1.3E+03
1,3-Butadiene	1.7E-04	6.0E-01	--	2.0E+01	--
Diesel Particulate Matter	--	1.1E+00	--	5.0 E+00	--
Ethylbenzene	2.5E-06	8.7E-03	--	2.0E+03	--
Formaldehyde	6.00E-06	2.1E-02	--	9.0E+00	5.5E+01
Hexane	--	--	--	7.0E+03	--
Naphthalene	3.40E-05	1.2E-01	3.4E-05	9.0E+00	--
Propylene oxide	3.7E-06	1.3E-02	--	3.0E+01	3.1E+03
Toluene	--	--	--	3.0E+02	3.7E+04
Xylenes	--	--	--	7.0E+02	2.2E+04
PAHs					
Benzo(a)anthracene	1.1E-04	3.9E-01	1.2E+00	--	--
Benzo(a)pyrene [B(a)P]	1.10E-03	3.9E+00	1.2E+01	--	--
Benzo(b)fluoranthene	1.1E-04	3.9E-01	1.2E+00	--	--
Benzo(k)fluoranthene	1.1E-04	3.9E-01	1.2E+00	--	--
Chrysene	1.1E-05	3.9E-02	1.2E-01	--	--

Table 4.2-18: Risk Assessment Health Values for TAC of Concern					
Compound	Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$	Cancer Risk		Non-cancer Effects	
		Inhalation Cancer Potency Factor $(mg/kg\text{-}day)^{-1}$	Oral Slope Factor $(\mu g/m^3)^{-1}$	Chronic Inhalation REL $(\mu g/m^3)$	Acute Inhalation REL $(\mu g/m^3)$
Dibenz(a,h)anthracene	1.2E-03	4.1E+00	4.1E+00	--	--
Indeno(1,2,3-cd) pyrene	1.1E-04	3.9E-01	1.2E+00	--	--
Source: Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values, OEHHA 2009.					

Emissions Characterization

A discussion of the emission calculation methodology and the estimated emissions from the proposed SCGS and ancillary units is presented in Section 4.2.2, Toxic Air Contaminant Emissions. In summary, the potential TAC emission sources associated with this proposed SCGS include the combustion of natural gas in the six CTs; the combustion of diesel in the two standby diesel generators; and the fugitive emissions from the diesel storage tank. TAC emissions are higher during normal operations of the turbines than during start-up or shutdown due to the increased fuel usage during normal operations. Consequently, the health risk impacts were modeled based on the emissions from normal operations. Emissions during commissioning of the turbines are also not modeled in the HRA as these emissions occur only for a short duration once in the lifetime of the facility. For a conservative health risk characterization, it was assumed that all six combustion turbines would operate throughout the year (8760 hours per year), a scenario that would be highly improbable.

Dispersion Modeling and Exposure Assessment

Concentrations of TAC in ambient air were estimated using the HARP software package (version 1.4a). HARP is a single integrated software package which integrates air dispersion modeling with risk analysis and mapping capabilities. HARP uses the ISCST3 air dispersion model (version 99155) in its dispersion module. ISCST3 accounts for site-specific terrain, meteorological conditions, and emissions parameters (such as stack exit velocities and temperatures) in order to estimate ambient concentrations. Although EPA adopted AERMOD as the guideline air quality model in 2006, the CARB has not yet integrated AERMOD into HARP, the preferred tool for conducting multi-pathway health risk assessment in California. Health risks potentially associated with the estimated concentrations of chemical substances in ambient air were characterized in terms of excess lifetime cancer risks (for substances listed by OEHHA as cancer causing), or comparison with RELs for non-cancer health effects (for substances listed by OEHHA with non-cancer effects). Building downwash for nearby structures was calculated internally by HARP using the USEPA Building Profile Input Program (BPIP) version dated 04112.

Air dispersion analysis was conducted using one year of hourly meteorological data for Anaheim which is the nearest representative meteorological station. The SCAQMD provides pre-processed 1981 meteorological data to use in dispersion modeling. The 1981 Los Alamitos data set included measurements from Los Alamitos surface station (surface wind speeds and directions) and the upper air soundings from the Los Angeles International Airport. The wind-rose for the Los Alamitos station used in this study is presented in Figure 4.2-1.

Terrain elevations were included in the dispersion modeling analysis to evaluate receptors above stack height and above final plume height for point source releases. ISCST3 incorporates both simple and complex terrain algorithms that can be enabled to predict ground-level concentrations at receptors below stack height as well as above stack height. DEM files for the project area were opened in the HARP software package and elevations calculated for all sources, buildings, and receptors. Terrain below source elevation is treated as flat terrain by the dispersion model. The terrain data were obtained from commercially available terrain models and were the same ones that were used by LADWP for air quality modeling in support of the SCAQMD PTC/PTO application.

A network of receptors at 50-meter spacing was used both for the facility fenceline and for a 5 km x 5 km fine grid to locate the region of maximum impact, including potential locations of the maximally exposed individual resident (MEIR) and maximally exposed individual worker (MEIW). In addition, discrete sensitive receptors, locations were a sensitive population segment such as children, elderly, or the infirmed may be exposed were also identified and modeled. Since model-predicted impacts at the property line, at the offsite Cartesian grid receptors, and at the offsite discrete sensitive receptors for a worst-case 70-year exposure scenario showed insignificant risks, discrete residential and worker receptors were not analyzed explicitly. Instead, for health risk evaluation, the location of the maximum individual cancer risk (MICR) determined by HARP for each of the exposure scenarios (resident – 70 year exposure; worker – 40 year exposure; and child – 9 year exposure) was assumed to be the Maximum Exposed Individual Resident (MEIR), or the Maximum Exposed Individual Worker (MEIW). The maximum exposed individual sensitive child (9-year child) receptor was identified from a list of 13 sensitive receptors modeled. All source and receptor locations were represented in UTM coordinate system using NAD 83 for Zone 11.

The ISCST3 dispersion modeling module in HARP was used in the urban mode with model option switches set to non-regulatory default settings, as required by SCAQMD guidance. Because ISCST3 is a single pollutant analysis model, the air dispersion patterns were developed using unit emission rates (1 g/s) for all the emission sources. The output of the ISCST3 modeling analyses was used in the risk assessment module of HARP for characterizing risks. Table 4.2-19 shows the summary of the modeling options selected for the HRA.

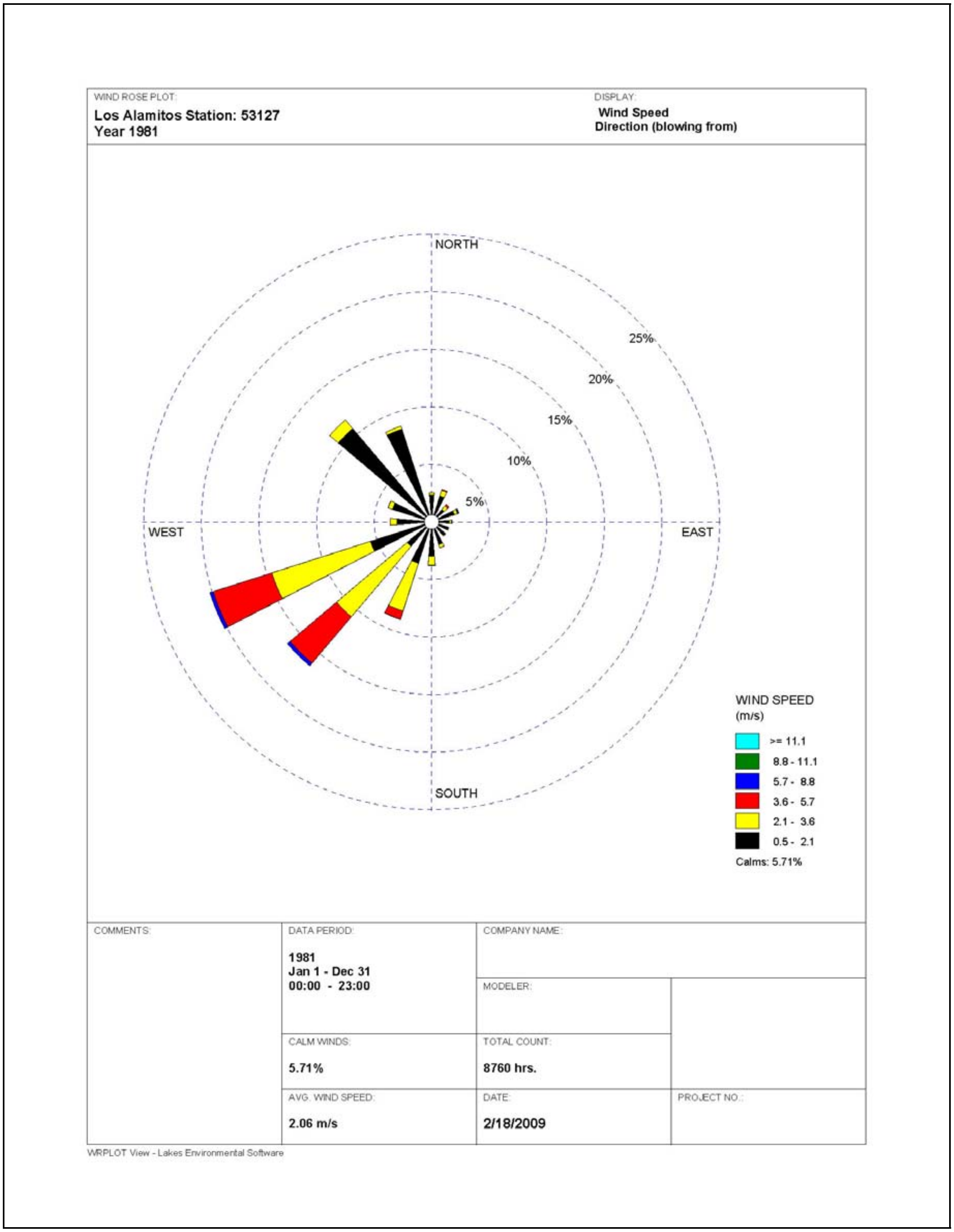
Table 4.2-19: Summary of Modeling Options

Modeling Parameters	Assumption	Comments
Model Control Options		
Use of regulatory default?	No	Calms processing not used
Urban or Rural?	Urban	SCAQMD policy for all air quality impact analyses in its jurisdiction
Gradual Plume Rise?	No	Default
Stack tip downwash?	Yes	Default
Buoyancy induced dispersion?	Yes	Default
Calms processing?	No	Calms processing is inappropriate for SCAQMD meteorological data as ➢ Wind speeds in SCAQMD stations are always 1 m/s or greater and wind direction is always recorded for all wind speeds. ➢ SCAQMD data is site-specific, not NWS data and therefore calms processing is not applicable. ➢ Many sites in the SC Air Basin experience high frequency of calms that correspond with pollutant build-up and therefore this data cannot be eliminated.

Table 4.2-19: Summary of Modeling Options		
Modeling Parameters	**Assumption**	**Comments**
Missing data processing?	No	Default
Source Options		
Include building downwash?	Yes	Default
Lowbound option?	No	Default
Meteorology Options		
Meteorological data	Los Alamitos, 1981	SCAQMD has made available 1981 meteorological datasets for dispersion modeling. The nearest representative meteorological station is chosen for modeling.

Source: Complied from SCAQMD, 2005 (Supplemental Guidelines for Preparing Risk Assessments to Comply with the Air Toxics "Hot Spots" Information and Assessment Act (AB2588))

Figure 4.2-1: 1981 Wind rose for the Los Alamitos Station



Risk Characterization

Carcinogenic, chronic non-carcinogenic and acute health effects were assessed using the dispersion modeling described above and numerical values of toxicity provided by OEHHA.

The HRA evaluated cancer risk and non-cancer health hazards based on the annual average and peak 1-hour ground level concentrations predicted from the dispersion module. Carcinogenic risks and potential non-carcinogenic chronic health effects were calculated using the annual ground level concentrations while the acute non-cancer health hazards were determined using the predicted maximum 1-hour ground level concentrations. The latest OEHHA cancer potency factors, and chronic and acute reference exposure levels (RELs) for each TAC were used (OEHHA, 2009). The approved health values are incorporated into HARP Version 1.4a. The HARP software performs the necessary risk calculations following the OEHHA risk assessment guidelines and the ARB Interim Risk Management Policy for risk management decisions (ARB 2003).

The following HARP modeling options were used for the risk analysis to estimate cancer and non-cancer impacts at the maximum exposed points.

- 70-year Resident Cancer Risk – Derived (Adjusted) Method
- 9-year (Child Resident) Cancer Risk – Derived (OEHHA) Method
- 40-year Worker Cancer Risk – Point Estimate
- Chronic Hazard Index – Derived (OEHHA) Method
- Acute Hazard Index – Simple Acute HI

The modeled exposure pathways consisted of all pathways recommended for a health risk assessment. Exposure pathways that were enabled include homegrown produce (using urban default ingestion fractions), dermal absorption, soil ingestion, and mother's milk in addition to the inhalation pathway. The off-site worker exposure duration assumed a standard work schedule since the facility will operate full time, per OEHHA guidance (OEHHA 2003). Long-term risks (i.e., cancer and chronic non-carcinogenic hazard index) and short-term risk (acute hazard index) were calculated at the property line as well as the offsite Cartesian grid and discrete receptor locations.

4.2.4.2 HRA Results

Table 4.2-20 presents the risk assessment results due to the operation of the proposed SCGS at HnGS. The HRA results show that the cancer and non-cancer impacts from the proposed permit units are below Rule 1401 significant risk thresholds adopted by the SCAQMD. SCAQMD allows for an incremental cancer risk of between one-in-one-million (1×10^{-6}) and 10-in-one-million (with T-BACT). For evaluation of the health risks, the MICR for each exposure scenarios was assumed to be MEIR (70-year), and the MEIW (40-year). The maximum exposed individual sensitive (9-year) receptor was identified from a list of 13 sensitive receptors modeled. Digital modeling files are provided in Attachment D.

Since the cancer risks and non-cancer health effects estimated from the HRA using a 5 km x 5 km fine gird at 50-meter spacing showed insignificant health effects (cancer risk and non-cancer HI below 1), modeling for discrete locations of residential and worker receptors was not conducted. The maximum cancer risk was obtained for the 70-year residential exposure scenario. Therefore for evaluation purposes, the estimated maximum impact for each exposure scenario was assumed to be the MEIR or the MEIW, though the actual use of the location could be residential or commercial or sensitive. This presents the conservative (absolute maximum) estimate of the health effects for each of the exposure scenario. The maximum individual cancer risk and chronic HI for the three exposure scenarios occurred approximately 4 km southeast of the facility and were driven by combustion turbine impacts. The acute HI occurred to the northeast of the facility.

Table 4.2-20: Maximum Predicted Health Risk Impacts			
Receptor/Exposure	**Cancer Risk [1] (Receptor ID)**	**Chronic HI (Receptor ID)**	**Acute HI (Receptor ID)**
MEIR Residential Exposure (grid)	0.28 (8477)	0.0093 (8477)	0.03 (1418)
MEIW Worker Exposure (grid)	0.05 (8374)	0.0093 (8477)	0.03 (1418)
Child			
Child Exposure (grid)	0.07 (8476)	--	--
Child Exposure (discrete)	0.05 (10413)	--	--
Significance Thresholds	**10.0**	**1.0**	**1.0**
Significant (Yes/No)?	**No**	**No**	**No**

[1]Cancer risk is reported in additional cases per one million exposures.

In conclusion, estimated cancer risks at all receptors in the health risk analysis were very low, with a worst-case cancer risk of 0.28-in-one-million for residential 70-year exposure scenario. This estimated cancer risk is significantly lower than the SCAQMD T-BACT threshold 10-in-one-million. The estimated health risks for all exposure scenarios were below the SCAQMD significance criterion of 10-in-one-million for cancer risk and one for non-cancer chronic and acute health impacts. Based on results of the risk assessment, the project poses an insignificant incremental cancer risk and non-cancer health risk impact, according to established regulatory guidelines.

4.3 GHG Emissions and Impact Analysis

Background

Greenhouse gases are defined as any gas that absorbs infrared radiation within the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorocarbons. These greenhouse gases lead to the trapping and buildup of heat in the atmosphere near the earth's surface, commonly known as the "greenhouse effect." The accumulation of greenhouse gases in the atmosphere regulates the earth's temperature. Without natural greenhouse gases, the earth's surface would be cooler. Emissions from human activities such as electricity production and vehicles have elevated the concentration of these gases in the atmosphere. Emissions of greenhouse gases in excess of natural ambient concentrations are thought to be responsible for the enhancement of the greenhouse effect and contribute to what is termed "global warming," a trend of unnatural warming of the earth's natural climate. Unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern, greenhouse gases are global pollutants and climate change is a global issue.

Types of Greenhouse Gases

Water vapor is the most abundant and variable greenhouse gas in the atmosphere. It is not considered a pollutant; in the atmosphere it maintains a climate necessary for life. The main source of water vapor is evaporation from the oceans (approximately 85%). Other sources include evaporation from other water bodies, sublimation (change from solid to gas) from ice and snow, and transpiration from plant leaves (AEP 2007).

Carbon dioxide (CO_2) is an odorless, colorless greenhouse gas. Natural sources include decomposition of dead organic matter; respiration of bacteria, plants, animals, and fungus; evaporation from oceans; and volcanic degassing. Anthropogenic (human caused) sources of carbon dioxide include burning fuels, such as coal, oil, natural gas, and wood. Concentrations are currently around 379 ppm; that may rise to 1,130 CO_2 equivalent (CO_2e) ppm by 2100 as a direct result of anthropogenic sources (IPCC 2007).

Methane is a gas and is the main component of natural gas used in homes. A natural source of methane is from the decay of organic matter. Geological deposits known as natural gas fields contain methane, which is extracted for fuel. Other sources are from decay of organic material in landfills, fermentation of manure and cattle.

Nitrous oxide (N_2O), also known as laughing gas, is a colorless gas. Nitrous oxide is produced by microbial processes in soil and water, including those reactions which occur in fertilizer containing nitrogen. In addition to agricultural sources, some industrial processes (nylon production, nitric acid production) also emit N_2O. It is used in rocket engines, as an aerosol spray propellant, and in race cars. During combustion, NO_x (NO_x is a generic term for mono-nitrogen oxides, NO and NO_2) is produced as a criteria pollutant and is not the same as N_2O. Very small quantities of nitrous oxide (N_2O) may be formed during fuel combustion by reaction of nitrogen and oxygen.

Chlorofluorocarbons are gases formed synthetically by replacing all hydrogen atoms in methane or ethane with chlorine and/or fluorine atoms. Chlorofluorocarbons are nontoxic, nonflammable, insoluble, and chemically nonreactive in the troposphere (the level of air at the earth's surface). Chlorofluorocarbons were first synthesized in 1928 for use as refrigerants, aerosol propellants and cleaning solvents. They destroy stratospheric ozone, therefore their production was stopped as required by the Montreal Protocol. Fluorocarbons have a global warming potential of between 140 and 11,700, with the low end being for HFC-152a and the higher end being for HFC-23. Sulfur hexafluoride (SF_6) is an inorganic, odorless, colorless, nontoxic, nonflammable gas. It has the highest global warming potential of any gas - 23,900. SF_6 is used for insulation in electric power transmission and distribution equipment, in the magnesium industry, in semiconductor manufacturing, and as a tracer gas for leak detection.

Ozone is a greenhouse gas; however, unlike the other greenhouse gases, ozone in the troposphere is relatively short-lived and therefore is not global in nature. According to CARB, it is difficult to make an accurate determination of the contribution of ozone precursors (NO_x and Volatile Organic Compounds) to global warming.

State-wide Regulatory Efforts

In efforts to reduce and mitigate climate change impacts, states and local governments are implementing policies and initiatives aimed at reducing GHG emissions. California, one of the largest state contributors to the national GHG emission inventory, has adopted significant reduction targets and strategies. A brief history of regulations and programs geared towards mitigating and reducing detrimental climate change impacts are represented in Table 4.3-1 below.

Table 4.3-1: California State-wide GHG Policy Progress		
Calendar Year	**Policy**	**Initiative**
1988	AB 4420	California Energy Commissioners began a study of statewide global warming impacts, and developed an inventory of GHG emission sources
2000	SB 1771	Established California Climate Action Registry to allow companies, cities, and government agencies the ability to voluntarily record GHG emissions in anticipation of early reduction credit
2004	AB 1493	CARB enacted and enforced emissions standards that reduced GHG emissions from automobiles
2005	EO S-3-05	Established GHG emission reduction targets through CY 2050 Assigned lead agencies to develop a Climate Action Plan; the Plan developed programs and strategies to meet reduction targets
2006	SB 107 (Renewable Portfolio Standard)	Required investor owned utilities to get 20% of electricity from renewable sources by 2010
2006	AB 1925	Required California Energy Commission to study and make recommendations for capturing and storing industrial CO_2
2006	SB 1368	Required Public Utilities Commission to develop and adopt a GHG emission performance standard for private electric utilities
2006	AB 32 (Global Warming Solutions Act)	Established statewide GHG emission limits, reporting requirements, and a verification procedure to monitor and enforce compliance
2007	SB 97	Required CEQA projects to provide GHG impact analysis; tasked local air districts to help lead and develop significance thresholds and significant impact criteria
2008	CARB Interim Significance Thresholds	CARB developed and proposed significance thresholds for industrial, commercial, and residential projects, final recommendations will be promulgated in 2009

AB 32 Scoping Plan

The California Global Warming Solutions Act, or AB 32, has been implemented to establish specific GHG emission reduction targets as well as monitoring and reporting requirements for businesses and industries state-wide. The first emission reduction target for California is to reduce GHG emissions back to 1990 levels by 2020. In order to achieve this goal, a Climate Action Team was formed and a Scoping Plan was drafted and accepted by the California Air Resources Board. The Scoping Plan describes comprehensive, sector-based strategies and programs tasked with significantly reducing statewide GHG emissions in California.

Sector based strategies will have a direct impact on electricity generators such as Los Angeles Department of Water & Power. Electricity generation is the second largest contributor to the national GHG emission inventory. In 2004, California's energy sector contributed 25 percent of the state's GHG emissions. The Draft Scoping Plan tasks the electricity sector with reducing GHG emissions by 40 percent by 2020. The Plan recommends a multi-faceted approach including aggressive energy efficiency programs and standards, a multi-sector regional cap-and-trade program, and economic incentives for renewable energy development in order to achieve the reduction targets.

California Air Resources Board: Interim Significance Thresholds

In October, 2008, CARB released interim guidance on significance thresholds for industrial and residential projects. The draft proposal for industrial project lists the GHG threshold at 7,000 metric tons of CO_2 equivalent per year (MTCO2e/year) for operational emissions (excluding transportation), and performance standards for construction and transportation emissions. This threshold of significance will result in the vast majority (~90% statewide) of the greenhouse gas (GHG) emissions from new industrial projects being subject to CEQA requirement to impose feasible mitigation.

Greenhouse Gas Significance Thresholds

On December 5, 2008, the SCAQMD Governing Board adopted the staff proposal for an interim GHG significance threshold for projects where the SCAQMD is the lead agency. The SCAQMD interim significance thresholds are designed to reduce greenhouse gas emissions by 90 percent. The interim thresholds provide guidance to existing and future projects required to complete a greenhouse gas impact analysis. Formal methodologies for determining project significance are being developed. SCAQMD has published a five tiered draft GHG threshold approach with bifurcated screening levels. Based on the SCAQMD draft, the Tier 3 industrial development projects such as the Haynes Repowering project have a significance threshold of 10,000 metric tons per year of CO_2 equivalent. If the project exceeds the GHG screening significance threshold level and GHG emissions cannot be mitigated to less than the screening level, the project would move to Tier 4.

SCAQMD recommends mitigation for projects that cause a significant impact to minimize potentially adverse impacts per CEQA Guidelines §15126.4. Because GHG emissions contribute to global change, mitigation measures could be implemented locally, nationally, or internationally and provide global climate change benefits. Because reducing GHG emissions may provide co-benefits through concurrent reductions in criteria pollutants, when considering mitigation measures where the SCAQMD is the lead agency under CEQA, staff recommends mitigation measures that are real, quantifiable, verifiable, and surplus to be selected in the following order of preference.

- Incorporate GHG reduction features into the project design, e.g., increase a boiler's energy efficiency, use materials with a lower global warming potential than conventional materials, etc.
- Implement onsite measures that provide direct GHG emission reductions onsite, e.g., replace onsite combustion equipment (boilers, heaters, steam generators, etc.) with more efficient combustion equipment, install solar panels on the roof, eliminate or minimize fugitive emissions, etc.
- Implement neighborhood mitigation measure projects that could include installing solar power, increasing energy efficiency through replacing low efficiency water heaters with high efficiency water heaters, increasing building insulation, using fluorescent bulbs, replacing old inefficient refrigerators with efficient refrigerators using low global warming potential refrigerants, etc.

- Implement in-district mitigation measures such as any of the above identified GHG reduction measures; reducing vehicle miles traveled through greater rideshare incentives, transit improvements, etc.
- Implement in-state mitigation measures, which could include any of the above measures.
- Implement out of state mitigation measure projects, which may include purchasing offsets if other options are not feasible.

4.3.1 GHG Impacts

Project Construction

CO_2 emissions during construction of the project were estimated using the URBEMIS model. The URBEMIS model quantifies CO_2 emissions from both direct and indirect sources during construction. Direct sources are produced directly at the site, from equipment operation and motor vehicles. Indirect sources are produced offsite, from worker commute trips, vendor trips, delivery trips, etc. Construction activities are scheduled to last approximately 26 months and emission impacts are anticipated to be short term. Table 4.3-2 presents the construction related CO_2 emissions.

Table 4.3-2: Greenhouse Gas Emissions During Construction			
Emission Source	Annual CO_2 Emissions (tons/yr)		
	2010	2011	2012
Direct Emission Sources			
TOTAL	953	2,145	772
		Total Construction Emissions (tons/yr)	3,870
		Total Construction Emissions (MT/yr)	3,510

Project Operation

The operation of the six combustion turbines and the two standby diesel generator engines will result in emissions of GHGs including CO_2, methane, and nitrous oxide. The GHG emissions from the operation of the stationary combustion sources are calculated using emission factors listed in California Climate Action Registry General Reporting Protocol (GRP) (CCAR, 2009) and the maximum usage of the units. The annual natural gas usage for the combustion turbines are estimated based on the predicted operating schedule and maximum fuel consumption rate. The annual diesel usage for each of the standby diesel generator engines are estimated based on fuel consumption rate and the non-emergency routine maintenance operation of 50 hours per year. GHG emissions are not estimated for emergency use of these engines. CO_2 equivalents (CO_2e) are calculated using the global warming potential (GWP) provided in Attachment C of the GRP (CCAR 2009). For example, the GWP of methane is 21 times that of CO_2 and the GWP of N_2O is 310 times that of CO_2. A summary of the net total GHG emissions from the Project, including shutdown of boiler units 5 and 6 is summarized in Table 4.3-3. Because units 5 and 6 will be decommissioned and will no longer be operational, there is a net GHG emissions reduction associated with the shutdown of the units. The GHG emissions from the two boiler units were estimated for an annual operation equivalent to the operational limit of the new turbines (5256 hours per year). Detailed emission calculations are provided in Attachment B.

Table 4.3-3: Summary of GHG Emissions During Operation				
	Emissions (MT/yr)			
Source	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
CT Unit 11	252849	5	0	**253097**
CT Unit 12	252849	5	0	**253097**
CT Unit 13	252849	5	0	**253097**
CT Unit 14	252849	5	0	**253097**
CT Unit 15	252849	5	0	**253097**
CT Unit 16	252849	5	0	**253097**
Standby Generator 1	88	0	0	**88**
Standby Generator 2	88	0	0	**88**
Potential GHG Emission from Current Project	***1517270***	***29***	***3***	***1518758***
Boiler Unit 5	(903,582)	(17)	(2)	**(904,468)**
Boiler Unit 6	(699,997)	(13)	(1)	**(700,683)**
Decrease in GHG due to shutdown of Units 5 & 6	***(1,603,579)***	***(30)***	***(3)***	***(1,605,151)***
Net Total GHG Emissions	**(86,309)**	**(2)**	**(0)**	**(86,393)**

Table 4.3-4 summarizes the annual GHG emissions against the SCAQMD interim significance threshold of 10,000 MT per year of CO2e for industrial projects. A project is considered to have an insignificant impact if the total annual GHG emissions from construction (amortized over 30 years) and operation is less than established threshold. As can be seen from Table 4.3-4, the project will not have a significant GHG impact.

Table 4.3-4: GHG Impact Analysis	
Source	**GHG Emissions (MT/yr)**
Amortized Construction GHG (over a 30 –year period)	117
Net Operational GHG	(86,393)
Total Project GHG	**(86,276)**
SCAQMD Interim GHG Threshold for Industrial Projects	***10,000***
Significant (Yes/No)?	**No**

4.4 Local Impacts - CO Hotspots

Carbon monoxide "hot spots," or areas where CO is concentrated typically occur near congested intersections, parking garages, and other spaces where a substantial number of vehicles remain idle. Petroleum-powered vehicles emit carbon monoxide, an unhealthy gas which disperses based on wind speed, temperature, traffic speeds, local topography, and other variables. As vehicles idle in traffic congestion or in enclosed spaces, CO can accumulate to create CO hot spots that can impact sensitive receptors.

Increases in traffic from a project might lead to impacts of CO emissions on sensitive receptors if the traffic increase worsens congestion on roadways or at intersections. An analysis of these impacts is required if:

- The project is anticipated to reduce the level of service (LOS) of an intersection rated at C or worse by one full level; or
- The project is anticipated to increase the volume-to-capacity (V/C) ratio of an intersection rated D or worse by 0.02.

A short-term increase in traffic to the facility will be unavoidable during the construction of the SCGS. The construction traffic analysis (Section 4.8, Traffic Study) conducted in support of this EIR analyzed nine intersections in the vicinity of the project for *Year 2008 Existing Conditions, Year 2012 "No Project" Conditions*, and *2012 "With Project Construction" Condition*s. The Year 2012 was selected for a conservative analysis since it provides the highest future baseline volumes to determine construction impacts.

The traffic study analysis showed that the project does not decrease the LOS of any intersection rated C or worse by one full level during the peak construction period, or reduce the V/C ratio of any intersection rated LOS E or LOS F by more than 0.020. Consequently, the operation of the project will not have any CO impacts, as the project will not result in any significant traffic increases to the facility as detailed in the Traffic Study. LADWP expects to operate the new units using the existing staff employed at HnGS.

Since peak construction will be a short-term event with temporary impacts, and since the proposed project will not result in any long-term operational impact on the traffic in the area, the project is not expected to cause significant impacts of CO emissions on nearby receptors. Therefore, a CO Hotspots analysis is not conducted for this project.

4.5 Odor Impacts

The SCGS has the potential to result in objectionable odors during construction, with some odors associated with the operation of diesel engines during construction. However, these odors are typical of urbanized environments and would be subject to construction and air quality regulations, including proper maintenance of machinery to minimize engine emissions. These emissions are also of short duration and they are quickly dispersed into the atmosphere. Therefore, the project would not create objectionable odor impacts during construction. The SCGS is not expected to cause any objectionable odors during operation.

4.6 Project Consistency with Air Quality Management Plan

CEQA requires that any inconsistencies between the proposed project and applicable regional and local plans (CEQA Guidelines Section 15125(d)) be addressed in the EIR. The 1997 Air Quality Management Plan (AQMP) and the 1999, 2003, and 2007 amendments to the AQMP demonstrate that the standards can be achieved within the required timeframes. The proposed project is being undertaken for several reasons, but the relevant reason as pertains to the AQMP is to comply with Regulation XX - RECLAIM. Accordingly, projects that comply with SCAQMD rules and regulations are considered consistent with the AQMP.

5.0 References

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Attachment A

Construction Emissions – URBEMIS Outputs

7/21/2009 5:32:00 PM

Urbemis 2007 Version 9.2.4

Summary Report for Annual Emissions (Tons/Year)

File Name: C:\Documents and Settings\SullivanS\My Documents\Haynes 7 13 09 - Revised Construction\Haynes Repower Project Construction Emissions.urb924

Project Name: Haynes Repower Project - Construction Emissions

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5	CO2
2010 TOTALS (tons/year unmitigated)	0.81	7.62	3.22	0.00	3.12	0.31	3.43	0.65	0.28	0.94	953.53
2011 TOTALS (tons/year unmitigated)	2.16	15.43	11.56	0.01	0.03	0.95	0.98	0.01	0.87	0.88	2,145.03
2012 TOTALS (tons/year unmitigated)	0.71	5.14	3.83	0.00	0.01	0.31	0.31	0.00	0.28	0.28	772.83

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Urbemis 2007 Version 9.2.4

Detail Report for Annual Construction Unmitigated Emissions (Tons/Year)

File Name: C:\Documents and Settings\SullivanS\My Documents\Haynes 7 13 09 - Revised Construction\Haynes Repower Project Construction Emissions.urb924

Project Name: Haynes Repower Project - Construction Emissions

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES (Annual Tons Per Year, Unmitigated)

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10 Total	PM2.5 Dust	PM2.5 Exhaust	PM2.5 Total	CO2
2010	0.81	7.62	3.22	0.00	3.12	0.31	3.43	0.65	0.28	0.94	953.53
Mass Grading 06/01/2010-08/30/2010	0.41	3.55	1.70	0.00	3.12	0.17	3.29	0.65	0.15	0.81	392.93
Mass Grading Dust	0.00	0.00	0.00	0.00	3.12	0.00	3.12	0.65	0.00	0.65	0.00
Mass Grading Off Road Diesel	0.40	3.54	1.52	0.00	0.00	0.17	0.17	0.00	0.15	0.15	371.10
Mass Grading On Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Grading Worker Trips	0.01	0.01	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.83
Asphalt 09/01/2010-12/30/2010	0.40	4.07	1.52	0.00	0.00	0.14	0.14	0.00	0.13	0.13	560.60
Paving Off-Gas	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	0.38	4.03	1.29	0.00	0.00	0.14	0.14	0.00	0.13	0.13	531.68
Paving On Road Diesel	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.04
Paving Worker Trips	0.01	0.01	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.87
2011	2.16	15.43	11.56	0.01	0.03	0.95	0.98	0.01	0.87	0.88	2,145.03
Building 01/01/2011-04/30/2012	2.16	15.43	11.56	0.01	0.03	0.95	0.98	0.01	0.87	0.88	2,145.03
Building Off Road Diesel	1.99	14.69	7.14	0.00	0.00	0.92	0.92	0.00	0.84	0.84	1,528.91
Building Vendor Trips	0.04	0.51	0.37	0.00	0.00	0.02	0.02	0.00	0.02	0.02	99.87
Building Worker Trips	0.12	0.23	4.05	0.01	0.02	0.01	0.04	0.01	0.01	0.02	516.25

2012	0.71	5.14	3.83	0.00	0.01	0.31	0.31	0.00	0.28	0.28	772.83
Building 01/01/2011-04/30/2012	0.67	4.73	3.64	0.00	0.01	0.29	0.30	0.00	0.27	0.27	705.84
Building Off Road Diesel	0.62	4.51	2.29	0.00	0.00	0.28	0.28	0.00	0.26	0.26	503.12
Building Vendor Trips	0.01	0.15	0.11	0.00	0.00	0.01	0.01	0.00	0.01	0.01	32.86
Building Worker Trips	0.04	0.07	1.24	0.00	0.01	0.00	0.01	0.00	0.00	0.01	169.86
Trenching 05/01/2012-07/30/2012	0.04	0.41	0.19	0.00	0.00	0.01	0.02	0.00	0.01	0.01	66.99
Trenching Off Road Diesel	0.04	0.40	0.14	0.00	0.00	0.01	0.01	0.00	0.01	0.01	60.93
Trenching Worker Trips	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.06

Phase Assumptions

Phase: Mass Grading 6/1/2010 - 8/30/2010 - Earthwork activities will be conducted for ~ 3 months

Total Acres Disturbed: 16.02

Maximum Daily Acreage Disturbed: 4

Fugitive Dust Level of Detail: Default

20 lbs per acre-day

On Road Truck Travel (VMT): 0

Off-Road Equipment:

1 Excavators (168 hp) operating at a 0.57 load factor for 6 hours per day

2 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day

2 Off Highway Trucks (479 hp) operating at a 0.57 load factor for 6 hours per day

5 Other Equipment (190 hp) operating at a 0.62 load factor for 4 hours per day

2 Scrapers (313 hp) operating at a 0.72 load factor for 6 hours per day

4 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day

2 Water Trucks (189 hp) operating at a 0.5 load factor for 4 hours per day

Phase: Trenching 5/1/2012 - 7/30/2012 - Equipment commissioning will be conducted for ~ 3 months

Off-Road Equipment:

1 Forklifts (145 hp) operating at a 0.3 load factor for 6 hours per day

4 Other Equipment (190 hp) operating at a 0.62 load factor for 4 hours per day

Phase: Paving 9/1/2010 - 12/30/2010 - Pile driving will be conducted for ~ 4 months

Acres to be Paved: 4

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Off-Road Equipment:

2 Bore/Drill Rigs (291 hp) operating at a 0.75 load factor for 6 hours per day

1 Cranes (399 hp) operating at a 0.43 load factor for 6 hours per day

2 Off Highway Trucks (479 hp) operating at a 0.57 load factor for 6 hours per day

8 Other Equipment (190 hp) operating at a 0.62 load factor for 6 hours per day

1 Signal Boards (15 hp) operating at a 0.78 load factor for 6 hours per day

2 Water Trucks (189 hp) operating at a 0.5 load factor for 3 hours per day

Phase: Building Construction 1/1/2011 - 4/30/2012 - General construction will be conducted for ~ 16 months

Off-Road Equipment:

2 Aerial Lifts (60 hp) operating at a 0.46 load factor for 6 hours per day

1 Air Compressors (106 hp) operating at a 0.48 load factor for 6 hours per day

3 Cranes (399 hp) operating at a 0.43 load factor for 6 hours per day

1 Excavators (168 hp) operating at a 0.57 load factor for 6 hours per day

1 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day

1 Off Highway Trucks (479 hp) operating at a 0.57 load factor for 6 hours per day

6 Other Equipment (190 hp) operating at a 0.62 load factor for 4 hours per day

7 Paving Equipment (104 hp) operating at a 0.53 load factor for 6 hours per day

3 Plate Compactors (8 hp) operating at a 0.43 load factor for 6 hours per day

2 Rollers (95 hp) operating at a 0.56 load factor for 6 hours per day

2 Rough Terrain Forklifts (93 hp) operating at a 0.6 load factor for 6 hours per day

2 Signal Boards (15 hp) operating at a 0.78 load factor for 2 hours per day

2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day

2 Welders (45 hp) operating at a 0.45 load factor for 6 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 4 hours per day

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Urbemis 2007 Version 9.2.4

Summary Report for Summer Emissions (Pounds/Day)

File Name: C:\Documents and Settings\SullivanS\My Documents\Haynes 7 13 09 - Revised Construction\Haynes Repower Project Construction Emissions.urb924

Project Name: Haynes Repower Project - Construction Emissions

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10	PM2.5 Dust	PM2.5 Exhaust	PM2.5	CO2
2010 TOTALS (lbs/day unmitigated)	10.52	91.15	43.61	0.01	80.03	4.29	84.32	16.72	3.95	20.66	10,780.75
2011 TOTALS (lbs/day unmitigated)	13.77	98.59	73.87	0.04	0.18	6.07	6.25	0.06	5.58	5.64	13,706.25
2012 TOTALS (lbs/day unmitigated)	13.01	91.89	70.74	0.04	0.18	5.64	5.82	0.06	5.18	5.24	13,705.68

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Urbemis 2007 Version 9.2.4

Detail Report for Summer Construction Unmitigated Emissions (Pounds/Day)

File Name: C:\Documents and Settings\SullivanS\My Documents\Haynes 7 13 09 - Revised Construction\Haynes Repower Project Construction Emissions.urb924

Project Name: Haynes Repower Project - Construction Emissions

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES (Summer Pounds Per Day, Unmitigated)

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10 Total	PM2.5 Dust	PM2.5 Exhaust	PM2.5 Total	CO2
Time Slice 6/1/2010-8/30/2010 Active Days: 78	10.52	91.15	43.61	0.01	**80.03**	4.29	**84.32**	**16.72**	3.95	**20.66**	10,075.15
Mass Grading 06/01/2010-08/30/2010	10.52	91.15	43.61	0.01	80.03	4.29	84.32	16.72	3.95	20.66	10,075.15
Mass Grading Dust	0.00	0.00	0.00	0.00	80.00	0.00	80.00	16.71	0.00	16.71	0.00
Mass Grading Off Road Diesel	10.38	90.87	38.89	0.00	0.00	4.28	4.28	0.00	3.93	3.93	9,515.37
Mass Grading On Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Grading Worker Trips	0.15	0.28	4.72	0.01	0.03	0.02	0.04	0.01	0.01	0.02	559.78
Time Slice 9/1/2010-12/30/2010 Active Days: 104	7.62	78.26	29.23	0.01	0.03	2.70	2.72	0.01	2.48	2.49	10,780.75
Asphalt 09/01/2010-12/30/2010	7.62	78.26	29.23	0.01	0.03	2.70	2.72	0.01	2.48	2.49	10,780.75
Paving Off-Gas	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving Off Road Diesel	7.36	77.58	24.87	0.00	0.00	2.67	2.67	0.00	2.45	2.45	10,224.66
Paving On Road Diesel	0.03	0.43	0.17	0.00	0.00	0.02	0.02	0.00	0.02	0.02	58.52
Paving Worker Trips	0.13	0.25	4.19	0.01	0.02	0.01	0.04	0.01	0.01	0.02	497.58
Time Slice 1/1/2011-12/31/2011 Active Days: 313	**13.77**	**98.59**	**73.87**	**0.04**	0.18	**6.07**	6.25	0.06	**5.58**	5.64	**13,706.25**
Building 01/01/2011-04/30/2012	13.77	98.59	73.87	0.04	0.18	6.07	6.25	0.06	5.58	5.64	13,706.25
Building Off Road Diesel	12.69	93.83	45.65	0.00	0.00	5.85	5.85	0.00	5.38	5.38	9,769.39
Building Vendor Trips	0.28	3.25	2.35	0.01	0.02	0.13	0.16	0.01	0.12	0.13	638.12
Building Worker Trips	0.80	1.50	25.88	0.03	0.16	0.09	0.25	0.06	0.08	0.13	3,298.73

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Time Slice 1/2/2012-4/30/2012 Active Days: 103	13.01	91.89	70.74	**0.04**	0.18	5.64	5.82	0.06	5.18	5.24	13,705.68
Building 01/01/2011-04/30/2012	13.01	91.89	70.74	0.04	0.18	5.64	5.82	0.06	5.18	5.24	13,705.68
Building Off Road Diesel	12.03	87.61	44.50	0.00	0.00	5.43	5.43	0.00	5.00	5.00	9,769.39
Building Vendor Trips	0.26	2.90	2.17	0.01	0.02	0.12	0.14	0.01	0.11	0.12	638.13
Building Worker Trips	0.73	1.37	24.07	0.03	0.16	0.09	0.25	0.06	0.08	0.13	3,298.16
Time Slice 5/1/2012-7/30/2012 Active Days: 78	1.02	10.42	4.82	0.00	0.01	0.38	0.39	0.00	0.35	0.35	1,717.61
Trenching 05/01/2012-07/30/2012	1.02	10.42	4.82	0.00	0.01	0.38	0.39	0.00	0.35	0.35	1,717.61
Trenching Off Road Diesel	0.98	10.36	3.69	0.00	0.00	0.38	0.38	0.00	0.35	0.35	1,562.18
Trenching Worker Trips	0.03	0.06	1.13	0.00	0.01	0.00	0.01	0.00	0.00	0.01	155.43

Phase Assumptions

Phase: Mass Grading 6/1/2010 - 8/30/2010 - Earthwork activities will be conducted for ~ 3 months

Total Acres Disturbed: 16.02

Maximum Daily Acreage Disturbed: 4

Fugitive Dust Level of Detail: Default

20 lbs per acre-day

On Road Truck Travel (VMT): 0

Off-Road Equipment:

1 Excavators (168 hp) operating at a 0.57 load factor for 6 hours per day

2 Graders (174 hp) operating at a 0.61 load factor for 6 hours per day

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4 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day

2 Water Trucks (189 hp) operating at a 0.5 load factor for 4 hours per day

Phase: Trenching 5/1/2012 - 7/30/2012 - Equipment commissioning will be conducted for ~ 3 months

Off-Road Equipment:

1 Forklifts (145 hp) operating at a 0.3 load factor for 6 hours per day

4 Other Equipment (190 hp) operating at a 0.62 load factor for 4 hours per day

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Phase: Paving 9/1/2010 - 12/30/2010 - Pile driving will be conducted for ~ 4 months

Acres to be Paved: 4

Off-Road Equipment:

2 Bore/Drill Rigs (291 hp) operating at a 0.75 load factor for 6 hours per day

1 Cranes (399 hp) operating at a 0.43 load factor for 6 hours per day

2 Off Highway Trucks (479 hp) operating at a 0.57 load factor for 6 hours per day

8 Other Equipment (190 hp) operating at a 0.62 load factor for 6 hours per day

1 Signal Boards (15 hp) operating at a 0.78 load factor for 6 hours per day

2 Water Trucks (189 hp) operating at a 0.5 load factor for 3 hours per day

Phase: Building Construction 1/1/2011 - 4/30/2012 - General construction will be conducted for ~ 16 months

Off-Road Equipment:

2 Aerial Lifts (60 hp) operating at a 0.46 load factor for 6 hours per day

1 Air Compressors (106 hp) operating at a 0.48 load factor for 6 hours per day

3 Cranes (399 hp) operating at a 0.43 load factor for 6 hours per day

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2 Rollers (95 hp) operating at a 0.56 load factor for 6 hours per day

2 Rough Terrain Forklifts (93 hp) operating at a 0.6 load factor for 6 hours per day

2 Signal Boards (15 hp) operating at a 0.78 load factor for 2 hours per day

2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day

2 Welders (45 hp) operating at a 0.45 load factor for 6 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 4 hours per day

Attachment B

Operational Emissions

Table 1: Haynes Equipment Summary		
LMS100 Combustion Turbine		
No. of CTs =	6	
Heat Input to CT, LHV =	816.8	MMBtu/hr
Heat Input to CT, HHV = MMBTU/hr LHV x 1.11	906.6	MMBtu/hr
Natural Gas Heating Value, LHV =	904	Btu/scf
Natural Gas Heating Value, HHV =	1004	Btu/scf
Hourly Fuel use =	0.903	MMscf/hr
Annual Fuel Use =	4746.4	MMscf/yr
Annual Operating Limit (Normal Operations) =	5256	hrs/yr
Duration of cold start-up =	20	minutes
Duration of hot start-up =	17	minutes
Duration of shut-down =	10.3	minutes
No. of SU/SD in a year =	1476	events
Total Annual Operation (Normal +SU+SD) =	6001	hours/year
Standby Diesel Generators		
No. of Generators =	2	
Diesel engine output =	3,622	bhp
Maximum Annual Hours of Operation =	50	hrs/yr
Hourly Fuel use =	173.30	gal/hr
Annual Fuel Use =	8,665.00	gal/yr
Existing Steam Boilers		
Heat Input of Boiler 5	3240	MMBtu/hr
Heat Input of Boiler 6	2510	MMBtu/hr

Table 2: Mercury 50 Hourly Emission Calculations During Normal Operations			
Pollutant	**Emission Factor**	**Emission Factor Units**	**Maximum Hourly (lb/hr)**
NOx	--	--	8.10
CO	--	--	11.80
PM10	0.0066	lb/MMBtu	5.98
PM10 Conversion from SO2	--	--	0.80
PM10 (Total)[1]	--	--	6.8
VOC	--	--	1.96
SO2	--	--	0.63

[1]Total PM10 Emissions inlcude both direct emissions from CT using AP-42 factor of 0.0066 lb/MMBTU and indirect PM10 formed by the conversion of SO2 in the exhaust to sulfur trioxide (SO3) in the SCR/CO catalyst system, which then interacts with ammonia to form ammonium sulfate which is a particulate matter.

Table 3: LMS100 Hourly Emission Calculations During Startup			
Pollutant	**Total Emissions During Startup (lb/event)**	**Duration of Startup (min)**	**Maximum Hourly (lb/hr)**
NOx- Cold SU	21.01	20	26.41
NOx- Hot SU	16.96	17	22.77
CO	17.82	20	25.69
PM10	2.96	20	7.49
VOC	5.17	20	6.48
SO2	0.27	20	0.69

Note: Cold start-up lasts 20 minutes in duration and hot start-up lasts 17 minutes. NOx event emissions for both cold and hot-starts were provided by LADWP. For all other pollutants, the start-up event emissions (lb/event) are as provided in the PTC/PTO application package (LADWP, 2009a). Hourly emissions are calculated using the start-up event emissions for the start-up duration and emissions from normal operation for the remaining duration.

Table 4: LMS100 Hourly Emission Calculations During Shutdown			
Pollutant	**Total Emissions During Shutdown (lb/event)**	**Duration of Shutdown (min)**	**Maximum Houly Rate (2) (lb/hr)**
NOx	3.97	10	10.68
CO	35.00	10	44.77
PM10	0.22	10	5.85
VOC	3.00	10	4.62
SO2	0.02	10	0.54

Note: Emissions per start-up event obtained from PTC/PTO application (LADWP, 2009). Each shutdown is 10.3 minutes.

Table 5: Emissions from One Diesel Standby Power Generator				
Pollutant	Emission Factor[1]	Units	Hourly Emissions[2] (lb/hr)	Annual Emissions[3] (lb/yr)
NOx	3.70	g/bhp-hr	29.545	1477.23
CO	0.67	g/bhp-hr	5.350	267.50
PM10	0.007	g/bhp-hr	0.056	2.79
VOC	0.25	g/bhp-hr	1.996	99.81
SO2[4]	0.2158	lbs/Mgal	0.037	1.87

[1] Emission Factors as reported by SCAQMD for Certified Internal Combustion Engines (July 10, 2008) for a Caterpillar engine, Model 3516C-DITA, 2500 KW (3622 bhp). PM_{10} emission factor represents emission after installation of DPM filter with 90% control efficiency (LADWP, 2009).

[2] Calculated for one hour per month of testing for an engine rating of3622 bhp.

[3] Calculated for testing and maintenance of 50 hours per year.

[4] SO_2 emissions are calculated for a fuel use of 173.3 gal/hr.

Table 6: Diesel Storage Tanks VOC Emissions			
	Daily Loss	Annual Loss	Annual Loss
	(lb/day)	(lb/yr)	(ton/yr)
Working Loss	0.0052	1.88	0.00094
Breathing Loss	0.0099	3.6	0.0018
Total Loss	**0.015**	**5.48**	**0.00274**
Note: Emissions are estimated using Tanks 4.0.9d for a 15,000 gallon horizontal Diesel Fuel Storage Tank			
Meterological Data used in Emissions Calculations: Long Beach, California (Avg Atmospheric Pressure = 14.7 psia.			
Input Data			
Parameter	**Values**		
Tank diameter	10	ft	
Tank length	25.5	ft	
Volume	15,000	gallons	
Turnovers	5	turnovers/year	
Throughput	75,000	gallons/yr	
Heated	No		
Undergournd	No		
Paint Color	White		
Paint Condition	Good		
Location of Weather Data	Long Beach		
Vacuum Setting	0	No vent valve	
Pressure Setting	0	No vent valve	
Material Stored	Diesel Fuel/Distillate Fuel No. 2		
Source: LADWP, 2009 (PTC/PTO Application for Haynes)			

Table 7: TAC Emission Calculations					
Pollutant	CAS	Emission Factor[1]		Emission Rate	
		(lb/MMscf)	(lb/MMBtu)	Maximum Hourly (lb/hr)	Maximum Annual Average (lb/yr)
Ammonia[2]	7664417	NA	NA	6.00E+00	5.26E+04
1,3-Butadiene	106990	4.32E-04	4.30E-07	4.00E-04	3.50E+00
Acetaldehyde	75070	4.02E-02	4.00E-05	3.63E-02	3.18E+02
Acrolein	107028	3.63E-03	3.62E-06	3.30E-03	2.89E+01
Benzene	71432	3.27E-03	3.26E-06	3.00E-03	2.63E+01
Ethylbenzene	100414	3.21E-02	3.20E-05	2.90E-02	2.54E+02
Formaldehyde	50000	3.61E-01	3.60E-04	3.26E-01	2.86E+03
Propylene Oxide	75569	2.91E-02	2.90E-05	2.63E-02	2.30E+02
Toluene	108883	1.31E-01	1.30E-04	1.18E-01	1.03E+03
Xylenes	1330207	6.43E-02	6.40E-05	5.80E-02	5.08E+02
Benzo(a)anthracene	56556	2.26E-05	2.25E-08	2.04E-05	1.79E-01
Benzo(a)pyrene	50328	1.39E-05	1.38E-08	1.26E-05	1.10E-01
Benzo(b)fluoranthene	205992	1.13E-05	1.13E-08	1.02E-05	8.94E-02
Benzo(k)fluoranthene	207089	1.10E-05	1.10E-08	9.93E-06	8.70E-02
Chrysene	218019	2.52E-05	2.51E-08	2.28E-05	1.99E-01
Diebenz(a,h)anthracene	53703	2.35E-05	2.34E-08	2.12E-05	1.86E-01
Indeno(1,2,3-cd)pyrene	193395	2.35E-05	2.34E-08	2.12E-05	1.86E-01
Naphthalene	91203	1.66E-03	1.65E-06	1.50E-03	1.31E+01
Notes:					
1 AP-42 Section 3.1, Table 3.1-3 dated April 2000.					
2 Ammonia emissions calculated for exhaust ammonia limit of 5 ppm (LADWP, 2009)					
Hourly Fuel flow rate (MMscf/hr)	0.903	MMscf/hr			
Approx. Annual Operating Hours	8760	hours/year			

Table 8: DPM Emissions Per Diesel Fired Standby Generator				
Pollutant	CAS	Emission Factor (g/bhp-hr)1	Maximum Hourly EMissions (lb/hr)[2]	Annual Emissions (lb/yr)[3]
DPM	9901	0.007	0.056	2.79
			Engine rating (bhp)	3622

[1]Emission Factor obtained from SCAQMD for Certified Internal Combustion Engines (July 10, 2008) for a Caterpillar engine, Model 3516C-DITA, 2500 KW (3622 bhp) engine. PM10 emission factor shown in table is after applyin a 90% control on the engine. The uncontrolled emission factor reported is 0.07 g/bhp-hr.

[2]Calculated for 1hour/month testing, and engine rating of3622 bhp per engine.

[3]Calculated for testing and maintenance of 50 hours per year per engine.

Table 9: TAC Emissions from Diesel Storage Tanks			
TAC	**CAS**	**Annual Emissions (lbs/yr)**	**Maximum Hourly Emissions (lb/hr)**
Benzene	71432	3.95E-01	4.51E-05
Ethylbenzene	100414	3.84E-02	4.38E-06
Hexane	110543	1.26E-01	1.44E-05
Naphthalene	91203	5.50E-03	6.30E-07
Toluene	108883	2.25E-01	2.57E-05
Xylene	1330207	1.37E-01	1.56E-05

Note: Annual Emissions for each TAC are calculated as the percentage of the TAC in the toal VOC emissions. The weight percentage of each TAC in vapor phase is shown below. Annual VOC emissions are estimated using TANKS 4.09d program (LADWP, 2009a).

Total VOC Emissions from Diesel Fuel Tank	5.48	lb/yr
TAC	**Weight Percent in Vapor Phase**	
Benzene in Diesel Fuel Vapor	7.20	% wt
Ethylbenzene in Diesel Fuel Vapor	0.70	% wt
n-Hexane in Diesel Fuel Vapor	2.30	% wt
Naphthalene in Diesel Fuel Vapor	0.10	% wt
Toluene in Diesel Fuel Vapor	4.10	% wt
Xylene in Diesel Fuel Vapor	2.50	% wt

The weight percentages were obtained from "Air Emissiosn Inventory Guidance Document for Stationary Sources at Air Force Installations, Prepared by United States Air Force, Institute for Envrionment, Safety and Occupational Health Risk Analysis (IERA, 1999) (LADWP, 2009).

Table 10: Emissions from Natural Gas Fired Auxiliary Boiler - Unit 5				
	Emission Factor [1] (lb/10^6 scf)	Emission Factor (lb/MMBtu)	Emission Rate (lb/hr)	Daily (lb/day)
NO_x [2]	-	-	-	779.7440
CO	84.00	0.084	271.08	6505.8167
PM_{10}	7.60	0.008	24.53	588.6215
VOC	5.50	0.005	17.75	425.9761
SO_2	0.60	0.001	1.94	46.4701
[1]Emission factors in lb/MMscf from AP42 - Table 1.4-1 and Table 1.4-2.				
[2] NOx emissions provided by LADWP based on CEMS data. The 24 hour worst-case actual occurred during a start up when the measured NOx was 779.7 lb/24hr.				
Permitted Heat Input for Boiler 5		3240	MMBtu/hr	
Natural Gas Heating Value (HHV)		1004	Btu/scf	

Table 10a: Emissions from Natural Gas Fired Auxiliary Boiler - Unit 6				
	Emission Factor [1] (lb/10^6 scf)	Emission Factor (lb/MMBtu)	Emission Rate (lb/hr)	Daily (lb/day)
NO_x [2]	-	-	-	449.4000
CO	84.00	0.084	210.00	5040.0000
PM_{10}	7.60	0.008	19.00	456.0000
VOC	5.50	0.005	13.75	
SO_2	0.60	0.001	1.50	36.0000
[1]Emission factors in lb/MMscf from AP42 - Table 1.4-1 and Table 1.4-2				
[2] NOx emissions provided by LADWP based on CEMS data. The 24 hour worst-case actual occurred during a start up when the measured NOx was 449.4 lb/24hr				
Permitted Heat Input for Boiler 6		2510	MMBtu/hr	
Natural Gas Heating Value (HHV)		1004	Btu/scf	

Table 11: Net Overall Daily Operational Mass Emissions					
Source	**Daily Mass Emissions (lbs/day)**				
	NOx	**CO**	**PM_{10}**	**VOC**	**SO_X**
Combustion Turbine (6 CTs)[1]	1069.31	1873.73	643.64	301.57	59.59
IC Engines[2]	59.09	10.70	0.11	3.99	0.07
Decrease due to shutdown of Unit 5[3]	(779.74)	(6505.82)	(588.62)	(425.98)	(46.47)
Decrease due to shutdown of Unit 6[3]	(449.40)	(5040.00)	(456.00)	0.00	(36.00)
Total Decrease due to Units 5 & 6	***(1229.14)***	***(11545.82)***	***(1044.62)***	***(425.98)***	***(82.47)***
Net Total	**(100.75)**	**(9661.39)**	**(400.87)**	**(120.41)**	**(22.81)**
Significance Threshold[4]	*10,045*	*550*	*150*	*55*	*150*
Significant? (Yes/No)	**No**	**No**	**No**	**No**	**No**

[1] Emissions are based on LADWP provided worst-case day operation including a total of 16 startups and shutdowns for all six CTs. One CT is assumed to have 6 startups (1 cold start and 1 hot start) and 6 shutdowns. The other 5 CTs are assumed to have 2 startups (1 cold start and 1 hot start) and 2 shutdowns each. The normal operation load is detailed in Tables 4.2-8 and 4.2-9. For all pollutants except NOx, cold start-up emissions are used. For NOx, both cold start and hot start emissions as shown in Table 4.2-1 are used.

[2] Emissions from the operation of 2 diesel engines. One hour operation per engine per day.

[3] CO, PM10, VOC and SOx daily emissions are based on USEPA AP-42 emission factors. Peak daily emissions are calculated based on a 24-hour period for a maximum permitted fuel use of 3240 MMBtu/hr for Unit 5, and 2510 MMBtu/hr for Unit 6. NOx emissions are based on CEMS data as provided by LADWP for units 5 and 6. The 24 hour worst-case actual occurred during a start up when the measured NOx was 779.7 lb/day for Unit 5 and 449.4 lb/day for Unit 6.

[4] NOx threshold based on the original 1994 RTCs allocated to the facility (10,045 lbs/day).

Table 12: Greenhouse Gases Emission Estimates													
Source	Annual Usage, MMBTU/yr[1]	Annual Usage, gal/yr	CO2 Emission Factor, kg CO2/MMBTU (a)	CH4 Emission Factor, kg CH4/MMBTU (b)	N2O Emission Factor, kg N2O/MMBTU (b)	CO2 Emission Factor, kg CO2/gallon (a)	CH4 Emission Factor, kg CH4/gallon (b)	N2O Emission Factor, kg N2O/gallon (b)	CO2 Emissions, metric tons/year	CH4 Emissions, metric tons/year	N2O Emissions, metric tons/year	CO2 Equivalents, metric tons/year
CT Unit 11	4,765,342	--	53.06	0.001	0.0001	--	--	--	252849	5	0	253097
CT Unit 12	4,765,342	--	53.06	0.001	0.0001	--	--	--	252849	5	0	253097
CT Unit 13	4,765,342	--	53.06	0.001	0.0001	--	--	--	252849	5	0	253097
CT Unit 14	4,765,342	--	53.06	0.001	0.0001	--	--	--	252849	5	0	253097
CT Unit 15	4,765,342	--	53.06	0.001	0.0001	--	--	--	252849	5	0	253097
CT Unit 16	4,765,342	--	53.06	0.001	0.0001	--	--	--	252849	5	0	253097
Standby Generator 1	--	8,665	73.15	0.003	0.0006	10.15	0.0004	0.0001	88	0	0	88
Standby Generator 2	--	8,665	73.15	0.003	0.0006	10.15	0.0004	0.0001	88	0	0	88
								Potential GHG Emissions from Current Project	***1517270***	***29***	***3***	***1518758***
Boiler 5	17,029,440		53.06	0.001	0.0001	--	--	--	(903,582)	(17)	(2)	(904,468)
Boiler 6	13,192,560		53.06	0.001	0.0001	--	--	--	(699,997)	(13)	(1)	(700,683)
								Decrease in GHG due to shutdown of Units 5 and 6	***(1,603,579)***	***(30)***	***(3)***	***(1,605,151)***
								Net Total GHG Emissions	**(86,309)**	**(2)**	**(0)**	**(86,393)**

Notes:

1. The combustion turbine annual usage was calculated for a maximum operation of 5256 hours per year of normal operation. The emissions from the boilers were also based on an equivalent CT permit limit of 5256 hours of normal operation.

(a) Table C.7, California Climate Action Registry General Reporting Protocol, Version 3.1, January 2009

(b) Table C.8, Industrial Sector, California Climate Action Registry General Reporting Protocol, Version 3.1, January 2009

Global warming potential of CH_4, Table C.1, California Climate Action Registry General Reporting Protocol, Version 3.1, January 2009	21
Global warming potential of N_2O, Table C.1, California Climate Action Registry General Reporting Protocol, Version 3.1, January 2009	310

Table 13: GHG Impact Analysis	
	GHG Emissions (MT/year)
Amortized Construction GHG	117
Net Operational GHG	(86,393)
Total Project GHG	**(86,276)**
SCAQMD Interim GHG Threshold for Industrial Projects (Metric Tons/year)	***10,000***
Significant (Yes/No)?	No

Table 13a: Greenhouse Gas Emissions During Construction			
Emission Source	**Annual CO2 Emissions (tons/year)**		
	2010	**2011**	**2012**
Direct Emission Sources			
Equipment Operations	953	2,145	772
TOTAL	**953**	**2,145**	**772**
Total Construction Emissions (tons/year)			**3,870**
Total Construction Emissions (MT/year)			**3,510**
Conversion factor = 0.907 metric tons/short tons			

Attachment C

Air Quality Impact Modeling Files

Haynes Generating Station
SCAQMD ID: 800074
Modeling Archive for Air Quality Impact Assessment

KEY TO FILES ON CD-ROM

July 2009

This document summarizes the content in the CD-ROM. The CD-ROM contains various directories as described below.

Directory: Attachment C – AQIA Modeling Files\AQIA– consists of AERMOD software database input and output files. The files are organized into two main folders based on operation of the turbine and further into sub-folders based on modeled pollutants. The folder structure is as given below:

- **Commissioning**
  - ***NOx***
    - NOx-1hr (1-hr NOx)
  - ***CO***
    - CO-1hr (1-hour CO)
    - CO-8hr (8-hour CO)
- **Normal**
  - ***NOx***
    - NOx1-hr (1-hour NOx)
    - NOx-Ann (Annual NOx)
  - ***CO***
    - CO-1hr (1-hour CO)
    - CO-8hr (8-hour CO)
  - ***PM10***
    - PM-24hr (24-hr PM10)
    - PM-Ann (Annual PM10)

The AERMET outputs (*.sfc and *.pfl) for all years (2003 through 2007) are available in the folder named "Met".

The hourly ozone data for all years (2003 through 2007) used in the PVMRM modeling scenario (for 1-hour NOx) are available in the folder named "Ozone".

The terrain files (*.dem) are available in the folder name "Elevation".

Attachment D

Health Risk Assessment Modeling Files

Haynes Generating Station
SCAQMD ID: 800074
Modeling Archive for Health Risk Assessment

KEY TO FILES ON CD-ROM

July 2009

This document summarizes the content in the CD-ROM.

Directory: \Attachment D – HRA Modeling Files\HRA– consists of HARP software database files and results.

Files:

HnGS.ini	: Initialization file specific to this project
Haynes.mdb	: Database for this project
Haynes-Res.sit	: Site parameter file for residential exposure non-inhalation pathways
Haynes-Worker.sit	: Site parameter file for worker exposure non-inhalation pathways
LOSALAM.ASC	: Meteorological Data
HAYNES-CEQA.INP	: ISCST3 input file
HAYENS-CEQA.OUT	: ISCST3 output file
HAYNES-CEQA.ISC	: HARP ISCST3 database file
HAYNES-CEQA.PLT	: ISCST3 plot file
HAYNES-CEQA.MAX	: ISCST3 MAX File
HAYNES-CEQA.SRC	: ISCST3 source/receptor file input to HARP risk module
HAYNES-CEQA.XOQ	: ISCST3 “X/Q” file
HAYNES-CEQA.RSK	: HARP Point estimate risk values file
HAYNES-CEQA.ERR	: ISCST3 error message file
BPIP.inp	: Building downwash input file
BPIP.out	: Building downwash output file

Directory: \Attachment D – HRA Modeling Files\HRA\Reports

*.txt	: Reports using HARP automatic file naming option.

Directory: \Attachment D – HRA Modeling Files\HRA\Elevation

*.txt	: DEM files for terrain elevations

APPENDIX C

MARINE BIOLOGICAL STUDIES, HAYNES GENERATING STATION UNITS 5&6 REPOWER PROJECT

MBC Applied Environmental Sciences
May 15, 2009

Marine Biological Studies

Haynes Generating Station
Units 5&6 Repower Project

Prepared for:

EDAW, Inc.
Los Angeles, California

Prepared by:

MBC *Applied Environmental Sciences*
Costa Mesa, California

May 15, 2009

Marine Biological Studies

Haynes Generating Station Units 5&6 Repower Project

Prepared for:

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Costa Mesa, California

May 15, 2009

PROJECT STAFF

Los Angeles Department of Water and Power

M. Sedlacek
T. Dailor

EDAW

T. Ryan

MBC Applied Environmental Sciences

Project Manager – M. Curtis

Marine Scientists

D. S. Beck
S. M. Beck
M. D. Curtis
T. C. Duvall
E. F. Miller
R. H. Moore
C. L. Paquette
D. G. Vilas

Technicians

W. H. Dossett
J. R. Nunex
F. C. Petry
J. L. Rankin
J. J. Sloan
B. L. Smith

Project Coordinators

M. R. Pavlick
K. L. Mitchell

Editors

M. D. Curtis
E. F. Miller
D. G. Vilas

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1.0 INTRODUCTION

The Los Angeles Department of Water and Power (LADWP) has proposed to repower Units 5&6 at the Haynes Generating Station (HnGS) in Long Beach, California. As part of this repowering project, Units 5&6 would be replaced with six simple cycle units that will use air cooling.

EDAW, Inc. is assisting LADWP in the preparation of required documentation pursuant to the California Environmental Quality Act (CEQA). MBC Applied Environmental Sciences (MBC) was contracted by EDAW, Inc. to assist in the evaluation of potential impacts to marine water quality and biological resources.

As there will be a decrease in the amount of water withdrawn from Alamitos Bay, through the Haynes Intake Canal, and ultimately discharged into the San Gabriel River, there will be effects on all three water bodies. As the decrease in cooling water flow could affect the water quality of these bodies and biota found within, MBC had proposed to perform field studies to document existing conditions and resources where little or no information was available. These field studies will be used as baseline data or to supplement data from past studies to determine potential effects from the proposed project.

2.0 DESCRIPTION OF THE STUDY AREA

2.1 HAYNES GENERATING STATION

Haynes Generating Station is located on the coast of the Pacific Ocean in the City of Long Beach, California (Figure 1). The station uses a once-through cooling water system for five of its generating units. Units 1 and 2 each have a rated electrical capacity of 222 megawatts (MW) each, Unit 5 is rated at 341 MW, Unit 6 is rated at 259 MW, and Unit 8, which recently replaced Units 3 and 4, is rated at 235 MW. Units 9 and 10 are gas-fired turbines rated at 170 MW each. The total net generating capacity of Haynes Generating Station is now 1,619 MW. A design capacity of 1,497.3 cfs (672,000 gallons per minute [gpm]) of cooling water theoretically can be withdrawn from Alamitos Bay when all units at HnGS are in operation.

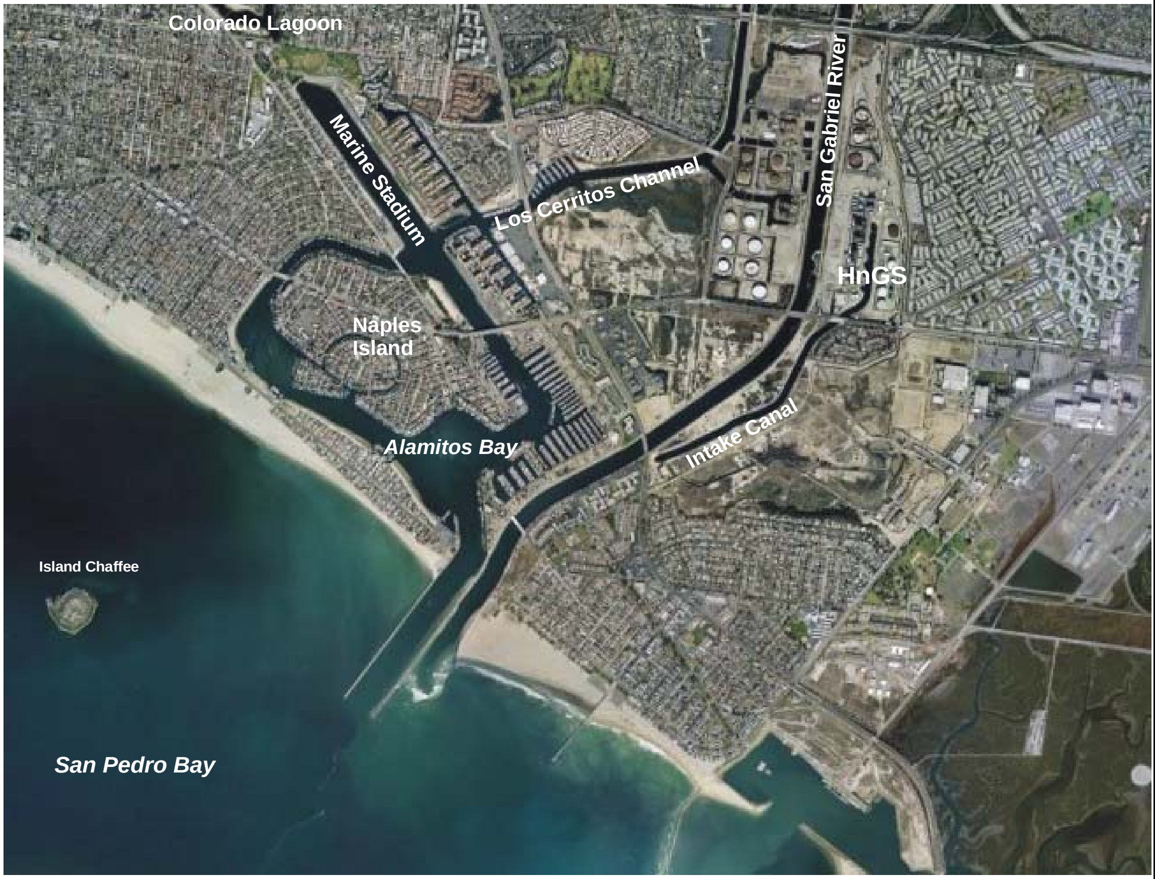

Figure 2.1-1. Aerial view of the HnGS and surrounding environment.

Circulating water for the five units is withdrawn from a single cooling water intake structure, located in the Long Beach Marina, about 2.4 kilometers (km) (1.5 miles) southeast of the facility. The normal depth of the marina at the site of the intake openings is 3 meters (m) (10 feet [ft]). There are seven intake openings in the marina's northwest facing bulkhead wall, below the gangways. To keep large debris from entering the intake bays, 0.9 cm (3/8 inch) by 7.6 cm (3 inches) trash bars centered every 15.2 cm (6 inches) are located at the face of each intake bay. The calculated intake velocity at the marina opening is 0.5 meter per second (m/s) (1.6 ft/sec). Each of the seven openings leads to a 2.4 m (8 ft) diameter conduit pipe that travels 335 m (1,100 ft) under the San Gabriel River into the intake channel. Only six of the intake tunnels are used during normal operation. Flow to the seventh pipe is blocked with stop logs to eliminate any biofouling. The velocities through the intake conduit pipes are 5.0 ft/s. The calculated velocity of the intake channel is 1.0 (3.2 ft) m/s.

A manmade, earthen intake channel runs 2.4 km (1.5 miles) along the east bank of the San Gabriel River to the HnGS screenhouses. The channel bottom is at El. –5.8 m (-19 ft) Mean Lower Low Water (MLLW), and its upper banks rise to El. 2.4 m (8 ft). The width of the channel bottom is 9.1 m (30 ft), and the distance between the opposing banks is 50.3 m (165 ft). The end of the channel runs parallel to the east side of the plant.

2.2 ALAMITOS BAY

Alamitos Bay is a man-made, small-vessel harbor that was constructed at the mouth of the San Gabriel River. It was once an estuary with tidal marshes and mud flats. Alamitos Bay is relatively shallow with water depths throughout most of the bay from 3.6–5.5 m (12–18 ft) MLLW. The bay is exposed to semidiurnal tides with a mean range of 1.1 m (3.6 ft).

Subtidal sediments in Alamitos Bay consist primarily of sand and mud, and waters are primarily saline (Allen and Horn 1975). Subtidal vegetation (eelgrass [*Zostera marina*]) is present at locations near the entrance channel, near the west end of Naples Island, and in the Marine Stadium arm of the Bay (Valle et al. 1999). Depths throughout most of the bay are shallow, ranging from 3.6–5.5 m (12–18 ft). Most of the shoreline is developed, and consists of hard intertidal and subtidal substrates, such as concrete bulkheads and piers. Long Beach Marina consists of numerous floating docks, including several in the vicinity of the HnGS bulkhead intake structure (Figure 2.2-1). The HnGS intake is submerged under the concrete walkway at left.

Figure 2.2-1. View of Long Beach Marina and the HnGS intake structure below the water surface along the concrete bulkhead.

Alamitos Bay has a surface area of approximately 1.2 km^2 (285 acres) (CSWRCB et al. 1998). Prominent features within Alamitos Bay include Naples Island, which is a marshland constructed of material dredged from the bay in 1908 and 1909 (Reish and Winter 1954), and Colorado Lagoon, which is a man-made tidal lagoon that receives sea water from an inlet that is connected to the Marine Stadium and Alamitos Bay. The Marine Stadium originally consisted of tidal flats and marshlands, and was dredged for rowing events for the 1932 U.S. Olympics (Reish and Winter 1954). Marinas within Alamitos Bay presently provide slips for approximately 4,000 boats.

Los Cerritos Channel is a flood control channel that connects with Alamitos Bay through the Marine Stadium. The tidal prism extends from Alamitos Bay to Anaheim Road. The channel was put on the USEPA 303(d) list of impaired water bodies by the LARWQCB due to elevated ammonia, sediment contamination, and elevated coliform levels (CSWRCB et al. 1998). The AES Alamitos Generating Station withdraws cooling water from Los Cerritos Channel via two rock-lined canals. The Los Cerritos Wetlands are located at the point where Los Cerritos Channel joins Alamitos Bay. The wetlands currently consist of about 0.5 km^2 (130 acres) of wetlands, with nearly 3.2 km^2 (800 acres) of degraded wetland habitat proposed for restoration. Historically the wetlands consisted of about 9.7 km^2 (2,400 acres) and included what is now Alamitos Bay. Much of the site was modified due to development activities by oil companies. In 2006, the California Coastal Conservancy was one of several agencies that purchased 0.3 km^2 (66 acres) of the wetlands, and hopes to acquire more.

Four oil production islands (Islands Grissom, Chaffee, Freeman, and White) - each 0.04-0.05 km^2 (10-12 acres) in size - are located just upcoast from the entrance to Alamitos Bay. The islands are constructed of large boulders and sand, and the drilling rigs are camouflaged and soundproofed. More than 1,200 wells have been drilled on the four islands. Platform Esther, an oil-drilling platform, is located approximately 2 km (1.2 miles) southeast from the entrance of Alamitos Bay in approximately 12 m (39 ft) of water. Another drilling platform, Belmont Island, was formerly located off the entrance to Alamitos Bay in 14 m (46 ft) of water. It was decommissioned and removed between 2000 and 2002.

2.3 SAN GABRIEL RIVER

The lower San Gabriel River empties into San Pedro Bay just downcoast, and adjacent to, the Alamitos Bay entrance jetty (Figure 2.2-1). The river originates in the San Gabriel Mountains, and historically flowed to the Los Angeles River. In 1867, flooding altered the river’s course, causing it to empty into Alamitos Bay. Catastrophic flooding in 1914 prompted flood protection measures on a basin-wide scale. During the 1920s, 1930s, and 1940s, several rivers, including the San Gabriel, were substantially dammed and channelized to prevent flooding and allow basin recharging. After this, most of the flow in the San Gabriel was reduced to the point that significant amounts of fresh water occurred in the lower reaches only during periods of rainfall.

2.4 TIDES AND CURRENTS

Tides in southern California are classified as mixed, semi-diurnal, with two unequal high tides (high water and higher high water) and two unequal low tides (low water and lower low water) each lunar day (approximately 24 hr 50 min). Between 1997 and 2002, water level extremes in Outer Los Angeles Harbor ranged from -0.6 m to +2.35 m (-1.97 ft to + 7.71 ft) above MLLW. The tidal prism of Alamitos Bay (defined as the body of water contained within the mean tidal range) is approximately 1.96 x 10^6 m^3 (517.8 million gallons) (IRC 1981).

Detailed circulation studies were performed within Alamitos Bay and the nearshore areas of San Pedro Bay during the original HnGS 316(b) Demonstration (IRC 1981). Waters drawn into the Bay become progressively better mixed as they are drawn toward the inner reaches where the cooling water intakes are located. This is the opposite of what would normally occur in back bay areas, which normally have the poorest flushing and longest retention times. IRC (1981) determined that cooling water withdrawals from Haynes and Alamitos induce a net transport into the bay, with the mean residence time of water estimated at about one day.

At the entrance to Alamitos Bay, currents are bi-directional, with a strong bias toward in-flowing over out-flowing currents, and speeds ranging to about 40 centimeters per second (cm/s) (1.4 feet per second [ft/s]) (IRC 1981). Current speeds diminish in mid-bay, with most current speeds less than 20 cm/s (0.7 ft/s). At the HnGS intake structure in Long Beach Marina, surface waters flow away from the intake structure approximately one-third of the time; however, mid-depth or below, waters flow directly toward the intake approximately 80% of the time.

Recirculation of discharged cooling water at the HnGS (from the San Gabriel River back to the intake structure in Alamitos Bay) was estimated to be about 4%. This relatively low value was attributed to predominant downcoast currents which transport discharged waters away from Alamitos Bay. It was concluded that "…very little of the water entrained into the Haynes Generating Station resided within Alamitos Bay more than five days" (IRC 1981). Due to the predominant downcoast water movement outside Alamitos Bay, the immediate oceanic source waters for Alamitos Bay were determined to lie in the northern lees of the Long Beach and Middle Breakwaters (Outer Long Beach Harbor), with minor amounts derived from downcoast between Alamitos and Anaheim Bays. Downcoast flow off Alamitos Bay averaged about 1.6 cm/s (0.05 ft/s), or about 1.5 km/day (0.9 miles/day) (IRC 1981).

3.0 MARINE RESOURCES

3.1 SAMPLING AREA DESCRIPTION

Biological and water quality sampling was conducted in three areas adjacent to the HnGS, Alamitos Bay, the San Gabriel River, and the HnGS Intake Canal (Figure 3.1-1). Water quality parameters were recorded at each station during all surveys except rocky intertidal. Rocky intertidal invertebrate communities were characterized at two sites in Alamitos Bay. Suitable rocky intertidal habitat was not observed in the HnGS Intake Canal and communities were previously characterized in the San Gabriel River. Benthic infaunal; demersal fish and macroinvertebrate communities; and fish recruitment were sampled at four sites in Alamitos Bay and three sites (each) in the San Gabriel River and the HnGS Intake Canal. Ichthyoplankton sampling occurred at four sites in Alamitos Bay and three sites (each) in the San Gabriel River and the HnGS Intake Canal. The presence and extent of eelgrass (*Zostera marina*) within the HnGS Intake Canal was surveyed by biologist-divers. Lastly, beach seines were conducted and soft intertidal cores were collected at three sites (each) in Alamitos Bay and in the HnGS Intake Canal.

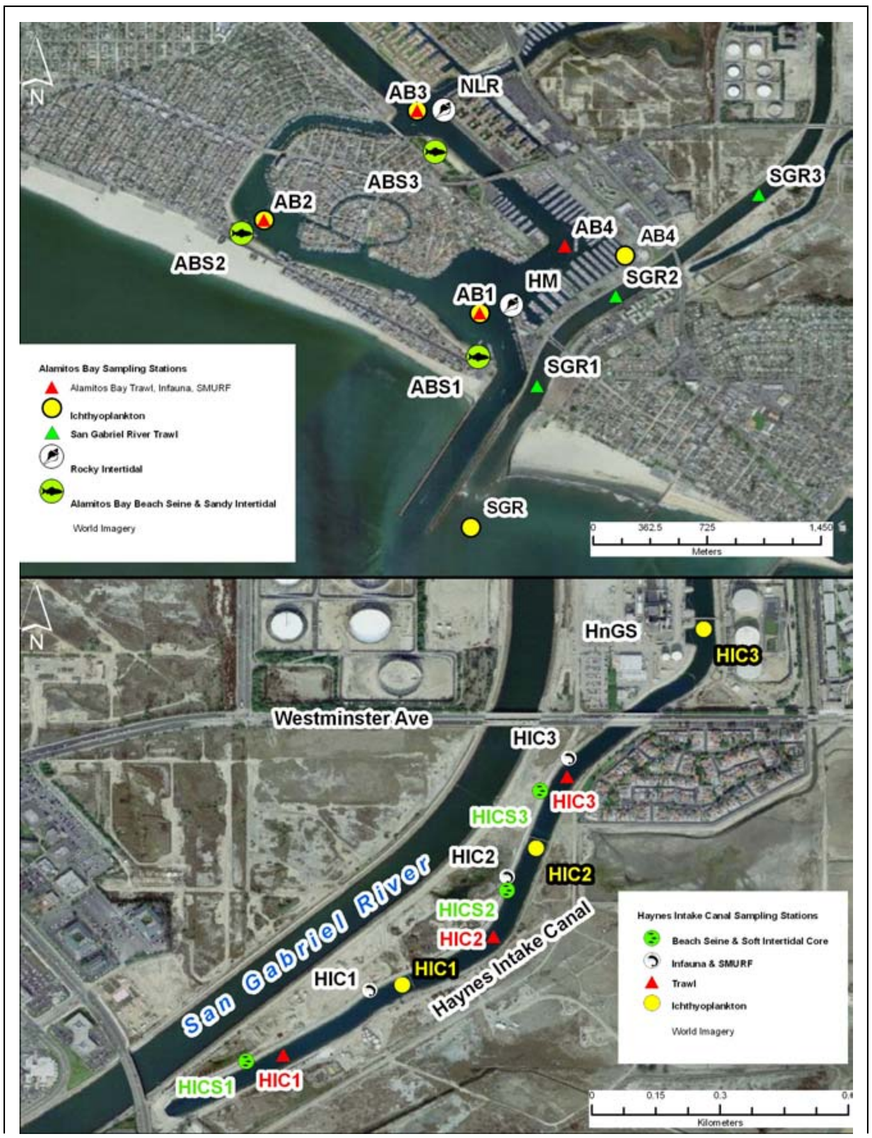

Figure 3.1-1. Haynes Intake Canal special studies sampling locations in Alamitos Bay (AB), San Gabriel River (SGR), and the Haynes Intake Canal (HIC).

3.2 WATER QUALITY

Previous studies have documented water quality in and around Alamitos Bay. These include long-term data sets from offshore of Alamitos Bay and within the San Gabriel River (MBC 1990-1994a, 1995, 1997-1998, 1999a-2004a, 2005-2008a), an ichthyoplankton characterization study (2004b), and an Alamitos Generating Station Thermal Effects Study (EQA/MBC 1973).

Water column measurements of physical and chemical characteristics of seawater such as water temperature, dissolved oxygen (DO) concentration, hydrogen ion (pH) concentration, and salinity are reliable indicators of the water quality of the marine ecosystem. Because biological communities exist in equilibrium in the marine environment, changes in these seawater characteristics can result in potentially adverse impacts to these communities. Receiving water characteristics can vary naturally on a relatively small scale, so water quality monitoring is typically conducted seasonally to assess these parameters in a way that helps determine the scale of the effect of natural oceanographic variability as well as anthropogenic influences. Shorter term monitoring can determine whether deviations from expected patterns exist, and they then can be placed into perspective by comparison with the long term data set. When no such long term data are available for a specific region, nearby areas subject to similar oceanographic influences can indicate whether the observed conditions are typical seasonal components or whether they may be indicators that impacts are occurring to the local biological communities.

3.2.1 Materials and Methods

Water quality monitoring was conducted during the surveys for ichthyoplankton (both day and night), trawl studies for fish and macroinvertebrates, as well as beach seine collections in February and March 2009. Surveys were conducted at up to 10 stations located within the waters of the Alamitos Bay (4 stations), Haynes Intake Canal (3 stations), and the San Gabriel River (3 stations), although not all stations were sampled during each survey (Figure 3.1-1). The Alamitos Bay stations were positioned at the approximate four corners of the bay, the three Haynes Intake Canal stations were located more-or-less evenly spaced between the PCH and the Westminister bridges, while the San Gabriel River stations were located between the 7th St. Bridge and the river mouth, at its exit into San Pedro Bay.

Temperature, DO, pH, and salinity were measured throughout the water column or at one-meter depth increments at each station during night and day sampling periods. Monitoring at the Alamitos Bay and San Gabriel River (SGR) stations was conducted using a Sea-Bird® Water Quality Monitoring System SBE 9/17 and SBE 25 during the trawling and most ichthyoplankton studies. Data was processed using the Sea-Bird proprietary software (SeaSoft). The resulting data were imported into Microsoft Office Excel spreadsheets for further reduction and analysis. Water quality monitoring within the Haynes Intake Canal, at the seine stations, and at one bay ichthyoplankton station, were conducted using an Eureka Manta® Multiprobe Data Sonde (Manta 588). The resulting data were entered directly into Microsoft Office Excel for further analysis.

During ichthyoplankton monitoring, water quality was sampled during the day at Stations AB-1 through AB-3, and the SGR on 12 February 2009 during a flood tide. On the day of monitoring, the tide rose to a high of +5.0 ft Mean Lower Low Water (MLLW) at 1045 hours (hr) and then fell to a low of +0.2 ft MLLW at 1700 hr. Skies at the river stations were mostly clear (15 to 20% cloud coverage) with winds from the west at 3 to 5 knots during the monitoring. Sea conditions were flat within Alamitos Bay and the San Gabriel River.

Water quality for ichthyoplankton monitoring during the night sampling was monitored at the same stations, Stations AB-1 through AB-3, and the SGR on 13 February 2009 during an ebb tide. During the night of monitoring, the tide fell from a high of +5.2 ft MLLW at 2324 hr (on 12 February) to a low of +0.9 ft MLLW at 0541 hr. Skies at the river stations were overcast with winds at 2 to 3 knots from the west in the late evening becoming stronger at 5 to 7 knots from the west in the early morning hours during the monitoring. Sea conditions were flat within Alamitos Bay and the San Gabriel River.

Water quality for beach seine monitoring was conducted during the day at the stations in Alamitos Bay Stations AB-1 through AB-3, and at the Stations HIC-1 through HIC-3 in the Haynes Intake Canal, on 23 February 2009 during an ebb tide. On the day of monitoring, the tide fell from a high of +5.7 ft MLLW at 0756 hr to a low of -0.5 ft MLLW at 1446 hr. Skies were 85 to 90% cloud coverage with winds at 2 to 3 knots from the west during the monitoring. Sea conditions were flat within Alamitos Bay and the Haynes Intake Canal.

Water quality for trawl monitoring was conducted on two days at stations in the San Gabriel River and Alamitos Bay on 26 February and at three stations within the Haynes Intake Canal on 19 March 2009. The 26 February sampling was conducted between 0945 hr and 1500 hr during an ebb tide. On that day, the tide fell from a high of +5.7 ft MLLW at 0756 hr to a low of -0.5 ft MLLW at 1446 hr and rose to a high of 5.1 ft MLLW at 2015 hr. Skies were 85 to 90% cloud coverage in the morning becoming clear by noon and 5 to 15 % coverage later in the afternoon with southwest winds at 2 to 3 knots during the morning, becoming 5 to 7 knots from the west in the late afternoon. Sea conditions were flat within Alamitos Bay and the Haynes Intake Canal. The 19 March sampling was conducted on the Haynes Intake Canal between 1000 hr and 1430 hr during an ebb tide that became slack and began flooding. On that day, the tide fell from a high of +4.2 ft MLLW at 0327 hr to a low of +0.5 ft MLLW at 1136 hr and rose again to a high of +3.4 ft MLLW at 1858 hr. Skies were cloudy with winds at 2 to 3 knots from the west during the morning monitoring. Sea conditions were flat within Alamitos Bay and the Haynes Intake Canal.

3.2.2 Results

Water quality data for the surveys are provided in Appendix A and are summarized in Tables 3.2-1 and 3.2-2.

3.2.2.1 Temperature

Haynes Intake Canal. During monitoring in the Haynes Intake Canal, surface water temperatures averaged 14.59°C during the 12 February 2009 day and, 14.25°C during the 13 February night ichthyoplankton surveys, 15.39°C during the 23 February seine survey, and 16.50°C during the 19 March day survey (Table 3.2-1). Temperatures generally decreased from surface to bottom at all stations, except during the 13 February when the trend was reversed (Appendix A). Average bottom water temperatures in the canal were 14.52°C on 12 February, 14.30°C on 13 February, 15.35°C on 23 February, and 16.41°C during the 19 March trawl survey (Table 3.2-2). Coolest water temperatures were recorded during the 13 February night survey, while warmest temperatures occurred during the 19 March survey. No thermoclines (1°C decrease per meter depth increase) were detected during any of the surveys in the Haynes Intake Canal.

Table 3.2-1. Summary of surface water quality parameters during ichthyoplankton, beach seine, and demersal fish trawl sampling.

	Temp. (°C)			D.O. (mg/l)			pH			Salinity (psu)		
	Ichthyoplankton - Day 12 February 2009											
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	14.59	14.71	14.59	5.75	6.71	7.83	8.34	8.01	8.00	33.3	32.3	32.8
Min.	14.55	14.61	14.59	5.60	5.81	7.83	8.22	7.91	8.00	33.3	31.7	32.8
Max.	14.62	14.95	14.59	5.90	7.29	7.83	8.45	8.19	8.00	33.3	33.3	32.8
	Ichthyoplankton - Night 13 February 2009											
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	14.25	14.22	15.46	8.84	6.52	7.92	8.08	7.92	7.85	33.3	32.4	30.2
Min.	14.24	14.12	15.46	8.66	5.31	7.92	8.08	7.82	7.85	33.2	31.9	30.2
Max.	14.26	14.35	15.46	8.95	7.23	7.92	8.09	8.09	7.85	33.4	33.0	30.2
	Beach Seine 23 February 2009 (AB) and 26 March 2009 (HIC)											
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	15.39	14.75	-	6.28	8.84	-	7.97	8.02	-	33.2	32.7	-
Min.	15.27	14.40	-	5.90	7.03	-	7.87	8.01	-	33.1	32.4	-
Max.	15.46	14.93	-	6.74	10.95	-	8.05	8.04	-	33.3	33.2	-
	Demersal Fish Trawl 26 February 2009 (AB and SGR) and 19 March 2009 (HIC)											
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	16.50	15.65	18.48	7.48	6.73	6.27	8.07	7.85	7.75	33.1	32.5	28.0
Min.	16.25	15.50	18.38	7.20	6.25	6.23	8.05	7.81	7.75	33.0	32.4	27.6
Max.	16.67	15.95	18.57	7.90	7.21	6.33	8.08	7.91	7.76	33.2	32.7	28.3

Alamitos Bay. During monitoring at Alamitos Bay, surface water temperatures averaged 14.71°C on 12 February 2009, 14.22°C on 13 February, 14.75°C on 23 February, and 15.65°C on the 26 February survey (Table 3.2-1). Temperatures generally decreased from surface to bottom at all stations except during the night survey of 13 February (Appendix A). Average bottom water temperatures were 14.43°C on 12 February, 14.41°C on 13 February, 14.70°C on 23 February, and 14.81°C during the 26 February survey (Table 3.2-2). Coolest water temperatures were again recorded during the 13 February night survey, while slightly warmer temperatures occurred during the 26 February survey. No thermoclines were detected during any of the surveys in Alamitos Bay.

Table 3.2-2. Summary of bottom water quality parameters during ichthyoplankton, beach seine, and demersal fish trawl sampling.

	Temp. (°C)			D.O. (mg/l)			pH			Salinity (psu)		
Ichthyoplankton - Day 12 February 2009												
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	14.52	14.43	14.09	5.18	7.29	7.72	8.24	8.02	7.99	33.4	32.7	33.2
Min.	14.49	14.33	14.09	4.99	6.81	7.72	8.17	7.93	7.99	33.3	32.3	33.2
Max.	14.55	14.52	14.09	5.36	8.00	7.72	8.31	8.20	7.99	33.4	33.5	33.2
Ichthyoplankton - Night 13 February 2009												
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	14.30	14.41	13.87	6.89	6.68	7.72	8.07	7.94	7.92	33.3	32.8	33.3
Min.	14.25	14.30	13.87	6.17	5.75	7.72	8.06	7.85	7.92	33.3	32.3	33.3
Max.	14.33	14.53	13.87	8.17	7.41	7.72	8.08	8.12	7.92	33.4	33.4	33.3
Beach Seine 23 February 2009 (AB) and 26 March 2009 (HIC)												
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	15.35	14.70	-	6.16	8.51	-	7.99	8.04	-	33.2	32.9	-
Min.	15.26	14.36	-	6.08	6.69	-	7.95	8.03	-	33.1	32.5	-
Max.	15.41	14.91	-	6.32	10.50	-	8.04	8.06	-	33.3	33.3	-
Demersal Fish Trawl 26 February 2009 (AB and SGR) and 19 March 2009 (HIC)												
	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR	HIC	AB	SGR
Mean	16.41	14.81	16.08	6.85	7.08	7.14	8.07	7.90	7.86	33.1	32.7	31.2
Min.	16.23	14.15	14.50	6.59	6.53	6.38	8.06	7.85	7.78	33.0	32.6	30.2
Max.	16.55	15.26	18.48	7.25	7.93	7.86	8.07	7.97	7.93	33.2	33.0	32.1

San Gabriel River. Within the San Gabriel River, surface water temperatures averaged 14.59°C on the 12 February 2009 survey, 15.46°C on the 13 February night survey, and 18.48°C during the 26 February survey, as no beach seine sampling occurred in the SGR, there were no samples on 23 February (Table 3.2-1). Temperatures generally decreased from surface to bottom at all stations, except at San Gabriel River Station SGR-3 where temperature rose slightly (Appendix A). Average bottom water temperatures were 14.09^{o}C on 12 February, 13.87^{o}C on 13 February, and 16.08^{o}C during the 26 February survey (Table 3.2-2). Coolest water temperatures were recorded during the 13 February night survey, while warmest temperatures occurred during the 26 February survey. Thermoclines were detected in the San Gabriel River at downriver Stations SGR-1 and SGR-2, where temperatures decreased from surface to bottom by 4.07^{o}C at SGR-1 and 3.24^{o}C at Station SGR-2 (Appendix A).

3.2.2.2 Dissolved Oxygen

Haynes Intake Canal. Surface dissolved oxygen concentration averaged 5.75 mg/l on 12 February 2009, 8.84 mg/l on 13 February, 6.28 mg/l during the 23 February survey, and 7.48 mg/l on 19 March (Table 3.2-1). Dissolved oxygen concentrations generally decreased with depth on 12 February, 23 February, and 19 March, but reached a subsurface maxima at depths between one and two meters, below which DO decreased with depth during the 13 February survey (Appendix A). The maximum surface-to-bottom difference was 2.73 mg/l recorded during the 13 February survey at HIC-1 (Appendix A-1). Average bottom DO concentrations were 5.18 mg/l on 12 February 2009, 6.89 mg/l on 13 February, 6.16 mg/l during the 23 February survey, and 6.85 mg/l on the 19 March survey (Table 3.2-2). Lowest bottom DO value was 4.99 mg/l, recorded at Station HIC-1 on 12 February and the highest bottom DO value was 8.17 mg/l, recorded at Station HIC-3 on 13 February (Appendix A).

Alamitos Bay. During monitoring, surface DO concentration averaged 6.71 mg/l on 12 February 2009, 6.52 mg/l on 13 February, 8.84 mg/l during the 23 February survey, and 6.73 mg/l on 26 February (Table 3.2-1). Dissolved oxygen concentrations generally decreased with depth on 23 February, but otherwise were generally highest mid-depth with subsurface maxima between three and five meters on 12 February, at one to four meters on 13 February, and at about four to five meters on 26 February (Appendix A). The maximum surface-to-bottom difference was 2.19 mg/l, recorded at Station AB-4 on 12 February. Average bottom DO concentrations were 7.29 mg/l on 12 February 2009, 6.68 mg/l on 13 February, 8.51 mg/l on 23 February, and 6.85 mg/l during the 26 February survey (Table 3.2-2). Lowest bottom DO value was 5.75 mg/l, recorded at Station AB-4 on 13 February and the highest bottom DO value was 10.5 mg/l, recorded at Station AB-1 on 23 February (Appendix A).

San Gabriel River. In the San Gabriel River, surface DO concentrations averaged 7.83 mg/l on 12 February 2009, 7.92 mg/l on 13 February, not sampled on 23 February, and was 6.27 mg/l during the 26 February survey (Table 3.2-1). Dissolved oxygen subsurface maxima were seen on 12 February at four-meters depth and on 26 February at three-to-four meters depth (Appendix A). On 13 February, dissolved oxygen decreased from surface to bottom (Appendix A). Average near bottom DO concentrations were 7.72 mg/l during both the 12 and 13 February 2009 surveys, and 7.14 mg/l during the 26 February survey (Table 3.2-2). The lowest near bottom DO value recorded was 6.38 mg/l at Station SGR-3, while the highest was 7.86 mg/l at Station SGR-1, both on 26 February (Appendix A).

3.2.2.2 Hydrogen Ion Concentration

Haynes Intake Canal. Surface hydrogen ion concentration averaged 8.34 on 12 February 2009, 8.08 on 13 February, 7.97 on 23 February, and 8.07 during the 19 March survey (Table 3.2-1). Hydrogen ion concentrations varied by less than 0.6 units among stations and through the water column (Appendix A). Average bottom pH values were 8.24 on 12 February 2009, 8.07 on 13 February, 7.99 on 23 February, and 8.07 during the 19 March survey (Table 3.2-2). The maximum surface-to-bottom difference was 0.14 units, recorded at Station HIC-2 on 12 February (Appendix A).

Alamitos Bay. Surface pH averaged 8.01 on 12 February 2009, 7.92 on 13 February, 8.02 on 23 February, and 7.85 on the 26 February survey (Table 3.2-1). Hydrogen ion concentrations varied by less than 0.4 units among stations and through the water column (Appendix A). Average bottom pH values were 8.02 on 12 February 20090, 7.94 on 13 February, 8.04 on 23 February, and 7.90 during the 26 February survey. The maximum surface-to-bottom difference was 0.06 at Station AB-1 on 26 February (Appendix A).

San Gabriel River. Within the San Gabriel River, surface pH values averaged 8.00 on 12 February 2009, 7.85 on 13 February, and 7.75 during the 26 February survey (Table 3.2-1). The highest surface pH value (8.00) was recorded on 12 February. Hydrogen ion concentrations decreased from surface to near bottom on 12 February and increased from surface to bottom on 13 and 26 February (Appendix A). Average near bottom pH values were 7.99 on 12 February, 7.92 on 13 February, and 7.86 during the 26 February survey (Table 3.2-2). The maximum surface-to-bottom difference was 0.18 at Station SGR-1 on 26 February (Appendix A).

3.2.2.3 Salinity

Haynes Intake Canal. During monitoring, surface salinity readings averaged 33.30 practical salinity units (psu) on 12 February, 33.3 psu on 13 February, 33.2 psu on 23 February, and 33.1 psu on 19 March (Table 3.2-1). Salinity generally increased or stayed the same with depth, with slight fluctuations throughout the water column (Appendix A). Average bottom salinity values were 33.4 psu on 12 February, 33.3 psu on 13 February, 32.2 psu on 23 February, and 33.1 psu on 19 March during sampling (Table 3.2-2). The maximum surface-to-bottom difference of 0.1 psu was found during several surveys in the HIC (Appendix A).

Alamitos Bay. Surface salinity readings averaged 32.3 psu on 12 February, 32.4 psu on 13 February, 32.4 psu on 23 February, and 32.7 psu during the 26 February survey (Table 3.2-1). At all stations, salinity generally increased with depth and fluctuated slightly through the water column (Appendix A). Average bottom salinity values were 32.7 psu during the 12 February survey, 32.8 on 13 February, 32.9 psu on 23 February, and 32.7 psu during the 26 February survey (Tables 3.2-2). The maximum surface-to-bottom differences was 0.53 psu at Station AB-2 on 12 February (Appendix A).

San Gabriel River. Within the San Gabriel River, surface salinity readings averaged 32.8 psu on 12 February, 30.2 psu on 13 February, and 28.0 psu during the 26 February monitoring (Table 3.2-1). At all stations, salinity increased from surface to near bottom (Appendix A) Average near bottom salinity values were 33.2 psu on 12 February, 33.3 psu on 13 February, and 31.2 psu on the 26 February survey (Table 3.2-2). The maximum surface-to-bottom difference was 4.05 psu at Station SGR-1 on 26 February (Appendix A)

3.2.3 Discussion

3.2.3.1 Temperature

Temperature within the Haynes Intake Canal appears to be similar to the temperatures found throughout Alamitos Bay. During the 12 February daytime survey of the ichthyoplankton in the canal, water temperatures in the canal ranged narrowly from about 14.5^{o}C to 14.6^{o}C, while temperature at AB-4 (closest to the intake structure) at the surface was 14.6^{o}C decreasing to 14.3^{o}C at three meters depth (Appendix A). Similarly, on the night of 13 February, water in the canal ranged from about 14.2^{o}C to 14.3^{o}C showing little-to-no stratification within the water column while temperatures throughout the bay ranged from 14.1^{o}C to 14.4^{o}C. Water is withdrawn from the northeast corner of Alamitos Bay near Station AB-4, passes through the grizzly bars into the intake siphon from near the surface to 2 meters depth. The water then travels under the San Gabriel River and into the Haynes Intake Canal. During periods of high flow (depending on the withdrawal of water for plant operations) water within the canal has very little temperature stratification with depth because its transit time down the 1.6 km long canal is relatively short. However, during periods of low flow, solar insolation could warm the surface water. Sea surface temperatures at Newport Beach Pier, approximately 23 km downcoast of the study area, averaged 13.6^{o}C to 14.5^{o}C during the time period of this survey, suggesting that water temperatures within the canal were typical of ambient ocean temperatures during the period of sampling from February through March 2009 (SCCOOS 2009).

Alamitos Bay water temperatures are dependent upon a number of factors including tidal cycles, distance from the bay mouth, fresh water input, and water residence time. Long water residence times can result in colder-than-ambient offshore temperatures in winter and warmer-than-ambient offshore temperatures in summer. Residence time of water in the bay is typically a factor of tidal currents; however, in Alamitos Bay, the withdrawal of cooling water from both the AES Alamitos and the Haynes generating stations can greatly affect the average residence time (Moffat & Nichols 2007). Residence time can range from almost 10 days at Mother's Beach (near Marine Stadium at the northern extent of Alamitos Bay) during low withdrawal rates at the power plants to less than one day during periods of high flow rates at the power plants (Moffat & Nichols 2007). Sea surface temperatures (SST) in Alamitos Bay ranged from 14.6^{o}C to 15.0^{o}C during the daylight survey on 12 February and from 14.1^{o}C to 14.4^{o}C during the night survey, indicating an approximately 0.5°C temperature difference between day and night (Table 3.2-1 and Appendix A). Temperatures remained similar (averaging about 14.8°C) during the 23 February survey, but increased to an average of about 15.1°C by the 26 February survey, indicating some solar insolation in the bay, as ambient conditions found offshore during the same period were slightly cooler at 13.6°C to 14.5°C during the same period (SCCOOS Newport Beach, 2009).

The San Gabriel River water quality sampling was conducted near the mouth of the river on 12 and 13 February 2009. Water temperatures (SST) were near the temperature found at Station AB-1 at the mouth of Alamitos Bay (ambient conditions), indicating little-or-no thermal input from either generating station. On 26 February, mean surface temperature (18.5°C) from three stations in the river was higher than ambient surface temperature (15.5°C) at the Alamitos Bay entrance, indicating a thermal input of about 3°C from the generating stations upriver. During three thermal effects studies in May, August, and November 1972, surface temperature at the river mouth ranged from 23.3° to 32.2°C (EQA/MBC 1973). From 1978 through 2001, water temperatures in the upper two meters downriver of the generating stations at Westminster Ave. and PCH averaged 21°C in winter and 27° to 28°C in summer. Maximum temperatures at those stations reached 26°C in winter and 34°C in summer (MBC 1979, 1981, 1986, 1988, 1990-1994a, 1995, 1997, 1998, 1999a-2001a). The temperatures recorded during the February and March 2009 surveys were well below temperatures previously reported in the San Gabriel River during this time of the year.

Results from the Thermal Effects Study (EQA/MBC 1973) indicated that surface water temperatures of the lower San Gabriel River were generally 6 to 10°C warmer than natural oceanic surface temperatures, and that colder bottom waters carried into the channel by tidal action do not penetrate very far past the channel entrance. Waters of the lower San Gabriel River tend to be well-mixed vertically, and that the thermal field from the generating station discharges extended no further than depths of three meters after passing through the river mouth. During winter months, temperature of water discharged into the lower river may decrease as it moves down stream due to atmospheric cooling, while during summer months, the temperature may increase due to absorption of solar radiation.

3.2.3.2 Dissolved Oxygen Concentration

The concentration of dissolved oxygen in seawater is affected by physical, chemical, and biological variables. High DO concentrations may result from cool water temperatures (solubility of oxygen in water increases as temperature decreases), active photosynthesis, and/or mixing at the air-water interface (Sverdrup et al. 1942). Conversely, low concentrations may result from warmer water temperatures, high rates of organic decomposition, and/or extensive mixing of surface waters with oxygen-poor subsurface waters. Dissolved oxygen typically fluctuates in the nearshore temperate environment around 7.5 mg/l (Kennish 2001), with the threshold of biological concern being 5 mg/l.

Average surface dissolved oxygen concentration at the three Haynes Intake Canal stations during the 12 February daytime were relatively low (5.8 mg/l), but were almost the same concentration recorded at the intake canal entrance (Station AB-4) in Alamitos Bay (5.8 mg/l). Dissolved oxygen concentrations were similarly low at Station AB-4 during the 13 February night survey, but the Haynes Intake Canal stations DO concentrations were considerably higher with a mean of 8.8 mg/l. The daytime surveys on 23 February were again generally low with a mean of 6.3 mg/l, while during the 19 March survey, DO concentrations were slightly higher with a mean of 6.7 mg/l. All DO sampling indicated that waters of the Haynes Intake Canal were generally within guidelines of the threshold for biological concerns, with the exception of one sample in the Haynes Intake Canal at 5 m depth on 12 February, where a DO of 4.99 mg/l was reported (Appendix A).

Alamitos Bay surface dissolved oxygen concentrations averaged 6.7 mg/l on 12 February and were slightly lower at 6.5 mg/l during the following night time survey of 13 February. The 23 February survey DO concentrations averaged 8.8 mg/l, but by the 26 February survey, DO had decreased to a mean of approximately 7.0 mg/l (Appendix A). None of the concentrations obtained were below the threshold for biological concerns.

Surface dissolved oxygen concentrations in the San Gabriel River during the 12 and 13 February surveys were higher (mean 7.9 mg/l) than ambient conditions reported near the bay mouth of Alamitos Bay (Station AB-1), where concentrations of 7.3 mg/l were recorded. On 26 February, lower DO concentrations were found in the river with a mean of 6.27 mg/l. These lower concentrations have been noted in previous surveys in the San Gabriel River and are probably a result of the warmer water temperatures found at these stations (MBC 1979, 1981, 1986, 1988, 1990-1993, 1994a, 1995, 1997, 1998, 1991a-2004a, 2005-2008a). Again, none of the concentrations obtained were below the threshold for biological concerns (Appendix A).

3.2.3.3 Hydrogen Ion Concentration

In the open ocean, hydrogen ion concentrations remains fairly constant due to the buffering capacity of seawater (Sverdrup et al. 1942). However, in nearshore areas, pH may vary due to physical, chemical, and biological influences. For instance, in areas with large organic influx such as bays, estuaries, and river mouths, microbial decomposition is greater and can alter pH levels. Along with a reduction in dissolved oxygen, decomposition also results in the production of humic acids, which decreases pH levels (Duxbury and Duxbury 1984). Reduced pH values may also occur in areas of freshwater influx, since freshwater generally has a lower pH than saltwater. In contrast, phytoplankton blooms, which are often associated with nearshore upwelling, may cause an increase in pH levels. High photosynthetic rates increase the removal of carbon dioxide from water, thus reducing the carbonic acid concentration and raising pH.

During monitoring, pH varied somewhat by station and with depth during sampling of the Haynes Intake Canal. On the day survey on 12 February, surface pH values varied by almost 0.3 units, while during the night survey on 13 February pH was slightly lower and more stable than during the daylight survey. Hydrogen ion concentrations were also stable during the 23 February and 19 March surveys.

In Alamitos Bay, concentration of the hydrogen ion was similar throughout the water column and amng stations and surveys on 12 and 13 February. Overall pH in Alamitos Bay varied by less than 0.4 units among all surveys.

At the San Gabriel River stations, surface pH was similar during the ichthyoplankton surveys varying by less than 0.2 units between the day and night surveys. During the later-February survey with slightly warmer temperatures, the pH values were about 0.2 units less than during the earlier-February surveys and varied between surface and bottom by as much as 0.18 units. Values were similar to those recorded at Alamitos Bay and the Haynes Intake Canal. These lower values can be associated with reduced salinity levels from freshwater influence as well as higher temperatures. All pH values were similar to or consistent with those previously recorded in the study area (MBC 1979, 1981, 1986, 1988, 1990-1993, 1994a, 1995, 1997, 1998, 1991a-2004a, 2005-2008a).

3.2.3.4 Salinity

The concentration of dissolved salts, salinity, in the open ocean is generally 35 practical salinity units (psu), which corresponds to a value of 35 parts per thousand (ppt) (Sverdrup et al. 1942). Salinity is typically determined by its electrical conductivity In nearshore areas or embayments subjected to freshwater influx, salinity is usually slightly lower. In southern California, salinity of nearshore waters and embayments is generally between 33 and 34 psu (Dailey et al. 1993). Reductions in nearshore or embayment salinity usually result from freshwater input, while slight increases are often associated with upwelling of colder, more saline deep waters or seasonal solar heating and evaporation in poorly-mixed surface waters during summer months (Dailey et al. 1993).

In the Haynes Intake Canal, surface salinity varied little during the four surveys with an average ranging from 33.1 psu to near 33.3 psu during the sampling events. These values indicate near normal near shore salinities with little or no freshwater influence.

The Alamitos Bay sampling indicated some near surface freshwater influence to depths of one to three meters as salinity varied with depth between 31.9 psu and 33.4 psu during the 12 February survey, and between 31.7 psu and 33.5 psu during the 13 February survey. Slight variations in psu (32.4 psu to 33.3 psu) also occurred during the 23 February survey, with slightly less variation (32.36 psu to 33.02 psu) found during the 26 February survey.

Near the mouth of the Lower San Gabriel River, freshwater influence was indicated by an increase of about 0.5 psu from the surface to the bottom during the 12 February survey. This trend became more pronounced during the night of the 13 February survey, when a difference of 3.1 psu was observed from the surface to the bottom. On 26 February, salinity was lower throughout the river stations, averaging about 28.0 psu on the surface and 31.2 psu on bottom, indicating a fresh water lens was present on the surface with a more mixed water column somewhat below the surface.

In the San Gabriel River, salinity downstream of the generating stations, is essentially that of salt water (30 to 34 parts per thousand [ppt]) (MBC 1979, 1981, 1986, 1988, 1990-1993, 1994a, 1995, 1997, 1998, 1991a-2004a, 2005-2008a). However, upriver from the generating stations, salinity is generally lower and more stratified; a lens of fresh water often overlies denser salt water, representing a tidal wedge. At the 7th Street Bridge, differences between salinity values at the water surface and a depth of one meter vary greatly, especially in winter. Plants typical of freshwater habitats, such as cattail, are common along the shore upstream of 7th Street. Within the San Gabriel River, reduced levels of salinity near the surface were recorded at most stations on occasion with stations furthest upstream of the generating stations discharges recording the lowest values. Reduced salinity concentrations within the river are typical due to freshwater inputs upriver of the generating stations' discharges. All salinity values were within ranges considered normal for nearshore and river water systems (Dailey et al. 1993) and are within the range of previously reported values for the area (MBC 2001a-2004a, 2005-2008a).

3.2.4 CONCLUSION

In February and March 2009 water quality characteristics in the HIC, AB, and SGR were typical of ambient conditions reported near the entrance to Alamitos Bay. In late-February, however, evidence of thermal input and some freshwater influence was observed in the San Gabriel River with temperatures higher than ambient conditions reported by 3^{o}C, lower pH, salinity, and DO. Where detected, the thermal influence was restricted to a warm water lens in the upper three to five meters of the water column. Reduced DO concentrations within the river were probably a result of the warmer water temperatures. Lower salinities were a result of freshwater input from the river upstream of the generating station discharges as a result of recent rains and discharges into the river above the generating stations. These lower values can be associated with reduced salinity levels from freshwater influence. The surveys indicated that water quality in the three water bodies affected by HnGS were typical of water quality characteristics previously reported for the study area.

3.3 EELGRASS

As part of the Environmental Impact Report (EIR) process for determining any potential impacts as a result of the plan to repower Haynes Units 5&6, it was necessary to determine the extent of the eelgrass (*Zostera marina*) resources that exist in the water bodies likely to be affected by the repowering project. These water bodies include Alamitos Bay, the Lower San Gabriel River, and the Haynes Intake Canal.

Eelgrass is a sensitive species under Federal and State law, therefore it was necessary to determine if the repowering project could have any potential impact on any eelgrass resources that may exist in Alamitos Bay, the Lower San Gabriel River, or within the Haynes Intake Canal. As existing eelgrass beds in Alamitos Bay have been documented previously, and studies have documented that no eelgrass is found in the Lower San Gabriel River, the goals of this study were to determine whether eelgrass is found in the Haynes Intake Canal, and if so, determine its spatial extent. Eelgrass in Alamitos Bay has been well documented via system-wide surveys conducted in 2005 by Coastal Resources Management (CRM 2005). Although anecdotal observations had indicated that eelgrass appeared to be present in the canal, a definitive identification of eelgrass and its areal extent within Haynes Intake Canal had not previously been determined. Therefore an eelgrass survey, following guidelines described in the Southern California Eelgrass Mitigation Policy adopted by National Marine Fisheries Services (NMFS) in 1991, with later suggested revisions, was conducted in the canal to determine a baseline from which to measure or predict impacts on this protected resource.

3.3.1 Materials and Methods

In the Haynes Intake Canal, eelgrass was surveyed on 19 March 2009 between 1030 and 1530 hours (Figure 3.1-1). On that day the tide fell from a high of +4.2 ft MLLW at 0327 hr to a low of +0.5 ft MLLW at 1136 hr, and then rose to a high of +3.4 ft MLLW at 1858 hr. Skies were overcast in the morning and clearing by early afternoon with winds from the northeast at 7 to 10 kn. The entire area between the PCH and Westminister bridges of the 1.6 km long intake canal was surveyed by biologist-divers swimming transects parallel to the canal banks and conducting perpendicular transects surveyed at intervals of 25 m or less. Latitude and longitude was taken via Global Positioning System (GPS) at 64 locations where transects were conducted. Eelgrass metrics (width, density of blades, and depth where eelgrass occurred) were taken at all of these locations where eelgrass was present (see Appendix B). Vertical control (depth) was in Mean Lower Low Water (MLLW) and was measured in feet. Identifications of incidental fish and macroinvertebrates observed during the course of the survey were also recorded. All data measurements taken were recorded and transferred onto an appropriate site map (Figure 3.3-1).

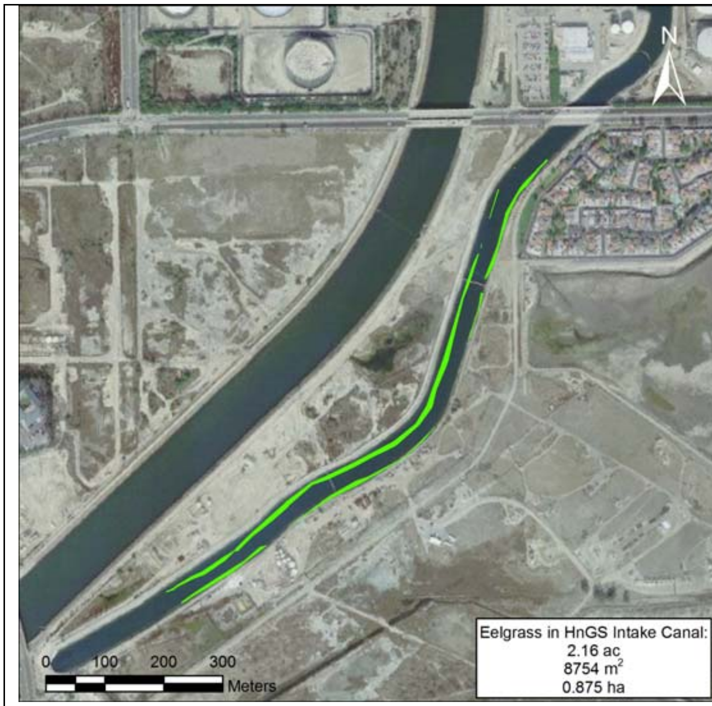

Figure 3.3-1. Position and size of identified eelgrass (*Zostera marina*) beds observed within the Haynes Intake Canal.

3.3.2 Results

About 220 m downstream from where seawater enters the canal from Alamitos Bay (the east side of the Pacific Coast Highway Bridge), eelgrass was found along the steep bank on the northwest of the canal (Figure 3.3-1). Eelgrass was more or less continuous on the northwest bank for more than 800 m, ranging in width from about 2 to 9 m. After a short gap of about 10 m, eelgrass was noted for another 10 m, then a 50-m gap was followed by a 60-m long narrower strip of eelgrass before finally ending. Beginning about 10 meters further down canal on the equally steep southeast bank, eelgrass was observed with the width of the bed ranging from 1.5 to 7 m; eelgrass was patchier than on the other side with the first strip of eelgrass about 175 m in length, followed by a gap of about 50 m. A longer thinner strip about 320 m in length was followed by a gap of about 175 m in length. Intermittent patchy eelgrass was found for the next 80 m, followed by a gap of about 20 m, and was then a continuous eelgrass to the end about 240 m further down canal. All eelgrass was found between Pacific Coast Highway and Westminster Avenue. In total, eelgrass covered 0.875 hectares (2.16 acres) of area along the canal banks. Eelgrass turion (shoot) densities in 20 quadrats (0.125 m^2 each) ranged from 5 to14 turions each and averaged 8 turions per quadrat or about 96 per m^2.

3.3.3 Discussion

Surveys conducted previously in Alamitos Bay had indicated that eelgrass was present throughout much of the bay, but eelgrass had not been found in the San Gabriel River, and had not previously been known to be in the Haynes Intake Canal. In Alamitos Bay, eelgrass is found along the Marine Stadium Channel leading to Colorado Lagoon; in that area, eelgrass covered more than 5.75 acres (CRM 2005). In addition, eelgrass has been found within the entrance channel, and was also found along the southwest shore of Alamitos Bay. A narrow strip of eelgrass is also found along the northeast shore of the bay from the launch ramp to the entrance to Marine Stadium and it is known to occur at other isolated locations within the harbor. During a visit to the Haynes Intake Canal in late-2008, a small strip of subtidal vegetation (that appeared to be eelgrass) was observed along part of the northwest bank; however, no definitive survey was conducted to ascertain the identity of the strip of vegetation. It was determined that a survey should be conducted within the canal to positively identify the vegetation and provide an areal extent of the existing vegetation. In March 2009, a survey to determine the composition of the benthic infauna at three locations in the canal definitively identified the vegetation as eelgrass at two of the three locations surveyed. The eelgrass survey determined that eelgrass was found on both sides of the banks, but was not continuous on either side. However, there were no gaps along the length that were found on both sides of the canal in the same area. Eelgrass started slightly closer to the PCH bridge where sea water entered the canal on the northwest side and persisted for almost 100 m longer on the southeast side.

During the survey, visibility was approximately 3 to 4 m (10 to 13 ft). A variety of fish and invertebrates were observed during the eelgrass survey. Several small California halibut (*Paralichthys californicus*), hundreds of small topsmelt (*Atherinops affinis*), about 10 diamond turbot (*Pleuronichthys guttulatus*), six spotted bass (*Paralabrax maculatofasciatus*), three staghorn sculpin (*Leptocottus armatus*), one speckled sanddab (*Citharichthys stigmaeus*), and many (>100) round stingray (*Urobatis halleri*) were observed on bottom or in the water column. The paper bubble snail *Bulla gouldiana* and the sea slug *Navanax inermis* were frequently observed. The steep slopes of the canal were fine sediments overlaying large gravel. Most of the bottom substrate was sand and shell hash, with areas with large concentrations of clam shells. Large amounts of the green alga sea lettuce (*Ulva* spp) were observed in the shallower portions of the eelgrass bed.

3.4 SEDIMENT GRAIN SIZE

Marine sediment characteristics are affected by both natural and anthropogenic influences. In embayments, reduced water movement allows finer material to settle out of the water column, leading to fine-grained, soft-bottom sediments. In harbor and port areas, however, propeller wash, ship wakes, and discharge streams from industrial sources can suspend and redistribute sediments, while dredging may cause long-term changes in sediment characteristics over a large area.

As part of the Environmental Impact Report (EIR) process for determining any potential impacts of a plan to repower Units 5&6 at the Haynes Generating Station, studies were conducted to determine the baseline conditions of the sediments in Alamitos Bay, San Gabriel River, and the Haynes Intake Canal. The goal of this study was to define spatial variability of sediment parameters in the three areas that will potentially be impacted by a reduction in the amount of water withdrawn and discharged by the HnGS.

3.4.1 Materials and Methods

Stations sampled for the repowering project were a mixture of regularly surveyed stations in the San Gabriel River for an ongoing existing NPDES monitoring program as well as additional stations from Alamitos Bay and the Haynes Intake Canal. Sediment characterization samples were collected at four stations in Alamitos Bay, three in the Haynes Intake Canal, and three in the San Gabriel River (for an ongoing NPDES program) for a total of 10 stations (Figure 3.1-1). In the San Gabriel River, sediments were collected on 19 June 2008 between 0830 and 1130 hours at river Stations B10-B12 as part of the yearly monitoring program. Skies were clear with winds from the northeast at 3 to 5 kn, changing to winds out of the southwest at 5 to 7 kn by late morning. Seas were flat in the vicinity of the San Gabriel River mouth, with swells from the south at 1 to 2 ft. Samples from Alamitos Bay were collected on 11 February 2009. Skies were clear with winds from the northeast at 3 to 5 kn, changing to winds out of the southwest at 5 to 7 kn by late morning. In the Haynes Intake Canal, sediments were sampled on 12 February 2009. Skies were partly cloudy with winds from the northeast at 2 to 3 kn, becoming 5 kn in late morning out of the west. Samples for sediment grain size analysis were collected by biologist-divers with a plastic core tube (15-cm long x 3.5-cm diameter). Core samples were transferred to prelabeled plastic bags for later laboratory analysis. Size distribution of sediment particles were determined using two techniques: laser light diffraction which measures light scattering to determine the sand/silt/clay fraction, and standard sieving for the gravel fraction. Resulting analyses include mean and median grain size, grain size standard deviation, sorting, skewness, and kurtosis. Sediment grain size is reported in phi (Φ), which is inversely proportional to grain diameter. A full description of grain size analytical techniques is presented in MBC (2008a).

3.4.2 Results

Sediments collected from all three stations within the San Gabriel River were dominated by sand, 83.3% on average, followed by 7.9% gravel, 7.5% silt, and 1.3% clay (Table 3.4-1). The finest sediments were collected at Station B12, farthest downriver, the only river station where clay was collected. Coarsest sediments were collected near the discharges at Station B11, with intermediate sediments collected at Station B10, upriver of the discharges. The overall mean grain size of river sediments was 1.02 phi (494 µm, medium sand), ranging from 1.40 phi (379 µm, medium sand) at Station B12, to 0.51 phi (701 µm, coarse sand) at Station B11.

Sorting is a measure of the spread of the particle distribution curve; a value under 0.35 phi indicates the particles are very well sorted (a narrow range of size classes); a value over 4.0 phi indicates that the sediments are extremely poorly sorted (evenly distributed among classes). Poorly sorted sediments are composed of larger number of particle size while moderately sorted sediments are composed of a smaller range of particle size classes (favoring a few size classes). Sorting at the San Gabriel River stations averaged 1.71, or poorly sorted (Table 3.4-1). Sediments at all stations were poorly sorted, with poorest sorting at the two stations downriver of the discharges.

Table 3.4-1. Sediment grain size parameters for samples taken from the source and receiving waters of the HnGS. Alamitos Bay and the Haynes Intake Canal were sampled in February 2009. San Gabriel River stations were sampled in June 2008.

	Alamitos Bay					Haynes Intake Chnl				River Stations				Overall	
Parameter	AB1	AB2	AB3	AB4	Mean	HIC1	HIC2	HIC3	Mean	B10	B11	B12	Mean	Mean	S.D.
% Gravel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.84	16.86	0.00	7.90	2.37	5.53
% Sand	5.48	0.72	15.93	65.17	21.83	61.58	86.61	85.56	77.92	85.46	76.91	87.45	83.27	57.09	35.62
% Silt	79.50	69.17	52.72	30.91	58.08	29.66	10.43	11.80	17.30	7.70	6.23	8.69	7.54	30.68	27.34
% Clay	15.02	30.11	31.35	3.92	20.10	8.76	2.96	2.64	4.79	0.00	0.00	3.86	1.29	9.86	11.86
Mean grain size															
phi	6.02	6.99	6.37	3.67	5.76	3.92	2.8	2.99	3.87	1.31	0.51	1.40	1.07	2.37	2.26
μm	15	8	12	78	28.25	66	143	126	90.81	402	701	379	494	193	229
Sorting (ϕ)	1.533	1.527	2.209	1.445	1.68	2.072	1.144	1.086	1.50	1.573	1.776	1.787	1.71	1.62	0.36
Skewness	0.229	0.173	0.036	0.303	0.19	0.525	0.395	0.29	0.35	0.129	-0.09	0.647	0.23	0.26	0.22
Kurtosis	1.129	0.970	0.774	1.275	1.04	1.095	2.122	1.697	1.49	1.791	1.607	2.624	2.01	1.51	0.57

Skewness is a measure of the symmetry of the particle distribution curve; a value of zero indicates a symmetrical distribution of fine and coarse materials around the median of the curve, while a value greater than zero (positive) indicates an excess of fine material, and a value less than zero (negative) indicates an excess of coarse material. Overall, sediments in the river were positively skewed (0.23), indicating an excess of finer materials in the sediments, although sediments were slightly skewed toward coarse material at Station B11 with a value of -0.09 (Table 3.4-1). Sediments were most strongly skewed at Station B12 (0.65). Sediments at Stations B10 and B11 displayed somewhat trimodal distributions of sediments with primary and secondary peaks in the medium and fine sand categories, respectively, with a third, smaller peak in distribution in the silt/clay category (Appendix C). Sediments at Station B12 displayed an essentially unimodal distribution peaking in the medium sand range, though a small peak in the contribution of clay was also suggested.

Kurtosis is a measure of the peakedness of the particle distribution curve. A kurtosis value of 1.0 represents a normal particle distribution curve while a value greater than 1.0 indicates a leptokurtic (peaked) distribution with better sorting in the central portion of the curve than in the tails. A value less than 1.0 indicates a platykurtic (flattened) distribution and a lack of dominance by any one size category. Mean kurtosis value in the San Gabriel River was 2.01 indicating dominance by few particle ranges (Table 3.4-1). Kurtosis values at all stations were greater than 1.00, indicating leptokurtic (excessively peaked) distributions, with dominance by a narrow range of particle sizes.

Sediments collected in Alamitos Bay were composed primarily of silt with varying amounts of sand and clay. No gravel was found at any of the four Alamitos Bay stations (Table 3.4-1). Overall, the samples from the four Alamitos Bay stations averaged about 22% sand, 58% silt, and 20% clay, with an average mean grain size of 5.17 phi (18 μm, medium silt). Sediments at Station AB4 were considerably coarser than those at the other three stations, averaging 65%

sand and 35% silt and clay (fines which are silt and clay combined) with an average mean grain size of 3.67 phi (78 µm, very fine sand). Sediments at AB2 in the southwest corner of the bay were the finest sediments averaging about 1% sand, 69% silt, and 30% clay, with a mean grain size of 6.99 phi (8 µm, fine silt). The remaining two stations (AB1 and AB3) had fine sediments that were in the fine silt category.

Sorting at the Alamitos Bay stations averaged 1.68 phi overall, indicating poorly sorted sediment (Table 3.4-1). Sediments ranged from 1.45 phi (poorly sorted) at Station AB4 to 2.21 phi (very poorly sorted) at Station AB3.

Skewness was positive at Alamitos Bay stations, averaging 0.19, and indicating smaller particle diameters or an excess of fine material (Table 3.4-1). Skewness ranged from 0.036 at Station AB3 to 0.303 at Station AB4. The particle distribution curves at all Alamitos Bay stations were unimodal with modes ranging from the fine sand to silt categories. There were pronounced tails at two stations with the tail at Station AB3 extending from the clay mode through the silt and into the fine sand designation, while at Station AB4 a very robust tail extended from the fine sand mode through the silt and into the clay category (Appendix C).

Kurtosis values at the Alamitos Bay stations ranged from 0.77 at Station AB3 to 1.28 at Station AB4, and averaged 1.04 (Table 3.4-1 and Appendix C). Kurtosis values at two of the four stations value exceeded 1.0, with a greater proportion of the sediments near the center of the distribution curve, while one station (AB2) had a near normal distribution and the other (AB3) station had a more platykurtic (flattened) distribution with a lack of dominance by any one size category.

Sediments collected from the three stations within the Haynes Intake Canal were dominated by sand, 77.9% on average, followed by 17.3% silt and 4.8% clay (Table 3.4-1). The finest sediments were collected at Station HIC1, at the marina entrance (at the seawater intake) to the canal. Coarsest sediments were collected at Station HIC2, halfway between the canal entrance and the intakes at Haynes Generating Station, with intermediate sediments collected at HIC3, closest to the intakes. The mean grain size of canal sediments was 3.46 phi (91 µm, very fine sand), ranging from 2.80 phi (143 µm, fine sand) at Station HIC2, to 3.92 phi (66 µm, very fine sand) at Station HIC1 .

The mean sediment sorting at the Haynes Intake Canal stations was 1.50, or poorly sorted (Table 3.4-1). Sediments at Stations HIC2 and HIC3 were poorly sorted, with very poorly sorted sediments at Station HIC1.

Overall, sediments in the canal were positively skewed (0.35), indicating an excess of finer materials in the sediments (Table 3.4-1). Sediments were most strongly skewed at Station HIC1 (0.53). Sediments at all stations displayed essentially unimodal distributions of sediments with primary modes in the fine sand categories and tails into the silt and clay categories. Although Station HIC1 sediments were essentially unimodal, it did have a particularly robust tail in the silt and clay categories while a small secondary peak in the clay category was also suggested.

Mean kurtosis value in the Haynes Intake Canal was 1.49 indicating dominance by few particle ranges (Table 3.4-1). Kurtosis values at all stations were greater than 1.00, indicating leptokurtic (excessively peaked) distributions, with dominance by a narrow range of particle sizes.

3.4.3 Discussion

Sediments were collected and analyzed from the San Gabriel River (collected during an earlier ongoing NPDES study), Alamitos Bay, and Haynes Intake Canal. Sediments from all three areas varied between the distinct water bodies. The river and intake canal sediments were predominantly composed of sand, although upriver sediments had relatively high proportions of gravel, and the intake canal had relatively large amounts of fines (silt and clay). Alamitos Bay sediment samples were composed primarily of silt with varying amounts of sand and clay.

Slightly coarser-than-average sediments were found in the San Gabriel River in 2008 (MBC 2008a). During years of normal or dry flow in such as occurred in 2006, 2007, and 2008 the percentage of fine material in the sediments begins to accumulate. Typically during wet years, runoff increases storm flow and removes the finer sediments from the river bottom, leaving sediments that are coarser. In the Haynes Intake Canal, sediment likely accumulates in the canal during years of increased runoff and settles differentially onto the canal bottom depending upon current speed in the canal which is dependent upon the power plant operations. During low flow periods, sediments are deposited more rapidly near the entrance to the canal at the PCH bridge, whereas during high flow conditions, sediments may stay suspended for longer periods and be deposited further along the canal towards Westminster bridge. Sediments were finer at the entrance portion of the canal than at the two stations closer to the generating station, suggesting that flow rates are sufficiently low to allow the finer particles to settle near the canal entrance. Sediments in Alamitos Bay were typical of bay environments with higher proportions of fines than found in the more dynamic river or canal environments. The pattern of distribution of sediment size in the bay is consistent with the stations location in the bay. Coarser sediments were found where tidal action and currents would be greatest (Station AB4) and were lowest where tidal influences were weaker. In general, sediments throughout the study area would be expected to be somewhat variable among years as has been observed in the long-term record in the San Gabriel River (MBC 2008a). This variability is not unexpected in shallow subtidal marine environments that are exposed to changeable weather conditions producing runoff and complicated by the movement of water through the bay and down channels such as the river and the intake canal.

Sediment characteristics in the study area appear to be primarily affected by naturally occurring oceanographic and seasonal weather conditions. Yearly rainfall affects the amount of sediment washed down the river into San Pedro Bay and via storm drains into the back of Alamitos Bay. Tidal actions distribute the sediments within Alamitos Bay where ultimately a portion, depending on the withdrawal rate from the HnGS circulator pumps, enters the Haynes Intake Canal; mean annual sediment discharge into the marine environment by the San Gabriel River was estimated to be about 1,200,000 tons per year (Dailey et al. 1993). However, during periods of low rainfall, this total is greatly reduced and during very wet periods, it will substantially increase.

3.5 INTERTIDAL COMMUNITY

Depending on substrate, the intertidal community is composed of a suite of plants and animals adapted to a wide range of unique, sometimes severe, physical conditions. The abundance and composition of the community is strongly determined by several physical factors, primarily duration of tidal immersion (exposure to air), substrate characteristics, surface water temperature, and wave action, as well as biological factors such as availability of food and competition (Doty 1971, Murray and Brey 1993). Hard-substrate communities consist primarily of sessile (attached) and motile plants and animals, while soft-substrate communities consist primarily of burrowing organisms.

Few studies have examined the intertidal communities in the vicinity of the Haynes Generating Station. Therefore, intertidal studies were performed in early 2009.

3.5.1 Materials and Methods

The intertidal biota on the rock riprap in Alamitos Bay was surveyed on 5 February 2009. (The rocky intertidal in the Haynes Intake Canal was not surveyed because all of the substrate was covered by a layer of silt and mud.) Station HM, at the Harbor Master's office near the entrance to the bay, was examined from 0855 to 1116 hr, and Station NLR, on Stadium Way northwest of the North Alamitos Bay launch ramp, was examined from 1145 to 1320 hr (Figure 3.1.1). Two tidal levels, +1 ft and +3 ft MLLW (mean lower low water), representing the lower- and mid-intertidal zones, respectively, were evaluated. At each tidal level, a meter tape was laid parallel to the water's edge, and four replicate sampling locations were randomly selected along a 25-m horizontal transect. At each replicate location, the flora and fauna at 40 random points within a 0.125-m2 quadrat were identified and recorded, for a total of 160 contact point at each tidal level. Percent cover was calculated by dividing the number of times a species was contacted at each level by 160. Extralimital observations (species that occurred in the quadrat but were not contacted at any of the random points) were also recorded. This random point method was originally developed for and is commonly applied in vegetation analyses, and has been used in the Long Beach Generating Station's Marine Monitoring and NPDES programs since 1974 (Gonor and Kemp 1978, MBC 2008a).

Samples for study of the intertidal sand- and mudflat communities in Alamitos Bay and the Haynes Intake Canal were taken at two tidal levels, +1 ft and +3 ft MLLW. Alamitos Bay was sampled on 23 February 2009, between 1230 and 1342 hr, at three locations: Station ABS1, on the Alamitos Peninsula near the bay entrance; Station ABS2, in the northwest corner of Alamitos Bay; and Station ABS3, on Naples Island along the Marine Stadium Channel (Figure 3.1-1). The Haynes Intake Canal was sampled on 26 March 2009, between 1430 and 1545 hr, at three locations: Station HICS1, near the southwest end of the canal; Station HICS2, midway between the southwest end of the canal and Westminster Avenue; and Station HICS3, just south of Westminster Avenue. Two samples were taken at each tidal level, using a round corer 20 cm in diameter (0.0314 m2) and 50 cm long (MBC 1999a). A sample depth of 30 cm was attempted at all locations, but several sample depths were less than 30cm due to the presence of rocks below the surface of the sediment. Samples were washed on a 6-mm mesh screen with clear seawater, and all retained organisms were preserved in buffered formalin and returned to the laboratory for identification.

3.5.2 Results

The rocky intertidal communities at the two study locations were comprised of two species of algae and 21 animal species in five phyla, including extralimital species (Appendices D-2 and D-3). Of the thirteen species counted at contact points, two (one red and one green alga) were primary producers, two (the *Lottia* limpets) were herbivores, one (the tubesnail *Serpulorbis squamigerus*) was a deposit feeder, and eight (barnacles, clams, ectoproct bryozoans, tubeworms, and tunicates) were filter feeders (Table 3.5-1).

Ten species were counted at Station HM, and a similar number, nine, were counted at Station NLR. More species were counted at the +1-ft level (eight at Station HM and nine at Station NLR) than at the higher +3-ft level (six species at Station HM and only two species at Station NRL).

The amount of available substrate covered by organisms was three times greater at Station HM (55%) than at Station NLR (18%). Percent cover was slightly greater at the +3-ft level than at the +1-ft level at Station HM, but it was much greater at the lower level than at the upper level at Station NLR.

Shannon-Wiener species diversity (H') was greater at Station HM than at Station NLR, but at each tidal level, diversity was greater at Station HM. At both study locations, diversity was greater at the lower tidal level than at the higher level.

Table 3.5-1. Rocky Intertidal abundance near the Harbor Master dock (HM) and near the launch ramp (NLR) by tidal level in Alamitos Bay, 2009.

Phylum	Species	Feeding Type	HM +1	HM +3	NLR +1	NLR +3	Overall Total	Percent Total
AR	*Chthamalus fissus*	F	40	52	1	4	97	41.99
MO	*Mytilus galloprovincialis*	F	-	12	30	-	42	18.18
AR	*Balanus glandula*	F	5	23	5	3	36	15.58
EP	*Watersipora arcuata*	F	20	5	1	-	26	11.26
RH	*Liagora californica*	PP	5	-	4	-	9	3.90
MO	*Serpulorbis squamigerus*	DF	5	-	1	-	6	2.60
AN	Serpulidae	F	-	-	3	-	3	1.30
CH	*Ulva* spp	PP	-	-	3	-	3	1.30
MO	*Lottia scabra*	H	1	2	-	-	3	1.30
MO	*Mytilus californianus*	F	-	2	-	-	2	0.87
MO	*Pseudochama exogyra*	F	2	-	-	-	2	0.87
CO	*Styela plicata*	F	1	-	-	-	1	0.43
MO	*Lottia limatula*	H	-	-	1	-	1	0.43
Number of Contacts			79	96	49	7	231	
% Cover			49	60	31	4	36	
Station % Cover			55		18			
Number of species			8	6	9	2	13	
Station number of species			10		9			
Common to both levels			4		2			
Diversity (H')			1.42	1.25	1.40	0.68	1.73	
Station Diversity (H')			1.50		1.55			

Feeding types: DF = deposit feeder, F = filter feeder, H = herbivore, PP = primary producer

The brown acorn barnacle, *Chthamalus fissus*, was the overall most abundant species counted. However, it was encountered primarily at Station HM, and was scarce at Station NLR. In addition to brown acorn barnacles, the white acorn barnacle, *Balanus glandula*, and the encrusting bryozoan *Watersipora arcuata*, the third and fourth most abundant species, respectively, were also more abundant at Station HM. Second most abundant was the bay mussel *Mytilus galloprovincialis*, which was more abundant at Station NLR. The other nine species counted were much less abundant than the top four community dominants.

Twenty-four infaunal species were found in the intertidal zone in Alamitos Bay and the Haynes Intake Canal (Appendix D-1). Results of the Alamitos Bay sandflat sampling were similar among stations (Table 3.5-2, Appendices D-2 and D-3). Animals were found only in the cores taken at the +1-ft level. Twenty-one species were collected: 10 species and 23 individuals (366 individuals/m^2) at Station ABS1, nine species and 21 individuals (334 individuals/m^2) at Station ABS2, and ten species and 28 individuals (446/m^2) at Station ABS3. Mean density for the +1-ft level at all stations was 382 individuals/m^2 (191 individuals/m^2) for all stations and both levels combined). Large clams were taken only at Station ABS3: one California Venus (*Chione californiensis*) and two Japanese littlenecks, also called Manila clams (*Venerupis philippinarum*). Due to the presence of the clams, biomass was highest at Station ABS3 (853 g/m2). Biomass was lowest at Station ABS2 (4 g/m^2), and intermediate at Station ABS1 (43 g/m^2) where three purple dwarf olives (*Callianax biplicata*) were found. The polychaete annelids *Scoloplos acmeceps*, *Pseudopolydora paucibranchiata*, and *Notomastus tenuis* were the most abundant and widespread species in the bay, with 96, 74, and 37 individuals/m^2, respectively, at the +1-ft level.

Table 3.5-2. Abundance and number of species of intertidal infauna invertebrates for Alamitos Bay (AB) and Haynes Intake Canal (HIC), 2009.

Station	ABS 1		ABS 2		ABS 3		HICS 1		HICS 2		HICS 3	
Tidal Level (ft MLLW)	+1	+3	+1	+3	+1	+3	+1	+3	+1	+3	+1	+3
Core Depth (cm)	30	28	30	26	30	25	21	24	29	24	10	20
Number of Individuals												
Phylum												
Annelida	16	-	19	-	24	-	1	-	1	-	-	-
Arthropoda	-	-	1	-	1	-	-	-	-	-	-	-
Mollusca	3	-	-	-	3*	-	1	-	-	-	5	1
Nemertea	1	-	1	-	-	-	-	-	-	-	-	-
Phoronida	3	-	-	-	-	-	-	-	-	-	-	-
Number of species	10	-	9	-	10	-	2	-	1	-	1	1
Number of Individuals	23	-	21	-	28	-	2	-	1	-	5	1
Density (no/m^2)	366	-	334	-	446	-	32	-	16	-	80	16
Biomass (g/m^2)	43	-	4	-	853	-	11	-	16	-	33	5

* One *Leukoma staminea* , shell length 33 mm; two *Venerupis philippinarum* , shell lengths 36 and 48 mm.

Only four species were taken from the mudflats in the Haynes Intake Canal. Most of the individuals were found at the +1-ft level: two species, each with one individual (32 individuals/m^2) at Station HICS1; one species and only one individual (16/m^2) at Station HICS2; and one species with five individuals (80/m^2) at Station HICS3. Animals were found at the +3-ft level in the canal at only one location, Station HICS3 (one species with only one individual (16 individuals/m^2). Mean density at the +1-ft level was 43 individuals/m^2, and for the +3-ft level, five individuals/m^2; density was for all stations and levels combined was 24 individuals/m^2. The most abundant species taken in the canal was Gould's paperbubble (*Bulla gouldiana*), with five individuals (80 individuals/m2) at the +1-ft level at Station HICS3. Biomass was highest at Station HICS3 due to the paperbubbles (33 g/m*2* at the +1-ft level). Gould's paperbubbles can become quite large, but all of the individuals collected in the March survey were small. No large clams were collected in the canal. Only one species, the polychaete *Hemipodia borealis*, occurred in both Alamitos Bay and the Haynes Intake Canal.

3.5.3 Discussion

Abundance, species richness, and diversity were all greater at Station HM, near the entrance to Alamitos Bay, than at Station NLR, farther inside the bay. These differences are probably due to varying water quality conditions within Alamitos Bay, with better water quality expected at Station HM, where better exchange of ocean water is likely because of its location near the bay entrance.

The intertidal communities at the two study locations in Alamitos Bay were not abundant, particularly in comparison with a recent survey of the rocky intertidal biota in Long Beach Harbor

(MBC 2008a). However, species richness and diversity values were similar to those for the Long Beach Harbor study.

In November 2003, the rocky intertidal communities were examined on the riprap at three locations along the San Gabriel River (Edaw/MBC 2004). In that study, the same methods were used as in Alamitos Bay, except that five quadrats were used along each transect, and the -1-ft tidal level was counted in addition to the +1-ft and +3-ft levels. Eight species were counted at the +1-ft and +3-ft levels only: six species at the Pacific Coast Highway station (five at the +1-ft level and two at the +3-ft level), four species at the Westminster Bridge station (four at the +1-ft level and two at the +3 ft-level), and three species at the 7th Street crossing (one at the +1-ft level and two +3-ft level). Green algae, such as *Ulva* spp, *Enteromorpha* sp, and *Ulothrix* sp, were the most abundant species, followed by an annelid worm (*Thelepus crispus*), the limpet-like spiny cup-and saucer (*Crucibulum spinosum*), and brown acorn barnacle. Abundance, as percent cover, was greater in the river than in Alamitos Bay, ranging from a mean of 60% at the two upper tidal levels at Westminster Bridge to 85% cover at 7th Street. At all locations, species diversity was low, ranging from a mean of 0.07 at 7th Street to a mean of 0.78 at Westminster Bridge, primarily due to the overwhelming dominance of the communities by the three species of algae. Only the diversity value at the lower tidal level at Station NLR in Alamitos Bay was lower than any of the values for the San Gabriel River.

The biota in the intertidal sediments in Alamitos Bay was considerably different from that in the Haynes Intake Canal, in terms of abundance (nine times more animals were found at the +1-ft level in Alamitos Bay than at the same level in the Haynes Intake Canal), species richness, and community composition. These dissimilarities are probably due to the difference in sediment characteristics. Observation of the sediments during sampling showed that the Alamitos Bay intertidal sediments were primarily sand, while those in the Haynes Intake Canal were mostly silt, with some sand and clay. Sediment grain size is important, as it influences properties such as ease of burrowing, availability of suitable particles for constructing burrows or tubes, and the amount of organic food material.

Two locations with intertidal mudflat habitat in the vicinity of the study region have been investigated in the past, using the same method as in Alamitos Bay and Haynes Intake Canal. Shoreline Lagoon (also called Shoreline Aquatic Park) was sampled in 1994 and 1996. In both surveys, three stations and five tidal levels (+2 ft to -2 ft) were sampled. In 1994, five species were found at the +1-ft and +2-ft tidal levels, with a mean density of organisms of 387 individuals/m^2. In 1996, four species were found at the same tidal levels, with a mean density of 143 individuals/m^2. California tagelus (*Tagelus californianus*) was the most abundant species in both surveys, with a mean density of 370 individuals/m^2 in 1994 and 326/m^2 in 1996. Bay ghost shrimp (*Neotrypaea californiensis*) were also abundant, with 11 individuals/m^2 in 1994 and 88/m^2 in 1996. Shoreline Lagoon was modified as part of the City of Long Beach's ocean waterfront development, and is now called Rainbow Harbor.

The second location investigated was Golden Shore Marine Reserve, which was created in 1997 as mitigation for the loss of intertidal habitat at Rainbow Harbor. Golden Shore Marine Reserve is west of Rainbow Harbor, near the mouth of the Los Angeles River. The mudflat habitat at that site was sampled yearly from 1998 to 2002 at three stations and two tidal levels, +2 ft and -1 ft MLLW (MBC 1999b-2003b). Because the Reserve was so new, only a few large organisms, primarily clams, had successfully recruited to the mudflats, even five years after establishment. No animals were found at the +2-ft level in 1998 and 2002. In 1999, Japanese mussel (*Musculista senhousia*) was found at a density of 16/m^2. Pacific littleneck (*Leukoma staminea*) was found in 2000 and 2001, at a density of 5/m^2 in both surveys, and California softshell (*Cryptomya californica*), California tagelus, and Guaymas solecurtus (*Solecurtus guaymasensis*) were found in 2001, each at a density of 5/m^2. The density of all animals in 2001 was 21 individuals/m^2.

Mean density of intertidal mudflat organisms in Alamitos Bay was much greater than in Golden Shore Marine Reserve (through 2002), but was about one-half that in the former Shoreline Lagoon. However, Alamitos Bay was sampled at the +3-ft level, higher than in any of the other studies. Based on the density at the +1-ft level only, density of organisms in Alamitos Bay was equivalent to that in Shoreline Lagoon. Density of organisms in the Haynes Intake Canal was only about 13% of that in Alamitos Bay and was only slightly greater than in Golden Shore Marine Reserve. None of the species found in the intertidal biota surveys is listed as endangered, threatened, or of special concern.

3.6 INFAUNAL COMMUNITY

The benthic infauna, invertebrates that live in the bottom sediments, are an important part of the marine ecosystem. These animals are an important food source for fish and larger invertebrates, and contribute to nutrient recycling. Some species are highly sensitive to the effects of human activities, while others thrive under altered conditions.

The infaunal community offshore Alamitos Bay and within the lower San Gabriel River is sampled annually as part of the NPDES receiving water monitoring program for the HnGS and AGS (MBC 2008a). Additional sampling was performed in 2009 to document the infaunal communities within Alamitos Bay and the Haynes Intake Canal.

3.6.1 Materials and Methods

Biologist-divers collected sediment samples for infauna analysis at four stations in Alamitos Bay (Stations AB1 through AB4) on 11 February 2009 and at three stations in the Haynes Intake Canal (Stations HIC1 through HIC3) on 12 February 2009 (Figure 3.1-1). Samples were taken between 0859 and 1150 hr on 11 February, and between 1017 and 1230 hr on 12 February. Winds were light on 11 February, from the NE at 2 to 5 kn, and were calm on 12 February; skies were partly cloudy to clear on both days. Three replicate samples were taken at each station using a diver-operated box corer, which takes a uniform sample of 10 cm x 10 cm x 10 cm for a sample volume of 1.0 liter. Samples were washed in the field on a 0.5-mm mesh stainless-steel screen, labeled, and fixed in buffered 10% formalin-seawater.

In the laboratory, samples were rescreened through a 0.25-mm mesh sieve, transferred to 70% isopropyl alcohol, sorted to major taxonomic groups, identified to the lowest practical taxonomic level, and counted. Identifications and nomenclature followed the usage accepted by the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT 20008). Following identification, samples were weighed by major group.

Included in the results are data from the infauna sampling at three locations in the San Gabriel River for the HnGS and AGS NPDES 2008 Annual Receiving Water Monitoring Program. Those samples were collected on 19 June 2008, using the same method as described above (MBC 2008a). However, only two replicates were taken at each river station in 2008 (instead of four replicates in most other years) due to the reduced sampling as a resource exchange to enable regional monitoring of the Southern California Bight. For purposes of comparison, abundance data are also given as density (number of organisms per m^2).

3.6.2 Results

Numbers of species collected totaled 93 in Alamitos Bay and 68 in the Haynes Intake Canal, compared with a total of 64 species in the San Gabriel River (Table 3.6-1, Appendices E-2 through E-4). A mean of 47 species per station was found in Alamitos Bay, with a replicate mean of 27 species per sample. The highest species richness (59 species) was found at Station AB1, near the Alamitos Bay entrance. The lowest species richness (41 species) was at Station AB4, at the easternmost part of the bay, not far from the entrance to the Haynes Intake Canal. A similarly low number (42 species) was found at Station AB2, at the westernmost portion of the bay.

Table 3.6-1. Infaunal community parameters for Alamitos Bay and Haynes Intake Canal, February 2009, and San Gabriel River, June 2008.

	Alamitos Bay Infauna (ABI)						Haynes Intake Canal (HICI)					San Gabriel River				
Parameter	ABI1	ABI2	ABI3	ABI4	Totals	Mean	HICI1	HICI2	HICI3	Totals	Mean	B10	B11	B12	Totals	Mean
Number of species																
Total	59	42	47	41	93	47	41	41	39	68	40	23	44	39	64	35
Mean	34	23	24	24		27	24	24	22		23	17	34	29		27
S.D.	1	6	2	8			5	3	2			0	9	8		
Number of individuals																
Total	461	483	426	321	1,691	423	2423	1977	3053	7,453	2,484	667	1,844	3,000	5,511	1,837
Mean	154	161	142	107		141	808	659	1018		828	334	922	1,500		919
S.D.	44	51	79	49			398	268	279			125	421	380		
Density (#/m^2)						14,092					82,811					91,867
Diversity (H')																
Total	3.10	1.87	2.14	2.38		2.37	1.52	1.25	1.12		1.30	2.22	1.74	1.42		1.79
Mean	2.43	1.40	1.61	1.96		1.85	1.34	1.26	0.97		1.19	2.05	1.70	1.35		1.70
S.D.	1.19	0.58	0.72	1.16			0.44	0.64	0.15			0.22	0.00	0.19		
Biomass (g)																
Total	1.58	5.13	3.98	0.83	11.52	2.88	13.40	65.10	46.99	125.49	41.83	0.89	196.39	19.61	216.88	72.29
Mean	0.53	1.71	1.33	0.28		0.96	4.47	21.70	15.66		13.94	0.45	98.20	9.80		36.15
S.D.	0.25	1.38	1.85	0.15			5.63	36.25	14.18			0.29	16.91	7.43		
Density (#/m^2)						95.97					1,394.36					3,614.88

Means of 40 species per station and 23 species per replicate were found in the Intake Canal. The numbers of species were similar among stations, with 41 species taken at both Stations HIC1 (farthest south) and HIC2 and 39 species at HIC3 (farthest north in the area studied).

In the San Gabriel River in 2008, species richness averaged 35 species per station and 27 species per replicate. The numbers of species were much greater at the two stations downriver of the generating stations (44 species at Station B11, near Westminster Boulevard and 39 species at Station B12, near Pacific Coast Highway) than at Station B10, upriver of the generating stations. Considering only the two downriver stations (the upriver station receives substantial freshwater input), the mean number of species per replicate was 32.

Only 1,691 individuals were collected at the four stations in Alamitos Bay, with a mean of 423 individuals per station, compared with a total 7,453 individuals in the Haynes Intake Canal, with a mean of 2,484 individuals per station (Table 3.6-1). Replicate means were 141 individuals in Alamitos Bay (14,092 individuals/m^2) and 828 individuals in the Intake Canal (82,811 individuals/m^2). Abundance in the San Gabriel River was also greater than in Alamitos Bay, with a total of 5,511 individuals and a station mean of 1,837 individuals (919 individuals per replicate, or 91,867 individuals/m^2). At the two downriver stations only, abundance was even higher, averaging 2,422 individuals per station, or 1,211 individuals per replicate (121,100 individuals/m^2).

Shannon-Wiener species diversity (H') averaged 2.37 per station (1.85 per replicate) for the four Alamitos Bay stations, and 1.30 per station (1.19 per replicate) for the three Haynes Intake Canal stations. Diversity values averaged 1.58 (1.52 per replicate) for the two downriver stations in the San Gabriel River.

Wet-weight biomass of infaunal organisms totaled 11.52 g in Alamitos Bay (2.88 g per station, or 0.96 g per replicate) and 125.49 g in the Haynes Intake Canal (41.83 g per station, or 13.94 g per replicate). Biomass was considerably greater in the San Gabriel River, with a total of 217 g (216 g for the two downriver stations, with 108.00 g per station, or 54.00 g per replicate). A substantial portion (93%) of the biomass for the Haynes Intake Canal samples was contributed by large clams: one Japanese littleneck (*Venerupis philippinarum*, sometimes also called Manila clam) at Station HIC1, and one Pacific (or common) littleneck (*Leukoma staminea*) and one California venus (*Chione californiensis*) each at both Stations HIC2 and HIC3 (Appendix E-3). An even greater portion (96%) of the biomass for the two downriver stations in the San Gabriel River was contributed by 41Japanese littlenecks.

Community composition was somewhat different among the three sampling areas in the study region (Table 3.6-2, Appendices E-2 and E-3). However, most of the 20 most abundant species (or taxa) in the study region were found in all three of the environments. These top 20 species comprised 92% of all individuals in the collections. The most abundant taxon, unidentified oligochaetes (a type of segmented worm) comprised 36% of all individuals taken. Oligochaetes were most abundant in the Haynes Intake Canal. Unidentified nematodes (round worms), comprising 32% of all individuals in the study region, were second most abundant in the Haynes Intake Canal, but they were the most abundant taxon in the San Gabriel River, followed by the polychaete *Streblospio benedicti* and oligochaetes. On the other hand, the polychaete *Euchone limnicola* was the most abundant species in Alamitos Bay, the only area where it occurred. Another polychaete, *Mediomastus ambiseta*, was second most abundant in Alamitos Bay, and it was also moderately abundant in the Haynes Intake Canal but was scarce in the river. Overall, three abundant species (spiny cup-and-saucer, *Crucibulum spinosum*; the polychaete *Polydora cirrosa*; and the amphipod *Monocorophium insidiosum*) were found only, or almost exclusively, in the river; one species, the ostracod *Postasterope barnesi* was found primarily in the Haynes Intake Canal; and two species, *Euchone limnicola* and another polychaete, *Leitoscoloplos pugettensis*, were found only, or almost exclusively, in Alamitos Bay. Five species, the amphipod *Acuminodeutopus heteruropus*, the ostracod *Euphilomedes carcharodonta*, the polychaetes *Exogone lourei* and *Prionospio heterobranchia*, and the brittlestar *Amphipholis squamata*, occurred only, or almost exclusively, in both Alamitos Bay and the Haynes Intake Canal but not in the San Gabriel River.

Table 3.6-2. The 20 most abundant infaunal species collected in Alamitos Bay and Haynes Intake Canal, February 2009, and San Gabriel River, June 2008.

		Alamitos Bay (ABI)					Haynes Intake Canal (HICI)				San Gabriel River			
Phy	Species	ABI1	ABI2	ABI3	ABI4	Total	HICI1	HICI2	HICI3	Total	B10	B11	B12	Total
AN	Oligochaeta	1	3	4	8	16	1391	1406	2093	4890	77	181	63	321
NT	Nematoda	51	8	5	5	69	553	244	612	1409	188	1100	1896	3184
AN	*Streblospio benedicti*	-	-	-	-	-	6	8	5	19	100	129	466	695
AN	*Euchone limnicola*	87	297	236	23	643	-	-	-	-	-	-	-	-
AN	*Mediomastus ambiseta*	53	18	16	148	235	24	13	68	105	-	-	3	3
MO	*Crucibulum spinosum*	-	-	-	-	-	-	1	-	1	4	110	157	271
AN	*Scoloplos acmeceps*	-	-	-	-	-	1	2	5	8	1	32	160	193
AR	*Acuminodeutopus heteruropus*	29	6	9	3	47	38	78	30	146	-	-	-	-
AN	*Neanthes acuminata* Cmplx	-	-	-	-	-	56	26	2	84	39	34	22	95
AR	*Postasterope barnesi*	1	1	1	1	4	85	39	40	164	-	2	-	2
AR	*Euphilomedes carcharodonta*	17	2	1	22	42	50	4	72	126	-	1	-	1
AN	*Capitella capitata* Cmplx	-	-	-	-	-	48	20	3	71	56	14	-	70
AN	*Polydora cirrosa*	-	-	-	-	-	-	-	-	-	55	11	24	90
AN	*Pseudopolydora paucibranchiata*	20	8	2	3	33	1	1	-	2	1	6	47	54
AN	*Exogone lourei*	11	-	1	15	27	19	26	13	58	-	1	-	1
MO	*Barleeia haliotiphila*	-	-	-	-	-	2	32	8	42	-	39	3	42
AR	*Monocorophium insidiosum*	-	-	-	-	-	-	-	-	-	65	-	-	65
AN	*Prionospio (Prionospio) heterobranchia*	26	12	16	2	56	2	3	1	6	-	-	-	-
EC	*Amphipholis squamata*	-	3	5	2	10	10	18	23	51	-	-	-	-
AN	*Leitoscoloplos pugettensis*	9	20	25	1	55	-	-	-	-	-	-	-	-

Key: Phy = Phylum, AN = Annelida, AR = Arthropoda, NT = Nematoda, MO = Mollusca, EC = Echinodermata

3.6.3 Discussion

Several factors may have influenced the size and composition of the infaunal communities found in the study region. These included, but are not limited to, sediment characteristics, food availability, disturbance, sediment contaminants, and water quality. Sediment grain size, in particular, is especially important, as it influences properties such as ease of burrowing, availability of suitable particles for constructing burrows and tubes, and the amount of organic food material. Generally, higher species richness has been associated with finer and/or more poorly sorted sediments. This relationship was seen to some extent for the infauna samples from Alamitos Bay and the Haynes Intake Canal: species richness was slightly greater and species diversity was considerably greater in Alamitos Bay, where sediments were finer than in the Haynes Intake Canal. However, species richness in the San Gabriel River was as high as in Alamitos Bay (at the two downriver stations, it was even greater than in the bay), even though sediments in the river were extremely coarse. (Mean species richness in the river in 2008 was slightly greater than the long-term mean of 24 species per replicate, based on yearly summer sampling in the river since 2001 [MBC 2001a-2004a, 2005-2007].) In addition, abundance was lowest where sediments were finest (in Alamitos Bay) and highest where sediments were coarsest (in the river). (Abundance in the river in 2008 was slightly lower than the long-term mean.) Large clams were also more abundant where sediments were coarser. The relatively low species diversity values for the Haynes Intake Canal and river communities were due to the strong numerical dominance of the communities by a single species, oligochaetes in the case of the Haynes Intake Canal and nematodes in the San Gabriel River, particularly downriver of the generating stations. In the past, the river communities have been strongly dominated by the amphipods *Monocorophium acherusicum*, *M. insidiosum*, and *Grandidierella japonica*, as well as by oligochaetes and the polychaetes *Capitella capitata* Cmplx, *Scoloplos acmeceps*, and *Polydora cirrosa*.

Communities dominated by oligochaete and nematode worms generally suggest environmental stress, such as disturbance of the sediments, occasional lower salinity, or low oxygen concentrations in the water. However, despite the dominance by oligochaetes, the community in the Haynes Intake Canal (and in Alamitos Bay) contained many abundant species that also occur offshore (MBC 2008a). No endangered, threatened or other category of sensitive species was found in the infaunal communities in Alamitos Bay or the Haynes Intake Canal.

3.7 ICHTHYOPLANKTON

Ichthyoplankton consists of fish eggs and larvae. Most of the fishes in the vicinity of the HnGS cooling water intake produce free floating larvae as an early life stage, a notable exception, among others, being the surfperches which bear well-developed live young. Planktonic larval development promotes dispersal of the population but also puts larvae at risk of entrainment in cooling water systems. Some fishes (e.g., croakers, flatfishes, anchovies) broadcast eggs directly to the water column where they develop in a free-floating state until hatching into the larval form. In this case, both eggs and larvae are potentially susceptible to entrainment. Some fishes deposit adhesive eggs onto substrate (e.g., gobies, sculpins) or brood eggs internally until larvae are extruded (e.g., rockfishes, pipefishes); in these cases, only the larvae are potentially susceptible to entrainment.

Recent studies have documented the ichthyoplankton of Alamitos Bay. These include an eight-week, day/night study at the HnGS intake structure (MBC 2004b) and a year-long study in Alamitos and San Pedro Bays in 2006 (MBC et al. 2007). Additional sampling was performed in 2009 to document the ichthyoplankton composition and density within Alamitos Bay, the Haynes Intake Canal, and at the mouth of the San Gabriel River.

3.7.1 Materials and Methods

Ichthyoplankton was sampled during each diel period (day and night) between 12 and 13 February 2009 at all eight stations (Figure 3.1-1). Station HIC3 was only sampled at night. Two types of sampling equipment were used, one deployed from a vessel (AB1, AB2, AB3, and SGR) and one towed by walking along the shoreline or across a bridge (AB4, HIC1-3). Boat sampling was completed using a 60-cm paired wheeled bongo frame fitted with 333-μm mesh nets and a calibrated General Oceanics flowmeter in each opening to document the volume filtered. Shoreline sampling was completed with a 0.5-m ring frame, also fitted with a 333-μm mesh net and General Oceanic flowmeter. One oblique tow was made by the boat at each station during each diel period with both nets processed as individual replicates per the methods described in MBC et al. (2007). Two replicate oblique shoreline tows were made at each station with sample processing also consistent with MBC et al. (2007). Sample volumes (m^3) were calculated for each replicate based on flowmeter revolutions and prior calibrations. All data is presented, by taxon, as mean density (#/1000 m^3) for each station. Station totals represent the summation of means across the three analysis periods: total, day, and night. Shannon-Weiner species diversity index was calculated based on the mean densities. Appendices F1 through F3 list the taxonomic groups taken and the catch by species and by replicate as well as the total water volume filtered.

In the laboratory, all samples were sorted to remove fish eggs and larvae, megalops stage crab larvae, squid paralarvae, and phyllosoma stage California spiny lobster (*Panulirus interruptus*)larvae. All samples were identified to the lowest practical taxon. Larval fish were typically identified to species, although differentiation between three goby genera (*Clevelandia, Ilypnus,* and *Quietula*) are especially problematic and are typically included in the taxonomic group goby A/C. Fish egg taxonomy is significantly problematic with few species easily identifiable past the taxonomic Family level.

3.7.2 Results

Overall,1,717 larval fish/1000 m^3 representing 20 taxa were taken during ichthyoplankton monitoring (Table 3.7-1). An additional 1,902 fish eggs/1000 m^3 were collected during this same survey. Sampling at all four Alamitos Bay stations recorded substantially higher larval densities than was recorded either at the San Gabriel River mouth or within the Haynes Intake Canal. Larval densities at Station AB2 were the highest overall, with more than 1,000 individuals/1000 m^3 than the next highest value recorded at Station AB1. Communities at all of the non-Alamitos Bay stations recorded densities of less than 730 larvae/1000 m^3. Species richness was similarly highest in Alamitos Bay with nine to 12 species per station. Species diversity was highest at the San Gabriel River mouth, moderate in Alamitos Bay, and lowest in the Haynes Intake Canal. Goby A/C was the most abundant taxon recorded, accounting for 75% of the total larval density. Haynes Generating Station Intake Canal collections were largely restricted to various gobies and blennies. Unidentified fish eggs represented 94% of the total catch, with nearly 40% of the density collected at Station AB1. In total, eggs from four taxonomic groups were identified, with northern anchovy (*Engraulis mordax*) eggs unique to the San Gabriel River mouth. All other taxa were taken at multiple stations. Three megalops stage crab larvae were collected at the San Gabriel River mouth at night. No other target invertebrates were collected.

Table 3.7-1. Mean ichthyoplankton density (#/1000 m^3) by station sampled on 12-13 February 2009 across both diel periods.

Larval Taxa	AB1	AB2	AB3	AB4	SGR	HIC1	HIC2	HIC3	Mean Density	% Density
goby A/C	2,318	3,256	1,837	1,278	406	28	485	670	1,285	75
yellowfin goby	186	406	314	-	-	-	26	-	116	7
larval fish - damaged	47	115	76	186	204	-	28	-	82	5
combtooth blenny	163	61	132	173	24	30	42	32	82	5
jacksmelt	-	-	28	168	24	-	-	-	28	2
longjaw mudsucker	22	35	59	31	26	-	-	-	22	1
spotted kelpfish	30	31	25	32	24	-	-	-	18	1
California clingfish	-	46	58	-	-	-	-	-	13	1
California halibut	65	-	-	31	-	-	-	-	12	1
goby unid.	-	58	-	-	20	-	-	-	10	1
arrow goby	51	-	22	-	-	-	-	-	9	1
blind goby	22	-	-	32	-	-	-	-	7	<1
cheekspot goby	-	-	22	-	-	27	-	-	6	<1
kelp blenny unid	-	48	-	-	-	-	-	-	6	<1
silverside unid	-	-	-	33	-	-	-	-	4	<1
bay goby	-	31	-	-	-	-	-	-	4	<1
white croaker	-	31	-	-	-	-	-	-	4	<1
larval fish fragment	-	-	31	-	-	-	-	-	4	<1
diamond turbot	30	-	-	-	-	-	-	-	4	<1
tube blenny unid.	-	24	-	-	-	-	-	-	3	<1
Total Density	2,933	4,142	2,604	1,965	727	85	582	702	1,717	
Number of Taxa	10	12	11	9	7	3	4	2	20	
Species Diversity	0.91	0.92	1.15	1.26	1.23	1.10	0.63	0.18	1.13	
Egg Taxa										
fish egg unid.	5,454	873	726	2,326	785	2,616	993	495	1,783	94
sand flounder unid.	184	119	69	109	173	28	29	32	93	5
turbot eggs	80	-	22	32	-	-	29	-	20	1
northern anchovy	-	-	-	-	41	-	-	-	5	<1
Total Density	5,718	993	817	2,467	999	2,644	1,050	526	1,902	

Daytime densities were substantially lower than those recorded during the nighttime sampling, (1,236/1000 m^3 and 2,485/1000 m^3, respectively) although only one more species was taken at night than during the day and 11 species common to both diel periods (Tables 3.7-2 and 3.7-3). Larval density was highest at Station AB2 during both diel periods, although the difference was more pronounced during the daytime sampling with more than twice the density of the next highest station while the night surveys recorded a 30% difference between AB2 and AB1. With the exception of AB4, Alamitos Bay daytime larval densities exceeded all other stations. At night, sampling at all four Alamitos Bay stations recorded higher larval densities than at the remaining stations. Goby A/C dominated both diel period densities, accounting for 78% and 91% of all collections during the day and night, respectively. Various gobies and blennies, along with damaged larvae, were the most abundant identified taxa during both diel periods, although jacksmelt (*Atherinopsis californiensis*) larvae were recorded during the day at Stations AB3 and AB4. Fish egg densities were similarly disparate between the two diel periods, with just over

1,400 eggs/1000 m^3 recorded during the day compared to nearly 2,400/1000 m^3 at night. Daytime densities at the two Haynes Intake Canal stations exceeded all other stations while night densities at the five non-HIC stations were substantially higher than was recorded at each of the three HIC stations.

Table 3.7-2. Mean daytime ichthyoplankton density (#/1000 m^3) by station sampled on 12 February 2009.

Larval Taxa	AB1	AB2	AB3	AB4	SGR	HIC1	HIC2	Mean Density	% Density
goby A/C	1,338	3,308	1,404	17	698	-	-	966	78
larval fish - damaged	26	180	25	116	204	-	-	79	6
jacksmelt	-	-	15	273	-	-	-	41	3
combtooth blenny	13	-	93	165	14	-	-	41	3
yellowfin goby	203	-	-	-	-	30	14	35	3
California clingfish	-	17	58	-	-	-	128	29	2
longjaw mudsucker	-	49	71	-	14	-	-	19	2
spotted kelpfish	15	15	13	16	-	-	-	8	1
arrow goby	26	-	-	-	-	-	-	4	<1
silverside unid	-	-	-	17	-	-	-	2	<1
blind goby	-	-	-	16	-	-	-	2	<1
bay goby	-	15	-	-	-	-	-	2	<1
white croaker	-	15	-	-	-	-	-	2	<1
larval fish fragment	-	-	15	-	-	-	-	2	<1
diamond turbot	15	-	-	-	-	-	-	2	<1
Total Density	1,635	3,600	1,695	619	930	30	143	1,236	
Number of Taxa	7	7	8	7	4	1	2	15	
Species Diversity	0.68	0.38	0.75	1.41	0.67	0.00	0.32	0.97	
Egg Taxa									
fish egg unid.	976	783	301	541	685	4,776	1,398	1,351	94
sand flounder unid.	179	116	28	115	56	-	29	75	5
turbot unid.	-	-	-	32	-	-	29	9	1
Total Density	1,155	900	329	688	741	4,776	1,455	1,435	

Table 3.7-3. Mean nighttime ichthyoplankton density (#/1000 m^3) by station sampled on 13 February 2009.

Larval Taxa	AB1	AB2	AB3	AB4	SGR	HIC1	HIC2	HIC3	Mean Density	% Density
goby A/C	4,457	6,461	3,188	1,901	520	14	843	670	2,257	91
combtooth blenny	232	61	171	94	22	-	28	16	78	3
yellowfin goby	75	203	157	-	-	-	13	-	56	2
larval fish - damaged	22	51	89	163	-	-	14	-	42	2
longjaw mudsucker	11	22	48	16	12	-	-	-	13	1
jacksmelt	-	-	13	64	12	-	-	-	11	<1
California halibut	32	-	-	16	-	-	-	-	6	<1
goby unid.	-	29	-	-	10	-	-	-	5	<1
California clingfish	-	29	-	-	-	-	-	-	4	<1
kelp blenny unid	-	24	-	-	-	-	-	-	3	<1
silverside unid	-	-	-	16	-	-	-	-	2	<1
tube blenny unid.	-	12	-	-	-	-	-	-	1	<1
spotted kelpfish	-	-	-	-	12	-	-	-	1	<1
blind goby	11	-	-	-	-	-	-	-	1	<1
arrow goby	-	-	11	-	-	-	-	-	1	<1
cheekspot goby	-	-	11	-	-	13	-	-	3	<1
Total Density	4,840	6,891	3,687	2,270	587	28	898	686	2,486	
Number of Taxa	7	9	8	7	6	2	4	2	16	
Species Diversity	0.37	0.34	0.60	0.67	0.53	0.69	0.29	0.11	0.48	

Egg Taxa	AB1	AB2	AB3	AB4	SGR	HIC1	HIC2	HIC3	Mean Density	% Density
fish egg unid.	9,932	964	1,152	4,111	835	456	587	495	2,316	95
sand flounder unid.	187	122	151	98	212	28	-	32	104	4
turbot unid.	80	-	22	32	-	-	-	-	17	1
northern anchovy	-	-	-	-	41	-	-	-	5	<1
Total Density	10,199	1,086	1,324	4,241	1,088	484	587	526	2,442	

3.7.3 Discussion

Ichthyoplankton communities in Alamitos Bay and surrounding waters, including the Haynes Intake Canal, were generally similar to that recorded in the two most recent surveys (MBC 2004b, MBC et al. 2007). Various gobies, blennies, silversides, and unidentified fish eggs again dominated the catch, especially in comparison to previous winter sampling. The prior year-long study by MBC et al. (2007) observed additional species during the spring and summer months, but, gobies and blennies were generally the most abundant species collected. Alamitos Bay has historically been characterized as a significant nearshore fish nursery (Valle et al. 1999), but ichthyoplankton densities in February are typically among the lowest recorded. This is consistent with minimal winter spawning activity by common southern California nearshore fishes (Cailliet et al. 2000). Specifically, sampling near the HnGS intake bulkhead in Alamitos Bay (Station AB4) recorded similar mean densities as that observed in February 2006 (MBC et al. 2007). The two studies also recorded similar species compositions.

The overall ichthyoplankton distribution suggests the Haynes Intake Canal community was relatively limited while the Alamitos Bay community was more robust, especially at Station AB2. Larval densities were consistently higher at Station AB2 than was recorded at all other stations. Ichthyoplankton communities at all four Alamitos Bay stations were typically nearly as dense, if not more dense, than those observed near the San Gabriel River mouth.

3.8 JUVENILE/ADULT FISHES AND INVERTEBRATES

Fishes off Alamitos Bay have been studied regularly since the 1970s to determine potential effects from the thermal discharges of the HnGS and AGS. Additional studies have been performed at irregular intervals within Alamitos Bay and the lower San Gabriel River. The role as a nursery ground for juveniles of coastal fish species is probably the most widely recognized and accepted function of bays and estuaries in their status as important fish habitats (Allen et al. 2006).

Valle et al. (1999) sampled the juvenile fishes of Alamitos Bay from 1992 through 1995 with a 1.6-m (5.2-ft) beam trawl fitted with 3-mm (0.1-inch) mesh. Of the 46 taxa collected, the most abundant were unidentified gobies (Gobiidae), cheekspot goby (*Ilypnus gilberti*), bay pipefish (*Syngnathus leptorhynchus*), shiner perch (*Cymatogaster aggregata*), and topsmelt (*Atherinops affinis*). The study concluded that shallow habitats, both vegetated with eelgrass and unvegetated, were especially important for juvenile fishes. Juvenile California halibut (*Paralichthys californicus*) inhabited unvegetated areas, while barred sand bass (*Paralabrax nebulifer*) inhabited eelgrass beds. The habitats nearest the bay mouth are particularly important for juveniles of these two species, whereas habitats further inside the bay are more important for most other fishes.

Bay and estuarine fish assemblages in California tend to be dominated in abundance by few (usually five or less) species and have low diversity even though many other species are typically encountered (Allen et al. 2006). In a previous study of the Colorado Lagoon area of the Bay, four species comprised 99% of the total abundance: northern anchovy (*Engraulis mordax*), topsmelt, slough anchovy (*Anchoa delicatissima*), and shiner perch (Allen and Horn 1975). Species diversity and abundance at Colorado Lagoon were highest during summer (May–September) and both were highly correlated with water temperature, which ranged between 12.8–25.0°C (55–77°F). Additional sampling was performed in 2009 to document the fish and invertebrate composition within the Haynes Intake Canal, Alamitos Bay, and the lower San Gabriel River.

3.8.1 Materials and Methods

Demersal fish and macroinvertebrates were sampled at ten sites throughout the study area (Figure 3.1-1). Four stations in Alamitos Bay and three in the San Gabriel River were sampled on 26 February 2009. Three stations in the Haynes Intake Canal were sampled on 19 March 2009. Two replicates were completed at all stations using a 4.5-m otter trawl net towed at 1-2 knots for five minutes. Each catch was sorted to separate the fish and macroinvertebrates from the assorted debris. Fish and macroinvertebrates were identified to the lowest practical taxon, typically species. During each replicate, all fish were measured, counted, and an aggregate weight recorded by species while macroinvertebrates were counted and an aggregate weight recorded by species. Data is presented as station-specific totals by area (Alamitos Bay, San Gabriel River, or Haynes Intake Canal) and across the entire study.

Comparisons were made against the mean trawl catch recorded during winter sampling (2004-2007) at three stations located along the 6-m (20-ft) isobath directly offshore of the San Gabriel River mouth during National Pollutant Discharge Elimination System (NPDES) monitoring (MBC 2004a, 2005-2007). These trawls were completed using a 7.6-m otter trawl towed for 10 minutes at 1-2 knots. The catches were processed consistent with the methods used in the current study. Due to the differences in sampling parameters, comparisons were limited to relative abundance and species composition between the two sampling programs.

Midwater and surface shoreline fishes were sampled using a 30-m x 2-m beach seine with 6-mm square mesh. Sampling was completed at six sites, three each in Alamitos Bay (23 February 2009) and the Haynes Intake Canal (26 March 2009) (Figure 3.1-1). Two replicate hauls were made at all sites except for Station HIC3, where sampling was suspended after one replicate due to the steepness of the bank, which submerged the net within one meter from shore. During all replicates, the net was drawn from the shoreline, spread parallel to shore at a water depth of approximately 1.5 m, and drawn back to shore. All fishes were identified to the lowest practical taxon (usually species), counted, and an aggregate weight recorded to the nearest gram (g). Most aggregate weights were less than 1 g, therefore only abundance data is presented. Most fish taken during the survey were generally small, therefore nearly all fish were returned to the laboratory for identification confirmation. A master species list of all collections is provided in Appendix G.

Fish recruitment patterns in Alamitos Bay and the Haynes Intake Canal were examined using Standard Monitoring Units for the Recruitment of Fish (SMURF; Valles et al. 2006). Pairs of SMURF modules were placed and retrieved by divers in both areas (Figure 3.1-1). Alamitos Bay modules were deployed for eight days while the Haynes Intake Canal Modules were deployed for 35 days. At retrieval, a fine mesh bag was closed around the artificial substrate and returned to the surface where it was sorted in a bucket of water. After agitating the material, all the water was strained through a 3-mm square mesh net to collect any fish.

3.8.2 Results

During trawl sampling, a total of 124 fish representing 15 species were collected (Table 3.8-1). Of these, 46 round stingrays (*Urobatis halleri*), 24 California halibut, and 17 bat rays (*Myliobatis californica*) combined to account for 70% of the total fish catch. Round stingray was the most abundant species in all three areas. The Alamitos Bay catch represented 70% (87) of the total catch, with 12 of the 15 species, led by round stingray and California halibut abundances. California halibut was the only species taken at each of the four Alamitos Bay stations. Three of the four Alamitos Bay stations (AB1, AB2, and AB4) registered relatively similar catches (20-32), while sampling at Station AB3 recorded only two species and six fish. Species diversity was highest at Station AB4 (1.90) and lowest at Station AB3 (0.64). Sampling in the San Gabriel River caught 20 fish, or less than one-fourth the Alamitos Bay total, representing six species, or one-half that taken in Alamitos Bay. Fifty percent of the San Gabriel River catch was contributed by round stingray (10) while Pacific staghorn sculpin (*Leptocottus armatus*) contributed an additional 25% (5) of the total catch. Otter trawl sampling in the Haynes Intake Canal recorded the lowest total catch, with 17 fish caught, of which, 10 were round stingrays. Of the remaining four species, only diamond turbot (*Pleuronichthys guttulatus*) and kelp bass (*Paralabrax clathratus*) were represented by more than one individual. Patterns in biomass were similar to that recorded for abundance, with bat ray and round stingray accounting for 89% of the total value (Table 3.8-2).

Table 3.8-1. Trawl-caught fish abundance by site and station. The mean winter catch (2004-2007) during NPDES trawls along the 6-m isobath directly off of the San Gabriel River mouth is included for comparison.

	Alamitos Bay					San Gabriel River				HnGS Intake Canal				Survey	%	NPDES
Species	AB1	AB2	AB3	AB4	Total	SGR1	SGR2	SGR3	Total	HIC1	HIC2	HIC3	Total	Total	Total	Mean
round stingray	20	4	-	2	26	-	10	-	10	5	4	1	10	46	37	1
California halibut	11	6	4	1	22	-	1	-	1	-	-	1	1	24	19	8
bat ray	-	17	-	-	17	-	-	-	-	-	-	-	-	17	14	<1
shiner perch	-	-	-	7	7	-	-	-	-	-	-	-	-	7	6	<1
spotted sand bass	-	-	2	4	6	-	-	-	-	1	-	-	1	7	6	-
diamond turbot	1	-	-	1	2	1	-	1	2	1	-	1	2	6	5	1
kelp bass	-	-	-	2	2	-	-	-	-	3	-	-	3	5	4	-
Pacific staghorn sculpin	-	-	-	-	-	1	4	-	5	-	-	-	-	5	4	<1
barcheek pipefish	-	-	-	-	-	1	-	-	1	-	-	-	-	1	1	<1
California corbina	-	1	-	-	1	-	-	-	-	-	-	-	-	1	1	1
fantail sole	-	-	-	1	1	-	-	-	-	-	-	-	-	1	1	1
shovelnose guitarfish	-	1	-	-	1	-	-	-	-	-	-	-	-	1	1	<1
specklefin midshipman	-	-	-	-	-	-	-	1	1	-	-	-	-	1	1	<1
spotted turbot	-	-	-	1	1	-	-	-	-	-	-	-	-	1	1	1
yellowfin croaker	-	-	-	1	1	-	-	-	-	-	-	-	-	1	1	-
white croaker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31
queenfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
speckled sanddab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
thornback	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
California tonguefish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
hornyhead turbot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
kelp pipefish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pacific sardine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
California lizardfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
barred sand bass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
northern anchovy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
deepbody anchovy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
big skate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
California skate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
Total Abundance	32	29	6	20	87	3	15	2	20	10	4	3	17	124		82
Number of Species	3	5	2	9	12	3	3	2	6	4	1	3	5	15		26
Species Diversity	0.77	1.14	0.64	1.90	1.84	1.10	0.80	0.69	1.37	1.17	0.00	1.10	1.20	1.96		1.89

The demersal macroinvertebrate catch totaled 758 individuals representing 19 species (Table 3.8-3). Purple sea urchins (*Strongylocentrotus purpuratus*) were the most abundant species taken representing 41% of the total catch with 313 individuals, although all but three individuals were taken in the Haynes Intake Canal. Each of the next three relatively abundant species; sea pen (*Acanthoptilum* spp), Xantus swimming crab (*Portunus xantusii*), and California bubble (*Bulla gouldiana*) were each taken in Alamitos Bay, exclusively. The top 11 of the 19 species occurred in only one of the survey areas. Overall, Alamitos Bay collections (418) exceeded the Haynes Intake Canal (340) while no macroinvertebrates were taken in the San Gabriel River. Although abundances abundances between the two sites were similar; Alamitos Bay had twice the species richness the Haynes Intake Canal, which translated to a nearly four-fold increase in species diversity.

Table 3.8-2. Trawl-caught fish biomass (kg) by site and station. The mean winter catch (2004-2007) during NPDES trawls along the 6-m isobath directly off of the San Gabriel River mouth is included for comparison.

	Alamitos Bay					San Gabriel River				HnGS Intake Canal				Survey	%	NPDES
Species	AB1	AB2	AB3	AB4	Total	SGR1	SGR2	SGR3	Total	HIC1	HIC2	HIC3	Total	Total	Total	Mean
bat ray	-	57.900	-	-	57.900	-	-	-	-	-	-	-	-	57.900	74	0.188
round stingray	4.400	1.050	-	0.840	6.290	-	3.400	-	3.400	0.990	0.800	0.290	2.080	11.770	15	0.21
California halibut	1.032	1.272	0.600	0.018	2.922	-	0.024	-	0.024	-	-	0.250	0.250	3.196	4	0.713
diamond turbot	0.150	-	-	0.130	0.280	0.270	-	0.300	0.570	0.490	-	0.370	0.860	1.710	2	0.141
shovelnose guitarfish	-	1.200	-	-	1.200	-	-	-	-	-	-	-	-	1.200	2	0.078
specklefin midshipman	-	-	-	-	-	-	-	0.560	0.560	-	-	-	-	0.560	1	0.054
spotted sand bass	-	-	0.090	0.390	0.480	-	-	-	-	0.021	-	-	0.021	0.501	1	-
fantail sole	-	-	-	0.480	0.480	-	-	-	-	-	-	-	-	0.480	1	0.098
California corbina	-	0.340	-	-	0.340	-	-	-	-	-	-	-	-	0.340	<1	0.113
shiner perch	-	-	-	0.130	0.130	-	-	-	-	-	-	-	-	0.130	<1	0.009
kelp bass	-	-	-	0.014	0.014	-	-	-	-	0.110	-	-	0.110	0.124	<1	-
yellowfin croaker	-	-	-	0.070	0.070	-	-	-	-	-	-	-	-	0.070	<1	-
Pacific staghorn sculpin	-	-	-	-	-	0.054	0.005	-	0.059	-	-	-	-	0.059	<1	0.008
spotted turbot	-	-	-	0.035	0.035	-	-	-	-	-	-	-	-	0.035	<1	0.121
barcheek pipefish	-	-	-	-	-	0.001	-	-	0.001	-	-	-	-	0.001	<1	<0.001
white croaker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.549
thornback	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.283
queenfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.213
speckled sanddab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.126
big skate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.075
hornyhead turbot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07
Pacific sardine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.064
California tonguefish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.036
California skate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.032
barred sand bass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.023
California lizardfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.023
deepbody anchovy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.003
kelp pipefish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.002
northern anchovy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.002
Total Biomass (kg)	5.582	61.762	0.690	2.107	70.141	0.325	3.429	0.860	4.614	1.611	0.800	0.910	3.321	78.076		3.233

Unlike abundance, biomass recorded in Alamitos Bay was more than twice that collected in the Haynes Intake Canal (Table 3.8-4). From Alamitos Bay, the 4.680 kg of warty sea cucumber (*Parastichopus parvimensis*), 2.287 kg of Xantus swimming crab, and 1.798 kg of California bubble taken ranked first, third, and fourth, respectively, in total biomass. Ochre star (*Pisaster ochraceus*) ranked second overall and was only taken in the Haynes Intake Canal where 2.550 kg were taken.

Beach seine sampling at six sites recorded a total of 493 fish representing at least six species (Table 3.8-5). Sampling in Alamitos Bay recorded substantially greater abundance (476) and two more species than was recorded in the Haynes Intake Canal. Overall, the 357 topsmelt (*Atherinops affinis*) collected account for 72% of the total abundance, ranking first at both areas. All of the topsmelt taken were 70 mm standard length or less (Figure 3.8-1). Pacific staghorn sculpin and a complex of arrow and cheekspot gobies (*Clevelandia ios/Ilypnus gilberti*) ranked second and third overall. In Alamitos Bay, collections at Station ABS3 accounted for 67% of the total catch, and 69% of the Alamitos Bay catch. Sampling at Station ABS2 resulted in the lowest catch in Alamitos Bay. In the Haynes Intake Canal, no fish were taken at Station HICS1, one arrow goby was taken at Station HICS3 (only one replicate completed). Fish were most abundant at Station HICS2 where 16 fish representing 3 species were taken, led by topsmelt.

Table 3.8-3. Trawl-caught macroinvertebrate abundance by site and station. The mean winter catch (2004-2007) during NPDES trawls along the 6-m isobath directly off of the San Gabriel River mouth is included for comparison.

	Alamitos Bay					San Gabriel River				HnGS Intake Canal				Survey	%	NPDES
Species	AB1	AB2	AB3	AB4	Total	SGR1	SGR2	SGR3	Total	HIC1	HIC2	HIC3	Total	Total	Total	Mean
purple sea urchin	1	-	-	2	3	-	-	-	-	275	8	27	310	313	41	-
sea pen	44	-	-	100	144	-	-	-	-	-	-	-	-	144	19	-
Xantus swimming crab	19	6	9	76	110	-	-	-	-	-	-	-	-	110	15	3.2
California bubble	18	2	2	86	108	-	-	-	-	-	-	-	-	108	14	-
warty sea cucumber	8	1	-	4	13	-	-	-	-	-	-	-	-	13	2	-
Pacific calico scallop	-	-	-	-	-	-	-	-	-	12	-	-	12	12	2	-
California aglaja	4	1	-	5	10	-	-	-	-	-	-	-	-	10	1	-
banded tegula	-	-	-	-	-	-	-	-	-	-	4	4	8	8	1	-
western mud nassa	-	2	6	-	8	-	-	-	-	-	-	-	-	8	1	-
shiny brittle star	6	-	-	1	7	-	-	-	-	-	-	-	-	7	1	-
tuberculate pear crab	-	1	2	2	5	-	-	-	-	-	-	-	-	5	1	8.1
California two-spot octopus	-	-	2	-	2	-	-	-	-	-	2	-	2	4	1	-
blackspotted bay shrimp	-	2	1	-	3	-	-	-	-	-	-	-	-	3	<1	53.4
foliate thornmouth	-	-	-	-	-	-	-	-	-	-	3	-	3	3	<1	-
ochre star	-	-	-	-	-	-	-	-	-	1	1	1	3	3	<1	-
New Zealand snail	1	-	-	1	2	-	-	-	-	-	-	-	-	2	<1	-
ring-spotted dorid	-	-	-	-	-	-	-	-	-	-	2	-	2	2	<1	-
yellow crab	-	-	1	1	2	-	-	-	-	-	-	-	-	2	<1	0.1
brittle star	-	-	1	-	1	-	-	-	-	-	-	-	-	1	<1	-
California spiny lobster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
fat western nassa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
festive murex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
globose sand crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
graceful crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.4
leafy dendronotid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
moon snail hermit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
Pacific rock crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
red jellyfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3
sand star	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2
sandflat elbow crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
sea pansy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
sheep crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
smooth-tooth aeolis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
Spanish shawl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
spiny sand star	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.3
Stimpson coastal shrimp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
target shrimp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1
Total Abundance	101	15	24	278	418	-	-	-	-	288	20	32	340	758		78.02
Number of Species	8	7	8	10	14	-	-	-	-	3	6	3	7	19		22
Species Diversity	1.57	1.71	1.73	1.35	1.62	-	-	-	-	0.20	1.58	0.51	0.43	1.75		1.53

No fish recruited to the SMURFS at either location. A variety of epibenthic macroinvertebrates were found in the SMURF habitat, such as various brittle stars, shrimps, and crabs. Fine sediment had accumulated on the SMURFs in varying levels, dependent upon the length of deployment and location. Anecdotally, greater sedimentation was observed at Station AB1 than at Station AB4.

Table 3.8-4. Trawl-caught macroinvertebrate biomass (kg) by site and station. The mean winter catch (2004-2007) during NPDES trawls along the 6-m isobath directly off of the San Gabriel River mouth is included for comparison.

	Alamitos Bay					San Gabriel River				HnGS Intake Canal				Survey	%	NPDES
Species	AB1	AB2	AB3	AB4	Total	SGR1	SGR2	SGR3	Total	HIC1	HIC2	HIC3	Total	Total	Total	Mean
warty sea cucumber	2.900	0.100	-	1.680	4.680	-	-	-	-	-	-	-	-	4.680	34	-
ochre star	-	-	-	-	-	-	-	-	-	0.860	1.000	0.690	2.550	2.550	19	-
Xantus swimming crab	0.260	0.097	0.200	1.730	2.287	-	-	-	-	-	-	-	-	2.287	17	0.048
California bubble	0.002	0.006	0.040	1.750	1.798	-	-	-	-	-	-	-	-	1.798	13	-
purple sea urchin	0.007	-	-	0.025	0.032	-	-	-	-	0.750	0.068	0.161	0.979	1.011	7	-
California aglaja	0.141	0.021	-	0.320	0.482	-	-	-	-	-	-	-	-	0.482	4	-
Pacific calico scallop	-	-	-	-	-	-	-	-	-	0.340	-	-	0.340	0.340	3	-
California two-spot octopus	-	-	0.180	-	0.180	-	-	-	-	-	0.020	-	0.020	0.200	1	-
sea pen	0.041	-	-	0.100	0.141	-	-	-	-	-	-	-	-	0.141	1	-
banded tegula	-	-	-	-	-	-	-	-	-	-	0.014	0.010	0.024	0.024	<1	-
foliate thornmouth	-	-	-	-	-	-	-	-	-	-	0.014	-	0.014	0.014	<1	-
ring-spotted dorid	-	-	-	-	-	-	-	-	-	-	0.013	-	0.013	0.013	<1	-
tuberculate pear crab	-	0.001	0.003	0.004	0.008	-	-	-	-	-	-	-	-	0.008	<1	0.008
western mud nassa	-	0.001	0.007	-	0.008	-	-	-	-	-	-	-	-	0.008	<1	-
blackspotted bay shrimp	-	0.005	0.001	-	0.006	-	-	-	-	-	-	-	-	0.006	<1	0.119
shiny brittle star	0.002	-	-	0.003	0.005	-	-	-	-	-	-	-	-	0.005	<1	-
yellow crab	-	-	0.001	0.002	0.003	-	-	-	-	-	-	-	-	0.003	<1	<0.001
New Zealand snail	0.001	-	-	0.001	0.002	-	-	-	-	-	-	-	-	0.002	<1	-
brittle star	-	-	0.001	-	0.001	-	-	-	-	-	-	-	-	0.001	<1	-
California spiny lobster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
graceful crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.121
spiny sand star	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.047
sheep crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.045
Pacific rock crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011
sand star	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.004
globose sand crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001
moon snail hermit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001
sea pansy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001
target shrimp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001
fat western nassa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
festive murex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
leafy dendronotid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
red jellyfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
sandflat elbow crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
smooth-tooth aeolis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
Spanish shawl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
Stimpson coastal shrimp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
Total Biomass (kg)	3.354	0.231	0.433	5.615	9.633	-	-	-	-	1.950	1.129	0.861	3.940	13.573		0.611

Table 3.8-5. Abundance of fish species taken by beach seine sampling in Alamitos Bay and the Haynes Intake Canal.

	Alamitos Bay				HnGS Intake Canal					
Species	ABS1	ABS2	ABS3	Total	HICS1	HICS2	HICS3	Total	Total	% Total
topsmelt	101	1	246	348	-	9	-	9	357	72
Pacific staghorn sculpin	7	25	64	96	-	2	-	2	98	20
arrow/cheekspot goby	-	10	17	27	-	-	-	-	27	5
arrow goby	-	-	-	-	-	5	1	6	6	1
diamond turbot	-	4	-	4	-	-	-	-	4	1
spotted turbot	-	-	1	1	-	-	-	-	1	<1
Total	108	40	328	476	-	16	1	17	493	
Number of Species	2	4	4	5	-	3	1	3	6	

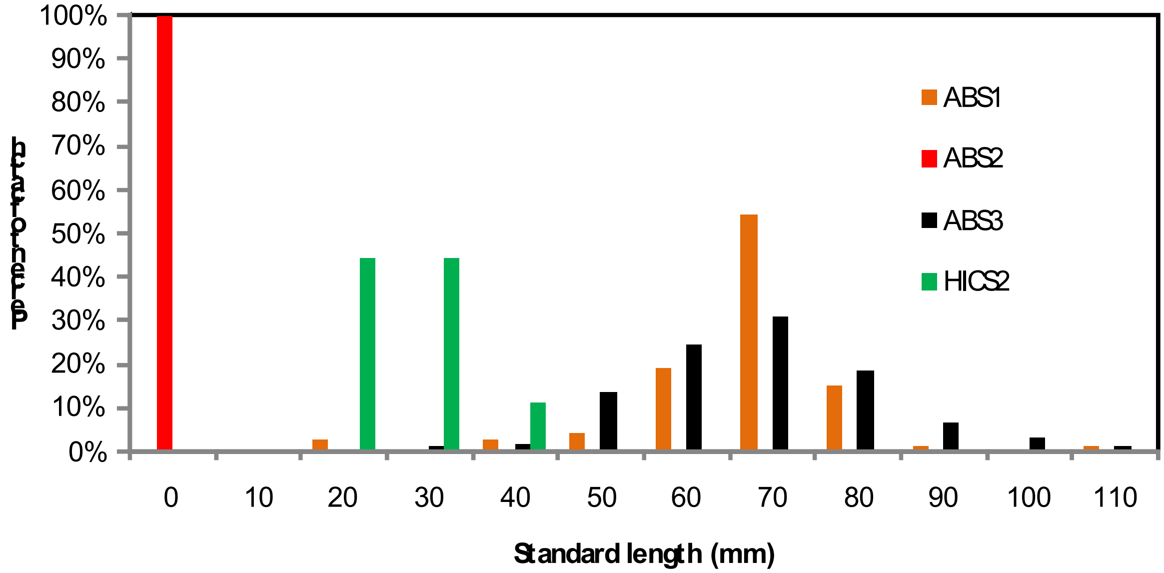

Figure 3.8-1. Length frequency distribution of topsmelt (*Atherinops affinis*) taken during beach seine sampling in Alamitos Bay and the Haynes Intake Canal.

3.8.3 Discussion

Historically, all but three species taken during the special studies were previously recorded during the annual nearshore trawl surveys (Table 3.8-1). Spotted sand bass (*Paralabrax maculatofasciatus*), kelp bass (*P. clathratus*) and yellowfin croaker (*Umbrina roncador*) have not been taken in the nearshore surveys (2004-2007). Fourteen species were unique to the nearshore sampling, including queenfish (*Seriphus politus*) and white croaker (*Genyonemus lineatus*), which rank as the first and second most abundant species taken. In the San Gabriel River, respectively, the current study recorded more than twice the number of fish collected by EDAW and MBC (2004) using similar trawl methods, and twice as many species. Seven of the 15 species taken in the current study were recorded by Valle et al. (1999), although the inconsistencies between the studies may be attributable to the differing sampling techniques: otter trawl versus hand-towed beam trawl. Valle et al. (1999) did not differentiate between months for the total fish community. Eleven of the 15 fish species taken in the current study were also recorded from nearby Anaheim Bay by Klingbeil et al. (1975). The high numbers of round stingray is consistent with previous studies by Hoisington and Lowe (2005) and Vaudo and Lowe (2006). Both studies found large aggregations of round stingray, predominantly near the mouth of the San Gabriel River. Vaudo and Lowe (2006) actively tracked round stingrays into Alamitos Bay, but no attempt was made to follow movements upriver. These authors suggested round stingrays preferred the area due to the warm water effluent from both the HnGS and nearby AGS. Their results found consistently higher abundances in the area exposed to the thermal effluent than at similar habitat outside the thermal field. They assumed the area served as preferential breeding habitat due to the elevated temperature. Overall, the

Alamitos Bay area winter fish community recorded by the current study was relatively consistent with previous studies in the area.

Less information is available regarding the area's macroinvertebrate community. Comparisons with recent winter NPDES trawl surveys indicate macroinvertebrates were not as cosmopolitan as the fish in comparisons between the two studies. Only four of the 22 macroinvertebrate species taken in the nearshore surveys (2004-2007) were recorded in Alamitos Bay and the surrounding study sites. Blackspotted bay shrimp (*Crangon nigromaculata*), recently the dominant species in the NPDES surveys, was represented by three individuals, or less than 1% of the total abundance.

A disconnect between Alamitos Bay and the open coast nearshore waters immediately adjacent to the Bay was detected in the fish communities, but most pronounced in the macroinvertebrate communities. This suggests the Alamitos Bay demersal communities, and surrounding areas, are relatively unique in comparison to the open coast, although this is consistent with the common differences between small, shallow embayments and the open coast.

The lack of recruitment documented by the SMURFS may simply be a seasonal artifact. Few common southern California fish species are known to recruit during the winter months (Cailliet et al. 2000). Of those species that do recruit during the winter months, few may be recruiting to the epibenthos or to rocky habitat. At least four storm fronts passed through the area resulting in measurable rain between 9 February and 19 March 2009. The effect of these storms, and the subsequent influx of freshwater, on recruitment patterns is not known.

3.9 MARINE BIRDS

Comprehensive bird surveys are rarely performed in southern California. However, species identifications and abundance estimates are commonly performed while performing other biological surveys. Such is the case with ongoing NPDES receiving water monitoring studies for the HnGS and AGS. In addition, bird surveys were performed along the lower San Gabriel River in 2004 as part of a special study for the HnGS Units 3&4 repower project. Additional sampling was performed in 2009 to document the bird community in the vicinity of the lower San Gabriel River.

3.9.1 Materials and Methods

Birds were observed along the San Gabriel River, including the adjacent Los Cerritos Wetland to the east of the river and south of Westminster Avenue, and the Haynes Intake Canal. Biologists traveled by bicycle along the bike path on the east side of the river, from the river mouth to 7th Street, stopping to identify and count birds where they occurred, using 8x36 binoculars. Two surveys were conducted each day on five consecutive days, from 9 March to 13 March 2009, starting earlier each day to cover as many tidal stages as possible during the five-day period. Survey start and end times and mean tidal heights are shown in Appendix H-1. Segment 1 (SGR1) was from the river mouth to Marina Drive, Segment 2 (SGR2) was from

Marina Drive to Pacific Coast Highway, Segment 3 (SGR3) was from Pacific Coast Highway to Westminster Avenue (Figure 3.1-1), and Segment 4 was from Westminster Avenue to 7th Street (not shown on map).

3.9.2 Results

Thirty-six species of water-oriented birds were observed during the five survey days, with means of 14 species and 102 individuals per survey (Table 3.9-1 and Appendices H-2 through H-4). The total number of species observed each day averaged 18 and ranged from 16 species on 10 March to 21 species on 13 March (Appendix H-4). The maximum number of birds observed each day was based on the highest numbers of each species in each segment for either survey. Daily maximum numbers of birds averaged 151 individuals, and ranged from 95 individuals on 11 March to 204 individuals on 13 March. The greatest numbers of species and individuals were observed in Segment 3, the segment that included additional habitat in the Haynes Intake Canal and the adjacent Los Cerritos Wetland (Table 3.9-2). The fewest numbers were seen in Segment 2, which consisted only of open water and rock riprap lining the river. Numbers were intermediate in Segments 1 and 4, due to a moderate variety of habitats in the river, such as the sandbars at the mouth and along the southeast side of the river in Segment 1, and the suspended pipeline over the river north of the AGS in Segment 4. Turbulence from the AGS and the HnGS in Segment 4 also attracted birds, particularly double-crested cormorants (*Phalacrocorax auritus*).

Table 3.9-1. Number of birds and bird species per survey and per day. March 2009.

Date/Survey	Number of Species	Number of Individuals
9 March 2009		
Survey 1	15	145
Survey 2	13	125
Total # Species	18	
Maximum # Individuals		184
10 March 2009		
Survey 1	14	76
Survey 2	13	100
Total # Species	16	
Maximum # Individuals		135
11 March 2009		
Survey 1	14	74
Survey 2	11	56
Total # Species	17	
Maximum # Individuals		95
12 March 2009		
Survey 1	16	101
Survey 2	13	100
Total # Species	20	
Maximum # Individuals		139
13 March 2009		
Survey 1	20	191
Survey 2	9	50
Total # Species	21	
Maximum # Individuals		204
Survey Mean	14	102
Daily Species Mean	18	
Daily Maximum Mean		151

Double-crested cormorant was the most abundant species overall, with a mean of 38 individuals observed per day. Willets (*Tringa semipalmatus*) were next most abundant, with a mean of 17 individuals seen per day, followed by ring-billed gulls (*Larus delawarensis*) at 14 individuals per day, snowy egrets (*Egretta thula*) at 13 per day, and lesser scaups (*Aythya affinis*) at 12 per day. Most of the cormorants were seen in Segment 4, particularly near one of the AGS discharges and on the suspended pipeline. Willets were found mostly in Segment 1, while ring-billed gulls, snowy egrets and lesser scaups were seen primarily in Segment 4 (the ring-billed gulls were typically found among the

Table 3.9-2. Greatest number of birds and bird species in each segment along the San Gabriel River, including the Haynes Intake Canal and Los Cerritos Wetland, March 2009.

	Seg 1	Seg 2	Seg 3	Seg 4
Max # Species	16	12	24	17
Max # Individuals	103	20	124	119
Species Diversity	2.16	2.39	2.17	1.97
Most Abundant by Segment	willet	ring-billed gull	dowitcher, unid.	double-crested cormorant
	ring-billed gull	western gull	western sandpiper	ring-billed gull
	sanderling		willet	snowy egret
	western gull		lesser scaup	lesser scaup

cormorants, on both the riprap and the suspended pipeline). Snowy egrets were the most consistently occurring and evenly distributed species, found in low numbers but in every segment on every day. Dowitchers (*Limnodromus* sp), on the other hand, were observed only once, although in high numbers, in the Los Cerritos Wetland, and western sandpipers were seen only twice, on a sandbar on the northeast side of the river, one of those times in high numbers.

Most of the birds observed during the five survey days are fish eaters, either swimming under water to catch their prey (cormorants, scaups, grebes [eared, *Podiceps nigricollis*, and pied-billed, *Podilymbus podiceps*], buffleheads [*Bucephala albeola*], and red-breasted mergansers [*Mergus serrator*]), stalking fish in shallow water or from nearby rocks (egrets [snowy and great, *Ardea alba*] and herons [blue, *A. herodias*, and green, *Butorides virescens*]), picking fish near the surface from the air (gulls [*Larus* spp], osprey [*Pandion haliaetus*], and belted kingfisher [*Ceryle alcyon*]) or diving into the water (brown pelicans [*Pelecanus occidentalis californicus*] and Caspian terns [*Hydroprogne caspia*]). Shorebirds, which were also abundant, forage by probing the mud or sand (willets, sandpipers [spotted, *Actitis macularia*; least, *Calidris minutilla*; western, *C. mauri*], sanderlings [*C. alba*], and marbled godwits [*Limosa fedoa*]), or by picking small prey from the surface (black oystercatchers [*Haematopus bachmani*] and plovers, including black-bellied [*Pluvialis squatarola*] and killdeer [*Charadrius vociferus*]). Some of the less abundant species observed included song sparrow (*Melospiza melodia*), which is a seed eater, northern rough-winged swallow (*Stelgidopteryx serripennis*), which plucks insects from the air (quite commonly over water), and surf scoter (*Melanitta perspicillata*), which dives to find animals in the sediment.

3.9.3 Discussion

Abundances and numbers of species of birds were similar among days and between surveys on each day, although numbers of species were usually slightly lower on the second survey of each day. The greatest difference between first and second surveys was recorded on 13 March, with 20 species and 191 individuals in the early morning (the earliest survey of the week) and only nine species and 50 individuals in the late morning. Otherwise, numbers did not appear to be related to time of day. They also did not seem to be associated with tidal stage. To some extent, disturbance by humans may have been a factor in bird abundance in Segment 1, as the sandbar on the southeast side of the river in that segment was usually occupied by fishermen or visitors playing with dogs. During the one survey when the sandbar was exposed and no people were present in that area (the first survey on 13 March), willets and ring-billed gulls were very abundant there, along with a pair of black oystercatchers. In other areas, the presence of humans (walkers, joggers, and bicyclists) did not appear to disturb the birds.

Abundances and species richness appeared to be related to the variety of habitat available. The high abundance and numbers of species in Segment 3 was due to inclusion of the Haynes Intake Canal and the Los Cerritos Wetlands in the observation area. In Segment 4, the discharges from the generating stations attracted cormorants and gulls, and the suspended pipeline provided a convenient roosting site. In Segment 1, the exposed sandbars at the mouth of the river and on the southeast side were favorable foraging areas for shorebirds, which often occur in large numbers.

Bird surveys were conducted using a similar method along the same portion of the San Gabriel River on four days in late November and early December 2003, except that only one survey was conducted per day. The Haynes Intake Canal and Los Cerritos Wetland were not included in the observations, although the river north of 7th Street to the 405 Freeway was included (Edaw/MBC 2004). In the same segments as surveyed in 2009, only 21 species of birds were seen in the 2003 surveys, with a mean of 14 species per survey, compared with a total of 36 species in 2009. However, abundance was considerably greater in 2003, with a mean of 735 birds observed per day compared with only 151 birds per day in 2009. Double-crested cormorants and California brown pelicans were very abundant in 2003, with means of 562 and 98 individuals per survey, respectively. The great majority of these birds were seen in Segment 4, in the same areas where cormorants were most abundant in 2009; only three brown pelicans were seen in 2009. Three species were seen in 2003 but not in 2009, while 18 species were observed in 2009 but not in 2003. Differences in survey results between fall 2003 and spring 2009 was undoubtedly due primarily to seasonal variations in species presence and abundance.

Only one species seen in the March 2009 surveys, California brown pelican, is considered to be endangered (it is both Federal-listed and California state-listed) (Appendix H-2). Two species, American black oystercatcher and California gull, have limited breeding populations in California, three species (double-crested cormorant, black-crowned night heron, and osprey) have somewhat limited populations, and four species (snowy egret, great blue heron, great egret, and Caspian tern) are apparently secure within California, but factors exist to cause some concern. Eleven of the species observed breed in southern California, while the others are winter visitors or spring and fall migrants.

3.10 SEA TURTLES

Sea turtles are air-breathing reptiles with streamlined bodies and large flippers, and are well-adapted to life in the marine environment. They inhabit tropical and subtropical ocean waters throughout the world. Of the seven species of sea turtles, six are found in U.S. waters, and all six species are afforded protection under the Endangered Species Act of 1973. Green turtle

(*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea),* loggerhead turtle (*Caretta caretta*), and olive ridley turtle (*Lepidochelys olivacea*) are known to occur in southern California. Sea turtles have been observed in Alamitos Bay and the lower San Gabriel River by MBC biologists for many years, and in 2008 a 17.2-kg (38-lb) green sea turtle was observed and captured by MBC biologists in the Haynes Intake Canal (Los Angeles Times 2008). The National Marine Fisheries Service and Aquarium of the Pacific are initiating a study to determine the estimated number of sea turtles in the lower San Gabriel River, and to track their movements over time (D. Lawson 2008, pers. comm.).

Additional observations were performed in 2009 to document sea turtle abundance and distribution in the lower San Gabriel River.

3.10.1 Materials and Methods

The Lower San Gabriel River (downriver of the 7th St bridge), as well as the adjacent Haynes Intake Canal, were surveyed over a five day period for the presence of turtles concurrently with the bird surveys discussed in Section 3.9. Biologists traversed the bike path on the east side of the river, from the river mouth to 7th Street, scanning for turtles using 8x36 binoculars. Two surveys were conducted each day for two hours each on five consecutive days (for a total observational period of 20 hours), from 9 March to 13 March 2009, starting earlier each day to cover as many tidal stages as possible. Survey start and end times and mean tidal heights are shown in Appendix H-1. Segment 1 was from the river mouth to Marina Drive (SGR1), Segment 2 was from Marina Drive to Pacific Coast Highway (SGR2), Segment 3 was from Pacific Coast Highway to Westminster Avenue (SGR3) (Figure 3.1-1), and Segment 4 was from Westminster Avenue to 7th Street (not shown).

3.10.2 Results

Turtles were observed in the river each day during the five survey days. There were seven observations of turtles in Segment 4 over a period of four days, with two turtles observed at the same time on several occasions. Turtles were also sighted in Segment 3 (one sighting each of three separate days). No turtles were observed in Segments 1 or 2 further downriver, and none were observed in the Haynes Intake Canal. No more than three turtles were seen during any one day of observations. Based on observations, the number of turtles seen in the San Gabriel River during the survey week is at least three, as they were seen at disparate enough times to be certain they were unique individuals.

3.10.3 Discussion

Only a few turtles were observed in the San Gabriel River during the survey period, but at least one was seen on a daily basis. Most of the sightings were in the vicinity of the warm water discharges from the HnGS and the AGS, or just down current suggesting the turtles were attracted to the warmer waters at/or immediately down river of the discharges. Based on observations, the number of turtles found in the Lower San Gabriel River during the survey week was at least three individuals; however, it is possible there are far more green sea turtles in the river than the three individuals confirmed, as anecdotal observations by others appear to suggest there may be more turtles than observed by the biologists. It cannot be certain that the turtles observed on the other four days were the same individuals; therefore, it is known there are at least 3 individuals, but (however unlikely) that as many as 10 turtles could have been in the canal during the week. Other factors which may have influenced the observations were also considered such as observational period and tidal conditions. Tidal condition was not considered to be a major influence as flow in the river is always downriver with the exception of at the river mouth in Segment 1. Time of day, however was considered, as green sea turtle sleep habits may have influenced the results, as they may stay submerged for up to five hours at a time (M. Curtis 2008, pers. obs.). As a result, the biologists may not have been in the vicinity when they were on the surface. However, time of observations were varied to account for any diel rhythm in their sleep cycles (observation periods became progressively earlier each day), with surveys conducted in early morning, mid day, and late afternoon (which incidentally accounted for tidal cycles). Because the surveys were time critical, seasonal differences in population numbers and behavior could not be evaluated.

4.0 LITERATURE CITED

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APPENDIX A

Appendix A-1. Water quality parameters at Haynes Intake Canal (HIC), Alamitos Bay (AB), and San Gabriel River (SGR) monitoring stations during day ichthyoplankton sampling, 12 February 2009.

	Depth (m)	Temp. (^{o}C)	DO (mg/l)	pH	Trans. (% light)	Salinity (psu)	Cond. (mS/cm)	Density (sigma-theta, Kg/m^{3})	Fluor. (mg/m^{3})	Nitrogen (mg/l)
HIC-1	0	14.55	5.60	8.22	-	33.3	50.8	-	-	-
	1	14.54	5.26	8.21	-	33.3	50.8	-	-	-
	2	14.53	5.16	8.20	-	33.3	50.8	-	-	-
	3	14.51	5.08	8.19	-	33.4	50.8	-	-	-
	4	14.49	5.02	8.18	-	33.3	50.8	-	-	-
	5	14.49	4.99	8.17	-	33.4	50.8	-	-	-
HIC-2	0	14.62	5.90	8.45	-	33.3	50.8	-	-	-
	1	14.58	5.70	8.38	-	33.4	50.8	-	-	-
	2	14.55	5.36	8.31	-	33.3	50.9	-	-	-
AB-1	0	14.63	7.29	7.98	63.23	32.38	39.69	24.03	1.75	13.28
	1	14.61	7.25	7.97	62.40	32.35	39.64	24.01	2.00	13.29
	2	14.61	7.14	7.96	62.24	32.34	39.63	24.01	2.28	13.29
	3	14.59	7.16	7.96	62.05	32.40	39.68	24.06	2.63	13.29
	4	14.49	7.24	7.97	62.13	32.52	39.71	24.17	3.25	13.30
	5	14.39	7.32	7.98	63.46	32.62	39.73	24.27	3.31	13.32
AB-2	0	14.63	7.09	7.96	66.52	31.97	39.24	23.71	1.63	13.32
	1	14.63	7.09	7.96	66.45	31.97	39.23	23.72	1.68	13.32
	2	14.60	7.09	7.96	66.31	32.04	39.28	23.78	2.09	13.32
	3	14.52	7.06	7.96	62.69	32.39	39.60	24.06	2.88	13.31
	4	14.49	7.02	7.96	60.04	32.46	39.65	24.12	3.06	13.31
	5	14.48	7.02	7.96	58.45	32.50	39.68	24.15	3.18	13.31
AB-3	0	14.95	6.66	7.91	59.08	31.66	39.19	23.41	1.58	13.27
	1	14.94	6.64	7.91	59.20	31.67	39.18	23.42	1.56	13.27
	2	14.81	6.54	7.90	61.06	31.73	39.13	23.49	1.86	13.30
	3	14.61	6.59	7.93	59.25	32.01	39.26	23.75	2.30	13.32
	4	14.56	6.77	7.93	56.86	32.10	39.32	23.83	3.26	13.32
	5	14.51	6.81	7.94	55.05	32.28	39.47	23.98	2.84	13.32
	6	14.52	6.81	7.93	50.40	32.31	39.52	24.00	2.68	13.32
AB-4	0	14.61	5.81	8.19	-	33.3	50.6	-	-	-
	1	14.43	5.48	8.20	-	33.2	50.6	-	-	-
	2	14.33	5.90	8.21	-	33.4	50.9	-	-	-
	3	14.33	8.00	8.20	-	33.5	51.0	-	-	-
SGR	0	14.59	7.83	8.00	61.80	32.76	40.07	24.33	2.32	13.26
	1	14.61	7.82	8.00	61.66	32.79	40.12	24.35	2.19	13.25
	2	14.63	7.84	8.00	61.86	32.78	40.13	24.34	2.58	13.25
	3	14.66	7.92	8.00	61.50	32.79	40.17	24.34	3.08	13.24
	4	14.60	7.93	8.00	58.59	32.87	40.21	24.42	3.84	13.25
	5	14.23	7.87	7.99	47.87	33.18	40.20	24.74	5.53	13.31
	6	14.09	7.72	7.99	37.74	33.24	40.13	24.81	6.24	13.34

Appendix A-2. Water quality parameters at Haynes Intake Canal (HIC), Alamitos Bay (AB), and San Gabriel River (SGR) monitoring stations during night ichthyoplankton sampling, 13 February 2009.

	Depth (m)	Temp. (^oC)	DO (mg/l)	pH	Trans. (% light)	Salinity (psu)	Cond. (mS/cm)	Density (sigma-theta, Kg/m^3)	Fluor. (mg/m^3)	Nitrogen (mg/l)
HIC-1	0	14.26	8.95	8.08	-	33.4	50.9	-	-	-
	1	14.28	8.97	8.07	-	33.4	50.9	-	-	-
	2	14.30	8.51	8.07	-	33.4	50.9	-	-	-
	3	14.31	7.15	8.07	-	33.4	50.9	-	-	-
	4	14.30	6.82	8.08	-	33.4	50.9	-	-	-
	5	14.31	6.33	8.08	-	33.4	50.9	-	-	-
HIC-2	0	14.26	8.90	8.08	-	33.2	50.7	-	-	-
	1	14.32	8.94	8.07	-	33.3	50.8	-	-	-
	2	14.33	7.70	8.07	-	33.3	50.7	-	-	-
	3	14.33	7.31	8.07	-	33.3	50.7	-	-	-
	4	14.32	6.29	8.07	-	33.3	50.7	-	-	-
	5	14.33	6.17	8.07	-	33.3	50.7	-	-	-
HIC-3	0	14.24	8.66	8.09	-	33.3	50.7	-	-	-
	1	14.24	8.77	8.07	-	33.3	50.7	-	-	-
	2	14.25	8.76	8.06	-	33.3	50.8	-	-	-
	3	14.22	8.46	8.06	-	33.3	50.8	-	-	-
	4	14.25	8.17	8.06	-	33.3	50.8	-	-	-
AB-1	0	14.17	7.23	7.89	68.02	32.49	39.39	24.21	3.98	13.39
	1	14.19	7.24	7.90	68.06	32.49	39.40	24.21	4.01	13.38
	2	14.20	7.23	7.90	67.91	32.50	39.43	24.21	4.06	13.38
	3	14.23	7.25	7.90	67.94	32.57	39.53	24.26	4.14	13.36
	4	14.30	7.41	7.92	67.68	32.85	39.90	24.46	3.66	13.32
AB-2	0	14.12	7.04	7.87	65.77	32.16	38.99	23.97	3.18	13.43
	1	14.13	7.08	7.87	65.32	32.16	39.00	23.97	3.12	13.42
	2	14.13	7.05	7.87	65.39	32.16	39.00	23.97	3.16	13.42
	3	14.28	7.04	7.87	65.43	32.24	39.21	24.00	3.22	13.38
	4	14.47	7.00	7.87	65.48	32.38	39.54	24.07	3.16	13.32
	5	14.47	6.93	7.87	65.06	32.45	39.62	24.12	2.55	13.32
AB-3	0	14.35	6.49	7.82	57.65	31.90	38.91	23.72	2.44	13.39
	1	14.36	6.50	7.83	57.58	31.91	38.93	23.73	2.49	13.39
	2	14.36	6.54	7.83	57.16	31.92	38.94	23.73	2.58	13.39
	3	14.37	6.60	7.84	57.34	31.95	38.99	23.76	2.78	13.38
	4	14.46	6.64	7.84	55.98	32.09	39.22	23.85	3.08	13.35
	5	14.53	6.64	7.85	52.72	32.34	39.56	24.02	2.88	13.31
AB-4	0	14.22	5.31	8.09	-	33.0	50.4	-	-	-
	1	14.40	5.50	8.11	-	33.2	50.7	-	-	-
	2	14.38	5.72	8.12	-	33.3	50.8	-	-	-
	3	14.36	5.75	8.12	-	33.4	50.9	-	-	-
SGR	0	15.46	7.92	7.85	57.08	30.20	38.00	22.18	5.44	13.27
	1	14.58	6.96	7.83	53.93	31.75	38.95	23.55	3.66	13.35
	2	14.49	7.68	7.91	56.07	32.59	39.79	24.23	5.63	13.30
	3	14.32	7.69	7.92	51.56	33.04	40.13	24.60	6.99	13.30
	4	14.06	7.73	7.93	50.36	33.15	40.01	24.75	6.78	13.35
	5	13.88	7.81	7.92	61.11	33.31	40.01	24.91	5.89	13.38
	6	13.87	7.72	7.92	65.04	33.32	40.01	24.91	5.65	13.39

Appendix A-3. Water quality parameters at Alamitos Bay (AB), 23 February 2009, and Haynes Intake Canal (HIC), 26 March 2009, monitoring stations during beach seine sampling.

	Depth	Temp. (^oC)	DO (mg/l)	pH	Salinity (psu)	Cond. (mS/cm)
HIC-1	Surface	15.27	6.74	7.87	33.3	50.7
	Mid	15.26	6.22	7.95	33.3	50.8
	Bottom	15.26	6.32	7.95	33.3	50.8
HIC-2	Surface	15.43	6.19	8.05	33.2	50.6
	Mid	15.38	5.96	8.02	33.2	50.6
	Bottom	15.39	6.09	8.04	33.2	50.6
HIC-3	Surface	15.46	5.90	8.00	33.1	50.5
	Mid	15.40	5.95	7.99	33.1	50.4
	Bottom	15.41	6.08	7.99	33.1	50.5
AB-1	Surface	14.40	10.95	8.04	33.2	50.6
	Bottom	14.36	10.50	8.06	33.3	50.7
AB-2	Surface	14.93	8.55	8.01	32.4	49.6
	Bottom	14.91	8.33	8.03	32.5	49.7
AB-3	Surface	14.93	7.03	8.02	32.6	49.8
	Bottom	14.84	6.69	8.04	32.8	50.0

Appendix A-4. Water quality parameters at Alamitos Bay (AB) and San Gabriel River (SGR), 26 February 2009, and Haynes Intake Canal (HIC), 19 March 2009, monitoring stations during trawl sampling.

	Depth (m)	Temp. (°C)	DO (mg/l)	pH	Trans. (% light)	Salinity (psu)	Cond. (mS/cm)	Density (sigma-theta, Kg/m^3)	Fluor. (mg/m^3)	Nitrogen (mg/l)
HIC-1	0	16.25	7.20	8.05	-	33.1	50.4	-	-	-
	1	16.25	7.00	8.06	-	33.1	50.4	-	-	-
	2	16.23	6.83	8.07	-	33.3	50.4	-	-	-
	3	16.23	6.74	8.07	-	33.0	50.4	-	-	-
	4	16.23	6.59	8.07	-	33.0	50.3	-	-	-
HIC-2	0	16.57	7.90	8.08	-	33.0	50.3	-	-	-
	1	16.42	7.74	8.07	-	33.0	50.3	-	-	-
	2	16.43	7.50	8.07	-	33.0	50.3	-	-	-
	3	16.42	7.33	8.07	-	33.0	50.3	-	-	-
	4	16.44	7.25	8.07	-	33.0	50.3	-	-	-
HIC-3	0	16.67	7.33	8.07	-	33.2	50.6	-	-	-
	1	16.58	7.09	8.06	-	33.2	50.6	-	-	-
	2	16.57	6.94	8.06	-	33.2	50.6	-	-	-
	3	16.55	6.82	8.06	-	33.2	50.6	-	-	-
	4	16.55	6.72	8.06	-	33.2	50.5	-	-	-
AB-1	0	15.50	7.21	7.91	70.21	32.66	40.80	24.06	1.36	13.05
	1	15.10	7.27	7.92	69.22	32.77	40.55	24.23	1.75	13.14
	2	14.66	7.56	7.94	67.48	32.89	40.28	24.42	3.34	13.23
	3	14.49	7.66	7.95	66.23	32.95	40.19	24.50	4.19	13.27
	4	14.15	7.93	7.97	62.29	33.02	39.95	24.63	7.18	13.34
AB-2	0	15.51	7.08	7.87	65.12	32.59	40.74	24.00	3.06	13.05
	1	15.49	7.04	7.87	64.42	32.59	40.72	24.01	3.30	13.06
	2	15.46	7.02	7.87	62.61	32.59	40.69	24.02	3.65	13.07
	3	14.97	7.02	7.88	53.57	32.65	40.29	24.16	4.27	13.18
	4	14.82	7.09	7.89	68.14	32.67	40.18	24.21	5.62	13.21
	5	14.83	7.10	7.89	66.58	32.68	40.20	24.22	4.81	13.21
AB-3	0	15.95	6.25	7.81	55.46	32.36	40.89	23.73	1.70	12.97
	1	15.83	6.33	7.82	54.20	32.40	40.82	23.78	2.84	12.99
	2	15.77	6.42	7.83	52.06	32.42	40.79	23.82	4.08	13.01
	3	15.66	6.45	7.83	49.44	32.46	40.73	23.87	4.76	13.03
	4	15.42	6.51	7.84	44.49	32.51	40.56	23.96	5.64	13.08
	5	15.26	6.53	7.85	39.56	32.56	40.47	24.03	5.94	13.11
AB-4	0	15.63	6.39	7.82	55.95	32.47	40.71	23.88	2.46	13.04
	1	15.38	6.42	7.83	52.22	32.51	40.53	23.97	3.46	13.09
	2	15.20	6.44	7.84	44.36	32.57	40.43	24.06	4.09	13.13
	3	15.05	6.63	7.86	34.08	32.66	40.39	24.16	4.50	13.16
	4	15.02	6.77	7.87	31.03	32.69	40.39	24.19	4.53	13.16
SGR-1	0	18.57	6.23	7.75	70.12	28.04	38.10	19.81	1.53	12.74
	1	18.47	6.23	7.75	69.31	28.45	38.51	20.15	1.43	12.73
	2	17.34	6.44	7.79	65.94	29.65	38.98	21.33	2.44	12.88
	3	15.01	7.27	7.89	56.44	31.50	39.06	23.27	6.23	13.27
	4	14.50	7.86	7.93	54.50	32.09	39.25	23.83	9.54	13.34
SGR-2	0	18.49	6.25	7.75	68.53	27.59	37.48	19.49	1.35	12.80
	1	18.45	6.22	7.75	69.26	28.29	38.30	20.04	1.36	12.75
	2	17.54	6.46	7.79	68.19	29.74	39.27	21.35	2.35	12.83
	3	15.25	7.19	7.88	63.85	31.15	38.89	22.96	4.03	13.24
SGR-3	0	18.38	6.33	7.76	68.99	28.28	38.23	20.04	1.87	12.76
	1	18.38	6.30	7.76	68.65	28.68	38.72	20.35	1.85	12.73
	2	18.43	6.35	7.77	67.01	29.68	39.97	21.10	1.90	12.64
	3	18.48	6.38	7.78	65.82	30.24	40.69	21.52	1.81	12.58

APPENDIX B

Appendix B. Time, latitude/longitude coordinates, and width of the eelgrass beds located within the Haynes Intake Canal on 19 March 2009.

	West Bank Position			Width of		East Bank Position			Width of
Time	Location	Latitude	Longitude	Eelgrass Bed (m)	Time	Location	Latitude	Longitude	Eelgrass Bed (m)
1045	1	33°45.099'	118°06.321	-	1113	33	33°45.155	118°06.204	3.1
1113	2	33°45.152	118°06.208	2.2	1118	34	33°45.163	118°06.189	4.0
1115	3	33°45.156	118°06.205	3.0	1121	35	33°45.174	118°06.177	5.5
1116	4	33°45.159	118°06.198	3.5	1126	36	33°45.185	118°06.149	6.2
1118	5	33°45.167	118°06.183	5.7	1128	37	33°45.192	118°06.134	3.5
1121	6	33°45.174	118°06.174	6.5	1133	38	33°45.204	118°06.115	6.0
1122	7	33°45.181	118°06.161	6.5	1134	39	33°45.210	118°06.107	0.0
1126	8	33°45.186	118°06.149	7.0	1138	41	33°45.225	118°06.085	1.0
1128	9	33°45.193	118°06.138	3.0	1221	43	33°45.234	118°06.070	1.5
1131	10	33°45.199	118°06.14	6.0	1226	44	33°45.252	118°06.039	5.0
1133	11	33°45.204	118°06.113	6.2	1230	45	33°45.264	118°06.009	8.0
1137	12	33°45.219	118°06.095	8.5	1233	46	33°45.267	118°05.997	4.5
1145	13	33°45.230	118°06.079	9.0	1238	47	33°45.290	118°05.960	1.5
1217	14	33°45.234	118°06.076	8.2	1241	48	33°45.303	118°05.935	2.5
1221	15	33°45.248	118°06.047	4.0	1246	49	33°45.317	118°05.923	1.0
1225	16	33°45.255	118°06.032	7.0	1402	50	33°45.400	118°05.891	-
1230	17	33°45.267	118°06.000	8.0	1414	51	33°45.423	118°05.880	1.5
1233	18	33°45.275	118°05.982	7.2	1416	52	33°45.423	118°05.877	2.0
1235	19	33°45.289	118°05.958	8.0	1421	53	33°45.439	118°05.871	5.0
1240	20	33°45.305	118°05.933	8.0	1424	54	33°45.437	118°05.872	3.0
1243	21	33°45.320	118°05.920	11.5	1428	55	33°45.468	118°05.860	7.0
1247	22	33°45.338	118°05.914	8.0	1431	56	33°45.483	118°05.852	4.0
1250	23	33°45.365	118°05.904	10.0	1434	57	33°45.511	118°05.840	7.0
1410	24	33°45.398	118°05.885	5.5	1438	58	33°45.528	118°05.822	6.7
1412	25	33°45.419	118°05.881	4.2	1442	59	33°45.533	118°05.814	7.5
1416	26	33°45.431	118°05.874	5.4	1446	60	33°45.536	118°05.794	4.0
1419	27	33°45.451	118°05.865	4.9	1449	61	33°45.551	118°05.789	3.0
1423	28	33°45.461	118°05.864	2.0					
1426	29	33°45.466	118°05.861	1.5					
1427	30	33°45.470	118°05.860	2.0					
1432	31	33°45.493	118°05.850	2.0					
1434	32	33°45.518	118°05.838	2.0					
1440	33	33°45.537	118°05.819	3.0					

NOTE: - = start location

APPENDIX C

Appendix C. Sediment grain size laboratory analysis results for samples collected in Alamitos Bay (ABI) and in the HnGS Intake Canal (HICI) in February 2009.

PTS Laboratories, Inc.

Calscience

PTS File No: 39215

PARTICLE SIZE SUMMARY

(METHODOLOGY: ASTM D422/D4464M)

PROJECT NAME: N/A

PROJECT NO: 09-03-0115

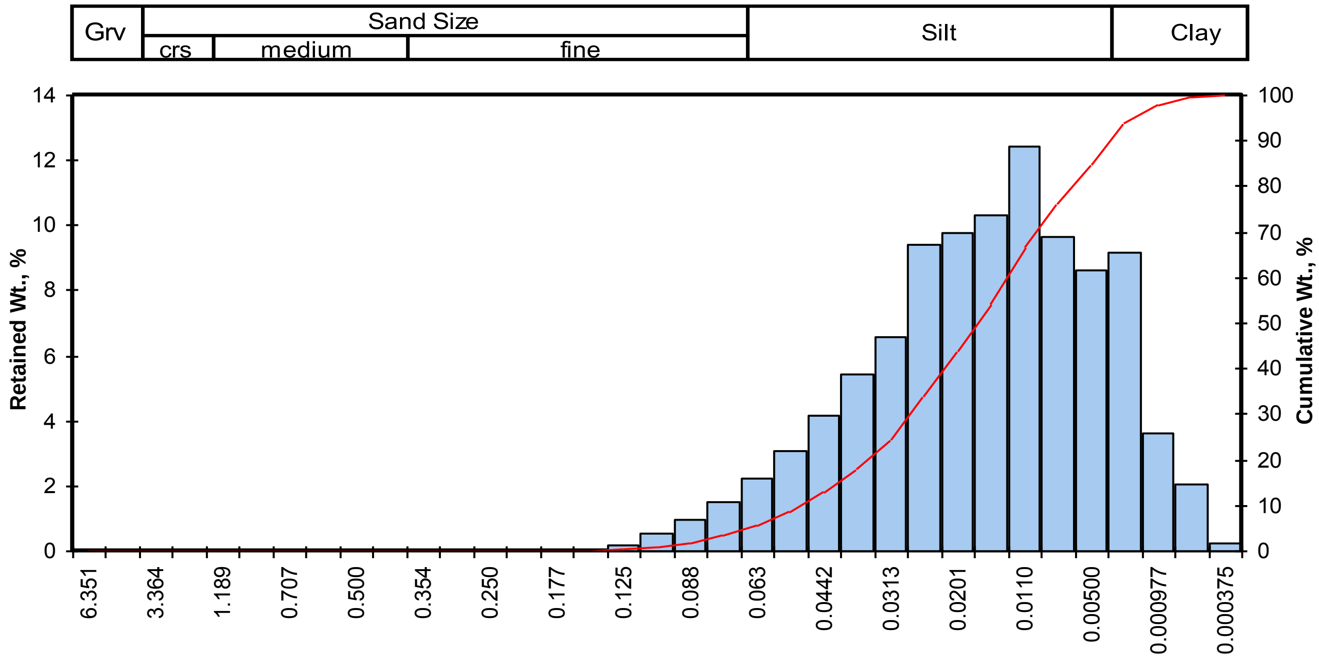
Sample ID	Depth, ft.	Mean Grain Size Description (1)	Median Grain Size mm	Particle Size Distribution, wt. percent						Silt & Clay
					Sand Size					
				Gravel	Coarse	Medium	Fine	Silt	Clay	
ABI 1	N/A	Silt	0.017	0.00	0.00	0.00	3.25	81.74	15.02	96.75
ABI 2	N/A	Silt	0.009	0.00	0.00	0.00	0.29	69.59	30.11	99.71
ABI 3	N/A	Silt	0.012	0.00	0.00	0.00	11.90	56.75	31.35	88.10
ABI 4	N/A	Fine sand	0.090	0.00	0.00	1.98	56.34	37.76	3.92	41.68
HICI 1	N/A	Fine sand	0.105	0.00	0.00	2.95	55.48	32.82	8.76	41.57
HICI 2	N/A	Fine sand	0.159	0.00	0.00	3.59	80.95	12.50	2.96	15.45
HICI 3	N/A	Fine sand	0.135	0.00	0.00	3.08	78.78	15.50	2.64	18.14

(1) Based on Mean from Trask

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	39215
Project:	N/A	**Sample ID:**	ABI 1
Project No:	09-03-0115	**Depth, ft:**	N/A



Particle Size, mm

Opening		Phi of	U.S.	Sample	Increment	Cumulative
Inches	**Millimeters**	**Screen**	**No.**	**Weight, grams**	**Weight, percent**	**Weight, percent**
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.00	0.00	0.00
0.0117	0.297	1.75	50	0.00	0.00	0.00
0.0098	0.250	2.00	60	0.00	0.00	0.00
0.0083	0.210	2.25	70	0.00	0.00	0.00
0.0070	0.177	2.50	80	0.00	0.00	0.00
0.0059	0.149	2.75	100	0.03	0.03	0.03
0.0049	0.125	3.00	120	0.20	0.20	0.23
0.0041	0.105	3.25	140	0.53	0.53	0.76
0.0035	0.088	3.50	170	0.96	0.96	1.72
0.0029	0.074	3.75	200	1.53	1.53	3.25
0.0025	0.063	4.00	230	2.23	2.23	5.48
0.0021	0.053	4.25	270	3.08	3.08	8.56
0.00174	0.0442	4.50	325	4.19	4.19	12.75
0.00146	0.0372	4.75	400	5.43	5.43	18.18
0.00123	0.0313	5.00	450	6.58	6.58	24.77
0.000986	0.0250	5.32	500	9.43	9.43	34.20
0.000790	0.0201	5.64	635	9.76	9.76	43.96
0.000615	0.0156	6.00		10.30	10.30	54.27
0.000435	0.0110	6.50		12.40	12.41	66.68
0.000308	0.00781	7.00		9.66	9.66	76.34
0.000197	0.00500	7.65		8.64	8.64	84.98
0.000077	0.00195	9.00		9.14	9.14	94.13
0.000038	0.000977	10.00		3.59	3.59	97.72
0.000019	0.000488	11.00		2.06	2.06	99.78
0.000015	0.000375	11.38		0.22	0.22	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight percent	**Phi Value**	**Particle Size Inches**	**Particle Size Millimeters**
5	3.95	0.0026	0.065
10	4.34	0.0019	0.050
16	4.65	0.0016	0.040
25	5.01	0.0012	0.031
40	5.51	0.0009	0.022
50	5.85	0.0007	0.017
60	6.23	0.0005	0.013
75	6.93	0.0003	0.008
84	7.57	0.0002	0.005
90	8.39	0.0001	0.003
95	9.24	0.0001	0.002

Measure	Trask	Inman	Folk-Ward
Median, phi	5.85	5.85	5.85
Median, in.	0.0007	0.0007	0.0007
Median, mm	0.017	0.017	0.017
Mean, phi	5.67	6.11	6.02
Mean, in.	0.0008	0.0006	0.0006
Mean, mm	0.020	0.014	0.015
Sorting	1.947	1.461	1.533
Skewness	0.921	0.178	0.229
Kurtosis	0.246	0.813	1.129

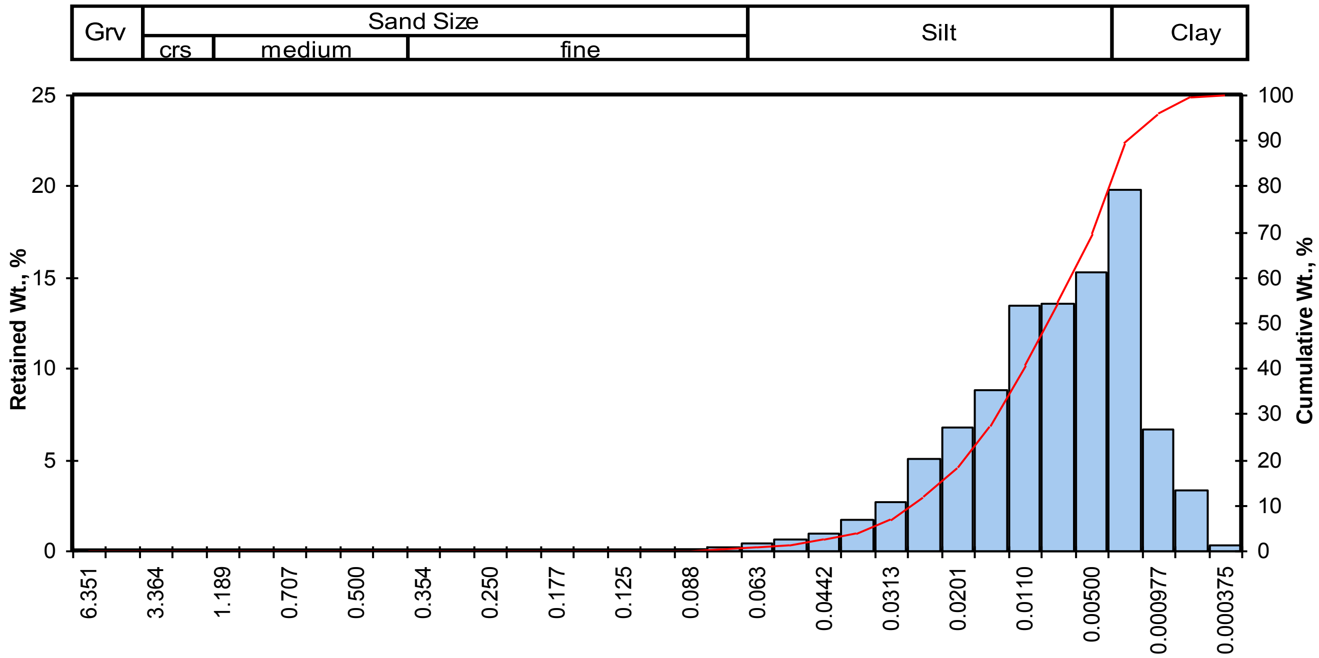
Grain Size Description (ASTM-USCS Scale)	Silt (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	3.25
Silt	>0.005 mm	81.74
Clay	<0.005 mm	15.02
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	39215
Project:	N/A	**Sample ID:**	ABI 2
Project No:	09-03-0115	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.00	0.00	0.00
0.0117	0.297	1.75	50	0.00	0.00	0.00
0.0098	0.250	2.00	60	0.00	0.00	0.00
0.0083	0.210	2.25	70	0.00	0.00	0.00
0.0070	0.177	2.50	80	0.00	0.00	0.00
0.0059	0.149	2.75	100	0.00	0.00	0.00
0.0049	0.125	3.00	120	0.00	0.00	0.00
0.0041	0.105	3.25	140	0.00	0.00	0.00
0.0035	0.088	3.50	170	0.06	0.06	0.06
0.0029	0.074	3.75	200	0.23	0.23	0.29
0.0025	0.063	4.00	230	0.43	0.43	0.72
0.0021	0.053	4.25	270	0.64	0.64	1.36
0.00174	0.0442	4.50	325	1.02	1.02	2.38
0.00146	0.0372	4.75	400	1.70	1.70	4.08
0.00123	0.0313	5.00	450	2.71	2.71	6.79
0.000986	0.0250	5.32	500	5.08	5.08	11.87
0.000790	0.0201	5.64	635	6.83	6.83	18.69
0.000615	0.0156	6.00		8.82	8.82	27.51
0.000435	0.0110	6.50		13.50	13.49	41.00
0.000308	0.00781	7.00		13.60	13.59	54.59
0.000197	0.00500	7.65		15.30	15.29	69.89
0.000077	0.00195	9.00		19.80	19.79	89.68
0.000038	0.000977	10.00		6.66	6.66	96.33
0.000019	0.000488	11.00		3.32	3.32	99.65
0.000015	0.000375	11.38		0.35	0.35	100.00
TOTALS				**100.10**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	4.83	0.0014	0.035
10	5.20	0.0011	0.027
16	5.51	0.0009	0.022
25	5.90	0.0007	0.017
40	6.46	0.0004	0.011
50	6.83	0.0003	0.009
60	7.23	0.0003	0.007
75	8.00	0.0002	0.004
84	8.61	0.0001	0.003
90	9.05	0.0001	0.002
95	9.80	0.0000	0.001

Measure	Trask	Inman	Folk-Ward
Median, phi	6.83	6.83	6.83
Median, in.	0.0003	0.0003	0.0003
Median, mm	0.009	0.009	0.009
Mean, phi	6.59	7.06	6.99
Mean, in.	0.0004	0.0003	0.0003
Mean, mm	0.010	0.007	0.008
Sorting	2.069	1.549	1.527
Skewness	0.923	0.150	0.173
Kurtosis	0.254	0.603	0.970

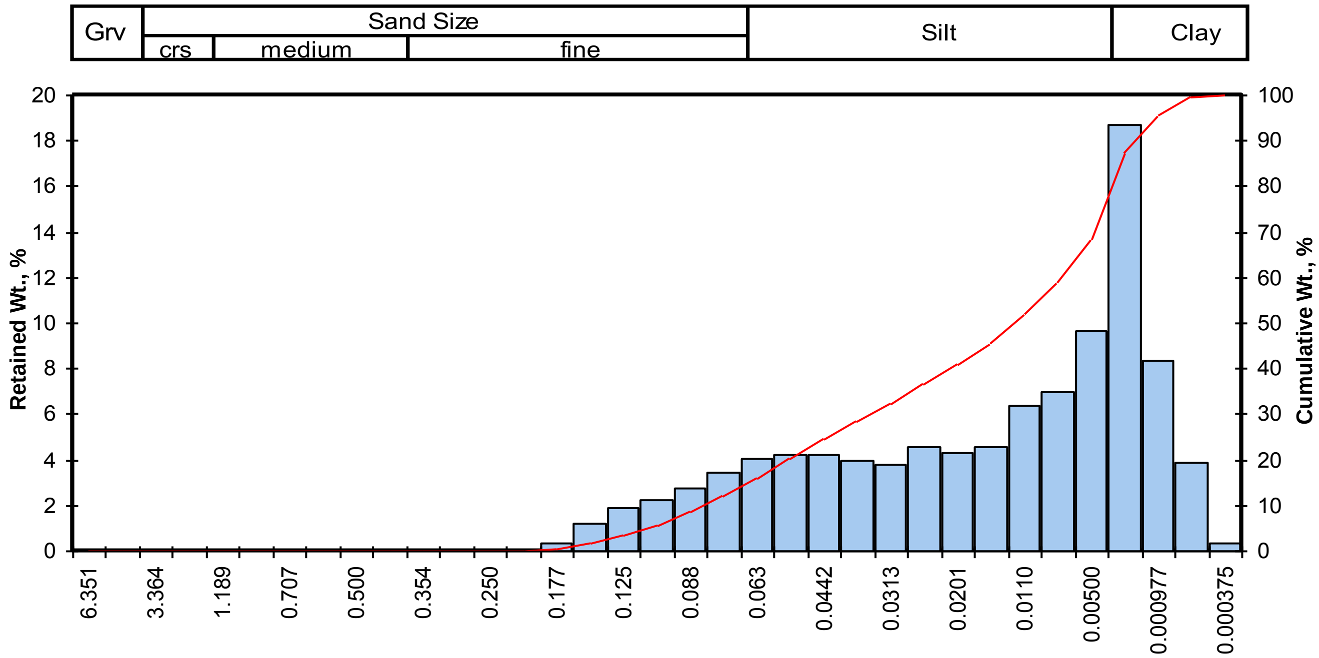
Grain Size Description (ASTM-USCS Scale)	Silt (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	0.29
Silt	>0.005 mm	69.59
Clay	<0.005 mm	30.11
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	39215
Project:	N/A	**Sample ID:**	ABI 3
Project No:	09-03-0115	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.00	0.00	0.00
0.0117	0.297	1.75	50	0.00	0.00	0.00
0.0098	0.250	2.00	60	0.00	0.00	0.00
0.0083	0.210	2.25	70	0.03	0.03	0.03
0.0070	0.177	2.50	80	0.34	0.34	0.37
0.0059	0.149	2.75	100	1.18	1.18	1.55
0.0049	0.125	3.00	120	1.87	1.87	3.42
0.0041	0.105	3.25	140	2.26	2.26	5.68
0.0035	0.088	3.50	170	2.76	2.76	8.44
0.0029	0.074	3.75	200	3.46	3.46	11.90
0.0025	0.063	4.00	230	4.03	4.03	15.93
0.0021	0.053	4.25	270	4.24	4.24	20.17
0.00174	0.0442	4.50	325	4.20	4.20	24.37
0.00146	0.0372	4.75	400	4.00	4.00	28.37
0.00123	0.0313	5.00	450	3.78	3.78	32.15
0.000986	0.0250	5.32	500	4.53	4.53	36.68
0.000790	0.0201	5.64	635	4.31	4.31	40.99
0.000615	0.0156	6.00		4.57	4.57	45.56
0.000435	0.0110	6.50		6.40	6.40	51.95
0.000308	0.00781	7.00		7.02	7.02	58.97
0.000197	0.00500	7.65		9.68	9.68	68.65
0.000077	0.00195	9.00		18.70	18.70	87.35
0.000038	0.000977	10.00		8.39	8.39	95.74
0.000019	0.000488	11.00		3.88	3.88	99.62
0.000015	0.000375	11.38		0.38	0.38	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	3.17	0.0044	0.111
10	3.61	0.0032	0.082
16	4.00	0.0025	0.062
25	4.54	0.0017	0.043
40	5.57	0.0008	0.021
50	6.35	0.0005	0.012
60	7.07	0.0003	0.007
75	8.10	0.0001	0.004
84	8.76	0.0001	0.002
90	9.32	0.0001	0.002
95	9.91	0.0000	0.001

Measure	Trask	Inman	Folk-Ward
Median, phi	6.35	6.35	6.35
Median, in.	0.0005	0.0005	0.0005
Median, mm	0.012	0.012	0.012
Mean, phi	5.42	6.38	6.37
Mean, in.	0.0009	0.0005	0.0005
Mean, mm	0.023	0.012	0.012
Sorting	3.441	2.376	2.209
Skewness	1.017	0.014	0.036
Kurtosis	0.246	0.417	0.774

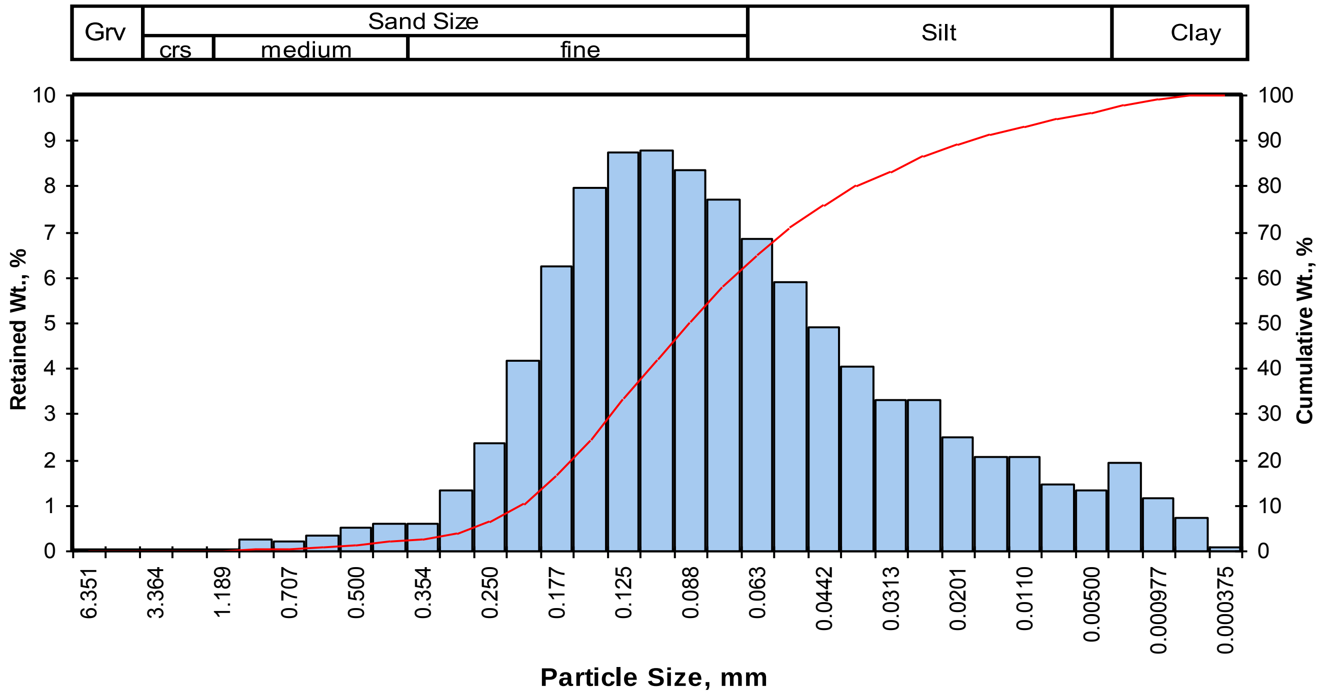
Grain Size Description (ASTM-USCS Scale)	Silt (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	11.90
Silt	>0.005 mm	56.75
Clay	<0.005 mm	31.35
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	39215
Project:	N/A	**Sample ID:**	ABI 4
Project No:	09-03-0115	**Depth, ft:**	N/A



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.01	0.01	0.01
0.0331	0.841	0.25	20	0.28	0.28	0.29
0.0278	0.707	0.50	25	0.22	0.22	0.51
0.0234	0.595	0.75	30	0.33	0.33	0.84
0.0197	0.500	1.00	35	0.52	0.52	1.36
0.0166	0.420	1.25	40	0.62	0.62	1.98
0.0139	0.354	1.50	45	0.59	0.59	2.57
0.0117	0.297	1.75	50	1.35	1.35	3.92
0.0098	0.250	2.00	60	2.36	2.36	6.28
0.0083	0.210	2.25	70	4.19	4.19	10.47
0.0070	0.177	2.50	80	6.25	6.25	16.72
0.0059	0.149	2.75	100	7.98	7.98	24.70
0.0049	0.125	3.00	120	8.77	8.77	33.47
0.0041	0.105	3.25	140	8.79	8.79	42.26
0.0035	0.088	3.50	170	8.36	8.36	50.62
0.0029	0.074	3.75	200	7.70	7.70	58.32
0.0025	0.063	4.00	230	6.85	6.85	65.17
0.0021	0.053	4.25	270	5.89	5.89	71.06
0.00174	0.0442	4.50	325	4.93	4.93	75.99
0.00146	0.0372	4.75	400	4.05	4.05	80.04
0.00123	0.0313	5.00	450	3.30	3.30	83.34
0.000986	0.0250	5.32	500	3.30	3.30	86.64
0.000790	0.0201	5.64	635	2.48	2.48	89.12
0.000615	0.0156	6.00		2.09	2.09	91.21
0.000435	0.0110	6.50		2.07	2.07	93.28
0.000308	0.00781	7.00		1.46	1.46	94.74
0.000197	0.00500	7.65		1.34	1.34	96.08
0.000077	0.00195	9.00		1.93	1.93	98.01
0.000038	0.000977	10.00		1.17	1.17	99.18
0.000019	0.000488	11.00		0.74	0.74	99.92
0.000015	0.000375	11.38		0.08	0.08	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	1.86	0.0108	0.275
10	2.22	0.0084	0.214
16	2.47	0.0071	0.180
25	2.76	0.0058	0.148
40	3.19	0.0043	0.110
50	3.48	0.0035	0.090
60	3.81	0.0028	0.071
75	4.45	0.0018	0.046
84	5.06	0.0012	0.030
90	5.79	0.0007	0.018
95	7.12	0.0003	0.007

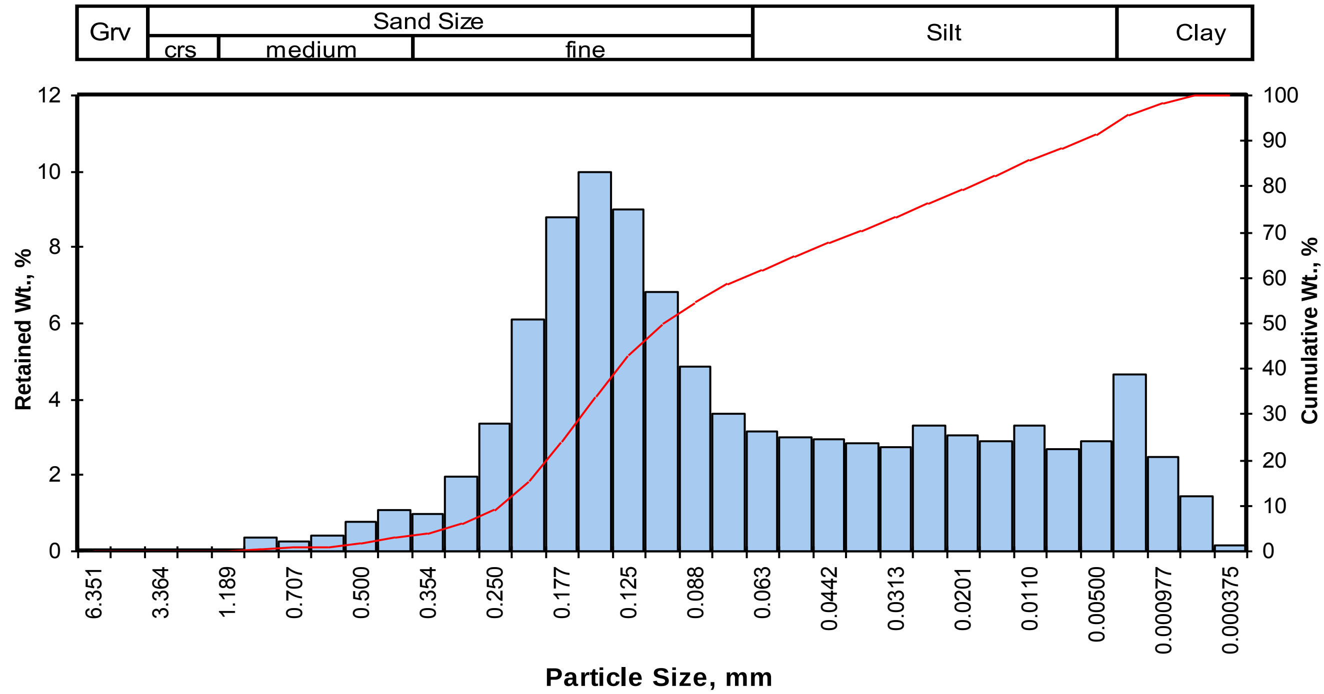
Measure	Trask	Inman	Folk-Ward
Median, phi	3.48	3.48	3.48
Median, in.	0.0035	0.0035	0.0035
Median, mm	0.090	0.090	0.090
Mean, phi	3.37	3.77	3.67
Mean, in.	0.0038	0.0029	0.0031
Mean, mm	0.097	0.073	0.078
Sorting	1.797	1.296	1.445
Skewness	0.918	0.221	0.303
Kurtosis	0.260	1.029	1.275
Grain Size Description (ASTM-USCS Scale)		Fine sand (based on Mean from Trask)	

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	1.98
Fine Sand	200	56.34
Silt	>0.005 mm	37.76
Clay	<0.005 mm	3.92
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	39215
Project:	N/A	**Sample ID:**	HICI 1
Project No:	09-03-0115	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.01	0.01	0.01
0.0331	0.841	0.25	20	0.38	0.38	0.39
0.0278	0.707	0.50	25	0.26	0.26	0.65
0.0234	0.595	0.75	30	0.41	0.41	1.06
0.0197	0.500	1.00	35	0.80	0.80	1.86
0.0166	0.420	1.25	40	1.09	1.09	2.95
0.0139	0.354	1.50	45	1.00	1.00	3.95
0.0117	0.297	1.75	50	1.95	1.95	5.90
0.0098	0.250	2.00	60	3.35	3.35	9.25
0.0083	0.210	2.25	70	6.09	6.09	15.33
0.0070	0.177	2.50	80	8.80	8.80	24.13
0.0059	0.149	2.75	100	10.00	10.00	34.13
0.0049	0.125	3.00	120	8.98	8.98	43.10
0.0041	0.105	3.25	140	6.84	6.84	49.94
0.0035	0.088	3.50	170	4.85	4.85	54.79
0.0029	0.074	3.75	200	3.64	3.64	58.43
0.0025	0.063	4.00	230	3.15	3.15	61.58
0.0021	0.053	4.25	270	3.00	3.00	64.57
0.00174	0.0442	4.50	325	2.95	2.95	67.52
0.00146	0.0372	4.75	400	2.85	2.85	70.37
0.00123	0.0313	5.00	450	2.74	2.74	73.11
0.000986	0.0250	5.32	500	3.31	3.31	76.42
0.000790	0.0201	5.64	635	3.03	3.03	79.45
0.000615	0.0156	6.00		2.92	2.92	82.37
0.000435	0.0110	6.50		3.30	3.30	85.67
0.000308	0.00781	7.00		2.69	2.69	88.35
0.000197	0.00500	7.65		2.89	2.89	91.24
0.000077	0.00195	9.00		4.64	4.64	95.88
0.000038	0.000977	10.00		2.49	2.49	98.37
0.000019	0.000488	11.00		1.47	1.47	99.84
0.000015	0.000375	11.38		0.16	0.16	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	1.63	0.0127	0.322
10	2.03	0.0096	0.245
16	2.27	0.0082	0.207
25	2.52	0.0069	0.174
40	2.91	0.0052	0.133
50	3.25	0.0041	0.105
60	3.87	0.0027	0.068
75	5.18	0.0011	0.028
84	6.25	0.0005	0.013
90	7.37	0.0002	0.006
95	8.74	0.0001	0.002

Measure	Trask	Inman	Folk-Ward
Median, phi	3.25	3.25	3.25
Median, in.	0.0041	0.0041	0.0041
Median, mm	0.105	0.105	0.105
Mean, phi	3.31	4.26	3.92
Mean, in.	0.0040	0.0021	0.0026
Mean, mm	0.101	0.052	0.066
Sorting	2.515	1.989	2.072
Skewness	0.660	0.505	0.525
Kurtosis	0.307	0.786	1.095

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	2.95
Fine Sand	200	55.48
Silt	>0.005 mm	32.82
Clay	<0.005 mm	8.76
	Total	**100**

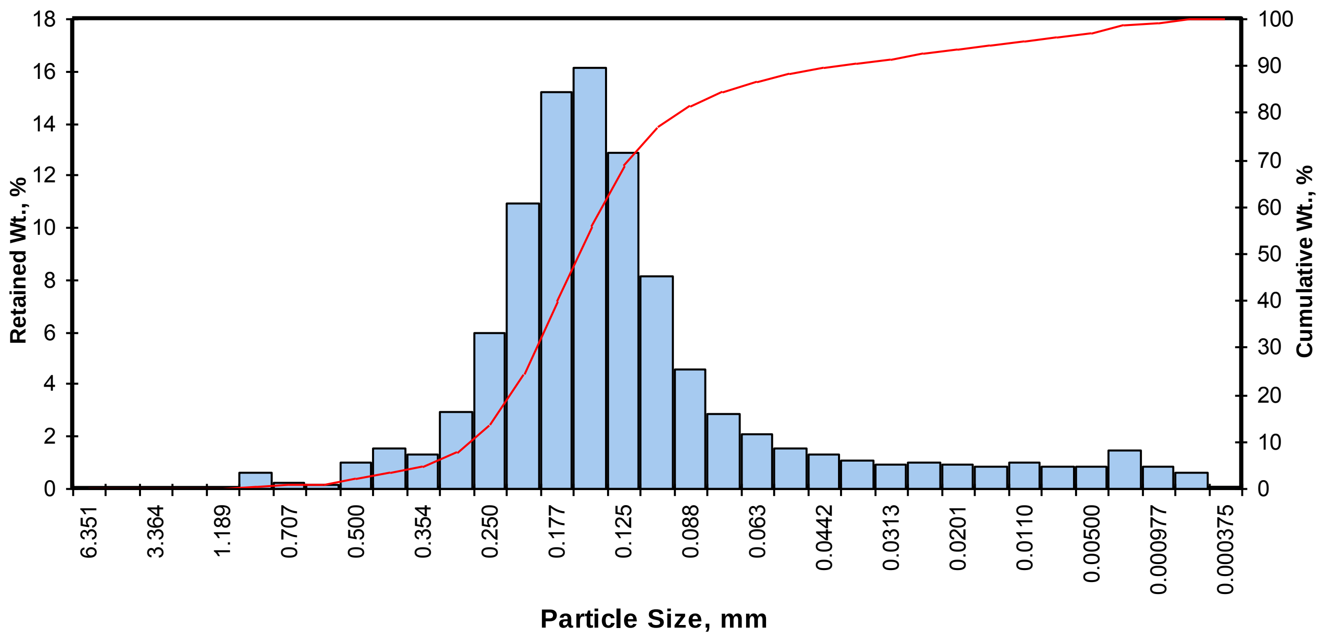
Phone: (562) 907-3607 Fax: (562) 907-3610

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	39215
Project:	N/A	**Sample ID:**	HICI 2
Project ID:	09-03-0115	**Depth, ft:**	N/A

Grv | Sand Size: crs, medium, fine | Silt | Clay



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.61	0.61	0.61
0.0278	0.707	0.50	25	0.25	0.25	0.86
0.0234	0.595	0.75	30	0.16	0.16	1.02
0.0197	0.500	1.00	35	0.99	0.99	2.01
0.0166	0.420	1.25	40	1.58	1.58	3.59
0.0139	0.354	1.50	45	1.34	1.34	4.93
0.0117	0.297	1.75	50	2.92	2.92	7.85
0.0098	0.250	2.00	60	5.94	5.94	13.80
0.0083	0.210	2.25	70	10.90	10.91	24.70
0.0070	0.177	2.50	80	15.20	15.21	39.91
0.0059	0.149	2.75	100	16.10	16.11	56.02
0.0049	0.125	3.00	120	12.90	12.91	68.93
0.0041	0.105	3.25	140	8.13	8.13	77.06
0.0035	0.088	3.50	170	4.61	4.61	81.67
0.0029	0.074	3.75	200	2.87	2.87	84.55
0.0025	0.063	4.00	230	2.06	2.06	86.61
0.0021	0.053	4.25	270	1.58	1.58	88.19
0.00174	0.0442	4.50	325	1.29	1.29	89.48
0.00146	0.0372	4.75	400	1.11	1.11	90.59
0.00123	0.0313	5.00	450	0.95	0.95	91.54
0.000986	0.0250	5.32	500	1.04	1.04	92.58
0.000790	0.0201	5.64	635	0.91	0.91	93.49
0.000615	0.0156	6.00		0.86	0.86	94.35
0.000435	0.0110	6.50		0.98	0.98	95.33
0.000308	0.00781	7.00		0.82	0.82	96.15
0.000197	0.00500	7.65		0.89	0.89	97.04
0.000077	0.00195	9.00		1.47	1.47	98.51
0.000038	0.000977	10.00		0.82	0.82	99.33
0.000019	0.000488	11.00		0.60	0.60	99.93
0.000015	0.000375	11.38		0.07	0.07	100.00
TOTALS				**99.90**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	1.51	0.0139	0.352
10	1.84	0.0110	0.279
16	2.05	0.0095	0.241
25	2.25	0.0082	0.210
40	2.50	0.0070	0.177
50	2.66	0.0062	0.159
60	2.83	0.0055	0.141
75	3.19	0.0043	0.110
84	3.70	0.0030	0.077
90	4.62	0.0016	0.041
95	6.33	0.0005	0.012

Measure	Trask	Inman	Folk-Ward
Median, phi	2.66	2.66	2.66
Median, in.	0.0062	0.0062	0.0062
Median, mm	0.159	0.159	0.159
Mean, phi	2.65	2.88	2.80
Mean, in.	0.0063	0.0054	0.0056
Mean, mm	0.160	0.136	0.143
Sorting	1.381	0.826	1.144
Skewness	0.956	0.266	0.395
Kurtosis	0.209	1.921	2.122

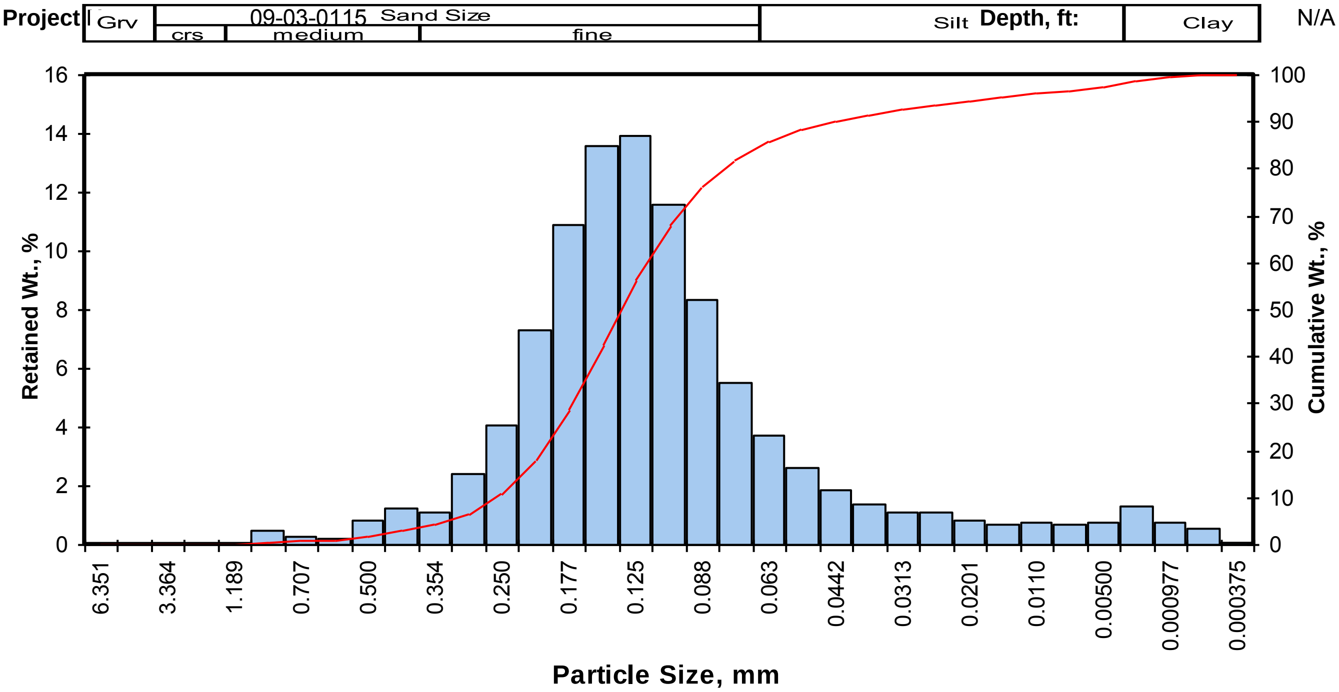
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	3.59
Fine Sand	200	80.95
Silt	>0.005 mm	12.50
Clay	<0.005 mm	2.96
	Total	**100**

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	39215
Project:	N/A	**Sample ID:**	HICl 3
Project No:	09-03-0115	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.50	0.50	0.50
0.0278	0.707	0.50	25	0.27	0.27	0.77
0.0234	0.595	0.75	30	0.24	0.24	1.01
0.0197	0.500	1.00	35	0.85	0.85	1.86
0.0166	0.420	1.25	40	1.22	1.22	3.08
0.0139	0.354	1.50	45	1.13	1.13	4.21
0.0117	0.297	1.75	50	2.38	2.38	6.59
0.0098	0.250	2.00	60	4.09	4.09	10.69
0.0083	0.210	2.25	70	7.31	7.31	18.00
0.0070	0.177	2.50	80	10.90	10.91	28.90
0.0059	0.149	2.75	100	13.60	13.61	42.51
0.0049	0.125	3.00	120	13.90	13.91	56.42
0.0041	0.105	3.25	140	11.60	11.61	68.02
0.0035	0.088	3.50	170	8.31	8.31	76.34
0.0029	0.074	3.75	200	5.52	5.52	81.86
0.0025	0.063	4.00	230	3.70	3.70	85.56
0.0021	0.053	4.25	270	2.59	2.59	88.15
0.00174	0.0442	4.50	325	1.88	1.88	90.03
0.00146	0.0372	4.75	400	1.41	1.41	91.44
0.00123	0.0313	5.00	450	1.09	1.09	92.54
0.000986	0.0250	5.32	500	1.07	1.07	93.61
0.000790	0.0201	5.64	635	0.82	0.82	94.43
0.000615	0.0156	6.00		0.72	0.72	95.15
0.000435	0.0110	6.50		0.79	0.79	95.94
0.000308	0.00781	7.00		0.67	0.67	96.61
0.000197	0.00500	7.65		0.75	0.75	97.36
0.000077	0.00195	9.00		1.28	1.28	98.64
0.000038	0.000977	10.00		0.75	0.75	99.39
0.000019	0.000488	11.00		0.55	0.55	99.94
0.000015	0.000375	11.38		0.06	0.06	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	1.58	0.0131	0.334
10	1.96	0.0101	0.257
16	2.18	0.0087	0.220
25	2.41	0.0074	0.188
40	2.70	0.0060	0.153
50	2.88	0.0053	0.135
60	3.08	0.0047	0.118
75	3.46	0.0036	0.091
84	3.89	0.0026	0.067
90	4.50	0.0017	0.044
95	5.93	0.0006	0.016

Measure	Trask	Inman	Folk-Ward
Median, phi	2.88	2.88	2.88
Median, in.	0.0053	0.0053	0.0053
Median, mm	0.135	0.135	0.135
Mean, phi	2.84	3.04	2.99
Mean, in.	0.0055	0.0048	0.0050
Mean, mm	0.139	0.122	0.126
Sorting	1.439	0.856	1.086
Skewness	0.966	0.179	0.290
Kurtosis	0.228	1.536	1.697

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	3.08
Fine Sand	200	78.78
Silt	>0.005 mm	15.50
Clay	<0.005 mm	2.64
	Total	**100**

APPENDIX D

Appendix D-1. Rocky intertidal master species list for Alamitos Bay, 2009.

PHYLUM Class Species	PHYLUM Class Species
CHLOROPHYTA (CH)	MOLLUSCA (MO) (cont.).
Ulva spp	Gastropoda
	*Acanthinucella spirata**
RHODOPHYTA (RH)	*Crepidula onyx**
Liagora californica	*Crucibulum spinosum**
	*Littorina scutulata**
ANNELIDA (AN)	*Lottia limatula*
Polychaeta	*Lottia scabra*
Serpulidae	*Serpulorbis squamigerus*
	*Tegula eiseni**
ARTHROPODA (AR)	Bivalvia
Maxillopoda	*Mytilus californianus*
*Balanus amphitrite**	*Mytilus galloprovincialis*
Balanus glandula	*Pseudochama exogyra*
Chthamalus fissus	
*Tetraclita rubescens**	ECTOPROCTA (BRYOZOA) (EP)
Malacostraca	*Watersipora arcuata*
*Hemigrapsus oregonensis**	
	CHORDATA (CO)
MOLLUSCA (MO)	Ascidiacea
Polyplacophora	*Styela plicata*
*Mopalia muscosa**	
*Nuttallina californica**	

* Extralimital species = additional species found within and adjacent to quadrats

Appendix D-2. Rocky intertidal data by quadrat in Alamitos Bay, 2009.

Station HM Level +1

		Quadrat							Percent	
Phylum	Species	1	2	3	4	Total	Mean	S.D.	Occur.	Cover
AR	*Chthamalus fissus*	15	6	13	6	40	10.0	4.7	50.0	25.0
EP	*Watersipora arcuata*	2	1	8	9	20	5.0	4.1	50.0	12.5
AR	*Balanus glandula*	5	-	-	-	5	1.3	2.5	12.5	3.1
MO	*Serpulorbis squamigerus*	-	1	3	1	5	1.3	1.3	37.5	3.1
RH	*Liagora californica*	-	1	2	2	5	1.3	1.0	37.5	3.1
MO	*Pseudochama exogyra*	-	-	-	2	2	0.5	1.0	12.5	1.3
CO	*Styela plicata*	-	1	-	-	1	0.3	0.5	12.5	0.6
MO	*Lottia scabra*	-	1	-	-	1	0.3	0.5	12.5	0.6
Contacts		22	11	26	20	79	19.8	6.3		
% Cover		55	28	65	50	49	49.4	15.9		
Number of species		3	6	4	5	8	4.5	1.3		
Diversity (H')		0.82	1.42	1.16	1.33	1.42	1.18	0.27		

EXTRALIMITAL SPECIES

AN	Serpulidae	MO	*Lottia limatula*
AR	*Balanus amphitrite*	MO	*Mopalia muscosa*
MO	*Acanthinucella spirata*	MO	*Tegula eiseni*
MO	*Crepidula onyx*		

Station HM Level +3

		Quadrat							Percent	
Phylum	Species	1	2	3	4	Total	Mean	S.D.	Occur.	Cover
AR	*Chthamalus fissus*	13	7	16	16	52	13.0	4.2	50.0	32.5
AR	*Balanus glandula*	7	6	-	10	23	5.8	4.2	37.5	14.4
MO	*Mytilus galloprovincialis*	1	11	-	-	12	3.0	5.4	25.0	7.5
EP	*Watersipora arcuata*	-	5	-	-	5	1.3	2.5	12.5	3.1
MO	*Lottia scabra*	1	-	-	1	2	0.5	0.6	25.0	1.3
MO	*Mytilus californianus*	-	2	-	-	2	0.5	1.0	12.5	1.3
Contacts		22	31	16	27	96	24.0	6.5		
% Cover		55	78	40	68	60	60.0	16.2		
Number of species		4	5	1	3	6	3.3	1.7		
Diversity (H')		0.96	1.49	-	0.80	1.25	0.81	0.62		

EXTRALIMITAL SPECIES

AR	*Hemigrapsus oregonensis*	MO	*Lottia limatula*
AR	*Tetraclita rubescens*	MO	*Nuttallina californica*
MO	*Littorina scutulata*		

Appendix D-2. (Cont.).

Station NLR Level +1

Phylum	Species	Quadrat 1	2	3	4	Total	Mean	S.D.	Percent Occur.	Cover
MO	*Mytilus galloprovincialis*	30	-	-	-	30	7.5	15.0	12.5	18.8
AR	*Balanus glandula*	1	1	-	3	5	1.3	1.3	37.5	3.1
RH	*Liagora californica*	-	-	4	-	4	1.0	2.0	12.5	2.5
AN	Serpulidae	1	-	1	1	3	0.8	0.5	37.5	1.9
CH	*Ulva* spp	-	-	3	-	3	0.8	1.5	12.5	1.9
AR	*Chthamalus fissus*	-	1	-	-	1	0.3	0.5	12.5	0.6
EP	*Watersipora arcuata*	1	-	-	-	1	0.3	0.5	12.5	0.6
MO	*Lottia limatula*	-	-	1	-	1	0.3	0.5	12.5	0.6
MO	*Serpulorbis squamigerus*	1	-	-	-	1	0.3	0.5	12.5	0.6
Contacts		34	2	9	4	49	12.3	14.8		
% Cover		85	5	23	10	31	30.6	37.0		
Number of species		5	2	4	2	9	3.3	1.5		
Diversity (H')		0.53	0.69	1.21	0.56	1.40	0.75	0.32		

EXTRALIMITAL SPECIES

AR *Balanus amphitrite*
MO *Acanthinucella spirata*
MO *Crucibulum spinosum*
MO *Lottia scabra*
MO *Nuttallina californica*

Station NLR Level +3

Phylum	Species	Quadrat 1	2	3	4	Total	Mean	S.D.	Percent Occur.	Cover
AR	*Chthamalus fissus*	-	4	-	-	4	1.0	2.0	12.5	2.5
AR	*Balanus glandula*	-	-	1	2	3	0.8	1.0	25.0	1.9
Contacts		-	4	1	2	7	1.8	1.7		
% Cover		-	10	3	5	4	4.4	4.3		
Number of species		-	1	1	1	2	0.8	0.5		
Diversity (H')		-	-	-	-	0.68	-	-		

EXTRALIMITAL SPECIES

AR *Balanus amphitrite*
MO *Lottia scabra*
MO *Mytilus galloprovincialis*

APPENDIX E

Appendix E-1. Infaunal master species list for Alamitos Bay and Haynes Intake Canal, February 2009, and San Gabriel River, June 2008.

- PHYLUM
  - Subphylum or Class
    - Species

- CNIDARIA (CN)
  - Anthozoa
    - Actiniaria

- PLATYHELMINTHES (PL)
  - Turbellaria
    - *Pseudoceros* sp
    - *Stylochoplana* sp

- NEMERTEA (NE)
  - Anopla
    - Lineidae
    - *Tubulanus cingulatus*
    - *Tubulanus frenatus*
    - *Tubulanus polymorphus*
  - Enopla
    - *Amphiporus* sp
    - Nemertea sp B Paquette 2005
    - *Paranemertes californica*
    - *Tetrastemma nigrifrons*
  - Uncertain
    - Nemertea

- NEMATODA (NT)
    - Nematoda

- MOLLUSCA (MO)
  - Gastropoda
    - *Acteocina harpa*
    - *Acteocina inculta*
    - *Alia carinata*
    - *Barleeia haliotiphila*
    - *Caecum californicum*
    - *Crepidula onyx*
    - *Crucibulum spinosum*
    - *Cylichnella culcitella*
    - *Fartulum occidentale*
    - Gastropoda
    - *Turbonilla raymondi*
  - Bivalvia
    - Bivalvia
    - *Chione californiensis*
    - *Hiatella arctica*
    - *Lasaea adansoni*
    - Lasaeidae
    - *Leporimetis obesa*
    - *Leukoma staminea*
    - *Lyonsia californica*
    - *Macoma secta*
    - *Macoma yoldiformis*
    - *Mactrotoma californica*
    - *Modiolus* sp
    - Mytilidae
    - *Mytilus* sp
    - *Periploma discus*
    - *Tagelus subteres*
    - *Tellina cadieni*
    - *Theora lubrica*
    - *Venerupis philippinarum*
  - Polyplacaphora
    - *Nuttallina californica*

- PHYLUM
  - Subphylum or Class
    - Species

- SIPUNCULA (SI)
  - Sipunculidea
    - Sipuncula

- ANNELIDA (AN)
  - Polychaeta
    - *Amaeana occidentalis*
    - *Amphicteis scaphobranchiata*
    - *Aphelochaeta phillipsi*
    - *Apoprionospio pygmaea*
    - *Armandia brevis*
    - *Capitella capitata* Cmplx
    - *Chone mollis*
    - *Cirriformia moorei*
    - *Cirriformia* sp
    - *Cossura* sp A Phillips 1987
    - *Diopatra* spp
    - *Dorvillea (Schistomeringos) annulata*
    - *Eteone californica*
    - *Eteone fauchaldi*
    - *Euchone limnicola*
    - *Eumida longicornuta*
    - *Eusyllis* sp
    - *Exogone lourei*
    - *Glycera americana*
    - *Goniada littorea*
    - *Laonice cirrata*
    - *Leitoscoloplos pugettensis*
    - Maldanidae
    - *Malmgreniella macginitiei*
    - *Marphysa sanguinea*
    - *Mediomastus ambiseta*
    - *Mediomastus californiensis*
    - *Megalomma pigmentum*
    - *Monticellina cryptica*
    - *Monticellina serratiseta*
    - *Monticellina siblina*
    - *Naineris* sp
    - *Neanthes acuminata* Cmplx
    - *Nephtys caecoides*
    - *Nephtys cornuta*
    - *Nereis latescens*
    - *Notomastus magnus*
    - *Notomastus* sp
    - *Notomastus tenuis*
    - *Owenia collaris*
    - *Pectinaria californiensis*
    - *Pherusa capulata*
    - *Phyllodoce longipes*
    - *Pista agassizi*
    - *Pista wui*
    - *Polydora cirrosa*
    - *Polydora cornuta*
    - *Prionospio (Minuspio) lighti*
    - *Prionospio (Prionospio) heterobranchia*
    - *Prionospio (Prionospio) jubata*
    - *Pseudopolydora kempi*
    - *Pseudopolydora paucibranchiata*
    - *Scolelepis (Parascolelepis*) sp SD1 Rowe 1995
    - *Scolelepis (Parascolelepis) tridentata*
    - *Scoletoma* sp C (Harris 1985)

Appendix E-1. (Cont.).

PHYLUM Subphylum or Class Species	PHYLUM Subphylum or Class Species
ANNELIDA (Cont.).	ARTHROPODA (cont.)
Polychaeta (cont.).	Malacostraca cont.
Scoletoma spp	*Ianiropsis tridens*
Scoloplos acmeceps	*Jassa slatteryi*
Scyphoproctus oculatus	*Leptochelia dubia*
Sphaerosyllis bilineata	*Listriella diffusa*
Sphaerosyllis californiensis	*Listriella melanica*
Sphaerosyllis ranunculus	*Mayerella banksia*
Spio filicornis	*Melita rylovae*
Spiochaetopterus costarum Cmplx	*Monocorophium insidiosum*
Spiophanes duplex	*Monocorophium* sp
Spirorbis sp	*Oxyurostylis pacifica*
Streblosoma sp B SCAMIT 1985	*Pachygrapsus crassipes*
Streblospio benedicti	*Paracerceis sculpta*
Syllis gracilis Cmplx	*Paracerceis* sp
Terebellidae	*Paramicrodeutopus schmitti*
Typosyllis hyalina	*Paranthura elegans*
Oligochaeta	*Photis bifurcata*
Oligochaeta	*Photis brevipes*
	Podocerus cristatus
ARTHROPODA (AR)	*Poecilostomatoida* sp A MBC 1998
Pycnogonida	*Rudilemboides stenopropodus*
Anoplodactylus erectus	*Sinocorophium heteroceratum*
Maxillopoda	*Uromunna ubiquita*
Clausidium vancouverense	*Zeuxo normani*
Harpacticoida	
Ostracoda	ECHINODERMATA (EC)
Euphilomedes carcharodonta	Ophiuroidea
Postasterope barnesi	*Amphiodia digitata*
Malacostraca	*Amphiodia* sp
Acuminodeutopus heteruropus	*Amphiodia urtica*
Allorchestes angusta	*Amphipholis squamata*
Americhelidium shoemakeri	Amphiuridae
Amphideutopus oculatus	Uncertain
Ampithoe valida	Ophiuroidea
Aoroides sp	
Apolochus barnardi	PHORONA (PR)
Caprella sp	Phoronida
Elasmopus bampo	*Phoronis* sp
Eochelidium sp A SCAMIT 1996	
Ericthonius brasiliensis	Chordata (CO)
Gammaridea	Urochordata
Grandidierella japonica	*Molgula "manhattanensis"*
Hemiproto sp A Benedict 1978	

Appendix E-2. Infauna results by station for Alamitos Bay (ABI) and Haynes Intake Canal, (HICI) February 2009, and San Gabriel River (B), June 2008.

		Station											Percent
Phylum	Species	ABI1	ABI2	ABI3	ABI4	HICI1	HICI2	HICI3	B10	B11	B12	Total	Total
AN	Oligochaeta	1	3	4	8	1391	1406	2093	77	181	63	5227	35.67
NT	Nematoda	51	8	5	5	553	244	612	188	1100	1896	4662	31.81
AN	*Streblospio benedicti*	-	-	-	-	6	8	5	100	129	466	714	4.87
AN	*Euchone limnicola*	87	297	236	23	-	-	-	-	-	-	643	4.39
AN	*Mediomastus ambiseta*	53	18	16	148	24	13	68	-	-	3	343	2.34
MO	*Crucibulum spinosum*	-	-	-	-	-	1	-	4	110	157	272	1.86
AN	*Scoloplos acmeceps*	-	-	-	-	1	2	5	1	32	160	201	1.37
AR	*Acuminodeutopus heteruropus*	29	6	9	3	38	78	30	-	-	-	193	1.32
AN	*Neanthes acuminata* Cmplx	-	-	-	-	56	26	2	39	34	22	179	1.22
AR	*Postasterope barnesi*	1	1	1	1	85	39	40	-	2	-	170	1.16
AR	*Euphilomedes carcharodonta*	17	2	1	22	50	4	72	-	1	-	169	1.15
AN	*Capitella capitata* Cmplx	-	-	-	-	48	20	3	56	14	-	141	0.96
AN	*Polydora cirrosa*	-	-	-	-	-	-	-	55	11	24	90	0.61
AN	*Pseudopolydora paucibranchiata*	20	8	2	3	1	1	-	1	6	47	89	0.61
AN	*Exogone lourei*	11	-	1	15	19	26	13	-	1	-	86	0.59
MO	*Barleeia haliotiphila*	-	-	-	-	2	32	8	-	39	3	84	0.57
AR	*Monocorophium insidiosum*	-	-	-	-	-	-	-	65	-	-	65	0.44
AN	*Prionospio (Prionospio) heterobranchia*	26	12	16	2	2	3	1	-	-	-	62	0.42
EC	*Amphipholis squamata*	-	3	5	2	10	18	23	-	-	-	61	0.42
AN	*Leitoscoloplos pugettensis*	9	20	25	1	-	-	-	-	-	-	55	0.38
AN	*Scoletoma* spp	1	34	18	2	-	-	-	-	-	-	55	0.38
AN	*Scyphoporoctus oculatus*	-	-	-	-	51	-	-	-	2	-	53	0.36
AR	*Grandidierella japonica*	-	-	-	-	-	-	1	33	9	8	51	0.35
AR	*Rudilemboides stenopropodus*	7	-	-	-	7	10	27	-	-	-	51	0.35
CN	Actiniaria	1	-	-	-	-	-	-	-	12	31	44	0.30
AN	*Sphaerosyllis californiensis*	-	-	-	-	-	-	-	-	18	24	42	0.29
MO	*Venerupis philippinarum*	-	-	-	-	1	-	-	-	38	3	42	0.29
AN	*Polydora cornuta*	-	-	-	-	-	-	-	16	2	19	37	0.25
EC	Amphiuridae	-	-	-	-	9	6	17	-	-	-	32	0.22
AR	*Paranthura elegans*	-	-	-	-	-	2	2	1	7	17	29	0.20
AN	*Marphysa sanguinea*	-	-	-	-	-	-	-	15	5	7	27	0.18
AN	*Cirriformia moorei*	-	-	-	-	21	3	2	-	-	-	26	0.18
AN	*Cossura* sp A Phillips 1987	20	3	2	1	-	-	-	-	-	-	26	0.18
AR	*Amphideutopus oculatus*	15	1	3	4	2	1	-	-	-	-	26	0.18
AN	*Goniada littorea*	13	-	-	11	-	-	-	-	-	-	24	0.16
AN	*Prionospio (Minuspio) lighti*	2	2	-	15	-	-	-	-	-	-	19	0.13
AR	*Elasmopus bampo*	-	-	-	-	-	1	-	1	11	6	19	0.13
AN	*Spiophanes duplex*	5	4	4	2	-	-	-	-	-	1	16	0.11
NE	Lineidae	5	1	1	9	-	-	-	-	-	-	16	0.11
AR	Harpacticoida	-	-	-	-	-	1	-	4	8	2	15	0.10
AR	*Eochelidium* sp A SCAMIT 1996	2	3	9	-	-	-	-	-	-	-	14	0.10
AR	*Melita rylovae*	-	-	-	-	-	1	-	-	13	-	14	0.10
AR	*Sinocorophium heteroceratum*	-	4	10	-	-	-	-	-	-	-	14	0.10
AN	*Pista agassizi*	-	3	10	-	-	-	-	-	-	-	13	0.09
MO	*Leukoma staminea*	-	3	-	-	6	1	3	-	-	-	13	0.09
AN	*Pherusa capulata*	-	6	5	1	-	-	-	-	-	-	12	0.08
AR	*Paramicrodeutopus schmitti*	4	6	2	-	-	-	-	-	-	-	12	0.08
AR	*Poecilostomatoida* sp A MBC 1998	10	-	-	2	-	-	-	-	-	-	12	0.08
MO	*Acteocina inculta*	-	-	-	-	-	-	-	-	-	12	12	0.08
PR	*Phoronis* sp	3	-	1	-	-	-	-	-	-	8	12	0.08
AN	Maldanidae	-	-	-	-	7	-	4	-	-	-	11	0.08
AN	*Nephtys cornuta*	5	2	1	3	-	-	-	-	-	-	11	0.08
AR	*Hemiproto* sp A Benedict 1978	1	4	5	1	-	-	-	-	-	-	11	0.08
AN	*Apoprionospio pygmaea*	-	-	1	5	-	-	1	-	2	1	10	0.07
AN	*Notomastus tenuis*	10	-	-	-	-	-	-	-	-	-	10	0.07
AN	*Spirorbis* sp	-	-	-	-	-	-	-	-	8	2	10	0.07
EC	Ophiuroidea	1	5	1	3	-	-	-	-	-	-	10	0.07
AN	*Mediomastus californiensis*	3	2	1	2	-	-	1	-	-	-	9	0.06
AR	*Anoplodactylus erectus*	-	-	-	-	6	2	1	-	-	-	9	0.06
MO	*Cylichnella culcitella*	-	-	-	-	-	-	-	-	9	-	9	0.06
AN	*Armandia brevis*	1	-	1	3	-	-	1	-	2	-	8	0.05
AN	*Streblosoma* sp B SCAMIT 1985	-	1	1	-	-	1	1	-	3	1	8	0.05
AR	*Paracerceis sculpta*	-	-	-	-	-	-	-	2	6	-	8	0.05
EC	*Amphiodia digitata*	-	-	-	-	-	-	-	-	8	-	8	0.05
AN	*Sphaerosyllis bilineata*	-	-	-	-	1	4	2	-	-	-	7	0.05

Appendix E-2. (Cont.).

Phylum	Species	Station ABI1	ABI2	ABI3	ABI4	HICI1	HICI2	HICI3	B10	B11	B12	Total	Percent Total
MO	*Mactrotoma californica*	-	4	2	-	-	-	1	-	-	-	7	0.05
AN	*Monticellina cryptica*	-	-	-	6	-	-	-	-	-	-	6	0.04
AN	*Monticellina siblina*	6	-	-	-	-	-	-	-	-	-	6	0.04
AN	*Scolelepis (Parascolelepis) tridentata*	-	-	3	3	-	-	-	-	-	-	6	0.04
AR	*Mayerella banksia*	3	-	-	-	1	1	1	-	-	-	6	0.04
AR	*Monocorophium* spp	-	-	-	-	-	-	-	-	5	1	6	0.04
EC	*Amphiodia* sp	1	-	-	-	4	-	-	-	-	1	6	0.04
MO	Lasaeidae	-	-	-	-	5	-	1	-	-	-	6	0.04
NE	Nemertea	2	-	1	1	1	-	-	-	-	1	6	0.04
AN	*Cirriformia* sp	-	-	-	-	-	-	-	-	1	4	5	0.03
AN	*Dorvillea (Schistomeringos) annulata*	-	1	4	-	-	-	-	-	-	-	5	0.03
EC	*Amphiodia urtica*	1	-	-	1	-	3	-	-	-	-	5	0.03
MO	*Tagelus subteres*	-	3	2	-	-	-	-	-	-	-	5	0.03
AN	*Nephtys caecoides*	2	-	-	2	-	-	-	-	-	-	4	0.03
AN	*Scoletoma* sp C (Harris 1985)	-	-	4	-	-	-	-	-	-	-	4	0.03
AR	*Photis bifurcata*	4	-	-	-	-	-	-	-	-	-	4	0.03
AR	*Uromunna ubiquita*	-	-	-	-	-	-	-	2	1	1	4	0.03
AR	*Zeuxo normani*	-	-	-	-	-	4	-	-	-	-	4	0.03
NE	*Paranemertes californica*	2	-	-	2	-	-	-	-	-	-	4	0.03
NE	*Tubulanus polymorphus*	2	1	1	-	-	-	-	-	-	-	4	0.03
PL	*Stylochoplana* sp	2	-	-	-	-	2	-	-	-	-	4	0.03
AN	*Pectinaria californiensis*	1	-	-	2	-	-	-	-	-	-	3	0.02
AN	*Prionospio (Prionopsio) jubata*	-	-	1	1	1	-	-	-	-	-	3	0.02
AN	*Sphaerosyllis ranunculus*	-	-	-	-	-	-	-	3	-	-	3	0.02
AN	*Spio filicornis*	-	-	-	-	-	-	3	-	-	-	3	0.02
AR	*Allorchestes angusta*	-	-	-	-	-	3	-	-	-	-	3	0.02
AR	*Aoroides* sp	-	-	-	-	-	-	-	-	2	1	3	0.02
AR	*Caprella* sp	-	-	-	-	2	-	1	-	-	-	3	0.02
AR	*Monocorophium* sp	-	-	-	1	-	2	-	-	-	-	3	0.02
MO	*Caecum californicum*	-	-	-	-	-	-	-	-	3	-	3	0.02
MO	*Tellina cadieni*	1	-	-	1	-	-	1	-	-	-	3	0.02
MO	*Theora lubrica*	-	1	2	-	-	-	-	-	-	-	3	0.02
SI	Sipuncula	-	-	-	-	-	1	2	-	-	-	3	0.02
AN	*Amaeana occidentalis*	1	-	-	1	-	-	-	-	-	-	2	0.01
AN	*Aphelochaeta phillipsi*	-	-	-	-	2	-	-	-	-	-	2	0.01
AN	*Diopatra* spp	2	-	-	-	-	-	-	-	-	-	2	0.01
AN	*Eumida longicornuta*	2	-	-	-	-	-	-	-	-	-	2	0.01
AN	*Megalomma pigmentum*	2	-	-	-	-	-	-	-	-	-	2	0.01
AN	*Phyllodoce longipes*	-	-	-	-	1	1	-	-	-	-	2	0.01
AN	*Syllis gracilis* Cmplx	-	-	-	-	1	-	-	1	-	-	2	0.01
AN	*Typosyllis hyalina*	-	-	-	-	1	1	-	-	-	-	2	0.01
AR	*Clausidium vancouverense*	-	-	-	-	-	2	-	-	-	-	2	0.01
AR	Gammaridea	-	-	-	-	-	-	-	-	2	-	2	0.01
AR	*Leptochelia dubia*	-	-	1	-	-	-	-	1	-	-	2	0.01
AR	*Listriella diffusa*	-	-	2	-	-	-	-	-	-	-	2	0.01
AR	*Podocerus cristatus*	-	2	-	-	-	-	-	-	-	-	2	0.01
MO	*Acteocina harpa*	1	-	1	-	-	-	-	-	-	-	2	0.01
MO	*Chione californiensis*	-	-	-	-	-	1	1	-	-	-	2	0.01
MO	*Leporimetis obesa*	1	-	1	-	-	-	-	-	-	-	2	0.01
MO	*Lyonsia californica*	-	1	-	-	-	-	-	-	-	1	2	0.01
MO	*Turbonilla raymondi*	-	-	-	-	2	-	-	-	-	-	2	0.01
NE	*Amphiporus* sp	-	2	-	-	-	-	-	-	-	-	2	0.01
AN	*Amphicteis scaphobranchiata*	1	-	-	-	-	-	-	-	-	-	1	0.01
AN	*Chone mollis*	-	-	-	1	-	-	-	-	-	-	1	0.01
AN	*Eteone californica*	-	-	-	-	-	-	-	-	-	1	1	0.01
AN	*Eteone fauchaldi*	1	-	-	-	-	-	-	-	-	-	1	0.01
AN	*Eusyllis* sp	-	-	-	-	-	-	-	-	1	-	1	0.01
AN	*Glycera americana*	-	-	-	-	-	-	-	-	-	1	1	0.01
AN	*Laonice cirrata*	-	-	-	-	-	-	-	-	-	1	1	0.01
AN	*Malmgreniella macginitiei*	1	-	-	-	-	-	-	-	-	-	1	0.01
AN	*Monticellina serratiseta*	1	-	-	-	-	-	-	-	-	-	1	0.01
AN	*Naineris* sp	-	-	-	-	1	-	-	-	-	-	1	0.01
AN	*Nereis latescens*	-	-	1	-	-	-	-	-	-	-	1	0.01
AN	*Notomastus magnus*	-	1	-	-	-	-	-	-	-	-	1	0.01
AN	*Notomastus* sp	1	-	-	-	-	-	-	-	-	-	1	0.01

Appendix E-2. (Cont.).

Phylum	Species	ABI1	ABI2	ABI3	ABI4	HICI1	HICI2	HICI3	B10	B11	B12	Total	Percent Total
		Station											
AN	*Owenia collaris*	1	-	-	-	-	-	-	-	-	-	1	0.01
AN	*Pista wui*	1	-	-	-	-	-	-	-	-	-	1	0.01
AN	*Pseudopolydora kempi*	1	-	-	-	-	-	-	-	-	-	1	0.01
AN	*Scolelepis (Parascolelepis)* sp SD1	-	-	-	-	-	-	-	-	-	1	1	0.01
AN	*Spiochaetopterus costarum* Cmplx	-	-	-	1	-	-	-	-	-	-	1	0.01
AN	Terebellidae	-	-	-	-	-	-	-	-	1	-	1	0.01
AR	*Americhelidium shoemakeri*	-	-	-	-	-	-	-	-	1	-	1	0.01
AR	*Ampithoe valida*	-	-	-	-	-	-	-	1	-	-	1	0.01
AR	*Apolochus barnardi*	-	-	-	-	-	-	1	-	-	-	1	0.01
AR	*Ericthonius brasiliensis*	-	-	-	-	-	1	-	-	-	-	1	0.01
AR	*Ianiropsis tridens*	-	-	-	-	1	-	-	-	-	-	1	0.01
AR	*Jassa slatteryi*	-	-	-	-	-	-	1	-	-	-	1	0.01
AR	*Listriella melanica*	-	-	1	-	-	-	-	-	-	-	1	0.01
AR	*Oxyurostylis pacifica*	-	-	-	-	-	-	1	-	-	-	1	0.01
AR	*Pachygrapsus crassipes*	-	-	1	-	-	-	-	-	-	-	1	0.01
AR	*Paracerceis* sp	-	1	-	-	-	-	-	-	-	-	1	0.01
AR	*Photis brevipes*	1	-	-	-	-	-	-	-	-	-	1	0.01
CO	*Molgula "manhattanensis"*	-	-	-	-	-	-	-	-	-	1	1	0.01
MO	*Alia carinata*	-	-	-	-	-	-	1	-	-	-	1	0.01
MO	Bivalvia	1	-	-	-	-	-	-	-	-	-	1	0.01
MO	*Crepidula onyx*	-	-	-	-	-	-	-	-	-	1	1	0.01
MO	*Cuminga californica*	-	1	-	-	-	-	-	-	-	-	1	0.01
MO	*Fartulum occidentale*	-	-	-	1	-	-	-	-	-	-	1	0.01
MO	Gastropoda	-	-	-	-	-	-	-	-	1	-	1	0.01
MO	*Hiatella arctica*	-	-	-	-	1	-	-	-	-	-	1	0.01
MO	*Lasaea adansoni*	-	-	-	-	-	-	-	-	-	1	1	0.01
MO	*Macoma secta*	-	1	-	-	-	-	-	-	-	-	1	0.01
MO	*Macoma yoldiformis*	1	-	-	-	-	-	-	-	-	-	1	0.01
MO	*Modiolus* sp	-	-	-	-	-	-	-	1	-	-	1	0.01
MO	Mytilidae	-	-	-	-	1	-	-	-	-	-	1	0.01
MO	*Mytilus* sp	-	-	-	-	-	-	-	-	1	-	1	0.01
MO	*Nuttallina californica*	-	-	-	-	-	-	-	-	1	-	1	0.01
MO	*Periploma discus*	-	1	-	-	-	-	-	-	-	-	1	0.01
NE	Nemertea sp B Paquette 2005	-	-	-	-	1	-	-	-	-	-	1	0.01
NE	*Tetrastemma nigrifrons*	-	-	-	-	-	1	-	-	-	-	1	0.01
NE	*Tubulanus cingulatus*	-	-	1	-	-	-	-	-	-	-	1	0.01
NE	*Tubulanus frenatus*	-	1	-	-	-	-	-	-	-	-	1	0.01
PL	*Pseudoceros* sp	-	-	-	-	-	-	-	-	1	-	1	0.01
	Number of individuals	461	483	426	321	2423	1977	3053	667	1844	3000	14655	
	Number of species	59	42	47	41	41	41	39	23	44	39	168	
	Diversity (H')	3.10	1.87	2.14	2.38	1.52	1.25	1.12	2.22	1.74	1.42	2.24	

Appendix E-3. Infaunal data by station and replicate, Alamitos Bay (AB) and Haynes Intake Canal (HIC), February 2009, and San Gabriel River, June 2008.

Station AB1

Phylum	Species	Replicate AB1-1	AB1-2	AB1-3	Total	Percent Composition	Density No./m²
AN	*Euchone limnicola*	36	37	14	87	18.87	2175.0
AN	*Mediomastus ambiseta*	33	11	9	53	11.50	1325.0
NT	Nematoda	25	12	14	51	11.06	1275.0
AR	*Acuminodeutopus heteruropus*	13	11	5	29	6.29	725.0
AN	*Prionospio (Prionospio) heterobranchia*	17	4	5	26	5.64	650.0
AN	*Cossura* sp A Phillips 1987	8	8	4	20	4.34	500.0
AN	*Pseudopolydora paucibranchiata*	9	4	7	20	4.34	500.0
AR	*Euphilomedes carcharodonta*	12	5	-	17	3.69	425.0
AR	*Amphideutopus oculatus*	3	6	6	15	3.25	375.0
AN	*Goniada littorea*	-	6	7	13	2.82	325.0
AN	*Exogone lourei*	3	3	5	11	2.39	275.0
AN	*Notomastus tenuis*	-	8	2	10	2.17	250.0
AR	*Poecilostomatoida* sp A MBC 1998	3	2	5	10	2.17	250.0
AN	*Leitoscoloplos pugettensis*	3	1	5	9	1.95	225.0
AR	*Rudilemboides stenopropodus*	3	3	1	7	1.52	175.0
AN	*Monticellina siblina*	4	1	1	6	1.30	150.0
AN	*Nephtys cornuta*	2	2	1	5	1.08	125.0
AN	*Spiophanes duplex*	4	1	-	5	1.08	125.0
NE	Lineidae	2	-	3	5	1.08	125.0
AR	*Paramicrodeutopus schmitti*	-	4	-	4	0.87	100.0
AR	*Photis bifurcata*	2	2	-	4	0.87	100.0
AN	*Mediomastus californiensis*	-	1	2	3	0.65	75.0
AR	*Mayerella banksia*	1	1	1	3	0.65	75.0
PR	*Phoronis* sp	1	1	1	3	0.65	75.0
AN	*Diopatra* spp	1	-	1	2	0.43	50.0
AN	*Eumida longicornuta*	-	1	1	2	0.43	50.0
AN	*Megalomma pigmentum*	2	-	-	2	0.43	50.0
AN	*Nephtys caecoides*	1	1	-	2	0.43	50.0
AN	*Prionospio (Minuspio) lighti*	-	2	-	2	0.43	50.0
AR	*Eochelidium* sp A SCAMIT 1996	-	2	-	2	0.43	50.0
NE	Nemertea	1	1	-	2	0.43	50.0
NE	*Paranemertes californica*	-	-	2	2	0.43	50.0
NE	*Tubulanus polymorphus*	2	-	-	2	0.43	50.0
PL	*Stylochoplana* sp	1	-	1	2	0.43	50.0
AN	*Amaeana occidentalis*	-	-	1	1	0.22	25.0
AN	*Amphicteis scaphobranchiata*	-	-	1	1	0.22	25.0
AN	*Armandia brevis*	-	-	1	1	0.22	25.0
AN	*Eteone fauchaldi*	-	-	1	1	0.22	25.0
AN	*Malmgreniella macginitiei*	-	1	-	1	0.22	25.0
AN	*Monticellina serratiseta*	1	-	-	1	0.22	25.0
AN	*Notomastus* sp	1	-	-	1	0.22	25.0
AN	Oligochaeta	-	1	-	1	0.22	25.0
AN	*Owenia collaris*	1	-	-	1	0.22	25.0
AN	*Pectinaria californiensis*	1	-	-	1	0.22	25.0
AN	*Pista wui*	-	-	1	1	0.22	25.0
AN	*Pseudopolydora kempi*	-	1	-	1	0.22	25.0
AN	*Scoletoma* spp	-	-	1	1	0.22	25.0
AR	*Hemiproto* sp A Benedict 1978	-	-	1	1	0.22	25.0
AR	*Photis brevipes*	1	-	-	1	0.22	25.0
AR	*Postasterope barnesi*	1	-	-	1	0.22	25.0
CN	Actiniaria	-	1	-	1	0.22	25.0
EC	*Amphiodia* sp	1	-	-	1	0.22	25.0
EC	*Amphiodia urtica*	-	1	-	1	0.22	25.0
EC	Ophiuroidea	1	-	-	1	0.22	25.0
MO	*Acteocina harpa*	1	-	-	1	0.22	25.0
MO	Bivalvia	-	1	-	1	0.22	25.0
MO	*Leporimetis obesa*	-	-	1	1	0.22	25.0
MO	*Macoma yoldiformis*	-	-	1	1	0.22	25.0
MO	*Tellina cadieni*	-	-	1	1	0.22	25.0

Summary

Parameter	Replicate ABI1-1	ABI1-2	ABI1-3	Station Total	Replicate Mean	S.D.
Number of individuals	201	147	113	461	154	44
Number of species	35	34	34	59	34	1
Diversity (H')	2.78	3.41	1.10	3.10	2.43	1.19

Appendix E-3. (Cont.).

Station AB2

Phylum	Species	Replicate AB2-1	AB2-2	AB2-3	Total	Percent Composition	Density No./m²
AN	*Euchone limnicola*	133	122	42	297	61.49	7425.0
AN	*Scoletoma* spp	16	8	10	34	7.04	850.0
AN	*Leitoscoloplos pugettensis*	6	3	11	20	4.14	500.0
AN	*Mediomastus ambiseta*	4	8	6	18	3.73	450.0
AN	*Prionospio (Prionospio) heterobranchia*	2	3	7	12	2.48	300.0
AN	*Pseudopolydora paucibranchiata*	1	7	-	8	1.66	200.0
NT	Nematoda	-	-	8	8	1.66	200.0
AN	*Pherusa capulata*	1	1	4	6	1.24	150.0
AR	*Acuminodeutopus heteruropus*	2	2	2	6	1.24	150.0
AR	*Paramicrodeutopus schmitti*	1	4	1	6	1.24	150.0
EC	Ophiuroidea	3	2	-	5	1.04	125.0
AN	*Spiophanes duplex*	4	-	-	4	0.83	100.0
AR	*Hemiproto* sp A Benedict 1978	-	4	-	4	0.83	100.0
AR	*Sinocorophium heteroceratum*	2	-	2	4	0.83	100.0
MO	*Mactrotoma californica*	3	1	-	4	0.83	100.0
AN	*Cossura* sp A Phillips 1987	-	3	-	3	0.62	75.0
AN	Oligochaeta	-	-	3	3	0.62	75.0
AN	*Pista agassizi*	3	-	-	3	0.62	75.0
AR	*Eochelidium* sp A SCAMIT 1996	2	1	-	3	0.62	75.0
EC	*Amphipholis squamata*	2	1	-	3	0.62	75.0
MO	*Leukoma staminea*	-	3	-	3	0.62	75.0
MO	*Tagelus subteres*	2	1	-	3	0.62	75.0
AN	*Mediomastus californiensis*	-	1	1	2	0.41	50.0
AN	*Nephtys cornuta*	-	1	1	2	0.41	50.0
AN	*Prionospio (Minuspio) lighti*	1	-	1	2	0.41	50.0
AR	*Euphilomedes carcharodonta*	1	1	-	2	0.41	50.0
AR	*Podocerus cristatus*	-	2	-	2	0.41	50.0
NE	*Amphiporus* sp	1	-	1	2	0.41	50.0
AN	*Dorvillea (Schistomeringos) annulata*	-	-	1	1	0.21	25.0
AN	*Notomastus magnus*	1	-	-	1	0.21	25.0
AN	*Streblosoma* sp B SCAMIT 1985	-	1	-	1	0.21	25.0
AR	Amphideutopus oculatus	-	1	-	1	0.21	25.0
AR	*Paracerceis* sp	1	-	-	1	0.21	25.0
AR	*Postasterope barnesi*	-	1	-	1	0.21	25.0
MO	*Cumingia californica*	1	-	-	1	0.21	25.0
MO	*Lyonsia californica*	1	-	-	1	0.21	25.0
MO	*Macoma secta*	-	1	-	1	0.21	25.0
MO	*Periploma discus*	-	1	-	1	0.21	25.0
MO	*Theora lubrica*	-	1	-	1	0.21	25.0
NE	Lineidae	1	-	-	1	0.21	25.0
NE	*Tubulanus frenatus*	1	-	-	1	0.21	25.0
NE	*Tubulanus polymorphus*	-	-	1	1	0.21	25.0

Summary

Parameter	Replicate ABI2-1	ABI2-2	ABI2-3	Station Total	Replicate Mean	S.D.
Number of individuals	196	185	102	483	161	51
Number of species	26	27	17	42	23	6
Diversity (H')	1.53	1.90	0.77	1.87	1.40	0.58

Appendix E-3. (Cont.).

Station AB3

Phylum	Species	Replicate AB3-1	AB3-2	AB3-3	Total	Percent Composition	Density No./m²
AN	*Euchone limnicola*	43	29	164	236	55.40	5900.0
AN	*Leitoscoloplos pugettensis*	8	11	6	25	5.87	625.0
AN	*Scoletoma* spp	4	3	11	18	4.23	450.0
AN	*Mediomastus ambiseta*	8	3	5	16	3.76	400.0
AN	*Prionospio (Prionospio) heterobranchia*	4	6	6	16	3.76	400.0
AN	*Pista agassizi*	5	3	2	10	2.35	250.0
AR	*Sinocorophium heteroceratum*	2	8	-	10	2.35	250.0
AR	*Acuminodeutopus heteruropus*	3	2	4	9	2.11	225.0
AR	*Eochelidium* sp A SCAMIT 1996	2	-	7	9	2.11	225.0
AN	*Pherusa capulata*	1	1	3	5	1.17	125.0
AR	*Hemiproto* sp A Benedict 1978	-	1	4	5	1.17	125.0
EC	*Amphipholis squamata*	-	4	1	5	1.17	125.0
NT	Nematoda	4	1	-	5	1.17	125.0
AN	*Dorvillea (Schistomeringos) annulata*	-	4	-	4	0.94	100.0
AN	Oligochaeta	4	-	-	4	0.94	100.0
AN	*Scoletoma* sp C (Harris 1985)	-	-	4	4	0.94	100.0
AN	*Spiophanes duplex*	-	2	2	4	0.94	100.0
AN	*Scolelepis (Parascolelepis) tridentata*	2	1	-	3	0.70	75.0
AR	*Amphideutopus oculatus*	3	-	-	3	0.70	75.0
AN	*Cossura* sp A Phillips 1987	-	1	1	2	0.47	50.0
AN	*Pseudopolydora paucibranchiata*	2	-	-	2	0.47	50.0
AR	*Listriella diffusa*	-	2	-	2	0.47	50.0
AR	*Paramicrodeutopus schmitti*	2	-	-	2	0.47	50.0
MO	*Mactrotoma californica*	-	-	2	2	0.47	50.0
MO	*Tagelus subteres*	-	-	2	2	0.47	50.0
MO	*Theora lubrica*	1	-	1	2	0.47	50.0
AN	*Apoprionospio pygmaea*	1	-	-	1	0.23	25.0
AN	*Armandia brevis*	1	-	-	1	0.23	25.0
AN	*Exogone lourei*	1	-	-	1	0.23	25.0
AN	*Mediomastus californiensis*	1	-	-	1	0.23	25.0
AN	*Nephtys cornuta*	-	-	1	1	0.23	25.0
AN	*Nereis latescens*	1	-	-	1	0.23	25.0
AN	*Prionospio (Prionospio) jubata*	-	1	-	1	0.23	25.0
AN	*Streblosoma* sp B SCAMIT 1985	-	-	1	1	0.23	25.0
AR	*Euphilomedes carcharodonta*	-	-	1	1	0.23	25.0
AR	*Leptochelia dubia*	-	-	1	1	0.23	25.0
AR	*Listriella melanica*	1	-	-	1	0.23	25.0
AR	*Pachygrapsus crassipes*	1	-	-	1	0.23	25.0
AR	*Postasterope barnesi*	-	-	1	1	0.23	25.0
EC	Ophiuroidea	-	1	-	1	0.23	25.0
MO	*Acteocina harpa*	-	1	-	1	0.23	25.0
MO	*Leporimetis obesa*	-	-	1	1	0.23	25.0
NE	Lineidae	-	-	1	1	0.23	25.0
NE	Nemertea	1	-	-	1	0.23	25.0
NE	*Tubulanus cingulatus*	1	-	-	1	0.23	25.0
NE	*Tubulanus polymorphus*	-	1	-	1	0.23	25.0
PR	*Phoronis* sp	-	1	-	1	0.23	25.0

Summary

Parameter	Replicate ABI3-1	ABI3-2	ABI3-3	Station Total	Replicate Mean	S.D.
Number of individuals	107	87	232	426	142	79
Number of species	26	22	24	47	24	2
Diversity (H')	2.44	1.28	1.11	2.14	1.61	0.72

Appendix E-3. (Cont.).

Station AB4

Phylum	Species	Replicate AB4-1	AB4-2	AB4-3	Total	Percent Composition	Density No./m²
AN	*Mediomastus ambiseta*	35	83	30	148	46.11	3700.0
AN	*Euchone limnicola*	6	11	6	23	7.17	575.0
AR	*Euphilomedes carcharodonta*	9	12	1	22	6.85	550.0
AN	*Exogone lourei*	8	7	-	15	4.67	375.0
AN	*Prionospio (Minuspio) lighti*	11	2	2	15	4.67	375.0
AN	*Goniada littorea*	4	6	1	11	3.43	275.0
NE	Lineidae	6	2	1	9	2.80	225.0
AN	Oligochaeta	4	4	-	8	2.49	200.0
AN	*Monticellina cryptica*	2	3	1	6	1.87	150.0
AN	*Apoprionospio pygmaea*	1	1	3	5	1.56	125.0
NT	Nematoda	-	4	1	5	1.56	125.0
AR	*Amphideutopus oculatus*	2	2	-	4	1.25	100.0
AN	*Armandia brevis*	1	2	-	3	0.93	75.0
AN	*Nephtys cornuta*	1	1	1	3	0.93	75.0
AN	*Pseudopolydora paucibranchiata*	2	1	-	3	0.93	75.0
AN	*Scolelepis (Parascolelepis) tridentata*	3	-	-	3	0.93	75.0
AR	*Acuminodeutopus heteruropus*	-	1	2	3	0.93	75.0
EC	Ophiuroidea	1	1	1	3	0.93	75.0
AN	*Mediomastus californiensis*	1	1	-	2	0.62	50.0
AN	*Nephtys caecoides*	2	-	-	2	0.62	50.0
AN	*Pectinaria californiensis*	1	1	-	2	0.62	50.0
AN	*Prionospio (Prionospio) heterobranchia*	1	1	-	2	0.62	50.0
AN	*Scoletoma* spp	-	2	-	2	0.62	50.0
AN	*Spiophanes duplex*	-	1	1	2	0.62	50.0
AR	*Poecilostomatoida* sp A MBC 1998	1	-	1	2	0.62	50.0
EC	*Amphipholis squamata*	2	-	-	2	0.62	50.0
NE	*Paranemertes californica*	-	2	-	2	0.62	50.0
AN	*Amaeana occidentalis*	1	-	-	1	0.31	25.0
AN	*Chone mollis*	1	-	-	1	0.31	25.0
AN	*Cossura* sp A Phillips 1987	1	-	-	1	0.31	25.0
AN	*Leitoscoloplos pugettensis*	1	-	-	1	0.31	25.0
AN	*Pherusa capulata*	1	-	-	1	0.31	25.0
AN	*Prionospio (Prionospio) jubata*	1	-	-	1	0.31	25.0
AN	*Spiochaetopterus costarum* Cmplx	1	-	-	1	0.31	25.0
AR	*Hemiproto* sp A Benedict 1978	1	-	-	1	0.31	25.0
AR	*Monocorophium* sp	1	-	-	1	0.31	25.0
AR	*Postasterope barnesi*	1	-	-	1	0.31	25.0
EC	*Amphiodia urtica*	-	1	-	1	0.31	25.0
MO	*Fartulum occidentale*	-	-	1	1	0.31	25.0
MO	*Tellina cadieni*	-	-	1	1	0.31	25.0
NE	Nemertea	-	-	1	1	0.31	25.0

Summary

Parameter	Replicate ABI4-1	ABI4-2	ABI4-3	Station Total	Replicate Mean	S.D.
Number of individuals	114	152	55	321	107	49
Number of species	32	24	17	41	24	8
Diversity (H')	2.72	2.53	0.62	2.38	1.96	1.16

Appendix E-3. (Cont.).

Station HIC1

Phylum	Species	Replicate HIC1-1	HIC1-2	HIC1-3	Total	Percent Composition	Density No./m²
AN	Oligochaeta	227	435	729	1391	57.41	34775.0
NT	Nematoda	45	141	367	553	22.82	13825.0
AR	*Postasterope barnesi*	17	32	36	85	3.51	2125.0
AN	*Neanthes acuminata* Cmplx	33	17	6	56	2.31	1400.0
AN	*Scyphoproctus oculatus*	43	8	-	51	2.10	1275.0
AR	*Euphilomedes carcharodonta*	9	14	27	50	2.06	1250.0
AN	*Capitella capitata* Cmplx	18	23	7	48	1.98	1200.0
AR	*Acuminodeutopus heteruropus*	1	9	28	38	1.57	950.0
AN	*Mediomastus ambiseta*	17	6	1	24	0.99	600.0
AN	*Cirriformia moorei*	-	21	-	21	0.87	525.0
AN	*Exogone lourei*	10	7	2	19	0.78	475.0
EC	*Amphipholis squamata*	-	3	7	10	0.41	250.0
EC	Amphiuridae	2	2	5	9	0.37	225.0
AN	Maldanidae	3	4	-	7	0.29	175.0
AR	*Rudilemboides stenopropodus*	1	3	3	7	0.29	175.0
AN	*Streblospio benedicti*	6	-	-	6	0.25	150.0
AR	*Anoplodactylus erectus*	-	3	3	6	0.25	150.0
MO	*Leukoma staminea*	2	2	2	6	0.25	150.0
MO	Lasaeidae	-	2	3	5	0.21	125.0
EC	*Amphiodia* sp	-	3	1	4	0.17	100.0
AN	*Aphelochaeta phillipsi*	2	-	-	2	0.08	50.0
AN	*Prionospio (Prionospio) heterobranchia*	2	-	-	2	0.08	50.0
AR	*Amphideutopus oculatus*	-	2	-	2	0.08	50.0
AR	*Caprella* sp	-	1	1	2	0.08	50.0
MO	*Barleeia haliotiphila*	-	2	-	2	0.08	50.0
MO	*Turbonilla raymondi*	-	2	-	2	0.08	50.0
AN	*Naineris* sp	1	-	-	1	0.04	25.0
AN	*Phyllodoce longipes*	1	-	-	1	0.04	25.0
AN	*Prionospio (Prionospio) jubata*	1	-	-	1	0.04	25.0
AN	*Pseudopolydora paucibranchiata*	1	-	-	1	0.04	25.0
AN	*Scoloplos acmeceps*	-	1	-	1	0.04	25.0
AN	*Sphaerosyllis bilineata*	-	1	-	1	0.04	25.0
AN	*Syllis gracilis* Cmplx	-	1	-	1	0.04	25.0
AN	*Typosyllis hyalina*	-	-	1	1	0.04	25.0
AR	*Ianiropsis tridens*	-	-	1	1	0.04	25.0
AR	*Mayerella banksia*	-	1	-	1	0.04	25.0
MO	*Hiatella arctica*	-	-	1	1	0.04	25.0
MO	Mytilidae	-	-	1	1	0.04	25.0
MO	*Venerupis philippinarum*	-	1	-	1	0.04	25.0
NE	Nemertea	-	1	-	1	0.04	25.0
NE	Nemertea sp B Paquette 2005	-	1	-	1	0.04	25.0

Summary

Parameter	Replicate HICI1-1	HICI1-2	HICI1-3	Station Total	Replicate Mean	S.D.
Number of individuals	442	749	1232	2423	808	398
Number of species	21	30	21	41	24	5
Diversity (H')	1.81	1.27	0.93	1.52	1.34	0.44

Appendix E-3. (Cont.).

Station HIC2

Phylum	Species	Replicate HIC2-1	HIC2-2	HIC2-3	Total	Percent Composition	Density No./m²
AN	Oligochaeta	197	422	787	1406	71.12	35150.0
NT	Nematoda	49	146	49	244	12.34	6100.0
AR	*Acuminodeutopus heteruropus*	25	17	36	78	3.95	1950.0
AR	*Postasterope barnesi*	23	11	5	39	1.97	975.0
MO	*Barleeia haliotiphila*	12	10	10	32	1.62	800.0
AN	*Exogone lourei*	20	5	1	26	1.32	650.0
AN	*Neanthes acuminata* Cmplx	14	4	8	26	1.32	650.0
AN	*Capitella capitata* Cmplx	5	10	5	20	1.01	500.0
EC	*Amphipholis squamata*	9	4	5	18	0.91	450.0
AN	*Mediomastus ambiseta*	3	6	4	13	0.66	325.0
AR	*Rudilemboides stenopropodus*	8	2	-	10	0.51	250.0
AN	*Streblospio benedicti*	8	-	-	8	0.40	200.0
EC	Amphiuridae	2	2	2	6	0.30	150.0
AN	*Sphaerosyllis bilineata*	4	-	-	4	0.20	100.0
AR	*Euphilomedes carcharodonta*	2	1	1	4	0.20	100.0
AR	*Zeuxo normani*	3	-	1	4	0.20	100.0
AN	*Cirriformia moorei*	-	1	2	3	0.15	75.0
AN	*Prionospio (Prionospio) heterobranchia*	2	-	1	3	0.15	75.0
AR	*Allorchestes angusta*	-	-	3	3	0.15	75.0
EC	*Amphiodia urtica*	-	-	3	3	0.15	75.0
AN	*Scoloplos acmeceps*	-	-	2	2	0.10	50.0
AR	*Anoplodactylus erectus*	-	1	1	2	0.10	50.0
AR	*Clausidium vancouverense*	-	2	-	2	0.10	50.0
AR	*Monocorophium* sp	-	1	1	2	0.10	50.0
AR	*Paranthura elegans*	1	1	-	2	0.10	50.0
PL	*Stylochoplana* sp	2	-	-	2	0.10	50.0
AN	*Phyllodoce longipes*	-	1	-	1	0.05	25.0
AN	*Pseudopolydora paucibranchiata*	1	-	-	1	0.05	25.0
AN	*Streblosoma* sp B SCAMIT 1985	1	-	-	1	0.05	25.0
AN	*Typosyllis hyalina*	1	-	-	1	0.05	25.0
AR	*Amphideutopus oculatus*	-	1	-	1	0.05	25.0
AR	*Elasmopus bampo*	1	-	-	1	0.05	25.0
AR	*Ericthonius brasiliensis*	-	-	1	1	0.05	25.0
AR	Harpacticoida	-	-	1	1	0.05	25.0
AR	*Mayerella banksia*	1	-	-	1	0.05	25.0
AR	*Melita rylovae*	-	-	1	1	0.05	25.0
MO	*Chione californiensis*	-	-	1	1	0.05	25.0
MO	*Crucibulum spinosum*	1	-	-	1	0.05	25.0
MO	*Leukoma staminea*	-	-	1	1	0.05	25.0
NE	*Tetrastemma nigrifrons*	-	1	-	1	0.05	25.0
SI	Sipuncula	1	-	-	1	0.05	25.0

Summary

Parameter	Replicate HICI2-1	HICI2-2	HICI2-3	Station Total	Replicate Mean	S.D.
Number of individuals	396	649	932	1977	659	268
Number of species	26	21	25	41	24	3
Diversity (H')	1.97	1.08	0.72	1.25	1.26	0.64

Appendix E-3. (Cont.).

Station HIC3

Phylum	Species	Replicate HIC3-1	HIC3-2	HIC3-3	Total	Percent Composition	Density No./m²
AN	Oligochaeta	616	595	882	2093	68.56	52325.0
NT	Nematoda	192	69	351	612	20.05	15300.0
AR	*Euphilomedes carcharodonta*	19	42	11	72	2.36	1800.0
AN	*Mediomastus ambiseta*	10	28	30	68	2.23	1700.0
AR	*Postasterope barnesi*	19	10	11	40	1.31	1000.0
AR	*Acuminodeutopus heteruropus*	12	8	10	30	0.98	750.0
AR	*Rudilemboides stenopropodus*	10	7	10	27	0.88	675.0
EC	*Amphipholis squamata*	9	11	3	23	0.75	575.0
EC	Amphiuridae	6	10	1	17	0.56	425.0
AN	*Exogone lourei*	3	3	7	13	0.43	325.0
MO	*Barleeia haliotiphila*	1	5	2	8	0.26	200.0
AN	*Scoloplos acmeceps*	-	4	1	5	0.16	125.0
AN	*Streblospio benedicti*	-	-	5	5	0.16	125.0
AN	Maldanidae	-	4	-	4	0.13	100.0
AN	*Capitella capitata* Cmplx	-	3	-	3	0.10	75.0
AN	*Spio filicornis*	-	-	3	3	0.10	75.0
MO	*Leukoma staminea*	1	2	-	3	0.10	75.0
AN	*Cirriformia moorei*	-	2	-	2	0.07	50.0
AN	*Neanthes acuminata* Cmplx	-	1	1	2	0.07	50.0
AN	*Sphaerosyllis bilineata*	-	1	1	2	0.07	50.0
AR	*Paranthura elegans*	2	-	-	2	0.07	50.0
SI	Sipuncula	1	1	-	2	0.07	50.0
AN	*Apoprionospio pygmaea*	1	-	-	1	0.03	25.0
AN	*Armandia brevis*	1	-	-	1	0.03	25.0
AN	*Mediomastus californiensis*	-	1	-	1	0.03	25.0
AN	*Prionospio (Prionospio) heterobranchia*	-	-	1	1	0.03	25.0
AN	*Streblosoma* sp B SCAMIT 1985	-	1	-	1	0.03	25.0
AR	*Anoplodactylus erectus*	-	-	1	1	0.03	25.0
AR	*Apolochus barnardi*	-	1	-	1	0.03	25.0
AR	*Caprella* sp	-	1	-	1	0.03	25.0
AR	*Grandidierella japonica*	1	-	-	1	0.03	25.0
AR	*Jassa slatteryi*	1	-	-	1	0.03	25.0
AR	*Mayerella banksia*	-	-	1	1	0.03	25.0
AR	*Oxyurostylis pacifica*	1	-	-	1	0.03	25.0
MO	*Alia carinata*	-	-	1	1	0.03	25.0
MO	*Chione californiensis*	-	-	1	1	0.03	25.0
MO	Lasaeidae	-	1	-	1	0.03	25.0
MO	*Mactrotoma californica*	1	-	-	1	0.03	25.0
MO	*Tellina cadieni*	-	-	1	1	0.03	25.0

Summary

Parameter	Replicate HICI3-1	HICI3-2	HICI3-3	Station Total	Replicate Mean	S.D.
Number of individuals	907	811	1335	3053	1018	279
Number of species	20	24	22	39	22	2
Diversity (H')	1.09	1.02	0.80	1.12	0.97	0.15

Appendix E-3. (Cont.).

San Gabriel River Station B10

Phylum	Species	Replicate B10-I	Replicate B10-II	Total	Percent Composition	Density No./m²
NT	Nematoda	1	187	188	28.19	4700.0
AN	*Streblospio benedicti*	54	46	100	14.99	2500.0
AN	Oligochaeta	17	60	77	11.54	1925.0
AR	*Monocorophium insidiosum*	48	17	65	9.75	1625.0
AN	*Capitella capitata* Cmplx	23	33	56	8.40	1400.0
AN	*Polydora cirrosa*	34	21	55	8.25	1375.0
AN	*Neanthes acuminata* Cmplx	21	18	39	5.85	975.0
AR	*Grandidierella japonica*	22	11	33	4.95	825.0
AN	*Polydora cornuta*	9	7	16	2.40	400.0
AN	*Marphysa sanguinea*	5	10	15	2.25	375.0
AR	Harpacticoida	-	4	4	0.60	100.0
MO	*Crucibulum spinosum*	4	-	4	0.60	100.0
AN	*Sphaerosyllis ranunculus*	-	3	3	0.45	75.0
AR	*Paracerceis sculpta*	1	1	2	0.30	50.0
AR	*Uromunna ubiquita*	2	-	2	0.30	50.0
AN	*Pseudopolydora paucibranchiata*	1	-	1	0.15	25.0
AN	*Scoloplos acmeceps*	-	1	1	0.15	25.0
AN	*Syllis gracilis* Cmplx	1	-	1	0.15	25.0
AR	*Ampithoe valida*	1	-	1	0.15	25.0
AR	*Elasmopus bampo*	-	1	1	0.15	25.0
AR	*Leptochelia dubia*	1	-	1	0.15	25.0
AR	*Paranthura elegans*	-	1	1	0.15	25.0
MO	*Modiolus* sp	-	1	1	0.15	25.0

Summary

Parameter	Replicate B10-I	Replicate B10-II	Station Total	Replicate Mean	Replicate S.D.
Number of individuals	245	422	667	334	125
Number of species	17	17	23	17	0.00
Diversity (H')	2.20	1.89	2.22	2.05	0.22

Appendix E-3. (Cont.).

San Gabriel River Station B11

Phylum	Species	Replicate B11-I	Replicate B11-II	Total	Percent Composition	Density No./m²
NT	Nematoda	347	753	1100	59.65	27500.0
AN	Oligochaeta	87	94	181	9.82	4525.0
AN	*Streblospio benedicti*	34	95	129	7.00	3225.0
MO	*Crucibulum spinosum*	57	53	110	5.97	2750.0
MO	*Barleeia haliotiphila*	4	35	39	2.11	975.0
MO	*Venerupis philippinarum*	19	19	38	2.06	950.0
AN	*Neanthes acuminata* Cmplx	8	26	34	1.84	850.0
AN	*Scoloplos acmeceps*	7	25	32	1.74	800.0
AN	*Sphaerosyllis californiensis*	6	12	18	0.98	450.0
AN	*Capitella capitata* Cmplx	11	3	14	0.76	350.0
AR	*Melita rylovae*	10	3	13	0.70	325.0
CN	Actiniaria	3	9	12	0.65	300.0
AN	*Polydora cirrosa*	1	10	11	0.60	275.0
AR	*Elasmopus bampo*	3	8	11	0.60	275.0
AR	*Grandidierella japonica*	-	9	9	0.49	225.0
MO	*Cylichnella culcitella*	1	8	9	0.49	225.0
AN	*Spirorbis* sp	8	-	8	0.43	200.0
AR	Harpacticoida	1	7	8	0.43	200.0
EC	*Amphiodia digitata*	4	4	8	0.43	200.0
AR	*Paranthura elegans*	2	5	7	0.38	175.0
AN	*Pseudopolydora paucibranchiata*	-	6	6	0.33	150.0
AR	*Paracerceis sculpta*	-	6	6	0.33	150.0
AN	*Marphysa sanguinea*	-	5	5	0.27	125.0
AR	*Monocorophium* spp	3	2	5	0.27	125.0
AN	*Streblosoma* sp B SCAMIT 1985	1	2	3	0.16	75.0
MO	*Caecum californicum*	1	2	3	0.16	75.0
AN	*Apoprionospio pygmaea*	-	2	2	0.11	50.0
AN	*Armandia brevis*	1	1	2	0.11	50.0
AN	*Polydora cornuta*	-	2	2	0.11	50.0
AN	*Scyphoproctus oculatus*	-	2	2	0.11	50.0
AR	*Aoroides* sp	1	1	2	0.11	50.0
AR	Gammaridea	2	-	2	0.11	50.0
AR	*Postasterope barnesi*	-	2	2	0.11	50.0
AN	*Cirriformia* sp	1	-	1	0.05	25.0
AN	*Eusyllis* sp	-	1	1	0.05	25.0
AN	*Exogone lourei*	-	1	1	0.05	25.0
AN	Terebellidae	-	1	1	0.05	25.0
AR	*Americhelidium shoemakeri*	1	-	1	0.05	25.0
AR	*Euphilomedes carcharodonta*	-	1	1	0.05	25.0
AR	*Uromunna ubiquita*	-	1	1	0.05	25.0
MO	Gastropoda	-	1	1	0.05	25.0
MO	*Mytilus* sp	-	1	1	0.05	25.0
MO	*Nuttallina californica*	-	1	1	0.05	25.0
PL	*Pseudoceros* sp	-	1	1	0.05	25.0

Summary

Parameter	Replicate B11-I	Replicate B11-II	Station Total	Replicate Mean	Replicate S.D.
Number of individuals	624	1220	1844	922	421
Number of species	27	40	44	34	9
Diversity (H')	1.70	1.69	1.74	1.70	0.00

Appendix E-3. (Cont.).

San Gabriel River Station B12

Phylum	Species	Replicate B12-I	Replicate B12-II	Total	Percent Composition	Density No./m²
NT	Nematoda	1077	819	1896	63.20	47400.0
AN	*Streblospio benedicti*	250	216	466	15.53	11650.0
AN	*Scoloplos acmeceps*	95	65	160	5.33	4000.0
MO	*Crucibulum spinosum*	157	-	157	5.23	3925.0
AN	Oligochaeta	33	30	63	2.10	1575.0
AN	*Pseudopolydora paucibranchiata*	20	27	47	1.57	1175.0
CN	Actiniaria	24	7	31	1.03	775.0
AN	*Polydora cirrosa*	14	10	24	0.80	600.0
AN	*Sphaerosyllis californiensis*	21	3	24	0.80	600.0
AN	*Neanthes acuminata* Cmplx	13	9	22	0.73	550.0
AN	*Polydora cornuta*	3	16	19	0.63	475.0
AR	*Paranthura elegans*	12	5	17	0.57	425.0
MO	*Acteocina inculta*	5	7	12	0.40	300.0
AR	*Grandidierella japonica*	6	2	8	0.27	200.0
PR	*Phoronis* sp	7	1	8	0.27	200.0
AN	*Marphysa sanguinea*	1	6	7	0.23	175.0
AR	*Elasmopus bampo*	5	1	6	0.20	150.0
AN	*Cirriformia* sp	3	1	4	0.13	100.0
AN	*Mediomastus ambiseta*	2	1	3	0.10	75.0
MO	*Barleeia haliotiphila*	3	-	3	0.10	75.0
MO	*Venerupis philippinarum*	2	1	3	0.10	75.0
AN	*Spirorbis* sp	2	-	2	0.07	50.0
AR	Harpacticoida	2	-	2	0.07	50.0
AN	*Apoprionospio pygmaea*	1	-	1	0.03	25.0
AN	*Eteone californica*	-	1	1	0.03	25.0
AN	*Glycera americana*	1	-	1	0.03	25.0
AN	*Laonice cirrata*	1	-	1	0.03	25.0
AN	*Scolelepis* (*Parascolelepis*) sp SD1	-	1	1	0.03	25.0
AN	*Spiophanes duplex*	-	1	1	0.03	25.0
AN	*Streblosoma* sp B SCAMIT 1985	1	-	1	0.03	25.0
AR	*Aoroides* sp	-	1	1	0.03	25.0
AR	*Monocorophium* spp	1	-	1	0.03	25.0
AR	*Uromunna ubiquita*	1	-	1	0.03	25.0
CO	*Molgula "manhattanensis"*	1	-	1	0.03	25.0
EC	*Amphiodia* sp	1	-	1	0.03	25.0
MO	*Crepidula onyx*	1	-	1	0.03	25.0
MO	*Lasaea adansoni*	1	-	1	0.03	25.0
MO	*Lyonsia californica*	1	-	1	0.03	25.0
NE	Nemertea	1	-	1	0.03	25.0

Summary

Parameter	Replicate B12-I	Replicate B12-II	Station Total	Replicate Mean	Replicate S.D.
Number of individuals	1769	1231	3000	1500	380
Number of species	35	23	39	29	8
Diversity (H')	1.49	1.22	1.42	1.35	0.19

Appendix E-4. Infaunal wet weight biomass data (g) from Alamitos Bay (AB), Haynes Intake Canal (HIC), February 2009, and San Gabriel River (B), June 2008.

Sta-Rep	Annelida	Arthropoda	Mollusca	Echinodermata	Misc.	Total
AB1-I	0.2683	0.0473	0.0356	0.0152	0.0079	0.3743
AB1-II	0.3036	0.0077	0.0053	0.0633	0.0117	0.3916
AB1-III	0.5043	0.0178	0.1613	0.1193	0.0114	0.8141
Total	1.0762	0.0728	0.2022	0.1978	0.0310	1.5800
AB2-I	0.5999	0.0136	1.2655	0.0081	0.0920	1.9791
AB2-II	0.3799	0.0181	2.5228	0.0173	-	2.9381
AB2-III	0.1949	0.0082	-	-	0.0090	0.2121
Total	1.1747	0.0399	3.7883	0.0254	0.1010	5.1293
AB3-I	0.1648	0.1019	0.0127	-	0.0405	0.3199
AB3-II	0.1564	0.0069	0.0017	0.0222	0.0148	0.2020
AB3-III	1.4679	0.0051	1.9698	0.0082	0.0073	3.4583
Total	1.7891	0.1139	1.9842	0.0304	0.0626	3.9802
AB4-I	0.2215	0.0013	-	0.1768	0.0048	0.4044
AB4-II	0.1815	0.0032	-	0.0824	0.0449	0.3120
AB4-III	0.0291	0.0089	0.0492	0.0115	0.0115	0.1102
Total	0.4321	0.0134	0.0492	0.2707	0.0612	0.8266
HIC1-I	0.4622	0.0751	1.2053	0.0238	0.0300	1.7964
HIC1-II	1.2355	0.0105	9.0487 [1]	0.5972	0.0397	10.9316
HIC1-III	0.2199	0.0222	0.1127	0.3122	0.0098	0.6768
Total	1.9176	0.1078	10.3667	0.9332	0.0795	13.4048
HIC2-I	0.5999	0.0635	0.1268	0.1948	0.1120	1.0970
HIC2-II	0.3184	0.0543	0.0288	0.0309	0.0105	0.4429
HIC2-III	0.4391	0.0167	62.6609 [2]	0.4172	0.0261	63.5600
Total	1.3574	0.1345	62.8165	0.6429	0.1486	65.0999
HIC3-I	0.2049	0.0186	17.0160 [3]	0.0825	0.0347	17.3567
HIC3-II	0.4985	0.0189	0.0817	0.1062	0.0105	0.7158
HIC3-III	0.0981	0.0088	28.6468 [4]	0.1524	0.0095	28.9156
Total	0.8015	0.0463	45.7445	0.3411	0.0547	46.9881
B10-I	0.5093	0.0640	0.0786	-	<0.0001	0.6519
B10-II	0.1454	0.0607	0.0097	-	0.0226	0.2384
Total	0.6547	0.1247	0.0883	-	0.0226	0.8903
B11-I	0.4038	0.0019	109.7321 [5]	0.0084	0.0075	110.1537
B11-II	0.3761	0.0319	85.5977 [6]	0.1398	0.0961	86.2416
Total	0.7799	0.0338	195.3298	0.1482	0.1036	196.3953
B12-I	0.8858	0.1158	13.8832 [7]	0.0010	0.1725	15.0583
B12-II	0.3327	0.0260	4.1819 [8]	-	0.0080	4.5486
Total	1.2185	0.1418	18.0651	0.0010	0.1805	19.6069
Grand Total	11.2017	0.8289	338.4348	2.5907	0.8453	353.9014

Note: - = no animals

[1] Includes one *Venerupis philippinarum* at 8.9139 g

[2] Includes one *Leukoma staminea* at 19.7989 g and one *Chione californiensis* at 42.8510 g

[3] Includes one *Leukoma staminea* at 16.4533 g

[4] Includes one *Chione californiensis* at 28.5764 g

[5] Includes 19 *Venerupis philippinarum* at 107.4761 g

[6] Includes 19 *Venerupis philippinarum* at 84.4634 g

[7] Includes two *V. philippinarum* at 10.8894 g

[8] Includes one large *V. philippinarum* at 4.1788 g

APPENDIX F

Appendix F-1. Master species list of all target taxa taken during plankton sampling in Alamitos Bay, the HnGS Intake Canal and offshore of the San Gabriel River mouth on 12 February 2009 .

Group	Scientific Taxon	Common name
Megalops		
	Cancer spp megalops	cancer crab unid
Fish Egg		
	Engraulis mordax	northern anchovy
	fish eggs unid.	fish egg unid.
	Paralichthyidae unid. (eggs)	sand flounder unid.
	Pleuronichthys sp (eggs)	turbot eggs
Larval Fish		
	Acanthogobius flavimanus	yellowfin goby
	Atherinopsidae unid	silverside unid
	Atherinopsis californiensis	jacksmelt
	Chaenopsidae unid	tube blenny unid.
	Clevelandia ios	arrow goby
	Clevelandia, Ilypnus, Quietula cmplx	goby A/C
	Clinidae unid	kelp blenny unid
	Genyonemus lineatus	white croaker
	Gibbonsia elegans	spotted kelpfish
	Gillichthys mirabilis	longjaw mudsucker
	Gobiesox rhessodon	California clingfish
	Gobiidae unid.	goby unid.
	Hypsoblennius spp.	combtooth blenny
	Ilypnus gilberti	cheekspot goby
	larval fish - damaged	larval fish - damaged
	larval fish fragment	larval fish fragment
	Lepidogobius lepidus	bay goby
	Paralichthys californicus	California halibut
	Pleuronichthys guttulatus	diamond turbot
	Typhlogobius californiensis	blind goby

Appendix F-2. Total daytime ichthyoplankton catch by station and repetition sampled on 12 February 2009 .

	AB1		AB2		AB3		AB4		SGR		HIC1		HIC2		Total	Percent
Larval Taxa	1	2	1	2	1	2	1	2	1	2	1	2	1	2	Abun.	Total
Clevelandia, Ilypnus, Quietula cmplx	68	31	103	102	57	45	-	1	11	40	-	-	5	4	467	80
larval fish - damaged	2	-	4	7	2	-	-	7	15	1	-	-	-	-	38	6
Hypsoblennius spp.	1	-	-	-	5	2	-	10	-	1	1	1	-	1	22	4
Atherinopsis californiensis	-	-	-	-	-	1	17	-	-	-	-	-	-	-	18	3
Acanthogobius flavimanus	10	5	-	-	-	-	-	-	-	-	-	-	-	-	15	3
Gillichthys mirabilis	-	-	1	2	2	3	-	-	-	1	-	-	-	-	9	2
Gobiesox rhessodon	-	-	-	1	1	3	-	-	-	-	-	-	-	-	5	1
Gibbonsia elegans	-	1	1	-	1	-	1	-	-	-	-	-	-	-	4	1
Clevelandia ios	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	<1
Atherinopsidae unid	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	<1
Genyonemus lineatus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	<1
larval fish fragment	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	<1
Lepidogobius lepidus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	<1
Pleuronichthys guttulatus	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	<1
Typhlogobius californiensis	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	<1
Total Abun.	83	38	111	112	68	55	19	19	26	43	1	1	5	5	586	
Number of Taxa	5	4	6	4	6	6	3	4	2	4	1	1	1	2	15	
Sample Volume (m^3)	39.2	33.0	32.4	29.7	39.7	32.8	31.2	30.2	39.4	35.8	34.5	32.9	35.0	35.1		

Egg Taxa																
fish egg unid.	61	13	30	19	13	9	9	24	21	30	20	295	58	40	642	96
sand flounder unid.	7	-	1	6	1	1	2	5	-	2	-	-	1	1	27	4
turbot eggs	-	-	-	-	-	-	1	-	-	-	-	-	1	1	3	<1
Total Abun.	68	13	31	25	14	10	12	29	21	32	20	295	60	42	672	
Number of Taxa	2	1	2	2	2	2	3	2	1	2	1	1	3	3	3	

Appendix F-3. Total nighttime ichthyoplankton catch by station and repetition sampled on 13 February 2009 .

	AB1		AB2		AB3		AB4		SGR		HIC1		HIC2		HIC3		Total	Percent
Larval Taxa	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	Abun.	Total
Clevelandia, Ilypnus, Quietula cmplx	213	164	363	245	216	66	79	41	29	20	1	-	32	30	26	16	1,541	91
Hypsoblennius spp.	13	7	5	1	11	4	5	1	1	1	-	-	2	-	-	1	52	3
Acanthogobius flavimanus	7	-	-	17	-	12	-	-	-	-	-	-	-	1	-	-	37	2
larval fish - damaged	2	-	4	1	1	6	1	9	-	-	-	-	1	-	-	-	25	1
Gillichthys mirabilis	1	-	1	1	2	2	1	-	-	1	-	-	-	-	-	-	9	1
Atherinopsis californiensis	-	-	-	-	-	1	2	2	-	1	-	-	-	-	-	-	6	<1
Gobiidae unid.	-	-	3	-	-	-	-	-	1	-	-	-	-	-	-	-	4	<1
Paralichthys californicus	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	4	<1
Gobiesox rhessodon	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	<1
Clinidae unid	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	<1
Ilypnus gilberti	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	2	<1
Atherinopsidae unid	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	<1
Chaenopsidae unid	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	<1
Clevelandia ios	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	<1
Gibbonsia elegans	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	<1
Typhlogobius californiensis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	<1
Total Abun.	240	171	379	268	232	91	89	54	31	24	1	1	35	31	26	17	1,690	
Number of Taxa	7	2	6	7	6	6	6	5	3	5	1	1	3	2	1	2	16	
Sample Volume (m^3)	46.4	37.9	51.3	41.9	46.5	38.2	32.1	30.5	51.1	42.4	35.3	37.4	35.8	37.9	31.3	31.4		

Egg Taxa																		
fish eggs unid.	512	335	45	44	56	42	140	118	115	46	18	15	26	17	15	16	1,560	95
Paralichthyidae unid. (eggs)	10	6	4	7	7	-	-	3	18	12	1	-	-	-	-	1	69	4
Pleuronichthys sp (eggs)	5	2	-	-	1	-	1	1	-	-	-	-	-	-	-	-	10	1
Engraulis mordax	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	4	<1
Total Abun.	527	343	49	51	64	42	141	122	136	59	19	15	26	17	15	17	1,643	
Number of Taxa	3	3	2	2	3	1	2	3	2	1	1	1	1	2	4	3	4	

APPENDIX G

Appendix G. Species list of fish and macroinvertebrate species taken by otter trawl in the HnGS Intake Canal, Alamitos Bay area, and historically offshore of the San Gabriel River mouth.

Phylum	Class	Family	Species	Common name
Annelida				
	Polychaeta			
		Aphroditidae		
			Aphrodita sp	sea mouse unid
Arthropoda				
	Malacostraca			
		Cancridae		
			Metacarcinus anthonyi	yellow crab
			Metacarcinus gracilis	graceful crab
			Romaleon antennarius	Pacific rock crab
		Crangonidae		
			Crangon alaskensis	Alaska bay shrimp
			Crangon nigromaculata	blackspotted bay shrimp
		Diogenidae		
			Isocheles pilosus	moon snail hermit
		Epialtidae		
			Pugettia producta	northern kelp crab
		Hippolytidae		
			Heptacarpus stimpsoni	Stimpson coastal shrimp
		Leucosiidae		
			Randallia ornata	globose sand crab
		Majidae		
			Loxorhynchus crispatus	moss crab
			Pyromaia tuberculata	tuberculate pear crab
		Paguridae		
			Pagurus spilocarpus	hermit crab
		Palinuridae		
			Panulirus interruptus	California spiny lobste
		Parthenopidae		
			Heterocrypta occidentalis	sandflat elbow crab
		Penaeidae		
			Farfantepenaeus californiensis	yellowleg shrimp
		Pinnotheridae		
			Pinnixa franciscana	pea crab (no common name)
		Portunidae		
			Portunus xantusii	Xantus swimming crab
		Sicyoniidae		
			Sicyonia penicillata	target shrimp
			Sicyonia ingentis	ridgeback rock shrimp
		Xanthidae		
			Pilumnus spinohirsutus	retiring hairy crab
Cnidaria				
	Anthozoa			
		Renillidae		
			Renilla koellikeri	sea pansy
		Virgulariidae		
			Stylatula elongata	slender sea pen
			Acanthoptilum spp	sea pen
	Hydrozoa			
		Polyorchidae		
			Scrippsia pacifica	giant bell jelly
			Polyorchis penicillatus	red jellyfish
	Scyphozoa			
		Pelagiidae		
			Chrysaora colorata	purple-striped jellyfish
		Ulmaridae		
			Aurelia aurita	moon jelly
Echinodermata				
	Asteroidea			
		Asterinidae		
			Patiria miniata	bat star
			Pisaster brevispinus	short-spined sea sta
			Pisaster ochraceus	ochre star
		Astropectinidae		
			Astropecten armatus	spiny sand star
			Astropecten verrilli	sand star
	Echinoidea			
		Strongylocentrotidae		
			Strongylocentrotus purpuratus	purple sea urchin
	Holothuroidea			
		Caudinidae		
			Caudina arenicola	sweet potatoe sea cucumbe
		Stichopodidae		
			Parastichopus parvimensis	warty sea cucumber
	Ophiuroidea			
		Amphiuridae		
			Amphipholis squamata	brittle star
		Ophiotricidae		
			Ophiothrix spiculata	shiny brittle star
Echiura				
	Echiuridea			
		Thalassematidae		
			Listriolobus pelodes	spoon worm
Mollusca				
	Bivalvia			
		Pectindae		
			Argopecten ventricosus	Pacific calico scallop
	Cephalopoda			
		Octopodidae		
			Octopus bimaculatus/bimaculoides	California two-spot octopus
			Octopus rubescens	East Pacific red octopus
	Gastropoda			
		Aglajidae		
			Navanax inermis	California aglaja
			Aglaja ocelligera	eyespot aglaja
		Buccinidae		
			Kelletia kelletii	Kellet's whelk
		Bullidae		
			Bulla gouldiana	California bubble
		Dendronotidae		
			Dendronotus frondosus	leafy dendronotid
			Dendronotus iris	giant-frond-aeolis
		Discodorididae		
			Diaulula sandiegensis	ring-spotted dorid
		Facelinidae		
			Hermissenda crassicornis	hermissenda
		Flabellinidae		
			Flabellina iodinea	Spanish shawl
			Flabellina pricei	smooth-tooth aeolis
		Muricidae		
			Forreria belcheri	Giant Forreria
			Pteropurpura festiva	festive murex
			Ceratostoma foliatum	foliate thornmouth
		Nassariidae		
			Arcularia tiarula	western mud nassa
			Caesia perpinguis	fat western nassa

Appendix G. (Cont.)

Phylum / Class / Family / Species	Common name
Mollusca (cont.)	
Gastropoda (cont.)	
Naticidae	
Euspira lewsii	moon snail
Onchidorididae	
Acanthodoris rhodoceras	black-tipped spiny doris
Philinidae	
Philine auriformis	New Zealand snail
Polyceridae	
Polycera atra	orange-spike polycera
Trochidae	
Tegula eiseni	banded tegula
Chordata	
Chondrichthyes	
Heterodontidae	
Heterodontus francisci	horn shark
Myliobatidae	
Myliobatis californica	bat ray
Platyrhinidae	
Platyrhinoidis triseriata	thornback
Rajidae	
Raja binoculata	big skate
Raja inornata	California skate
Rhinobatidae	
Rhinobatos productus	shovelnose guitarfish
Torpedinidae	
Torpedo californica	Pacific electric ray
Urolophidae	
Urobatis halleri	round stingray
Actinopterygii	
Atherinopsidae	
Atherinops affinis	topsmelt
Atherinopsis californiensis	jacksmelt
Batrachoididae	
Porichthys myriaster	specklefin midshipman
Clupeidae	
Sardinops sagax	Pacific sardine
Cottidae	
Leptocottus armatus	Pacific staghorn sculpin
Cynoglossidae	
Symphurus atricaudus	California tonguefish
Embiotocidae	
Amphistichus argenteus	barred surfperch
Cymatogaster aggregata	shiner perch
Embiotoca jacksoni	black perch
Hyperprosopon argenteum	walleye surfperch
Phanerodon furcatus	white seaperch
Rhacochilus toxotes	rubberlip seaperch
Engraulidae	
Anchoa compressa	deepbody anchovy
Engraulis mordax	northern anchovy
Gobiidae	
Lepidogobius lepidus	bay goby
Clevelandia ios	arrow goby
Clevelandia ios/Ilypnus gilberti	arrow/cheekspot goby
Haemulidae	
Xenistius californiensis	salema
Ophidiidae	
Ophidion scrippsae	basketweave cusk-eel

Phylum / Class / Family / Species	Common name
Chordata (cont.)	
Actinopterygii (cont.)	
Paralichthyidae	
Citharichthys stigmaeus	speckled sanddab
Paralichthys californicus	California halibut
Xystreurys liolepis	fantail sole
Pleuronectidae	
Parophrys vetulus	English sole
Pleuronichthys guttulatus	diamond turbot
Pleuronichthys ritteri	spotted turbot
Pleuronichthys verticalis	hornyhead turbot
Sciaenidae	
Atractoscion nobilis	white seabass
Genyonemus lineatus	white croaker
Menticirrhus undulatus	California corbina
Seriphus politus	queenfish
Umbrina roncador	yellowfin croaker
Scorpaenidae	
Scorpaena guttata	California scorpionfish
Serranidae	
Paralabrax clathratus	kelp bass
Paralabrax maculatofasciatus	spotted sand bass
Paralabrax nebulifer	barred sand bass
Stromateidae	
Peprilus simillimus	Pacific pompano
Syngnathidae	
Syngnathus californiensis	kelp pipefish
Syngnathus exilis	barcheek pipefish
Synodontidae	
Synodus lucioceps	California lizardfish

APPENDIX H

Appendix H-1. Bird survey times (hr) and mean tidal stages (ft MLLW). March 2009.

Date	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar
Survey 1					
Start	1315	1200	1035	0922	0800
End	1515	1415	1217	1103	1010
Tide	low (-0.9)	ebb (+1.0)	ebb (+3.8)	high (+4.7)	flood (+3.3)
Survey 2					
Start	1630	1542	1352	1243	1122
End	1733	1715	1513	1415	1230
Tide	flood(+1.3)	flood (+0.5)	ebb (+0.2)	ebb (+2.0)	ebb (+3.7)

Appendix H-2. Master species list of birds observed in and near the lower San Gabriel River, 9-13 March 2009.

Common name	Scientific Name	Status*	Occurrence
eared grebe	*Podiceps nigricollis*	-	V
pied-billed grebe	*Podilymbus podiceps*	-	B
California brown pelican	*Pelecanus occidentalis californicus*	FE, SE	V
double-crested cormorant	*Phalacrocorax auritus*	S3	V
green heron	*Butorides virescens*	-	B
black-crowned night heron	*Nycticorax nycticorax*	S3	B
snowy egret	*Egretta thula*	S4	B
great blue heron	*Ardea herodias*	S4	B
great egret	*Ardea alba*	S4	V
American black oystercatcher	*Haematopus bachmani*	S2	V
black-bellied plover	*Pluvialis squatarola*	-	V
killdeer	*Charadrius vociferus*	-	B
spotted sandpiper	*Actitis macularia*	-	V
willet	*Tringa semipalmatus*	-	V
dowitcher, unidentified	*Limnodromus* sp	-	V
least sandpiper	*Calidris minutilla*	-	V
western sandpiper	*Calidris mauri*	-	V
sanderling	*Calidris alba*	-	V
marbled godwit	*Limosa fedoa*	-	V
mallard	*Anas platyrhynchos*	-	B
American wigeon	*Anas americana*	-	V
northern pintail	*Anas acuta*	-	V
lesser scaup	*Aythya affinis*	-	V
bufflehead	*Bucephala albeola*	-	V
surf scoter	*Melanitta perspicillata*	-	V
red-breasted merganser	*Mergus serrator*	-	V
California gull	*Larus californicus*	S2	V
Heermann's gull	*Larus heermanni*	-	V
ring-billed gull	*Larus delawarensis*	-	V
western gull	*Larus occidentalis*	-	V
gull, unidentified	*Larus* sp	-	V
Caspian tern	*Hydroprogne caspia*	S4	B?
osprey	*Pandion haliaetus*	S3	B
belted kingfisher	*Ceryle alcyon*	-	V
northern rough-winged swallow	*Stelgidopteryx serripennis*	-	B
song sparrow	*Melospiza melodia*	-	B

* California Department of Fish and Game, 2003.

FE = Federal-listed endangered

SE = California state-listed endangered

S2 = California state rank: 6-20 populations, or 1,000-3,000 individuals

S3 = California state rank: 21-200 populations, or 3,000-10,000 individuals

S4 = California state rank: Appparently secure within California, but factors exist to cause some concern

V = Visitor

B = Breeder

Appendix H-3. Number of birds observed by day. March 2009.

9 March 2009 Survey 1

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	1315	1330	1400	1430	Total	Total
eared grebe	-	2	-	1	3	2.07
pied-billed grebe	-	2	1	1	4	2.76
double-crested cormorant	-	1	1	46	48	33.10
snowy egret	2	1	1	3	7	4.83
great blue heron	-	-	-	1	1	0.69
spotted sandpiper	1	1	-	3	5	3.45
willet	8	-	6	-	14	9.66
least sandpiper	-	-	1	-	1	0.69
western sandpiper	-	-	35	-	35	24.14
sanderling	4	-	-	-	4	2.76
mallard	2	-	-	-	2	1.38
lesser scaup	-	1	1	6	8	5.52
ring-billed gull	1	-	-	4	5	3.45
western gull	4	-	-	3	7	4.83
gull, unidentified	1	-	-	-	1	0.69
Number of individuals	23	8	46	68	145	
Number of species	8	6	7	9	15	

9 March 2009 Survey 2

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	1630	1700	1707	1716	Total	Total
eared grebe	-	-	1	4	5	3.45
pied-billed grebe	-	-	-	3	3	2.07
California brown pelican	-	1	-	-	1	0.69
double-crested cormorant	-	-	2	55	57	39.31
snowy egret	2	-	2	1	5	3.45
great blue heron	-	-	-	1	1	0.69
willet	11	-	-	-	11	7.59
mallard	2	-	-	-	2	1.38
lesser scaup	-	1	-	6	7	4.83
California gull	4	1	-	-	5	3.45
ring-billed gull	2	3	-	14	19	13.10
western gull	4	3	-	1	8	5.52
Caspian tern	1	-	-	-	1	0.69
Number of individuals	26	9	5	85	125	
Number of species	7	5	3	8	13	

Appendix H-3. (Cont.).

10 March 2009 Survey 1

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	1200	1224	1238	1303	Total	Total
eared grebe	1	1	2	1	5	6.58
pied-billed grebe	-	2	-	-	2	2.63
double-crested cormorant	1	1	1	24	27	35.53
snowy egret	2	1	2	3	8	10.53
great blue heron	-	-	2 *	-	2	2.63
spotted sandpiper	-	1	-	2	3	3.95
mallard	1	-	-	4	5	6.58
lesser scaup	-	1	3	6	10	13.16
bufflehead	-	-	-	1	1	1.32
red-breasted merganser	-	-	-	1	1	1.32
ring-billed gull	-	-	-	6	6	7.89
western gull	-	-	2	1	3	3.95
osprey	-	-	-	1	1	1.32
belted kingfisher	-	-	1	1	2	2.63
Number of individuals	5	7	13	51	76	
Number of species	4	6	7	12	14	

10 March 2009 Survey 2

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	1542	1607	1616	1639	Total	Total
eared grebe	-	-	1	1	2	2.63
pied-billed grebe	-	-	-	1	1	1.32
double-crested cormorant	-	-	-	39	39	51.32
snowy egret	1	2	-	2	5	6.58
great blue heron	-	-	-	1	1	1.32
spotted sandpiper	-	-	-	1	1	1.32
willet	11	-	1	2	14	18.42
sanderling	13	-	-	-	13	17.11
mallard	2	-	-	-	2	2.63
lesser scaup	-	1	-	4	5	6.58
ring-billed gull	-	-	-	2	2	2.63
western gull	12	-	-	2	14	18.42
osprey	-	-	1	-	1	1.32
Number of individuals	39	3	3	55	100	
Number of species	5	2	3	10	13	

* one at intake canal, one in Cerritos Wetland, between the intake canal and the river

Appendix H-3. (Cont.).

11 March 2009 Survey 1

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	1035	1052	1104	1138	Total	Total
eared grebe	-	1	2	-	3	4.05
pied-billed grebe	-	1	1	2	4	5.41
double-crested cormorant	-	-	1 *	12	13	17.57
snowy egret	5	1	2	8	16	21.62
great egret	-	-	1 **	-	1	1.35
killdeer	-	-	1 *	-	1	1.35
spotted sandpiper	-	-	-	1	1	1.35
mallard	-	-	1	-	1	1.35
American wigeon	-	-	1 *	-	1	1.35
lesser scaup	-	-	4 *	9	13	17.57
bufflehead	-	-	2 *	-	2	2.70
ring-billed gull	-	-	-	11	11	14.86
western gull	1	-	-	4	5	6.76
song sparrow	-	-	-	2	2	2.70
Number of individuals	6	3	16	49	74	
Number of species	2	3	10	8	14	

11 March 2009 Survey 2

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	1352	1402	1414	1427	Total	Total
eared grebe	1	1	-	-	2	2.70
pied-billed grebe	-	-	-	1	1	1.35
California brown pelican	-	-	1	-	1	1.35
double-crested cormorant	-	1	-	20	21	28.38
snowy egret	1	-	2	3	6	8.11
great blue heron	-	-	-	2	2	2.70
spotted sandpiper	-	-	-	2	2	2.70
willet	-	-	-	1	1	1.35
lesser scaup	-	1	-	5	6	8.11
ring-billed gull	-	-	-	7	7	9.46
western gull	4	-	2	1	7	9.46
Number of individuals	6	3	5	42	56	
Number of species	3	3	3	9	11	

* at Haynes intake canal

** at Cerritos Wetland, between the intake canal and the river

Appendix H-3. (Cont.).

12 March 2009 Survey 1

Species	Segment 1 0922	Segment 2 0941	Segment 3 0950	Segment 4 1014	Total	Percent Total
eared grebe	3	1	3	-	7	6.93
pied-billed grebe	-	-	2	-	2	1.98
double-crested cormorant	-	-	1	29	30	29.70
black-crowned night heron	-	-	1	-	1	0.99
snowy egret	3	-	2	9	14	13.86
great blue heron	-	-	-	-	-	0.00
willet	3	-	7	-	10	9.90
sanderling	4	-	-	-	4	3.96
marbled godwit	6	-	-	-	6	5.94
mallard	3	1	-	-	4	3.96
lesser scaup	-	-	3	7	10	9.90
surf scoter	1	-	-	-	1	0.99
red-breasted merganser	-	-	-	1	1	0.99
ring-billed gull	-	-	-	8	8	7.92
western gull	-	-	-	1	1	0.99
osprey	-	-	-	1	1	0.99
northern rough-winged swallow	-	-	1	-	1	0.99
Number of individuals	23	2	20	56	101	
Number of species	7	2	8	7	16	

12 March 2009 Survey 2

Species	Segment 1 1243	Segment 2 1255	Segment 3 1303	Segment 4 1320	Total	Percent Total
eared grebe	2	-	-	-	2	1.98
pied-billed grebe	-	-	-	3	3	2.97
double-crested cormorant	-	1	-	37	38	37.62
green heron	-	-	1	-	1	0.99
snowy egret	4	2	2	4	12	11.88
great blue heron	-	1	-	1	2	1.98
killdeer	-	-	-	1	1	0.99
spotted sandpiper	-	-	-	1	1	0.99
willet	-	-	15	1	16	15.84
mallard	2	2	-	-	4	3.96
lesser scaup	-	-	5 *	6	11	10.89
ring-billed gull	-	-	-	2	2	1.98
western gull	1	-	-	6	7	6.93
Number of individuals	9	6	23	62	100	
Number of species	4	4	4	10	13	

* in Haynes intake canal

Appendix H-3. (Cont.).

13 March 2009 Survey 1

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	0800	0829	0843	0911	Total	Total
eared grebe	2	2	1	1	6	3.14
pied-billed grebe	-	-	-	3	3	1.57
double-crested cormorant	-	-	-	26	26	13.61
snowy egret	6	2	1*	3	12	6.28
great blue heron	-	1	-	2	3	1.57
great egret	-	-	1*	-	1	0.52
American black oystercatcher	2 **	-	-	-	2	1.05
black-bellied plover	-	-	1*	-	1	0.52
willet	34	-	1*	-	35	18.32
dowitcher, unidentified	-	-	37 *	-	37	19.37
western sandpiper	-	-	3 *	-	3	1.57
sanderling	3	-	-	-	3	1.57
mallard	-	2	-	2	4	2.09
Northern pintail	-	-	2 *	-	2	1.05
lesser scaup	-	1	4	7	12	6.28
California gull	2	-	-	-	2	1.05
Heermann's gull	1	-	-	-	1	0.52
ring-billed gull	14	-	-	13	27	14.14
western gull	5	-	1	3	9	4.71
osprey	-	-	1	1	2	1.05
Number of individuals	69	8	53	61	191	
Number of species	9	5	11	10	20	

13 March 2009 Survey 2

	Station					
	Segment 1	Segment 2	Segment 3	Segment 4		Percent
Species	1122	1134	1144	1200	Total	Total
eared grebe	-	1	1	1	3	1.57
pied-billed grebe	-	-	-	1	1	0.52
California brown pelican	1	-	-	-	1	0.52
double-crested cormorant	1	1	-	9	11	5.76
snowy egret	3	1	2	5	11	5.76
great blue heron	-	-	1	1	2	1.05
mallard	1	-	-	-	1	0.52
lesser scaup	-	1	8	8	17	8.90
western gull	3	-	-	-	3	1.57
Number of individuals	9	4	12	25	50	
Number of species	5	4	4	6	9	

* at Cerritos Wetland, between the Haynes intake canal and the river
** on sand bar on east side
*** at the Haynes Units 5&6 discharge

Appendix H-4. Maximum number of individuals and species of birds observed per day. March 2009.

	Dates																				
	9-Mar-09				10-Mar-09				11-Mar-09				12-Mar-09				13-Mar-09				Day
Species	Seg 1	Seg 2	Seg 3	Seg 4	Seg 1	Seg 2	Seg 3	Seg 4	Seg 1	Seg 2	Seg 3	Seg 4	Seg 1	Seg 2	Seg 3	Seg 4	Seg 1	Seg 2	Seg 3	Seg 4	Mean
double-crested cormorant	-	1	2	55	1	1	1	39	-	1	1[2]	20	-	1	1	37	1	1	-	26	38
willet	11	-	6	-	11	-	1	2	-	-	-	1	3	-	15	1	34	-	1[3]	-	17
ring-billed gull	2	3	-	14	-	-	-	6	-	-	-	11	-	-	-	8	14	-	-	13	14
snowy egret	2	1	2	3	2	2	2	3	5	1	2	8	4	2	2	9	6	2	2[4]	5	13
lesser scaup	-	1	1	6	-	1	3	6	-	1	4[2]	9	-	-	5[2]	7	-	1	8	8	12
western gull	-	3	-	3	12	-	2	2	4	-	2	4	1	-	-	6	5	-	1	3	10
western sandpiper	-	-	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3[3]	-	8
dowitcher, unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37[3]	-	7
eared grebe	-	2	1	4	1	1	2	1	1	1	2	-	3	1	3	-	2	2	1	1	6
sanderling	4	-	-	-	13	-	-	-	-	-	-	-	4	-	-	-	3	-	-	-	5
pied-billed grebe	-	2	1	3	-	2	-	1	-	1	1	2	-	-	2	3	-	-	-	3	4
mallard	2	-	-	-	2	-	-	4	-	-	1	-	3	2	-	-	1	2	-	2	4
great blue heron	-	-	-	1	-	-	2[1]	-	-	-	-	2	-	1	-	1	-	1	1	2	2
spotted sandpiper	-	1	-	3	-	1	-	2	-	-	-	2	-	-	-	1	-	-	-	-	2
California gull	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1
marbled godwit	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	1
osprey	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-	1	1	1
bufflehead	-	-	-	-	-	-	-	1	-	-	2[2]	-	-	-	-	-	-	-	-	-	1
California brown pelican	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	1
American black oystercatcher	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2[5]	-	-	-	<1
belted kingfisher	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	<1
great egret	-	-	-	-	-	-	-	-	-	-	1[3]	-	-	-	-	-	-	-	1[3]	-	<1
killdeer	-	-	-	-	-	-	-	-	-	-	1[2]	-	-	-	-	1	-	-	-	-	<1
Northern pintail	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2[3]	-	<1
red-breasted merganser	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	<1
song sparrow	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	<1
American wigeon	-	-	-	-	-	-	-	-	-	-	1[2]	-	-	-	-	-	-	-	-	-	<1
black-bellied plover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1[3]	-	<1
black-crowned night heron	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	<1
Caspian tern	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
green heron	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	<1
gull, unidentified	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
Heermann's gull	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	<1
least sandpiper	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
northern rough-winged swallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	<1
surf scoter	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	<1
Number of individuals	27	16	49	92	42	8	15	70	10	5	19	61	25	7	31	76	72	9	59	64	151
Number of species	8	10	8	9	7	6	9	14	3	5	12	10	8	5	9	12	12	6	12	10	36
Number of species per day	18				16				17				20				21				18

Footnotes:
1 one at intake canal, one in Cerritos Wetland, between the intake canal and the river
2 at Haynes intake canal
3 at Cerritos Wetland, between the intake canal and the river
4 one at Cerritos Wetland, between the intake canal and the river
5 on sand bar on east side

APPENDIX D

WATER QUALITY ANALYSIS FOR CEQA EVALUATION OF THE HAYNES GENERATING STATION UNITS 5 AND 6 REPOWERING PROJECT: ALAMITOS BAY, HAYNES INTAKE CHANNEL, AND LOWER SAN GABRIEL RIVER FLOOD CONTROL CHANNEL

Flow Science Incorporated

September 1, 2009

Flow Science Incorporated
420 Neff Avenue, Suite 230, Harrisonburg, VA 22801
(540) 442-8433 • FAX (540) 442-8863

FLOW SCIENCE®

Water Quality Analysis for CEQA Evaluation of the Haynes Generating Station Units 5 and 6 Repowering Project: Alamitos Bay, Haynes Intake Channel, and Lower San Gabriel River Flood Control Channel

Prepared for
Los Angeles Department of Water and Power

Prepared By	Reviewed By	Reviewed By
Li Ding, Ph.D., P.E. (VA)	Imad A. Hannoun, Ph.D., P.E. (PA)	Susan Paulsen, Ph.D., P.E. (CA)

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SUMMARY

BACKGROUND

Alamitos Bay (Bay) is located on the Southern California coast between the cities of Long Beach and Seal Beach. The Bay is connected to the ocean through a channel delineated by jetties located at the south of the Bay, and water movement within the Bay is strongly influenced by the rise and fall of the ocean tide. The Lower San Gabriel River Flood Control Channel (LSGR Channel) is located to the east side of the Bay (separated by a jetty) and is also tidally influenced. Two power generating stations are located adjacent to the LSGR Channel: the Haynes Generating Station (HnGS) and Alamitos Generating Station (AES). These generating stations are operated by the Los Angeles Department of Water and Power (LADWP) and AES Pacific Inc., respectively. Both HnGS and AES are cooled by ocean water drawn from Alamitos Bay and returned to the LSGR Channel. HnGS draws its cooling water through an intake structure located at the northeastern corner of the Bay. The cooling water is then conveyed to the south end of the HnGS Intake Channel via an inverted siphon beneath the LSGR Channel and is subsequently drawn into the generating station at the north end of the HnGS Intake Channel. After passing through HnGS, the heated cooling water is discharged to the LSGR Channel through three outfalls located on the eastern side of the channel just north of the Westminster Avenue Bridge. AES draws its cooling water directly from the Los Cerritos Channel and discharges it to the LSGR Channel through outfall structures located on the western side of the channel just upstream of the HnGS outfalls. The combined maximum design cooling water flow for both HnGS and AES is 2.2 million gallons per day (2,200 MGD), which is about equal to the tidal prism in Alamitos Bay. These cooling water flows therefore constitute a significant portion of the exchange between the ocean and the Bay and also between the ocean and the LSGR Channel. As a result, the generating station flows affect the circulation and water quality within the Bay, the HnGS Intake Channel, and the LSGR Channel.

The LADWP is in the process of preparing California Environmental Quality Act (CEQA) compliance documents for the proposed HnGS Units 5 and 6 Repowering Project. As part of the process, Flow Science Incorporated (Flow Science) has conducted three-dimensional computational fluid dynamics (CFD) and water quality modeling of Alamitos Bay, the HnGS Intake Channel, and the LSGR Channel to assist LADWP in evaluating the effects of proposed changes in HnGS cooling water flow rates on the hydrodynamics and the water quality in these water bodies.

At the request of LADWP, simulations were performed for calendar year 2005 for two HnGS flow operation scenarios (**Table S.1**): (1) Base Case and (2) CEQA Normal Minimum Operations. In the Base Case, actual 2005 HnGS flow rates were used, corresponding to an annual average of 540,000 gallon per minute (GPM), or 778 MGD. The Base Case also features actual year 2005 flow rates at AES. Other inputs to the modeling correspond to actual measured field data (*e.g.*, meteorological data, runoff flow rates, measured tidal elevations). The CEQA Normal Minimum Operations scenario was defined as having a constant flow rate of 216,000 GPM, or 311 MGD, for the entire year for HnGS, corresponding to the situation in which two of the four pumps at Units 1 and 2 are operational (at 48,000 GPM each) and three of the four pumps (81-84) are operational (at 40,000 GPM each). All other model inputs for the CEQA Normal Minimum Operations simulation scenario are identical to the Base Case.

Table S.1: Flow Scenarios (and Average Annual Flow Rates) Simulated for Calendar Year 2005

Scenario Name	Flow Rates	
	HnGS	**AES**
Base Case	Actual 2005 flow (778 MGD)	Actual 2005 flow (422 MGD)
CEQA Normal Minimum Operations	Constant 311 MGD	Actual 2005 flow (422 MGD)

APPROACH

Flow Science determined that it was not possible to obtain well-resolved simulations within a reasonable simulation time for the large domain that incorporated the entire Alamitos Bay, HnGS Intake Channel, and LSGR Channel. Thus, separate models were set up for Alamitos Bay, the HnGS Intake Channel, and the LSGR Channel. The model for the HnGS Intake Channel was coupled with the model for Alamitos Bay by using the output from the Alamitos Bay model as the boundary conditions for the siphon inflows into the HnGS Intake Channel model. The LSGR Channel was modeled independently.

Flow Science used a comprehensive modeling computer code to simulate water quality for this study. The code includes a three-dimensional hydrodynamic model (Estuary Lake and Coastal Ocean Model, or ELCOM) and a water quality module (Computational Aquatic Ecosystem DYnamics Model, or CAEDYM) that uses ELCOM as its hydrodynamic "driver". The results of the ELCOM model include predicted water velocities, temperatures, water age (the amount of time that a water particle at a certain location has resided in the model domain), and concentrations of salinity and tracers. Meanwhile, CAEDYM computes changes in dissolved oxygen (DO), nutrients, organic matter, pH and chlorophyll *a*. These two models are coupled to provide a powerful tool to study the spatial and temporal relationships between physical, biological, and chemical variables in various types of water bodies. ELCOM/CAEDYM simulations were performed for the Alamitos Bay and the HnGS Intake Channel, while only ELCOM simulations were performed for the LSGR Channel. The main model characteristics and results of the three models are discussed below.

ELCOM simulation results focus on flow distributions and water age, and CAEDYM simulation results presented here focus on chlorophyll *a* and DO (nutrients and pH are also simulated). Water age is important because it is an indicator of other water quality parameters. High water age can be related to lower DO concentrations, higher bacterial counts, and higher chlorophyll *a* concentrations (Moffat and Nichol, 2007). Chlorophyll *a* is used as a surrogate for algae and is an indicator of trophic state. High chlorophyll *a* concentrations can be related to increased turbidity and color, and reduced transparency. DO is of interest because of its importance for aquatic life and the unpleasant water characteristics (taste, odor, discoloration) that can occur under anoxic conditions.

The boundary condition data required by ELCOM include meteorological, tidal elevation, bathymetry, storm water, and generating station flow data, as well as temperature and salinity for ocean water, storm water, and generating station flows. The boundary condition data required by CAEDYM include pH, DO, nutrients, and chlorophyll *a* concentrations for ocean water, storm water, and generating station flows. The boundary condition data specified in the models were either based on measured data or derived from these data. Available field data were too limited to allow a full calibration of the biogeochemical CAEDYM model. Instead, an extensive literature review representing a wide range of geographic locations was used as a guide for determining the range of model parameter values used to define the CAEDYM modeling conditions. Two CAEDYM simulations were conducted for each flow scenario listed in **Table S.1:** the first set used parameter values representing moderate, mid-range literature values, while the second set used high parameter values that result in increased DO depletion and algal growth.

RESULTS

Results from the ELCOM simulations for the three separate model domains focus on water age in Alamitos Bay and the HnGS Intake Channel and on salinity, temperature, and an outfall tracer for the LSGR Channel. CAEDYM modeling in Alamitos Bay and the HnGS Intake Channel focused on chlorophyll *a* and DO concentrations. Simulation results were evaluated both in the context of the other simulations conducted and in the context of water quality objectives. The modeling was used to evaluate the effects of varying HnGS cooling water flow rates on the hydrodynamics and the water quality in these water bodies. Results for the three studies are presented separately below.

Relevant water quality objectives can be found in the Water Quality Control Plan, Los Angeles Region (Basin Plan) (LARWQCB, 1994, with subsequent amendments) and the California Ocean Plan (SWRCB, 2006). The Basin Plan specifies that, for the Outer Harbor area of the Los Angeles-Long Beach Harbors (similar to Alamitos Bay), mean annual DO should be 6 mg/L or greater, and that no single measurement should be less than 5 mg/L. The California Ocean Plan specifies that DO should not be depressed more than 20% from the naturally occurring DO levels.

Neither the Basin Plan nor the Ocean Plan specify objectives for algae or chlorophyll *a*, but the Basin Plan indicates that waters shall be free of coloration and changes in turbidity that cause nuisance or adversely affect beneficial uses. Since both coloration and turbidity can be affected by chlorophyll *a* concentrations (Horne and Goldman, 1994), these objectives should be considered in evaluating the simulation results for different CAEDYM scenarios.

Chlorophyll *a* is usually monitored and used as one major component in determining trophic state of lakes, reservoirs and estuaries. Traditionally, most lakes and water bodies have been placed in one of three trophic categories: oligotrophic, mesotrophic, or eutrophic. Oligotrophic water bodies are characterized by low nutrient levels, low chlorophyll *a* and high transparency (low turbidity); eutrophic water bodies are rich in nutrients and algae with low transparency (high turbidity); and mesotrophic water bodies fall somewhere in between. In general, oligotrophic water bodies have chlorophyll concentrations less than about 5 μg/L, mesotrophic water bodies have chlorophyll concentrations in the range 5-10 μg/L, and eutrophic water bodies have chlorophyll concentrations of more than about 10 μg/L. These trophic categories were used to help evaluate simulation results.

Results for Alamitos Bay

The Alamitos Bay model domain extends from the ocean entrance of Alamitos Bay to the upstream portions of the Bay, and includes the Bay itself, the Marine Stadium, and Los Cerritos Channel to 1.4 miles (2.2 km) north of the AES intake channels.

As discussed above, ELCOM/CAEDYM modeling was conducted for two flow scenarios (**Table S.1**): (1) Base Case using actual 2005 flow rates for both generating stations, and (2) CEQA Normal Minimum Operations using actual 2005 flow rates for AES and a constant flow rate of 216,000 GPM (311 MGD) for HnGS. The Alamitos Bay ELCOM model was verified as able to reproduce the observed data in 2005, but available data were too limited to allow full calibration of the biogeochemical CAEDYM model for Alamitos Bay. As previously stated, simulations with both moderate and high CAEDYM conditions were conducted for each flow scenario.

The lowest water age is found in the channel connecting the Bay and the ocean, and the highest water age is found in the upper portion of the Marine Stadium. CEQA Normal Minimum Operations flow rates result in less water being pulled both from the ocean and through the main portion of Alamitos Bay, but only slight rises in near-surface water age are predicted in Los Cerritos Channel and the Marine Stadium under CEQA Normal Minimum Operations (see **Table S.2**) relative to the Base Case. For both flow scenarios, near-surface annual average water age in most of the Bay is predicted to be less than six days throughout the year, with small portions of the Marine Stadium and the marinas adjacent to Los Cerritos channel predicted to have water age of up to 8 days. Maximum water age during the summer is predicted to reach between 20 and 22 days in a marina adjacent to Los Cerritos Channel for both flow scenarios. The CEQA Normal Minimum Operations scenario is predicted to cause increases in annual average near-surface water age of less than 1 day. Increases in the annual maximum near-surface water age are expected with CEQA Normal Minimum Operations, with the largest change in maximum water age (between 3.0 and 3.5 days) predicted to occur south of the 2nd Street Bridge.

Table S.2: Predicted Annual Maximum and Average Water Age Select Locations in 2005

Stations	Base Case		CEQA Normal Minimum Operations	
	Ave. (days)	Max. (days)	Ave. (days)	Max. (days)
Station 1 (channel connecting ocean)	0.1	4.5	0.2	5.3
Station 4 (Alamitos Bay near the HnGS Intake)	1.0	6.8	1.5	7.6
Station 9 (2nd Street Bridge)	3.3	8.2	4.0	10.3
Station 11 (Marine Stadium)	5.8	8.2	6.3	15.1
Station 12 (Los Cerritos Channel)	3.0	9.5	3.4	10.3

Peaks in nutrient concentrations in the Bay occur as a result of storm water inflows. Since the proposed CEQA Normal Minimum Operations scenario will not affect storm water inflows, nutrient concentrations are predicted to be nearly identical for all simulation scenarios. Thus, changes in chlorophyll *a* and DO are more directly related to season and changes in water age and are largely unaffected by the CEQA Normal Minimum Operations.

Chlorophyll *a* concentrations are predicted to be highest during the summer months for all modeled scenarios. Maximum annual chlorophyll *a* concentrations are predicted to be highest at the upstream end of Alamitos Bay, where water age is greatest. Most peaks in chlorophyll *a* are short-lived. Higher peaks in chlorophyll *a* concentrations are predicted for CEQA Normal Minimum Operations (see **Table S.3)**, especially during the spring. For the high CAEDYM parameters considered, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 4.1 μg/L for the Base Case and 4.3 μg/L for CEQA Normal Minimum Operations.

With moderate CAEDYM parameter values, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 3.4 µg/L for the Base Case and 3.8 µg/L for Normal CEQA Normal Minimum Operations. The highest annual maximum chlorophyll *a* concentrations at any location within the Bay are predicted to be greater than 60 µg/L for all scenarios, but these high values are expected to occur only at a few locations and are atypical. Over most of the Bay, increases in annual maximum chlorophyll *a* concentration are predicted to be less than 4 µg/L under CEQA Normal Minimum Operations. Under CEQA Normal Minimum Operations, annual maximum chlorophyll *a* concentrations are generally predicted to increase by less than 8 µg/L in the corner of the Bay near the HnGS Intake, with only a few locations predicted to have higher increases in chlorophyll *a* concentrations. In general, CEQA Normal Minimum Operations results in an increase in chlorophyll *a* (algae) concentrations in Alamitos Bay, but predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the average annual values, and smaller than the ranges that span the trophic state categories.

Table S.3: Summary of Predicted Maximum and Average Chlorophyll *a* Near the Surface at Selected Locations as a Function of Scenario and CAEDYM Parameter Choice

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (µg/L)	Max. (µg/L)	Ave. (µg/L)	Max. (µg/L)
Station 1 (channel connecting ocean)	Moderate	2.7	7.9	2.7	10.1
	High	2.7	8.7	2.7	9.8
Station 4 (Alamitos Bay near the HnGS Intake)	Moderate	2.6	9.4	2.9	13.9
	High	2.6	9.6	3.0	14.1
Station 9 (2nd Street Bridge)	Moderate	2.4	12.4	2.5	12.0
	High	2.6	15.2	2.8	15.9
Station 11 (Marine Stadium)	Moderate	2.4	13.6	2.6	14.6
	High	2.9	21.4	3.1	21.1
Station 12 (Los Cerritos Channel)	Moderate	2.7	9.5	2.9	8.9
	High	2.9	10.8	3.2	11.9

DO is generally predicted to be higher in the summer months, with dips in DO corresponding to large peaks in chlorophyll *a* concentration. DO concentrations are slightly higher and more uniform in the channel connecting the Bay to the Ocean than in other portions of the Bay. In general, DO concentrations are predicted to be slightly lower under CEQA Normal Minimum Operations than under the Base Case scenario (see **Table S.4**). Annual average near-bottom DO concentrations at all locations in the Bay for all scenarios simulated are predicted to be greater than the Basin Plan mean annual DO specification of 6.0 mg/L. Using moderate CAEDYM parameter values, both flow scenarios are also predicted to maintain annual minimum DO concentrations above 6.0 mg/L at all locations throughout the year. With high CAEDYM parameter values, the Base Case flow scenario is predicted to produce near-bottom DO concentrations below the single occurrence Basin Plan minimum of 5.0 mg/L at some locations, particularly in the upstream ends of the Marine Stadium, and the Los Cerritos Channel, and in the marinas adjacent to Los Cerritos Channel. Low DO concentrations would be expected to occur infrequently anywhere in the domain, with total annual duration below 5.0 mg/L on the order of days. CEQA Normal Minimum Operations is predicted to cause an increase in the frequency of low DO concentration, but DO is not predicted to fall below 3.1 mg/L, thus staying well above 0 mg/L (anoxic conditions) under any of the scenarios simulated. As a result, undesirable odors or the release of undesirable chemical constituents from channel bottom sediments are not expected to occur as a result of DO depletion. For both flow scenarios, the lowest DO concentrations are predicted to occur in the Marine Stadium and the marinas adjacent to the Los Cerritos Channel since these areas have restricted flow, high water age, and relatively high chlorophyll *a* concentrations. The largest decreases in DO with CEQA Normal Minimum Operations flows are predicted to be between 0.5 and 1.0 mg/L at locations to the north and south of the 2nd Street Bridge.

Table S.4: Summary of Predicted Near-Bottom Minimum DO at Selected Locations as a Function of Scenario and CAEDYM Parameter Choice.

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (mg/L)	Min. (mg/L)	Ave. (mg/L)	Min. (mg/L)
Station 1 (channel connecting ocean)	Moderate	9.0	8.1	9.0	8.1
	High	9.0	8.0	9.0	8.0
Station 4 (Alamitos Bay near the HnGS Intake)	Moderate	8.9	7.8	8.8	7.8
	High	8.7	7.5	8.6	7.3
Station 9 (2nd Street Bridge)	Moderate	8.6	7.7	8.5	7.5
	High	8.0	6.5	7.8	5.7
Station 11 (Marine Stadium)	Moderate	8.3	6.8	8.3	6.6
	High	7.5	5.0	7.4	4.2
Station 12 (Los Cerritos Channel)	Moderate	8.5	7.3	8.5	7.2
	High	8.0	6.0	7.9	5.7

Results for HnGS Intake Channel

The HnGS Intake Channel model extends from the downstream (northern) end of the channel, where the HnGS cooling water intakes are located, to the southern end of the channel where an inverted siphon intake structure is located. The Intake Channel is approximately 6600 ft (2000 m) long, 100 ft (30 m) wide.

Simulation results indicate that the flow rate at HnGS for CEQA Normal Minimum Operations will lead to slightly higher water age in the Intake Channel as compared to the Base Case (see **Table S.5**), where water age is defined relative to the time when water first enters Alamitos Bay (note that the theoretical average residence time of water in the Intake Channel is only 2.4 hours for the Base Case and 6.0 hours for CEQA Normal Minimum Operations). The mean annual average water age in the Intake Channel is predicted to increase from 1.1 days for the Base Case to 1.7 days for CEQA Normal Minimum Operations, while the maximum water age at any cell within the domain is predicted to increase from 6.9 days to 7.3 days. Water age in the northern portion of the Intake Channel (between Station 2 and Station 1) is slightly higher than in the southern portion (between Station 2 and Station 3) due mainly to the effect of tidal flushing with Alamitos Bay (via the Intake Channel siphons), which decreases with increasing distance from the channel entrance.

Table S.5: Predicted Annual Maximum and Average Water Age (days) For Scenarios

Stations	Base Case		CEQA Normal Minimum Operations	
	Ave. (days)	Max. (days)	Ave. (days)	Max. (days)
Station 1 (HnGS Intakes)	1.2	4.4	1.9	7.1
Station 2 (middle of the channel)	1.1	6.1	1.7	6.5
Station 3 (entrance to the channel)	1.1	6.9	1.6	7.3
Inflow from the Bay (entrance to siphons in Bay)	1.1	6.9	1.6	7.3

Chlorophyll *a* concentrations are predicted to be highest during the summer months. Higher chlorophyll *a* concentrations are also predicted to occur under CEQA Normal Minimum Operations scenarios relative to the Base Case (see **Table S.6)**. As with water age, most of the chlorophyll *a* formation occurs within Alamitos Bay as evidenced by comparing the average and maximum chlorophyll *a* concentrations in the inflow from Alamitos Bay with the concentrations predicted within the Intake Channel (see **Tables S.6**). The springtime peaks in chlorophyll *a* within the Intake Channel in 2005 are due to storm water pushing the Alamitos Bay water with increased water age and chlorophyll *a* concentrations into the Intake Channel. For the moderate and high CAEDYM parameters, the highest annual average chlorophyll *a* concentrations within the model domain are predicted to increase from 2.9 µg/L for the Base Case, to 3.4-3.5 µg/L for CEQA Normal Minimum Operations. The highest maximum chlorophyll *a* concentrations are predicted to increase from 9.0-9.1 µg/L for the Base Case to 11.7-11.8 µg/L for CEQA Normal Minimum Operations (presented as a range for the moderate and high CAEDYM parameters). Thus, the predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the average annual and maximum predicted values, and smaller than the ranges that span the trophic state categories.

Table S.6: Predicted Annual Maximum and Average Chlorophyll *a* Concentrations (at 0 ft or 0 m MLLW) as a Function of Scenario and CAEDYM Parameter Choice

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (µg/L)	Max. (µg/L)	Ave. (µg/L)	Max. (µg/L)
Station 1 (HnGS Intakes)	Moderate	2.8	7.8	3.2	9.5
	High	2.9	7.8	3.4	9.4
Station 2 (middle of the channel)	Moderate	2.9	8.8	3.3	9.5
	High	2.9	8.7	3.4	9.4
Station 3 (entrance to the channel)	Moderate	2.8	9.0	3.2	11.7
	High	2.9	9.0	3.3	11.8
Inflow from the Bay (entrance to siphons in Bay)	Moderate	2.9	9.0	3.2	11.7
	High	2.9	9.0	3.3	11.8

The predicted DO concentrations do not vary greatly along the length of the Intake Channel or over depth for either the Base Case or CEQA Normal Minimum Operations scenarios (see **Table S.7)**. The minimum DO concentrations are predicted to be 7.4-7.9 mg/L for the Base Case and 7.3-7.8 mg/L for CEQA Normal Minimum

Operations (presented as a range for the moderate and high CAEDYM parameters). The lowest annual minimum DO concentration in any cell of the model domain for any scenario is predicted to be 7.3 mg/L. As such, the annual average and minimum DO concentrations for the scenarios modeled are predicted to meet Basin Plan DO criteria and are not predicted to result in undesirable odors or release of undesirable chemical constituents from channel bottom sediments.

Table S.7: Predicted Annual Minimum and Average DO Concentrations (at 0 ft or 0 m MLLW) as a Function of Scenario and CAEDYM Parameter Choice

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (mg/L)	Min. (mg/L)	Ave. (mg/L)	Min. (mg/L)
Station 1 (HnGS Intakes)	Moderate	8.8	7.9	8.7	7.8
	High	8.7	7.7	8.4	7.5
Station 2 (middle of the channel)	Moderate	8.9	7.9	8.8	7.9
	High	8.7	7.5	8.5	7.6
Station 3 (entrance to the channel)	Moderate	8.9	7.9	8.8	7.9
	High	8.7	7.4	8.6	7.3
Inflow from the Bay (entrance to siphons in Bay)	Moderate	8.9	7.9	8.8	7.9
	High	8.7	7.4	8.6	7.3

These simulation results indicate that the Intake Channel water quality is largely controlled by the water quality of the inflow from Alamitos Bay and the cooling water flow rate for HnGS. The CEQA Normal Minimum Operations scenario is predicted to result in slight increases in water age and chlorophyll *a* concentrations in the Intake Channel as compared to the Base Case. The CEQA Normal Minimum Operations scenario is also predicted to cause a slight decrease in DO concentrations in the bottom waters of the Intake Channel; however, the DO concentrations are not predicted to drop below 6 mg/L for any of the simulated scenarios.

Results for Lower San Gabriel River Channel

The LSGR Channel is a man-made channel that has a trapezoidal shape and that extends from the confluence of the San Gabriel River and Coyote Creek to the ocean, approximately 4 miles. ELCOM was calibrated and validated for the LSGR Channel using five field sampling events. Each field sampling event collected data during one 24 hour period. Simulations of the LSGR Channel were performed for a 24 period so that the field sample data could be used for calibration/validation as well as providing a detailed analysis of hydrodynamics over the course of a tidal cycle. Modeling periods also had to be kept short because of long computation times caused by the size of the ELCOM grid. A large grid was needed to model the entire LSGR Channel while still providing enough resolution near the generating station outfalls to capture the interactions of various water sources.

Modeling periods for the LSGR Channel can be divided into two categories: calibration/validation periods and Base Case/CEQA simulation periods. Calibration/validation periods were used to model the days during which field sampling for temperature and salinity occurred. Base Case/CEQA simulation periods modeled a high flow/high heat load period and a low flow/low heat load period. A period of relatively high flow and high heat load for both generating stations occurred on July 20, 2005, and a period of low flow and low heat load occurred on October 24, 2005. Simulation scenarios for the LSGR Channel model are summarized in **Table S.8**.

Table S.8: Simulation Scenario List

Scenario Number	Scenario Name	Scenario Type	Simulation Period	Generating Station Flow (MGD)	
				HnGS	AES
1	2005 A1	Baseline	October 24, 2005	483 - 507	195
2	2005 A2	Baseline	July 20, 2005	921 - 968	1270
3	CEQA Oct	CEQA Normal Minimum Operations	October 24, 2005	311	195
4	CEQA July	CEQA Normal Minimum Operations	July 20, 2005	311	1270

Each calibration/validation simulation captured the characteristics of the LSGR Channel and properly predicted the interactions of salt and freshwater within the LSGR Channel. ELCOM was therefore confirmed to be capable of describing the temperature and salinity distributions in the LSGR Channel under both typical conditions and subsequent to post-rain events with equivalent accuracy.

Conditions in the LSGR Channel under the Base Case (existing condition) scenario do not resemble conditions in a typical estuary, in that the cooling water discharges form a “barrier” between freshwater and saline ocean water, such that there is little or no upstream movement of ocean water from San Pedro Bay. Under Base Case conditions there is no direct contact between San Pedro Bay water and freshwater.

The generating station outfalls provide the major source of inflow to the LSGR Channel and greatly affect the hydrodynamics of the LSGR Channel. The flow from the outfalls has a large effect on the net transport into and out of the LSGR Channel and effectively prevents contact between ocean water entering the channel with the tides and freshwater inflows from upstream, even when the generating stations are operating at relatively low capacity, such as on October 24, 2005. This barrier is present during both CEQA Normal Minimum Operations scenarios.

Both the low heat load scenario and high heat load scenario indicate that predicted water temperatures in the LSGR Channel are sensitive to the heat loading provided by the cooling water discharges. Comparisons between the Base Case and CEQA Normal Minimum Operations scenarios confirm this effect. If flow rates and cooling water discharge temperatures change, the effect can be seen in the water temperature profile within the LSGR Channel; however, the effect is mostly localized to the areas near the outfalls. The majority of the LSGR Channel shows less than a one degree increase in water temperature for CEQA Normal Minimum Operations scenarios relative to the Base Case.

Since the generating stations use saline water from Alamitos Bay as cooling water, and provide the major source of inflow to the LSGR Channel, the majority of water in the LSGR Channel has the approximate salinity of ocean water. Freshwater from upstream forms a lens on the surface of the LSGR Channel upstream of the generating station outfalls. The freshwater lens is diluted upon passing the outfalls and, depending on the flow rates, can be almost entirely mixed with saltwater before reaching the mouth of the channel. HnGS outfall salinities remained the same regardless of whether Base Case flow rates or CEQA Normal Minimum Operations flow rates were simulated due to the lack of outfall salinity data. Differences between the predicted salinity for Base Case scenarios and CEQA Normal Minimum Operations scenarios are typically less than one PSU, although some areas do show larger differences. Lower flow rates cause less mixing, which in turn causes lower salinities along the surface and higher salinities along the bottom of the channel. The largest salinity differences are seen at the surface, where predicted salinity values are one to four PSU lower for the CEQA Normal Minimum Operations scenarios than the Base Case scenarios.

An investigation of water age in the LSGR Channel demonstrated that water in the LSGR Channel is likely less than 12 hours older than the water from HnGS and AES discharges when HnGS operates at full capacity. When HnGS operates at the CEQA Normal Minimum Operations level, net transport over one tidal cycle is reduced and flushing of the LSGR Channel model domain takes less than two tidal cycles or one day. Overall, increases in water age between Base Case and CEQA Normal Minimum Operations in the whole channel are not expected to exceed about one tidal cycle or 12 hours. Because of the close coupling of the flows in the LSGR Channel and the HnGS Intake Channels, changes in water quality parameters such as chlorophyll *a* and DO predicted in the HnGS Intake Channel with CEQA Normal Minimum Operations will also be experienced in the LSGR Channel. Ranges of chlorophyll *a* and DO in the LSGR Channel will be similar to those predicted by the HnGS Intake Channel modeling. As a result, similar conclusions to those drawn from the HnGS Intake Channel modeling can be drawn for water quality in the LSGR Channel: (1) increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios in the LSGR Channel are expected to be an order of magnitude smaller than the average annual values, and smaller than the ranges that span the trophic state categories; (2) the annual average and minimum DO concentrations in the LSGR Channel are all expected to meet Basin Plan DO criteria.

OVERALL CONCLUSIONS

The following provides an overall summary of the hydrodynamic and water quality effects on the water bodies of Alamitos Bay, HnGS Intake Channel and the LSGR Channel that would be expected with CEQA Normal Minimum Operations due to the Units 5 and 6 Repowering Project.

- In Alamitos Bay, lower water age is generally found in the channel connecting the Bay and the ocean, and higher water age is generally found in the upper portion of the Marine Stadium and the Los Cerritos Channel. CEQA Normal Minimum Operations results in only slight rises in predicted near-surface water age in Los Cerritos Channel and the Marine Stadium under CEQA Normal Minimum Operations relative to the Base Case: (1) annual average near-surface water age increases by less than 1 day; (2) The largest increases in annual maximum water age are predicted to be between 3.0 and 3.5 days and occur south of the 2nd Street Bridge. In the HnGS Intake Channel, simulation results indicate that CEQA Normal Minimum Operations will lead to slightly higher water age in the Intake Channel (less than one day for both mean annual average and annual maximum water age) as compared to the Base Case. An investigation concludes that increases of water age are expected to be less than 12 hours in the LSGR Channel with CEQA Normal Minimum Operations.

- In Alamitos Bay and HnGS Intake Channel, predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are an order of magnitude smaller than the average annual predicted values and smaller than the ranges that span trophic state categories. The same conclusions can be drawn for the LSGR Channel based on its similarity to the HnGS Intake Channel.

- In Alamitos Bay and HnGS Intake Channel, the annual average DO concentrations were predicted to exceed the Basin Plan mean annual DO specification of 6 mg/L. DO concentrations are predicted to stay well above 0 mg/L (anoxic conditions) for all scenarios considered. Similar ranges of DO are expected in the LSGR Channel based on its similarity to the HnGS Intake Channel. As a result, undesirable odors or the release of undesirable chemical constituents from channel bottom sediments are not predicted since anaerobic conditions are not expected to occur.

1.0 Introduction

1.1 BACKGROUND

Alamitos Bay (Bay) is located on the Southern California coast between the cities of Long Beach and Seal Beach (**Figure 1.1**). It receives most of its freshwater via runoff from Los Cerritos Channel, Bouton Creek, and Belmont Pump Station. The Bay is connected to the ocean through a channel delineated by jetties and located at the south of the Bay, and water movement in the Bay is strongly influenced by the rise and fall of the ocean tide. The Lower San Gabriel River Flood Control Channel (LSGR Channel) is located to the east side of the Bay (separated by a jetty) and is also tidally influenced. It receives runoff from the San Gabriel River and Coyote Creek, as well as cooling water discharges from two power generating stations, which are all discharged to the ocean.

Two power generating stations are located adjacent to the LSGR Channel: the Haynes Generating Station (HnGS) and Alamitos Generating Station (AES) (**Figure 1.1**). These generating stations are operated by the Los Angeles Department of Water and Power (LADWP) and AES Pacific Inc., respectively. Both HnGS and AES are cooled by ocean water drawn from Alamitos Bay and returned to the LSGR Channel. HnGS draws its cooling water through an intake structure located at the northeastern corner of the Bay. The cooling water is then conveyed to the south end of the HnGS Intake Channel, via an inverted siphon beneath the LSGR Channel, and subsequently drawn into the generating station at the north end of the HnGS Intake Channel. After passing through HnGS, the warmed cooling water is discharged to the LSGR Channel through three outfalls located just north of the Westminster Avenue Bridge on the eastern side of the LSGR Channel (**Figure 1.1**). AES draws its cooling water directly from the Los Cerritos Channel and discharges it to the LSGR through three outfalls located on the western side of the LSGR Channel just upstream of the HnGS outfalls. The combined maximum design cooling water flow for both HnGS and AES is 2.2 million gallons per day (2,200 MGD), which is about equal to the tidal prism in Alamitos Bay. Thus, these flows constitute a significant portion of the exchange between the ocean and the Bay and also between the ocean and the LSGR Channel. As a result, the generating station flows affect the circulation and water quality within the Bay, the HnGS Intake Channel, and the LSGR Channel.

The LADWP is in the process of preparing California Environmental Quality Act (CEQA) compliance documents for the proposed HnGS Units 5 and 6 Repowering Project. As part of the process, Flow Science Incorporated (Flow Science) has conducted three-dimensional computational fluid dynamics (CFD) modeling of Alamitos Bay, the HnGS Intake Channel, and the LSGR Flood Control Channel to assist LADWP in evaluating the effects of varying HnGS cooling water flow rates on hydrodynamics and water quality. This report provides a detailed description of the modeling efforts and an assessment of the effects on the hydrodynamics and the water quality within the Bay, the HnGS Intake Channel, and LSGR Channel that would result from the reduction in HnGS cooling water flow rates that would occur following the proposed Units 5 and 6 Repowering Project.

At the request of LADWP, simulations were performed for calendar year 2005 for two HnGS flow operation scenarios (**Table 1.1**): (1) Base Case and (2) CEQA Normal Minimum Operations (also referred as CEQA NMO). In the Base Case, actual 2005 HnGS flow rates were used, corresponding to an annual average of 540,000 gallon per minute (GPM) or 778 MGD. The Base Case also features actual year 2005 flow rates at AES. Other inputs to the model correspond to measured field data (*e.g.*, meteorological data, runoff flow rates, measured tidal elevations). The CEQA Normal Minimum Operations scenario was defined as having a constant flow rate of 216,000 GPM or 311 MGD for the entire year for HnGS, corresponding to the situation in which two of the four pumps at Units 1 and 2 are operational (at 48,000 GPM each) and three of the four pumps (81-84) are operational (at 40,000 GPM each). All other model inputs for the CEQA Normal Minimum Operations simulation scenario are identical to the Base Case.

Table 1.1: Flow Scenarios Simulated for Calendar Year 2005

Scenario Name	Flow Rates	
	HnGS	**AES**
Base Case	Actual 2005 flow	Actual 2005 flow
CEQA Normal Minimum Operations	Constant 311 MGD	Actual 2005 flow

1.2 APPROACH

During the evaluation, Flow Science determined that it was not possible to obtain well-resolved simulations within a reasonable simulation time for the large domain required for the entire Alamitos Bay, HnGS Intake Channel, and LSGR Channel. Thus, separate models were set up for Alamitos Bay, the HnGS Intake Channel, and the LSGR Channel (see **Figure 1.2** for the three model domains). The model for the HnGS Intake Channel was coupled with the model for Alamitos Bay by using the output from the Alamitos Bay model as the boundary conditions for the siphon inflows into the HnGS Intake Channel model. The LSGR Channel model was not coupled to the other two models.

Flow Science used a comprehensive modeling computer code to simulate water quality for this study. It includes a three-dimensional hydrodynamic model (Estuary Lake and Coastal Ocean Model, or ELCOM) and a water quality module (Computational Aquatic Ecosystem DYnamics Model, or CAEDYM) that uses ELCOM as its hydrodynamic "driver". The results of the ELCOM model include predicted water velocities, temperatures, water age, and concentrations of salinity and tracers. Meanwhile, CAEDYM computes changes in dissolved oxygen (DO), nutrients, organic matter, pH and chlorophyll *a*, which is a surrogate for the presence of algae. These two models are coupled to provide a powerful tool to study the spatial and temporal relationships between physical, biological, and chemical variables in various types of water bodies. A detailed description of the ELCOM and CAEDYM models is provided in **Appendix A** of this report. ELCOM/CAEDYM simulations were performed for the Alamitos Bay and the HnGS Intake Channel, while only ELCOM simulations were performed for the LSGR Channel.

The boundary condition data required by ELCOM include meteorological, tidal elevation, bathymetry, storm water, and generating station flow data, as well as temperatures and salinity for ocean, storm water, and generating station flows. The boundary condition data required by CAEDYM include pH, DO, nutrients, and chlorophyll *a* concentrations for ocean, storm water, and generating station flows. The boundary condition data specified in the models were either based on measured data or derived from these data. Details on the boundary conditions for each model can be found in subsequent chapters of this report.

1.3 REPORT ORGANIZATION

Chapter 1 introduces the background and general approach of the project. **Chapters 2**, **3** and **4** provide details on the modeling efforts for each of Alamitos Bay, HnGS Intake Channel, and the LSGR Channel, respectively, including model approach, model set-up, model validation/verification, and analysis of modeling results. **Chapter 5** summarizes the findings of all three models, discusses their implications for water quality, and summarizes the conclusions.

Appendix A presents a detailed description of the ELCOM and CAEDYM models. **Appendix B** discusses the CAEDYM water quality parameter values determined from an extensive literature search. **Appendix C** presents additional model input data and calibration results for the LSGR Channel model. Animations of modeling results are included in **Appendix D**.

2.0 ALAMITOS BAY

2.1 INTRODUCTION

Alamitos Bay and connected waterways create a complex system of channels surrounding Naples Island (see **Figure 2.1**). Alamitos Bay is connected to the ocean through a channel delineated by jetties to the south of the Bay, and to the Colorado Lagoon through a culvert to the north-west. Freshwater enters the Bay mainly from the Los Cerritos Channel to the north-east and from Belmont Creek to the west. Cooling water for AES is drawn through the Bay and into the Los Cerritos Channel. HnGS cooling water is drawn through an intake structure in the northeast corner of the Bay. Because these generating station flows are drawn through Alamitos Bay and returned to the LSGR Channel, they affect circulation and water quality within the Bay.

ELCOM/CAEDYM modeling was conducted to investigate the potential hydrodynamic and water quality effects of reducing cooling water flows at HnGS (see **Figure 1.2** for model domain). Two flow scenarios were simulated (see **Table 1.1**): (1) Base Case using actual 2005 flow rates for both generating stations, (2) CEQA Normal Minimum Operations using actual 2005 flow rates for AES and a constant flow rate of 216,000 GPM (311 MGD) for HnGS. Aside from the reduced HnGS flows, all other model inputs for the CEQA Normal Minimum Operations simulation scenario are identical to the Base Case.

2.2 MODELING APPROACH

ELCOM was used to simulate the hydrodynamics within Alamitos Bay, and CAEDYM was used to evaluate changes in DO, nutrients, and chlorophyll *a* that would occur under the operational scenario for the proposed project. A detailed description of the ELCOM and CAEDYM models can be found in **Appendix A**. See **Section 2.3** for a description of model inputs.

The ELCOM model validation process (see **Section 2.4**) involved the comparison of simulation results with field data that include: 1) water surface elevation and velocity data collected by Moffatt and Nichol (2004 and 2007), and 2) storm event monitoring data collected in 2004 from the *City of Long Beach Storm Water Monitoring Reports* (Kinnetic Laboratories Incorporated, 2004 and 2005). Validation of the model for calendar year 2004 showed good agreement between simulation results and field data, and the calibrated model was then run for calendar year 2005 and results were compared to field data for 2005, available only for the storm event of October 18, 2005 (**Section 2.4**), to verify the ability of the calibrated model to reproduce observed data for calendar year 2005. After confirming the validation of the model, the 2005 simulation scenarios were conducted.

2.2.1 Biogeochemical Methodology

Flow Science has found that available field data were too limited to allow for a full calibration of the CAEDYM biogeochemical model for DO, nutrients, and/or chlorophyll *a* (a surrogate for algae). Given the limited availability of data for Alamitos Bay, Flow Science originally proposed to calibrate the CAEDYM model using representative data from other southern California coastal regions (*e.g.*, Newport Bay, Los Peñasquitos Lagoon) where low DO concentrations have been observed and where the tidal flushing is dominant. However, research indicated that these locations are generally dominated by macroalgae [(Schiff and Kamer (2000), Kamer *et al.*, (2001, 2002)], which is the main cause of low DO concentrations (Nezlin *et al.*, 2006). By contrast, a field trip to Alamitos Bay in April 2008 determined that macroalgae were only present in a few isolated locations and at low biomass densities. This is likely a result of the predominantly sandy substrate in Alamitos Bay, which does not provide adequate anchor points for macroalgae (Trancoso, *et al*., 2005). Alamitos Bay would probably be dominated by floating microalgae (phytoplankton), rather than attached macroalgae.

Due to the differences between Alamitos Bay and other southern California coastal regions, as well as the general limited availability of phytoplankton and sediment data, literature from a wider range of geographic locations was used to estimate model parameters. Parameter values obtained from an extensive literature search are tabulated in **Appendix B**.

Table 2.1 lists the CAEDYM parameter values that were used in the modeling. These parameters define the phytoplankton response to light, temperature, and nutrient supply, as well as DO and nutrient flux rates between the water column and sediments.

Two sets of parameters are listed. The first set of values represents moderate, mid-range literature values, while the second set represents high values that result in more DO depletion and algal growth.

Table 2.1: CAEDYM Parameter Values Used

Parameter	Description	Units	Moderate	High
Pmax	growth rate at reference temperature	/day	2.0	2.5
Ycc	ratio of C to Chla	mg C/ mg Chla	40	50
Ist	optimum intensity for photosynthesis	μmol/m^2/s	470	470
Kep	specific attenuation coefficient for Chla	/ (μg Chla / L) / m	0.02	0.02
KN	half saturation constant for N	mg N / L	0.02	0.02

INmin	minimum internal N	mg N/ mg Chla	3.0	3.0
INmax	maximum internal N	mg N/ mg Chla	9.0	9.0
UNmax	maximum N uptake rate	mg N / mg Chla / day	12	12
KP	half saturation constant for P	mg P / L	0.005	0.005
IPmin	minimum internal P	mg P/ mg Chla	0.5	0.5
IPmax	maximum internal P	mg P/ mg Chla	2.0	2.0
UPmax	maximum P uptake rate	mg P / mg Chla / day	1.2	1.2
vT	temperature multiplier for growth	-	1.09	1.09
Tsta	standard temperature	°C	25	25
Topt	optimal temperature	°C	27	27
Tmax	maximum temperature	°C	33	33
Kr	respiration rate coefficient	/ day	0.2	0.25
vR	temperature multiplier for respiration	-	1.07	1.07
fRES	fraction of loss that is respiration	-	0.8	0.8
fDOM	fraction of loss that goes to DOM	-	0.7	0.7
rSOs	sediment oxygen demand rate	g O / m^2 /day	0.7	2.0
KSOs	half-saturation constant for SOD	mg O / L	1.0	1.0
SmpNH4	sediment release rate of NH4	g N / m^2 /day	0.06	0.135
SmpNO3	sediment release rate of NO3	g N / m^2 /day	0	0.012
SmpPO4	sediment release rate of PO4	g P / m^2 /day	0.008	0.012

2.3 MODEL SET-UP

2.3.1 Computational Domain and Grid

The model domain extends from the ocean entrance of Alamitos Bay to the upstream portions of the Bay, and includes the Bay itself, the Marine Stadium, and Los Cerritos Channel to 1.4 miles (2.2 km) north of the AES intake channels (see **Figures 1.2 and 2.1**).

Bathymetry data for Alamitos Bay, including the Marine Stadium and Los Cerritos Channel up to the AES intake channels, were measured by Fugro West, a subcontractor to MBC, in 2007. Bathymetry data for Alamitos Bay have a horizontal resolution of 6.56 ft (2 m) (see **Figure 2.2**). The Colorado Lagoon bathymetry data are not included in this data set, and the inclusion of Colorado Lagoon in the model domain is described below.

The model grid was extended along Los Cerritos Channel past the extent of the available bathymetry to 1.4 miles north of the AES intake channels. Channels leading to the AES generating station cooling water intakes were also added. The bottom elevations of these channels were based on the Los Cerritos Channel and the channel bottom elevations shown on the AES intake structure drawings in Bailey (2005).

Since water movement in the Bay is strongly influenced by the ocean tide, including all areas that are under tidal influence is essential to accurately capture the exchange volume of water between the Bay and ocean and to accurately simulate the velocities of the water in the Bay. As a result, the Colorado Lagoon was approximately represented in the model domain even though it is not part of the study area and was not included in the bathymetry data. For the same reason, the model grid was expanded to include the approximate volume of the Los Cerritos Wetlands and to include other areas that were not included in the Fugro bathymetry data set but that are under tide influence.

The model grid was rotated 42 degrees counter-clockwise from North in order to align the major channels of the Bay with the model grid axes. The 6.6 ft (2-m) resolution bathymetry data were used to create a grid with a horizontal cell size of 98 ft (30-m) by 98 ft (30-m) (**Figure 2.2**).

A variable grid size was used in the vertical dimension. A vertical grid size of 0.49 ft (0.15 m) was used for the top 4.9 ft (1.5 m) of the water column in order to provide a high resolution for resolving vertical stratification in the Bay. Below this level a stretched grid was used in order to decrease the number of cells needed and to improve computational efficiency. Each stretched cell is 6.4 percent larger (in the vertical direction) than the cell directly above it. The maximum cell depth near the bottom was 2.1 ft (0.63 m).

2.3.2 Modeling Period

Simulations were conducted for one calendar year in order to study the seasonal pattern of stratification and algal growth in the Bay. The calibrated/validated model was run for calendar year 2005 data, as HnGS operations during 2005 are representative of existing condition operations following the completion of the Units 3 and 4 Repowering Project.

2.3.3 ELCOM Boundary Conditions

The input data collected for the ELCOM model for boundary conditions include meteorological, tidal, temperature, salinity, bathymetry, storm water, and generating station flow rate data. Sources of these data sets are described in detail below.

2.3.3.1 Meteorological Data

The meteorological data required for the model, which features a complete thermodynamic calculation, include solar radiation, air temperature, wind speed, wind direction, relative humidity, and rainfall. Input data for these parameters were compiled from hourly data from the California Irrigation Management Information System (CIMIS) stations at Irvine (Station #75), Long Beach (Station #174), and Santa Monica (Station #99), based on the availability of data.

Time series of precipitation, solar radiation and air temperature and wind rose data in 2004 (used for model validation) and 2005 (representative of existing conditions and used to evaluate the proposed project) are shown in **Figures 2.3** through **2.6**.

2.3.3.2 Water Surface Elevations

The ocean represents an open boundary for which the water surface elevation is specified as a function of time during the model simulation. Water surface elevations measured at the NOAA station at Los Angeles Harbor (NOAA Station #9410660; **Figure 2.7**) were used for this boundary condition. The data include water levels measured every 6 minutes relative to MLLW.

2.3.3.3 Temperature and Salinity

Ocean temperature profiles collected in 1971 and 1972 as part of the Alamitos and Haynes generating station thermal effect study (Environmental Quality Analysts, Incorporated & Marine Biological Consultants, Incorporated, 1972a-e and 1973) were manually digitized and used as temperature boundary conditions at the open ocean since more recent data profiles at sites close to the entrance to Alamitos Bay were very sparse. Sampling site RW-14, located less than one mile south-west of the entrance to Alamitos

Bay, was the site closest to the entrance to Alamitos Bay (see Environmental Quality Analysts [1973], Figure 3-7) where temperature profiles were collected on a regular basis, so temperature profiles measured at this site were used. Temperature profiles showing unstable conditions were assumed to represent transient conditions and were excluded. On days when multiple temperature profiles were collected, the profile closest to noon was considered. Temperature profiles collected at site RW-14 on the following dates were used for the corresponding day in 2004 and 2005, since more recent data were unavailable: 01/31/1971 13:26, 02/01/1971 01:23, 04/12/1972 10:03, 05/11/1972 11:05, 05/12/1972 02:07, 06/07/1972 21:43, 07/06/1972 15:22, 08/09/1972 12:10, 08/10/1972 08:28, 09/07/1972 12:27, 10/20/1972 10:02, 11/02/1971 10:35, 11/03/1971 10:35, 12/20/2004 12:27. Interpolation within the ELCOM code was used to estimate boundary conditions between these dates. Since ocean temperature variation from year to year is small compared to seasonal variations, this method of estimating 2004/2005 ocean temperature profiles is sufficient for the purpose of the ELCOM simulations.

A constant salinity of 33.5 practical salinity units (PSU) was used at the ocean boundary.

2.3.3.4 Freshwater Inflow Rates

The storm water flow rates measured at three locations (Kinnetic Laboratories Incorporated, 2004, 2005 and 2006) were used to determine freshwater entering Alamitos Bay following precipitation events. These locations include Belmont Pump Station, Los Cerritos Channel, and Bouton Creek (see **Figure 2.1** for locations of inflows; see **Figures 2.8** for measured flow rates).

Bouton Creek stormflows were estimated due to multiple gaps in the 2005 data set (data were unavailable from 1/29/05 through 2/14/05 and from 3/24/05 through 11/02/05) and the strong tidal influence at this site. The tidal influence at Bouton Creek causes negative inflow to mask the net freshwater/storm water inflow. In order to fill the data gap and estimate net inflow, the correlation between Los Cerritos storm water volume and Bouton Creek stormflow volume was examined. Los Cerritos Channel was selected as the base because of its proximity to Bouton Creek and its lack of tidal influence. The storm events in 2004-2005 that meet the following requirements were chosen to build the correlation of stormflow volume at Bouton Creek and Los Cerritos Channel: (1) peak stormflow at Los Cerritos Channel exceeds 200 cfs, (2) stormflow lasts longer than one 12-hour tidal period, (3) stormflow data were available at both Bouton Creek and Los Cerritos Channel. Fifteen storm events during 2004-2005 met these requirements, and the strong correlation between stormflow events at these two sites (see **Figure 2.9**) was used to estimate net stormflow at Bouton Creek by using the following formula: Bouton Creek Flow (m^3/s) = 0.1142×Los Cerritos Flow (m^3/s).

During non-storm periods, inflow of freshwater from Belmont Pump Station, Los Cerritos Channel, and Bouton Creek was assumed to be the average of the measured dry flows, which are measured twice per year, during 2004 and 2005 (Kinnetic Laboratories Incorporated, 2005 and 2006).

Inflow water temperature was assumed to be a constant 20 degrees C and inflow salinity was assumed to be constant at 0.5 PSU.

2.3.3.5 Generating Station Intake Flow Rates

HnGS and AES cooling water intake flow rates were also required for the analysis. AES cooling water intake flow rates were available on a daily basis and were provided by LADWP. HnGS cooling water intake flow rate data were provided in chart format by LADWP and were manually digitized on an hourly basis by Flow Science. Generating station flow rate data are shown in **Figure 2.10**.

2.3.4 CAEDYM Boundary Conditions

Nutrients and chlorophyll *a* (a surrogate for algae) enter the Bay through the ocean boundary and through storm water inflows. These parameters, as well as DO and pH, are specified at the ocean boundary and for the three storm water inflows included in the model: Los Cerritos Channel, Bouton Creek, and Belmont Pump station. Sources of these data sets are described in detail below.

2.3.4.1 Dissolved Oxygen and pH

DO and pH data for the storm water inflows were obtained from the *City of Long Beach Storm Water Monitoring Reports* (Kinnetic Laboratories Incorporated, 2005 and 2006) and include data measured during monitored stormflow events and during two dry weather monitoring events. These data are shown in **Figures 2.11** and **2.12**. Dry weather field data were interpolated to cover non-stormflow time periods. Storm water nutrient concentrations were estimated by interpolating between the sampled stormflow periods.

DO concentrations for ocean water were measured by California Cooperative Oceanic Fisheries Investigation (CALCOFI) (Station 88.5) and is also shown in **Figure 2.11**. Ocean water pH was assumed to be 8 at all times (**http://www.seafriends.org.nz/oceano/seawater.htm**) since measured data were not available.

2.3.4.2 Nutrient Data

Nutrient data, including total phosphorus, orthophosphate, nitrate, and total organic carbon, were obtained from the *City of Long Beach Storm Water Monitoring Reports* (Kinnetic Laboratories Incorporated, 2004, 2005 and 2006) and include data during stormflow events and during dry weather monitoring events (**Figures 2.13-2.16**). Dry weather field data were interpolated to cover non-stormflow time periods. Storm water nutrient concentrations were estimated by interpolating between the sampled stormflow periods.

Concentrations of nitrate and orthophosphate for ocean water were measured by CALCOFI (Station 88.5) and are also shown on **Figures 2.13-2.16**. Ammonia concentration was assumed to be the average concentration (0.00035 mg/L) measured in the Southern California Bight from Eppley *et al.* (1979). Particulate organic carbon (POC), dissolved organic carbon (DOC), particulate organic nitrogen (PON) and dissolved organic nitrogen (DON) were assumed to be 0.15, 0.89, 0.018, and 0.066 mg/L, respectively, based on the study from Hill and Wheeler (2002).

2.3.4.3 Chlorophyll a Data

Chlorophyll *a* concentration (a surrogate for algae) was not available for inflows at Los Cerritos Channel, Bouton Creek, or Belmont Pump station, and chlorophyll *a* concentrations for these inflows were assumed to be 2 μg/L. Concentrations of chlorophyll *a* for ocean water measured by CALCOFI (Station 88.5, **Figure 2.17**) were used as chlorophyll *a* boundary conditions at the open ocean; interpolation within the CAEDYM code was used to estimate boundary conditions for days when measured data were not available.

2.4 HYDRODYNAMIC VALIDATION

Calibration of the hydrodynamic model ELCOM involves the comparison of simulation results with field data, and the adjustment of model parameters to increase the accuracy of the simulation. The ability of the model to reproduce observed data at field sampling sites provides assurance of the predictive capability of the model. Validation consisted of 1) comparisons of model results with water surface elevation and velocity data collected by Moffatt and Nichol (2004 and 2007), and 2) comparisons of model output with event monitoring data for storm events on February 2-3, 2004 and October 19-20, 2004 (Kinnetic Laboratories Incorporated, 2004 and 2005).

Calibration and validation were completed using these data and data from the October 18, 2005 storm event (see **Section 2.4.3.2**), the only event during 2005 for which extensive field data were available (Kinnetic Laboratories Incorporated, 2006). Following this verification of the model calibration, the same model parameters were used for all subsequent simulations.

2.4.1 Water Surface Elevation

Moffatt and Nichol (2004) deployed a tide gage in the Marine Stadium in June-July 2004 and found that water levels and tidal phase at this location were very close to those observed at Los Angeles Outer Harbor (see Moffat and Nichol [2004], Figure 9). The simulation results (**Figure 2.18**) are in close agreement with Moffatt and Nichol's (2004) observed water surface elevations in the Marine Stadium.

2.4.2 Water Velocities

Moffatt and Nichol (2007) measured flow velocity in Alamitos Bay at about one foot above the channel bed using a current meter located near 2nd Street Bayshore (see Moffatt and Nichol [2007], Figure 5-1). Simulated near-bottom velocities for the same time period were obtained using 2007 tidal elevations and generating station flow rates shown in Moffatt and Nichol (2007, Figure 5-2) and compared to the velocities measured by Moffatt and Nichol (2007). As shown in **Figure 2.19,** the ELCOM velocity and water surface elevation predictions compare well to those observed by Moffatt and Nichol (2007).

2.4.3 Storm Events

2.4.3.1 2004 Storm Events

Water salinity and temperature in Alamitos Bay were measured as part of the storm water monitoring conducted for the City of Long Beach (Kinnetic Laboratories Incorporated, 2004 and 2005). These observations included surface salinity observations in Alamitos Bay following precipitation events in February and October 2004. Vertical profiles of temperature and salinity were also collected at specific locations in the Bay following these events. Comparison of measured and simulated salinity and temperature were generally good.

Except where noted below, the data sources described in **Section 2.3** were used for 2004 storm event calibration and validation for these two stormflow events in 2004.

The *City of Long Beach Storm Water Monitoring Report 2004/2005* (Kinnetic Laboratories Incorporated, 2005) includes temperature and salinity profiles at the ocean entrance to Alamitos Bay following the October 19-20, 2004 storm event (see Figure 17 in Kinnetic Laboratories Incorporated, 2005). These temperature and salinity profiles were applied at the ocean boundary during the event to improve the accuracy of the boundary conditions during this time of high streamflow, since they most probably represent the effect of high flows within the LSGR Channel.

Meteorological data were obtained from the California Irrigation Management Information System (CIMIS) station at Long Beach (Station #174; see **Figure 2.1**). The model calibration indicated that a wind speed increase of 50 percent was needed, probably due to the open nature of the Bay. The wind speed measurement location was several miles inland, and these measurements likely underestimate wind speed in the open Alamitos Bay area. All simulation scenarios used a 50 percent increase in wind speed over observed values.

The February 2-3, 2004 weather event produced approximately 0.8 in (20 mm) of precipitation with a maximum intensity of nearly 2 in/hr (75 mm/hr) at the four stations reported in Kinnetic Laboratories Incorporated (2004). This event occurred with relatively dry antecedent conditions (~0.2 in [5 mm] of precipitation more than five days prior). Monitoring of the storm water plume in Alamitos Bay occurred between 05:21 and 09:54 on February 3, 2004, beginning six hours after precipitation ended, and 7.5 hours after the storm water flow peak at the Los Cerritos Channel monitoring site (Kinnetic Laboratories Incorporated, 2004).

At the time of monitoring, only small changes in surface salinity in Alamitos Bay were observed. **Figure 2.20** shows both measured surface salinity (Kinnetic Laboratories Incorporated, 2004) and simulated surface salinity following this event. It should be noted that surface salinities were measured over a 4.5 hour period, making comparison with an instantaneous simulation result difficult. **Figures 2.21** and **2.22** show measured and simulated temperature and salinity profiles at eight locations (shown on **Figure 2.20**) in Alamitos Bay, Los Cerritos Channel, and the Marine Stadium. Simulated vertical profiles agree well with observed temperature and salinity profiles (Kinnetic Laboratories Incorporated, 2004). The lower salinity storm water plume was restricted to the upper meter of the water column, and at the time of the measurements was not observed to reach much farther than the end of the Los Cerritos Channel.

The October 19-20, 2004 precipitation event caused a more extensive freshwater plume in Alamitos Bay. This precipitation event produced 1.6-1.9 in (40-48 mm) of rainfall at the four stations reported in Kinnetic Laboratories Incorporated (2005). The maximum observed rainfall intensity was greater than 1 in/hr (25 mm/hr), and the event occurred under relatively wet antecedent conditions (a previous rainfall event with greater than 0.8 in (20 mm) of precipitation occurred on October 16, 2004; Kinnetic Laboratories Incorporated, 2005). Peak flow rates exceeded 2100 cfs (59.5 m^3/s) at the Los Cerritos monitoring station (Kinnetic Laboratories Incorporated, 2005).

Figure 2.23 shows the measured surface salinity in Alamitos Bay between 12:25 and 15:00 on October 20, 2004 and the simulation results for surface salinity at 14:00 on October 20, 2004. Close agreement between simulated and observed surface salinities was found throughout most of Alamitos Bay. The simulation results show a rapidly evolving salinity plume, making it difficult to exactly match surface salinities that were measured over a period of 2.5 hours. Although minor local freshwater inflows (*e.g.*

drainage from Naples Island) are evident in the measured data but were not included in the model simulations, overall the comparison between measured and simulated data is very good.

Measured and simulated vertical profiles of salinity and temperature are shown in **Figures 2.24** and **2.25** (cast locations are shown **Figure 2.23**). The simulation results show a greater degree of stratification and less mixing in Alamitos Bay than the measured profiles, but, as noted above, surface salinities were reasonably well matched at most locations.

Water temperature and salinity at cast locations 1 and 2 (**Figure 2.24**) were largely controlled by the ocean water. During the October 20 event, flow from the LSGR Channel likely lowered salinities by entering Alamitos Bay at the ocean boundary. For this reason the measured profiles at cast 2 were used as model input during this event, as described in the previous section.

Simulation results at cast locations 4 through 6 (**Figure 2.24**) predict a more pronounced stratification and a less-mixed water column than measured profiles show. The simulation results predict that the storm water was largely confined to the upper meter of the water column at these locations, while measurements suggest that these locations in the main portion of Alamitos Bay had a more vertically mixed profile, with storm water mixed over approximately the upper 4.9 - 6.6 ft (1.5-2 meters) of the water column.

At cast locations 7 through 11 (**Figure 2.25**) salinity measurements and simulation results agree well, with slightly lower mixing predicted by the model at most locations. Although less mixing is predicted by the simulation at most locations, the depth to which the storm water was mixed is usually within 1.6 ft (0.5 meter) of the observations. At cast location 9, closest to where the storm water from Los Cerritos Channel and Bouton Creek enter the domain, simulated profiles of temperature and salinity agree well with observations.

Simulated temperature and salinity are generally in good agreement with measured data, with a few differences in the depth of mixing and degree of stratification between simulated and observed data.

2.4.3.2 2005 Storm Event

The calibrated model was run for calendar year 2005 and the results were compared against field data to verify the ability of the calibrated model to reproduce observed data.

Water salinity and temperature in Alamitos Bay were measured as part of the 2005 storm water monitoring program conducted for the City of Long Beach (Kinnetic

Laboratories Incorporated, 2005 and 2006). These observations included surface salinity observations in Alamitos Bay following the precipitation events in October 2005. Vertical profiles of temperature and salinity were also collected at specific locations in the Bay following these events. Comparison of measured and simulated salinity and temperature provides the verification for the calibrated model.

The October 17-18, 2005 weather event produced approximately 0.5 in (13 mm) of precipitation at the Long Beach mass emission sites reported in Kinnetic Laboratories Incorporated, (2006). Monitoring of the storm water plume in Alamitos Bay occurred between 06:57 and 11:14 on October 18, 2005 (Kinnetic Laboratories Incorporated, 2006). The Los Cerritos Channel was the major source of storm water entering Alamitos Bay and peak flow rates exceeded 273 cfs (7.7 m^3/s) at the Los Cerritos monitoring station.

Figure 2.26 shows the measured surface salinity in Alamitos Bay between 06:57 and 11:14 on October 18, 2005 and the simulation results for surface salinity at 11:00 on October 18, 2005. Close agreement between simulated and observed surface salinities was found throughout most of Alamitos Bay. It should be noted that the simulation results show a rapidly evolving salinity plume, making it difficult to exactly match surface salinities that were measured over a period of 4 hours. Also note that minor local freshwater inflows (*e.g.* drainage from Naples Island) are evident in the measured data but were not included in the model simulations.

Measured and simulated vertical profiles of salinity and temperature are shown in **Figures 2.27-2.29** (cast locations are shown **Figure 2.26**). Simulated temperatures are generally slightly lower (by 1-2 degrees Celsius) than observed temperatures, but simulation results are in good agreement with the measured profiles at most locations.

Water temperature and salinity at cast locations 10 and 13 (**Figure 2.24**) were largely controlled by the ocean water. Simulated temperatures are cooler than observed ocean temperatures at these locations, likely as a result of lower input ocean temperatures.

Cast locations 4 and 5 are closest to the major inflow of freshwater from Los Cerritos Channel. At these locations the simulation does a reasonably good job of capturing the stratification with low salinity freshwater in the upper half meter of the water column. By cast location 3, the simulation agrees very well with the observed salinity profile. The complexity of the measured salinity profile at cast location 8 is not captured. At the other cast locations the simulation is in good agreement with the measured data, but with slightly more mixing in the very top portions of the water column.

Simulated temperature and salinity are generally in good agreement with measured data, with a few differences in the depth of mixing and degree of stratification between simulated and observed data.

2.5 SIMULATION SCENARIOS

As discussed above, ELCOM/CAEDYM modeling was conducted for two flow scenarios to evaluate the potential impact of the proposed project (see **Table 1.1**): (1) Base Case using actual 2005 flow rates for both generating stations, (2) CEQA Normal Minimum Operations using actual 2005 flow rates for AES (**Figure 2.30**) and a constant flow rate of 216,000 GPM (311 MGD) for HnGS (**Figure 2.31**).

2.5.1 Base Case

The Base Case flow scenario used actual 2005 flow rates for both AES and Haynes generating stations. The average flow rates were 422 MGD for AES and 778 MGD for HnGS (see **Table 2.2** and **Figures 2.30** and **2.31**). CAEDYM simulations were conducted with both high and moderate parameter values (see **Section 2.2.1** and **Table 2.3**).

Table 2.2: Average Annual Flow Rates for the Flow Scenarios Simulated for 2005

Scenario Name	Flow Rates (MGD)	
	HnGS	AES
Base Case	778	422
CEQA Normal Minimum Operations	311	422

Table 2.3: CAEDYM Scenarios Modeled for 2005

Flow Scenario	CAEDYM Parameter Values	
Base Case	Moderate	High
CEQA Normal Minimum Operations	Moderate	High

2.5.2 CEQA Normal Minimum Operations

The CEQA Normal Minimum Operations (listed as CEQA Normal Minimum Operations in some figures) flow scenario used actual 2005 flow rates for AES and a constant flow rate of 311 MGD for HnGS (**Table 2.2** and **Figures 2.30** and **2.31**), corresponding to the situation in which two of the four pumps at Units 1 and 2 are operational (at 48,000 GPM each) and three of the four pumps (81-84) are operational (at

40,000 GPM each). All other model inputs for the CEQA Normal Minimum Operations simulation scenario were identical to the Base Case.

CAEDYM biogeochemical modeling was conducted using both moderate and high parameter values (**Table 2.3**).

2.6 SIMULATION RESULTS

ELCOM hydrodynamic simulation results focus on hydrodynamics and water age. Temperature, salinity, and ocean tracer distributions were also modeled. Water age is a measure of the amount of time that a water particle at a certain location (computational cell) has resided in the Bay. For example, the age of ocean water as it enters the Bay is considered to be zero. As this inflowing water travels through the Bay, its water age increases by one day for each day it remains in the Bay. As time passes, water already present in the Bay continues to "age" as it mixes with incoming new water. Therefore, the age of a water "particle" is determined by following its pathline and calculating how many days it takes for the water to travel along this path from the inflow to the outflow location, while taking into account the mixing that occurs within a given computational cell. Water age describes the length of time water particles have spent in the Bay. As an example, if a Bay is filled at time t = 0, and all inflows and outflows are halted, the water age in the Bay would be uniform and increase at the rate of one day per day.

Temperature and salinity distributions were also modeled and daily animations of these parameters for each scenario are included with this report.

CAEDYM biogeochemical simulation results focus on chlorophyll *a* and DO concentrations in the Bay. Nutrient concentrations were also examined at select locations within the model domain. The two sets of CAEDYM model parameters, moderate and high, used for each generating station flow scenario allow for examination of the sensitivity of the model and cover the range of probable outcomes for these flow scenarios (see **Section 2.2.1**). Animations (listed in **Appendix D**) of water age, chlorophyll *a* and DO are included with this report.

Time-series of simulation results are presented at select stations shown in **Figure 2.32**.

2.6.1 Hydrodynamics

The exchange of water between the ocean and the Bay is referred to as flushing and is a fundamental determinant of water quality in the Bay. The average volume drawn by generating stations during one tidal cycle in 2005 is 8.0×10^7 ft^3 (2.27×10^6 m^3), and is slightly larger than the 2005 annual average of the tidal prism 7.8×10^7 ft^3 (2.20×10^6 m^3) (see **Figure 2.33**).

Figure 2.34 shows summer near-surface velocity vectors for the two flow scenarios. In each scenario high flow velocities are predicted in the Los Cerritos Channel and in the channel connecting Alamitos Bay to the ocean (not shown in this figure). Under Base Case conditions (actual flow for both AES and HnGS in 2005), relatively high velocities are seen in the eastern portion of Alamitos Bay. The velocity vectors indicate that the main flow path in this region takes water from the ocean channel toward the HnGS Intake Channel. Under CEQA Normal Minimum Operations,, flow in the eastern region of the Bay is predicted to change more than in other portions of the Bay (**Figure 2.34**).

Figure 2.35 shows the magnitude of summer near-surface net transport vectors for the two flow scenarios. Model simulations demonstrate that net transport within the Bay is affected by the flows drawn by HnGS. CEQA Normal Minimum Operations would have the largest effect on flow in the channel connecting to the ocean and in the southeastern portion of Alamitos Bay. CEQA Normal Minimum Operations is predicted to have little effect on transport in the upper portion of the Marine Stadium. In the western portion of the Marine Stadium and Alamitos Bay, where velocities are low even under Base Case conditions, flow is predicted to drop slightly (decreases of less than 0.1 ft/s are predicted) under CEQA Normal Minimum Operations.

2.6.2 Water Age

Water age is a computed indicator for other water quality parameters. Low water age means that water in an area is frequently replaced with "new" water, bringing with it the water quality properties of the "new" water (generally ocean water in this case, but also freshwater during storm runoff). High water age is indicative of limited flushing, and may correspond to higher bacteria levels (Moffat and Nichol, 2007), lower DO, and higher algae concentrations (see the following sections on DO and chlorophyll *a* concentrations).

Simulation results indicate that there is generally little difference in water age across the depth in the relatively-shallow Alamitos Bay except during storm events, when stratification keeps storm water (with low water age) near the surface. The analyses presented here focus on near-surface water age (*i.e.*, at a fixed elevation of -2.3 ft [-0.7 m] MLLW).

Time series of water age (**Figure 2.36**) for the Base Case scenario show that the lowest water age is found in the channel connecting the Bay and the ocean (Station 1, see **Figure 3.32** for station locations), and the highest water age is found in the upper portion of the Marine Stadium (Station 11). The approximately two-week cycles in water age (see Station 1 in **Figure 2.36**) result from the neap and spring phases of the tidal cycle.

Figure 2.36 shows that only slight rises in near-surface water age are predicted in Los Cerritos Channel and the Marine Stadium under CEQA Normal Minimum

Operations. Larger increases in water age are predicted to occur at Station 9 at the 2nd Street Bridge, due to reduced flushing in this portion of the Bay under CEQA Normal Minimum Operations. CEQA Normal Minimum Operations would cause less water to being drawn both from the ocean channel and through the western portion of Alamitos Bay, leading to higher water age in this area. Annual maximum and average water age at these stations are summarized in **Table 2.4.**

Table 2.4: Predicted Annual Maximum and Average Water Age at Stations in 2005 (see Figure 2.32 for Station Locations)

Stations	Base Case		CEQA Normal Minimum Operations	
	Ave. (days)	Max. (days)	Ave. (days)	Max. (days)
Station 1 (channel connecting ocean)	0.1	4.5	0.2	5.3
Station 4 (Alamitos Bay near the HnGS Intake)	1.0	6.9	1.5	7.6
Station 9 (2nd Street Bridge)	3.3	8.2	4.0	10.3
Station 11 (Marine Stadium)	5.8	8.2	6.3	15.1
Station 12 (Los Cerritos Channel)	3.0	9.5	3.4	10.3

Box plots (see **Figure 2.37** for box plot description) of water age at select stations for the two flow scenarios are shown in **Figure 2.38**. The box plots show that water age is predicted to be higher in the Marine Stadium than the other stations shown, and that CEQA Normal Minimum Operations is predicted to cause increases in water age at each of these stations.

Annual average near-surface water age is shown in **Figure 2.39** for the two flow scenarios. For both flow scenarios, near-surface water age in most of the Bay is predicted to be less than six days throughout the year with small portions of the Marine Stadium and the marinas adjacent to Los Cerritos channel predicted to have water age of up to 8 days (**Figure 2.39**). Maximum water age (**Figure 2.38**) during the summer is predicted to reach between 20 and 22 days in a marina adjacent to Los Cerritos Channel for both flow scenarios.

Figure 2.41 shows the predicted increase in mean annual and annual maximum water age between the Base Case and CEQA Normal Minimum Operations flow scenarios. CEQA Normal Minimum Operations is not predicted to cause large increases in annual average near-surface water age (**less than 1 day**). Changes in the annual maximum near-surface water age are expected under CEQA Normal Minimum Operations, with the largest change (between 3.0 and 3.5 days) in maximum water age predicted to occur south of the 2nd Street Bridge.

Box plots summarizing the predicted mean annual and maximum annual water age are shown in **Figure 2.42**.

2.6.3 Water temperature

Predicted water temperature at select station locations for the Base Case flow scenario with moderate parameter values is shown in **Figure 2.43.** Near-surface water temperature is predicted to be higher during the summer months, and some storm events cause temporary rises in water temperature, especially in the Los Cerritos Channel. **Figure 2.43** also shows that there is little spatial variation in water temperature in Alamitos Bay. **Figure 2.43** shows that little difference is predicted in near-surface temperature for the different flow scenarios.

2.6.4 Nitrate

Nitrate may be an important nutrient because it can influence algal growth. **Figure 2.44** shows near-surface nitrate concentrations for the Base Case scenario with moderate CAEDYM parameter values. Nitrate is at ocean background levels of 0.001-0.027 mg/L throughout much of the year, and peaks in direct response to stormflow events. Peaks in nitrate concentration are highest in the Los Cerritos Channel and decrease toward the ocean channel as freshwater inflows are diluted.

The flow scenario (Base Case versus CEQA Normal Minimum Operations) is predicted to have a small effect on nitrate concentration (see **Figure 2.44**). Small differences in nitrate concentration are predicted in Los Cerritos Channel for the different flow scenarios. Under CEQA Normal Minimum Operations, downstream locations are predicted to have small rises in nitrate concentrations due to changes in flow dynamics and the fact that less water will be removed from the Bay via the HnGS cooling flows. Little difference in nitrate concentrations is predicted between the moderate and high CAEDYM parameters used in the simulations (see **Figure 2.44**).

2.6.5 Phosphorus

Phosphorus is likely an important nutrient as it is integral to algae growth. As with nitrate, orthophosphate is largely controlled by freshwater inflows (**Figure 2.45**). Orthophosphate concentrations are very low except during and after stormflow events. Peaks in orthophosphate concentrate are highest in the Los Cerritos Channel and decrease toward the ocean channel as freshwater inflows are diluted.

The flow scenario is predicted to have a minimal effect on orthophosphate concentrations (**Figure 2.45**), and the differences that are seen follow the pattern predicted for nitrate. Similar to nitrate, predicted orthophosphate concentrations are nearly identical for the range of CAEDYM input parameter values used (moderate or high) (**Figures 2.45**).

2.6.6 Chlorophyll *a*

Time series of predicted chlorophyll *a* concentrations, a surrogate for algae, for the Base Case scenario with moderate CAEDYM parameter values are shown in **Figure 2.46**. In general, chlorophyll *a* concentrations in 2005 are predicted to be highest during the summer months. Chlorophyll *a* concentrations are more uniform in the channel connecting the Ocean than in Alamitos Bay and the Marine Stadium.

Figure 2.47 shows a comparison of predicted chlorophyll *a* concentrations at select locations for the two flow scenarios with moderate model parameter values. Higher peaks in chlorophyll *a* concentrations are expected if CEQA Normal Minimum Operations is implemented, especially during the spring, due to changes in flow dynamics, water age, and nutrient distributions.

High CAEDYM parameter values are predicted to result in slightly higher chlorophyll *a* concentrations for each flow scenario (see **Figure 2.48**). CAEDYM parameter values (high or moderate) have the least effect in the channel connecting the Bay to the Ocean, and the effect of CAEDYM parameter values is predicted to be least during the summer months.

Box plots (see **Figure 2.37** for description of box plots) showing the distribution of predicted chlorophyll *a* concentration at select stations are shown in **Figure 2.49**. Predicted annual average and annual maximum chlorophyll *a* concentrations are summarized in **Table 2.5** for the different simulation scenarios at the five selected stations. Maximum chlorophyll *a* concentrations are predicted to be highest at the upstream end of Alamitos Bay and the Marine Stadium.

Table 2.5: Summary of Predicted Maximum and Average Chlorophyll *a* Near the Surface at Selected Stations as a Function of CAEDYM Parameter Choice

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (µg/L)	Max. (µg/L)	Ave. (µg/L)	Max. (µg/L)
Station 1 (channel connecting ocean)	Moderate	2.7	7.9	2.7	10.1
	High	2.7	8.7	2.7	9.8
Station 4 (Alamitos Bay near the HnGS Intake)	Moderate	2.6	9.4	2.9	13.9
	High	2.6	9.6	3.0	14.1
Station 9 (2nd Street Bridge)	Moderate	2.4	12.4	2.5	12.0
	High	2.6	15.2	2.8	15.9
Station 11 (Marine Stadium)	Moderate	2.4	13.6	2.6	14.6
	High	2.9	21.4	3.1	21.1
Station 12 (Los Cerritos Channel)	Moderate	2.7	9.5	2.9	8.9
	High	2.9	10.8	3.2	11.9

The spatial distribution of predicted chlorophyll *a* concentrations using high CAEDYM parameter values is similar to that predicted when moderate CAEDYM parameters are used (**Figure 2.51**). Base Case chlorophyll *a* concentrations, and increases in chlorophyll *a* concentration with CEQA Normal Minimum Operations (**Figure 2.52**), are predicted to be greater with high CAEDYM parameters than with moderate CAEDYM parameters. **Figure 2.52** shows that the largest increases in maximum near-surface chlorophyll *a* are expected near the HnGS Intake Channel, near Alamitos Bay Beach and south of Naples Island. Modest increases in chlorophyll *a* are expected over much of the remainder of Alamitos Bay.

Figure 2.53 summarizes these results in box plots showing the average annual and maximum annual chlorophyll *a* predicted for Alamitos Bay. Maximum annual chlorophyll *a* values are predicted to be greater than 60 µg/L for all scenarios. However, these high values are expected to occur only at a few locations (as indicated by the much lower 99th percentile values shown as blue horizontal lines on the box plots) and are not predicted to be the norm. **Figure 2.53** shows that increases in the average and maximum annual chlorophyll *a* are predicted to occur with CEQA Normal Minimum Operations, and that the use of high CAEDYM parameters predicted higher chlorophyll *a* values than moderate CAEDYM parameter simulations.

For the high CAEDYM parameters, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 4.1 μg/L for the Base Case and 4.3 μg/L for CEQA Normal Minimum Operations. With moderate CAEDYM parameter values, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 3.4 μg/L for the Base Case and 3.8 μg/L for CEQA Normal Minimum Operations. Although the selected locations in **Table 2.6** do not correspond exactly with the locations with the highest annual average or annual maximum chlorophyll *a* concentrations, the annual highest average chlorophyll *a* concentrations are within a factor of two of the values listed in **Table 2.6**, and the highest annual maximum chlorophyll *a* concentrations are of the same order of magnitude as the results presented in **Table 2.6**.

As can be seen from the time series in **Figures 2.46-2.48**, most peaks in chlorophyll *a* are short-lived (usually single day peaks, sometimes with elevated chlorophyll *a* each day for around a week). Over most of the Bay, increases in annual maximum chlorophyll *a* concentration are predicted to be less than 4 μg/L with CEQA Normal Minimum Operations (see **Figure 2.52**). Under CEQA Normal Minimum Operations, annual maximum chlorophyll *a* concentrations are generally predicted to increase by less than 8 μg/L in the corner of the Bay near the HnGS Intake, with only a few locations predicted to have higher increases in chlorophyll *a* concentrations.

Water quality objectives relevant to Alamitos Bay include the Water Quality Control Plan, Los Angeles Region (Basin Plan) (LARWQCB, 1994, with subsequent amendments) and the California Ocean Plan (SWRCB, 2006). Neither the Basin Plan nor the Ocean Plan specifies objectives for algae or chlorophyll *a*, but the Basin Plan indicates that waters shall be free of coloration and changes in turbidity that cause nuisance or adversely affect beneficial uses. Since both coloration and turbidity can be affected by chlorophyll *a* concentrations (Horne and Goldman, 1994), these objectives are considered in evaluating the simulation results for different CAEDYM scenarios.

Chlorophyll *a* is usually monitored and used as one major component in determining trophic state of lakes, reservoirs and estuaries. Traditionally, most lakes have been placed in one of three trophic categories (*i.e.*, oligotrophic, mesotrophic, or eutrophic). Oligotrophic water bodies are characterized by low nutrient levels, low chlorophyll *a* and high transparency (low turbidity); eutrophic water bodies are rich in nutrients and algae with low transparency (high turbidity); and mesotrophic water bodies fall somewhere in between. Numerous physical, chemical and biological parameters have been used to measure trophic state of water bodies. **Table 2.6** presents some commonly used classifications for chlorophyll *a* (FDEPA, 1996; Taylor, *et al*., 1980). The values presented in **Table 2.6** are generally based on studies of lakes and reservoirs; however, Smith (1998) and Molvaer *et al*., (1997) present values for a marine environment. The values presented by Molvaer are similar to the ranges given by the Carlson Trophic State Index for freshwater water bodies; the values given by Smith are somewhat more conservative than the U.S. EPA, Carlson, or Molvaer values. It should be noted in this table that the ranges of chlorophyll *a* used to define trophic state of the water bodies vary from different sources; however, in general the criteria in **Table 2.6** indicate that oligotrophic water bodies have chlorophyll concentrations less than about 5 µg/L, mesotrophic water bodies have chlorophyll concentrations of about 5-10 µg/L, and eutrophic water bodies have chlorophyll concentrations of more than about 10 µg/L. Predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the ranges that span the trophic state categories.

Table 2.6: Commonly Used Trophic Classification Criteria for Chlorophyll *a*

Trophic State			Comments	Reference
Oligotrophic (µg/L)	Mesotrophic (µg/L)	Eutrophic (µg/L)		
	Annual Average < 10.0	Annual average >10.0	Florida Trophic State Index for Lakes and Estuaries	Florida DEPA (1996)
<2.3	2.3-6.4	>6.4		Hern *et al*., (1981)
0.3-2.5	1.0-15.0	5.0 to 140.0	Nonmacrophyte dominated lakes	Sakamoto (1966)
0.0-4.0	4.0-10.0	>10.0	Nonmacrophyte dominated lakes	National Academy of Science (1972), Allum, Glessner, and Gakstatter (1977), Cited in Rogers (1977)
0.0-4.5	4.3-8.8	>8.8	Nonmacrophyte dominated lakes	Dobson, Gilbertson, and Sly (1974)
<7.0	7.0-12.0	>12.0	Based empirically on data from 98 phosphorus-limited lakes sampled by WES* during 1972)	U.S. EPA (1974)
0.0-3.0	3.0-5.0	>5.0		Ministry (1973), cited in Rogers (1977)
0.0-3.0	3.0-20.0	>20.0		Weber (unpublished)
<2.6	2.6-7.2	>7.2	Carlson Trophic State Index	Carlson (1977)
0.3-3	2-15	>10	Mean chlorophyll *a* for freshwater	Wetzel (2001)
<1	1-3	3-5	Mean chlorophyll *a* for marine systems	Smith (1998)
<2	2-7	>7	Mean chlorophyll *a* for marine systems	Molvaer *et al*., (1997)

2.6.7 Dissolved Oxygen

DO deficiency occurs when heterotrophic organisms (*i.e.*, organisms that depend on organic carbon) feed on organic material that was produced in the surface layer and settled to the bottom. Eventually DO may be depleted and the water conditions may become anoxic (*i.e.*, DO concentrations are 0 mg/L), resulting in a dramatic effect on the chemistry and biology. Since DO is essential to the metabolism of all aerobic organisms, such as fish species, the formation of an anoxic hypolimnion may result in seasonal fish deaths and general biological deterioration. Additionally, anoxic conditions at the sediment-water interface often give rise to the release of nutrients and metal compounds from the sediments and into the water column (Henderson-Sellers, 1984; Mortimer, 1941 and 1942). This phenomenon, known as internal loading, can accentuate eutrophication and the formation of undesirable and unpleasant water characteristics (*e.g.*, tastes, odors and coloration).

Water quality objectives relevant to Alamitos Bay include the Basin Plan (LARWQCB, 1994) and the California Ocean Plan (SWRCB, 2006). The Basin Plan specifies that, for the Outer Harbor area of the Los Angeles-Long Beach Harbors (similar to Alamitos Bay), mean annual DO should be 6 mg/L or greater, and that no single measurement should be less than 5 mg/L. The California Ocean Plan specifies that DO should not be depressed more than 20% from the naturally occurring DO levels.

Time series of predicted bottom DO concentrations for the Base Case flow scenario with moderate CAEDYM parameter values are shown in **Figure 2.54**. DO is generally higher in the summer months, with dips in DO corresponding to large peaks in chlorophyll *a* concentration (see Station 11, **Figures 2.46 and 2.54**). DO concentrations are slightly higher and more uniform in the channel connecting the Bay to the Ocean than in other portions of the Bay.

Figure 2.55 shows a comparison of predicted bottom DO concentrations at selected locations for the two flow scenarios with moderate CAEDYM parameter values. Changes in cooling water flow rate at HnGS are predicted to have a minimal effect on DO concentrations in the Los Cerritos Channel, where AES flows are the main factor controlling flushing. CEQA Normal Minimum Operations is predicted to cause slight reductions in DO in the Marine Stadium and Alamitos Bay. Both flow scenarios using moderate CAEDYM parameter values are predicted to maintain DO above 6.0 mg/L at all locations in the domain throughout the year and are not predicted to result in anaerobic conditions.

Time series of predicted bottom DO concentrations at the selected stations show lower DO concentrations with high parameter values than those with moderate parameter values for both flow scenarios (see **Figure 2.56**). The annual average and annual minimum DO concentrations are summarized in **Table 2.7** for the five selected locations, and box plots showing the distribution of DO concentrations at these sites are shown in **Figure 2.57** (see **Figure 2.37** for box plot description).

Table 2.7: Summary of Predicted Near-Bottom Minimum DO at Selected Stations as a Function of CAEDYM Parameter Choice

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (mg/L)	Min. (mg/L)	Ave. (mg/L)	Min. (mg/L)
Station 1 (channel connecting ocean)	Moderate	9.0	8.1	9.0	8.1
	High	9.0	8.0	9.0	8.0
Station 4 (Alamitos Bay near the HnGS Intake)	Moderate	8.9	7.8	8.8	7.8
	High	8.7	7.5	8.6	7.3
Station 9 (2nd Street Bridge)	Moderate	8.6	7.7	8.5	7.5
	High	8.0	6.5	7.8	5.7
Station 11 (Marine Stadium)	Moderate	8.3	6.8	8.3	6.6
	High	7.5	5.0	7.4	4.2
Station 12 (Los Cerritos Channel)	Moderate	8.5	7.3	8.5	7.2
	High	8.0	6.0	7.9	5.7

Annual average DO concentrations are predicted to be greater than 6 mg/L for all locations in the Bay for both flow scenarios (using both moderate and high CAEDYM parameters). The minimum predicted near-bottom DO at any location in the domain for each of the scenarios simulated is predicted to occur in the marina adjacent to the Los Cerritos Channel. With high CAEDYM parameters, the lowest annual minimum DO anywhere in the Bay is predicted to be 3.1 mg/L for the Base Case and 3.2 mg/L for CEQA Normal Minimum Operations. Although the Base Case is predicted to have the lowest DO value at a single point with high CAEDYM parameter values, in general DO values are predicted to decrease with CEQA Normal Minimum Operations. The lowest values of DO are found only in locations with very restricted flow. The frequency and duration of the lowest DO concentrations observed at any location would be expected to persist for relatively short time periods, on the other of days.

Time periods when DO drops below 5.0 mg/L are likely to become more common with CEQA Normal Minimum Operations, but are not predicted to be frequent or widespread. For example, of the Stations shown in **Figures 2.54-2.65** and in **Table 2.7**, only Station 11 (located in the Marine Stadium, see **Figure 2.32** for stations location) is predicted to have DO concentrations that drop below 5.0 mg/L at any time during the year, and only with high CAEDYM parameters. With high CAEDYM parameters DO is predicted to fall below 5.0 mg/L at Station 11 for one day in June 2005 under both flow scenarios. Under the Base Case flow scenario DO is predicted to drop to just below 5.0 mg/L for a single period of less than six hours, and under CEQA Normal Minimum Operations DO is predicted to drop to as low as 4.2 mg/L at Station 11, and to be below 5.0 mg/L for a single period of less than 12 hours. Results vary spatially, but the DO concentration at most locations is not predicted to ever drop below 5.0 mg/L, even under CEQA Normal Minimum Operations with high CAEDYM parameter values.

The annual minimum near-bottom DO is shown in **Figure 2.58** for both flow scenarios with moderate CAEDYM parameter values. For all flow scenarios, the lowest DO concentrations are predicted to occur in the Marine Stadium and in the marinas adjacent to the Los Cerritos Channel since these areas have restricted flow, high water age, and relatively high chlorophyll *a* concentrations. Minimum DO concentrations are not predicted to be below 6 mg/L at any location in the Bay under moderate CAEDYM parameter simulations. **Figure 2.59** shows that with high CAEDYM parameters, even under Base Case flow conditions, near-bottom annual minimum DO is predicted to be below 4.0 mg/L in the upper portions of the Marine Stadium and marinas adjacent to the Los Cerritos Channel.

The difference in near-bottom DO concentrations between the Base Case and CEQA Normal Minimum Operations flow scenarios simulated with moderate CAEDYM parameter values is shown in **Figure 2.60**. The largest decreases in DO with CEQA Normal Minimum Operations are less than 1.0 mg/L and are predicted to occur north of the 2nd Street Bridge and in the Marine Stadium. **Figure 2.60** shows that with high CAEDYM parameter values, DO is predicted to fall between 0.5 and 1.0 mg/L at some locations to the north and south of 2nd Street Bridge under the CEQA Normal Minimum Operations scenario. The change in hydrodynamics with CEQA Normal Minimum Operations, combined with relatively high water age and chlorophyll *a* concentrations in these regions, results in DO being further reduced in these areas. Box plots comparing the distribution of annual minimum DO concentrations in the Bay are shown in **Figure 2.61**.

These analyses indicate that annual average near-bottom DO concentrations at all locations in the Bay for both scenarios simulated are predicted to be greater than the Basin Plan mean annual DO specification of 6.0 mg/L or greater. Using moderate

CAEDYM parameter values, both flow scenarios are also predicted to maintain minimum DO concentrations above 6.0 mg/L at all locations throughout the year. With high CAEDYM parameter values even the Base Case flow scenario is predicted to produce near-bottom DO concentrations below the single occurrence Basin Plan minimum of 5.0 mg/L at some locations, particularly in the upstream ends of the Marine Stadium, the Los Cerritos Channel, and in the marinas adjacent to Los Cerritos Channel. For the simulated scenarios, DO concentrations are fairly homogenous over depth, so that DO concentrations at the surface of the Bay are similar to bottom concentrations. CEQA Normal Minimum Operations is predicted to cause an increase in the frequency of low DO concentration, but DO is not predicted to go below 3.1 mg/L, thus staying well above 0 mg/L (anoxic conditions) for all scenarios simulated. As a result, undesirable odors or the release of undesirable chemical constituents from channel bottom sediments are not expected to occur as a result of DO depletion. For both flow scenarios, the lowest DO concentrations are predicted to occur in the Marine Stadium and the marinas adjacent to the Los Cerritos Channel since these areas have restricted flow, high water age, and relatively high chlorophyll *a* concentrations. The largest decreases in DO with CEQA Normal Minimum Operations are predicted to be between 0.5 and 1.0 mg/L at locations to the north and south of the 2nd Street Bridge.

2.6.8 Other CAEDYM results

Total organic carbon (TOC, see **Figure 2.62**) and biological oxygen demand (BOD, see **Figure 2.63**) are predicted to follow patterns similar to nitrate and orthophosphate (peaking in response to storm events), and are not predicted to vary appreciably either with changes in flow scenario, or with changes in CAEDYM parameter values. pH (**Figure 2.64**) is predicted to be nearly constant throughout the year, and is not predicted to be influenced by storm water inflows in the way that nutrient concentrations are. Neither changes in CAEDYM parameter values nor flow scenario are predicted to have any significant effect on pH in Alamitos Bay.

2.7 CONCLUSIONS

Three-dimensional computational fluid dynamics modeling (ELCOM modeling) was performed for two cooling water flow conditions at HnGS (Base Case and CEQA Normal Minimum Operations) in order to identify possible changes in circulation and water quality within Alamitos Bay. ELCOM was coupled with the biogeochemical model CAEDYM to evaluate temperature, salinity, hydrodynamics, water age, DO, nutrient concentrations, and chlorophyll *a*. The Alamitos Bay ELCOM model was verified as being able to reproduce the observed data in 2005, but available data were too limited to allow full calibration of the biogeochemical CAEDYM model for Alamitos Bay. Instead, an extensive literature review representing a wide range of geographic locations was used as a guide for determining the range of model parameter values used to define the moderate and high CAEDYM conditions. Simulations were conducted for one calendar year, 2005, in order to study the seasonal pattern of stratification and algal growth in the Bay.

This chapter has emphasized three key water quality parameters in Alamitos Bay: water age, chlorophyll *a*, and DO. Water age is important because it is an indicator of other water quality parameters. High water age can be related to lower DO concentrations, higher bacterial counts, and higher chlorophyll *a* concentrations. Chlorophyll *a* is used as a surrogate for algae and is an indicator of trophic state. High chlorophyll *a* concentrations can be related to increased turbidity and color, and reduced transparency. DO concentrations are of interest with respect to the standards set forth in the Water Quality Control Plan (Basin Plan) for the Los Angeles Region (LARWQCB, 1994, plus amendments).

The main results of the ELCOM and CAEDYM simulations for the two flow scenarios considered are:

- The lowest water age is found in the channel connecting the Bay and the ocean, and the highest water age is found in the upper portion of the Marine Stadium. CEQA Normal Minimum Operations flow rates result in less water being pulled both from the ocean and through the main portion of Alamitos Bay, but only slight rises in near-surface water age are predicted in Los Cerritos Channel and the Marine Stadium under CEQA Normal Minimum Operations relative to the Base Case. For both flow scenarios, near-surface annual average water age in most of the Bay is predicted to be less than six days throughout the year, with small portions of the Marine Stadium and the marinas adjacent to Los Cerritos channel predicted to have water age of up to 8 days. Maximum water age during the summer is predicted to reach between 20 and 22 days in a marina adjacent to Los Cerritos Channel for both flow scenarios. The CEQA Normal Minimum Operations scenario is predicted to cause increases in annual average near-surface water age of less than 1 day. Increases in the annual maximum near-surface water age are expected with CEQA Normal Minimum Operations, with the largest change in maximum water age (between 3.0 and 3.5 days) predicted to occur south of the 2nd Street Bridge.

- Peaks in nutrient concentrations in the Bay occur as a result of storm water inflows. Since the proposed CEQA Normal Minimum Operations scenario will not affect storm water inflows, nutrient concentrations are predicted to be nearly identical for all simulation scenarios. Thus, changes in chlorophyll *a* and DO are more directly related to season and changes in water age and are largely unaffected by the CEQA Normal Minimum Operations.

- Chlorophyll *a* concentrations are predicted to be highest during the summer months for all modeled scenarios. Maximum annual chlorophyll *a* concentrations are predicted to be highest at the upstream end of Alamitos Bay, where water age is greatest. Most peaks in chlorophyll *a* are short-lived. Higher peaks in chlorophyll *a* concentrations are predicted for CEQA Normal Minimum Operations, especially during the spring. For the high CAEDYM parameters considered, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 4.1 μg/L for the Base Case and 4.3 μg/L for CEQA Normal Minimum Operations. With moderate CAEDYM parameter values, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 3.4 μg/L for the Base Case and 3.8 μg/L for Normal CEQA Normal Minimum Operations. The highest annual maximum chlorophyll *a* concentrations at any location within the Bay are predicted to be greater than 60 μg/L for all scenarios, but these high values are expected to occur only at a few locations and are atypical. Over most of the Bay, increases in annual maximum chlorophyll *a* concentration are predicted to be less than 4 μg/L under CEQA Normal Minimum Operations. Under CEQA Normal Minimum Operations, annual maximum chlorophyll *a* concentrations are generally predicted to increase by less than 8 μg/L in the corner of the Bay near the HnGS Intake, with only a few locations predicted to have higher increases in chlorophyll *a* concentrations. In general, CEQA Normal Minimum Operations results in an increase in chlorophyll *a* (algae) concentrations in Alamitos Bay, but predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the average annual values, and smaller than the ranges that span the trophic state categories.

- DO is generally predicted to be higher in the summer months, with dips in DO corresponding to large peaks in chlorophyll *a* concentration. DO concentrations are slightly higher and more uniform in the channel connecting the Bay to the Ocean than in other portions of the Bay. In general, DO concentrations are predicted to be slightly lower under CEQA Normal Minimum Operations than under the Base Case scenario. Annual average near-bottom DO concentrations at all locations in the Bay for all scenarios simulated are predicted to be greater than the Basin Plan mean annual DO specification of 6.0 mg/L. Using moderate CAEDYM parameter values, both flow scenarios are also predicted to maintain annual minimum DO concentrations above 6.0 mg/L at all locations throughout the year. With high CAEDYM parameter values, the Base Case flow scenario is predicted to produce near-bottom DO concentrations below the single occurrence Basin Plan minimum of 5.0 mg/L at some locations, particularly in the upstream ends of the Marine Stadium, and the Los Cerritos Channel, and in the marinas adjacent to Los Cerritos Channel. Low DO concentrations would be expected to occur infrequently anywhere in the domain, with total annual duration below 5.0 mg/L on the order of days. CEQA Normal Minimum Operations is predicted to cause an increase in the frequency of low DO concentration, but DO is not predicted to fall below 3.1 mg/L, thus staying well above 0 mg/L (anoxic conditions) under any of the scenarios simulated. As a result, undesirable odors or the release of undesirable chemical constituents from channel bottom sediments are not expected to occur as a result of DO depletion. For both flow scenarios, the lowest DO concentrations are predicted to occur in the Marine Stadium and the marinas adjacent to the Los Cerritos Channel since these areas have restricted flow, high water age, and relatively high chlorophyll *a* concentrations. The largest decreases in DO with CEQA Normal Minimum Operations flows are predicted to be between 0.5 and 1.0 mg/L at locations to the north and south of the 2nd Street Bridge.

3.0 INTAKE CHANNEL

3.1 INTRODUCTION

Cooling water for Haynes Generating Station (HnGS) is withdrawn from the east side of Alamitos Bay, and these withdrawals affect circulation and water quality within the Bay. HnGS cooling water flows from the Bay and enters the HnGS Intake Channel via an inverted siphon beneath the Lower San Gabriel River Flood Control Channel (LSGR Channel). They are then conveyed to HnGS and subsequently discharged to the LSGR Channel (**Figures 1.2 and 3.1**).

LADWP requested that Flow Science perform ELCOM/CAEDYM three-dimensional modeling to evaluate the water quality changes in the HnGS Intake Channel that would be associated with CEQA Normal Minimum Operations. Specifically, LADWP requested an evaluation of the flow through the Intake Channel as well as the residence time and water quality changes related to operating the cooling water intakes for HnGS under current operating conditions (*i.e.*, Base Case) and for CEQA Normal Minimum Operations (**Table 1.1**).

3.2 MODELING APPROACH

As described in **Chapter 2**, Flow Science analyzed the hydrodynamics and mixing within the Bay for HnGS and AES Base Case and CEQA Normal Minimum Operations scenarios. LADWP also requested that Flow Science extend the Bay model to include the Intake Channel to the HnGS. Since the numerical grid used for the Bay model (100 ft x 100 ft horizontally) will not resolve the geometry of the narrow Intake Channel, a finer grid model for the Intake Channel was developed.

Flow Science used the same ELCOM/CAEDYM modeling approach and model parameter values for the Intake Channel as previously described for Alamitos Bay. ELCOM was used to predict temperature, salinity, and water age in the Intake Channel, while CAEDYM was used to predict chlorophyll *a*, nutrient, DO, and pH concentrations. The water quality at the siphon inflow boundary (*i.e.*, the inflow from the Bay into the Intake Channel) was determined from the results of ELCOM/CAEDYM simulations performed for Alamitos Bay for Year 2005 (see **Chapter 2**).

Validation of the Alamitos Bay model was completed as documented in **Chapter 2**. Thus the Bay model, which was used to generate inflow water quality boundary conditions for the Intake Channel modeling, was verified as being able to reproduce the observed data in 2005.

3.3 MODEL SET-UP

The input data to the ELCOM model included meteorological, tidal, temperature, salinity, bathymetry, and HnGS intake flow data. The CAEDYM input data included water pH, DO, nutrients, and chlorophyll *a* concentrations. Both simulations were conducted using calendar year 2005 data unless otherwise noted.

3.3.1 Computational Domain and Grid

The current model consists entirely of the Intake Channel and extends from the downstream end of the channel, where the HnGS cooling water intakes are located, to the end of the channel where the siphon intake structure is located (**Figure 3.2**). The Intake Channel is approximately 6,600 ft (2,000 m) long, 100 ft (30 m) wide, and has a mean bottom elevation of -12 ft (-3.67 m) MLLW.

Bathymetry data for the Intake Channel were collected by Fugro West in 2008 and provided to Flow Science. The raw data consisted of 67 cross-sections spaced approximately every 100 ft (30 m) along the channel. Data points within a cross-section were typically around 2 ft (1.3-3.3 ft), or 0.6 m (about 0.4-1.0 m), apart. **Figure 3.3** shows a typical cross-section of the Intake Channel near its southern end based on the original trapezoidal design; the bottom elevation is given as -16.3 ft (-4.98 m) MLLW. **Figure 3.4** shows the locations of the 67 cross-sections collected by Fugro West in 2008. Selected cross-sections along the channel are plotted in **Figure 3.5** in comparison to the bottom elevation noted in **Figure 3.3** (-16.3 ft or -4.98 m MLLW). The shapes of the cross-sections surveyed by Fugro West indicate that sedimentation may have occurred and may have altered the channel geometry as compared to its original trapezoidal design.

The survey cross-sections were used to create a representation of the channel that was discretized to create a grid with uniform cell sizes. The resulting grid has a horizontal cell size of 65 ft (20 m) in the longitudinal direction and 13.1 ft (4 m) in the transverse direction. The resulting grid contours closely match the contours provided by Fugro. A constant grid size of 3.3 ft (1 m) was used in the vertical direction (**Figure 3.6**).

3.3.2 Modeling Period

Simulations were conducted to study the seasonal water quality patterns in the Intake Channel for calendar year 2005 conditions. The simulations used calendar year 2005 data as representative of existing HnGS operations.

3.3.3 Meteorological Data

The meteorological data used for the Intake Channel simulations are identical to the data used in the Alamitos Bay model as described in **Section 2.3.3.1**.

3.3.4 Boundary Conditions

The Intake Channel domain includes two flow boundaries: the HnGS cooling water intakes and the Intake Channel siphon connected to Alamitos Bay. Details on the data inputs for each of these boundary conditions are described below.

3.3.4.1 HnGS Cooling Water Intake

The HnGS cooling water intake boundary consists of six pump intakes located at the northern end of the Intake Channel (**Figure 3.6**). This is an outflow boundary condition that requires model input data that describe the cooling water outflow rate as a function of time. The flow rates plotted in **Figure 3.7** were used to define the HnGS cooling water intake flow boundary values at the pumps.

3.3.4.2 Siphon Inflows from Alamitos Bay

Flow between Alamitos Bay and the Intake Channel occurs via the HnGS intake structure (**Figure 3.1**). The intake structure consists of seven inverted siphons (**Figure 3.8**). The intake openings in the Long Beach Marina area of Alamitos Bay are located between elevations -2.0 and -9.5 ft MLLW (-6.6 and -31.2 m MLLW). The siphons enter the Intake Channel at its southern end (**Figure 3.6**). The siphons are large enough that they do not restrict the amount of water passing through (that is, the water level upstream and downstream of the siphons is expected to be nearly identical). This is an open boundary condition that requires model input data that describe the tidal elevation and the water quality values (*e.g.*, temperature, salinity, nutrients) as a function of time.

The tidal elevation data were the same as the ocean tidal elevation data used for the Alamitos Bay ocean boundary condition (see **Section 2.3.3.2**). The flow through the siphons was computed by the model based upon the flow rate needed to maintain the tidal elevations in the Intake Channel. For the Base Case and CEQA Normal Minimum Operations scenarios, simulation results indicated that the HnGS flow rates were sufficient to maintain a net flow from Alamitos Bay into the Intake Channel throughout the simulation period despite periodic ebbing tides.

The water quality time series data (*i.e.*, temperature, salinity, water age, DO, nutrient, and chlorophyll data) for the siphon inflows were computed every six hours as depth-averaged values of the water quality data predicted in the Alamitos Bay model at the model grid cells corresponding to the location of the siphon intake openings.

3.4 SIMULATION SCENARIOS

Two HnGS cooling water intake flow scenarios were simulated to support this CEQA analysis: Base Case and CEQA Normal Minimum Operations (**Table 2.2**). In the Base Case scenario, HnGS is operated at 100% of actual Year 2005 flows. The annual average flow rate for the Base Case scenario is 778 MGD. Under CEQA Normal Minimum Operations, HnGS is simulated at a constant flow rate of 216,000 GPM (311 MGD) for the entire year; this is equivalent to approximately 40% of the Base Case annual average flow rate. **Figure 3.7** is a comparison plot of the simulated HnGS cooling water intake flow rate for each flow scenario. In all cases, AES was operated at 100% of actual year 2005 flows; this is equivalent to an average annual flow rate of 422 MGD. Aside from the HnGS flow rates, all other model inputs for the CEQA Normal Minimum Operations simulation scenario are identical to the Base Case.

For each flow scenario, a CAEDYM evaluation was performed for both "moderate" and "high" CAEDYM parameter values as previously described for the Alamitos Bay model (see **Section 2.2.1** for a more detailed description of the CAEDYM methodology and model parameters). Thus, a total of four simulations were performed for the Intake Channel (**Table 2.3**).

3.5 SIMULATION RESULTS

The results of the four model simulations (two flow scenarios for each of two CAEDYM parameter values) are presented below. In a similar fashion to the Alamitos Bay model, the discussion focuses on three key water quality parameters in the Intake Channel: water age, chlorophyll *a*, and DO (see **Section 2.6**).

3.5.1 Hydrodynamics

The theoretical average residence time of water in the Intake Channel is 0.1 days (2.4 hrs) for the Base Case and 0.25 days (6.0 hrs) for CEQA Normal Minimum Operations. The theoretical average residence time was computed based on the average volume of water in the Intake Channel and the average HnGS cooling water flow rate. It represents the average amount of time that water spends in the Intake Channel. Due to the generally high flow rates through the Intake Channel for each scenario, the average residence times are less than one day and the Intake Channel is generally well-mixed over depth and across the width of the channel. These high HnGS flow rates and low average residence times also have the effect of limiting the variations in water quality along the length of the channel.

3.5.2 Water Age

For the Intake Channel analysis, water age is a measure of the cumulative amount of time that water at a certain location (computational cell) has resided in the Bay *and* Intake Channel. Thus, water age in the Intake Channel behaves similarly to water age in the Bay, except unlike the age of ocean water as it enters the Bay, the water age of the flow from Alamitos Bay into the Intake Channel via the siphons is not zero. Rather, it is the water age computed by the Alamitos Bay model. Therefore, the age of a water "particle" is determined by following its pathline and calculating the number of days it takes for the water to travel along a path between the entrance of the Bay and the HnGS cooling water pumps, while taking into account the mixing that occurs within a given computational cell.

The analyses presented here focus on near-surface water age (*i.e.*, at a fixed elevation of 0 ft or 0 m MLLW). Simulation results indicate that there is generally little difference in water age over the depth of the shallow Intake Channel except due to occasional storm events. As described in more detail later, storm events can cause a spike in water age and a reduction in salinity of the surface water in Alamitos Bay because "old" water from upstream areas (*e.g.*, the Los Cerritos Channel or the Marine Stadium) is pushed downstream by freshwater storm inflows. The transport and mixing of the "old" water and the "new" freshwater storm flows is complex and can lead to a situation where the water passing through the intake to the siphons is both lower in salinity and higher in water age than the water typically in the Intake Channel; see discussion of **Figure 3.12** below. At these times, the salinity of the inflow to the Intake Channel drops and the water age increases.

A summary of the maximum and annual average water age for each flow scenario is included in **Table 3.1** at three selected locations in the model domain and in the inflow to the Intake Channel from Alamitos Bay (*i.e.*, at the entrance to the siphons within Alamitos Bay). The three stations were selected at approximately equidistant locations along the length of the Intake Channel: at the downstream end near the HnGS intakes (Station 1), at the mid-point of the channel (Station 2), and at the upstream end near the entrance to the channel (Station 3). The locations of the selected stations are indicated in **Figure 3.2**. The annual average water age in the entire domain is 1.1 days for the Base Case and 1.7 days for CEQA Normal Minimum Operations. The maximum water age values predicted anywhere in the domain are 6.9 days for the Base Case and 7.3 days for CEQA Normal Minimum Operations. Thus, the values given in **Table 3.1** are representative of the annual average and maximum values measured throughout the domain for 2005. These values are provided as a reference for the following discussion on the results of the modeled water age. For each flow scenario, the water age is independent of whether the high or moderate CAEDYM parameter values were used.

Table 3.1: Predicted Maximum and Annual Average Water Age (days) For Scenarios

Stations	Base Case		CEQA Normal Minimum Operations	
	Ave. (days)	Max. (days)	Ave. (days)	Max. (days)
Station 1 (HnGS Intakes)	1.2	4.4	1.9	7.1
Station 2 (middle of the channel)	1.1	6.1	1.7	6.5
Station 3 (entrance to the channel)	1.1	6.9	1.6	7.3
Inflow from the Bay (entrance to siphons in Bay)	1.1	6.9	1.6	7.3

Figure 3.9 is a box plot (see **Figure 2.37** for a description of the box plots) of the water age distribution at the three selected locations in the Intake Channel (Station 1, Station 2, and Station 3) for each of the Base Case and CEQA Normal Minimum Operations scenarios. As shown, water age increases with distance from the channel entrance (Station 3) to the HnGS Intakes (Station 1). **Figure 3.10** presents box plots that compare the annual average water age and maximum water age between the two scenarios for all locations within the Intake Channel domain. As shown, the 25th percentile, median, 75th percentile, and maximum water age are generally higher for CEQA Normal Minimum Operations than for the Base Case. The annual average water age is predicted to increase from 1.1 days for the Base Case to 1.7 days for CEQA Normal Minimum Operations, while the maximum water age is predicted to increase from 6.9 days to 7.3 days.

The theoretical average residence times discussed in the previous section (**Section 3.5.1**) are significantly lower than the simulated water age values in **Table 3.1**, since water age in the Intake Channel is predominantly controlled by the water age of the inflow from Alamitos Bay. As previously described, the water age of siphon flows into the Intake Channel is not zero; it is equal to the depth-averaged water age predicted by ELCOM in the Alamitos Bay model at the grid cells located adjacent to the siphon intake openings. Therefore, water age in the Intake Channel is generally higher than the average residence time and always higher than the actual residence time.

Figure 3.11 includes computed contour plots of the annual average water age near the surface (*i.e.*, at a fixed elevation of 0 ft or 0 m MLLW) of the Intake Channel for each scenario.

Contour plots of the computed maximum water age near the surface of the Intake Channel are included in **Figure 3.12**. The highest predicted annual maximum water age at Station 3 is 7.3 days for the CEQA Normal Minimum Operations scenario. Similar to the annual average water age, the maximum water age increases as the HnGS cooling water flow rate decreases. However, the maximum water age results require some explanation, since the annual maximum water age as plotted for the Base Case decreases towards the northern end of the channel. The highest water ages of the inflows from Alamitos Bay via the siphon are related to large rainfall events in January, February, and March 2005. Storm events cause a spike in water age and a reduction in salinity of the surface waters in Alamitos Bay because "old" water from upstream areas (*e.g.*, the Los Cerritos Channel or Marina Stadium) is flushed downstream by freshwater storm inflows. As mentioned previously, the transport and mixing of the "old" water and the "new" freshwater storm flows is complex and can lead to a situation where the water passing through the intake to the siphons is both lower in salinity and higher in water age than the water typically found in the Intake Channel during dry weather conditions. During these times the inflows from the siphons are less dense, and density stratification develops in the Intake Channel with the lower density (higher water age) water occurring near the surface in the southern end of the channel. As the water in the Intake Channel moves northward towards the HnGS pump intakes, the higher water age (lower density) surface water mixes with the more typical water age (higher density) water that has previously entered the Intake Channel. This phenomenon is most pronounced for the Base Case scenario because of the high inflow volumes entering the Intake Channel at reduced salinity and elevated water age due to the spring rainfall events. The enclosed animations of water age for the Base Case and CEQA Normal Minimum Operations scenarios from March 17-26, 2005, further demonstrate that this phenomenon is related to storm water inflows from rainfall events.

Figure 3.13 is a plot of the predicted water age for each of the flow scenarios at three selected locations along the Intake Channel (Station 1, Station 2, and Station 3) and in the Intake Channel inflow from Alamitos Bay. Note the elevated water age in March for each flow scenario that is due to a large rainfall event that has increased the water age of the incoming inflow from Alamitos Bay.

3.5.3 Water Temperature

Predicted near-surface water temperatures at select station locations are shown in **Figure 3.14** for the Base Case and CEQA Normal Minimum Operations flow scenarios. The temperature is generally uniform over depth due to the well-mixed nature of the channel. Water temperature is predicted to be higher during the summer months. **Figure 3.14** also shows that there is little spatial variation in water temperature along the length of the Intake Channel or between the two scenarios evaluated. For example, the median difference in predicted temperatures between the Base Case and CEQA Normal Minimum Operations is 0.15 ºC at Stations 1, 2, and 3.

3.5.4 Nitrate

Figure 3.15 shows near-surface nitrate concentrations for the Base Case and CEQA Normal Minimum Operations scenarios with high CAEDYM parameter values. **Figure 3.16** shows the corresponding results with moderate CAEDYM parameter values. Nitrate in the siphon inflow is at ocean background levels of 0.001-0.027 mg/L throughout much of the year and peaks in direct response to stormflow events in Alamitos Bay.

Figures 3.15 and **3.16** show that there is little spatial variation in nitrate concentrations along the length of the Intake Channel, and concentrations are generally uniform over depth. Minimal differences in nitrate concentrations are predicted between the moderate and high CAEDYM parameters used in the simulations. The decrease in HnGS flow between the Base Case and CEQA Normal Minimum Operations scenario is also predicted to have a minimal effect on nitrate concentrations. For example, the medianaverage difference in predicted nitrate concentrations between the Base Case and CEQA Normal Minimum Operations is 0.0003 mg/L at Stations 1, 2, and 3.

3.5.5 Phosphorus

Figures 3.17 and **3.18** show that there is little spatial variation in orthophosphate concentrations along the length of the Intake Channel. Similar to nitrate, predicted orthophosphate concentrations are generally uniform over depth and nearly identical for the range of CAEDYM input parameter values used (moderate or high). The decrease in HnGS flow between the Base Case and CEQA Normal Minimum Operations scenario is also predicted to have a minimal effect on orthophosphate concentrations. For example, the medianaverage difference in predicted orthophosphate concentrations between the Base Case and CEQA Normal Minimum Operations is 0.0004 mg/L at Stations 1, 2, and 3.

3.5.6 Chlorophyll *a*

Tables 3.2 summarizes the predicted annual average and annual maximum chlorophyll *a* concentrations for each of the two flow scenarios for both the moderate and high CAEDYM parameters, respectively, at Stations 1, 2, 3, and in the Intake Channel inflow from Alamitos Bay. The maximum chlorophyll *a* values predicted anywhere in the domain (presented as a range for the moderate and high CAEDYM parameters) increase from 9.0-9.1 µg/L for the Base Case to 11.7-11.8 µg/L for CEQA Normal Minimum Operations. Thus, the values given in **Tables 3.2** are representative of the maximum values predicted throughout the domain. For each scenario, the annual average predicted chlorophyll *a* concentrations differ by about 0.2 µg/L regardless of whether the moderate or high CAEDYM parameters are used. The differences in the maximum predicted chlorophyll *a* concentrations for each case using the moderate or high

CAEDYM parameters are of similar magnitude. This is a result of the average residence time for the two flow scenarios being only on the order of 2.4-6.0 hours. The predicted annual average and maximum chlorophyll *a* concentrations increase with decreasing HnGS cooling water flows.

Table 3.2: Predicted Annual Maximum and Annual Average Chlorophyll *a* Concentrations (at 0 ft or 0 m MLLW) as a Function of CAEDYM Parameter Choice

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (µg/L)	Max. (µg/L)	Ave. (µg/L)	Max. (µg/L)
Station 1 (HnGS Intakes)	Moderate	2.8	7.8	3.2	9.5
	High	2.9	7.8	3.4	9.4
Station 2 (middle of the channel)	Moderate	2.9	8.8	3.3	9.5
	High	2.9	8.7	3.4	9.4
Station 3 (entrance to the channel)	Moderate	2.8	9.0	3.2	11.7
	High	2.9	9.0	3.3	11.8
Inflow from the Bay (entrance to siphons in Bay)	Moderate	2.9	9.0	3.2	11.7
	High	2.9	9.0	3.3	11.8

Figure 3.19 is a box plot of the chlorophyll *a* distribution at the three selected locations in the Intake Channel (Station 1, Station 2, and Station 3) for the Base Case and CEQA Normal Minimum Operations scenarios. **Figure 3.20** presents box plots that compare the average annual chlorophyll *a* concentrations and maximum annual chlorophyll *a* concentrations between the two scenarios for all locations within the Intake Channel domain. As shown, the 25th percentile, median, 75th percentile, and 99th percentile chlorophyll *a* concentrations are higher for CEQA Normal Minimum Operations than for the Base Case. The mean annual average chlorophyll *a* concentration is predicted to increase from 2.8-2.9 µg/L for the Base Case to 3.2-3.3 µg/L for CEQA Normal Minimum Operations for the range of CAEDYM parameter values used. The annual average chlorophyll *a* concentration is not predicted to exceed 3.5 µg/L in any cell of the model domain for either scenario.

Contour plots of the annual average chlorophyll *a* concentrations near the surface of the Intake Channel for each flow condition are included in **Figures 3.21** and **3.22** for the moderate and high CAEDYM parameter simulations, respectively. Concentrations are generally uniform along the length of the Intake Channel and over depth.

Figures 3.23 and **3.24** include contour plots of the annual average and maximum chlorophyll *a* concentrations, respectively, near the surface of the Intake Channel for the CEQA Normal Minimum Operations scenario for the moderate and high CAEDYM parameters. The highest annual average values and the highest maximum values occur between Station 2 and Station 3.

The enclosed animations (**Appendix D**) of chlorophyll *a* distributions show concentrations near the surface (*i.e.*, at a fixed elevation of 0 ft or 0 m MLLW) at six-hour intervals for each of the two flow scenarios with high CAEDYM parameters from July 1-31 and November 1 - December 31. Diurnal variation in chlorophyll *a* concentrations is apparent for all scenarios; chlorophyll *a* concentrations peak in the afternoon when the growth rate exceeds the mortality rate and drop to a minimum overnight when a lack of sunlight prevents any growth to offset the mortality rate.

As shown in **Figure 3.25**, the maximum chlorophyll *a* (*i.e.,* algae) values for the Base Case and CEQA Normal Minimum Operations scenarios occur during the summer when growth is at a maximum. The chlorophyll *a* concentrations do not vary greatly along the length of the Intake Channel or over depth for either the Base Case or CEQA Normal Minimum Operations scenarios.

For the range of CAEDYM parameters considered, the highest annual average chlorophyll *a* concentrations throughout the domain are predicted to be 2.9 μg/L for the Base Case and 3.4-3.5 μg/L for CEQA Normal Minimum Operations. The highest annual maximum chlorophyll *a* concentrations are predicted to be 9.0-9.1 μg/L for the Base Case and 11.7-11.8 μg/L for CEQA Normal Minimum Operations.

As previously discussed in **Section 2.6.6**, water quality objectives relevant to the Intake Channel can be found in the Water Quality Control Plan (Basin Plan) for the Los Angeles Region (LARWQCB, 1994, plus amendments) and the California Ocean Plan (COP, 2006). These objectives were considered in evaluating the simulation results for different CAEDYM scenarios.

Table 2.6 presented some commonly used criteria for chlorophyll *a* (FDEPA, 1996; Taylor, *et al.,* 1980). It was previously noted that the ranges of chlorophyll *a* provided in the table to define trophic state of the water bodies vary from different sources. To summarize, the criteria in **Table 2.6** indicate that oligotrophic water bodies have chlorophyll concentrations less than about 5 μg/L, mesotrophic water bodies have chlorophyll concentrations of about 5-10 μg/L, and eutrophic water bodies have chlorophyll concentrations more than about 10 μg/L. Thus, the predicted increases in chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the average annual and maximum predicted values and smaller than the ranges that span the trophic state categories.

3.5.7 Dissolved Oxygen

As discussed previously, DO concentrations are important because DO deficiency can have a dramatic effect on water chemistry and biology. Anaerobic conditions change the chemical equilibrium of nutrients and trace elements to a state that is unfavorable for water quality and result in general biological deterioration. The result is a significant increase in the concentrations of ammonia, phosphate, hydrogen sulfide, iron, manganese and other compounds. Anaerobic conditions also give rise to the release of nutrients and metal compounds from the sediments and into the water column (Henderson-Sellers, 1984; Mortimer 1941 and 1942). These are among the reasons that the simulated DO concentrations within the Intake Channel are important.

Table 3.3 summarizes the predicted annual average and annual minimum DO concentrations at the channel bottom for each of the two flow scenarios for both the moderate and high CAEDYM parameters, respectively, at Stations 1, 2, 3, and in the Intake Channel inflow from Alamitos Bay. The minimum DO concentrations predicted anywhere in the domain (presented as a range for the moderate and high CAEDYM parameters) decrease from 7.4-7.9 mg/L for the Base Case to 7.3-7.8 mg/L for CEQA Normal Minimum Operations. Thus, the values given in **Table 3.3** are representative of the minimum values measured anywhere in the domain. For each scenario, the average annual predicted DO concentrations differ by about 0.1-0.3 mg/L regardless of whether the moderate or high CAEDYM parameters are used. The differences in the minimum predicted DO concentrations for each case using the moderate or high CAEDYM parameters are 0.2-0.6 mg/L. The differences are small because the Intake Channel is fairly shallow and the average residence time for the two flow scenarios is only on the order of 2.4-6.0 hours. The predicted annual average and annual minimum DO concentrations decrease with decreasing HnGS cooling water flows.

Figure 3.26 is a box plot of the DO distribution at the three selected locations in the Intake Channel (Station 1, Station 2, and Station 3) for each of the Base Case and CEQA Normal Minimum Operations scenarios. As shown, there is little variation in DO concentrations along the length of the Intake Channel. **Figure 3.27** presents box plots that compare the average annual DO concentrations and minimum DO concentrations between the two scenarios for all locations within the Intake Channel domain. As shown, the minimum, 25th percentile, median, and 75th percentile DO concentrations are lower for CEQA Normal Minimum Operations than for the Base Case. However, the lowest annual minimum DO concentration in any cell of the model domain for either scenario is predicted to be 7.3 mg/L.

Table 3.3: Predicted Annual Minimum and Annual Average DO Concentrations (at 0 ft or 0 m MLLW) as a Function of CAEDYM Parameter Choice

Stations		Base Case		CEQA Normal Minimum Operations	
		Ave. (mg/L)	Min. (mg/L)	Ave. (mg/L)	Min. (mg/L)
Station 1 (HnGS Intakes)	Moderate	8.8	7.9	8.7	7.8
	High	8.7	7.7	8.4	7.5
Station 2 (middle of the channel)	Moderate	8.9	7.9	8.8	7.9
	High	8.7	7.5	8.5	7.6
Station 3 (entrance to the channel)	Moderate	8.9	7.9	8.8	7.9
	High	8.7	7.4	8.6	7.3
Inflow from the Bay (entrance to siphons in Bay)	Moderate	8.9	7.9	8.8	7.9
	High	8.7	7.4	8.6	7.3

Contour plots of the annual average DO concentrations at the bottom of the Intake Channel for each flow scenario are included in **Figures 3.28** and **3.29** for the moderate and high CAEDYM parameter simulations, respectively. The largest decrease in annual average DO concentrations at the bottom due to the CAEDYM parameter values is about 0.3 mg/L for the CEQA Normal Minimum Operations scenario. (The change in color for the Base Case contour is somewhat misleading, since the DO concentrations are only dropping by about 0.2-0.3 mg/L, yet the color of the contour changes from light orange to yellow).

Figure 3.30 includes contour plots of the annual minimum DO concentrations at the bottom of the Intake Channel for each flow scenario for the high CAEDYM parameter values. The annual minimum DO concentrations decrease with decreasing HnGS cooling water flow rate. The DO animations (**Appendix D**) show concentrations at the channel bottom at six-hour intervals for each of the two flow scenarios with high CAEDYM parameters from July 1-31 and November 1-December 31.

Time series plots comparing the bottom DO concentrations for each flow scenario at each of Station 1, Station 2, and Station 3 and the siphon inflow from Alamitos Bay are included in **Figures 3.31** and **3.32** for the moderate and high CAEDYM parameter values, respectively. The DO concentrations do not vary greatly along the length of the Intake Channel or over depth for either the Base Case or CEQA Normal Minimum Operations Scenarios.

As previously stated in Chapter 2, the Basin Plan specifies that, for the Outer Harbor area of the Los Angeles-Long Beach Harbors (similar to Alamitos Bay and the Intake Channel), mean annual DO should be 6 mg/L or greater, and that no single measurement should be less than 5 mg/L. The California Ocean Plan specifies that DO should not be depressed more than 20% from the naturally occurring DO level.

The lowest predicted DO value that occurs is 7.3 mg/L for CEQA Normal Minimum Operations and high CAEDYM parameter values; this is above the Basin Plan mean annual DO specification of 6 mg/L or greater and the single occurrence Basin Plan minimum of 5 mg/L. DO concentrations were not predicted to drop to 0 mg/L (anoxic conditions) under either of the scenarios considered, and should therefore not result in undesirable odors or release of undesirable chemical constituents from channel bottom sediments as a result of anaerobic conditions.

3.5.8 Other CAEDYM Results

Total organic carbon (TOC, see **Figures 3.33** and **3.34**) and biological oxygen demand (BOD, see **Figures 3.35** and **3.36**) are predicted to follow patterns similar to nitrate and orthophosphate (peaking in response to storm events), and are not predicted to vary appreciably either with changes in flow scenario or with changes in CAEDYM parameter values. pH (**Figures 3.37** and **3.38**) is predicted to be nearly constant throughout the year, and is not predicted to be influenced by storm water inflows in the way that nutrient concentrations are. For example, the median difference in predicted pH between the Base Case and CEQA Normal Minimum Operations is 0.01 at Stations 1, 2, and 3.

3.6 CONCLUSIONS

Three-dimensional computational fluid dynamics modeling (ELCOM/CAEDYM modeling) has been performed for two cooling water flow conditions at HnGS (Base Case and CEQA Normal Minimum Operations) in order to evaluate the water quality changes that would be associated with CEQA Normal Minimum Operations flow rates in the HnGS Intake Channel. The Alamitos Bay ELCOM model, which was used to define the inflow water quality of the siphon inflows, was calibrated with 2004 data and validated against 2005 data; the model was verified as able to reproduce the observed data in 2005 that are used as input to the Intake Channel model.

The results have focused on three key water quality parameters in the Intake Channel: water age, chlorophyll *a*, and DO. Water age is important because it is an indicator of other water quality parameters. High water age can be related to lower DO concentrations, higher bacterial counts, and higher chlorophyll *a* concentrations. Chlorophyll *a* is used as a surrogate for algae and is an indicator of trophic state. High chlorophyll *a* concentrations can be related to increased turbidity and color, and reduced transparency. DO concentrations are of interest with respect to the standards set forth in the Water Quality Control Plan (Basin Plan) for the Los Angeles Region (LARWQCB, 1994, plus amendments).

The main results of the ELCOM and CAEDYM Intake Channel simulations are:

- Simulation results indicate that the flow rate at HnGS for CEQA Normal Minimum Operations will lead to slightly higher water age in the Intake Channel as compared to the Base Case (see **Table S.5**), where water age is defined relative to the time when water first enters Alamitos Bay (note that the theoretical average residence time of water in the Intake Channel is only 2.4 hours for the Base Case and 6.0 hours for CEQA Normal Minimum Operations). The mean annual average water age in the Intake Channel is predicted to increase from 1.1 days for the Base Case to 1.7 days for CEQA Normal Minimum Operations, while the maximum water age at any cell within the domain is predicted to increase from 6.9 days to 7.3 days. Water age in the northern portion of the Intake Channel (between Station 2 and Station 1) is slightly higher than in the southern portion (between Station 2 and Station 3) due mainly to the effect of tidal flushing with Alamitos Bay (via the Intake Channel siphons), which decreases with increasing distance from the channel entrance.

- Chlorophyll *a* concentrations are predicted to be highest during the summer months. Higher chlorophyll *a* concentrations are also predicted to occur under CEQA Normal Minimum Operations scenarios relative to the Base Case. As with water age, most of the chlorophyll *a* formation occurs within Alamitos Bay as evidenced by comparing the annual average and maximum chlorophyll *a* concentrations in the inflow from Alamitos Bay with the concentrations predicted within the Intake Channel. The springtime peaks in chlorophyll *a* within the Intake Channel in 2005 are due to storm water pushing the Alamitos Bay water with increased water age and chlorophyll *a* concentrations into the Intake Channel. For the moderate and high CAEDYM parameters, the highest annual average chlorophyll *a* concentrations within the model domain are predicted to increase from 2.9 μg/L for the Base Case, to 3.4-3.5 μg/L for CEQA Normal Minimum Operations. The highest maximum chlorophyll *a* concentrations are predicted to increase from 9.0-9.1 μg/L for the Base Case to 11.7-11.8 μg/L for CEQA Normal Minimum Operations (presented as a range for the moderate and high CAEDYM parameters). Thus, the predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the average annual and maximum predicted values, and smaller than the ranges that span the trophic state categories.

- The predicted DO concentrations do not vary greatly along the length of the Intake Channel or over depth for either the Base Case or CEQA Normal Minimum Operations scenarios. The minimum DO concentrations are predicted to be 7.4-7.9 mg/L for the Base Case and 7.3-7.8 mg/L for CEQA Normal Minimum Operations (presented as a range for the moderate and high CAEDYM parameters). The lowest annual minimum DO concentration in any cell of the model domain for any scenario is predicted to be 7.3 mg/L. As such, the annual average and minimum DO concentrations for the scenarios modeled are predicted to meet Basin Plan DO criteria and are not predicted to result in undesirable odors or release of undesirable chemical constituents from channel bottom sediments.

These simulation results indicate that the Intake Channel water quality is largely controlled by the water quality of the inflow from Alamitos Bay and the cooling water flow rate for HnGS. The CEQA Normal Minimum Operations scenario is predicted to result in slight increases in water age and chlorophyll *a* concentrations in the Intake Channel as compared to the Base Case. The CEQA Normal Minimum Operations scenario is also predicted to cause a slight decrease in DO concentrations in the bottom waters of the Intake Channel; however, the DO concentrations are not predicted to drop below 7.3 mg/L for any of the simulated scenarios.

4.0 LOWER SAN GABRIEL RIVER FLOOD CONTROL CHANNEL

4.1 INTRODUCTION

4.1.1 Background

Haynes Generating Station (HnGS), located adjacent to the Lower San Gabriel River Flood Control Channel (LSGR Channel) on the east, and AES, located adjacent to the LSGR Channel on the opposite side (west side) from HnGS side (see **Figures 1.1 and 1.2)**, discharge into the LSGR Channel. LADWP requested that Flow Science conduct detailed modeling of HnGS CEQA flows and in particular the interface between freshwater from the San Gabriel River and saline water from the generating station discharges. This analysis used the model ELCOM (but not CAEDYM) and focused on the year 2005, which represents existing operating conditions.

The analysis made use of five field sampling studies in the LSGR Channel that provided temperature and salinity measurements used to calibrate and validate ELCOM. The calibrated model was then used to simulate CEQA flow scenarios within the LSGR Channel. Specifically, LADWP wanted to examine HnGS CEQA flow conditions during both high flow/high heat load and low flow/low heat load conditions from AES generating station.

4.1.2 Lower San Gabriel River Flood Control Channel

Figure 4.1 shows the model domain, which extends upstream to where the San Gabriel River and Coyote Creek (CC) meet and ends in San Pedro Bay. **Figure 4.2** is a United States Geological Survey (USGS) map of the same area and shows important features within the model domain, including the freshwater inflows, generating station outfalls, reference locations, and field study data sampling locations. The LSGR Channel flows approximately northeast to southwest.

4.1.2.1 River Channel

The LSGR Channel is a man-made channel that has a trapezoidal shape. From the mouth to a location 21,400 ft upstream it has a sediment base and riprap walls. This soft-bottom portion of the LSGR Channel is a constructed channel that redirects flow that originally entered Alamitos Bay. The base width of the soft-bottom portion ranges from approximately 500 ft at the mouth in San Pedro Bay to 240 ft at the upstream location, 21,400 ft from San Pedro Bay, where the sediment base and riprap walls transition to a concrete-lined channel. The interface between the two sections of the LSGR Channel is a concrete apron. Above the apron the concrete channel has a width of 240 ft at the base, and the walls of the channel slope outward at an approximate slope of 2:1. The confluence of the San Gabriel River and Coyote Creek, marked on **Figure 4.2**, is approximately 1,200 ft upstream of the concrete apron.

4.1.2.2 San Pedro Bay

San Pedro Bay forms the lower boundary of the model domain. The Bay is part of the Pacific Ocean and therefore has typical oceanic water quality properties. The mouth of LSGR Channel is open to the Bay, which allows the tide to propagate upstream. Under normal generating station operations (with both AES and HnGS) there is no upstream flow generated by the tide, just a reduction in the outflow and an increase in the water surface elevation at high tide.

4.1.2.3 Freshwater Inflows

There are three main freshwater inflows into LSGR Channel: the upper San Gabriel River (Gotingco, 2006), Coyote Creek (Gotingco, 2006) and the Long Beach Water Reclamation Plant (LBWRP) (Platt, 2005). The San Gabriel River and Coyote Creek are primarily flood control channels. Flow rates during typical dry conditions are on the order of two hundred MGD or less and primarily consist of discharges from water reclamation plants upstream. However, storm events in the region can produce short duration channel flow rates of several thousand MGD. The LBWRP discharges near the confluence of the San Gabriel River and Coyote Creek, and typical flow rates from the LBWRP discharge are below 30 MGD.

4.1.2.4 Generating Station Outfalls

The major inflow into the model domain is from the six outfalls that discharge cooling water from HnGS and AES. AES operates three outfalls on the west side of the LSGR Channel while HnGS operates three on the east side. The locations of the six outfalls are indicated in **Figure 4.2**.

4.1.2.5 Field Study Data Sampling Locations

Field data for five sampling events within the LSGR Channel were collected by MBC Applied Environmental Sciences (Moore, 2005). Sampling locations in the LSGR Channel are shown in **Figure 4.2.** Sampling was conducted during September, October, and November of 2004, as well as May and August of 2005. Measurements of temperature and salinity were taken throughout the water column along the LSGR Channel during various tidal periods. Data collected during these sampling events were used to verify the calibration of ELCOM.

4.2 MODELING APPROACH

Flow Science calibrated and validated ELCOM for the LSGR Channel for each of the five field sampling events. ELCOM was first calibrated for typical dry conditions (September 2004) and for post-rain conditions (October 2004). The calibrated model was then validated using field sampling data from November 2004, May 2005, and August 2005. Calibration/validation runs simulated the four days prior to the sampling event date, as well as flows on the event date itself to allow the model initial conditions to become "washed out" before simulating the period for which field observations were available.

Results from the model calibration/validation runs were compared to Conductivity-Temperature-Depth (CTD) data profiles. Since the CTD data were plotted using water depth, the calibration/validation results were also plotted versus depth. Because of this, there is no slope of the river surface in the graphical plots, when in reality there is a slight slope toward the ocean. Calibration/validation data files were made for every half-hour during the sampling event. From these files, composite calibration data files were constructed using the CTD sampling locations and measurement times. These composite files allowed for a more accurate comparison of the individual CTD profiles, which spanned several hours. Both contour and line profile plots were used for comparison. Contour plots show a complete two-dimensional view of the LSGR Channel longitudinal profile. Line plots allow modeled and measured data at specific depths to be easily compared.

The calibrated ELCOM model was used to simulate existing (Base Case) conditions and HnGS CEQA Normal Minimum Operations in the LSGR Channel for two time periods. The time periods were selected to include a high flow/high heat load period (July 20, 2005) and a low flow/low heat load period (October 24, 2005). No CAEDYM simulations were performed for the LSGR Channel.

Two Base Case scenarios were simulated, one for each time period. The Base Case scenarios used measured data from the simulation period as model input data. Freshwater temperature and salinity measurements for the freshwater inflows were not available, so the values were estimated based on previous data and the previous calibration of the LSGR Channel model. Temperature and salinity values from the August 24, 2005 and October 22, 2004 calibrations were used for the July 20, 2005 and October 24, 2005 simulation periods, respectively. HnGS CEQA scenarios simulated conditions within the LSGR Channel for the CEQA Normal Minimum Operations scenario. Two CEQA simulations were run, one for each time period. A list of the four simulations is provided in **Table 4.1.** For convenience, simulations will be referred to by the scenario names listed in the table.

Table 4.1: Simulation Scenario List

Scenario Number	Scenario Name	Scenario Type	Simulation Period	Generating Station Flow (MGD)	
				HnGS	AES
1	2005 A1	Base Case	October 24, 2005	483 - 507	195
2	2005 A2	Base Case	July 20, 2005	921 - 968	1270
3	CEQA Oct	CEQA Normal Minimum Operations	October 24, 2005	311	195
4	CEQA July	CEQA Normal Minimum Operations	July 20, 2005	311	1270

Scenario simulations were run in a similar manner to the calibration and validation runs. However, calibration simulations showed that the initial conditions dissipated quickly after the simulation began. Therefore, simulation time was shortened and each scenario simulated three identical days. The first two days allowed the initial conditions to "wash out" and eliminate model start-up transients. The third day of the simulation was used to present the results of the model.

4.3 MODEL SET-UP

As discussed in previous chapters, data required for the modeling include the river channel bathymetry, inflows to the domain, ocean conditions, and meteorological data. The field data from five sampling events were used to calibrate and validate the model. Sampling events profiled the water temperature and salinity within LSGR Channel at locations shown in **Figure 4.2**. Field sampling events were scheduled for different weather conditions and for a range of generating capacities, including four sampling events covering a range of typical dry conditions. One additional event was scheduled and conducted after a period of significant rain.

Plots of data discussed in this section can be found in **Appendix C** unless noted specifically in the section. Data figures located in **Appendix C** include: meteorological data during 2004 and 2005, tidal height during months containing and surrounding field sampling events, San Pedro Bay water surface temperatures during 2004 and 2005, freshwater flow rates into the LSGR Channel, and histograms of daily average flow rate and daily average temperature data from the generating station outfalls. Plots of data during the CEQA simulation periods (July 20 and October 24, 2005) can also be found in **Appendix C**.

4.3.1 Computational Domain and Grid

The LSGR Channel is a man-made channel that has a trapezoidal shape, as descried in Section 4.1.2.1. Erosion of the soft-bottom section of LSGR Channel has occurred since completion of the channel in 1967, as current WSEL measurements are actually below the original bottom elevation of the LSGR Channel. The amount of erosion was estimated by comparing US Army Corps of Engineers (USACE) construction drawings from 1967 to current water surface elevation (WSEL) measurements and to field observations. The USACE drawings show a constant slope across the transition from the concrete to the soft-bottom portion of LSGR Channel, whereas the existing transition has a 4 to 6 ft (1.2 – 1.8 m) drop in channel invert elevation at the end of the concrete apron, confirming that there has been significant scouring along the soft-bottom section of LSGR Channel. To accurately model the channel bathymetry, the channel bottom elevations were assumed to reduce gradually (*i.e.*, non-uniform scour) from a 5 ft (1.5 m) scour depth at the end of the concrete apron to a 0 ft scour depth at a location just downstream of the Pacific Coast Highway Bridge. From this starting point, the Hydrologic Engineering Center River Analysis System (HEC-RAS) model was used to evaluate the resulting water surface elevations over a range of adjusted bottom elevations. **Figure 4.3** shows the simulated WSEL (obtained using the "best-fit" adjusted channel bottom elevation and a Manning's roughness coefficient, *n*, of 0.025 [an average value for a natural or excavated channel]) and the measured WSEL in LSGR Channel. The figure also shows the difference between the original construction elevation and the best estimate of the current channel invert elevation. The resulting WSELs, as simulated by HEC-RAS using the adjusted channel bottom elevations, show reasonably good agreement with the measured data, and confirm that the adjustments in the channel bottom elevations were necessary to account for historical scour. In the absence of recent river cross-sections, or a bathymetry survey, the adjusted channel bottom elevations shown in **Figure 4.3** are believed to reasonably represent current channel conditions.

ELCOM requires a continuous surface and cannot simulate a sudden vertical drop between two simulated bodies of water. To avoid a loss of continuity within the model as water "drops" over the end of the concrete apron, it was necessary to construct a smooth transition within the model domain. A four-cell wide channel in the model domain was lowered by approximately 15 ft (4.6 m) at the top of the domain and given a constant slope. It merges with the HEC-RAS estimated elevations near the lower end of the model domain. The lowered channel allows for a continuous surface between the upstream freshwater inflows and water within the LSGR Channel regardless of tidal elevation, which should have little effect on simulation results.

The cell sizes in the model grid used for the LSGR Channel were non-uniform. This approach was used since the simulated area is relatively large, approximately four miles of channel, but the simulation required high resolution in the area of interest, *i.e.*, the area near the outfalls. Overall the computational grid size is 55 cells (width) by 252 cells (length) by 26 cells (depth). The grid used a standard 13.12 ft (4 m) cell width across the width of the channel. Likewise a standard 49.21 ft (15 m) length is used for most of the cells along the length of the channel. The standard length cells covered the area between about 10,000 ft and 19,600 ft (3,048 m and 5,974 m) in the channel. Outside of those two distances a stretching factor of 1.1 was applied to the length of the cell. This allowed for fewer cells in areas of less interest and had little effect on the calibration. The reduced grid size increased the speed of the ELCOM model computation, thereby allowing for more efficient calibrations and simulations. Cell depths were a standard 0.66 ft. (0.2 m). A plan view and longitudinal view of the grid are plotted in **Figure 4.4**.

4.3.2 Modeling Period

Simulations of the LSGR Channel were performed for a 24 period so that the field sample data could be used for calibration/validation as well as provide a detailed analysis of hydrodynamics over the course of a tidal cycle. Modeling periods also had to be kept short because of long computation times caused by the size of the ELCOM grid. A large grid was needed to model the entire LSGR Channel while still providing enough resolution near the generating station outfalls to capture the interactions of various water sources.

Modeling periods can be divided into two categories: calibration/validation periods and Base Case/CEQA simulation periods. Calibration/validation periods model the days during which field sampling occurred. Field samples were collected on September 15, October 22, and November 12, 2004, and on May 31, and August 24, 2005. The calibration and validation simulations model a twenty-four hour period for each of the five sample events.

Base Case/CEQA simulation periods modeled a high flow/high heat load period and a low flow/low heat load period. Flows from HnGS and AES were used to determine two periods to simulate in 2005. HnGS and AES total flow rates for 2005 are shown in **Figure 4.5**. A period of relatively high flow for both stations occurred on July 20, 2005, and a period of low flow occurred on October 24, 2005. Daily maximum temperature measurements of AES discharges are shown in **Figure 4.6** along with individual outfall discharge flow rates. These temperature measurements show relatively high heat load from AES on July 20, 2005 and relatively low heat load on October 24, 2005. Daily temperature measurements were not available for HnGS for the entire 2005 year, but hourly measurements for time periods including July 20 and October 24, 2005, confirm those periods as high heat load and low heat load periods, respectively. Hourly cooling water temperature measurements for HnGS are plotted in **Figure 4.7** along with individual outfall flow rates. The Base Case/CEQA simulations model the twenty-four hour periods of July 20 and October 24, 2005.

4.3.3 Meteorological Data

Meteorological data (solar radiation, air temperature, wind speed and direction, relative humidity, and precipitation) required by the modeling software ELCOM were collected from a weather station managed by the generating station: Station #174 (Long Beach, see **Figure 2.1** for location).

Meteorological data recorded during the Base Case/CEQA simulation periods (July 20 and October 24, 2005) show differences that would be expected when comparing summer conditions to fall conditions. There was significantly more solar radiation during July 20, 2005 (peak ~800 W/m^2) than October 24, 2005 (peak ~200 W/m^2). Wind speeds were similar during both periods, ranging from approximately 0.5 m/s to 2.5 m/s, with speeds increasing in the early afternoon and into the evening. Winds were from the southwest during July 20, 2005 and from the northeast during October 24, 2005. Air temperatures showed a significant increase during the afternoon on July 20, 2005, from approximately 18°C to 30°C, while temperatures remained an almost constant 16°C on October 24, 2005. Relative humidity showed an inverse relationship to temperature. There was a large drop in humidity during July 20, 2005, from over 90% in the morning to around 40% during the afternoon. October 24, 2005 remained humid all day, with relative humidity values between 80 and 94%.

4.3.4 BOUNDARY CONDITIONS

Three flows can enter the model domain of the LSGR Channel: ocean water from San Pedro Bay, freshwater flows from upstream, (specifically flows from San Gabriel River, Coyote Creek, and Long Beach Water Reclamation Plant), and discharge from the HnGS and AES outfalls. San Pedro Bay forms the lower boundary of the model domain. It is an open boundary allowing the tidal elevation to freely influence the LSGR Channel. The freshwater flows enter the domain at the upper boundary and the outfall discharges enter at the edges of the model domain along the river channel were the generating stations are located. Locations of the inflows are marked on **Figures 4.1** and **4.2**.

Data collected to define each of these boundaries are discussed in the following sections. Ocean conditions forming the open boundary at San Pedro Bay are defined by tide height, temperature, and salinity. Freshwater inflows and outfall discharges are defined by flow rate, temperature, and salinity.

4.3.4.1 Ocean Conditions

Oceanic data for the model were collected from the National Oceanic & Atmospheric Administration (NOAA) station at Los Angeles, CA (Station ID #9410660). The station is located in the Los Angeles Harbor approximately nine miles across San Pedro Bay from the mouth of the Flood Control Channel. Tidal ranges were between ± 5 ft of the National Geodetic Vertical Datum 29 (NGVD 29) datum during field sampling events. The height of the concrete apron referenced to NGVD 29 is approximately + 4 ft. Therefore tidally-induced flows could penetrate upstream past that point in the LSGR Channel if they were unimpeded by the outfall flows.

Ocean temperatures vary seasonally in San Pedro Bay while salinity is generally fairly constant from season to season and year to year. During 2004 and 2005, the two years including the field sampling events, ocean surface temperatures fluctuated between 12^{o}C and 22^{o}C. Aside from September 2004, temperatures generally exhibited an eight degree range between 12^{o}C and 20^{o}C. During September of 2004 temperatures were between 20^{o}C and 22^{o}C. No time series of salinity in San Pedro Bay was available, so a constant value of 33.5 PSU was used (Stabeno, 2003).

Tidal ranges for the Base Case/CEQA simulation periods, July 20, 2005, and October 24, 2005, were very different. The July simulation period exhibited a large tidal range, with a low-low tide of -2.0 ft and a high-high tide of +6.7 ft. The tidal range during the October period was more compact with a low-low tide of -0.2 ft and a high-high tide of +3.3 ft.

Ocean surface water temperatures within each of the selected simulation periods fluctuated less than one degree Celsius. The July 20, 2005 ocean surface temperatures ranged between 18.7°C and 19.5°C. Surface temperatures during October 24, 2005 were slightly cooler, ranging between 17.1°C and 17.6°C. A summary of oceanic data is provided in **Table 4.2**.

Table 4.2: ELCOM Inputs – Ocean Conditions and Freshwater Flows

Model Variable	Parameter	Simulation Dates	
		July 20, 2005 High Flow/High Heat Load Conditions	October 24, 2005 Low Flow/Low Heat Load Conditions
Ocean	Temperature (°C)	18.7 – 19.5	17.1 – 17.6
	Salinity (PSU)	33.5	33.5
Tidal Range	High (ft)	6.7	3.3
	Low (ft)	-2.0	-0.2
San Gabriel River	Flow Rate (MGD)	12.6 – 82.6	28.3 – 105.2
	Temperature (°C)	24.2 – 28.7	19.8 – 28.0
	Salinity (PSU)	1.8	0.6
Coyote Creek	Flow Rate (MGD)	54.8 – 113.9	31.0 – 86.5
	Temperature (°C)	24.2 – 28.7	19.8 – 28.0
	Salinity (PSU)	1.8	0.6
Long Beach Water Reclamation Plant	Flow Rate (MGD)	1.3 – 15.6	4.4 – 14.9
	Temperature (°C)	24.2 – 28.7	20.5 – 28.0
	Salinity (PSU)	1.8	0.6
Total Freshwater Flow (SGR, CC, LBWRP)	Flow Rate (MGD)	84.0 – 192.8	73.9 – 178.4

4.3.4.2 Lower San Gabriel River Inflows

Freshwater inflow enters the LSGR Channel from three sources: the upper San Gabriel River (Gotingco, 2006), Coyote Creek (Gotingco, 2006), and the LBWRP (Platt, 2005). The San Gabriel River and Coyote Creek are primarily flood control channels. Flows in the channels during typical conditions (dry conditions) are small, on the order of about two hundred MGD or less, and consists primarily of discharges from water reclamation plants upstream. However, storm events can produce short periods of large freshwater flows in the channels. During rain storms, flow rates in the San Gabriel River and Coyote Creek can be several thousand MGD. LBWRP flows are not affected by storm events to the extent that flows from the San Gabriel River and Coyote Creek are affected. LBWRP flow rates are consistently between 0 and 30 MGD.

No precipitation was recorded during the days prior to either July 20, 2005 or October 24, 2005, so flow rates in the San Gabriel River and Coyote Creek were typical dry season flows from water reclamation plants upstream (only a few hundred MGD combined) (Gotingco, 2006). Flow rates recorded in the San Gabriel River ranged between 13 and 105 MGD during the selected periods. Recorded flow rate measurements in Coyote Creek ranged between 31 and 114 MGD during the selected periods.

The LBWRP discharges near the confluence of the San Gabriel River and Coyote Creek and typical flow rates are below 30 MGD. LBWRP flow rates during July 20, 2005 and October 24, 2005 ranged between 1 and 16 MGD (Platt, 2005).

Temperature and salinity measurements for the freshwater inflows were not available, so the values were estimated based on field sample data and the calibration of the LSGR Channel model. Temperature and salinity values from the August 24, 2005 and October 22, 2004 calibrations were used for the July 20, 2005 and October 24, 2005 simulation periods, respectively. A summary of the freshwater flow rates, temperatures, and salinities is provided in **Table 4.2**.

4.3.4.3 Generating Station Inflows

The other and major sources of inflow into LSGR Channel are the six outfalls that discharge cooling water from HnGS (Krivack, 2005 and 2006) and AES (Srinivasan, 2005 and 2006), into the LSGR Channel. Cooling water for the HnGS outfalls is drawn directly from the upper reaches of Alamitos Bay, which is connected to San Pedro Bay, and generally has the same salinity as ocean water. AES draws water from canals joined to the Los Cerritos Channel, which is connected to Alamitos Bay. The water discharged from the AES outfalls usually has the same salinity as ocean water, but its salinity can be reduced by freshwater flowing through Los Cerritos Channel during and following rain events.

The high flow/high heat load period (2005 A2) that occurred on July 20, 2005 had significantly larger outfall discharge flow rates than the low flow/low heat load period (2005 A1) that occurred on October 24, 2005. Total flow rates during 2005 A2 ranged from 2,192 MGD to 2,238 MGD. During this period the total flow rate from the AES outfalls was a constant 1,270 MGD (Srinivasan, 2005 and 2006), while HnGS outfall flow rates ranged between 921 MGD and 968 MGD (Krivack, 2005 and 2006). During 2005 A1, total outfall flow rates ranged between 678 MGD and 701 MGD. The AES total flow rate was a constant 195 MGD while HnGS total flow rate ranged from 483 MGD to 507 MGD.

Flow rates for CEQA Normal Minimum Operations scenarios were based on the capacities of new intake pumps installed during repowering in 2005. Flow rates for the CEQA Normal Minimum Operations scenario are 311 MGD (Yoshida, 2009). Discharges during CEQA operations will be through HnGS outfall #2, the central HnGS outfall (**Figure 1.2**). Discharges during CEQA operations will be through HnGS outfall

#2, the central HnGS outfall (**Figure 1.2**). Measured AES flow rates were used for all the CEQA simulations.

Temperature differences between outfall discharges and ocean temperatures were significantly higher during the high heat load period compared to the low heat load period (Krivack, 2005 and 2006; Srinivasan, 2005 and 2006). On July 20, 2005, the range of outfall discharge temperatures was 23.0°C to 37.5°C, while the range of discharge temperatures on October 24, 2005, was 17.0°C to 25.0°C. Ocean temperatures were only 1.8°C higher on average during July 20, 2005 than during October 24, 2005. Therefore, the heat load to the receiving water was greater in the high heat load period during July than in the low load period in October. CEQA Normal Minimum Operations scenarios use outfall temperatures that were observed during the Base Case period since CEQA Normal Minimum Operations temperatures have not been projected.

Both HnGS and AES draw water from Alamitos Bay, which generally has the same salinity as ocean water. Measurements taken from the HnGS inlet in early 2005 yielded a salinity of 33.1 PSU (Krivack, 2005 and 2006), which is consistent with surface salinity measurements taken from San Pedro Bay (Stabeno, 2003). Rain can influence the salinity of the water entering the stations, but since no rain was recorded during the selected periods the value of 33.1 PSU was used for the outfall discharges.

A summary of AES and HnGS outfall flow rates, temperatures, and salinities during simulations periods is provided in **Tables 4.3** and **4.4**.

Table 4.3: ELCOM Inputs – Baseline Generating Station Outfall Flows

Model Variable	Parameter	Simulation Dates	
		July 20, 2005 High Flow/High Heat Load Conditions	October 24, 2005 Low Flow/Low Heat Load Conditions
AES Outfall #1	Flow Rate (MGD)	207.4	0.0
	Temperature (°C)	24.0 – 27.9	-
	Salinity (PSU)	33.1	-
AES Outfall #2	Flow Rate (MGD)	389.0	194.5
	Temperature (°C)	23.6 – 34.2	19.9 – 20.3
	Salinity (PSU)	33.1	33.1
AES Outfall #3	Flow Rate (MGD)	673.9	0.0
	Temperature (°C)	24.8 – 32.2	-
	Salinity (PSU)	33.1	-
HnGS Outfall #1	Flow Rate (MGD)	230.2 – 276.5	253.0 – 276.5
	Temperature (°C)	24.8 – 36.7	20.0 – 24.5
	Salinity (PSU)	33.1	33.1
HnGS Outfall #2	Flow Rate (MGD)	230.4	0.0
	Temperature (°C)	27.2 – 32.1	-
	Salinity (PSU)	33.1	-
HnGS Outfall #3	Flow Rate (MGD)	460.8	230.4
	Temperature (°C)	22.6 – 27.5	17.4 – 17.7
	Salinity (PSU)	33.1	33.1

Table 4.4: ELCOM Inputs – CEQA Normal Minimum Operations Outfall Flows

Model Variable	Parameter	Simulation Dates	
		July 20, 2005 High Flow/High Heat Load Conditions	October 24, 2005 Low Flow/Low Heat Load Conditions
AES Outfall #1	Flow Rate (MGD)	207.4	0.0
	Temperature (°C)	24.0 – 27.9	-
	Salinity (PSU)	33.1	-
AES Outfall #2	Flow Rate (MGD)	389.0	194.5
	Temperature (°C)	23.6 – 34.2	19.9 – 20.3
	Salinity (PSU)	33.1	33.1
AES Outfall #3	Flow Rate (MGD)	673.9	0.0
	Temperature (°C)	24.8 – 32.2	-
	Salinity (PSU)	33.1	-
HnGS Outfall #1	Flow Rate (MGD)	0.0	0.0
	Temperature (°C)	-	-
	Salinity (PSU)	-	-
HnGS Outfall #2	Flow Rate (MGD)	311.0	311.0
	Temperature (°C)	27.2 – 32.1	19.1 – 20.5
	Salinity (PSU)	33.1	33.1
HnGS Outfall #3	Flow Rate (MGD)	0.0	0.0
	Temperature (°C)	-	-
	Salinity (PSU)	-	-

4.4 HYDRODYNAMIC CALIBRATION AND VALIDATION

4.4.1 FIELD DATA SAMPLING EVENTS

In-channel data for the LSGR Channel from the field sampling events were used to calibrate and validate the modeling software. Field data from the LSGR Channel were collected by MBC Applied Environmental Sciences (Moore, 2005). MBC used CTD instruments to measure temperature and salinity at various depths along the length of the river. Upstream distances within the river were established relative to a starting location at the mouth of the Flood Control Channel in San Pedro Bay, referred to as Station 0+00. Upstream distances are positive, so 1,000 ft upstream corresponds to Station 10+00.

During 2004, MBC took CTD measurements between stations 85+00 and 210+00. These sampling locations are marked in **Figure 4.2**. In 2005, data collection was expanded and measurements were taken between stations 15+00 and 210+00. In a few instances (*e.g.*, high tide in November 2004), coverage was not complete. Because several hours were required to take all of the measurements at the many data sampling locations within the LSGR Channel, profiles of the LSGR Channel are not snapshots of one particular time, but composites of several hours of data.

MBC collected field data on September 15, October 22, and November 12, 2004, and on May 31, and August 24, 2005. The September 2004, November 2004, and August 2005 sampling events occurred during typical dry conditions. The May 2005 field sampling event is discussed in detail below, since field samples were available for three tide phases. Conditions were considered to be typical and dry when there is little or no rain prior to the event, so that freshwater flows from upstream were limited to several hundred MGD. During these conditions, water in the LSGR Channel consists mostly of generating station discharge from AES and HnGS. The October 2004 field sampling event was a post-rain conditions event since a significant amount of rain was recorded two days prior to sampling. This event is discussed in the Post-Rain Conditions section. The three remaining field sampling events were all conducted during typical dry, or normal, conditions and are discussed in the Other Sampling Events section.

4.4.1.1 Typical Dry Conditions Data

Measurements for the May 2005 sampling event were taken on May 31, 2005, so data for the event are concentrated on that day and the preceding days. No precipitation occurred in the days preceding the sampling event; therefore there was a typical amount of freshwater in the LSGR Channel. Throughout the period there were only a few hundred MGD or less of freshwater entering the LSGR Channel. Although Coyote Creek data appear to show several large inflows, these are present for only very short periods of time and are likely the result of measurement errors. Because of their short duration, these errors had no effect on the calibrations or simulations of the LSGR Channel.

The HnGS outfalls were in constant use up to and through May 31. Outfalls HnGS #1 and #3 were running at capacity, while HnGS #2 was slightly less than full capacity. AES outfalls show periods of non-use with no flow through AES #1 and #2 until the afternoon of the 31st. AES #3 appears to have been running at half flow during this time period. Outfall water temperatures hovered between 20°C and 25°C. Several discharge temperatures rose to the upper twenties and low thirties on May 31.

LSGR Channel temperature and salinity profiles were collected for select tide levels during the May sampling event: low, mid, and high tide. Measured temperature profiles clearly show the thermal plumes from the outfalls, especially late in the day when the discharge temperatures rose sharply. Rising temperatures were also observed in the freshwater inflow as it is heated by the sun in the afternoon. Freshwater and saltwater are easily distinguished in the salinity profiles. The field measurements clearly show freshwater flowing over the denser saltwater in the LSGR Channel. The discharge from the outfalls prevents the freshwater wedge from traveling downstream intact, instead inducing mixing of the freshwater inflows with the generating station discharges. A comparison of the position of the leading edge of the freshwater wedge during the three tide levels shows that the wedge was pushed farther upstream during mid tides than during low or high tides. This is likely due to the highest differential in water surface elevation between San Pedro Bay and the LSGR Channel, which would peak during flooding mid tides. The location of the leading edge of the wedge is comparable at high and low tides.

Data collected during the May 2005 field data sampling event as well as data collected to model the event is located in **Appendix C**.

4.4.1.2 Post-Rain Conditions Data

A post-rain event was captured on October 22, 2004. Rain two days prior to the sampling event augmented freshwater flows in the LSGR Channel. The total rainfall amount for this storm was 1.0 in. Flow rates for Coyote Creek and the San Gabriel River showed large spikes in freshwater flow on October 22nd. Flow rates from these two tributaries indicate a twelve-hour delay between when the rain occurred and when the water from these rains was recorded entering the LSGR Channel. Flow rates from LBWRP were unaffected by rainstorms.

AES #1 was not operating during the entire period leading up to the sampling event of October 22nd. AES #2 was operating at full flow, but was shutoff mid-morning of the 22nd, while AES #3 was operating at half-flow the entire time. HnGS #1 and #3 were operating at full flow during most of the period. However, flows from HnGS #3 dropped to 350 MGD on the morning of the 21st, but the reason for the lull is unclear. HnGS #2 appeared to be flowing at slightly less than full flow, around 230 MGD, for the period surrounding the sampling event. The outfall discharge temperatures on and around October 22nd generally ranged between 10°C and 30°C. The most any one discharge temperature fluctuated during the period is approximately 10°C. However, several discharge temperatures only fluctuated 3°C to 4°C. Outfall discharge temperatures were slightly cooler in October compared to temperatures recorded in May.

Only one sampling profile, at low tide, was available for the post-rain conditions. An increase of water depth, due to the rain water, within the LSGR Channel was evident in both the temperature and salinity profiles. The background temperatures in the LSGR Channel appeared similar to the temperatures measured in May. Thermal plumes from the outfalls were less prominent, and there was a region of cold water in the middle of the plot. The measured salinity profile shows an abundance of freshwater in the LSGR Channel, with colder temperatures in the freshwater wedge. Salinities downstream of the HnGS outfalls appeared to be somewhat diluted with freshwater, reaching a peak value of

28 PSU. The water being discharged by the AES outfalls appeared to have salinity between 20 and 25 PSU. This was likely caused by freshwater from Los Cerritos Channel mixing with saltwater in Alamitos Bay before being drawn into the Alamitos cooling water intakes.

Data collected during the October 2004 field data sampling event as well as data collected to model the event is located in **Appendix C**.

4.4.1.3 Other Sampling Events

In addition to the May 2005 field sampling event, three other field sampling events were conducted during typical dry conditions. The sampling events occurred on September 15, 2004, November 12, 2004, and August 24, 2005. Weather conditions during these sampling events were similar to the weather observed during the May event. Air temperatures were cooler in September and November and slightly warmer in August. Very little or no precipitation occurred during the four events. September 2004, like May 2005, did not register any precipitation during or preceding the sampling. November 2004 registered several precipitation data points and August also registered a precipitation data point in the days preceding the sampling date. However, none of these points showed precipitation of more than 0.025 inches.

The measured salinity and temperature profiles from September 2004 included high tide in the morning and low tide in the afternoon. Water temperatures recorded in September were the warmest of all five sampling events. The salinity profiles exhibited the same characteristics as the May profiles, with a thin freshwater wedge riding on top of the saltwater, which mixed rapidly with the discharges from the outfalls and did not travel to the Bay as a freshwater lens at the water surface.

Field sampling for November 2004 also captured both high and low tide. Observed temperatures were similar to those observed during the May sampling event. However, unlike May, there appeared to be plumes of cold water coming from the Alamitos outfalls. The salinity profiles for November again featured a freshwater wedge traveling downstream only as far as the outfall discharges.

Measured profiles from three tidal elevations were available for August 2005. Temperatures within the LSGR Channel rose continually during the observation period due to increasing temperatures in both the HnGS discharges and freshwater inflows. Salinity profiles show the same motion of the freshwater wedge that was observed in the May profiles. The boundary of the wedge was pushed farther upstream during mid tides than during high tide.

4.4.2 TYPICAL DRY CONDITIONS

The discussion of the typical conditions calibration/validation will focus on May 2005. Temperature contour profile comparisons of the May 2005 validation and the measured data are plotted in **Figures 4.8** through **4.10,** with the simulation results shown in the top frame and the measured data shown in the bottom frame. Simulation plots shown are composites of several hours of model results. The simulation composites match the time span of the plotted data, which required several hours to collect. The figures show good agreement between the model predictions and the measured data. The model captured the background temperatures within the LSGR Channel as well as the thermal plumes from the outfalls and the temperature fluctuations of the freshwater inflows. The salinity comparisons exhibited the ability of the model to effectively reproduce the movement and mixing of water within the LSGR Channel. Salinity contour profile comparisons are presented in **Figures 4.11** through **4.13**. The figures show that the model accurately captured the location of the leading edge of the freshwater wedge. Additionally, the motion of the wedge due to the tide in the calibration matched that shown by the data. Salinity levels both upstream and downstream of the outfalls were the same in the model and the CTD data.

Modeled and measured water temperature and salinity values at the surface and near the bottom were compared using line plots. Temperature line plots for all three tidal phases are plotted in **Figures 4.14** through **4.16**. These plots illustrate the accuracy of the ELCOM calibration/validation. Increases in water temperature shown in the data near the outfalls and near the upstream inflows were matched by the model. Salinity line plots are shown in **Figures 4.17** through **4.19**. These figures show that the model was able to reproduce the measured salinity values upstream and downstream as well as the sharp interface between waters of different salinity values.

The locations of the 25 PSU and 5 PSU interfaces at the surface along the LSGR Channel are plotted in **Figure 4.20**. Both measured and modeled data showed that the interface between freshwater and saltwater was tidally-influenced and is sharpest at ebb tide. Animations were produced for each calibration and are listed in **Appendix D**. Animations for the May 2005 calibration are listed as Items 1 and 2.

4.4.3 POST-RAIN CONDITIONS

Rain occurred on October 19 and 20, 2004, and a post-rain model calibration was conducted using field data collected on the 22nd. For this calibration, only the low tide phase was available in the field dataset. A contour plot of the temperature calibration is shown in **Figure 4.21.** The simulation plots shown are composites of several hours of model results that correspond to the collection times of the field data. Again there was good agreement between the ELCOM results and measured data. The model captured the thermal plume from HnGS Outfall #3, the section of colder water in the middle of the domain, and the warmer freshwaters entering the domain from upstream. A salinity contour profile comparison is shown in **Figure 4.22**. The model again captured the major characteristics of the interactions between the salt and freshwater. The model showed the higher salinities originating from the HnGS outfalls, as well as the mixture of salt and freshwater coming from the AES outfalls. Also captured was the larger freshwater wedge that resulted from the rain during the previous days. The calibration results and the field data both show that the freshwater surface layer was mixed over the water depth by the outfall discharges. The model had a more gradual interface between the salt and freshwater than the data, but the location of the interface was about the same.

Figures 4.23 and **4.24** show the line plots for the temperature and salinity. A comparison of the temperatures shows good agreement between the model results and the field data, both at the surface and at the bottom of the LSGR Channel. Salinities near the surface show that the model predicts a more gradual slope in salinity along the entire domain during a post-rain event. However, the model results are still a good match, deviating from the data by no more than a few PSU both upstream and downstream of the salt/freshwater interface. Salinities near the bottom of the LSGR Channel were a near perfect match. The ELCOM model was therefore able to effectively capture both the temperature and salinity characteristics of the LSGR Channel after a storm event. The locations of the 25 PSU and 5 PSU interfaces are plotted in **Figure 4.25**. Animations for the post-rain calibration are listed as Items 3 and 4 in **Appendix D**.

4.4.4 ADDITIONAL CALIBRATION AND VALIDATION

The typical dry conditions calibration was completed using field data from the September 2004 sampling event. November 2004 and August 2005 field sampling events were used for model validation. Each of these events was a typical dry sampling event similar to the May 2005 event. The ELCOM model reproduced the characteristics of each period well. The results of all three compared favorably with the measured data from the same period. Contour and line plots of the additional calibration/validation simulation results are shown in **Appendix C**. The simulation plots are composites of several hours of model results which correspond to the collection times of the field data. September 2004 calibration animation results are listed as Items 5 and 6 in **Appendix D**, November 2004 animation results are Items 7 and 8 of **Appendix D**, and August 2005 animation results are Items 9 and 10 of **Appendix D**.

4.4.5 CALIBRATION AND VALIDATION CONCLUSIONS

Each calibration/validation simulation captured the characteristics of the flows within the LSGR Channel and properly predicted the interactions of salt and freshwater within the LSGR Channel. ELCOM was confirmed to be capable of describing the temperature and salinity dynamics in the LSGR Channel. Typical conditions and post-rain conditions events were both calibrated with equivalent accuracy.

4.5 SIMULATION SCENARIOS

Two scenarios, the Base Case and CEQA Normal Minimum Operations scenarios, were modeled during both the high flow/high heat load period (July 20, 2005) and the low flow/low heat load period (October 24, 2005). A list of the four simulations performed herein is provided in **Table 4.1.** For convenience, simulations will be referred to by the scenario names listed in the table.

CEQA Normal Minimum Operations scenarios used an HnGS flow rate of 311 MGD (Yoshida, 2009) during July 20 and October 24, 2005 simulation periods. All other model inputs, including ocean temperature and salinity, tidal range, freshwater inflows (SGR, CC, LBWRP), and AES outfall flows were consistent between scenario simulations. HnGS outfall temperatures and salinities remained the same regardless of whether Base Case flow rates or CEQA Normal Minimum Operations flow rates were simulated due to the lack of outfall temperature and salinity data for the CEQA Normal Minimum Operations flow rates. A summary of model boundary conditions (ocean conditions, tidal range, and freshwater flows) can be found in **Table 4.2**. Generating station outfall flow rates, temperatures, and salinities are listed for Base Case scenarios in **Table 4.3** and for CEQA Normal Minimum Operations scenarios in **Table 4.4**.

4.6 SIMULATION RESULTS

Results of the simulations presented herein (a brief description of the scenarios is provided in **Table 4.1**) compare the CEQA Normal Minimum Operations simulation to the corresponding Base Case simulation. Therefore, scenario CEQA October is compared to 2005 A1, while scenario CEQA July is compared to 2005 A2 (see Table **4.1**).

The simulations modeled three parameters: outfall tracers, water temperature, and salinity. Outfall tracers show the percentage concentration of water within the LSGR Channel that is discharged from the six generating station outfalls; outfall tracer model results are illustrated on a longitudinal section of the model domain. The location of the longitudinal section within the model grid is marked on **Figure 4.4**. Results are plotted using line and contour figures. The line plots show the selected parameter near the surface and bottom of the channel. The contour figures provide a full two-dimensional view of the longitudinal section of the LSGR Channel.

4.6.1 Hydrodynamics

An estuary is generally defined as an area where freshwater meets ocean water that is driven by the tides; estuaries typically exhibit a freshwater lens atop higher salinity bottom waters. Conditions in the LSGR Channel with HnGS and AES operating (*i.e.*, existing conditions) do not resemble conditions in a typical estuary in that the cooling water discharges form a "barrier" between freshwater and saline water from the ocean, such that there is little or no upstream movement of ocean water from San Pedro Bay into the LSGR Channel, and San Pedro Bay water does not come into contact with freshwater from upstream.

4.6.2 Outfall Tracer

A "tracer" concentration of 100% was assigned in the model to cooling water discharges from the HnGS and AES outfalls; the outfall tracer indicates the percentage of water at a given location within the model domain that originated from the generating station outfalls. Model results indicate that generating station cooling water discharges make up a majority of the water within the LSGR Channel when the generating stations outfalls are operating. Outfall tracers show high levels of concentration (over 90%) near the outfalls during periods of relatively low flow, such as October 24, 2005. Predicted outfall tracer concentrations during the October 24, 2005 simulation period comparing Base Case and CEQA Normal Minimum Operations scenarios are plotted in **Figures 4.26** through **4.29**. The figures show a high concentration (over 90%) of outfall discharge water throughout the majority of the LSGR Channel. A lens of freshwater from upstream is visible along the surface of the channel and becomes more diluted as it flows downstream past the outfalls. A wedge of ocean water can be seen along the bottom of the channel at the downstream end of the domain. Tides drive the wedge of water past PCH during the October 24, 2005 period, but the wedge of ocean water at the bottom of the lower end of the LSGR Channel never reaches the outfall locations or comes into contact with freshwater from upstream.

Differences in the outfall tracer concentration in the LSGR Channel can be seen when comparing the predicted outfall tracers of the Base Case scenario (2005 A1) and the CEQA Normal Minimum Operations scenario (CEQA Oct). Decreasing the HnGS flow by a few hundred MGD does affect the hydrodynamics of LSGR Channel during a period of relatively low flow from the generating stations. However, differences that occur as a results of the CEQA Normal Minimum Operations scenario are small when looking at the entire profile of the channel (**Figures 4.28** and **4.29**), and basic features of the flow in the LSGR Channel are consistent with the Base Case.

The July 20, 2005 simulation period is a period of relatively high outfall flow rates. Comparisons of Base Case and CEQA Normal Minimum Operations scenarios predicted outfall tracer concentrations are plotted in **Figures 4.30** through **4.33**. LSGR Channel profiles show predicted outfall tracer concentrations similar to the levels predicted during the low flow period (over 90% for a majority of the channel). A lens of freshwater is visible along the surface of the channel; however it is almost completely diluted after passing the outfalls. The lens is also deeper even though total freshwater flow rates are approximately the same during both periods (**Table 4.2**). However, it is not possible to tell if the deepening of the lens is due to the increased flow, larger tidal range, or timing of the freshwater flow into the channel. The bottom wedge of ocean water is not simulated to travel as far upstream due to larger outfall flows even though there is a larger tidal range. The wedge of ocean water stops at approximately PCH during the July 20, 2005 period.

The larger observed flow rates during the July 20, 2005 period causes the reduction from observed HnGS flow rates to CEQA Normal Minimum Operations flow rates to be larger than the reduction during the October 24, 2005. However, because of the much larger AES flow rates, differences between the Base Case scenario (2005 A2) and the CEQA Normal Minimum Operations scenario (CEQA July) remain small. . As during the low flow period, reducing HnGS flow rates to CEQA Normal Minimum Operations levels does affect the hydrodynamics of the LSGR Channel. However, because of the consistently high flow rates of cooling water from AES during the high flow period, the CEQA Normal Minimum Operations scenario does not result in significant changes (**Figures 4.32** and **4.33**) in hydrodynamics in the LSGR Channel.

During both simulation periods, low flow (October 24, 2005) and high flow (July 20, 2005), the "barrier" formed by the cooling water discharges remains intact and separates the freshwater from upstream and the ocean water from San Pedro Bay. The HnGS CEQA Normal Minimum Operations flow rate, combined with observed AES flow rates, is sufficient to maintain the "barrier" during both simulated periods.

Animations showing outfall tracer concentrations for the four simulations are listed in **Appendix D** as Items 11 through 12.

4.6.3 Water Temperature

Differences in generating station heat loads do make a difference in LSGR Channel water temperature. As expected, higher heat loads will raise the average temperature of the flood control channel more than low heat loads. Simulated predictions of water temperature show higher water temperature profiles in the LSGR Channel during the high heat load period. However, outfall discharges are not the only inflow with a higher heat load. Freshwater inflows also provide some heat load to the LSGR Channel. Flows from upstream are usually small, shallow and heated by the sun. Freshwater high heat loads are higher in July, which has higher solar radiation, than in October.

Temperatures within the LSGR Channel are affected only slightly by the difference in flow rates between Base Case and CEQA Normal Minimum Operations during a low flow/low heat condition. This effect is noticeable in **Figures 4.34** through **4.37** that compare Base Case and CEQA Normal Minimum Operations scenarios. Excluding the immediate area around the outfalls, predicted water temperature differences in the rest of the channel are less than one degree when CEQA Normal Minimum Operations scenario is compared to the Base Case.

The high flow/high heat load period also shows only a slight difference in predicted water temperature during the CEQA Normal Minimum Operations scenario compared to the Base Case scenario. Predicted water temperatures for Base Case and CEQA Normal Minimum Operations scenarios are plotted in **Figures 4.38** through **4.41**. Similar to the low flow/low heat load scenarios the temperature differences are small for the majority of the LSGR Channel. Temperature differences are less than one degree between the CEQA Normal Minimum Operations scenarios and Base Case except in the immediate area around the outfalls.

Both the low heat load scenario and high heat load scenario show that the predicted water temperatures in the LSGR Channel are sensitive to the heat loading provided by the cooling water discharges. If flow rates and cooling water discharge temperatures change, the effect can be seen in the simulated water temperature profiles of the LSGR Channel. However, the effect is mostly localized to the areas near the outfalls.

Animations showing predicted water temperatures for the four simulations are listed in **Appendix D** as Items 13 through 14.

4.6.4 Salinity

Since the generating stations use saline water from Alamitos Bay as cooling water and provide the major source of inflow to the LSGR Channel, the majority of the water in the LSGR Channel has the approximate salinity of ocean water. Freshwater from upstream forms a lens on the surface of the LSGR Channel upstream of the generating station outfalls. The freshwater lens is diluted by mixing upon passing the outfalls and, depending on the relative flow rates, can be almost entirely diluted by saltwater before reaching the mouth of the channel.

Predicted salinity profiles closely resemble predicted tracer profiles in the LSGR Channel. During the low flow scenario, the lens of freshwater is predicted to travel almost intact past the generating station outfalls. The outfall discharges do mix and dilute the freshwater lens, but the predicted salinity of the lens is still well below that of saline water. Predicted levels of salinity along the surface past the outfalls are approximately 18 to 20 PSU. Comparisons of Base Case and CEQA Normal Minimum Operations scenario results are plotted in **Figures 4.42** through **4.45**. Differences between the predicted salinity of the Base Case scenario and the CEQA Normal Minimum Operations scenario are less than one PSU for the majority of the LSGR Channel. However, some areas do show larger changes in salinity. The largest salinity differences are seen at the surface, where predicted salinity values are one to four PSU lower for the CEQA Normal Minimum Operations scenario. The lower outfall flow rates of the CEQA Normal Minimum Operations scenario decreases mixing and dilution of the freshwater lens at the surface causing the lower salinity values. Less mixing within the channel also results in slightly higher salinities along the bottom of the channel during CEQA Normal Minimum Operations scenarios. Differences in salinity along the bottom are less than one PSU since the water is almost entirely ocean and discharge water which has approximately the same salinity (33.5 and 33.1 PSU, respectively).

The high flow period predicts more dilution of the freshwater lens. Flow rates are large enough to almost fully mix and dilute the freshwater lens when it reaches the generating station outfalls. Predicted salinity levels downstream of the outfalls range from approximately 24 and 32 PSU. Comparisons of Base Case and CEQA Normal Minimum Operations scenario results are plotted in **Figures 4.46** through **4.49**. Similar to the low flow scenario, CEQA Normal Minimum Operations causes salinity values within the channel to change to a lesser degree. Lower flow rates cause less mixing which causes lower salinities along the surface and higher salinities along the bottom of the channel. However, differences are less than one PSU for the majority of the salinity profile. The largest differences are again seen at the surface (approximately one to two PSU) due to less mixing of the freshwater lens. However, due to the consistently high flow rate of the AES outfalls the differences between CEQA Normal Minimum Operations and Base Case scenarios are smaller than predicted in the low flow scenario.

Animations showing predicted salinity for the four simulations are listed in **Appendix D** as Items 15 through 16.

4.6.5 Water Quality

Since only ELCOM was used to simulate the LSGR Channel, water quality parameters such as chlorophyll *a* and DO were not directly modeled. Instead, estimated changes in water age between Base Case and CEQA Normal Minimum Operations scenario were used to investigate water quality impacts of the proposed project. Using this information, effects of the proposed project on chlorophyll *a*, pH and DO in the LSGR Channel were then evaluated using information on simulated water quality in the HnGS Intake Channel, which has similar water age and hydrodynamic characteristics.

Water age is not a water quality parameter by itself, but is used as a computed indicator for other water quality parameters. Low water age means that water in an area is frequently replaced with "new" water, bringing with it the properties of the "new" water. High water age is indicative of poor flushing, and can be related to water quality problems such as high bacteria levels, lower DO, and high algae concentrations (Moffat and Nichol, 2007).

Water age in the LSGR Channel is not significantly increased with respect to water age in the Intake Channel due to the effective flushing in the LSGR Channel by cooling water discharges from the generating stations. Over one tidal cycle (approximately 12 hours), the net transport by the tide is zero, and the net transport due to the HnGS and AES cooling water discharges is about 7.8×10^7 ft^3 (2.2×10^6 m^3) toward the ocean. The overall volume of the LSGR Channel within the model domain is about 7.1×10^7 ft^3 (2.0×10^6 m^3), so that the "old" water in the whole LSGR Channel can be displaced and replenished by the "new" water from HnGS and AES in approximately one tidal cycle. Thus, water age in the LSGR Channel will increase by, on average, less than 12 hours when compared to the water discharged from HnGS and AES. When HnGS operates at the CEQA Normal Minimum Operation level, the net transport over one tidal cycle is reduced to 4.9×10^7 ft^3 (1.4×10^6 m^3) and the flushing of the whole LSGR Channel is estimated to require less than two tidal cycles, or one day.

From simulation results presented previously, well-mixed conditions are apparent in the LSGR Channel starting from a location just downstream of the outfalls to the ocean. **Figures 4.42** and **4.43** show few differences in outfall tracer concentrations between the Base Case and the CEQA Normal Minimum Operations. This indicates the hydrodynamics change only slightly at the upstream of the outfalls during CEQA Normal Minimum Operations; water age is expected to change very little as well in this area. Overall, increases in water age between Base Case and CEQA Normal Minimum Operations in the whole channel are estimated not to exceed about one tidal cycle or 12 hours. The increases are similar to those experienced in the HnGS Intake Channel when the HnGS Intake Channel model predicts that the mean annual average water age in the Intake Channel increases from 1.1 days for the Base Case to 1.7 days for CEQA Normal Minimum Operations.

Given the similarities in water age and the river-like (uni-directional) hydrodynamic characteristics of both the LSGR and HnGS Intake Channels, changes in water quality parameters such as chlorophyll *a* and DO in the LSGR Channel will be similar to those simulated using CAEDYM in the Intake Channel. As previously discussed in Section 3.5, the highest annual average chlorophyll *a* concentrations within the Intake Channel are predicted to increase from 2.9 μg/L for the Base Case to 3.4-3.5 μg/L for CEQA Normal Minimum Operations. The highest maximum chlorophyll *a* concentrations are predicted to increase from 9.0-9.1 μg/L for the Base Case to 11.7-11.8 μg/L for CEQA Normal Minimum Operations (presented as a range for the moderate and high CAEDYM parameters). In the Intake Channel, the minimum DO concentrations are predicted to be 7.4-7.9 mg/L for the Base Case and 7.3-7.8 mg/L for CEQA Normal Minimum Operations (presented as a range for the moderate and high CAEDYM parameters). Similar ranges of chlorophyll *a* and DO are expected in the LSGR Channel. As a result, results for water quality in the LSGR Channel are as follows: (1) increases in chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios in the LSGR Channel are expected to be smaller than the ranges that span the trophic state categories listed in **Table 2.6**; (2) the annual average and minimum DO concentrations in the LSGR Channel are expected to be above the Basin Plan mean annual DO specification of 6 mg/L or greater and the single occurrence Basin Plan minimum of 5 mg/L. DO concentrations are not expected to drop to 0 mg/L (anoxic conditions) under either of the scenarios considered, and should therefore not result in undesirable odors or release of undesirable chemical constituents from channel bottom sediments since no anaerobic conditions are expected to occur.

4.7 Conclusions

ELCOM was successfully calibrated and validated for the LSGR Channel using five field sample events. Each calibration/validation simulation captured the characteristics of the LSGR Channel and properly predicted the interactions of salt and freshwater within the LSGR Channel. ELCOM was therefore confirmed to be capable of describing the temperature and salinity distributions in the LSGR Channel under both typical conditions and subsequent to post-rain events with equivalent accuracy.

Conditions in the LSGR Channel under the Base Case (existing condition) scenario do not resemble conditions in a typical estuary, in that the cooling water discharges form a "barrier" between freshwater and saline ocean water, such that there is little or no upstream movement of ocean water from San Pedro Bay. Under Base Case conditions there is no direct contact between San Pedro Bay water and freshwater.

The generating station outfalls provide the major source of inflow to the LSGR Channel and dominate the hydrodynamic behavior of the LSGR Channel. The flow from the outfalls has a large effect on the net transport into and out of the LSGR Channel, even when the generating stations are operating at relatively low capacity, such as on October 24, 2005. The generating station discharges form a "barrier" between the ocean and LSGR Channel freshwater flows, and this barrier remains intact during both CEQA Normal Minimum Operations scenarios. The HnGS CEQA Normal Minimum Operations flow rate, combined with observed AES flow rates, is sufficient to maintain the "barrier" during both simulated periods.

During both CEQA Normal Minimum Operations scenarios the cooling water discharge "barrier" remains intact between the freshwater from upstream and the ocean water from San Pedro Bay. The HnGS CEQA Normal Minimum Operations flow rate, combined with observed AES flow rates, is sufficient to maintain the "barrier" during both simulated periods.

Both the low heat load scenario and high heat load scenario indicate that predicted water temperatures in the LSGR Channel are sensitive to the heat loading provided by the cooling water discharges. Comparisons between the Base Case and CEQA Normal Minimum Operations scenarios confirm this effect. If flow rates and cooling water discharge temperatures change, the effect can be seen in the water temperature profile within the LSGR Channel; however, the effect is mostly localized to the areas near the outfalls. The majority of the LSGR Channel shows less than a one degree increase in water temperature for CEQA Normal Minimum Operations scenarios relative to the Base Case.

Since the generating stations use saline water from Alamitos Bay as cooling water, and provide the major source of inflow to the LSGR Channel, the majority of water in the LSGR Channel has the approximate salinity of ocean water. Freshwater from upstream forms a lens on the surface of the LSGR Channel upstream of the generating station outfalls. The freshwater lens is diluted upon passing the outfalls and, depending on the flow rates, can be almost entirely mixed with saltwater before reaching the mouth of the channel. HnGS outfall salinities remained the same regardless of whether Base Case flow rates or CEQA Normal Minimum Operations flow rates were simulated due to the lack of outfall salinity data. Differences between the predicted salinity for Base Case scenarios and CEQA Normal Minimum Operations scenarios are typically less than one PSU, although some areas do show larger differences. Lower flow rates cause less mixing, which in turn causes lower salinities along the surface and higher salinities along the bottom of the channel. The largest salinity differences are seen at the surface, where predicted salinity values are one to four PSU lower for the CEQA Normal Minimum Operations scenarios than the Base Case scenarios.

An investigation of water age in the LSGR Channel demonstrated that water in the LSGR Channel is likely less than 12 hours older than the water from HnGS and AES discharges when HnGS operates at full capacity. When HnGS operates at the CEQA Normal Minimum Operations level, net transport over one tidal cycle is reduced and flushing of the LSGR Channel model domain takes less than two tidal cycles or one day. Overall, increases in water age between Base Case and CEQA Normal Minimum Operations in the whole channel are not expected to exceed about one tidal cycle or 12 hours. Because of the close coupling of the flows in the LSGR Channel and the HnGS Intake Channels, changes in water quality parameters such as chlorophyll *a* and DO predicted in the HnGS Intake Channel with CEQA Normal Minimum Operations will also be experienced in the LSGR Channel. Ranges of chlorophyll *a* and DO in the LSGR Channel will be similar to those predicted by the HnGS Intake Channel modeling. As a result, similar conclusions to those drawn from the HnGS Intake Channel modeling can be drawn for water quality in the LSGR Channel: (1) increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios in the LSGR Channel are expected to be an order of magnitude smaller than the average annual values, and smaller than the ranges that span the trophic state categories; (2) the annual average and minimum DO concentrations in the LSGR Channel are all expected to meet Basin Plan DO criteria.

5.0 DISCUSSION AND CONCLUSIONS

The LADWP is in the process of preparing CEQA compliance documents for the proposed HnGS Units 5 and 6 Repowering Project. As part of the process, Flow Science has conducted three-dimensional CFD modeling of Alamitos Bay, the HnGS Intake Channel, and the LSGR Channel to assist LADWP in evaluating the effects of the proposed CEQA Normal Minimum Operations on hydrodynamics and water quality. Simulations were performed for calendar year 2005 for two flow operation scenarios: (1) Base Case with actual 2005 HnGS and AES flow rates (2) CEQA Normal Minimum Operations with constant flow rate of 311 MGD for HnGS and actual 2005 AES flow rates. All other model inputs for the CEQA Normal Minimum Operations run simulation scenario are identical to the Base Case.

Chapters 2, 3, and **4** presented the results from the three models developed by Flow Science: the Alamitos Bay ELCOM/CAEDYM model, the HnGS Intake Channel ELCOM/CAEDYM model, and the LSGR Channel ELCOM model. Below are the main conclusions from these three modeling efforts.

5.1 Alamitos Bay

The main results of the ELCOM and CAEDYM simulations for the two flow scenarios considered are:

- The lowest water age is found in the channel connecting the Bay and the ocean, and the highest water age is found in the upper portion of the Marine Stadium. CEQA Normal Minimum Operations results in less water being pulled both from the ocean and through the main portion of Alamitos Bay, but only slight rises in near-surface water age are predicted in Los Cerritos Channel and the Marine Stadium under CEQA Normal Minimum Operations relative to the Base Case. For both flow scenarios, near-surface annual average water age in most of the Bay is predicted to be less than six days throughout the year, with small portions of the Marine Stadium and the marinas adjacent to Los Cerritos channel predicted to have water age of up to 8 days. Maximum water age during the summer is predicted to reach between 20 and 22 days in a marina adjacent to Los Cerritos Channel for both flow scenarios. CEQA Normal Minimum Operations is not predicted to cause large increases in annual average near-surface water age (less than 1 day). Increases in the annual maximum near-surface water age are expected with CEQA Normal Minimum Operations, with the largest change in maximum water age (between 3.0 and 3.5 days) predicted to occur south of the 2nd Street Bridge.

- Peaks in nutrient concentration correspond to storm water inflows, but nutrient concentrations are found to be nearly identical for all simulation scenarios. Thus, changes in chlorophyll *a* and DO are more directly related to season and changes in water age.

- Chlorophyll *a* concentrations are predicted to be highest during the summer months for all modeled scenarios. Maximum annual chlorophyll *a* concentrations are predicted to be highest at the upstream end of Alamitos Bay, and most peaks in chlorophyll *a* are short-lived. Higher peaks in chlorophyll *a* concentrations are predicted for CEQA Normal Minimum Operations, especially during the spring. For the high CAEDYM parameters considered, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 4.1 µg/L for the Base Case and 4.3 µg/L for CEQA Normal Minimum Operations. With moderate CAEDYM parameter values, the highest annual average chlorophyll *a* concentrations at any location within the Bay are predicted to be 3.4 µg/L for the Base Case and 3.8 µg/L for Normal CEQA Normal Minimum Operations. The highest annual maximum chlorophyll *a* concentrations at any location within the Bay are predicted to be greater than 60 µg/L for all scenarios, but these high values are expected to occur only at a few locations and are not predicted to be the norm. Over most of the Bay, increases in annual maximum chlorophyll *a* concentration are predicted to be less than 4 µg/L with CEQA Normal Minimum Operations. Under CEQA Normal Minimum Operations, annual maximum chlorophyll *a* concentrations are generally predicted to increase by less than 8 µg/L in the corner of the Bay near the HnGS Intake, with only a few locations predicted to have higher increases in chlorophyll *a* concentrations. In general, CEQA Normal Minimum Operations a predicted to result in an increase in chlorophyll *a* (algae) concentrations in Alamitos Bay, but predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the average annual values, and smaller than the ranges that span the trophic state categories.

- DO is generally found to be higher in the summer months, with dips in DO corresponding to large peaks in chlorophyll *a* concentration. DO concentrations are slightly higher and more uniform in the channel connecting the Bay to the Ocean than in other portions of the Bay. In general, DO concentrations are predicted to be slightly lower under CEQA Normal Minimum Operations than under the Base Case scenario. Annual average near-bottom DO concentrations at all locations in the Bay for all scenarios simulated are predicted to be greater than the Basin Plan mean annual DO specification of 6.0 mg/L. Using moderate CAEDYM parameter values, both flow scenarios are also predicted to maintain annual minimum DO concentrations above 6.0 mg/L at all locations throughout the year. With high CAEDYM parameter values, even the Base Case flow scenario is predicted to produce near-bottom DO concentrations below the single occurrence Basin Plan minimum of 5.0 mg/L at some locations, particularly in the upstream ends of the Marine Stadium, and the Los Cerritos Channel, and in the marinas adjacent to Los Cerritos Channel. Low DO concentrations would be expected to occur infrequently anywhere in the domain, with total annual duration below 5.0 mg/L on the order of days. CEQA Normal Minimum Operations is predicted to cause an increase in the frequency of low DO concentration, but DO is not predicted to go below 3.1 mg/L, thus staying well above 0 mg/L (anoxic conditions) under any of the scenarios simulated. As a result, undesirable odors or the release of undesirable chemical constituents from channel bottom sediments are not expected to occur as a result of DO depletion. For both flow scenarios, the lowest DO concentrations are predicted to occur in the Marine Stadium and the marinas adjacent to the Los Cerritos Channel since these areas have restricted flow, high water age, and relatively high chlorophyll *a* concentrations. The largest decreases in DO with CEQA Normal Minimum Operations are predicted to be between 0.5 and 1.0 mg/L at locations to the north and south of the 2nd Street Bridge.

5.2 HnGS Intake Channel

The main results of the ELCOM and CAEDYM simulations for the two flow scenarios considered are:

- Simulation results indicate that the flow rate at HnGS for CEQA Normal Minimum Operations will lead to slightly higher water age in the Intake Channel as compared to the Base Case (see **Table S.5**), where water age is defined relative to the time when water first enters Alamitos Bay (note that the theoretical average residence time of water in the Intake Channel is only 2.4 hours for the Base Case and 6.0 hours for CEQA Normal Minimum Operations). The mean annual average water age in the Intake Channel is predicted to increase from 1.1 days for the Base Case to 1.7 days for CEQA Normal Minimum Operations, while the maximum water age at any cell within the domain is predicted to increase from 6.9 days to 7.3 days. Water age in the northern portion of the Intake Channel (between Station 2 and Station 1) is slightly higher than in the southern portion (between Station 2 and Station 3) due mainly to the effect of tidal flushing with Alamitos Bay (via the Intake Channel siphons), which decreases with increasing distance from the channel entrance.

- Chlorophyll *a* concentrations are predicted to be highest during the summer months. Higher chlorophyll *a* concentrations are also predicted to occur under CEQA Normal Minimum Operations scenarios relative to the Base Case. As with water age, most of the chlorophyll *a* formation occurs within Alamitos Bay as evidenced by comparing the average and maximum chlorophyll *a* concentrations in the inflow from Alamitos Bay with the concentrations predicted within the Intake Channel. The springtime peaks in chlorophyll *a* within the Intake Channel in 2005 are due to storm water pushing the Alamitos Bay water with increased water age and chlorophyll *a* concentrations into the Intake Channel. For the moderate and high CAEDYM parameters, the highest annual average chlorophyll *a* concentrations within the model domain are predicted to increase from 2.9 µg/L for the Base Case, to 3.4-3.5 µg/L for CEQA Normal Minimum Operations. The highest maximum chlorophyll *a* concentrations are predicted to increase from 9.0-9.1 µg/L for the Base Case to 11.7-11.8 µg/L for CEQA Normal Minimum Operations (presented as a range for the moderate and high CAEDYM parameters). Thus, the predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are typically an order of magnitude smaller than the average annual and maximum predicted values, and smaller than the ranges that span the trophic state categories.

- The predicted DO concentrations do not vary greatly along the length of the Intake Channel or over depth for either the Base Case or CEQA Normal Minimum Operations scenarios. The minimum DO concentrations are predicted to be 7.4-7.9 mg/L for the Base Case and 7.3-7.8 mg/L for CEQA Normal Minimum Operations (presented as a range for the moderate and high CAEDYM parameters). The lowest annual minimum DO concentration in any cell of the model domain for any scenario is predicted to be 7.3 mg/L. As such, the annual average and minimum DO concentrations for the scenarios modeled are predicted to meet Basin Plan DO criteria and are not predicted to result in undesirable odors or release of undesirable chemical constituents from channel bottom sediments.

These simulation results indicate that the Intake Channel water quality is largely controlled by the water quality of the inflow from Alamitos Bay and the cooling water flow rate for HnGS. The CEQA Normal Minimum Operations scenario is predicted to result in slight increases in water age and chlorophyll *a* concentrations in the Intake Channel as compared to the Base Case. The CEQA Normal Minimum Operations scenario is also predicted to cause a slight decrease in DO concentrations in the bottom waters of the Intake Channel; however, the DO concentrations are not predicted to drop below 7.3 mg/L for any of the simulated scenarios.

5.3 Lower San Gabriel River Channel

ELCOM was successfully calibrated and validated for the LSGR Channel using five field sample events. Each calibration/validation simulation captured the characteristics of the LSGR Channel and properly predicted the interactions of salt and freshwater within the LSGR Channel. ELCOM was therefore confirmed to be capable of describing the temperature and salinity dynamics in the LSGR Channel. Typical conditions and post-rain conditions events were both calibrated with equivalent accuracy.

- Conditions in the LSGR Channel under the Base Case (existing condition) scenario do not resemble conditions in a typical estuary, in that the cooling water discharges form a "barrier" between freshwater and saline ocean water, such that there is little or no upstream movement of ocean water from San Pedro Bay. Under Base Case conditions there is no direct contact between San Pedro Bay water and freshwater.

- The generating station outfalls provide the major source of inflow to the LSGR Channel and greatly affect the hydrodynamics of the LSGR Channel. The flow from the outfalls has a large effect on the net transport into and out of the LSGR Channel and effectively prevents contact between ocean water entering the channel with the tides and freshwater inflows from upstream, even when the generating stations are operating at relatively low capacity, such as on October 24, 2005. This barrier is present during both CEQA Normal Minimum Operations scenarios.

- Both the low heat load scenario and high heat load scenario indicate that predicted water temperatures in the LSGR Channel are sensitive to the heat loading provided by the cooling water discharges. Comparisons between the Base Case and CEQA Normal Minimum Operations scenarios confirm this effect. If flow rates and cooling water discharge temperatures change, the effect can be seen in the water temperature profile within the LSGR Channel; however, the effect is mostly localized to the areas near the outfalls. The majority of the LSGR Channel shows less than a one degree increase in water temperature for CEQA Normal Minimum Operations scenarios relative to the Base Case.

- Since the generating stations use saline water from Alamitos Bay as cooling water, and provide the major source of inflow to the LSGR Channel, the majority of water in the LSGR Channel has the approximate salinity of ocean water. Freshwater from upstream forms a lens on the surface of the LSGR Channel upstream of the generating station outfalls. The freshwater lens is diluted upon passing the outfalls and, depending on the flow rates, can be almost entirely mixed with saltwater before reaching the mouth of the channel. HnGS outfall salinities remained the same regardless of whether Base Case flow rates or CEQA Normal Minimum Operations flow rates were simulated due to the lack of outfall salinity data. Differences between the predicted salinity for Base Case scenarios and CEQA Normal Minimum Operations scenarios are typically less than one PSU, although some areas do show larger differences. Lower flow rates cause less mixing, which in turn causes lower salinities along the surface and higher salinities along the bottom of the channel. The largest salinity differences are seen at the surface, where predicted salinity values are one to four PSU lower for the CEQA Normal Minimum Operations scenarios than the Base Case scenarios.

- An investigation of water age in the LSGR Channel demonstrated that water in the LSGR Channel is likely less than 12 hours older than the water from HnGS and AES discharges when HnGS operates at full capacity. When HnGS operates at the CEQA Normal Minimum Operations level, net transport over one tidal cycle is reduced and flushing of the LSGR Channel model domain takes less than two tidal cycles or one day. Overall, increases in water age between Base Case and CEQA Normal Minimum Operations in the whole channel are not expected to exceed about one tidal cycle or 12 hours. Because of the close coupling of the flows in the LSGR Channel and the HnGS Intake Channels, changes in water quality parameters such as chlorophyll *a* and DO predicted in the HnGS Intake Channel with CEQA Normal Minimum Operations will also be experienced in the LSGR Channel. Ranges of chlorophyll *a* and DO in the LSGR Channel will be similar to those predicted by the HnGS Intake Channel modeling. As a result, similar conclusions to those drawn from the HnGS Intake Channel modeling can be drawn for water quality in the LSGR Channel: (1) increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios in the LSGR Channel are expected to be an order of magnitude smaller than the average annual values, and smaller than the ranges that span the trophic state categories; (2) the annual average and minimum DO concentrations in the LSGR Channel are all expected to meet Basin Plan DO criteria.

5.4 Overall Conclusions

The following provides an overall summary of the hydrodynamic and water quality effects on the water bodies of Alamitos Bay, HnGS Intake Channel and the LSGR Channel that would be expected with CEQA Normal Minimum Operations due to the Units 5 and 6 Repowering Project.

- In Alamitos Bay, lower water age is generally found in the channel connecting the Bay and the ocean, and higher water age is generally found in the upper portion of the Marine Stadium and the Los Cerritos Channel. CEQA Normal Minimum Operations results in only slight rises in predicted near-surface water age in Los Cerritos Channel and the Marine Stadium under CEQA Normal Minimum Operations relative to the Base Case: (1) annual average near-surface water age increases by less than 1 day; (2) The largest increases in annual maximum water age are predicted to be between 3.0 and 3.5 days and occur south of the 2nd Street Bridge. In the HnGS Intake Channel, simulation results indicate that CEQA Normal Minimum Operations will lead to slightly higher water age in the Intake Channel (less than one day for both mean annual average and annual maximum water age) as compared to the Base Case. An investigation concludes that increases of water age are expected to be less than 12 hours in the LSGR Channel with CEQA Normal Minimum Operations.

- In Alamitos Bay and HnGS Intake Channel, predicted increases in annual average chlorophyll *a* concentrations between the Base Case and CEQA Normal Minimum Operations scenarios are an order of magnitude smaller than the average annual predicted values and smaller than the ranges that span trophic state categories. The same conclusions can be drawn for the LSGR Channel based on its similarity to the HnGS Intake Channel.

- In Alamitos Bay and HnGS Intake Channel, the annual average DO concentrations were predicted to exceed the Basin Plan mean annual DO specification of 6 mg/L. DO concentrations are predicted to stay well above 0 mg/L (anoxic conditions) for all scenarios considered. Similar ranges of DO are expected in the LSGR Channel based on its similarity to the HnGS Intake Channel. As a result, undesirable odors or the release of undesirable chemical constituents from channel bottom sediments are not predicted since anaerobic conditions are not expected to occur.

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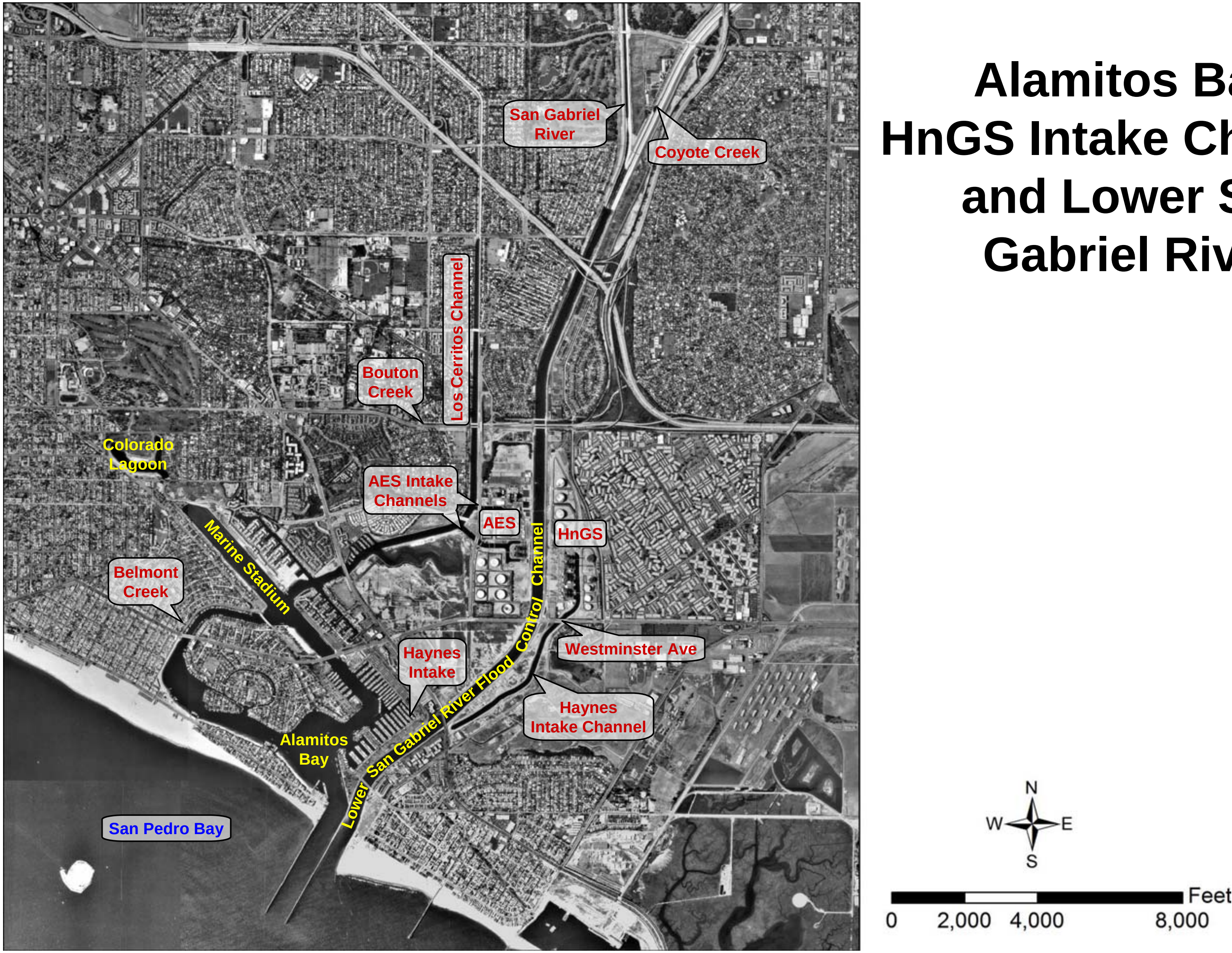
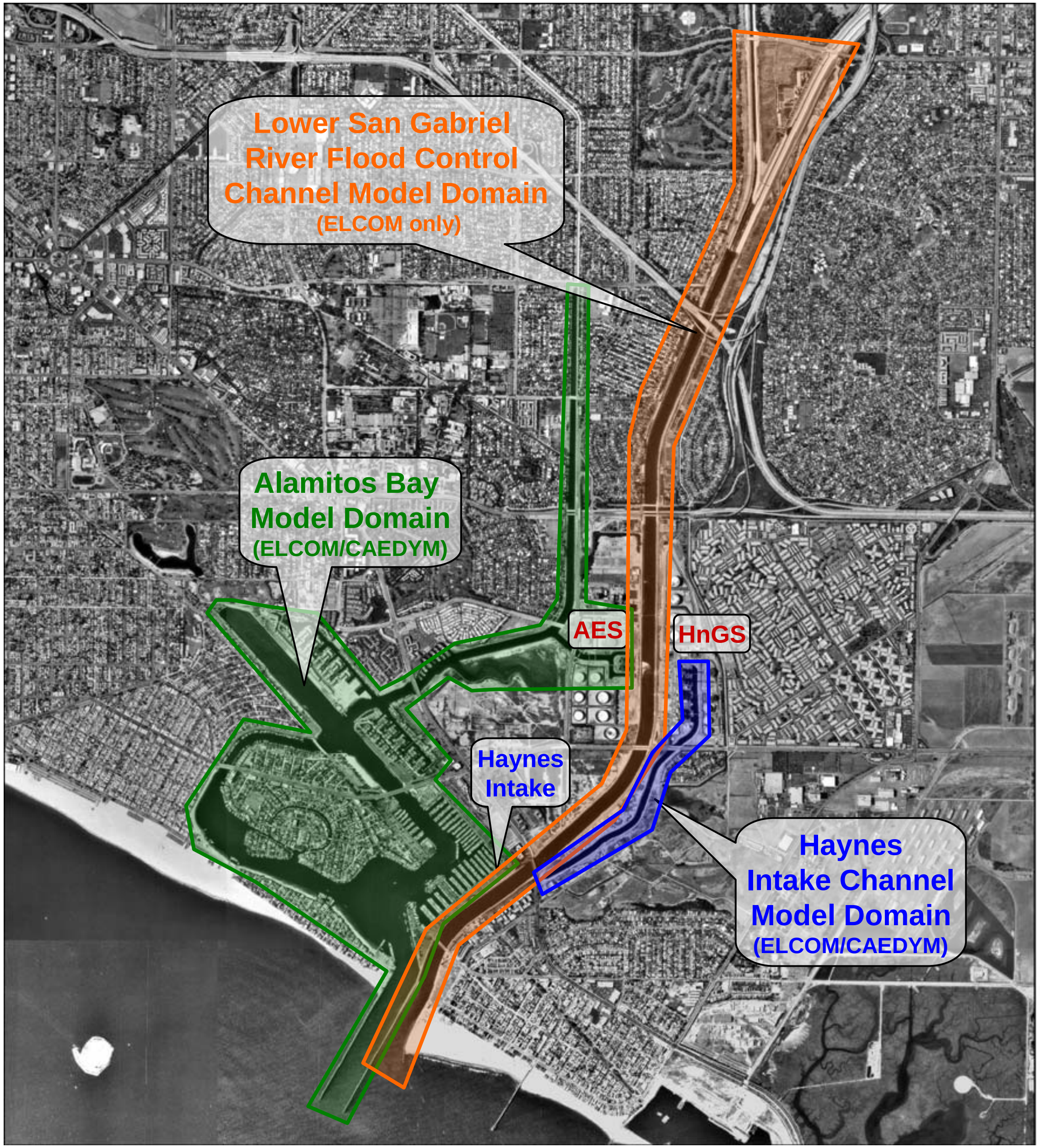
FIGURES



Alamitos Bay, HnGS Intake Channel, and Lower San Gabriel River

Figure 1.1



Alamitos Bay, HnGS Intake Channel, and Lower San Gabriel River Model Domains

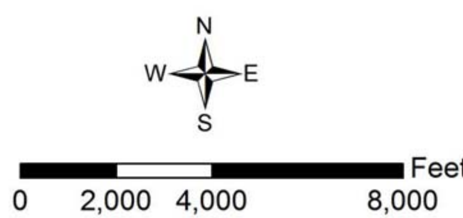
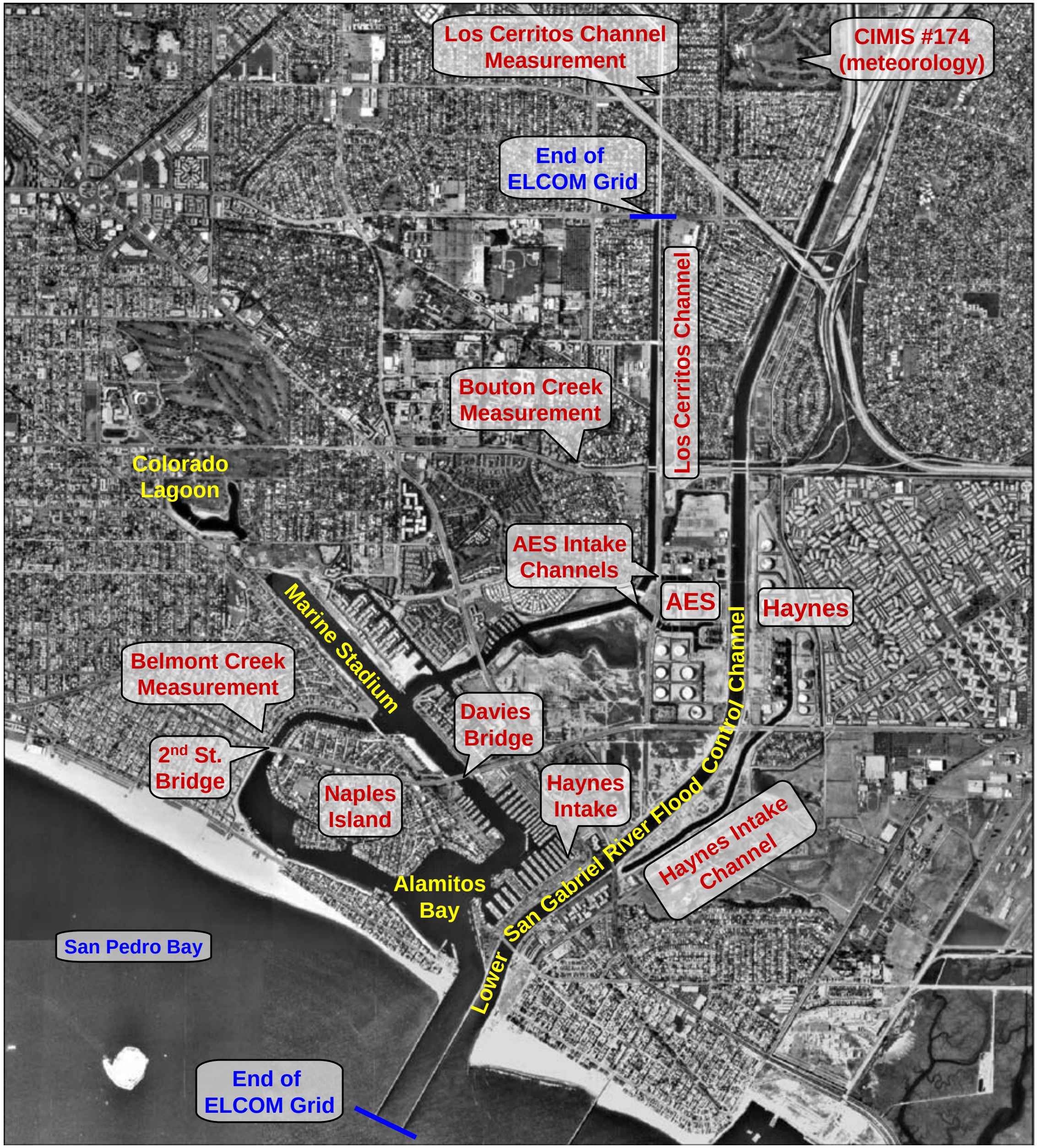
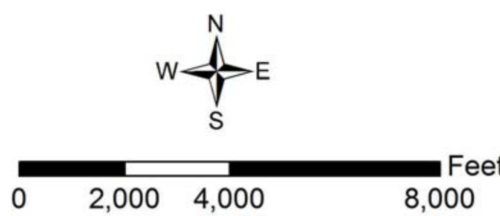


Figure 1.2



Alamitos Bay and Vicinity



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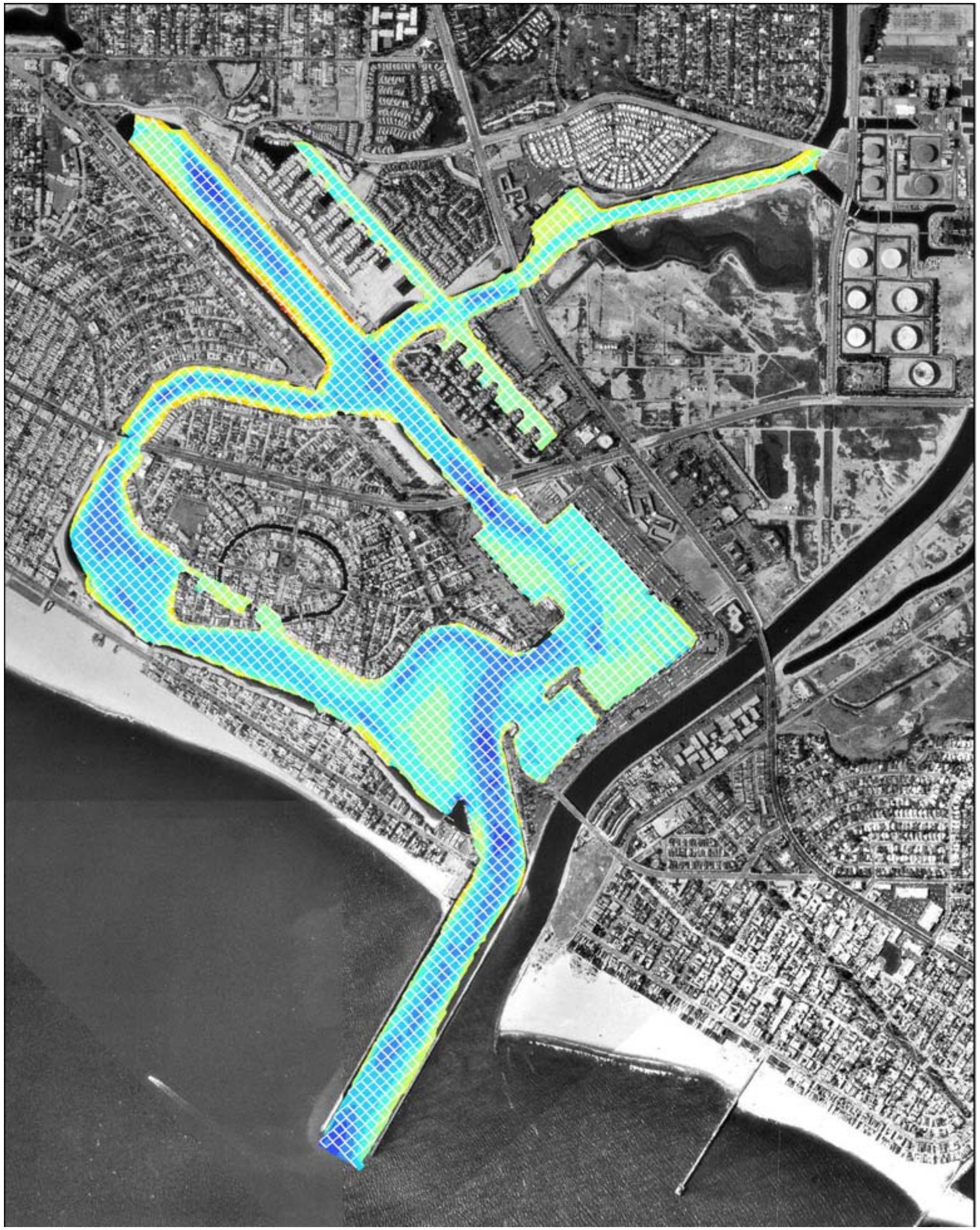


Alamitos Bay Bathymetry Data

2-m (6.6 ft) bathymetry data is shown with 30-m (98 ft) grid superimposed

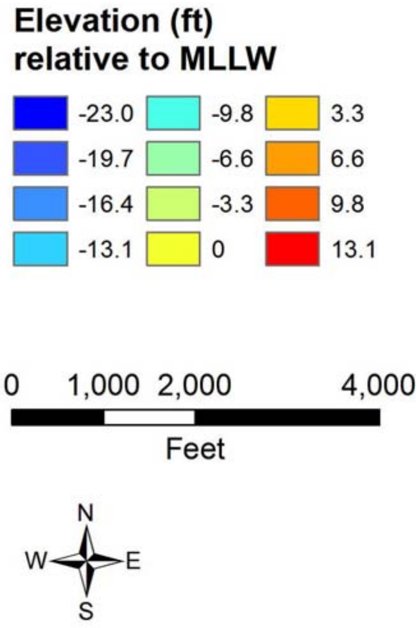


Figure 2.2

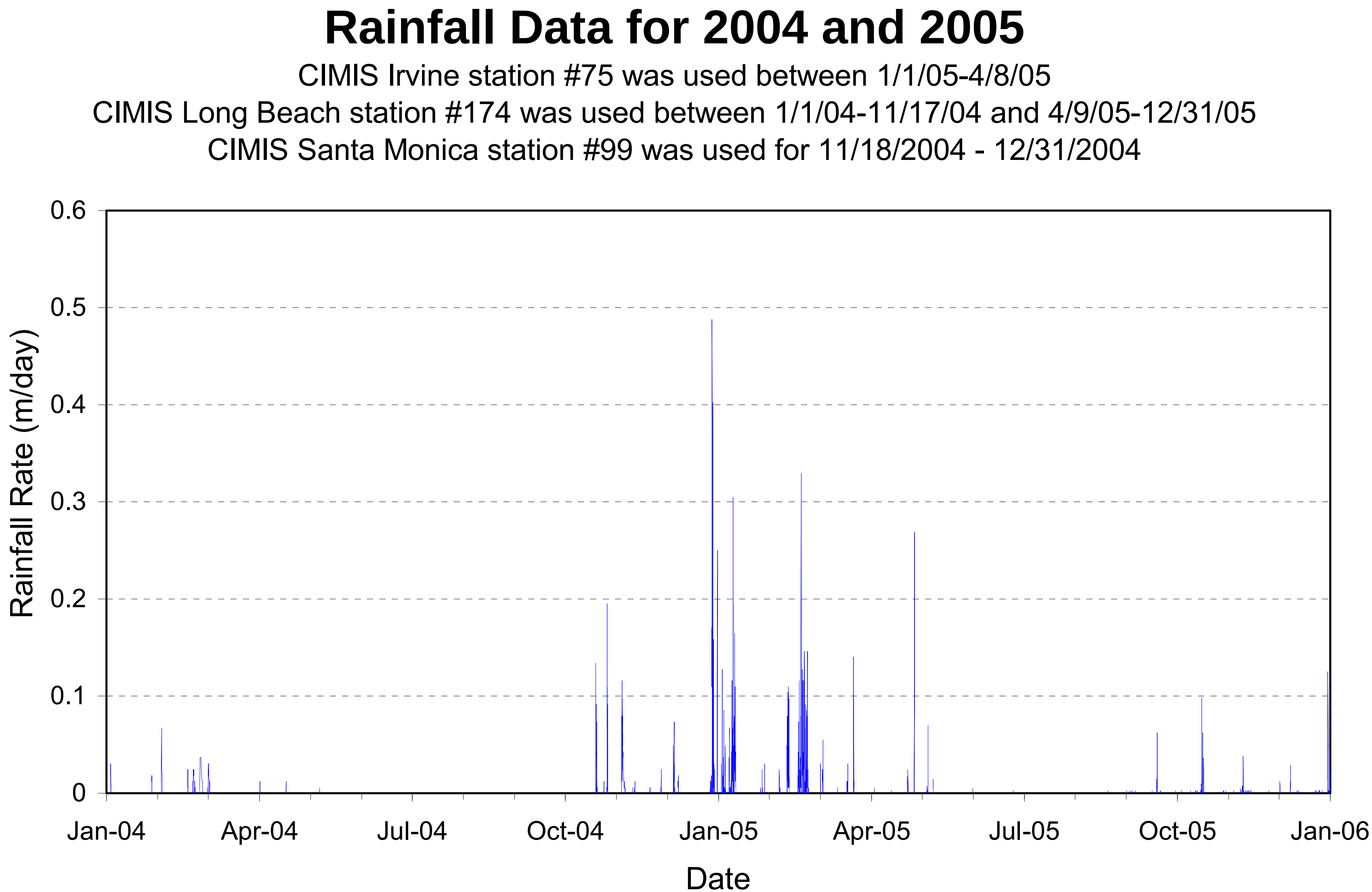

Rainfall Data for 2004 and 2005
CIMIS Irvine station #75 was used between 1/1/05-4/8/05
CIMIS Long Beach station #174 was used between 1/1/04-11/17/04 and 4/9/05-12/31/05
CIMIS Santa Monica station #99 was used for 11/18/2004 - 12/31/2004
Rainfall Rate (m/day)
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Date

Figure 2.3

Solar Radiation Data for 2004 and 2005

CIMIS Irvine station #75 was used between 1/1/05-4/8/05 and 10/27/05-12/31/05
CIMIS Long Beach station #174 was used between 1/1/04-11/17/04 and 4/9/05-10/26/05
CIMIS Santa Monica station #99 was used for 11/18/2004 - 12/31/2004

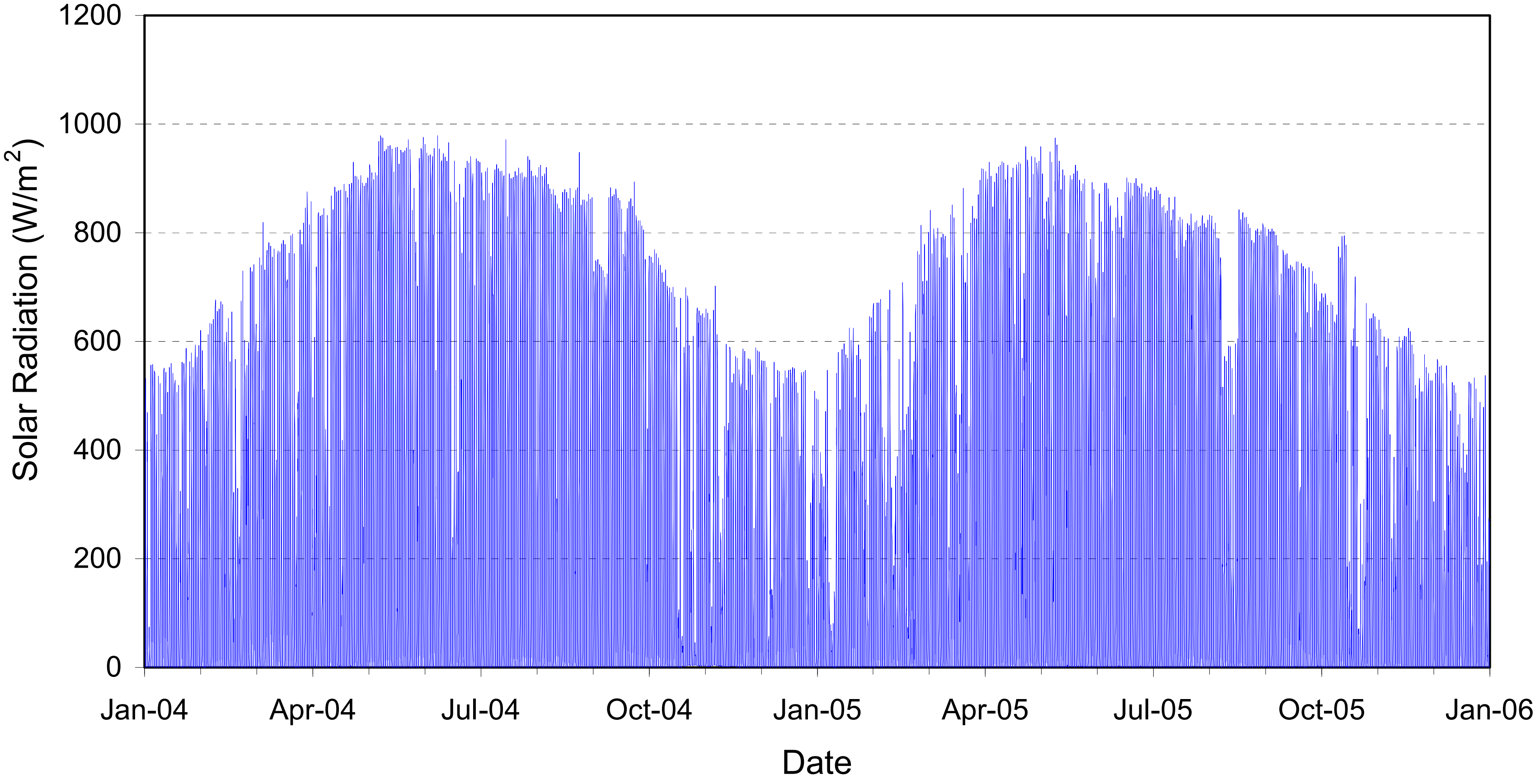
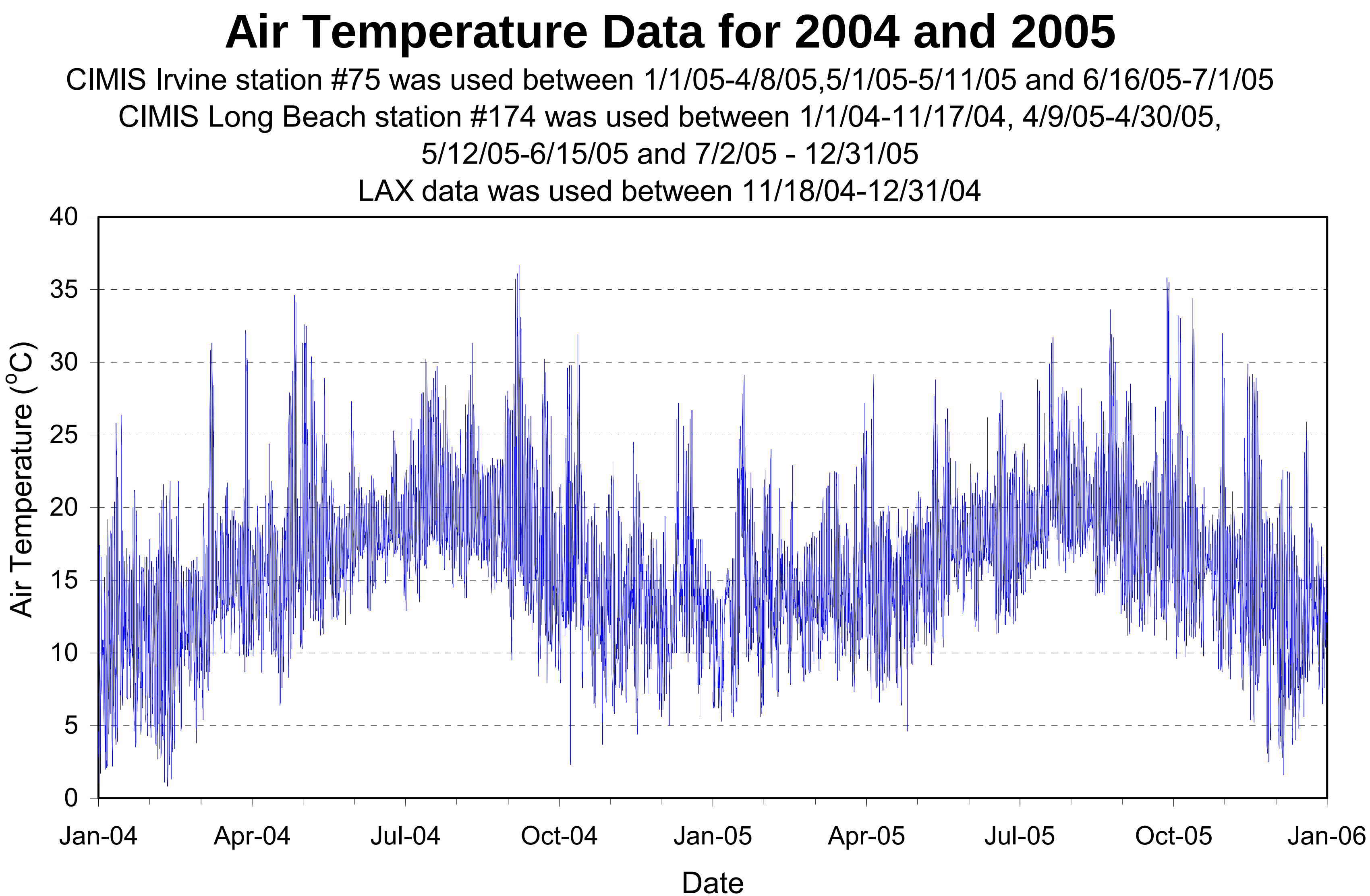


Figure 2.4

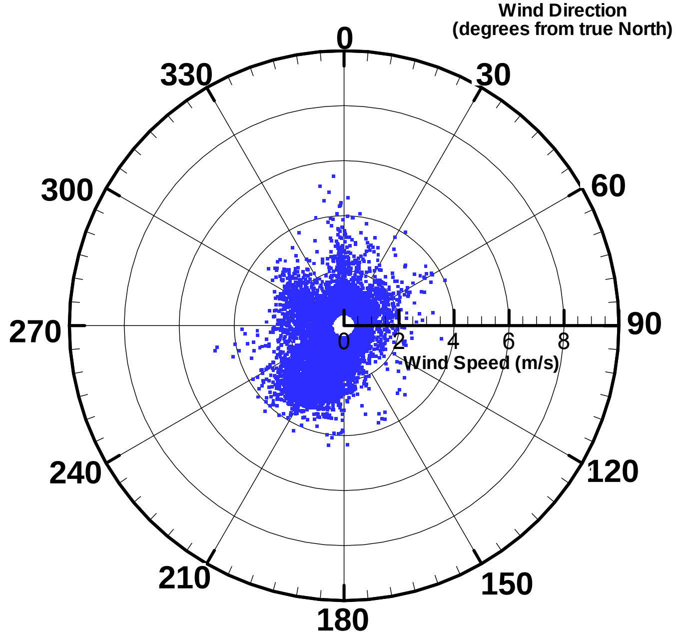


Air Temperature Data for 2004 and 2005
CIMIS Irvine station #75 was used between 1/1/05-4/8/05,5/1/05-5/11/05 and 6/16/05-7/1/05
CIMIS Long Beach station #174 was used between 1/1/04-11/17/04, 4/9/05-4/30/05,
5/12/05-6/15/05 and 7/2/05 - 12/31/05
LAX data was used between 11/18/04-12/31/04
Air Temperature (°C)
0
5
10
15
20
25
30
35
40
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Date

Wind Rose of Hourly Wind Data

2004

CIMIS Long Beach station #174 was used through 11/17/04;
CIMIS Santa Monica station #99 was used for 11/17/04 - 12/31/04



2005

CIMIS Irvine station #75 was used between 1/1/05-4/8/05
CIMIS Long Beach station #174 was used for the rest of the year

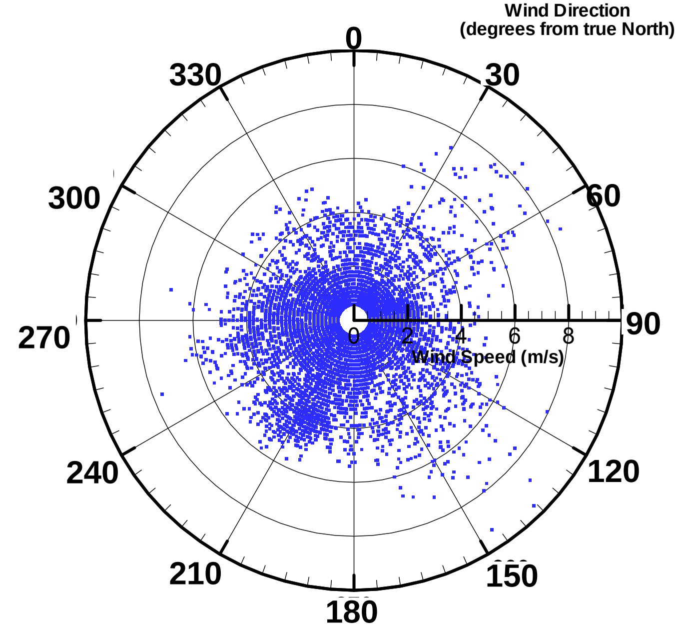
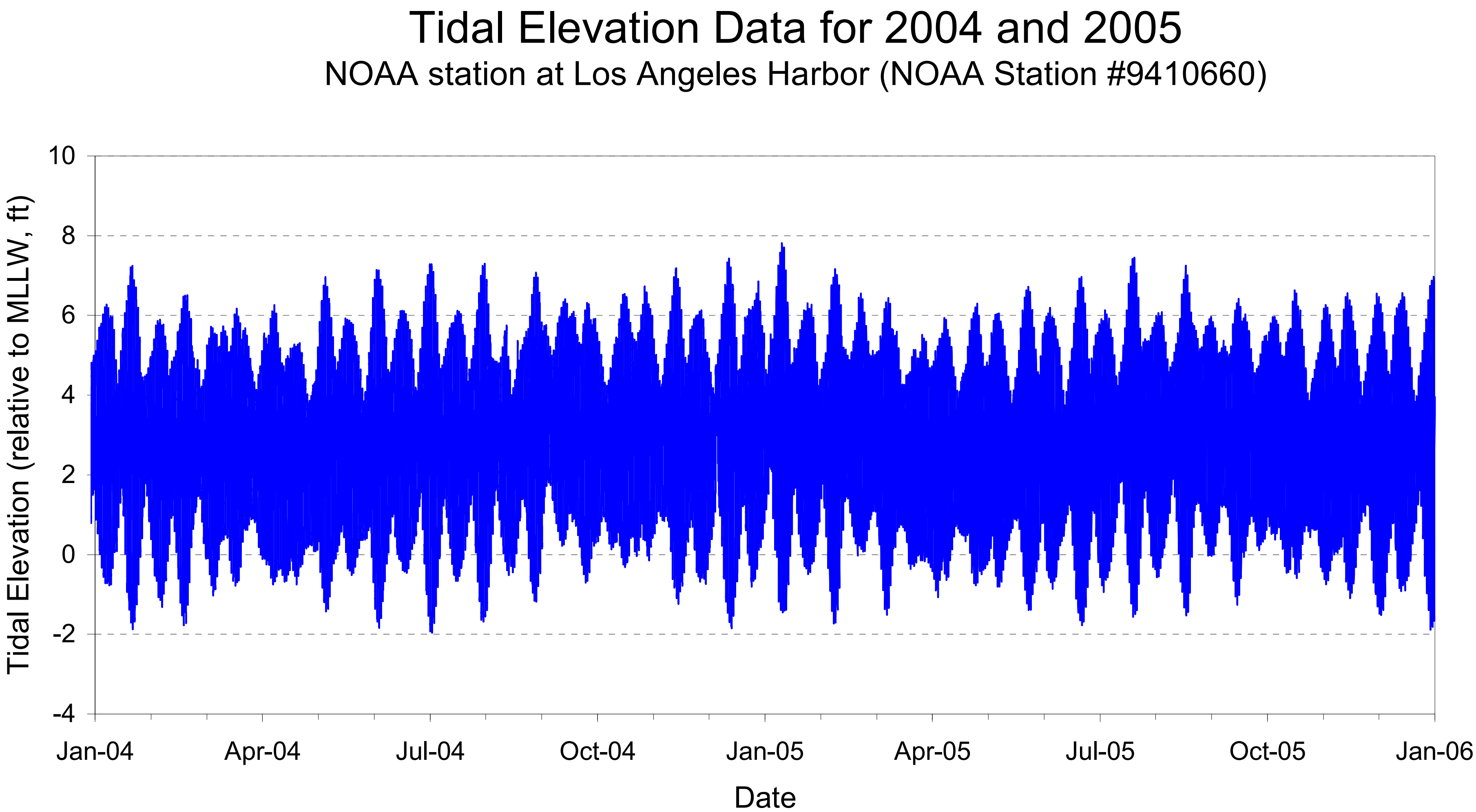


Figure 2.6



Tidal Elevation Data for 2004 and 2005
NOAA station at Los Angeles Harbor (NOAA Station #9410660)
Tidal Elevation (relative to MLLW, ft)
10
8
6
4
2
0
-2
-4
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Date

Figure 2.7

Flow Rate Data for 2004 and 2005

(Kinnetic Laboratories, 2008)

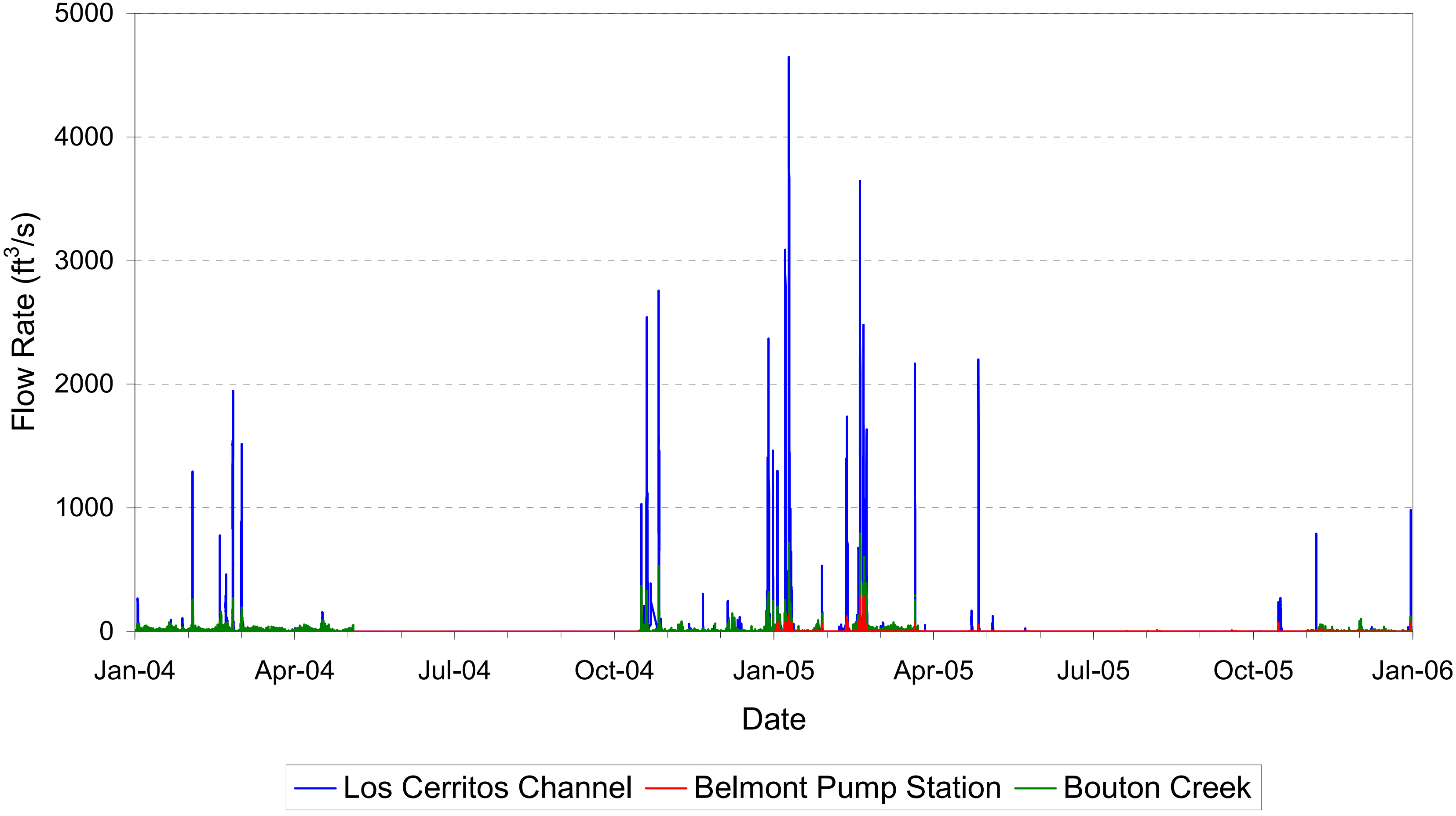


Figure 2.8

Correlation Between Volumes of Fresh Water During Storm Events at Los Cerritos Channel and Bouton Creek

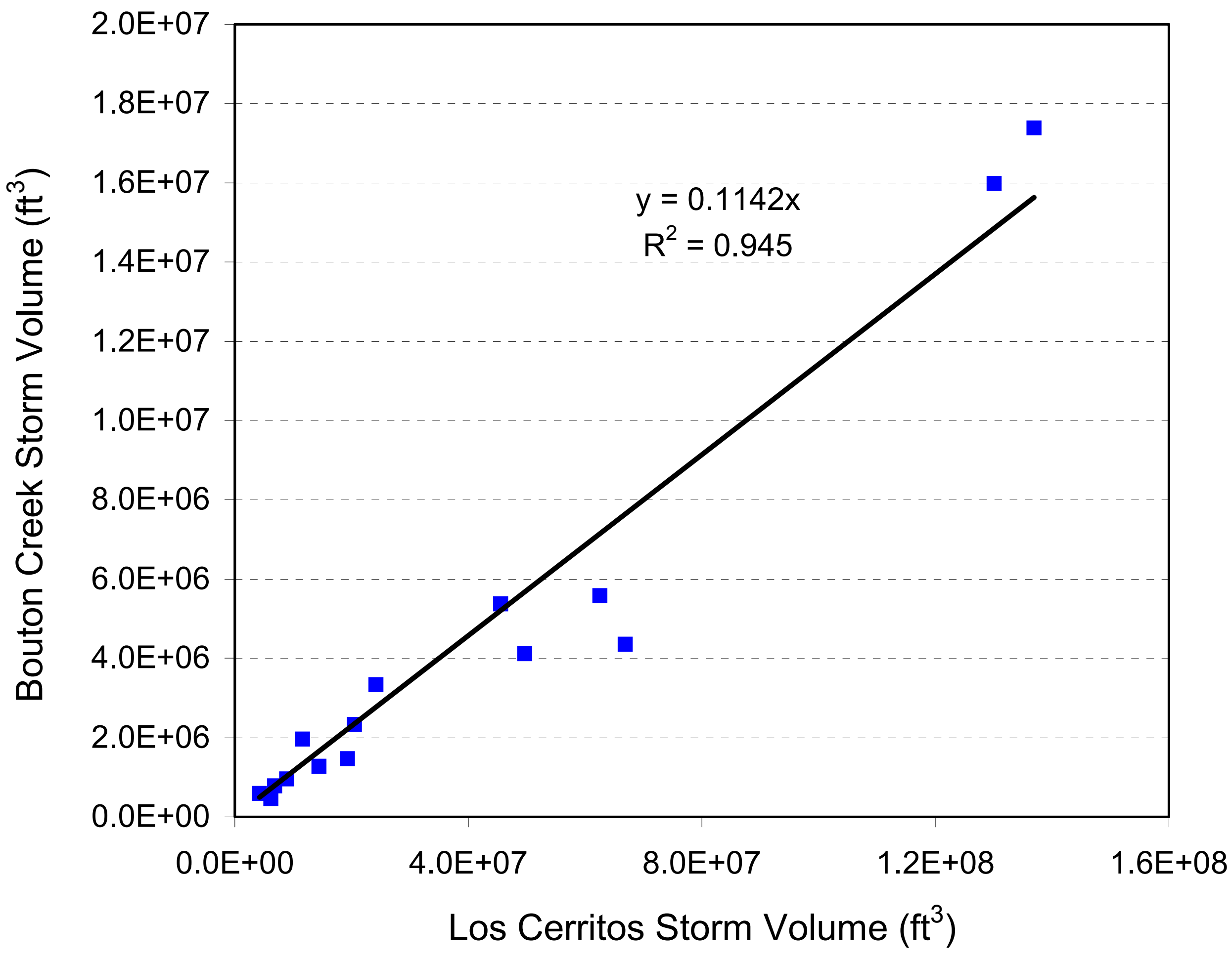
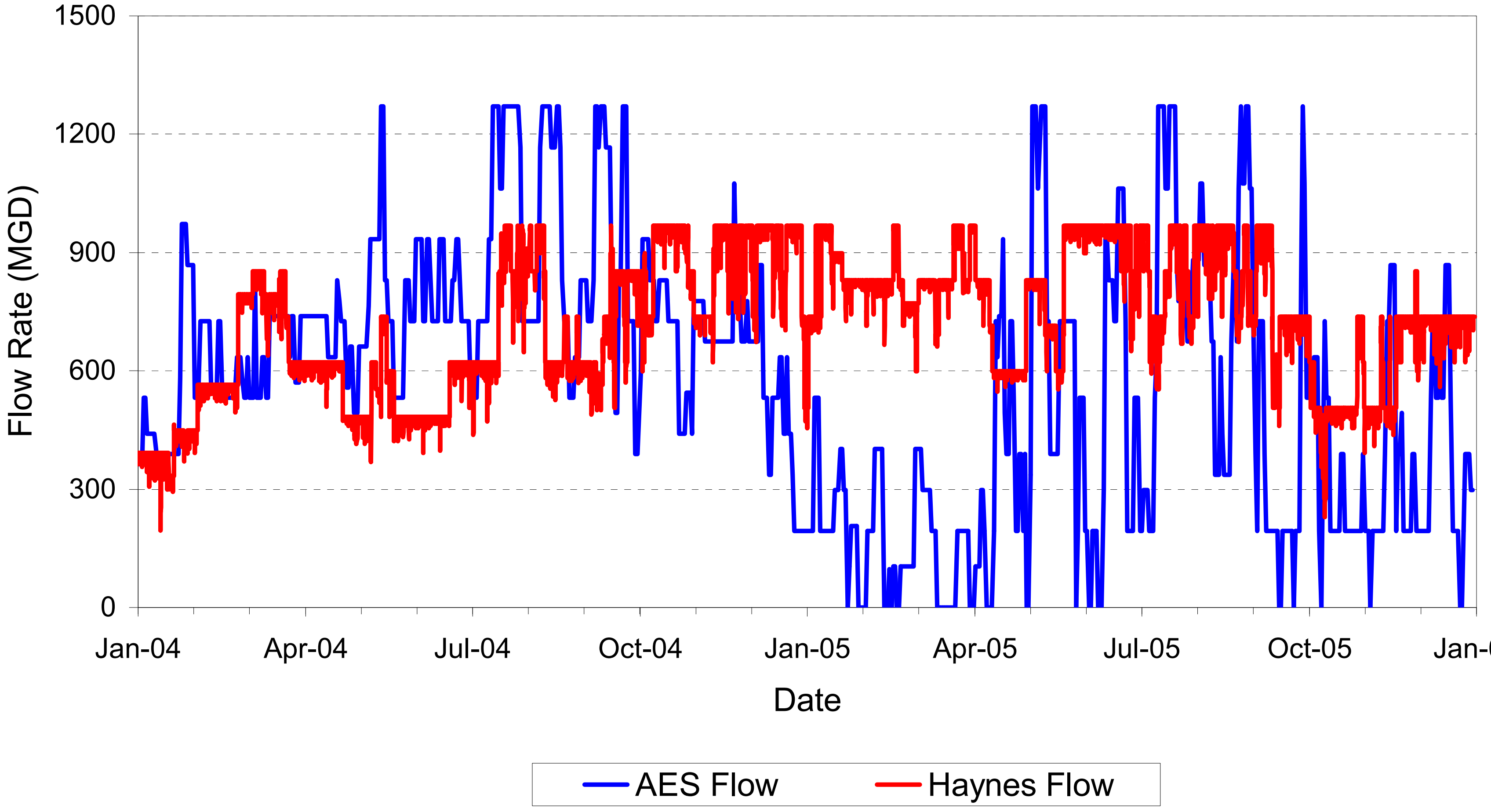
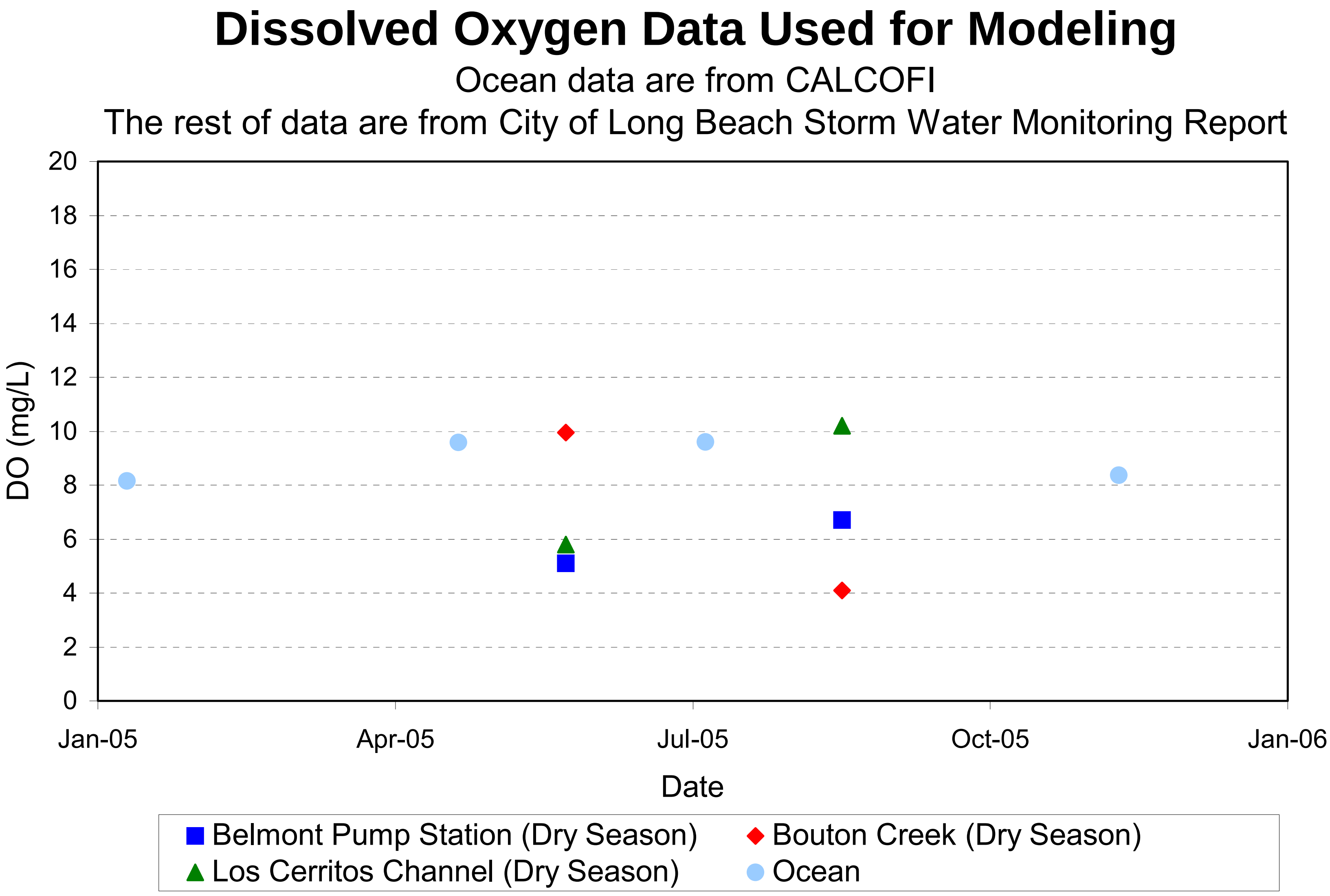


Figure 2.9

AES and Haynes Generating Station Cooling Water Flow Rates for 2004 and 2005





Dissolved Oxygen Data Used for Modeling
Ocean data are from CALCOFI
The rest of data are from City of Long Beach Storm Water Monitoring Report
DO (mg/L)
20
18
16
14
12
10
8
6
4
2
0
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Date
Belmont Pump Station (Dry Season)
Bouton Creek (Dry Season)
Los Cerritos Channel (Dry Season)
Ocean

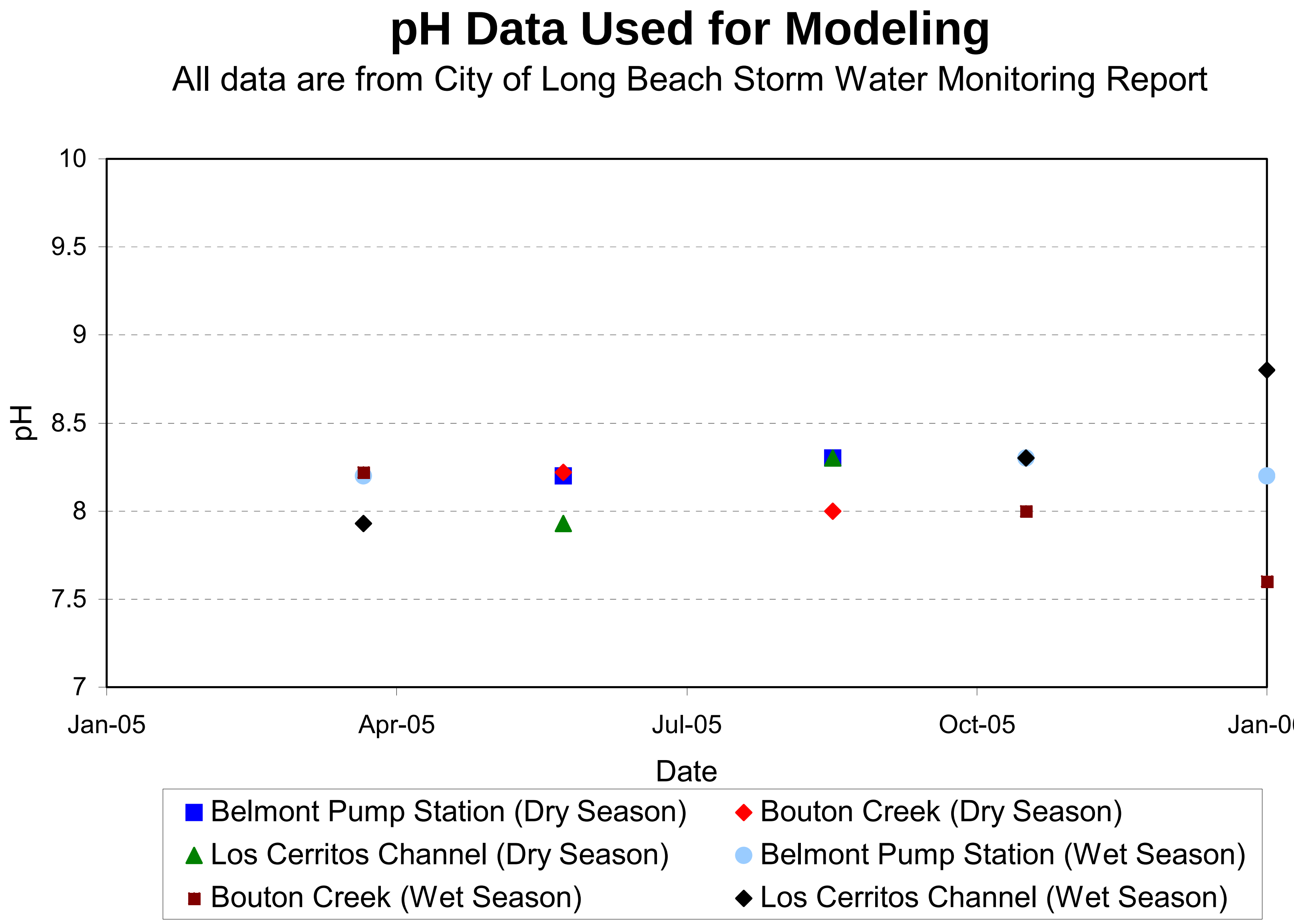
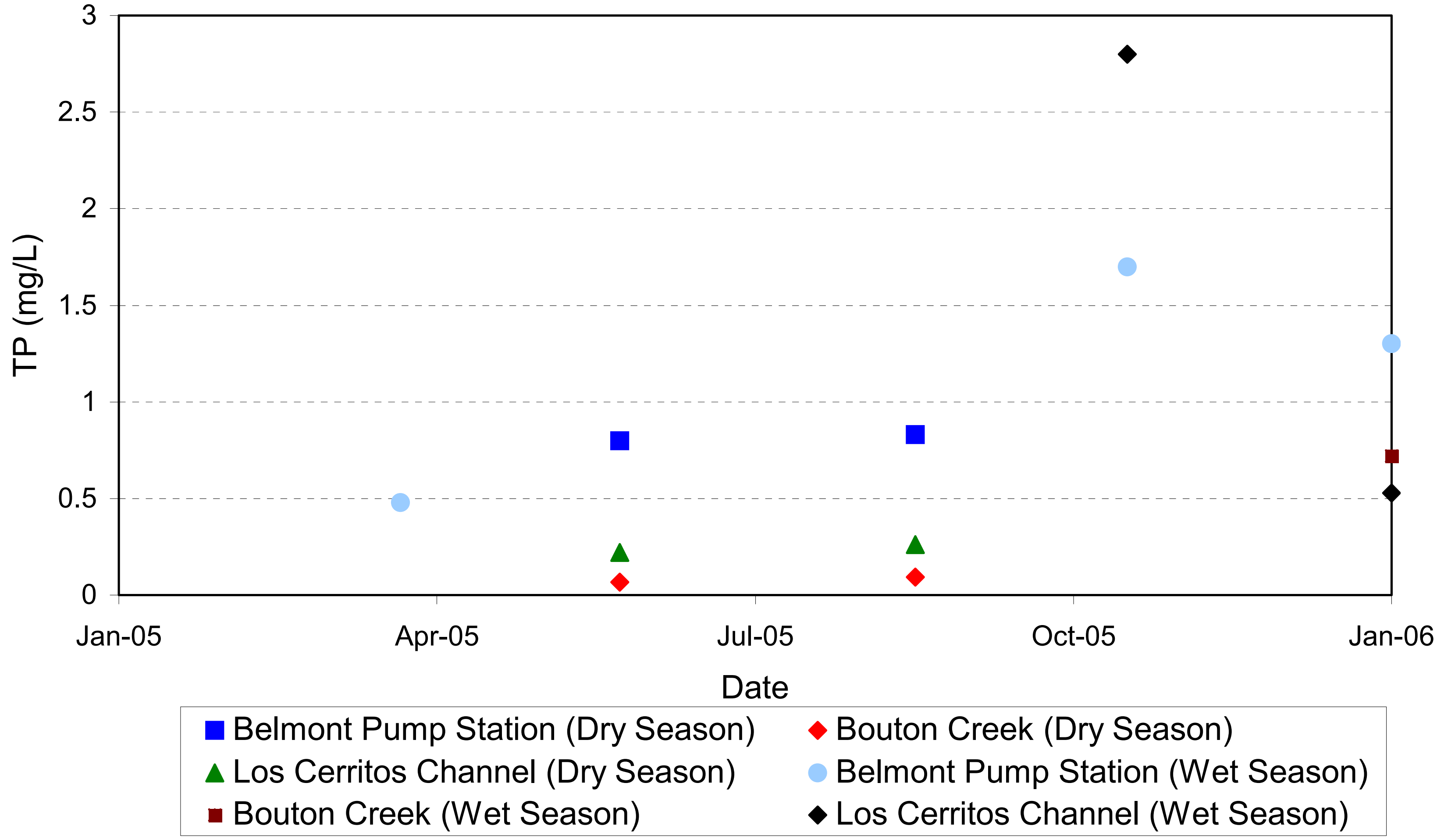

pH Data Used for Modeling
All data are from City of Long Beach Storm Water Monitoring Report
10
9.5
9
8.5
8
7.5
7
pH
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Date
Belmont Pump Station (Dry Season)
Bouton Creek (Dry Season)
Los Cerritos Channel (Dry Season)
Belmont Pump Station (Wet Season)
Bouton Creek (Wet Season)
Los Cerritos Channel (Wet Season)

Figure 2.12

Total Phosphorus Data Used for Modeling

All data are from City of Long Beach Storm Water Monitoring Report



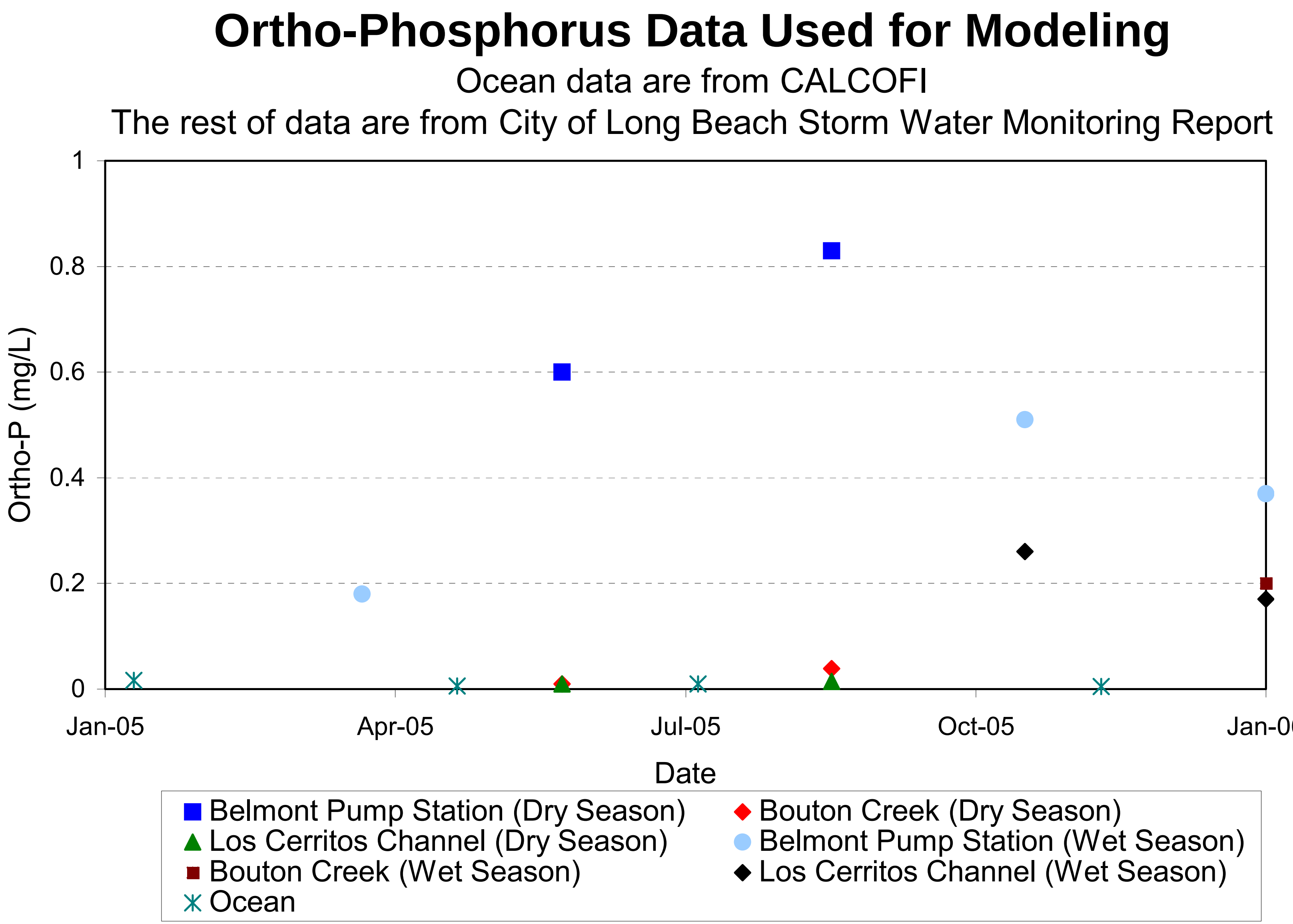

Ortho-Phosphorus Data Used for Modeling
Ocean data are from CALCOFI
The rest of data are from City of Long Beach Storm Water Monitoring Report
1
0.8
0.6
0.4
0.2
0
Ortho-P (mg/L)
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Date
Belmont Pump Station (Dry Season)
Bouton Creek (Dry Season)
Los Cerritos Channel (Dry Season)
Belmont Pump Station (Wet Season)
Bouton Creek (Wet Season)
Los Cerritos Channel (Wet Season)
Ocean

Figure 2.14

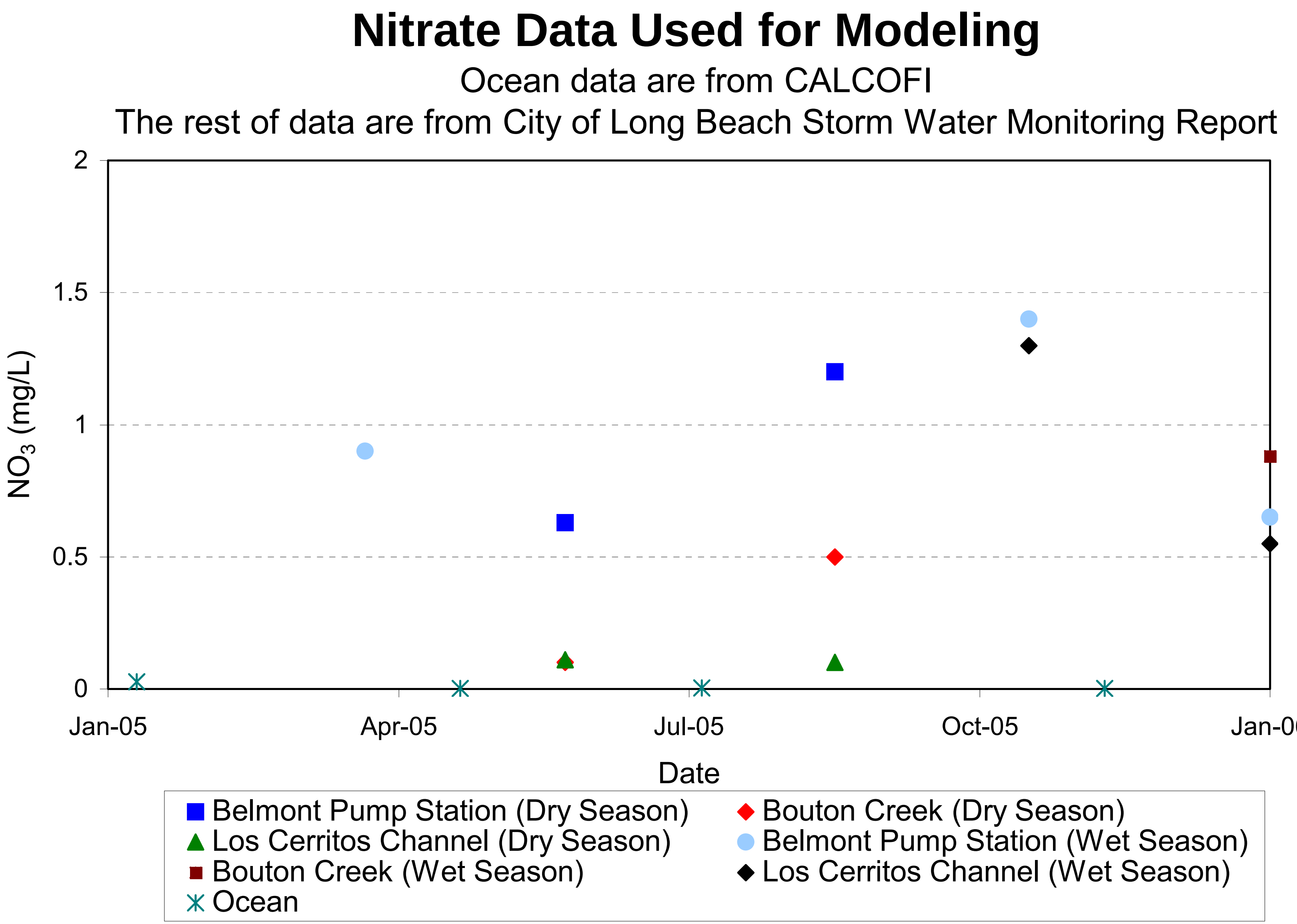
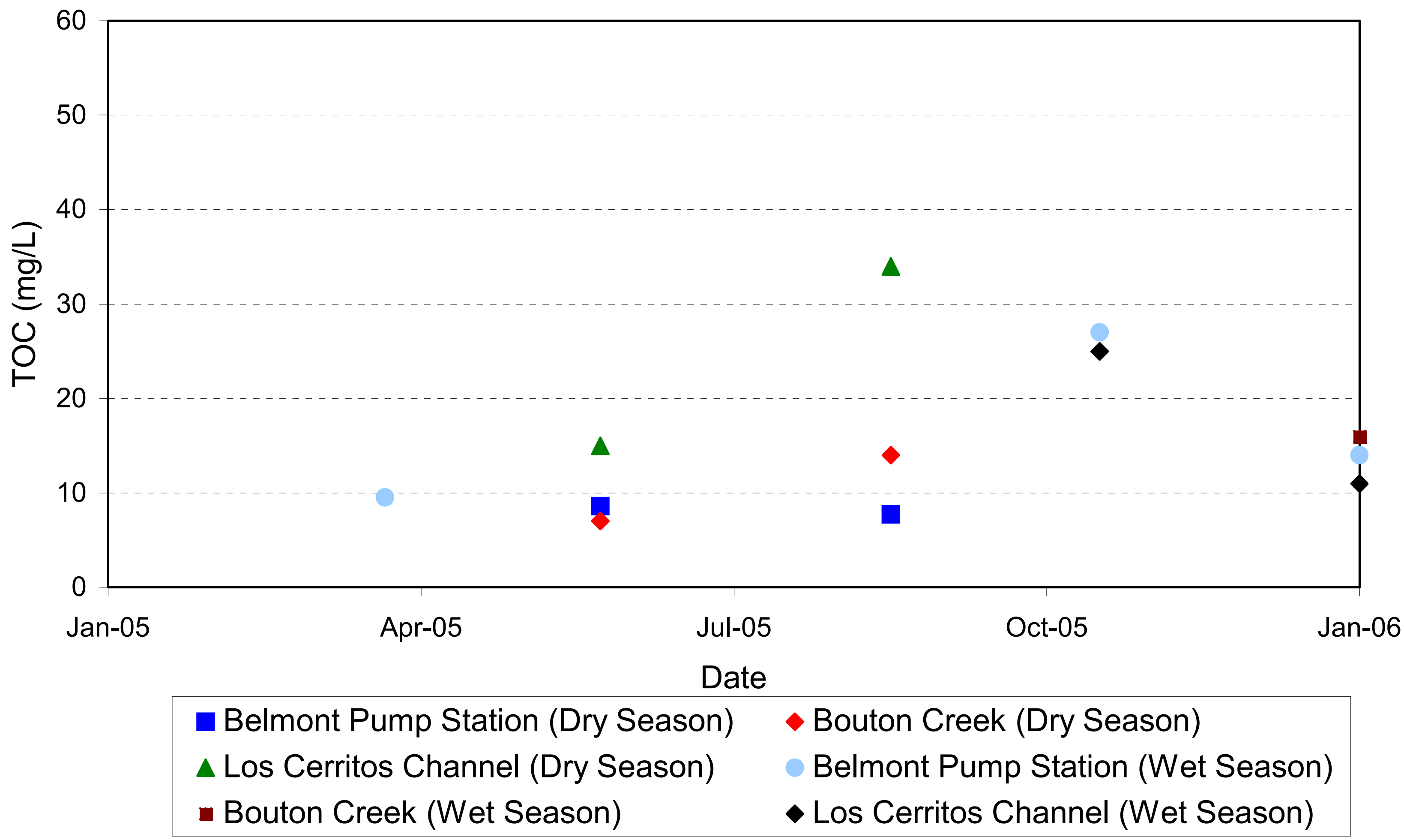


Figure 2.15

FLOW SCIENCE

Total Organic Carbon Data Used for Modeling

All data are from City of Long Beach Storm Water Monitoring Report



Chlorophyll a Data in Ocean Water Used for Modeling

(from CALCOFI Station 88.5)

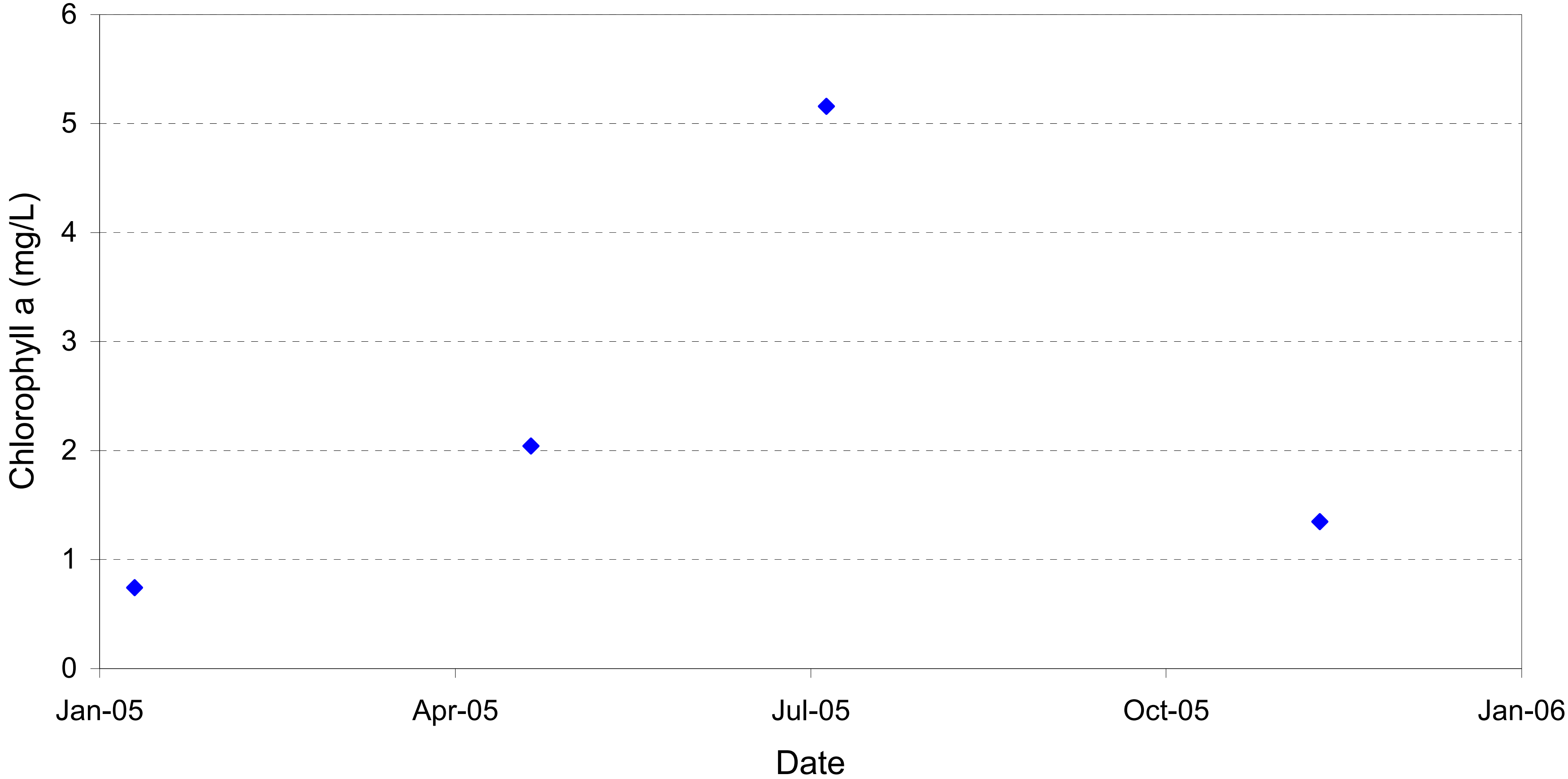
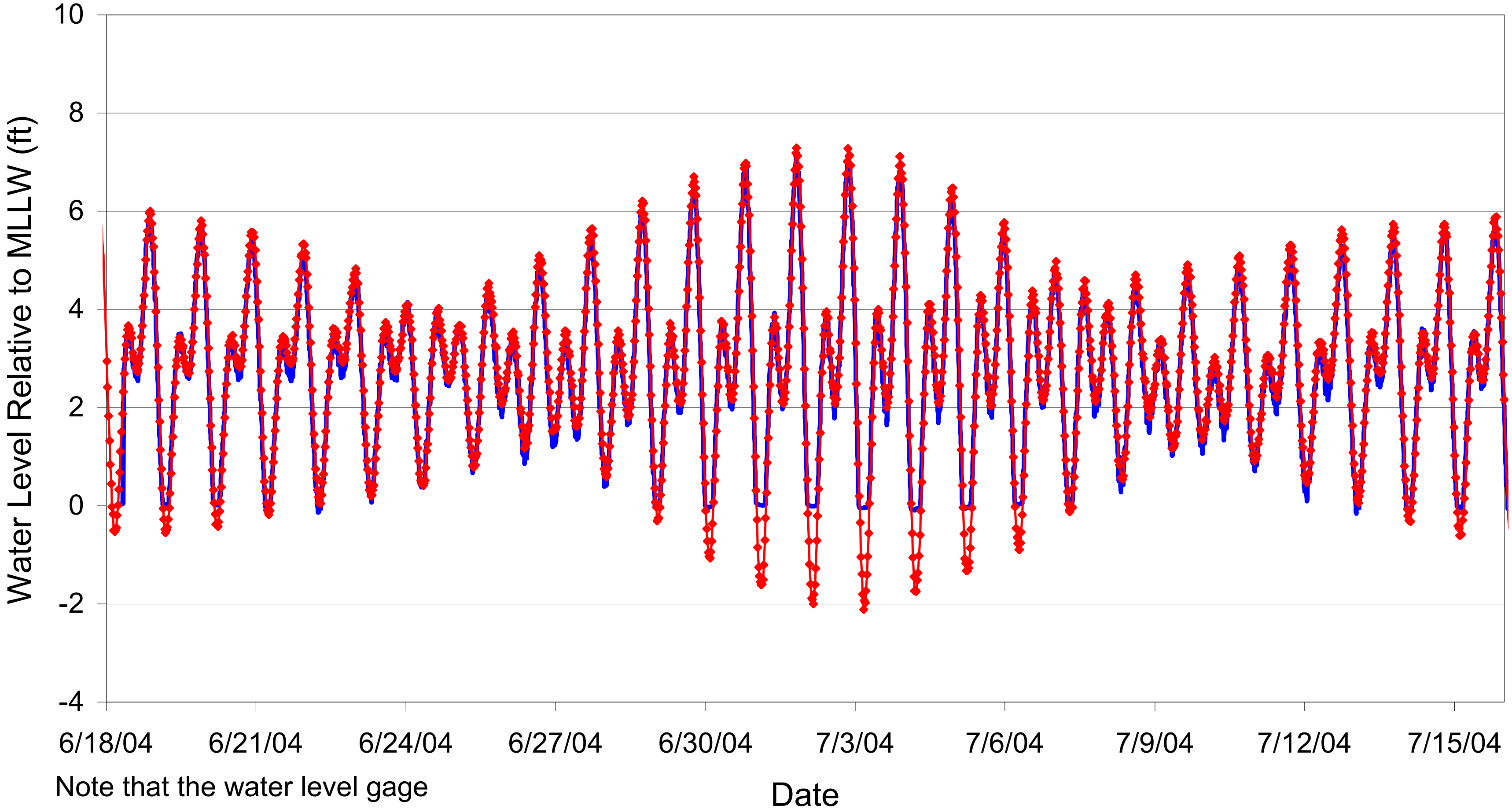


Figure 2.17

Comparison of Measured and Simulated Water Surface Elevation in Marine Stadium



Note that the water level gage deployed by Moffatt and Nichol (2004) did not capture water levels below approximately 0 ft MLLW

Currents Comparison at 2nd Street Bayshore

(Data Digitized from Figures 5-6 in Moffat & Nichol [2007])

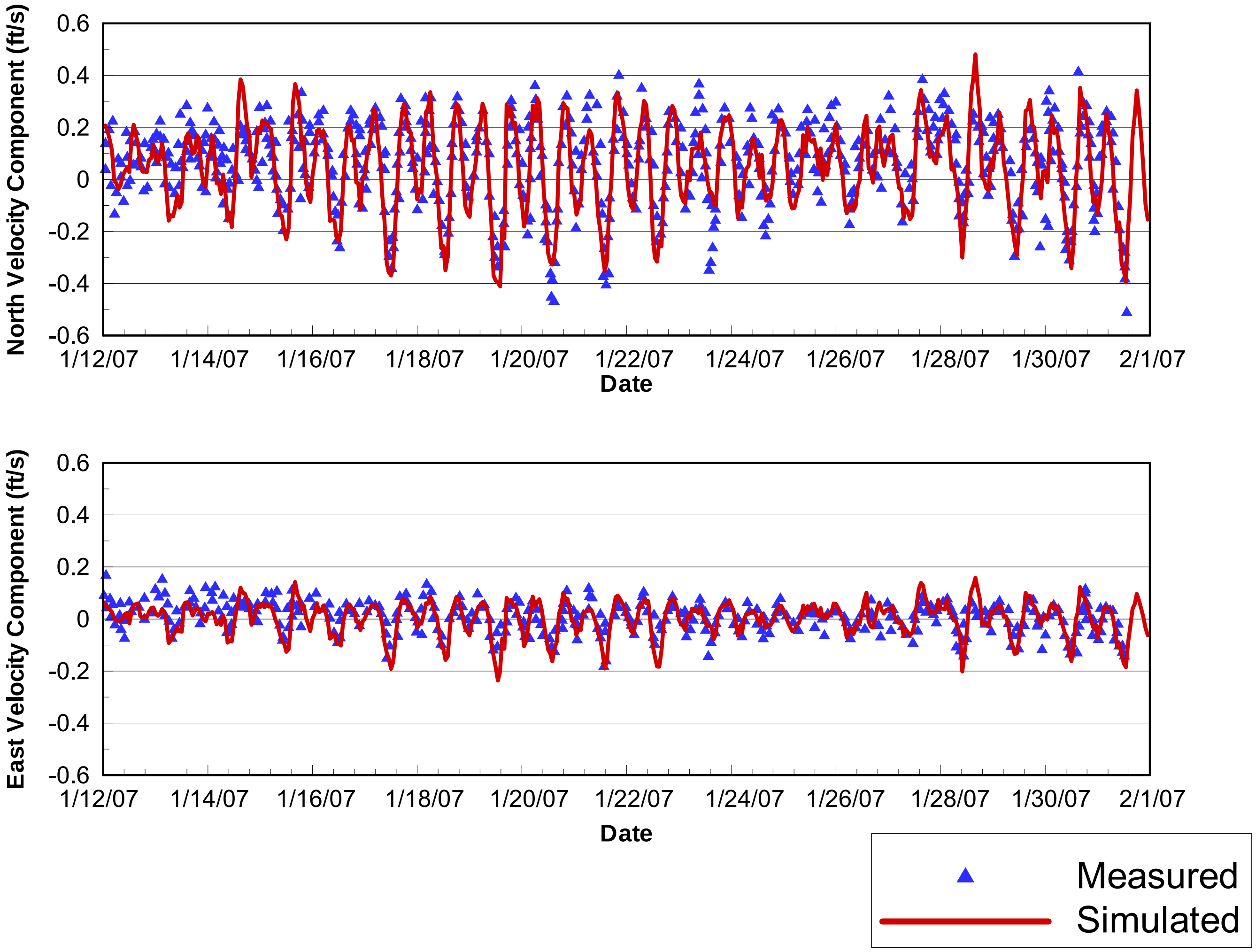
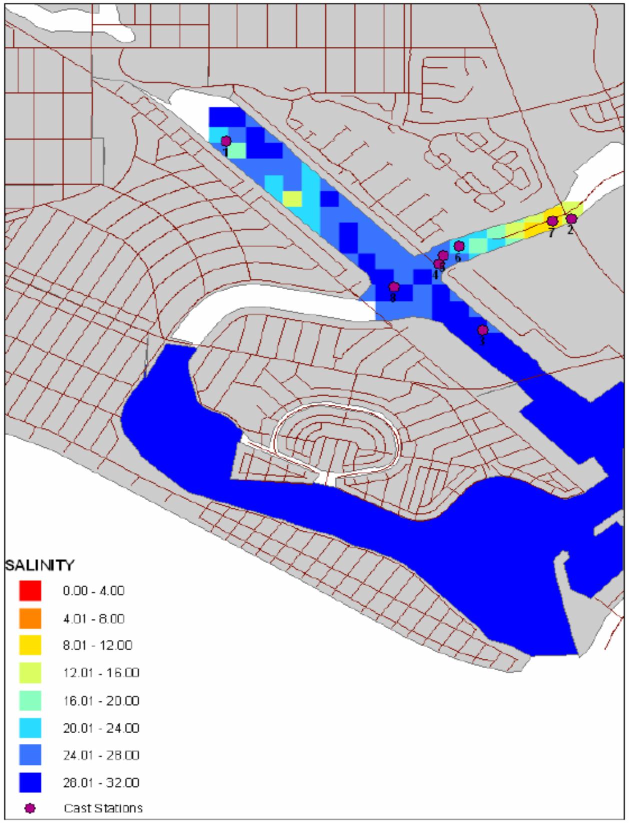


Figure 2.19

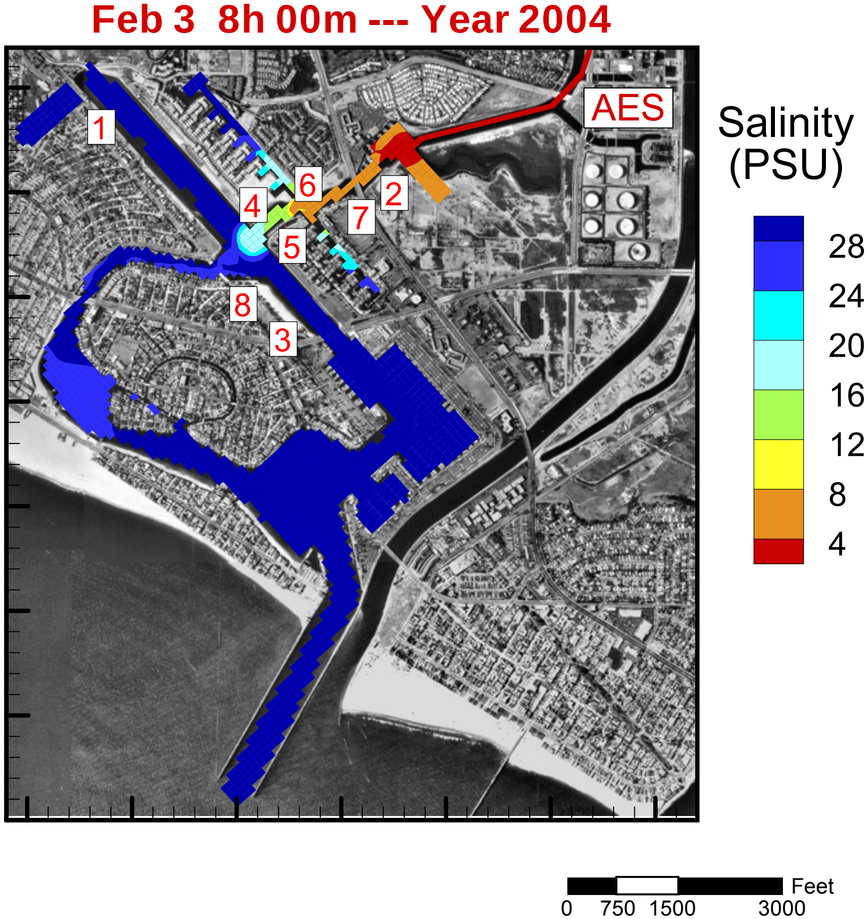
Comparison of Measured and Simulated Surface Salinity for the February 3, 2004 Storm Event

(Measured Data are from Long Beach Storm Water Monitoring Report)

Data were measured on Feb 3, 2004 from 05:21 to 09:54



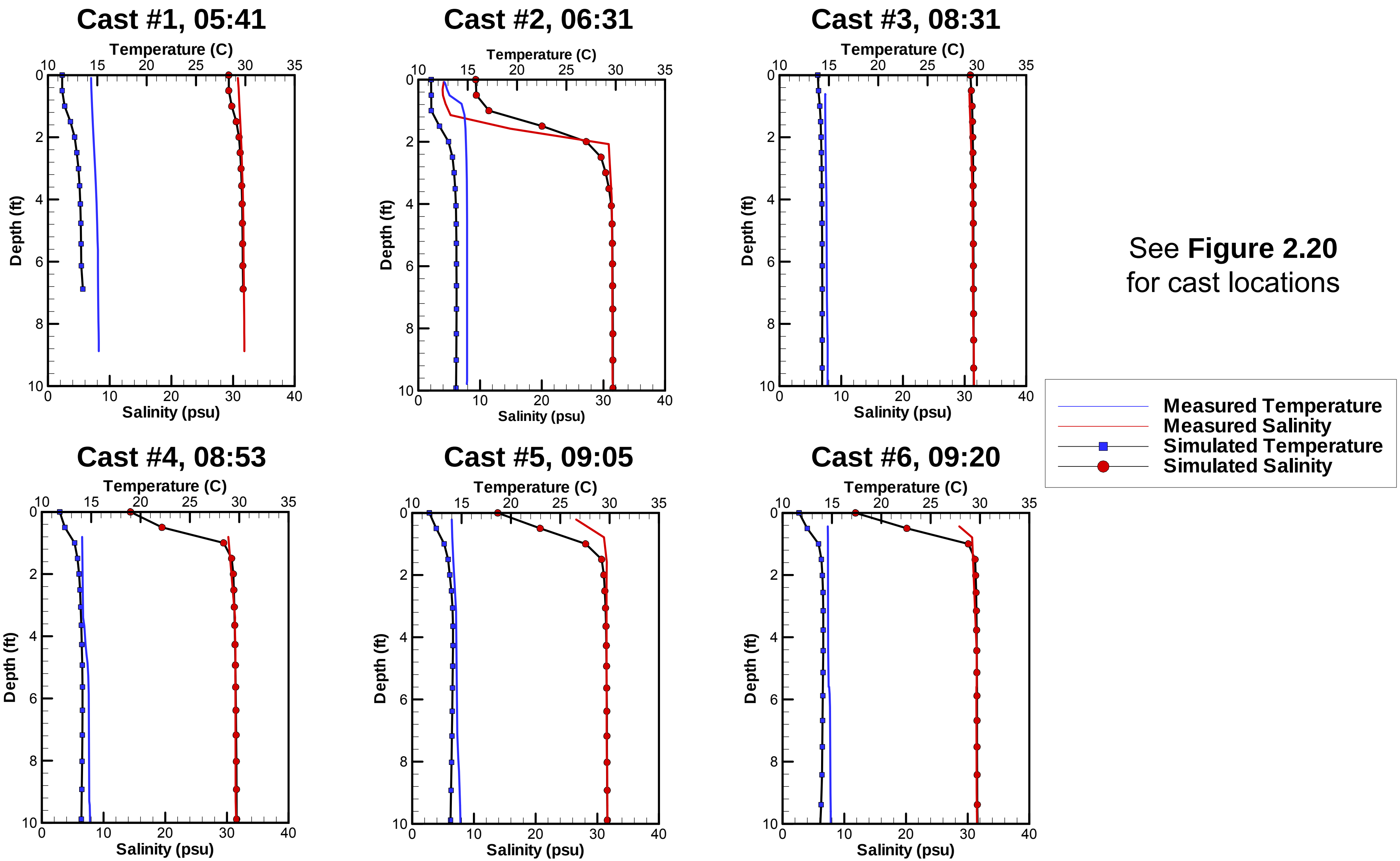
Measured surface salinity
(from Kinnetic [2004])



ELCOM simulation results
(cast locations are shown in numbered boxes)

Comparison of Measured and Simulated Salinity and Temperature Profiles for the February 3, 2004 Storm Event

(Measured Data are from Long Beach Storm Water Monitoring Report)

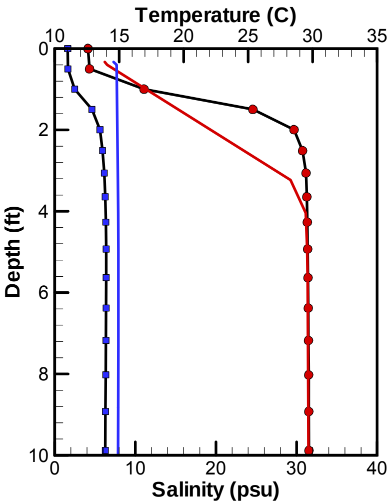


See **Figure 2.20** for cast locations

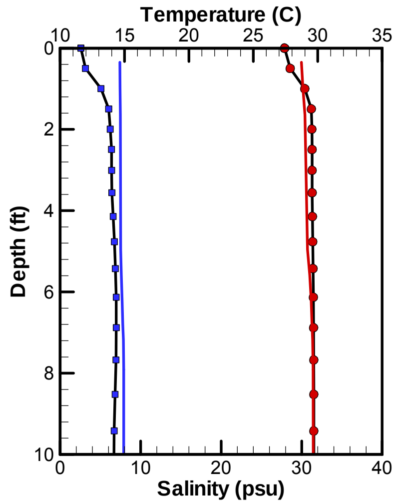
Comparison of Measured and Simulated Salinity and Temperature Profiles for the February 3, 2004 Storm Event

(Measured Data are from Long Beach Storm Water Monitoring Report)

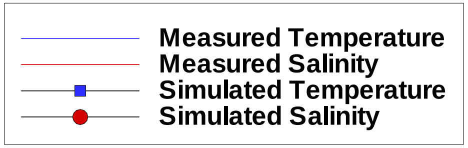
Cast #7, 09:30



Cast #8, 09:41



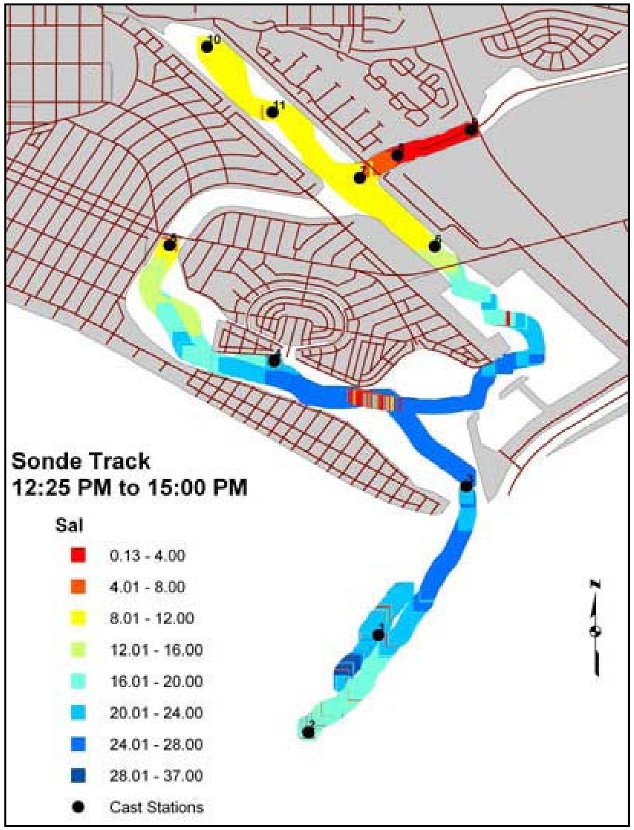
See **Figure 2.20** for cast locations



Comparison of Measured and Simulated Surface Salinity for the October 20, 2004 Storm Event

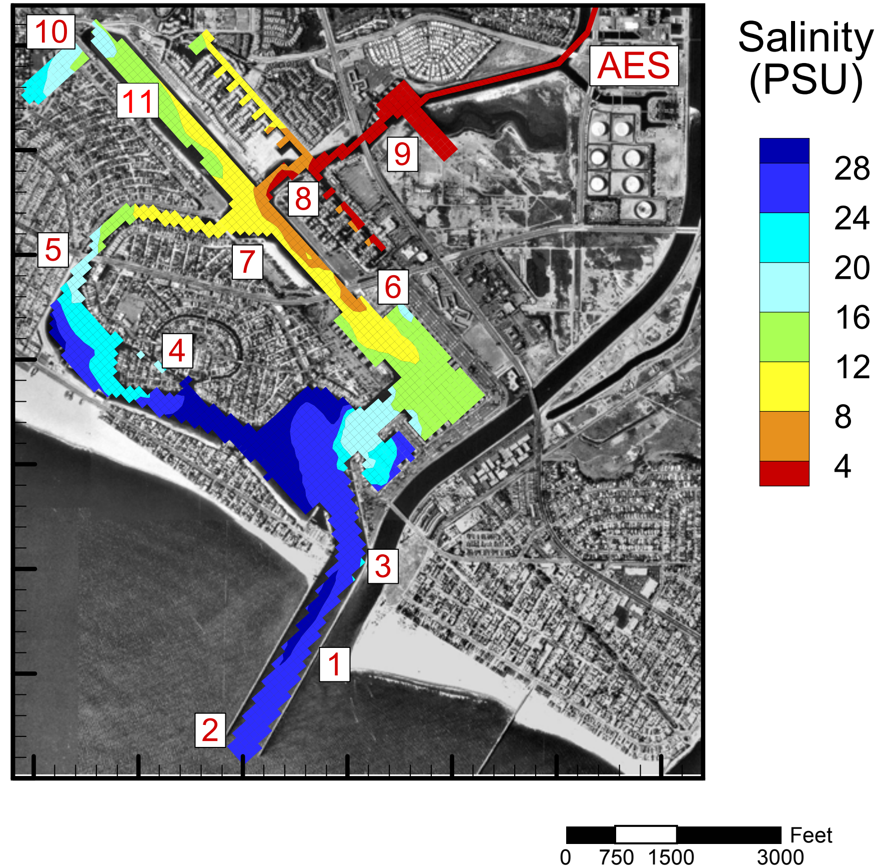
(Measured Data are from Long Beach Storm Water Monitoring Report)

Data were measured on Oct 20, 2004 from 12:25 to 15:00



Measured surface salinity
(from Kinnetic [2005])

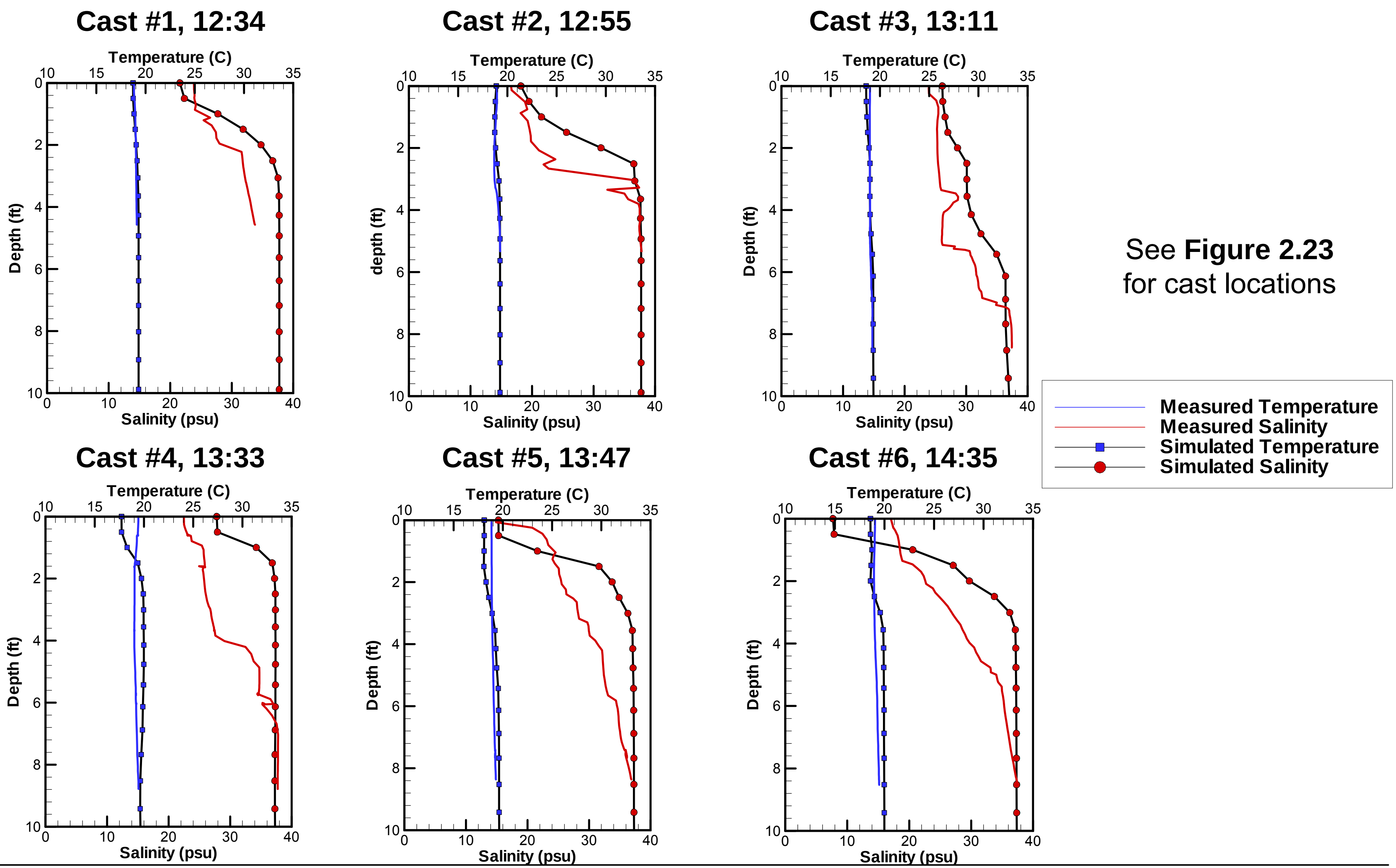
Oct 20 14h 00m --- Year 2004



ELCOM simulation results
(cast locations are shown in numbered boxes)

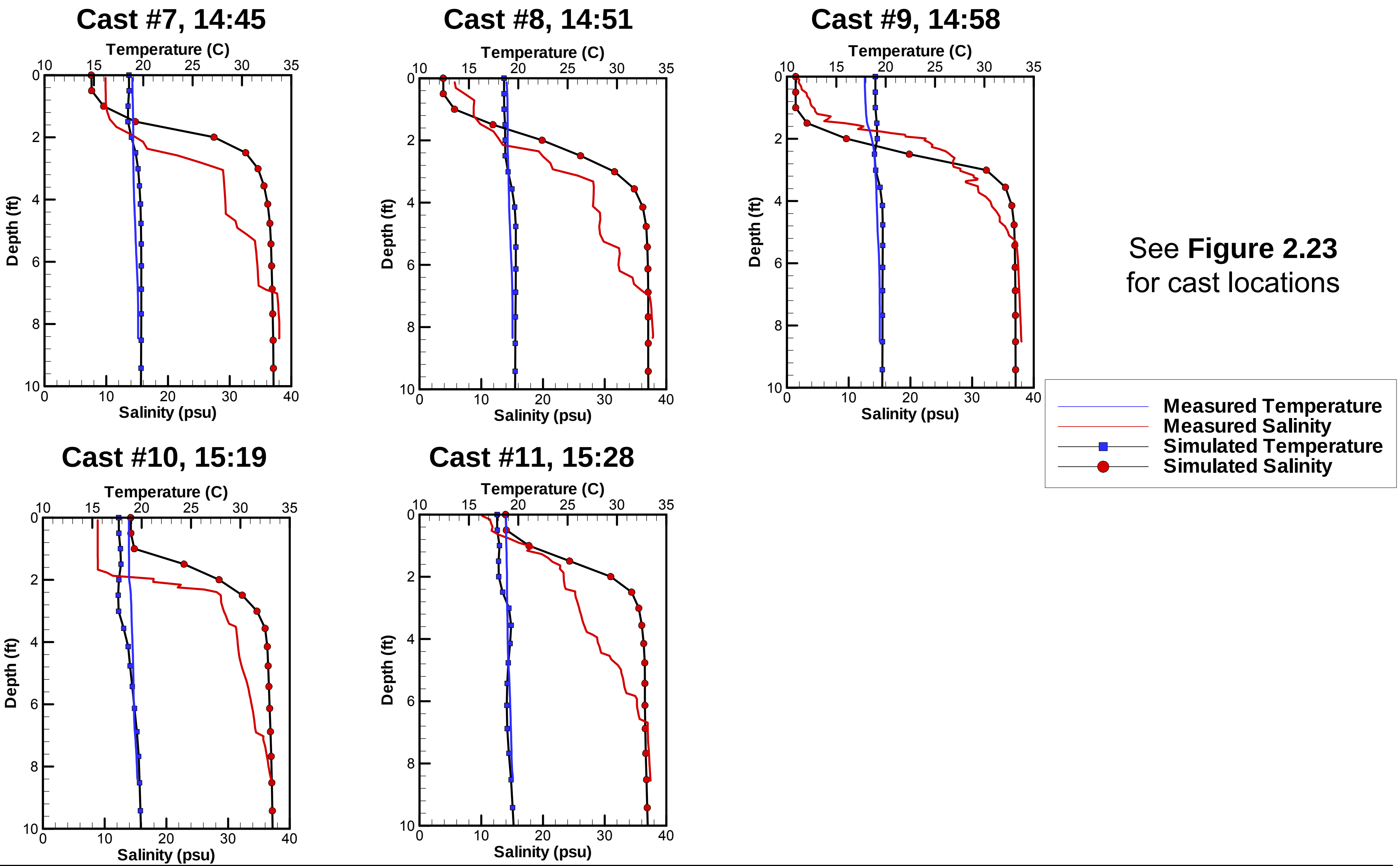
Comparison of Measured and Simulated Salinity and Temperature Profiles for the October 20, 2004 Storm Event

(Measured Data are from Long Beach Storm Water Monitoring Report)



Comparison of Measured and Simulated Salinity and Temperature Profiles for the October 20, 2004 Storm Event

(Measured Data are from of Long Beach Storm Water Monitoring Report)



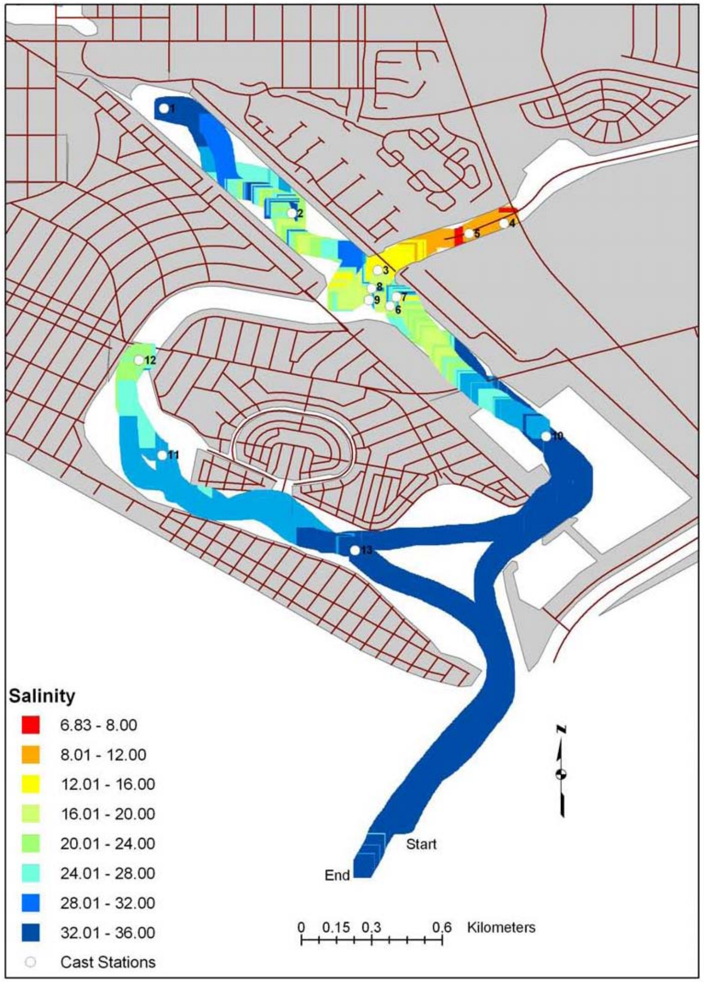
See **Figure 2.23** for cast locations

Figure 2.25

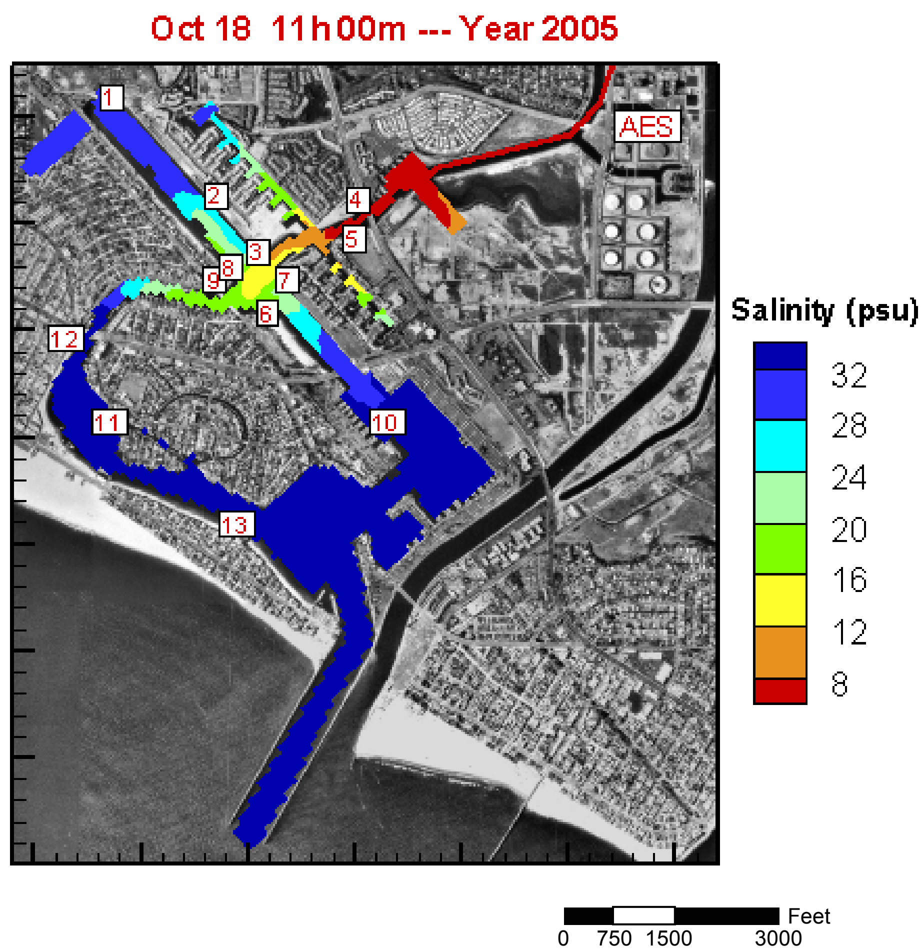
FLOW SCIENCE

Comparison of Measured and Simulated Surface Salinity for the October 18, 2005 Storm Event

Data were measured on Oct 18, 2005 from 06:57 to 11:14



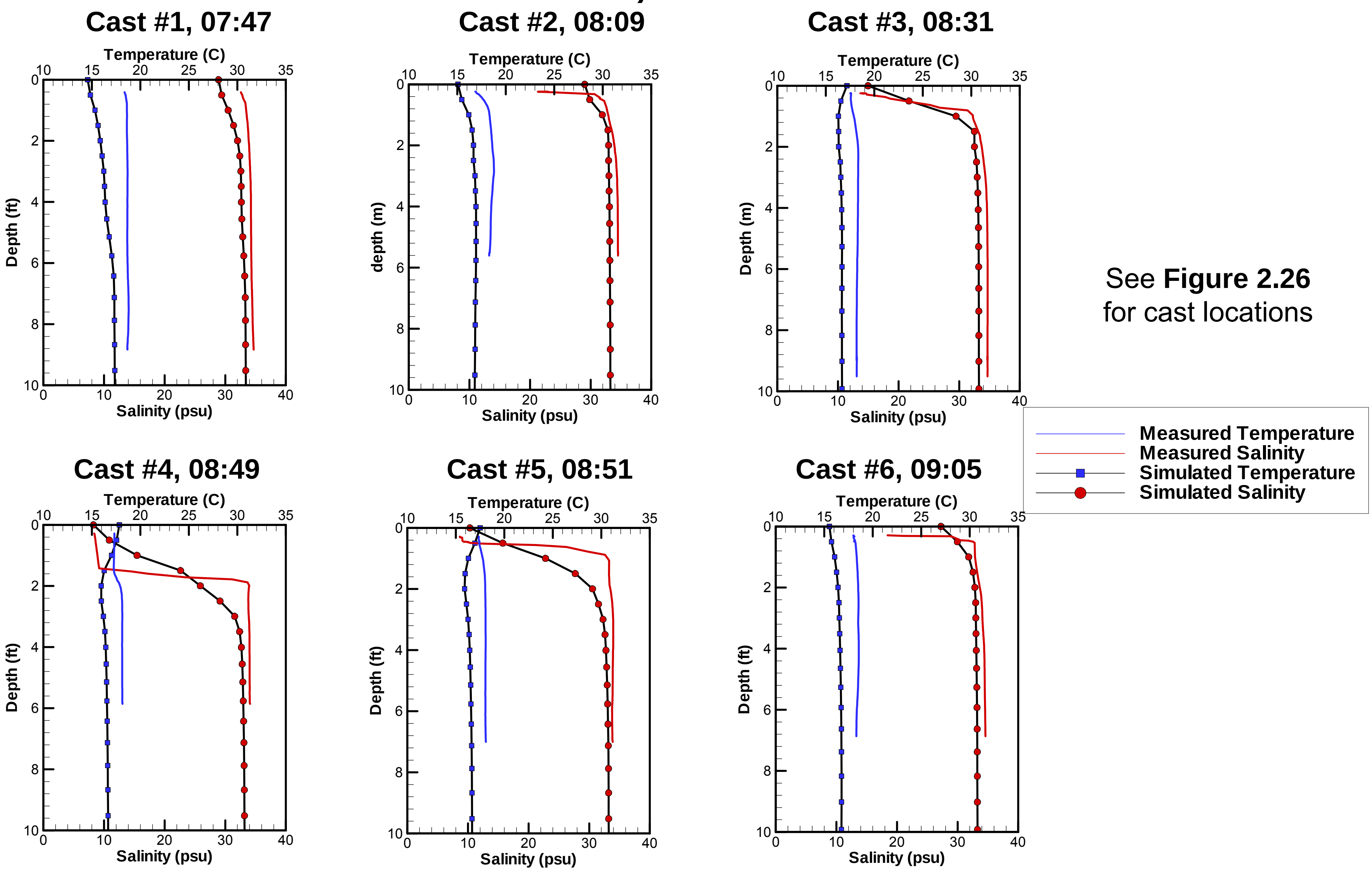
Measured surface salinity (from Kinnetic [2006])



ELCOM simulation results

(cast locations are shown in numbered boxes)

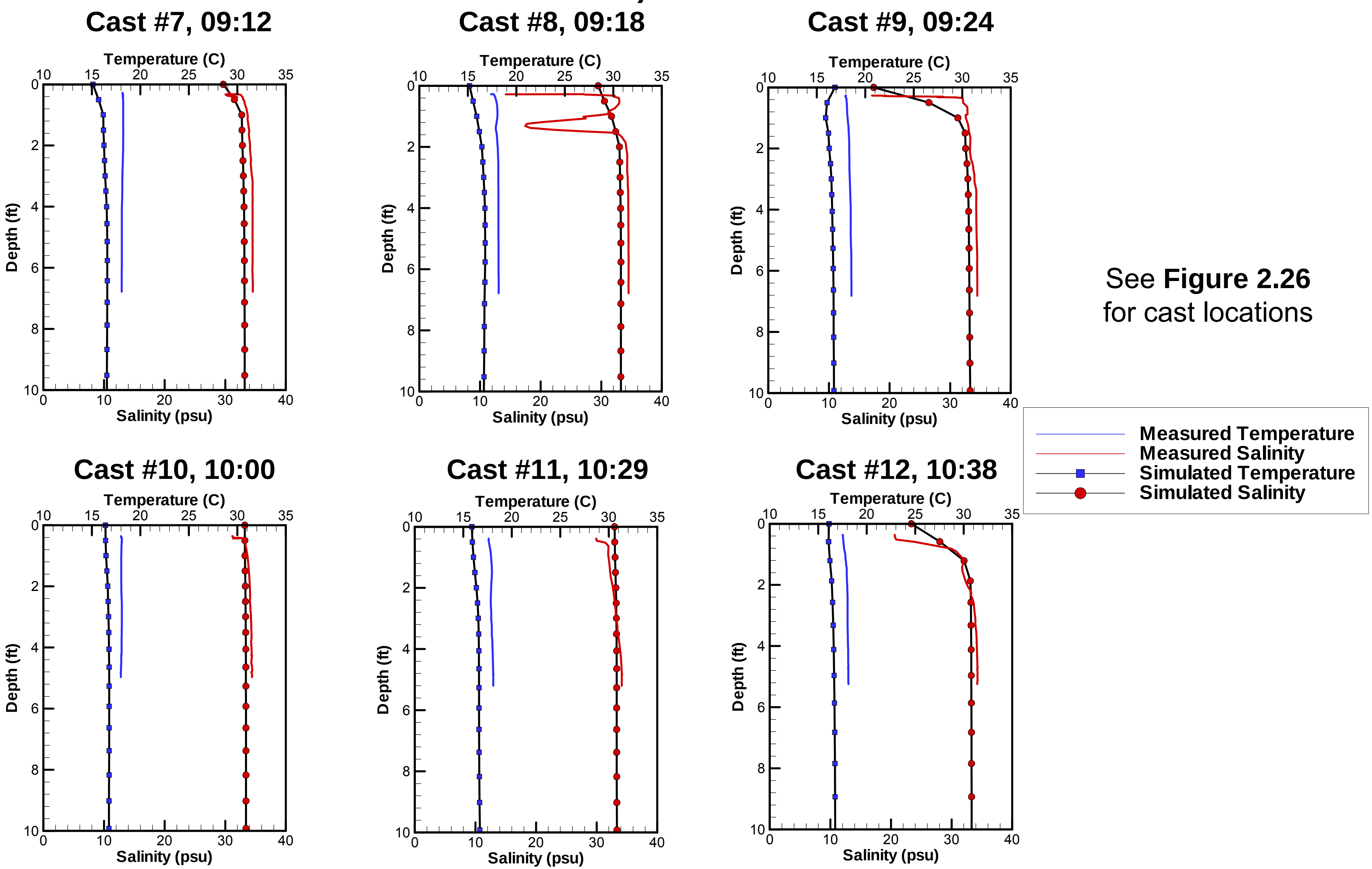
Comparison of Measured and Simulated Surface Salinity for the October 18, 2005 Storm Event



See **Figure 2.26** for cast locations

Figure 2.27

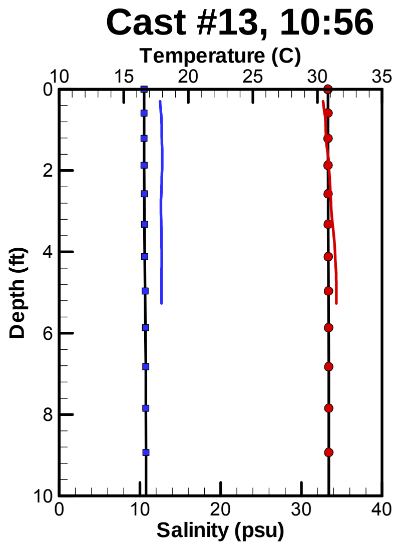
Comparison of Measured and Simulated Surface Salinity for the October 18, 2005 Storm Event



See **Figure 2.26** for cast locations

Figure 2.28

Comparison of Measured and Simulated Surface Salinity for the October 18, 2005 Storm Event



See **Figure 2.26** for cast locations

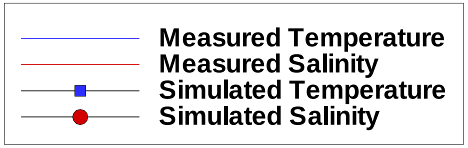
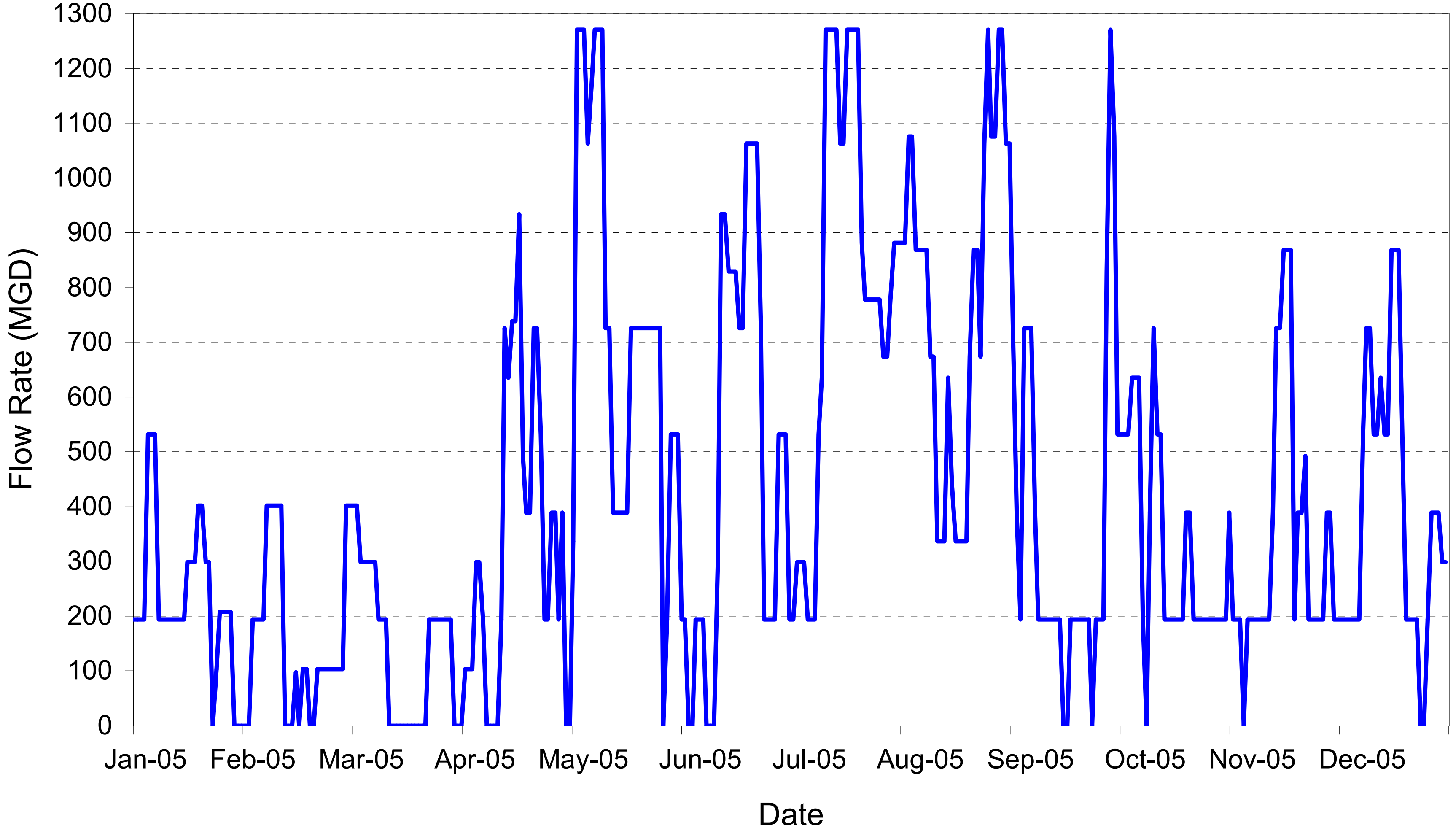
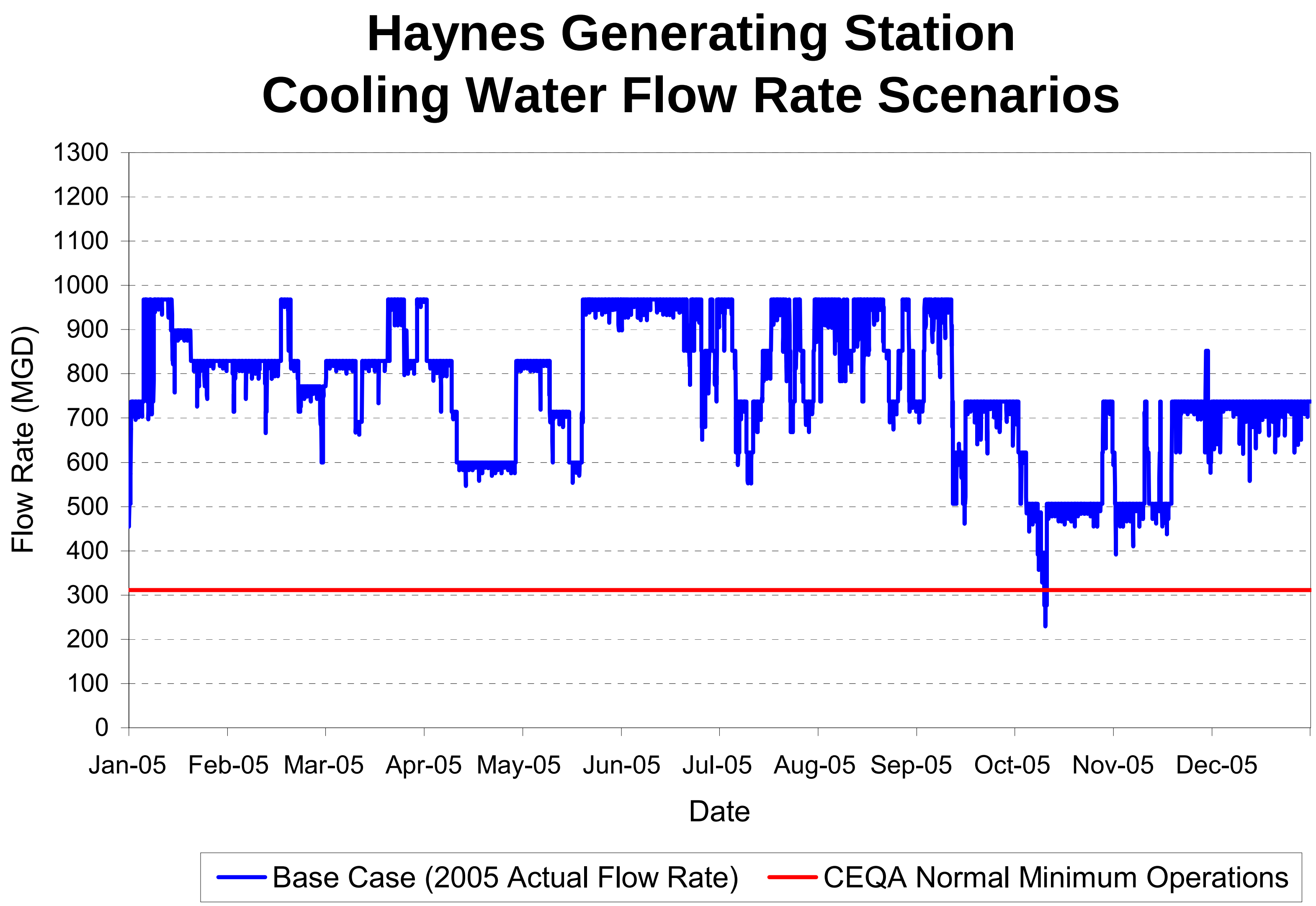


Figure 2.29

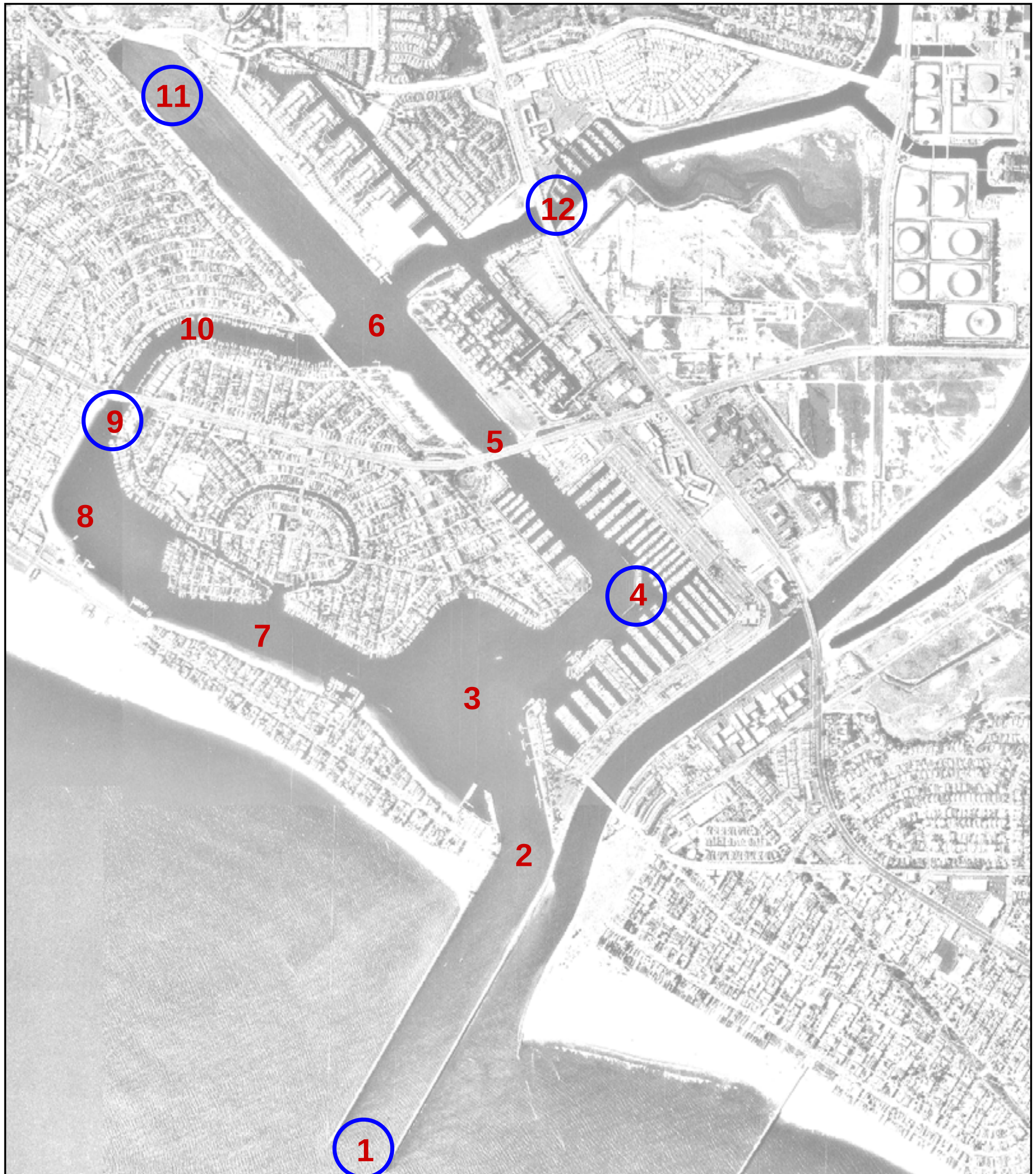
AES Generating Station
Cooling Water Flow Rates for 2005





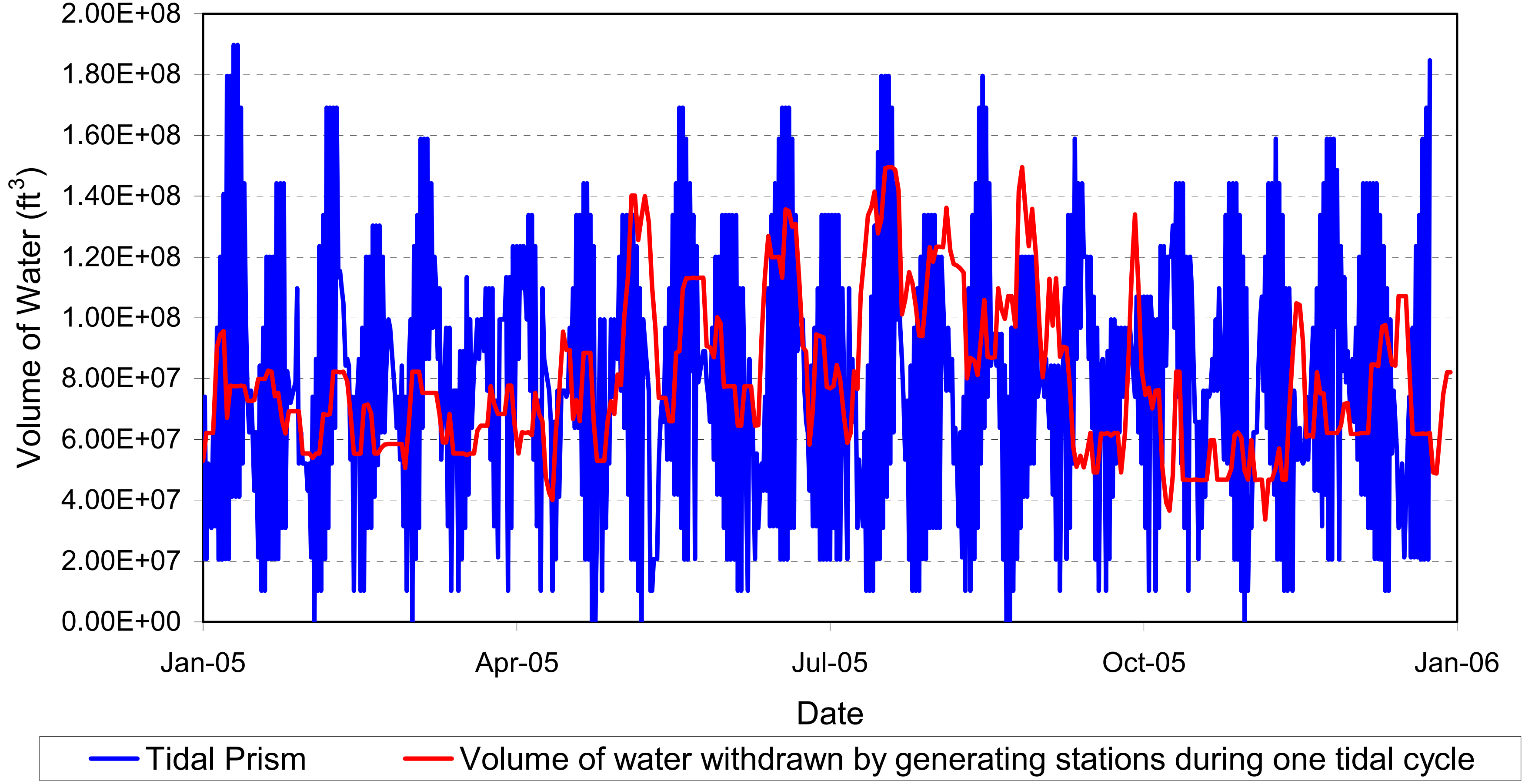
Haynes Generating Station
Cooling Water Flow Rate Scenarios
Flow Rate (MGD)
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Jan-05
Feb-05
Mar-05
Apr-05
May-05
Jun-05
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Date
Base Case (2005 Actual Flow Rate)
CEQA Normal Minimum Operations

Figure 2.31



Station Locations Shown in Time-series Plots

Comparison of Tidal Prism and Volume of Water Withdrawn by Generating Stations During One Tidal Cycle



Comparison of Summer Near-Surface Net Transport Vectors

Base Case

CEQA Normal Minimum Operations

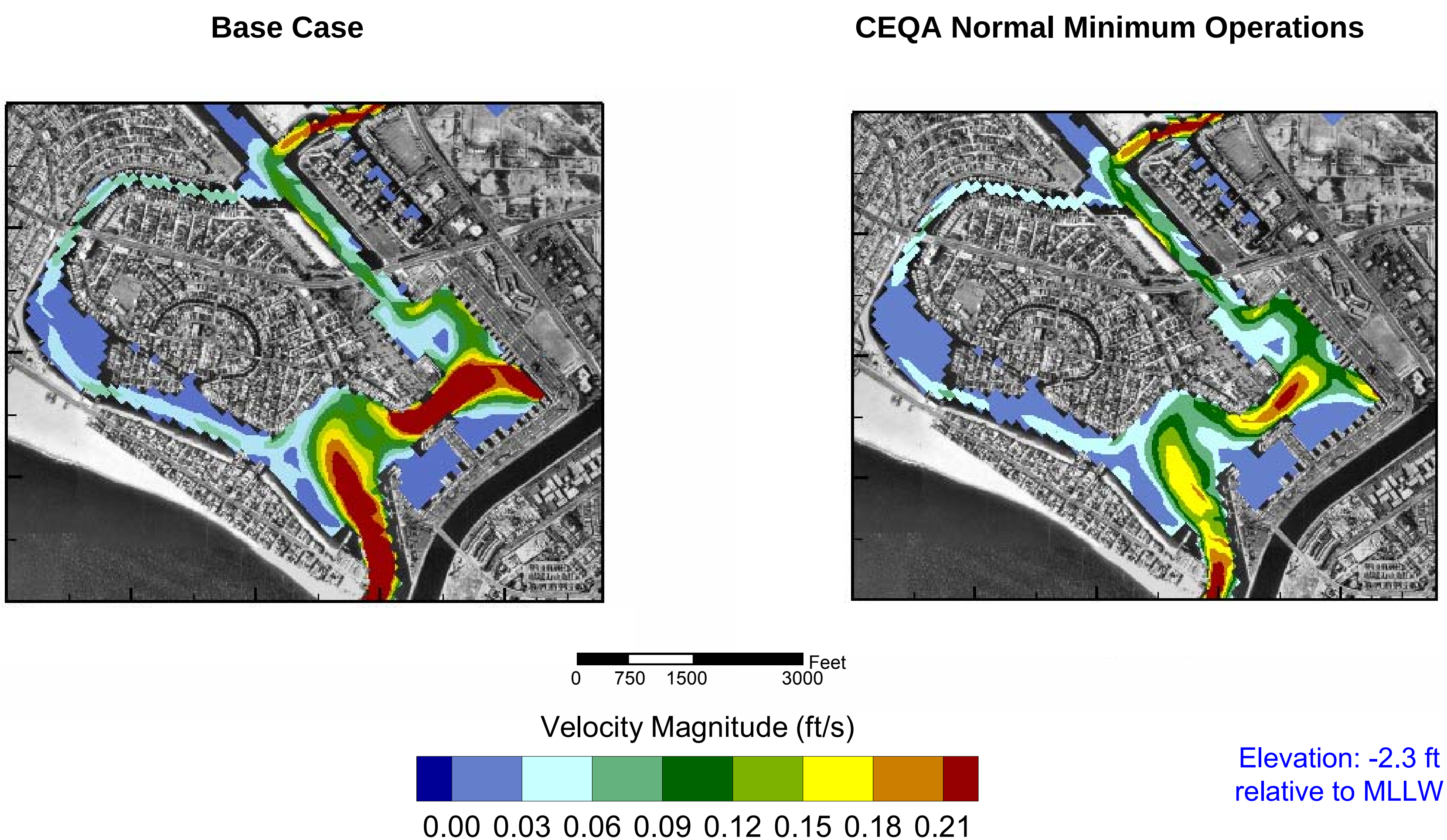
Feet
0 750 1500 3000

0.6 ft/s

Elevation: -2.3 ft
relative to MLLW

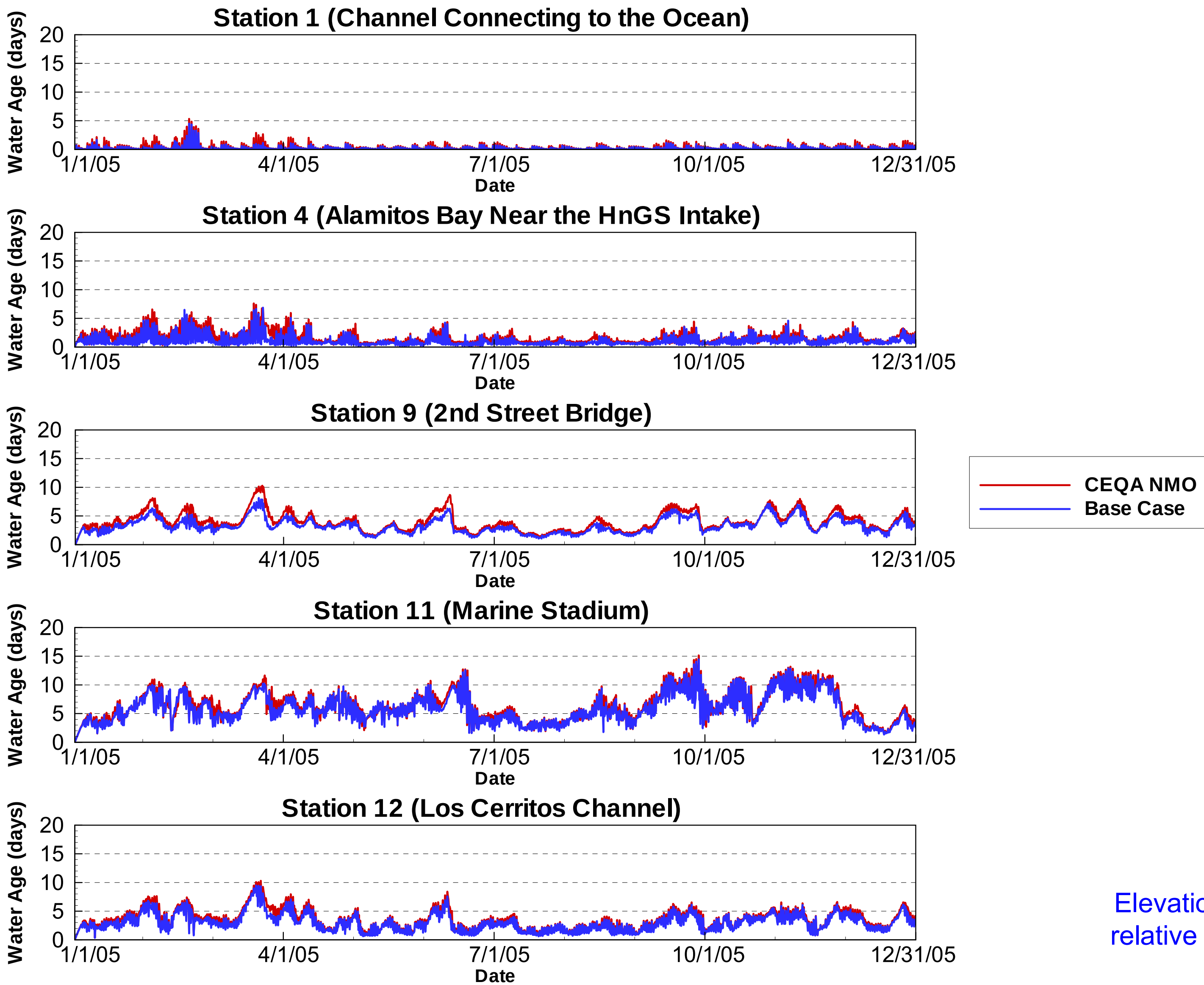
Figure 2.34

Comparison of Magnitude of Summer Near-Surface Net Transport Vectors



Elevation: -2.3 ft relative to MLLW

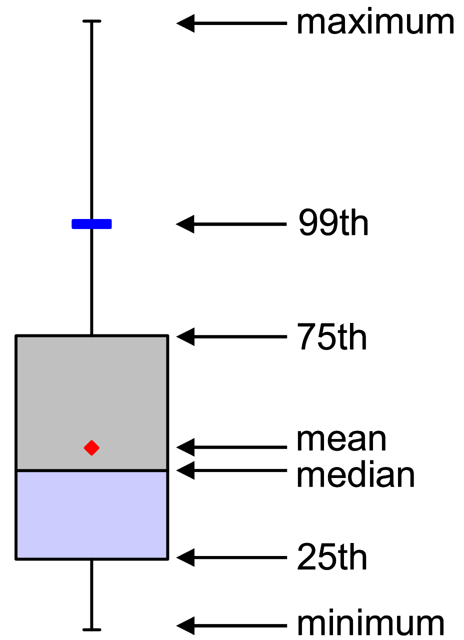
Predicted Near-Surface Water Age at Alamitos Bay Stations



Elevation: -2.3 ft relative to MLLW

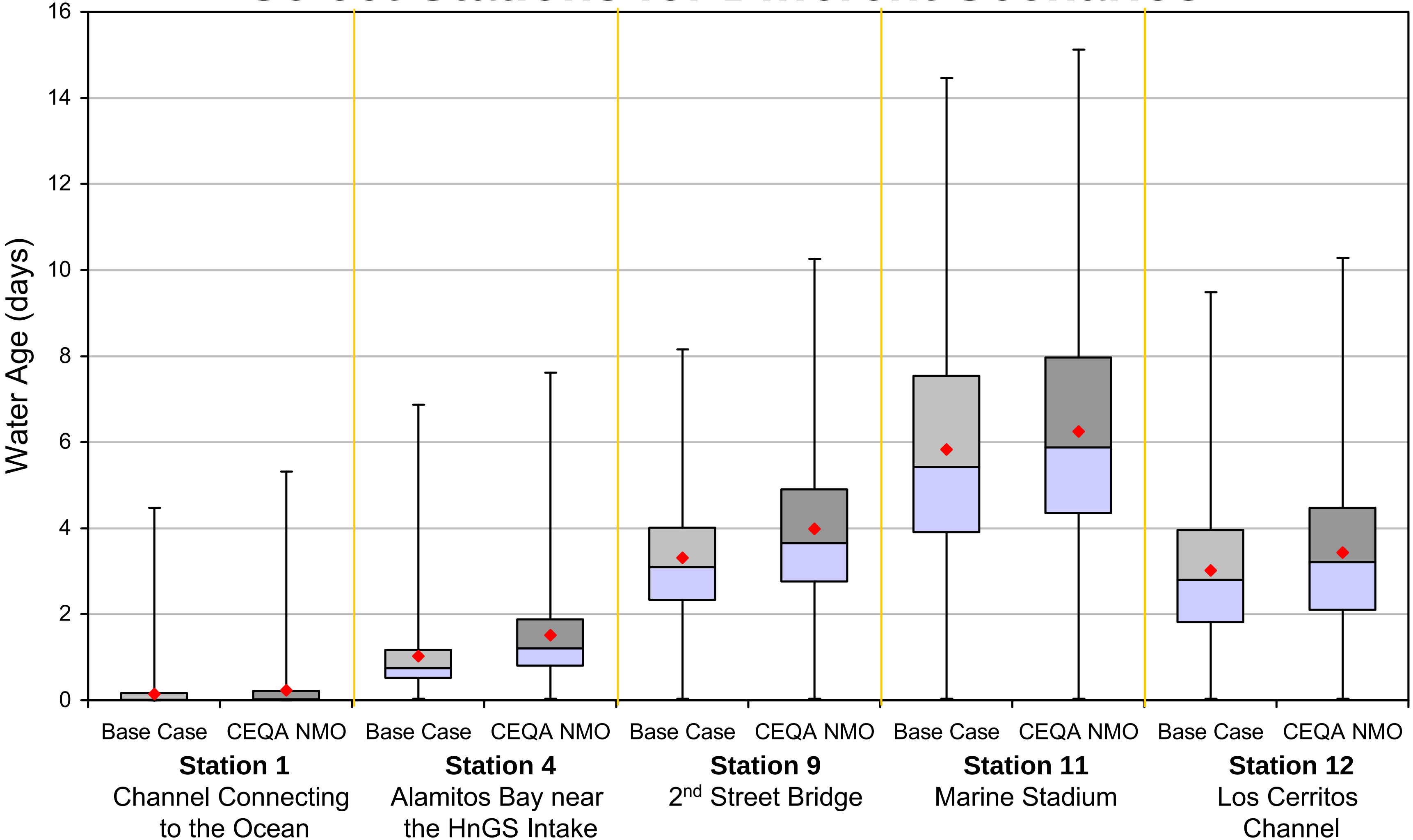
Figure 2.36

Box Plot Description



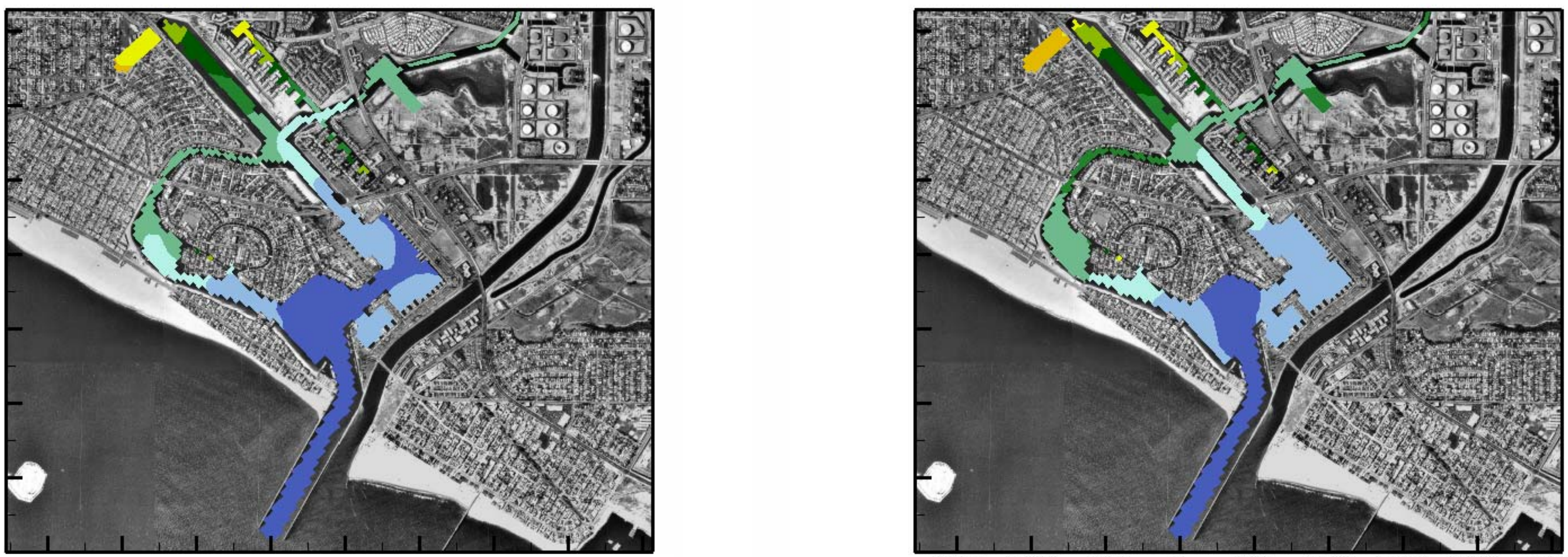
99th percentile only shown for chlorophyll *a* results

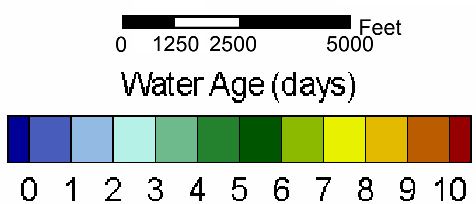
Box Plots Showing the Distribution of Water Age at Select Stations for Different Scenarios



Comparison of Annual Average Near-Surface Water Age

Base Case | **CEQA Normal Minimum Operations**



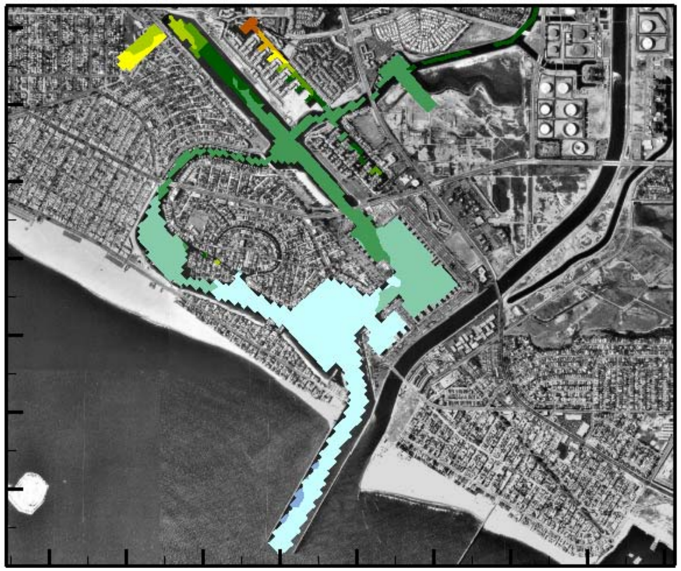


Elevation: -2.3 ft relative to MLLW

Figure 2.39

Comparison of Annual Maximum Near-Surface Water Age

Base Case



CEQA Normal Minimum Operations

0 1250 2500 5000 Feet

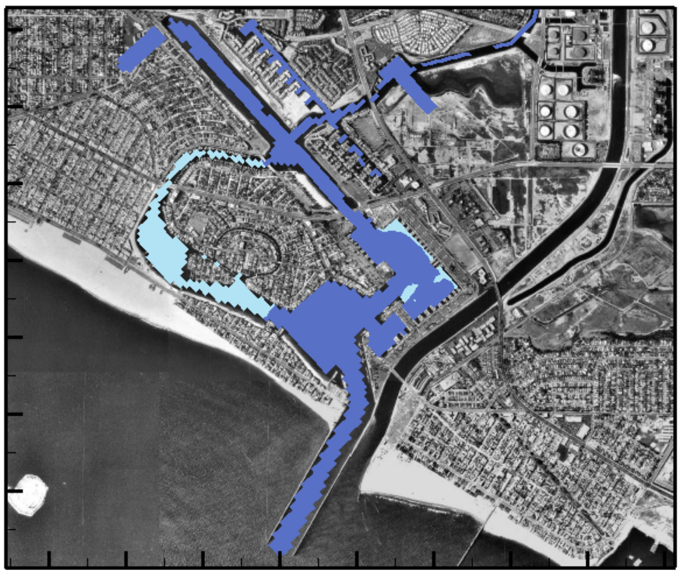
Water Age (days)

0 2 4 6 8 10 12 14 16 18 20 22

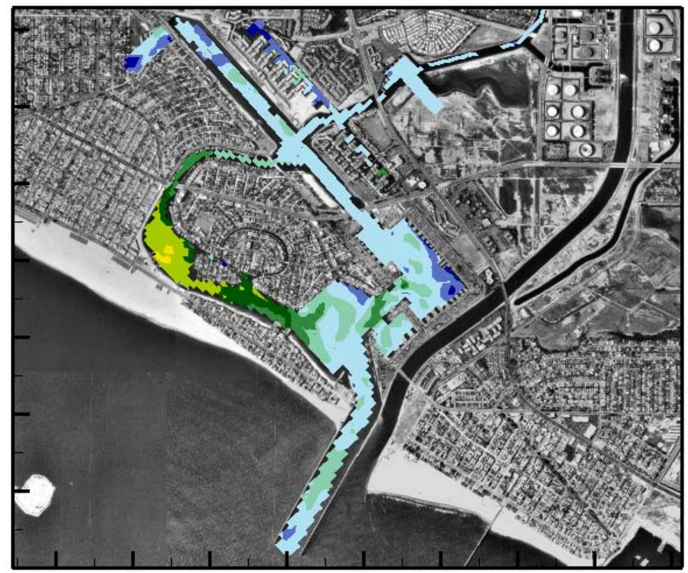
Elevation: -2.3 ft relative to MLLW

Alamitos Bay Water Age
Difference Between Base Case and CEQA Normal Minimum Operations

Annual Average



Annual Maximum



0 1250 2500 5000 Feet

Water Age (days)

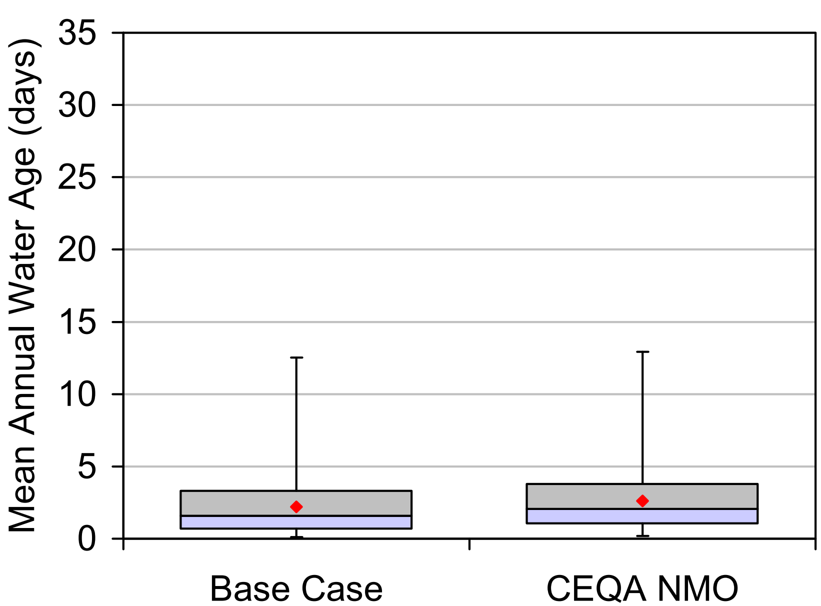
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

Elevation: -2.3 ft relative to MLLW

Figure 2.41

Comparison of Maximum and Mean Annual Water Age

Box Plots Comparing Mean Annual Water Age for Different Simulation Scenarios



Box Plots Comparing Maximum Annual Water Age for Different Simulation Scenarios

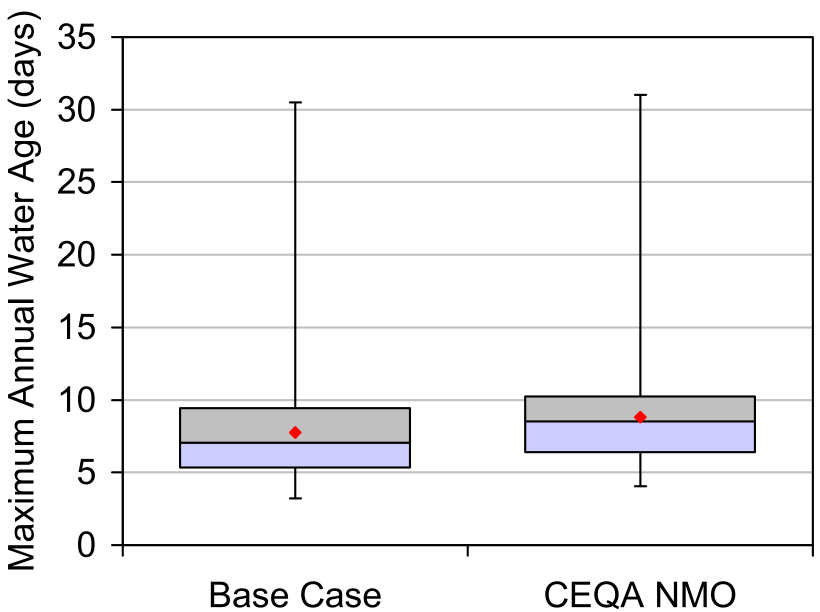
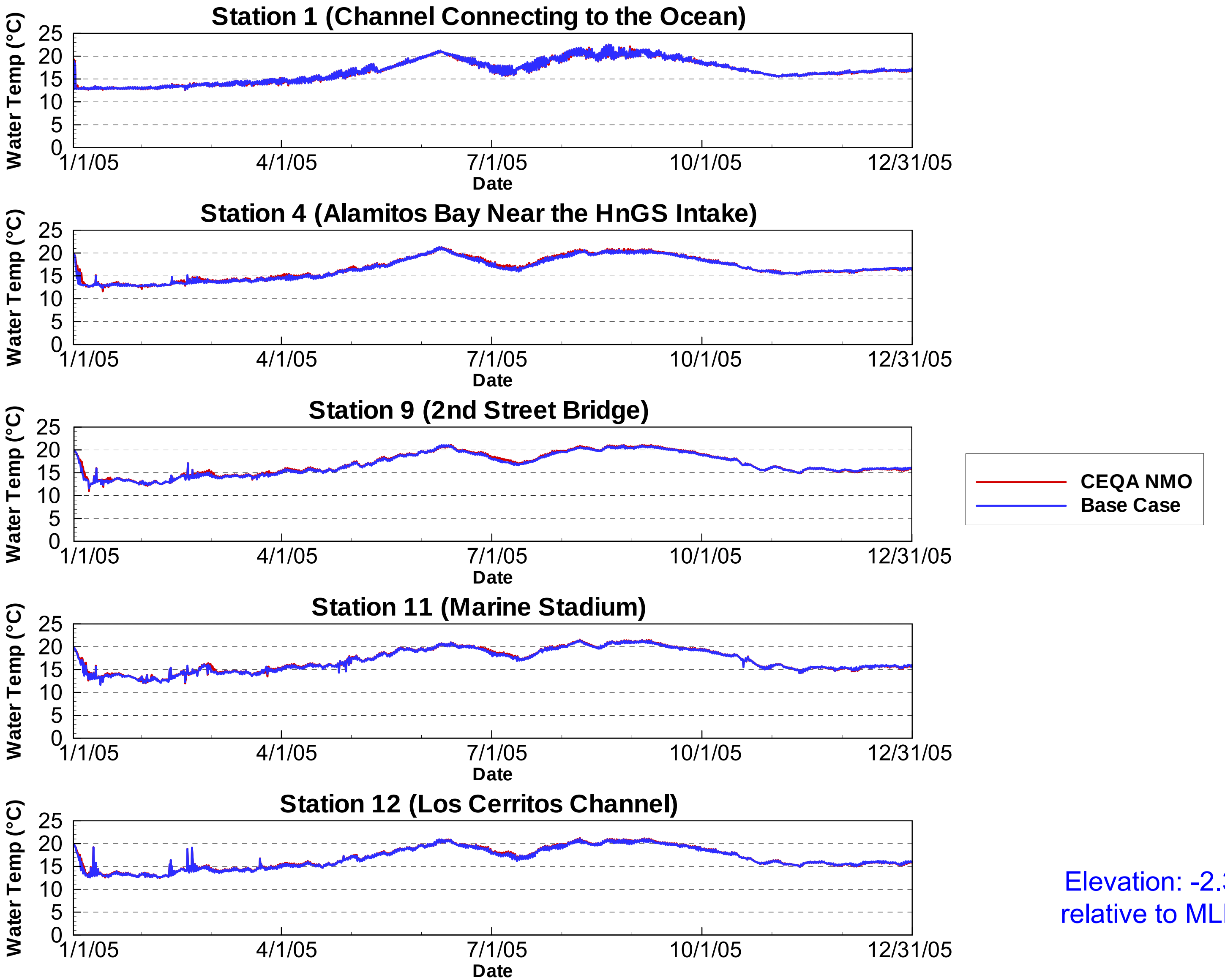


Figure 2.42

Predicted Near-Surface Temperature



Elevation: -2.3 ft relative to MLLW

Predicted Near-Surface Nitrate Concentrations

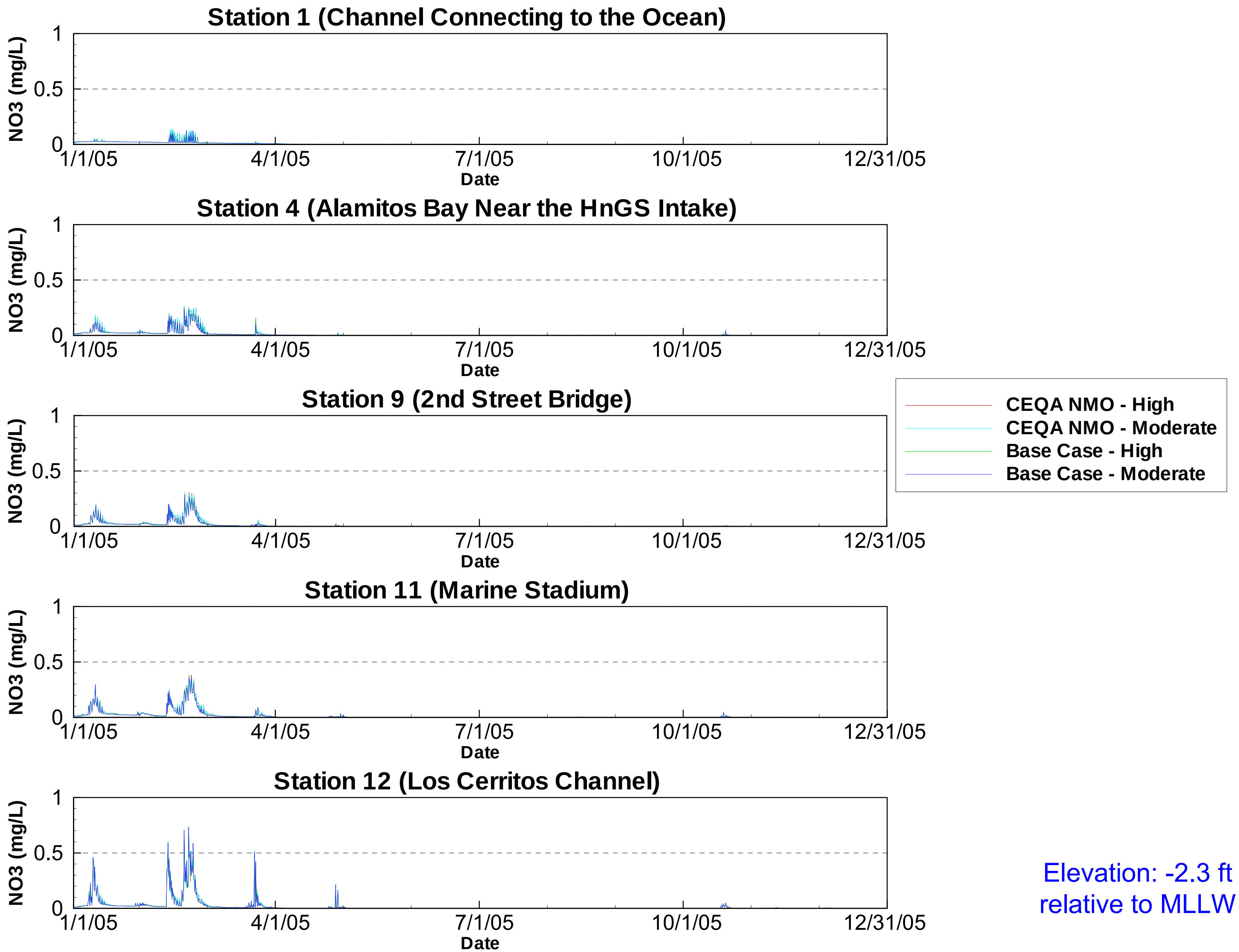
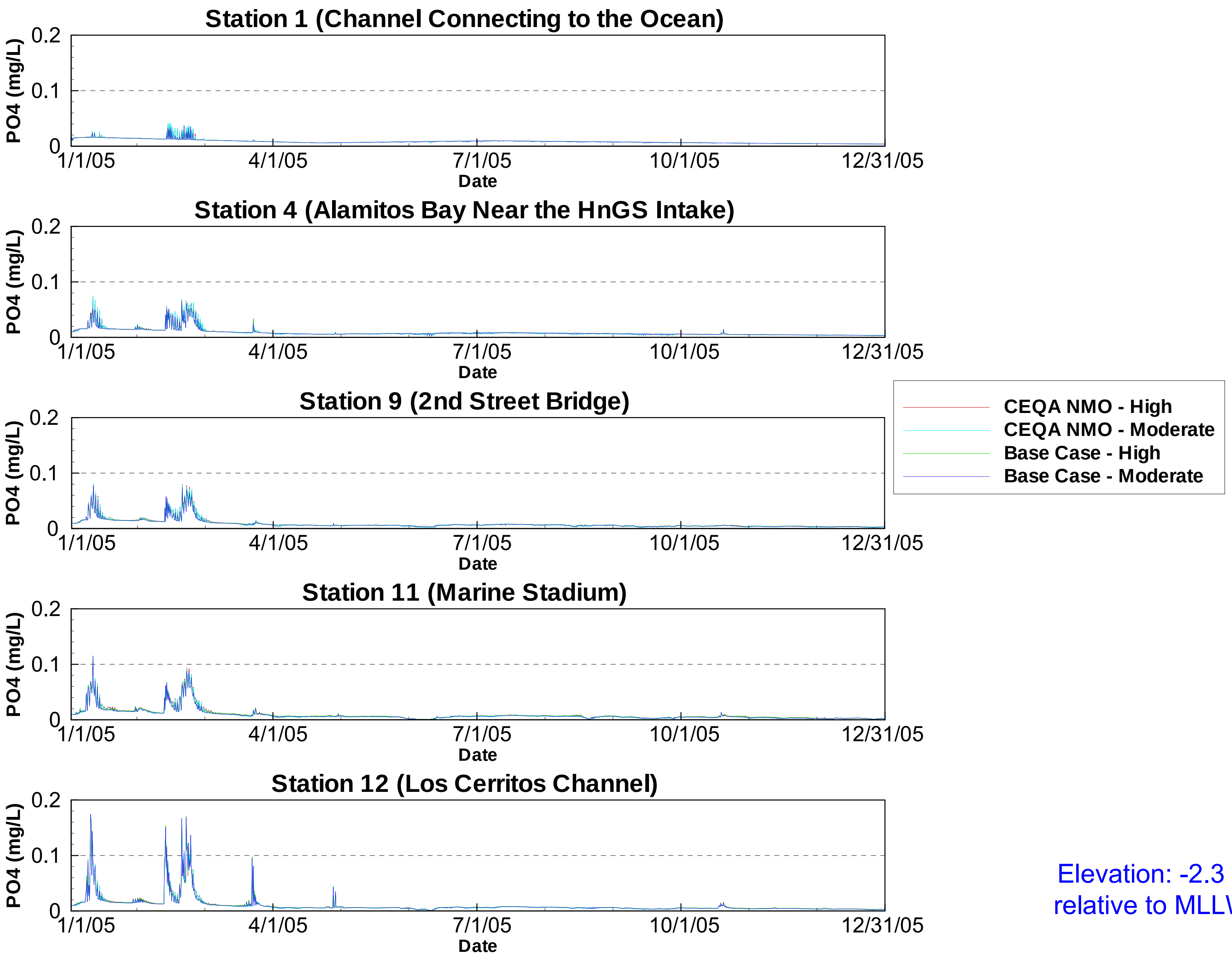


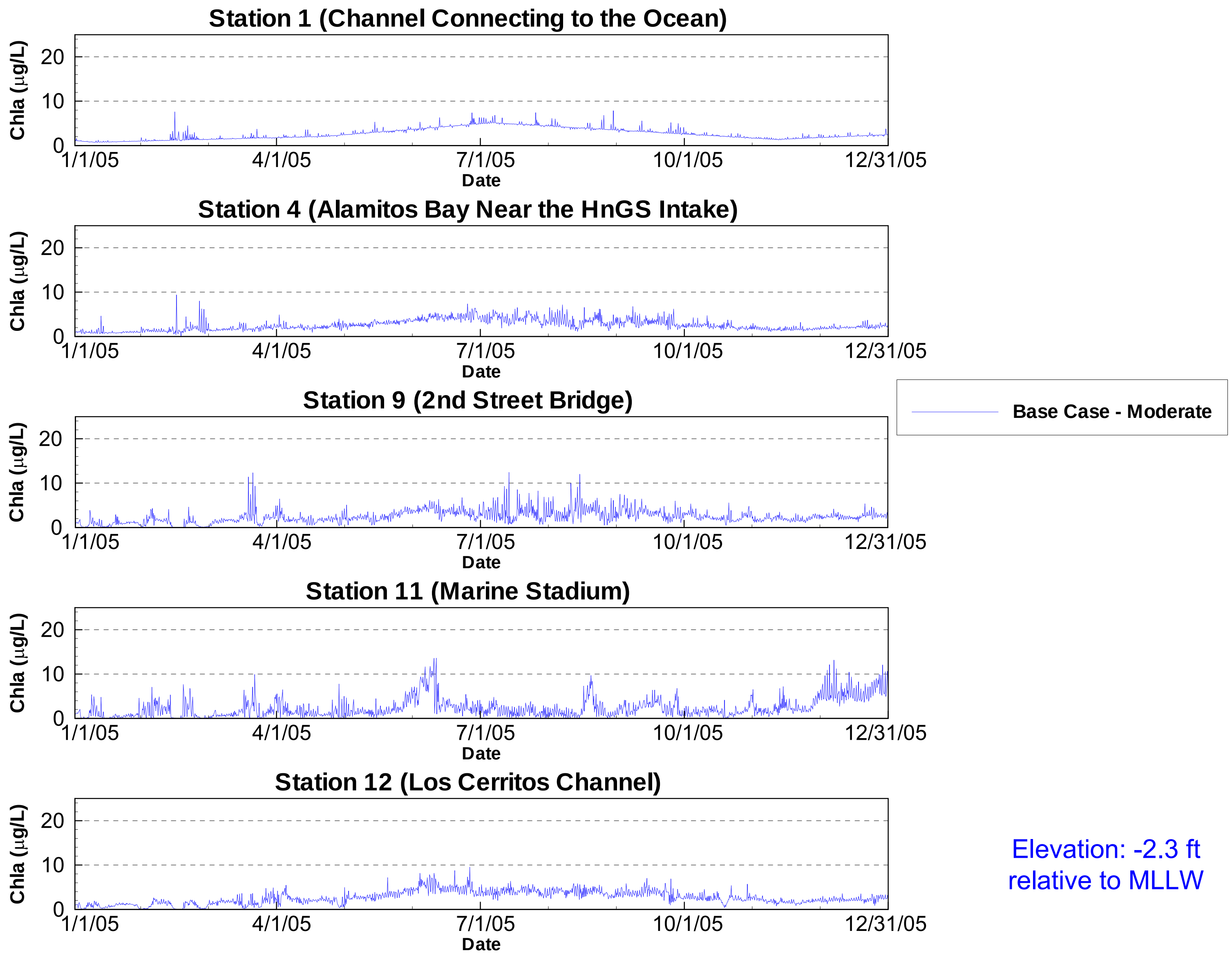
Figure 2.44

Predicted Near-Surface Orthophosphate Concentrations



Elevation: -2.3 ft relative to MLLW

Predicted Near-Surface Chlorophyll *a* Concentrations
Base Case – Moderate CAEDYM Parameter Values



Predicted Near-Surface Chlorophyll *a* Concentrations
Moderate CAEDYM Parameter Values

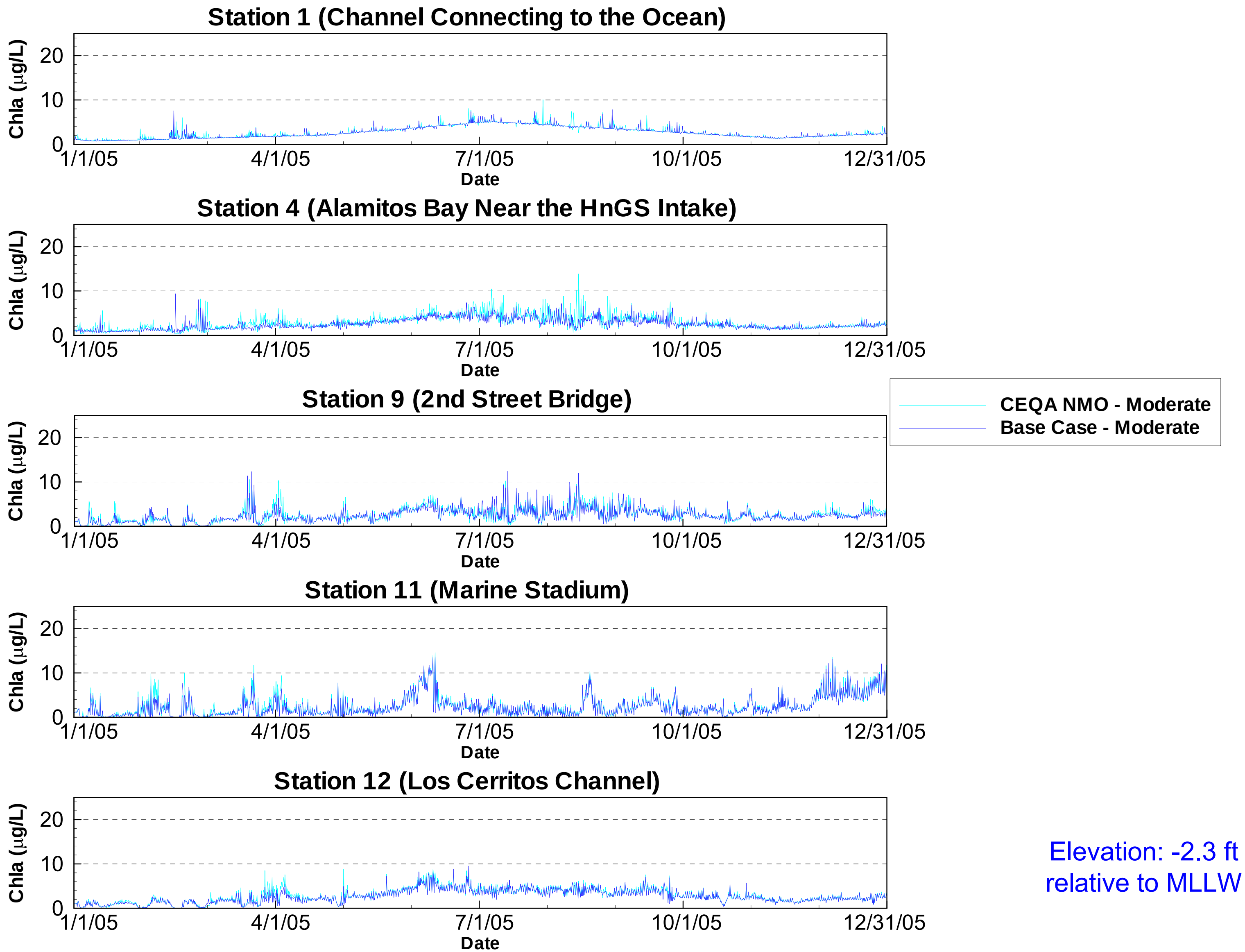


Figure 2.47

Predicted Near-Surface Chlorophyll *a* Concentrations High CAEDYM Parameter Values

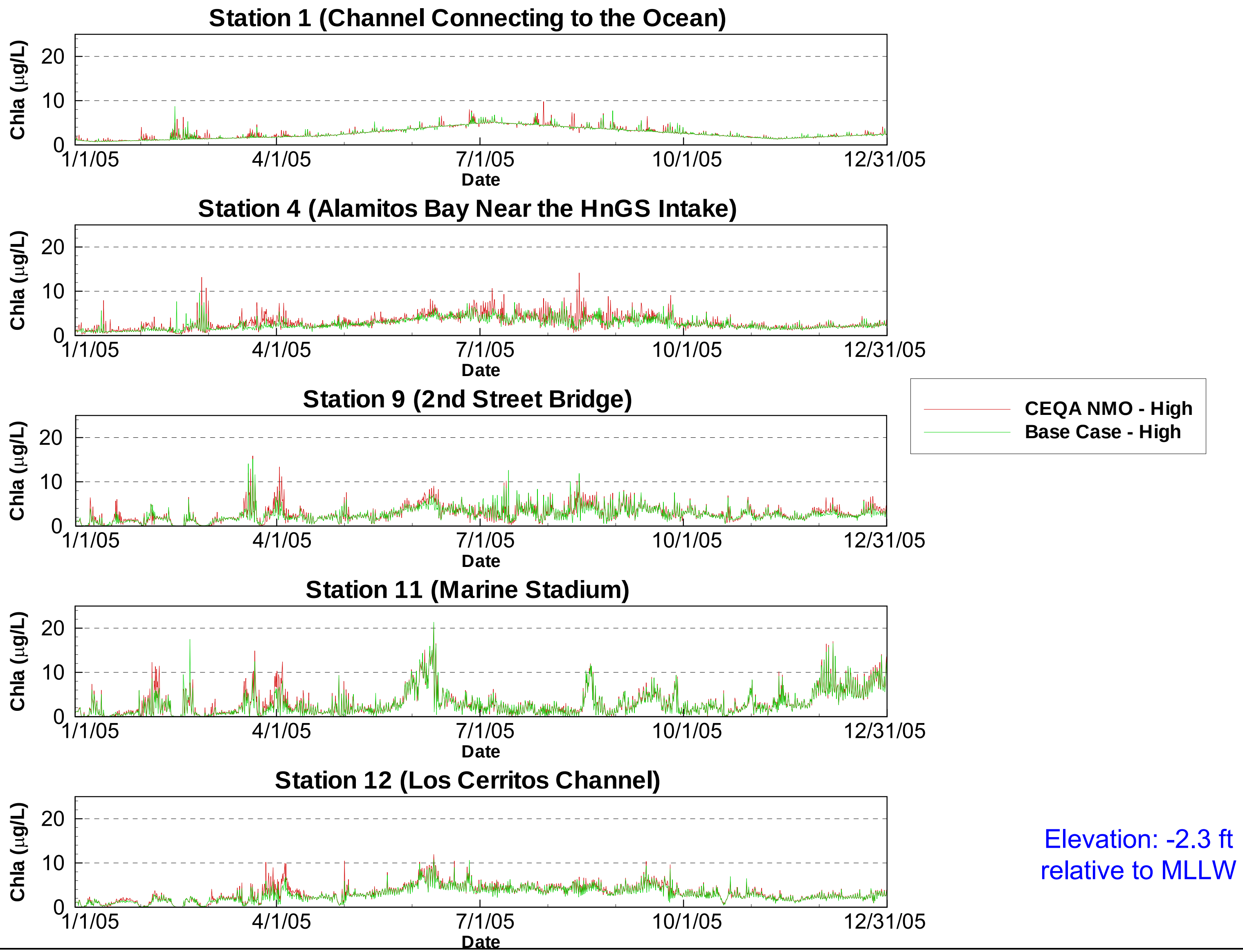
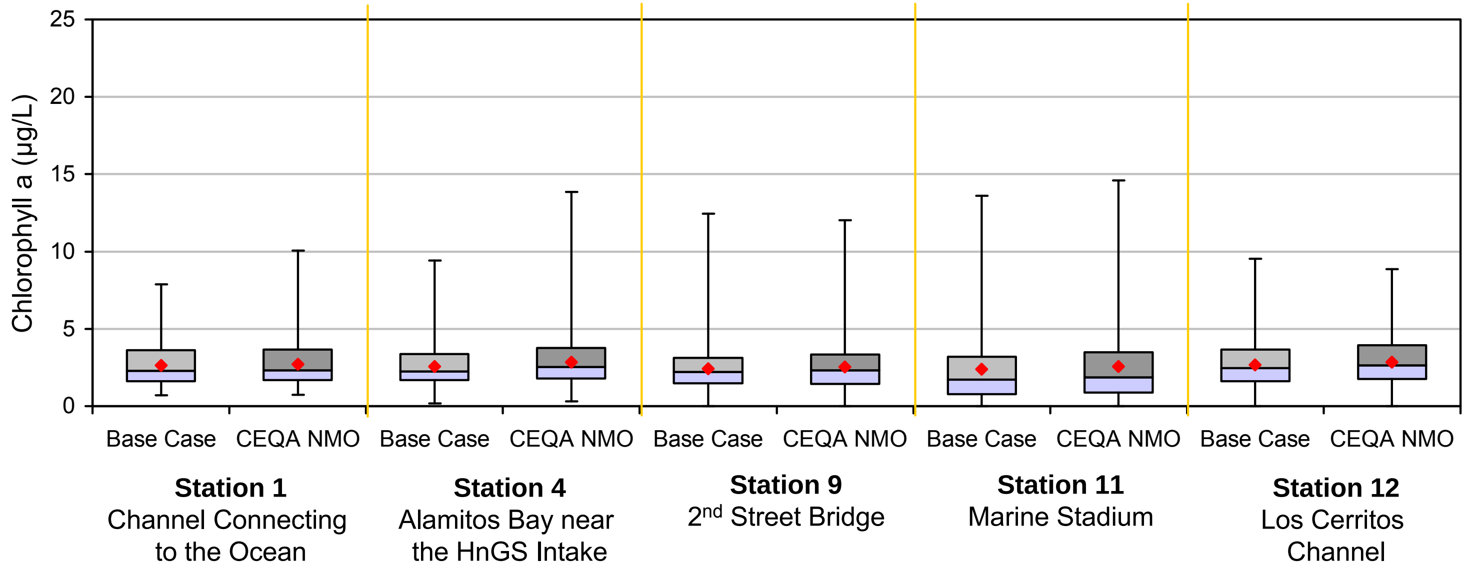


Figure 2.48

Box Plots Showing the Distribution of Chlorophyll *a* at Select Stations for Different Scenarios

Moderate CAEDYM Parameters



High CAEDYM Parameters

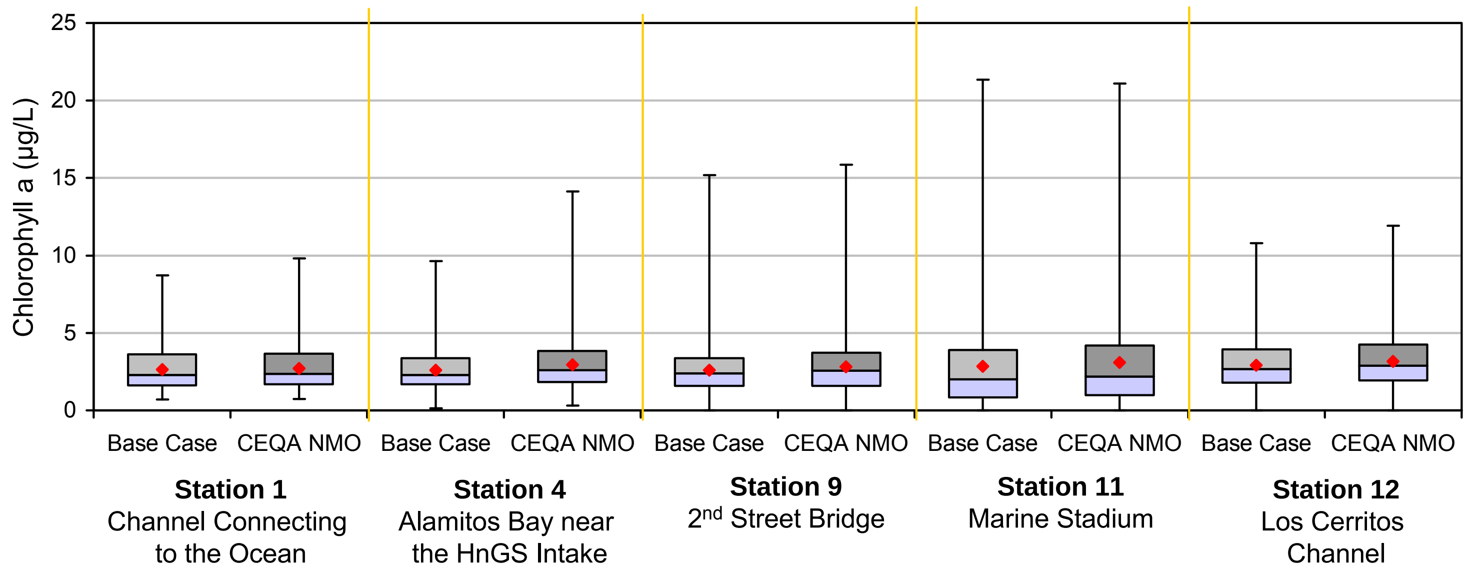
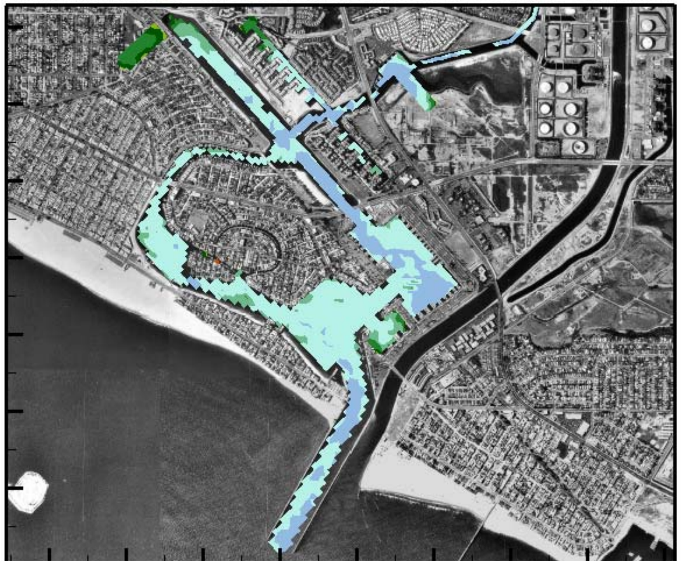


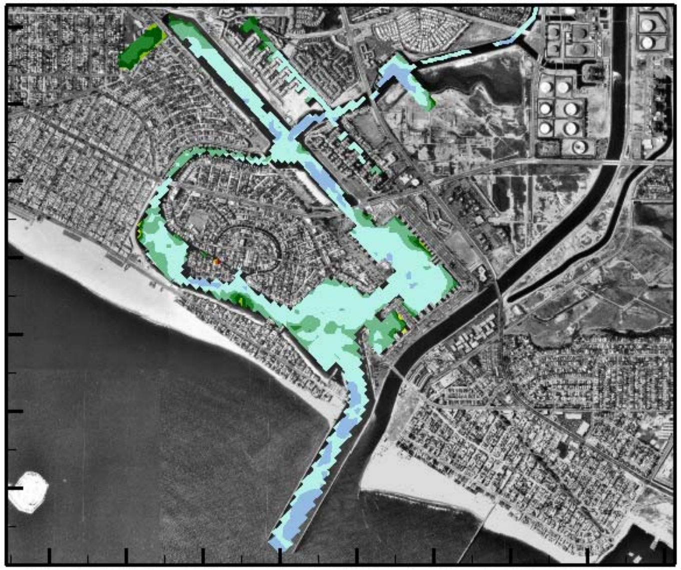
Figure 2.49

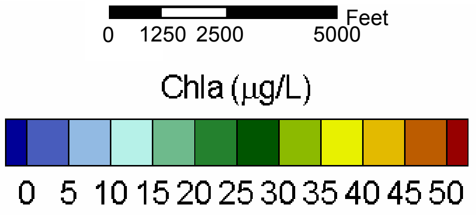
Comparison of Near-Surface Chlorophyll *a* Concentrations Annual Maximum – Moderate Parameter Values

Base Case



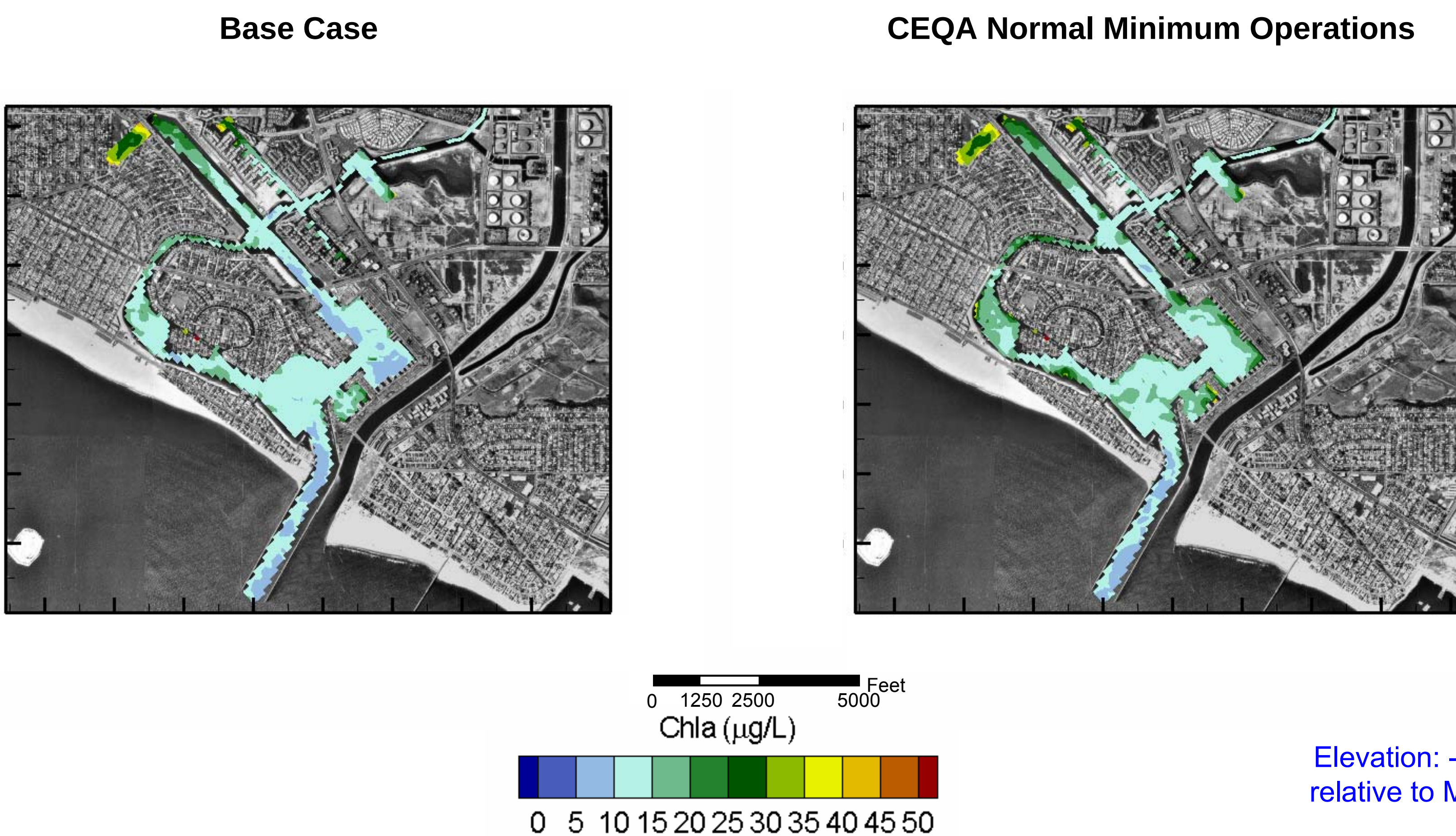
CEQA Normal Minimum Operations





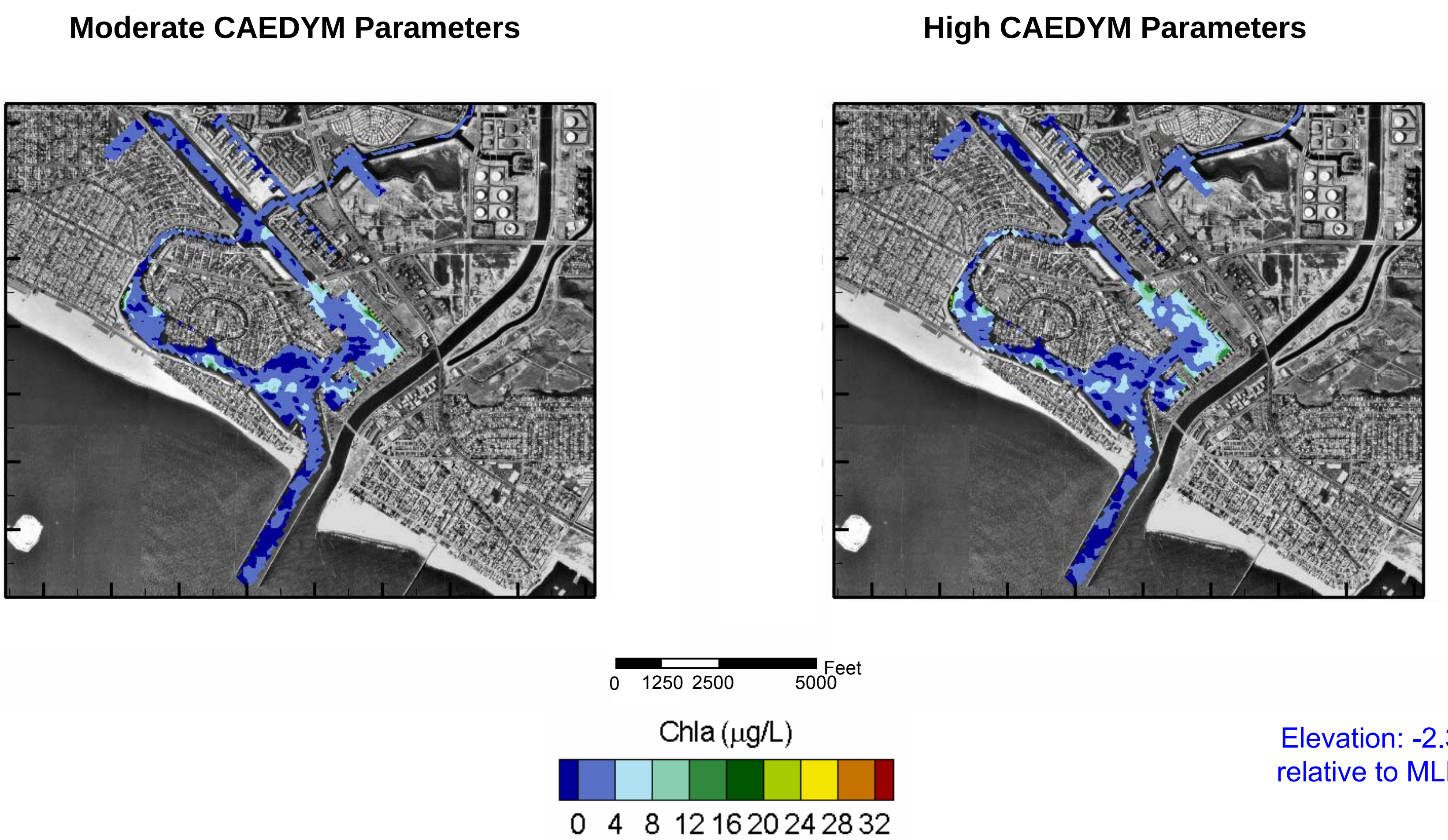
Elevation: -2.3 ft relative to MLLW

Comparison of Near-Surface Chlorophyll *a* Concentrations
Annual Maximum – High Parameter Values



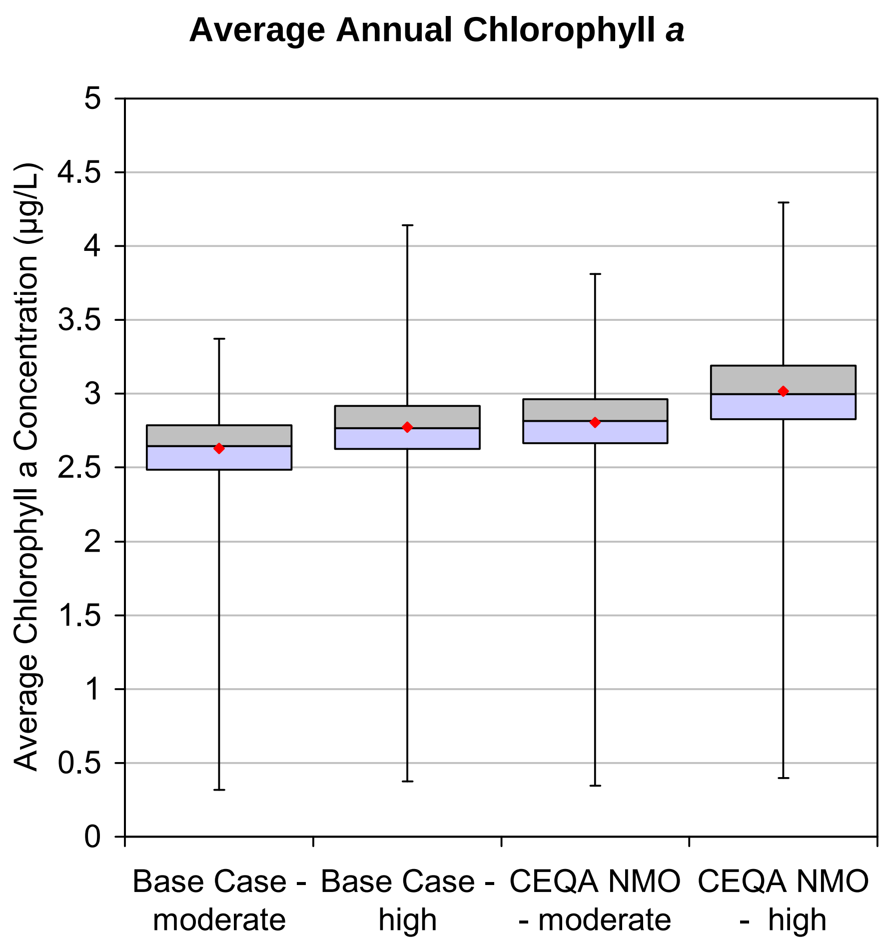
Elevation: -2.3 ft
relative to MLLW

Alamitos Bay Near-Surface Chlorophyll *a* - Annual Maximum - Difference Between CEQA Normal Minimum Operations and Base Case Scenarios



Elevation: -2.3 ft relative to MLLW

Box Plots Comparing Maximum and Average Chlorophyll *a* Concentrations for Different Simulations Scenarios



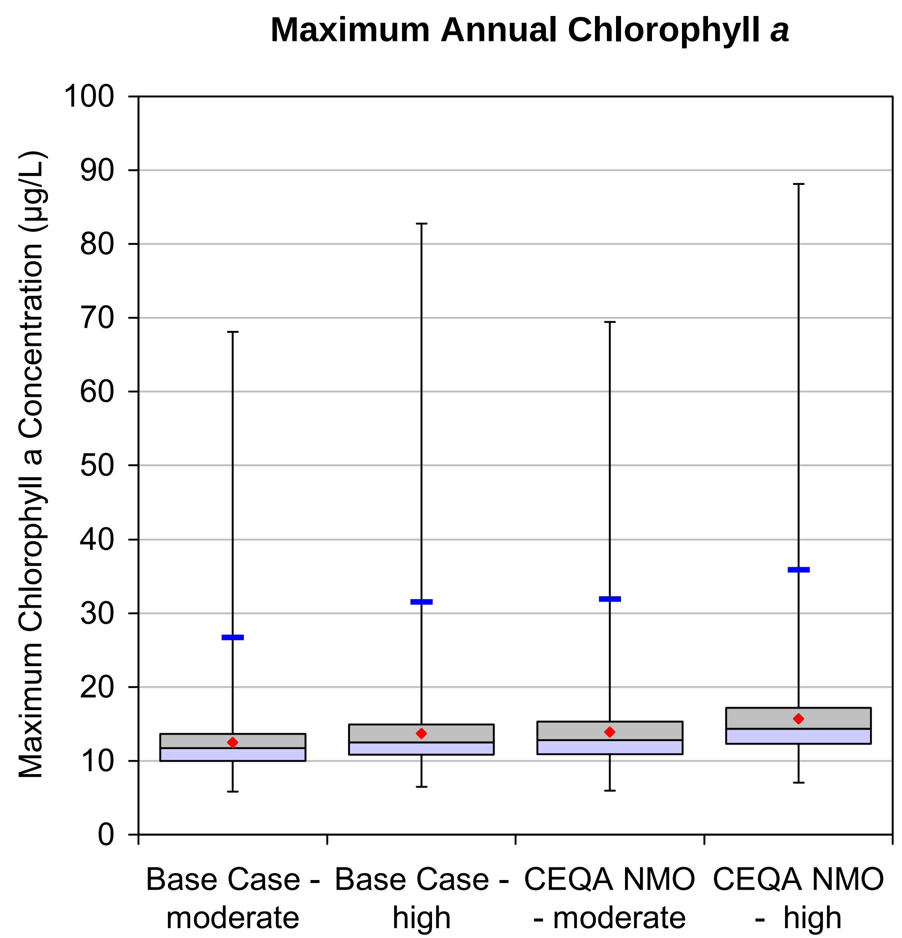


Figure 2.53

Predicted Near-Bottom Dissolved Oxygen Concentrations
Base Case – Moderate CAEDYM Parameter Values

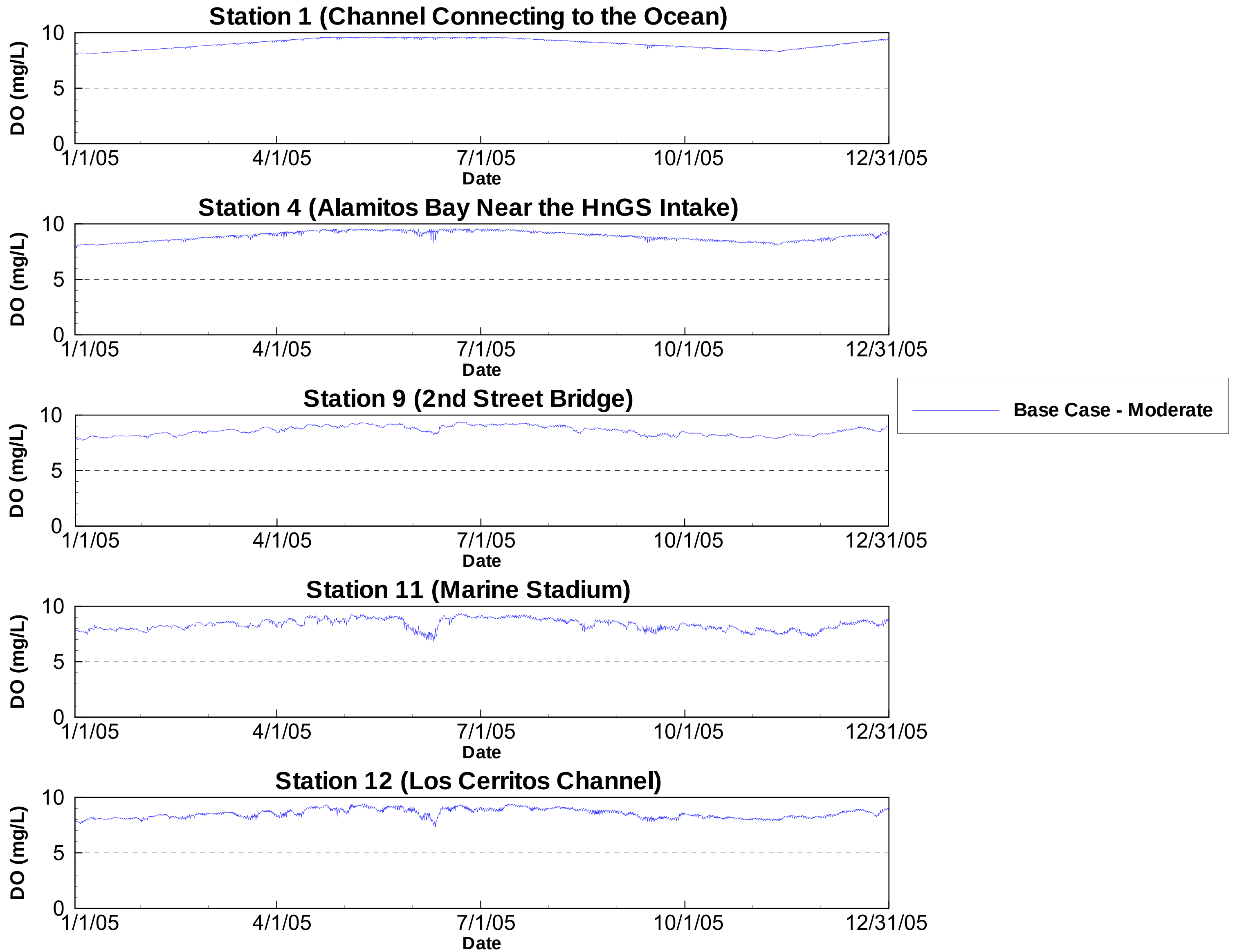


Figure 2.54

Predicted Near-Bottom Dissolved Oxygen Concentrations
Moderate CAEDYM Parameter Values

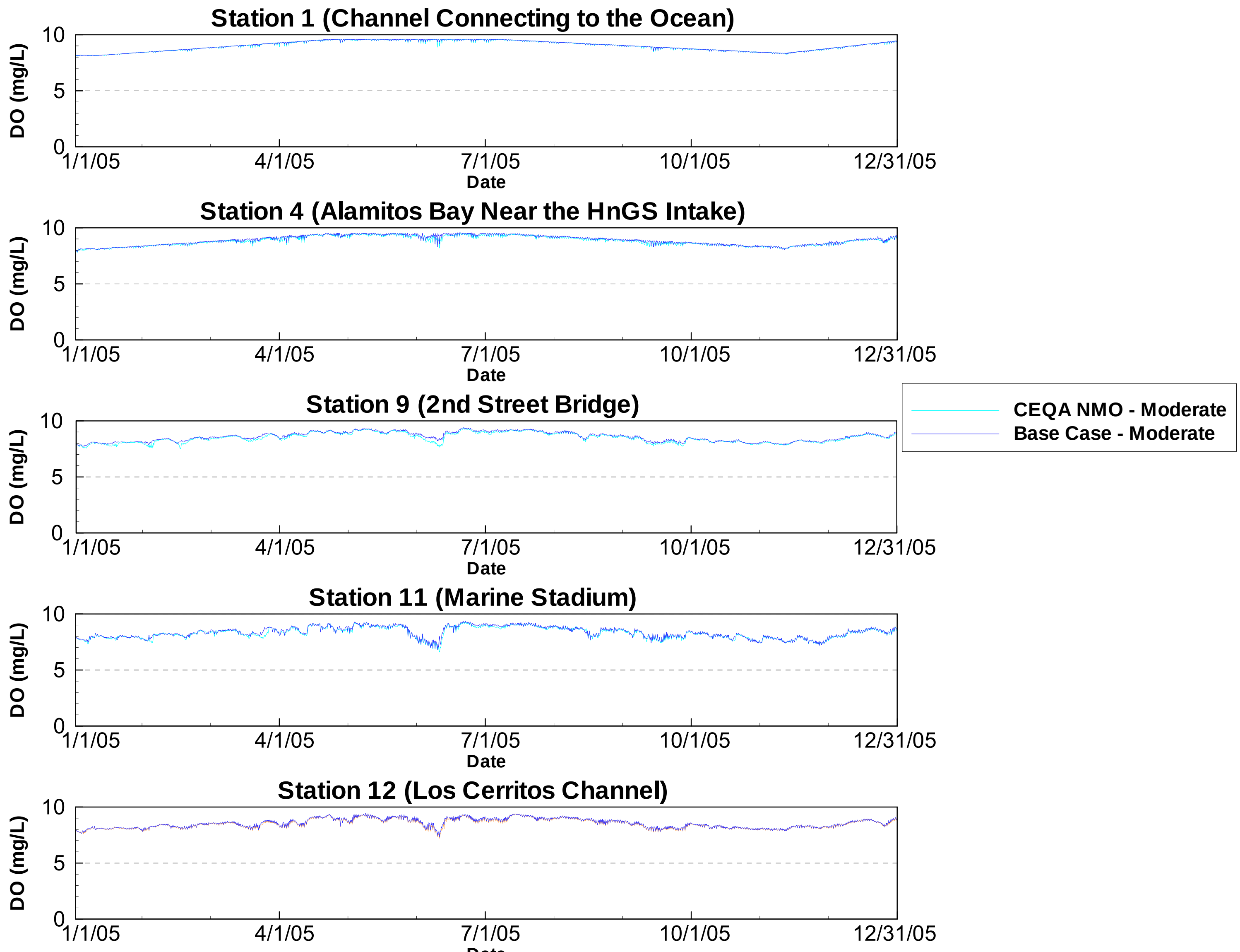
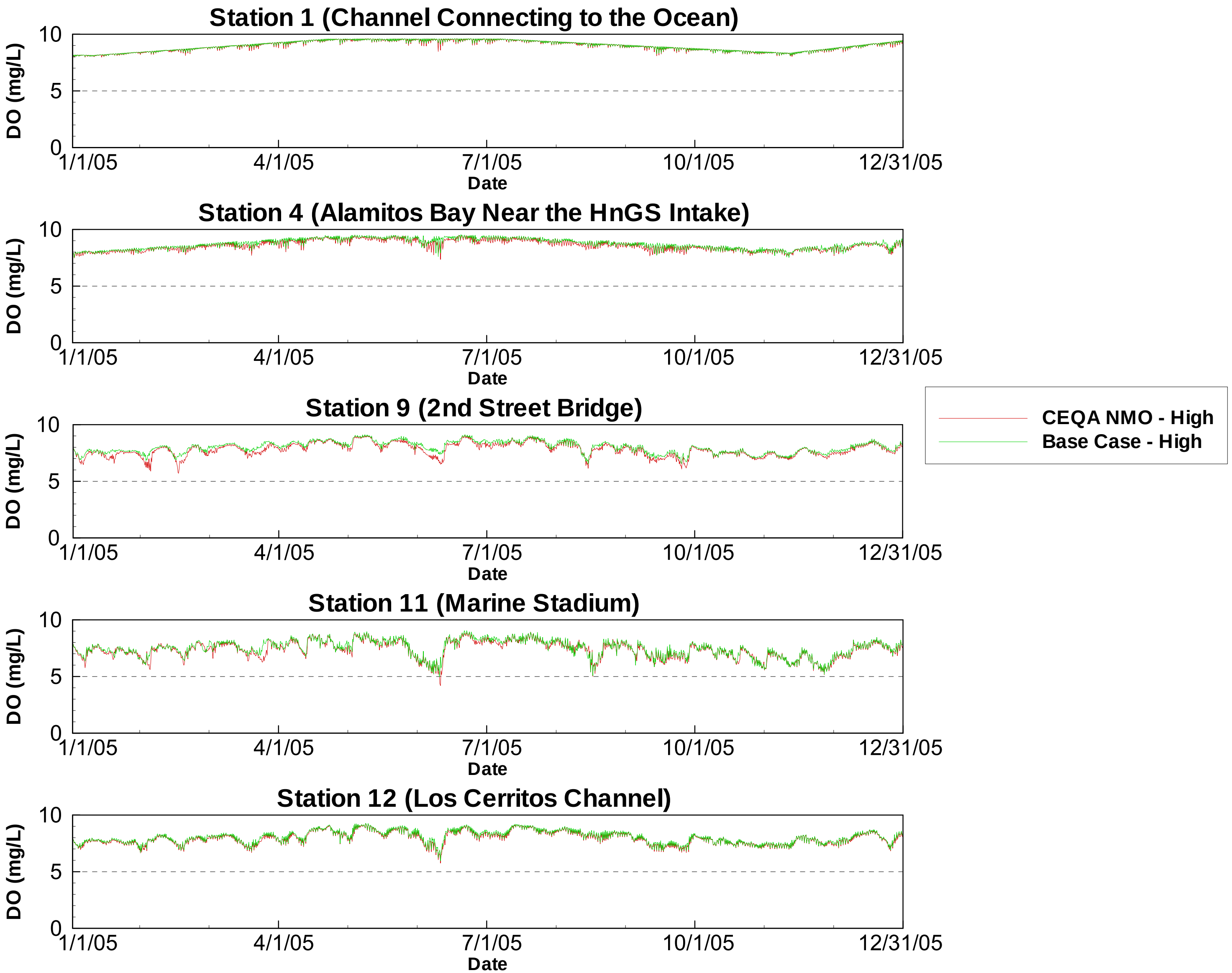


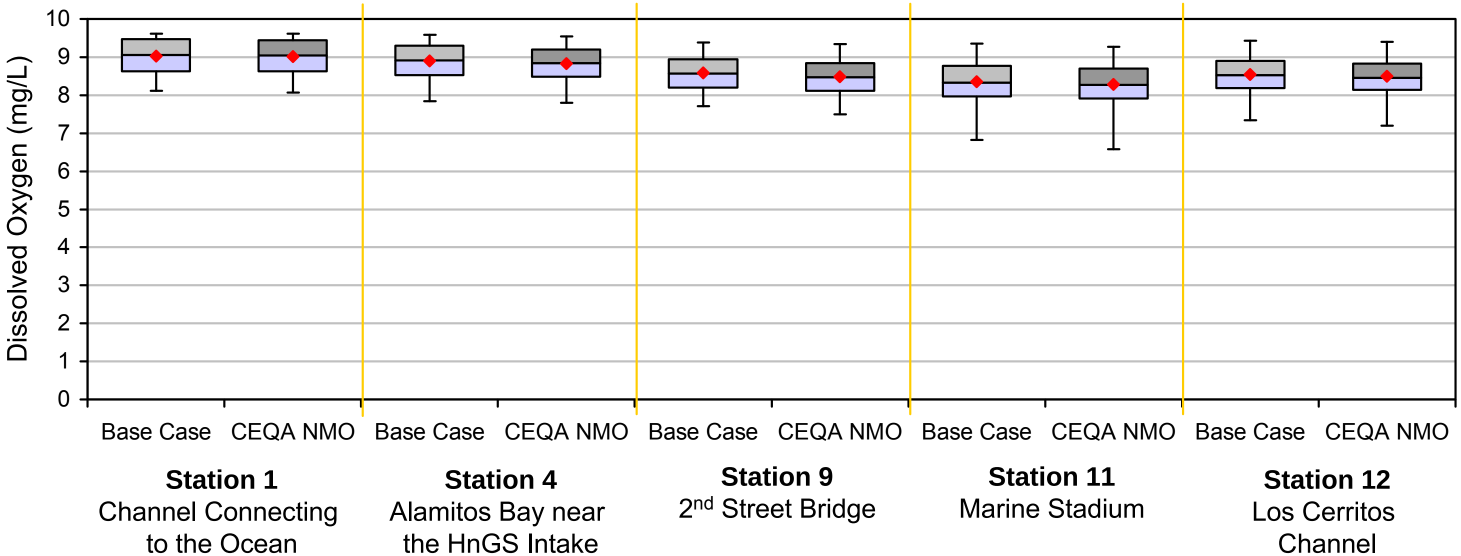
Figure 2.55

Predicted Near-Bottom Dissolved Oxygen Concentrations
High CAEDYM Parameter Values

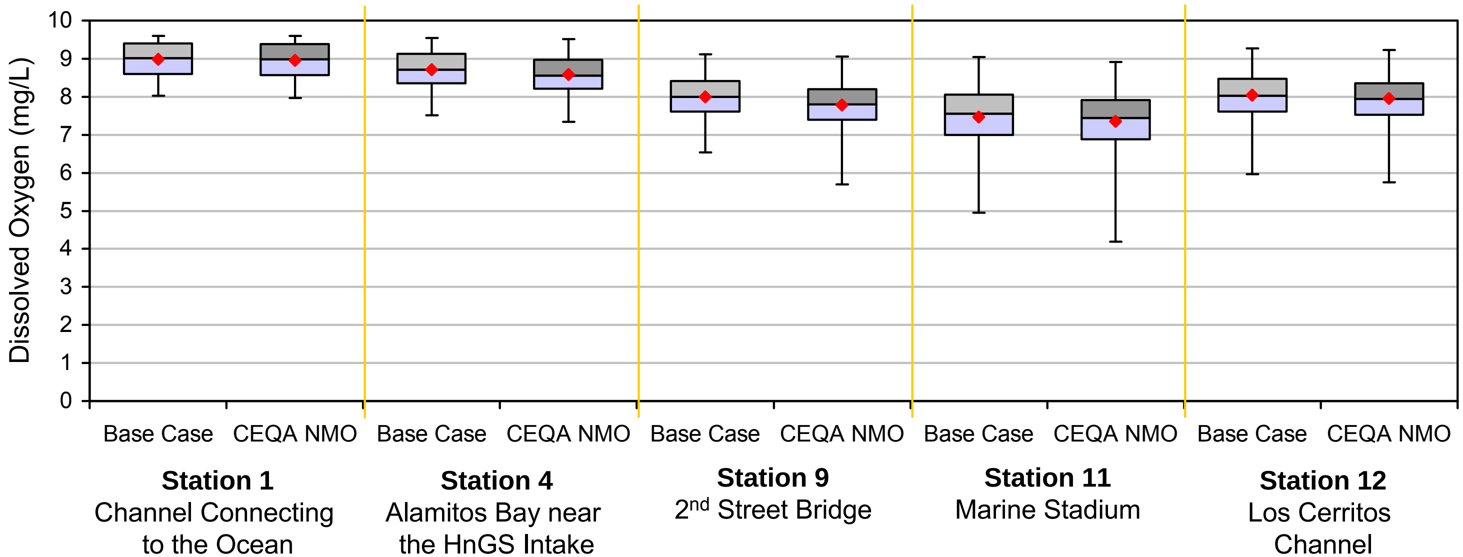


Box Plots Showing the Distribution of Dissolved Oxygen at Select Stations for Different Scenarios

Moderate CAEDYM Parameters

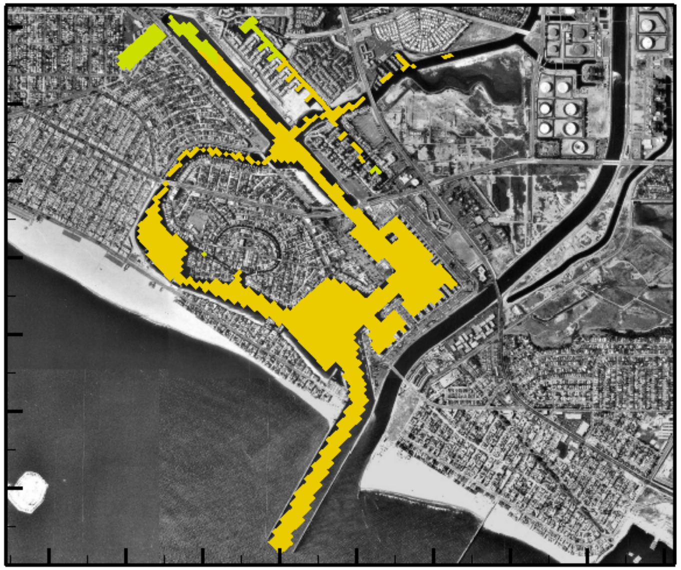


High CAEDYM Parameters

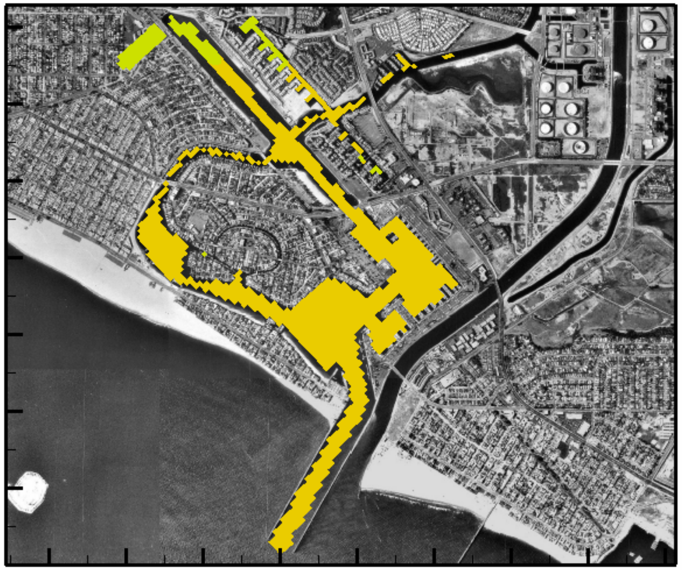


Near-Bottom Dissolved Oxygen Concentrations
Annual Minimum – Moderate Parameter Values

Base Case



CEQA Normal Minimum Operations



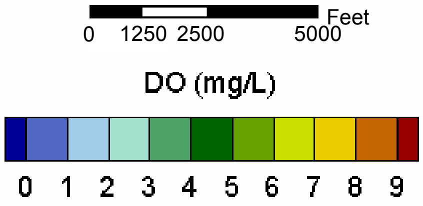
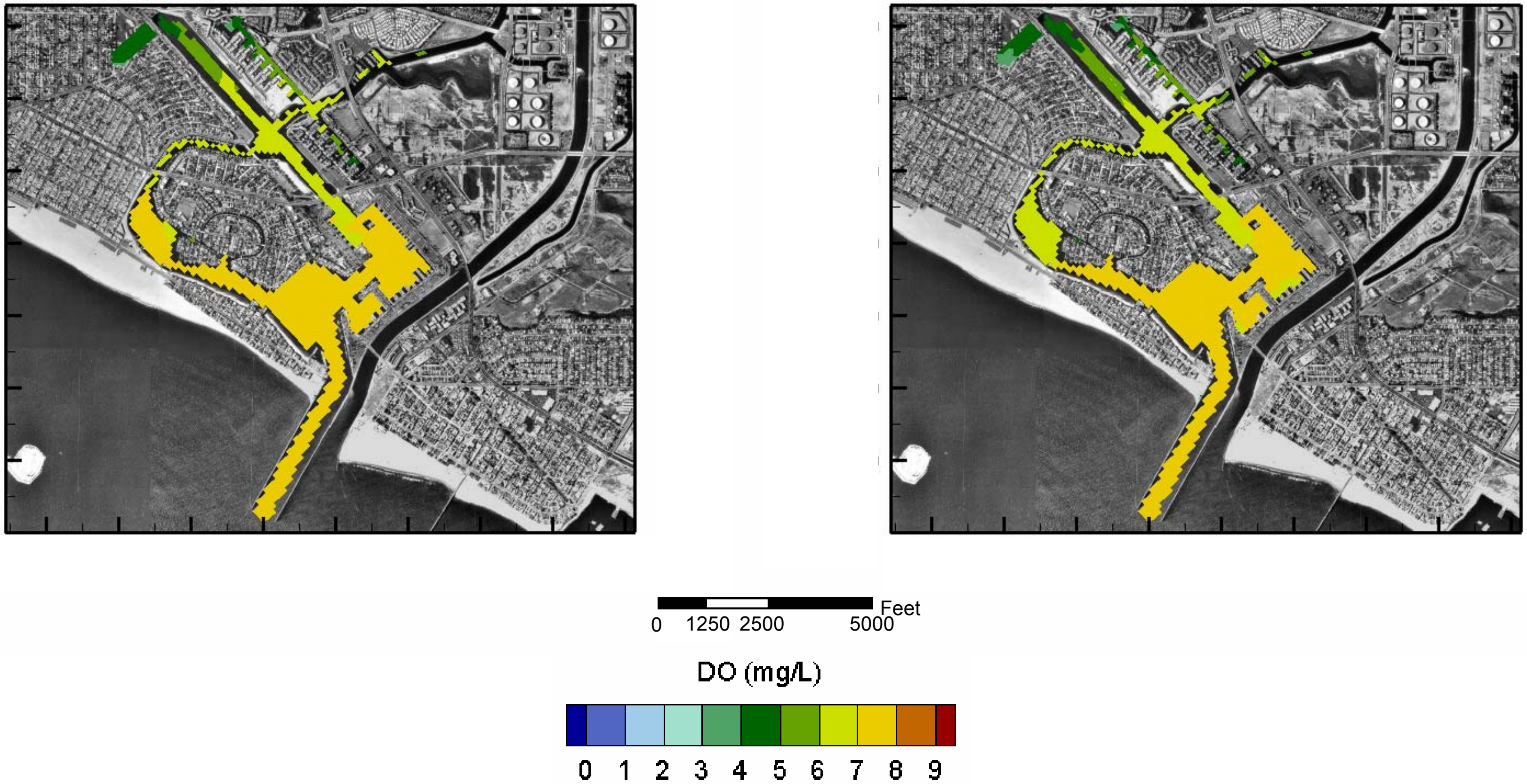


Figure 2.58

Near-Bottom Dissolved Oxygen Concentrations
Annual Minimum – High Parameter Values

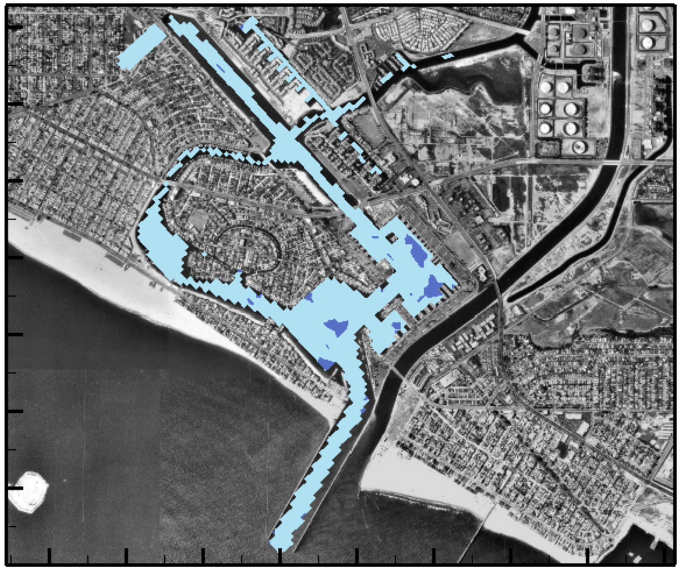
Base Case

CEQA Normal Minimum Operations

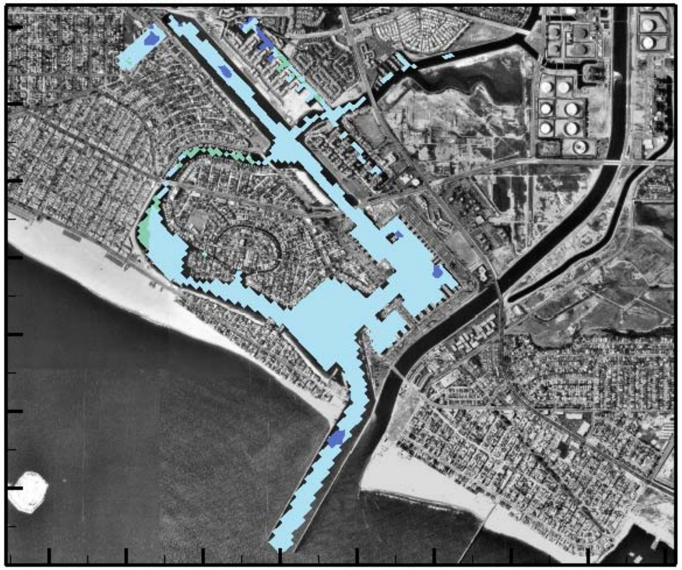


Alamitos Bay Dissolved Oxygen - Annual Minimum - Difference Between CEQA Normal Minimum Operations and Base Case Scenarios

Moderate CAEDYM Parameters



High CAEDYM Parameters



0 1250 2500 5000 Feet

DO (mg/L)

-3.5 -3.0 -2.5 -2.0 -1.5 -1.0 -0.5 0.0 0.5

Figure 2.60

Box Plots Comparing Minimum Dissolved Oxygen Concentrations for Different Simulations Scenarios

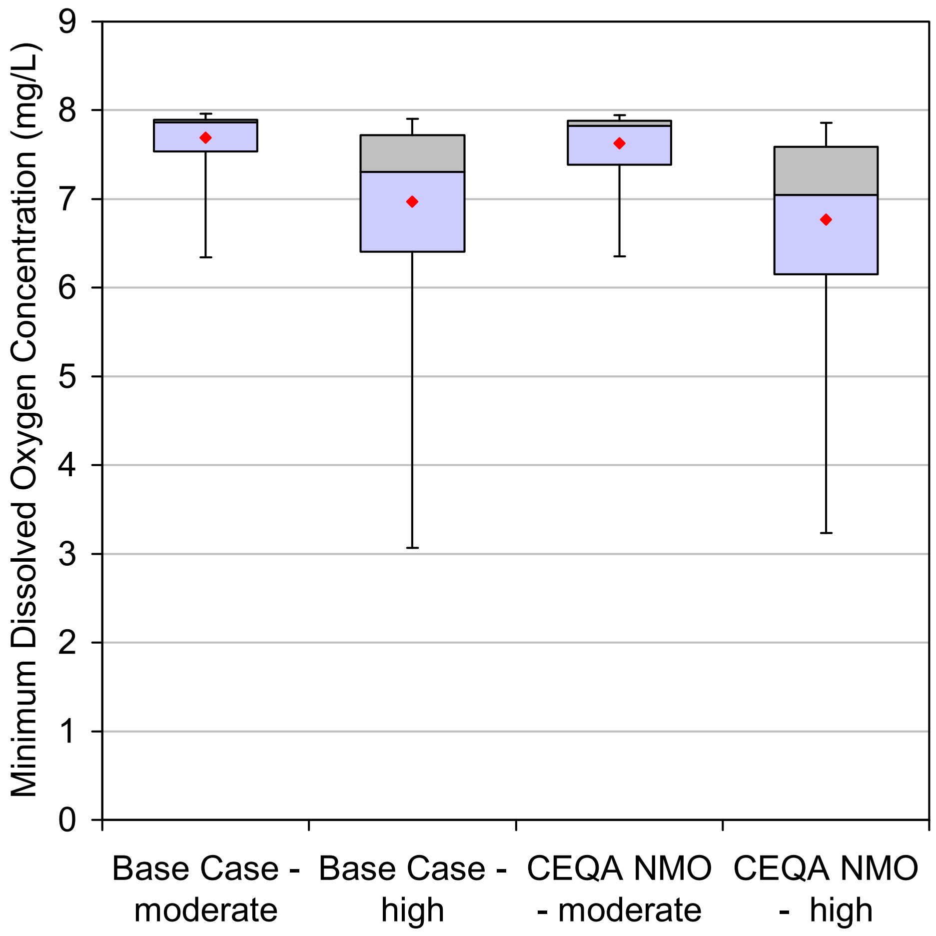
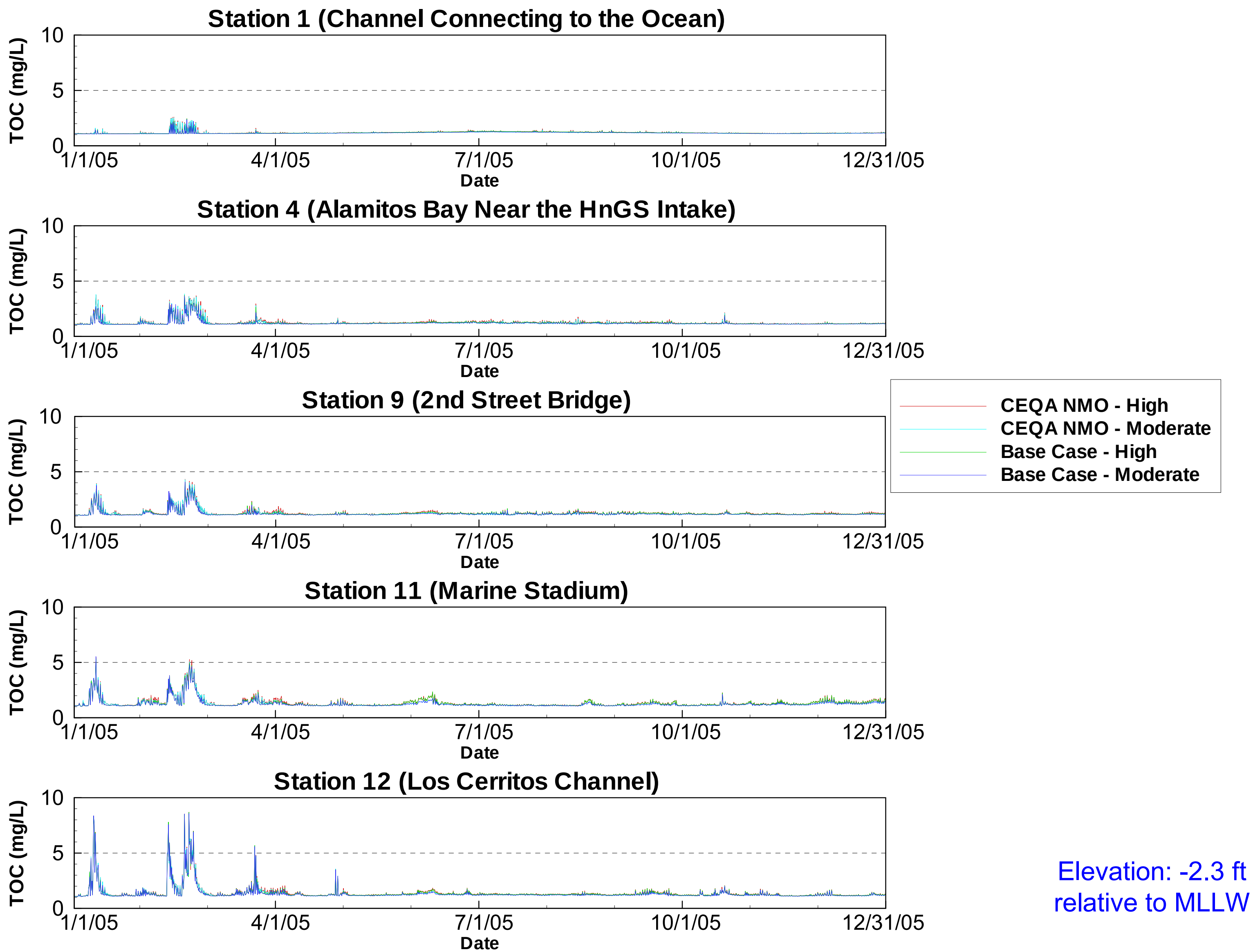
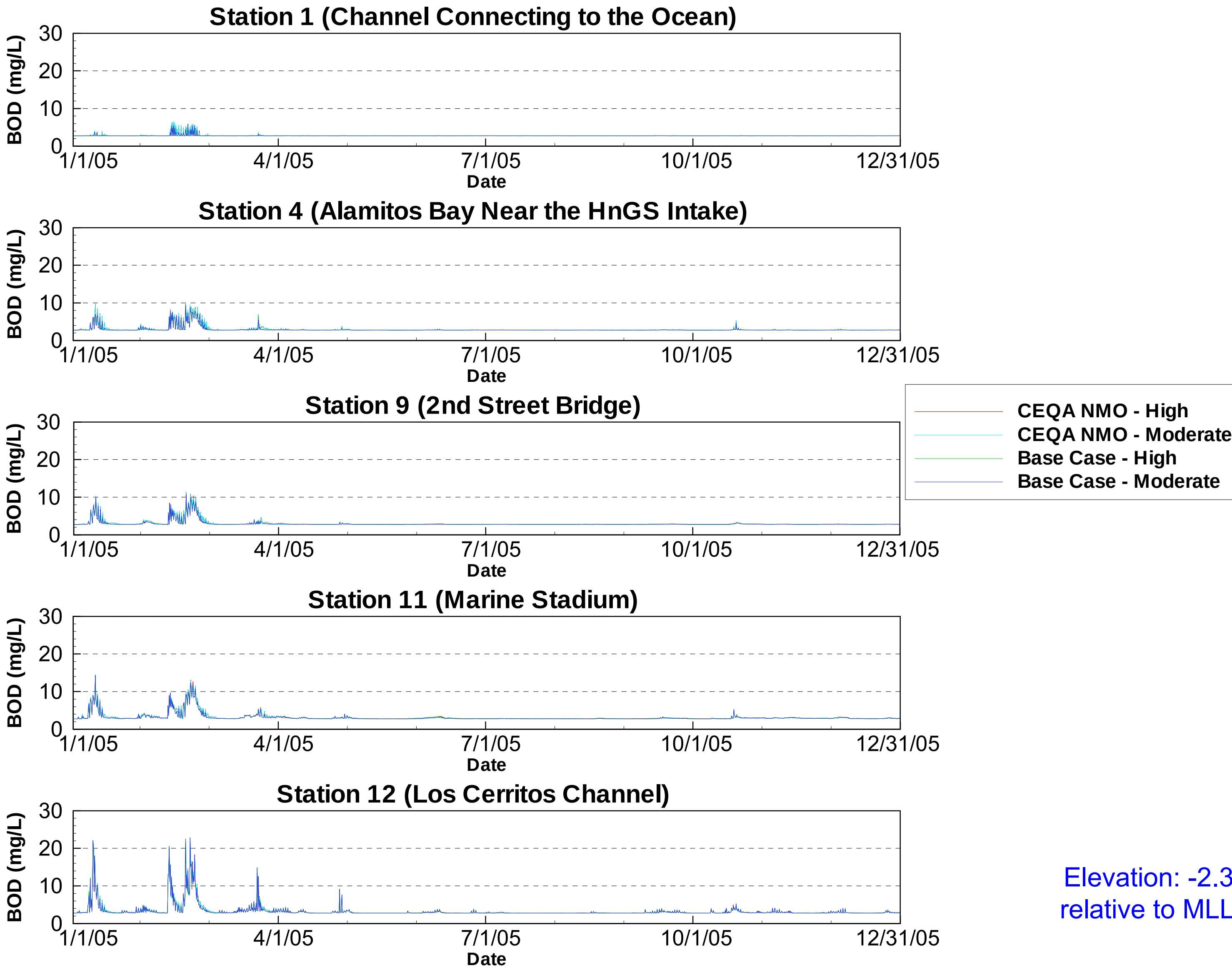


Figure 2.61

Predicted Near-Surface Total Organic Carbon Concentrations

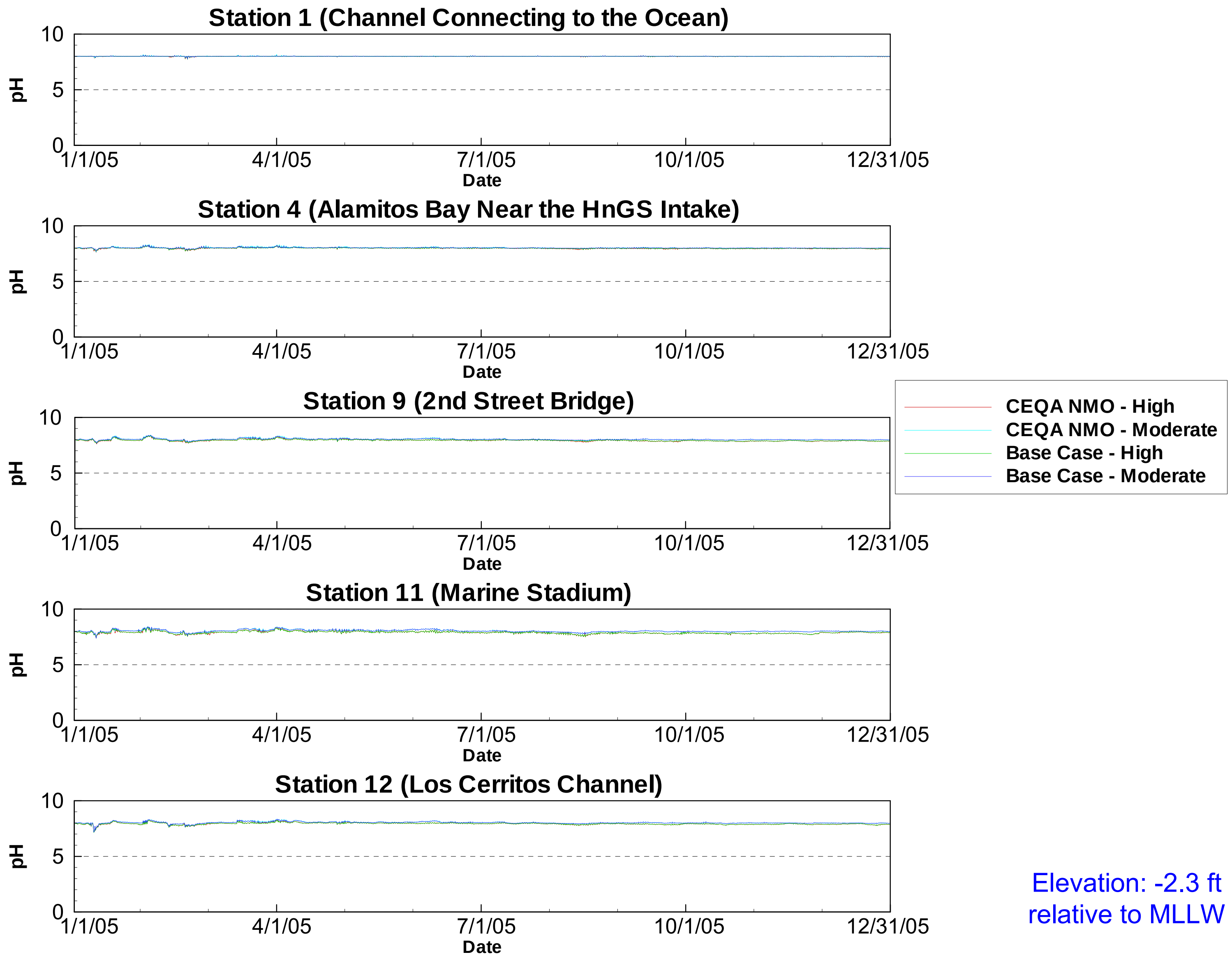


Predicted Near-Surface Biological Oxygen Demand



Elevation: -2.3 ft
relative to MLLW

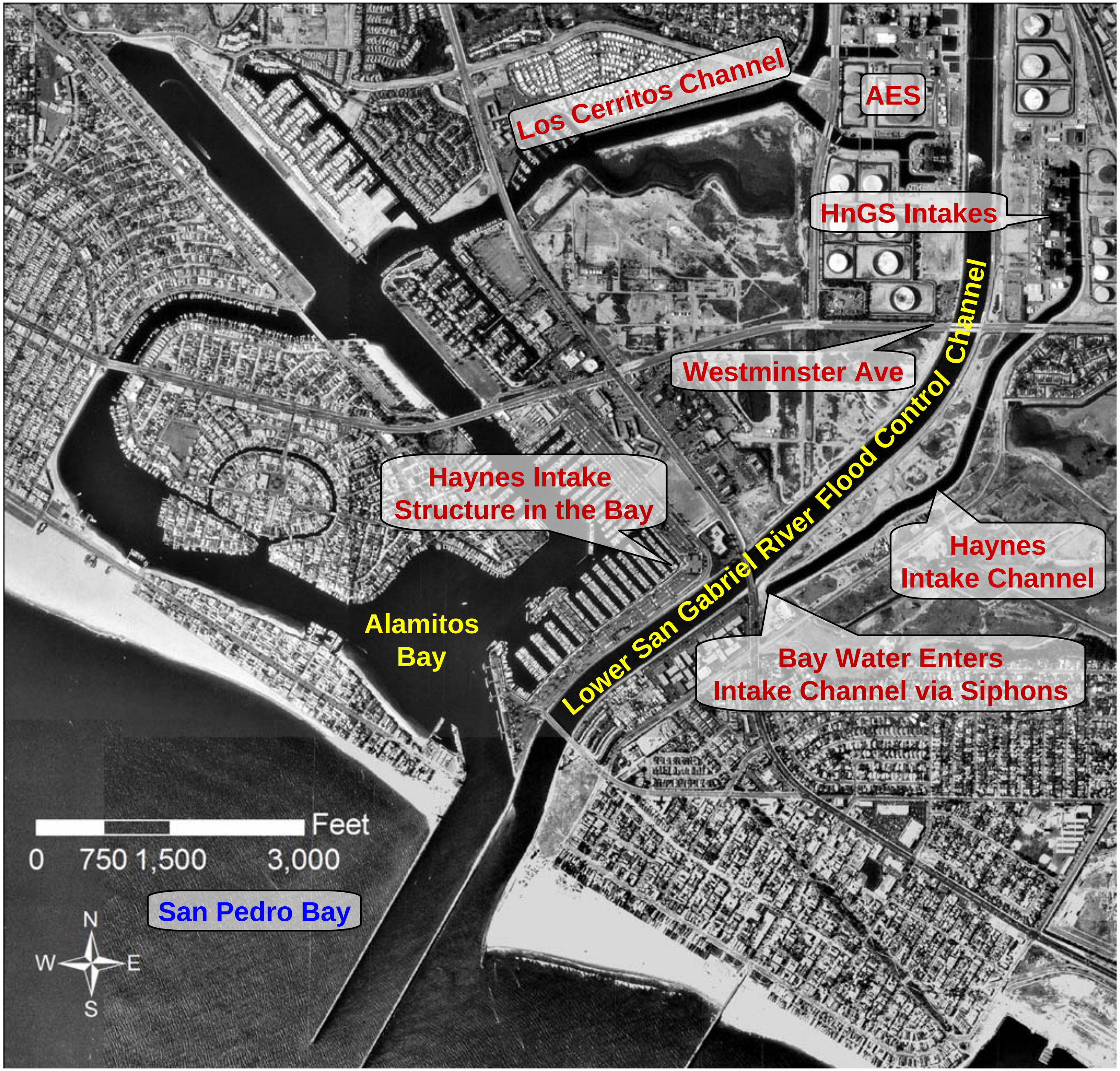
Predicted Near-Surface pH



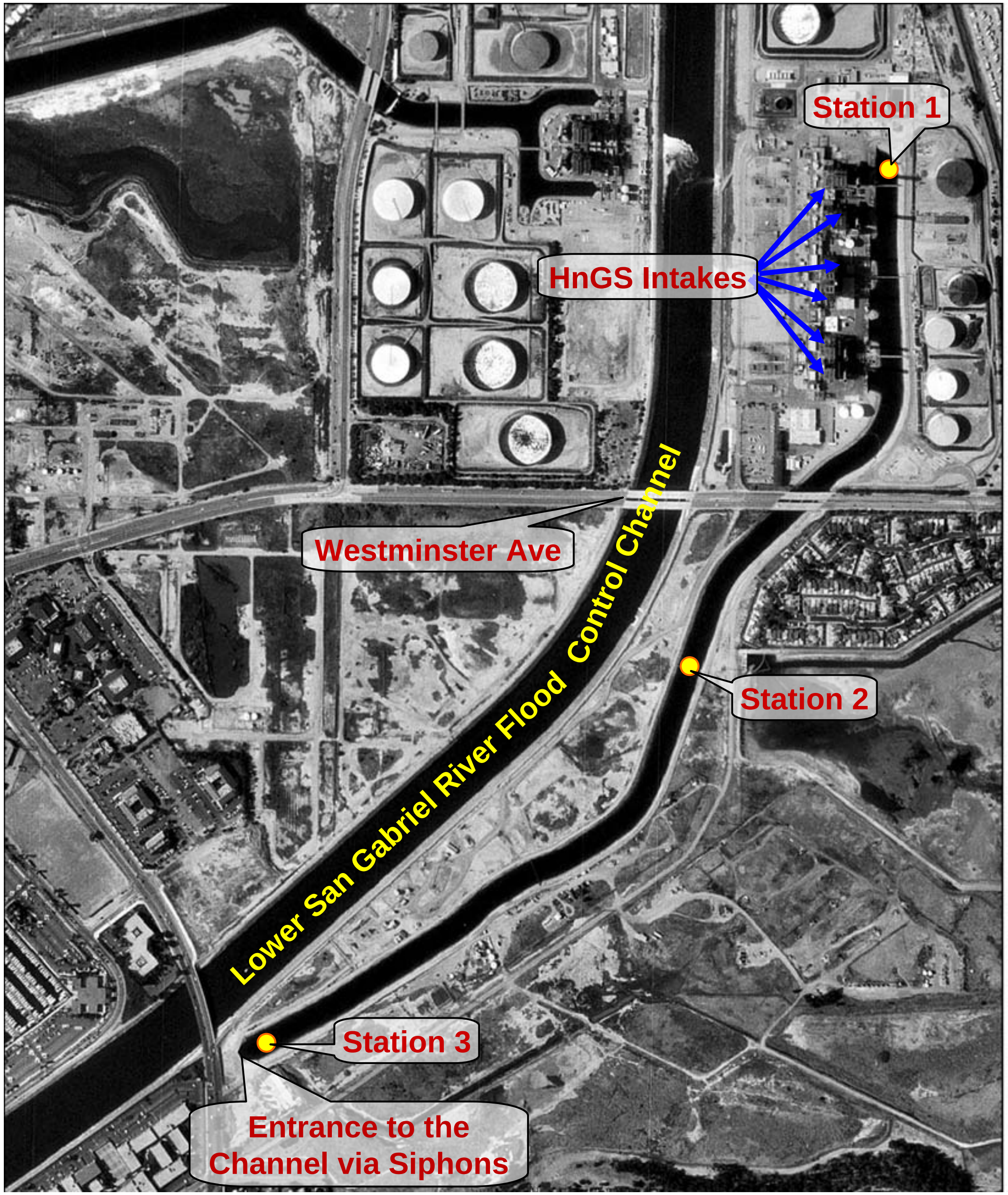
Elevation: -2.3 ft relative to MLLW

Figure 2.64

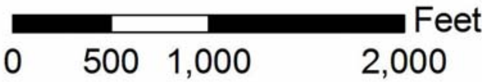
FLOW SCIENCE



Alamitos Bay and HnGS Intake Channel

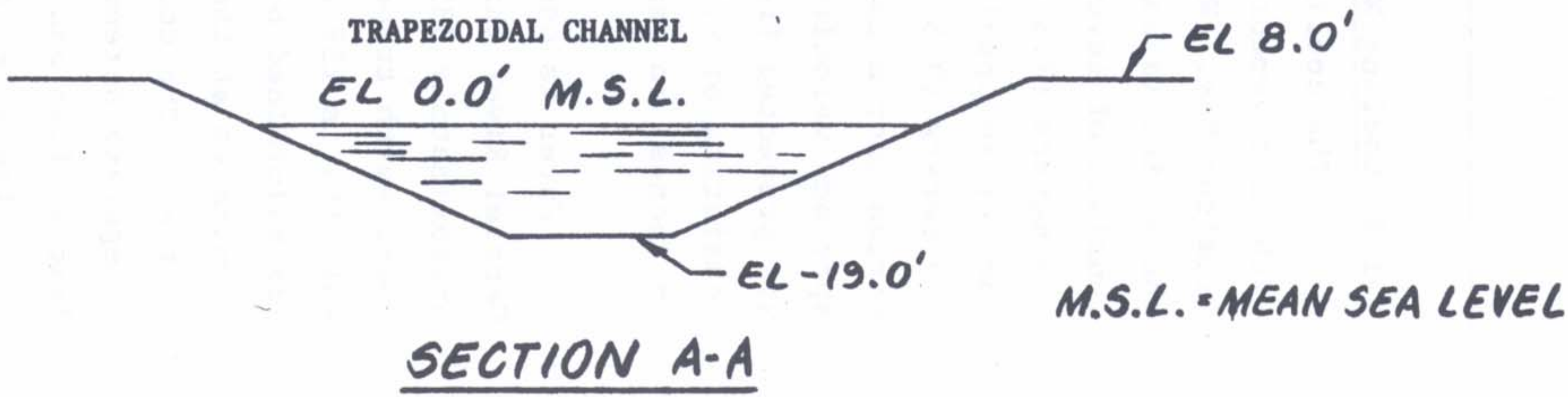


HnGS Intake Channel



Cross Section of Intake Channel at Southern End (Near HnGS Intake Structure and Siphons)

(Provided by LADWP)



***At NOAA tide station (9410660), mean sea level (MSL) = 2.82 ft MLLW. Thus, channel bottom of -19.0 ft MSL = -16.3 ft MLLW.*

Cross-Section Locations Surveyed by Fugro West

Southern Half of Intake Channel

Northern Half of Intake Channel

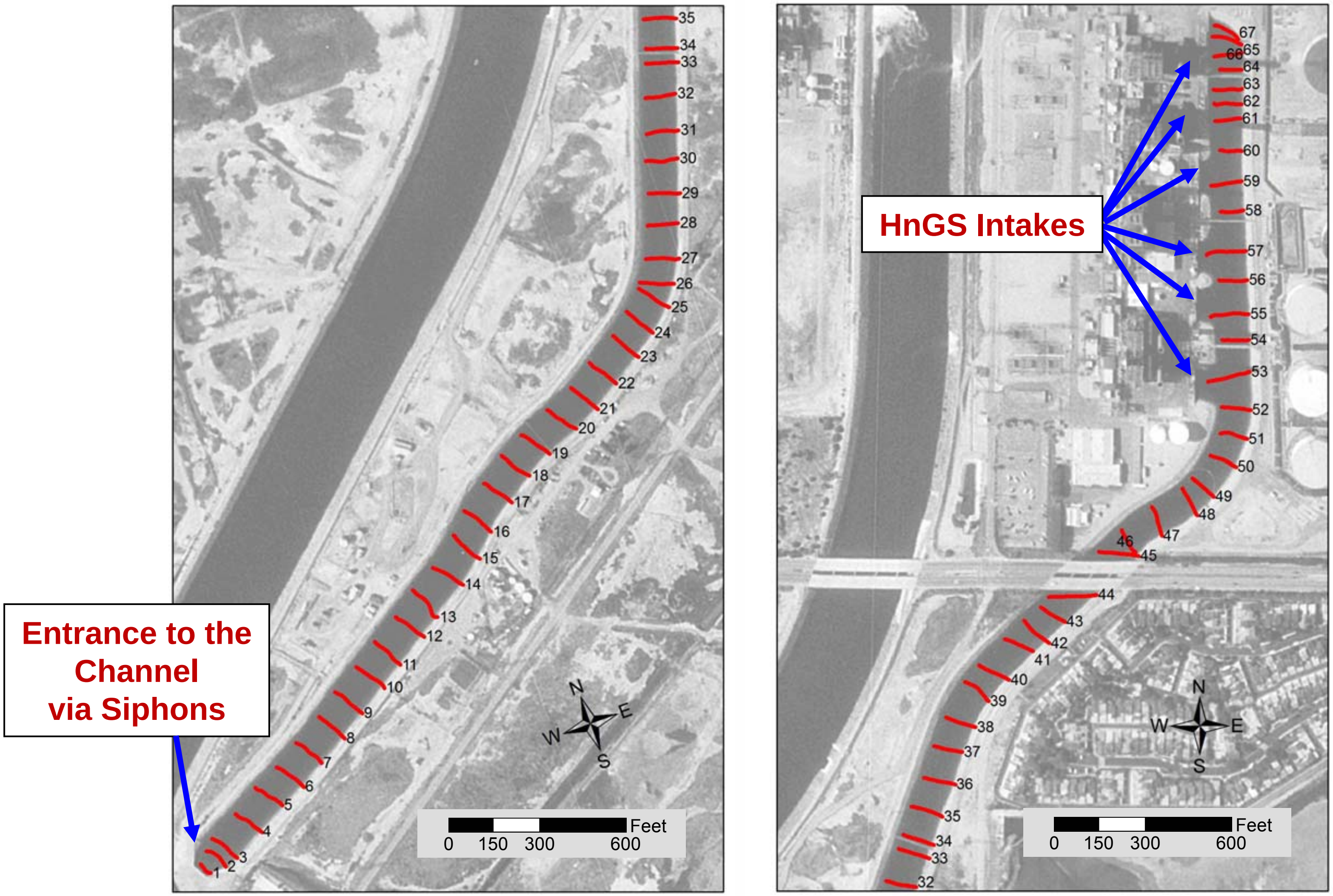


Figure 3.4

Fugro West 2008 Cross-Sections at Selected Locations

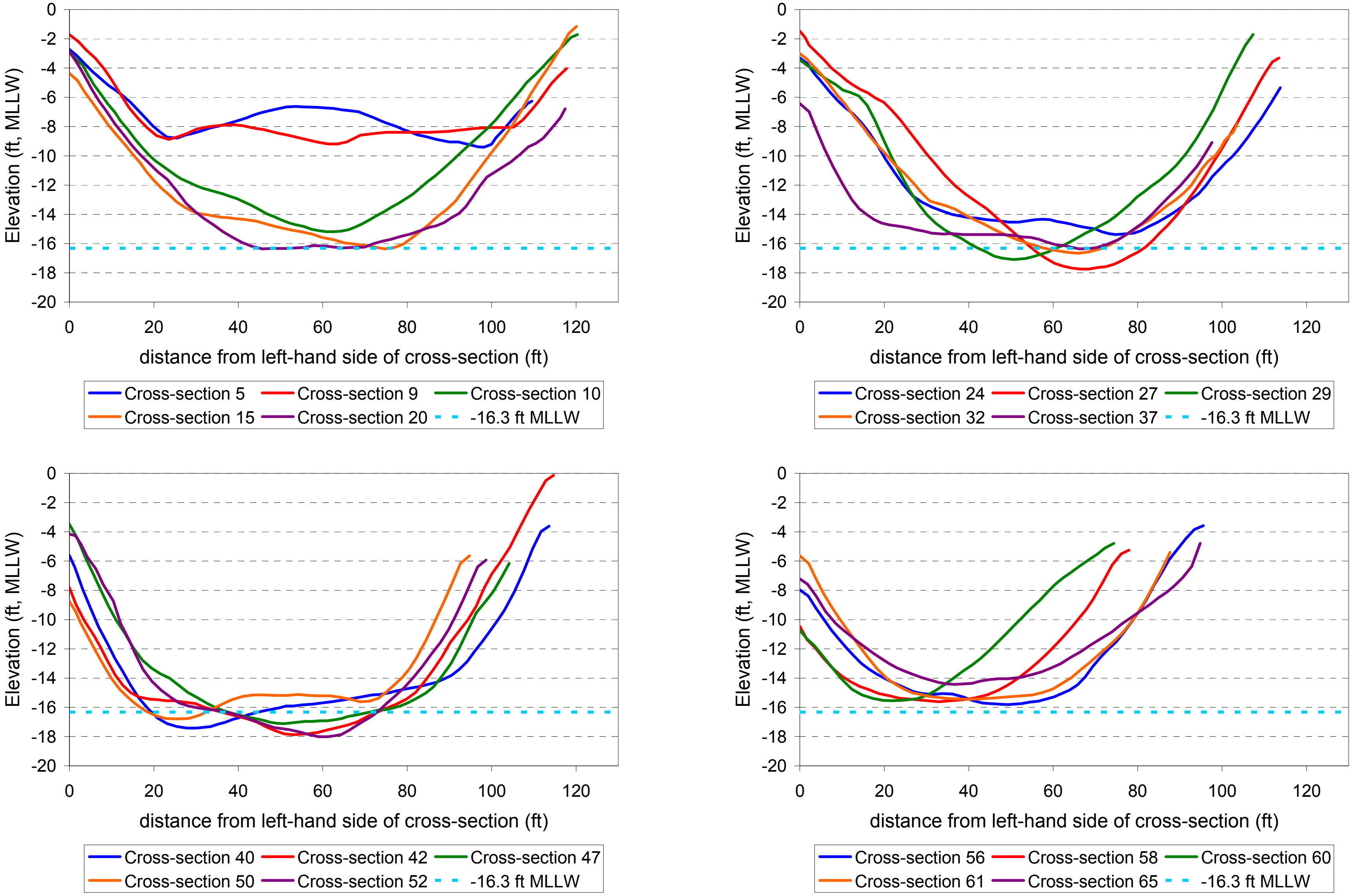
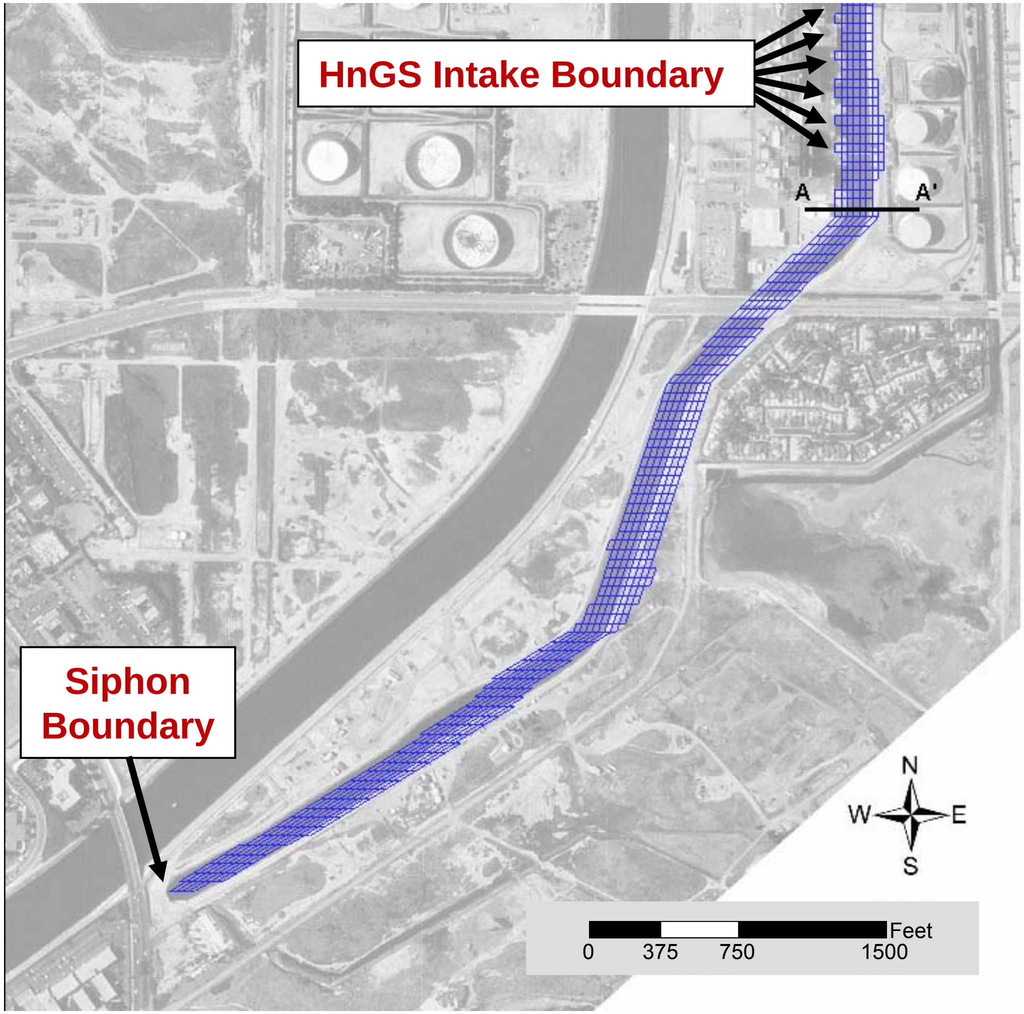


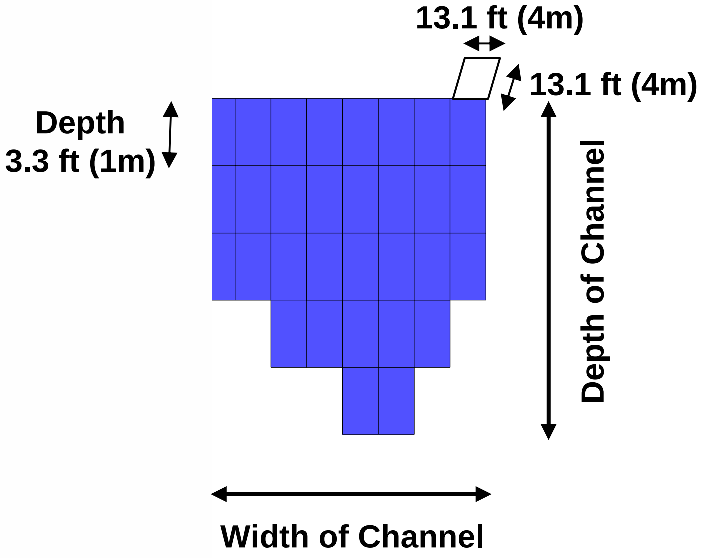
Figure 3.5

Computational Grid

Plan View of the Grid



Channel Cross Section (A-A')



Haynes Generating Station
Cooling Water Flow Rate Scenarios

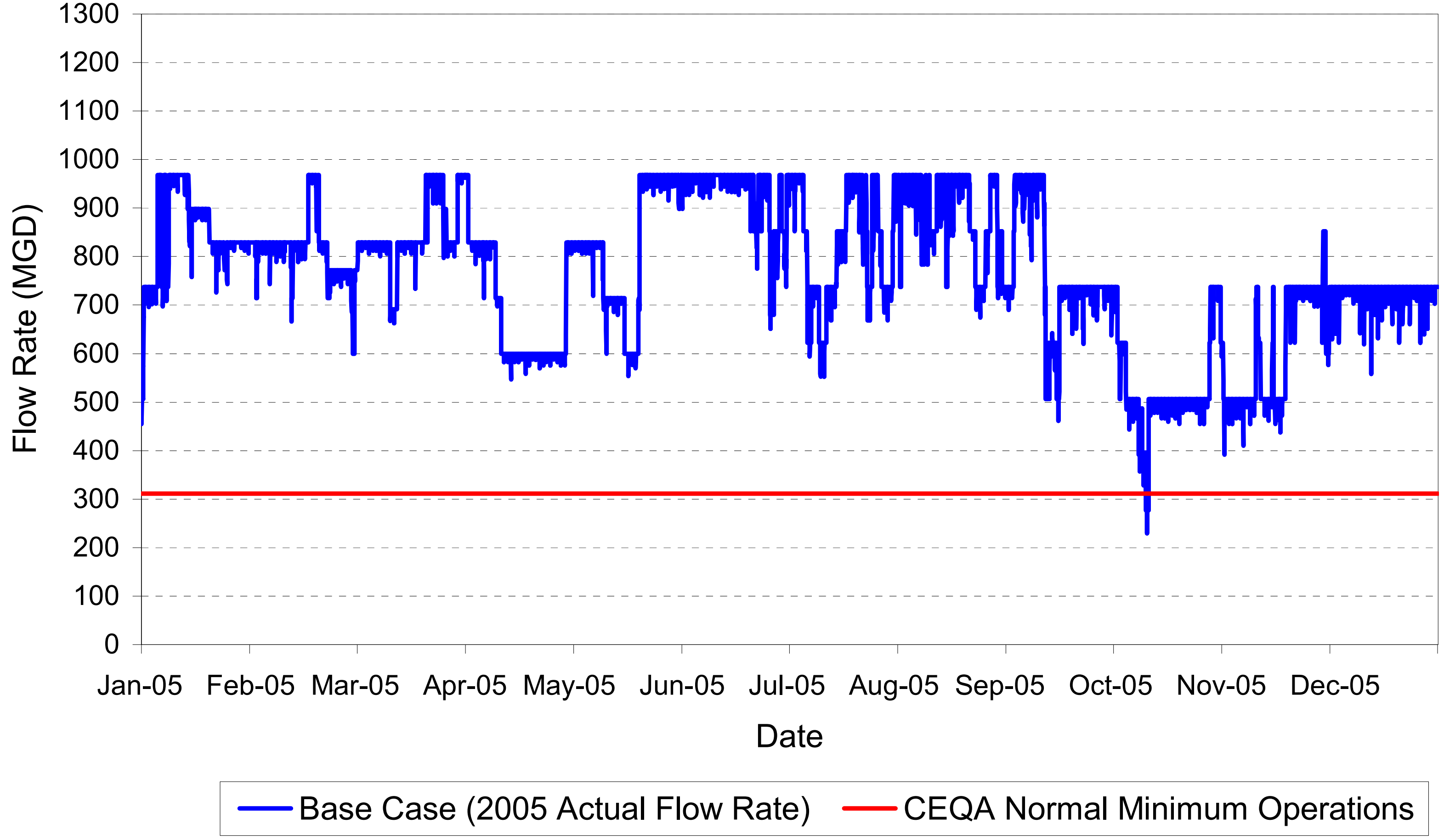
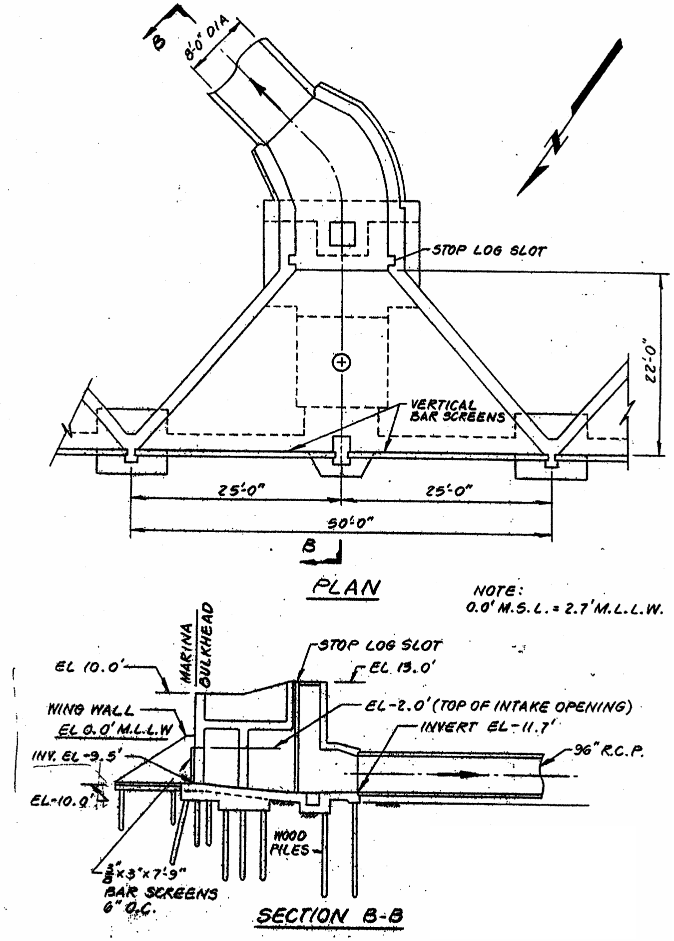
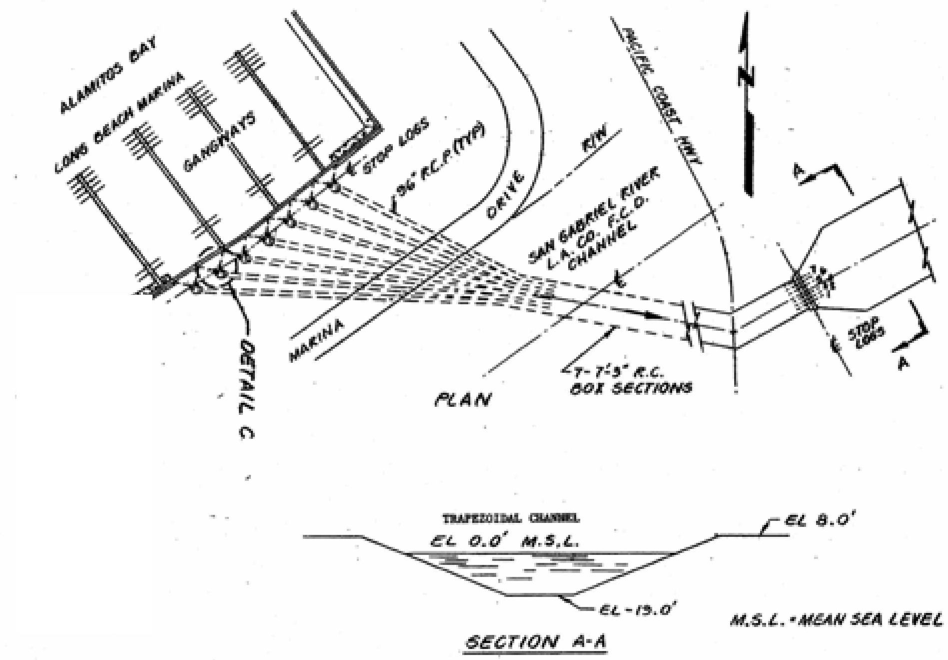


Figure 3.7

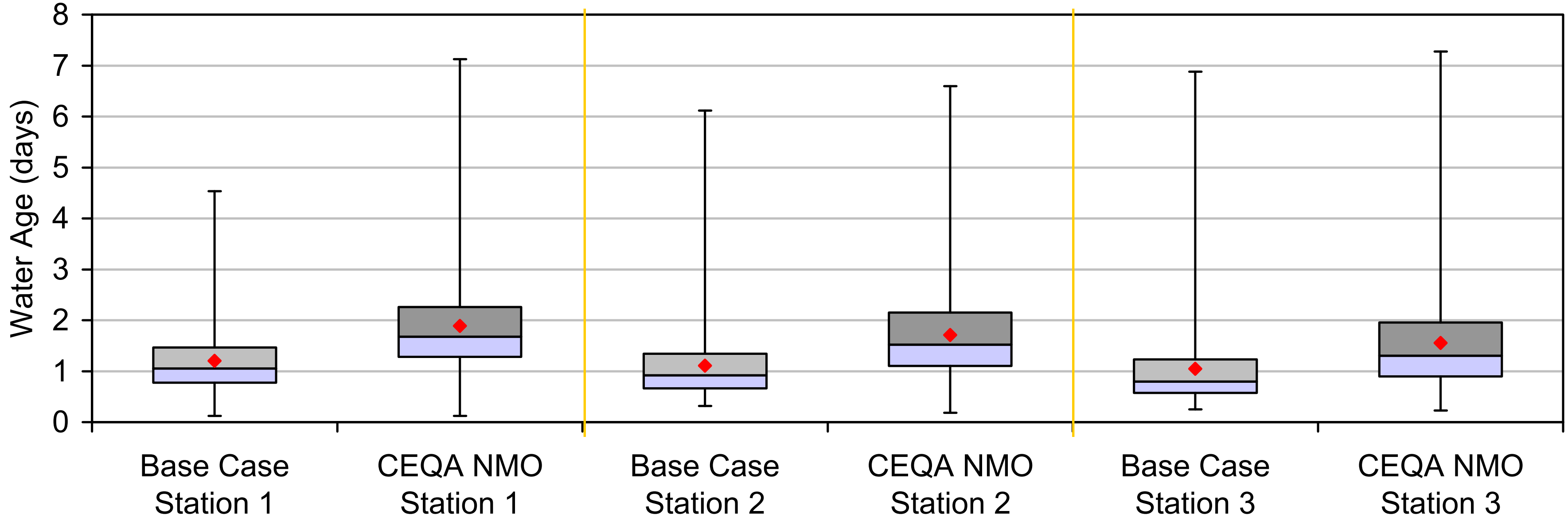
HnGS Intake Structure and Siphons

(Provided by LADWP)



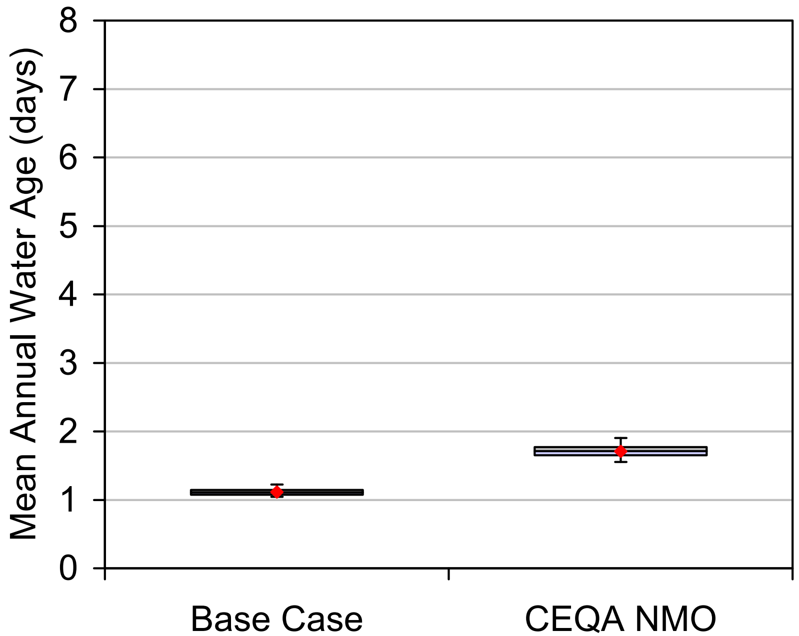


Box Plots Showing the Distribution of Water Age at the Stations for Different Scenarios



Comparison of Maximum and Mean Annual Water Age

Box Plots Comparing Mean Annual Water Age for Different Simulation Scenarios



Box Plots Comparing Maximum Annual Water Age for Different Simulation Scenarios

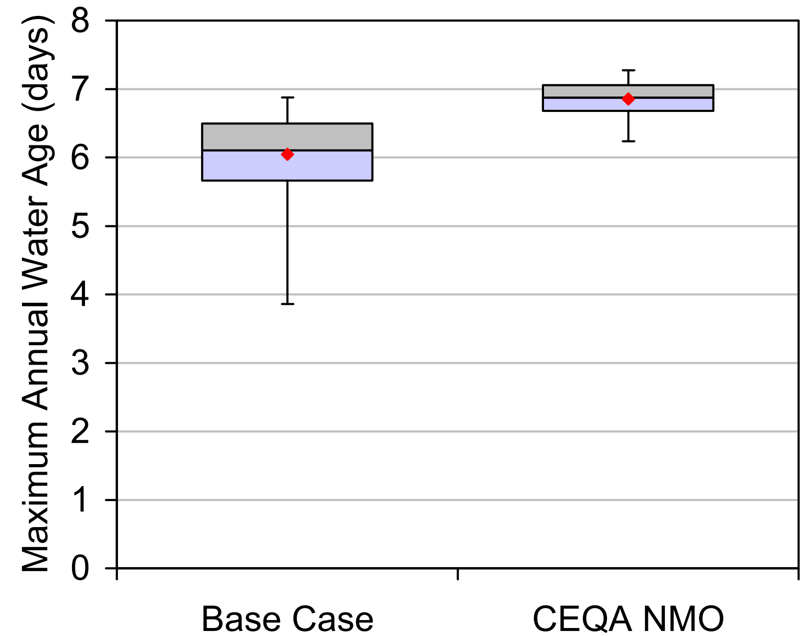
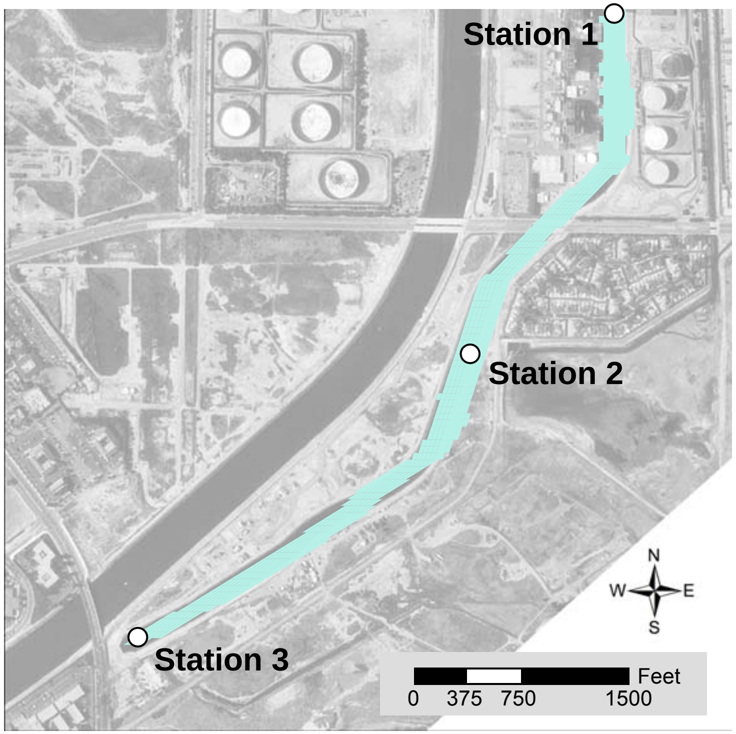


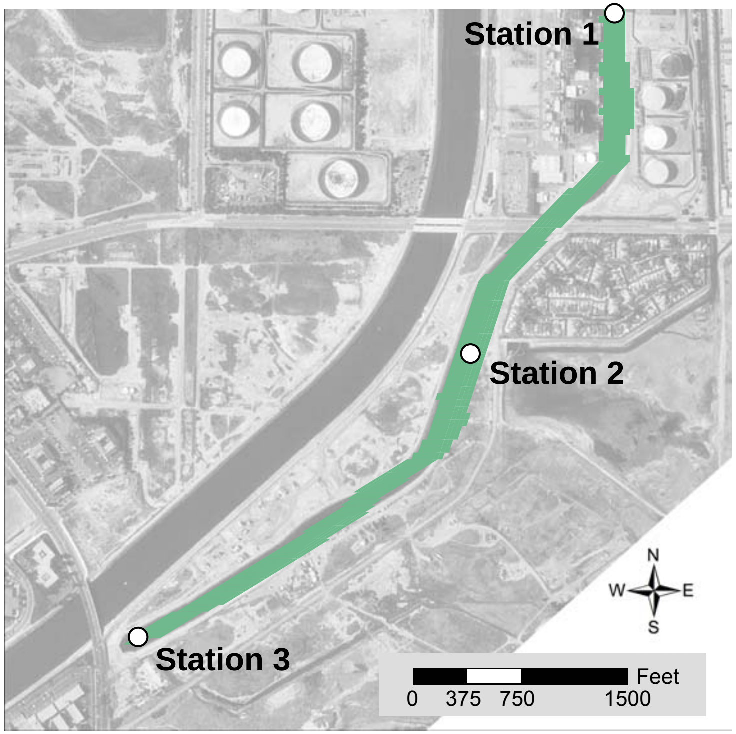
Figure 3.10

HnGS Intake Channel --- Annual Average Water Age
At Elevation 0 ft MLLW (near surface)

Base Case



CEQA Normal Minimum Operations

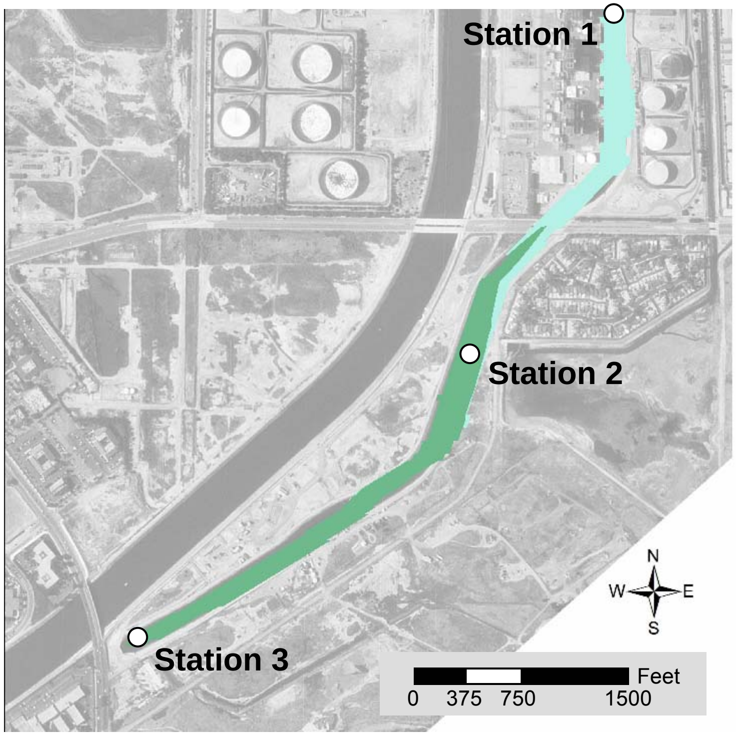


Water Age (days)

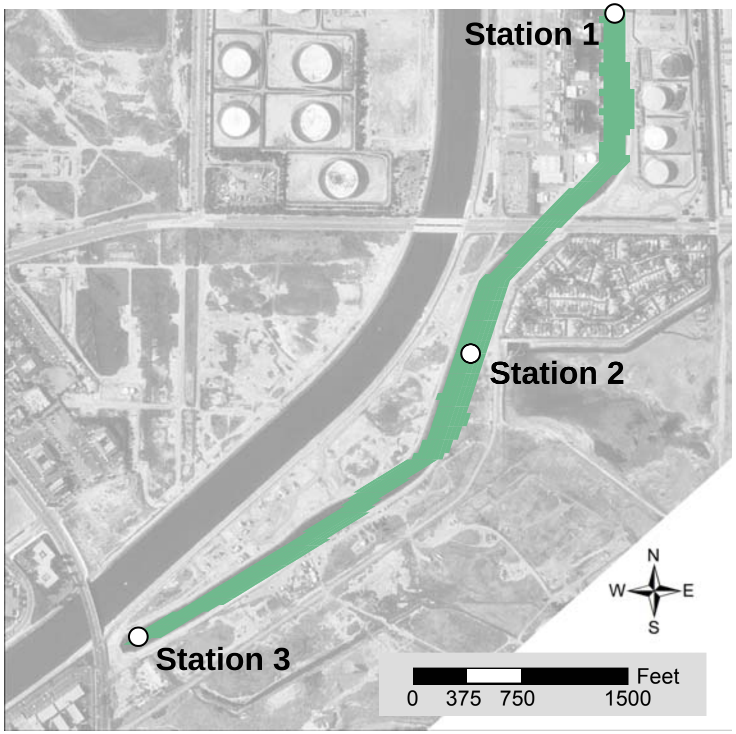
HnGS Intake Channel --- Annual Maximum Water Age

At Elevation 0 ft MLLW (near surface)

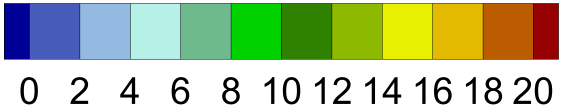
Base Case



CEQA Normal Minimum Operations



Water Age (days)



HnGS Intake Channel --- Water Age

At Elevation 0 ft MLLW (near surface)

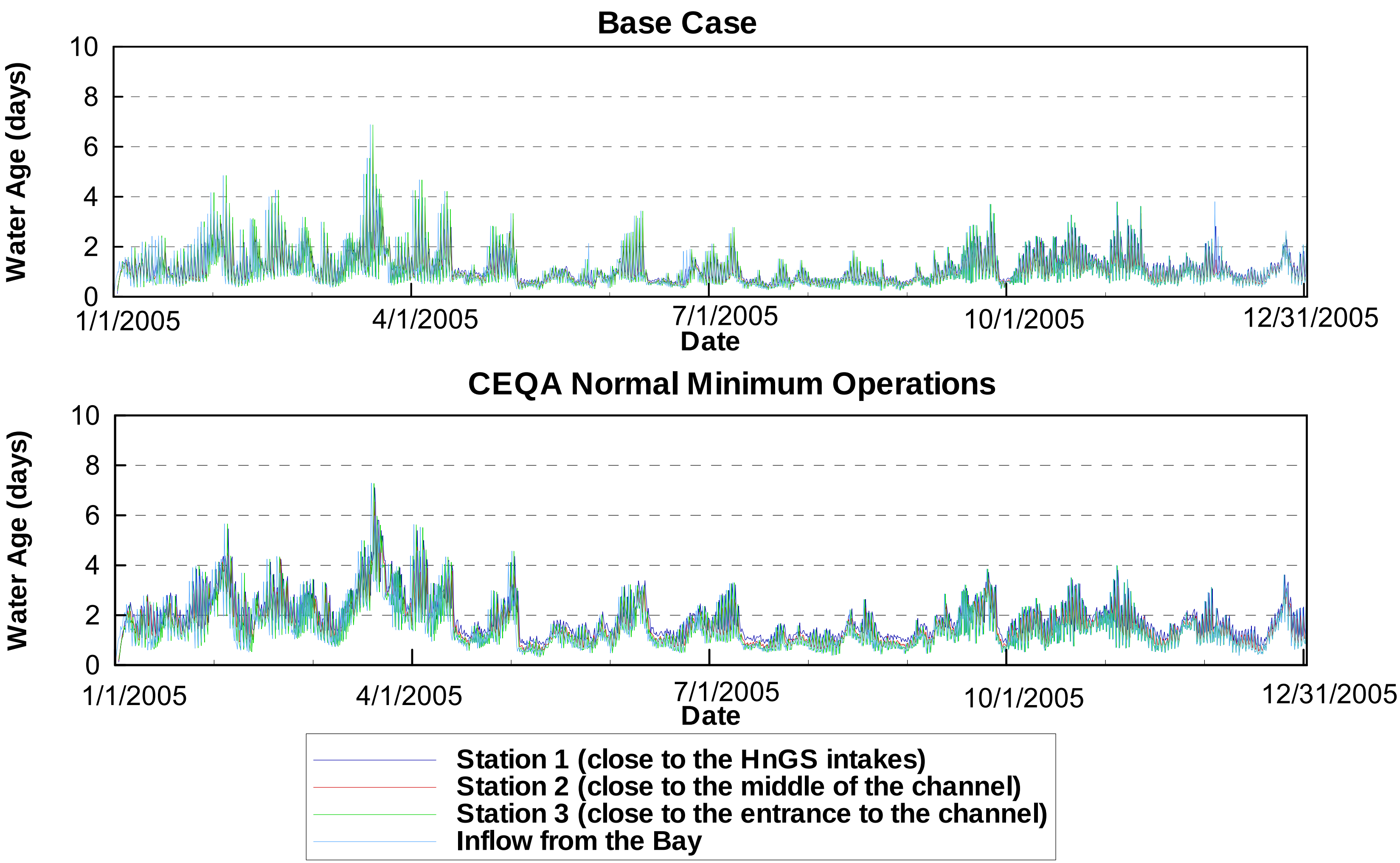


Figure 3.13

HnGS Intake Channel --- Temperature

At Elevation 0 ft MLLW (near surface)

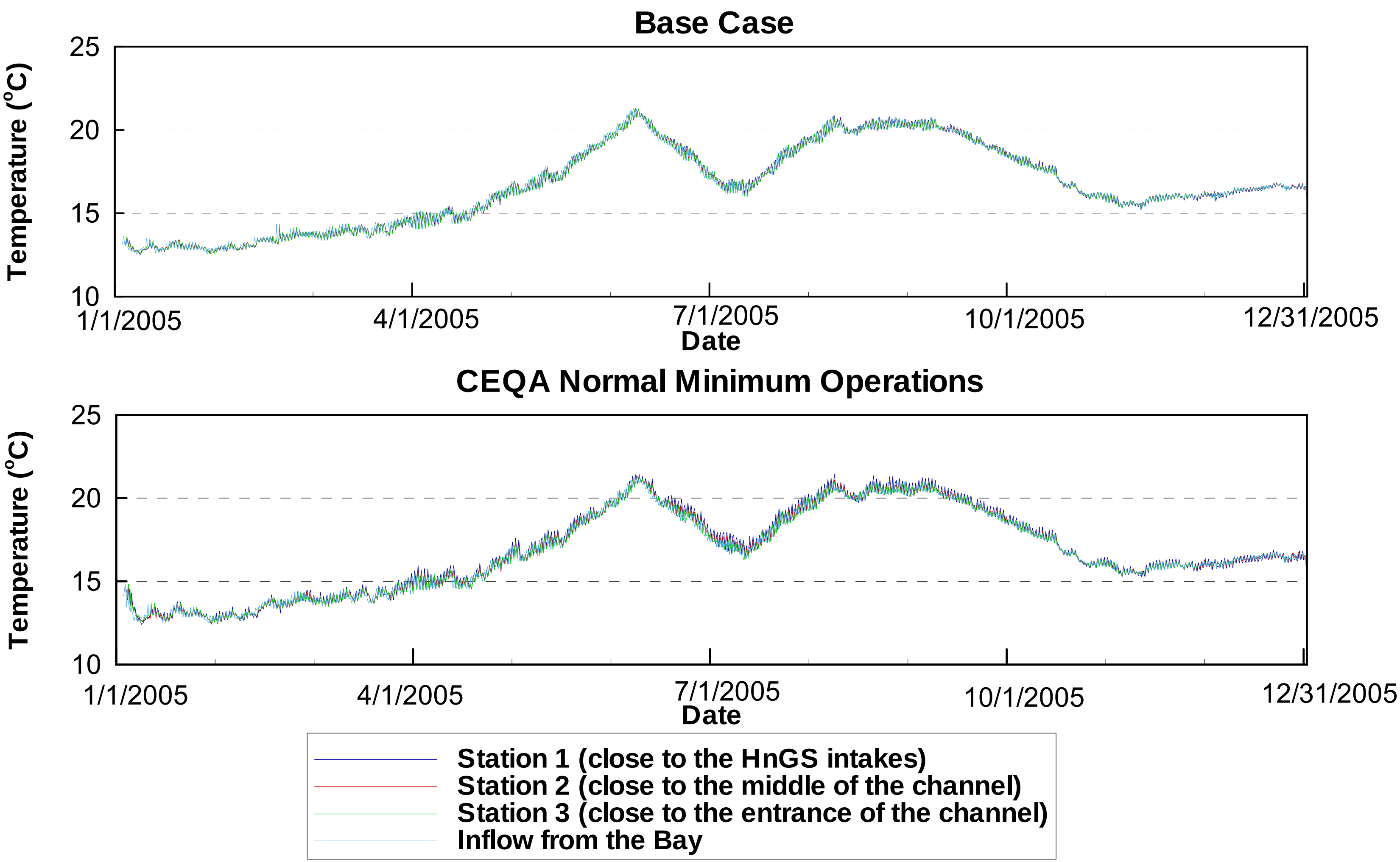


Figure 3.14

HnGS Intake Channel --- Nitrate

At Elevation 0 ft MLLW (near surface) – High CAEDYM Parameter Values

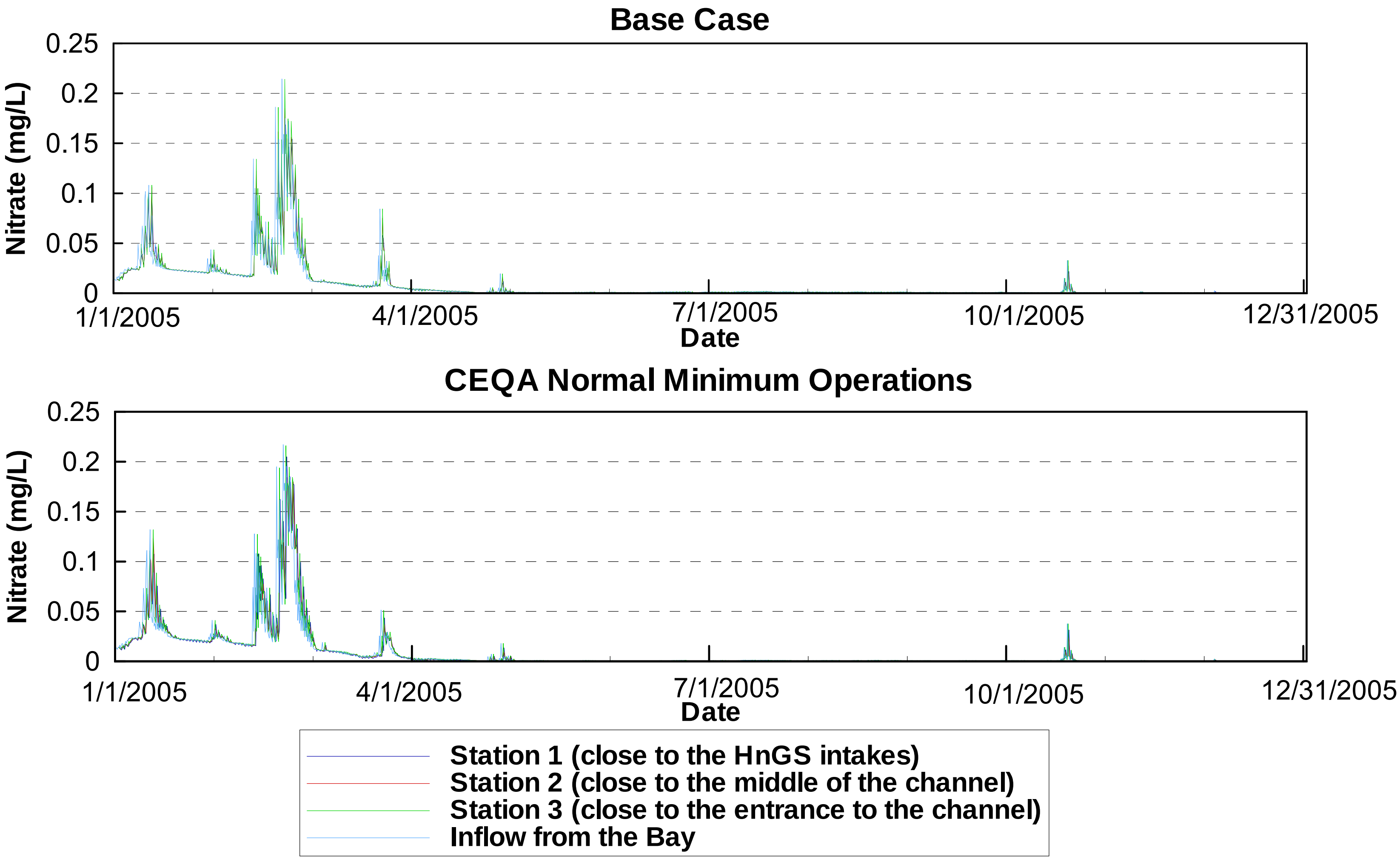
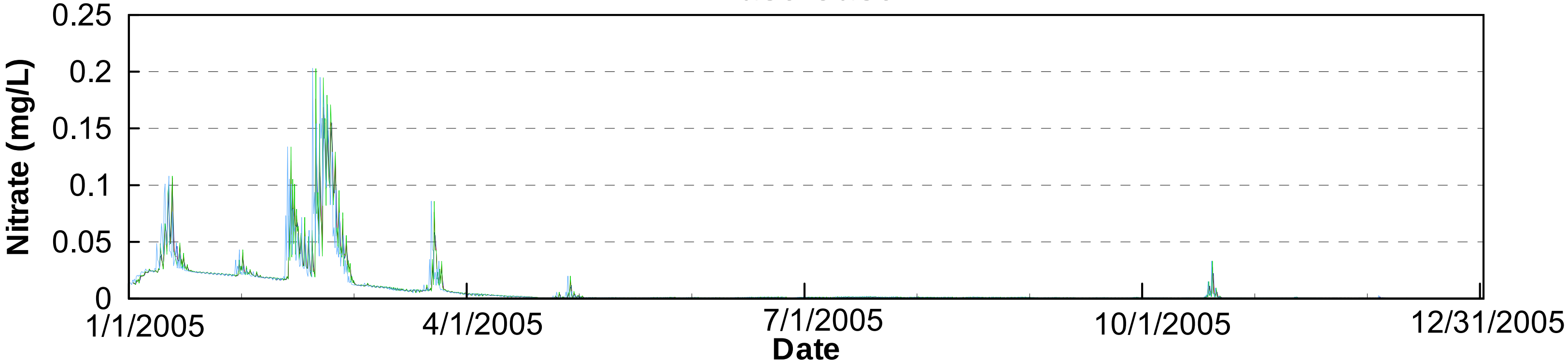
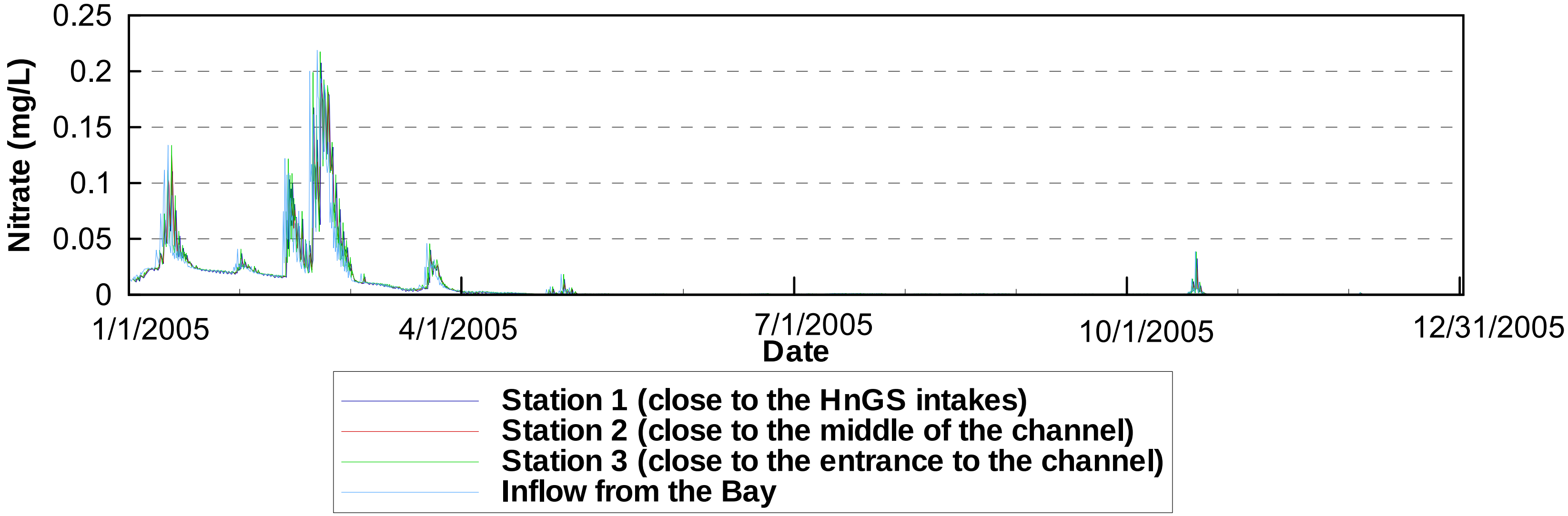


Figure 3.15

HnGS Intake Channel --- Nitrate

At Elevation 0 ft MLLW (near surface) – Moderate CAEDYM Parameter Values





HnGS Intake Channel --- Orthophosphate

At Elevation 0 ft MLLW (near surface) – High CAEDYM Parameter Values

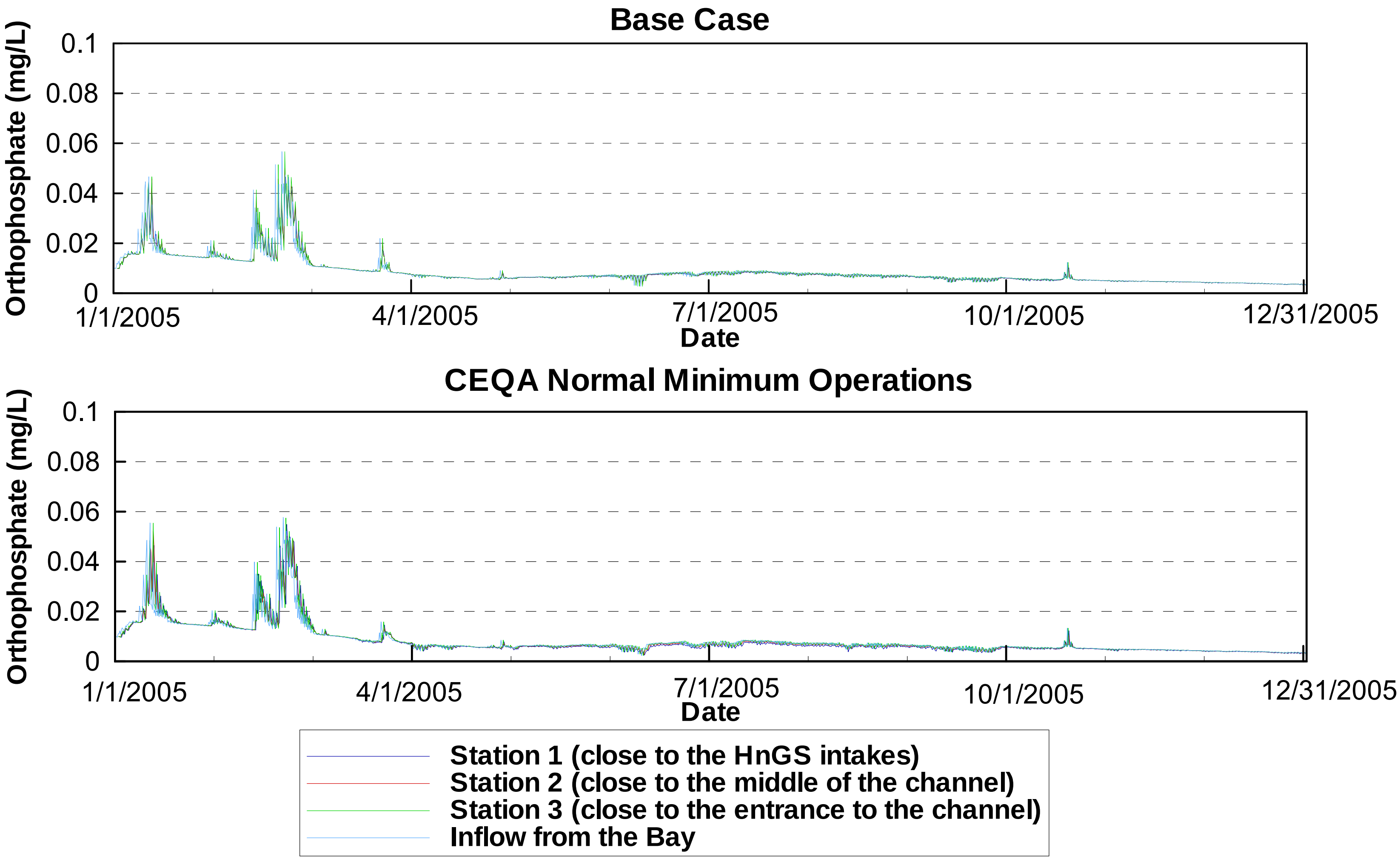


Figure 3.17

HnGS Intake Channel --- Orthophosphate

At Elevation 0 ft MLLW (near surface) – Moderate CAEDYM Parameter Values

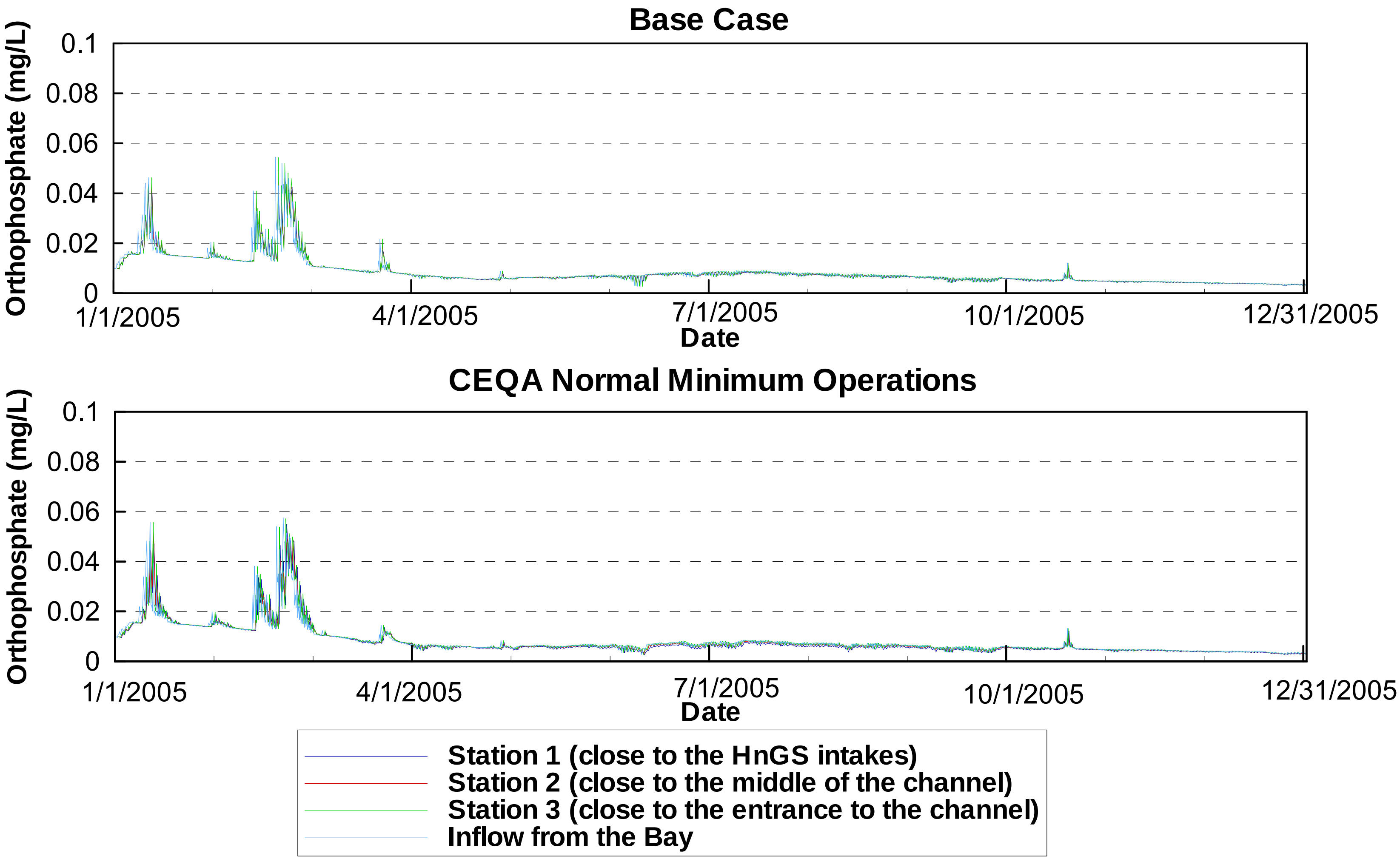
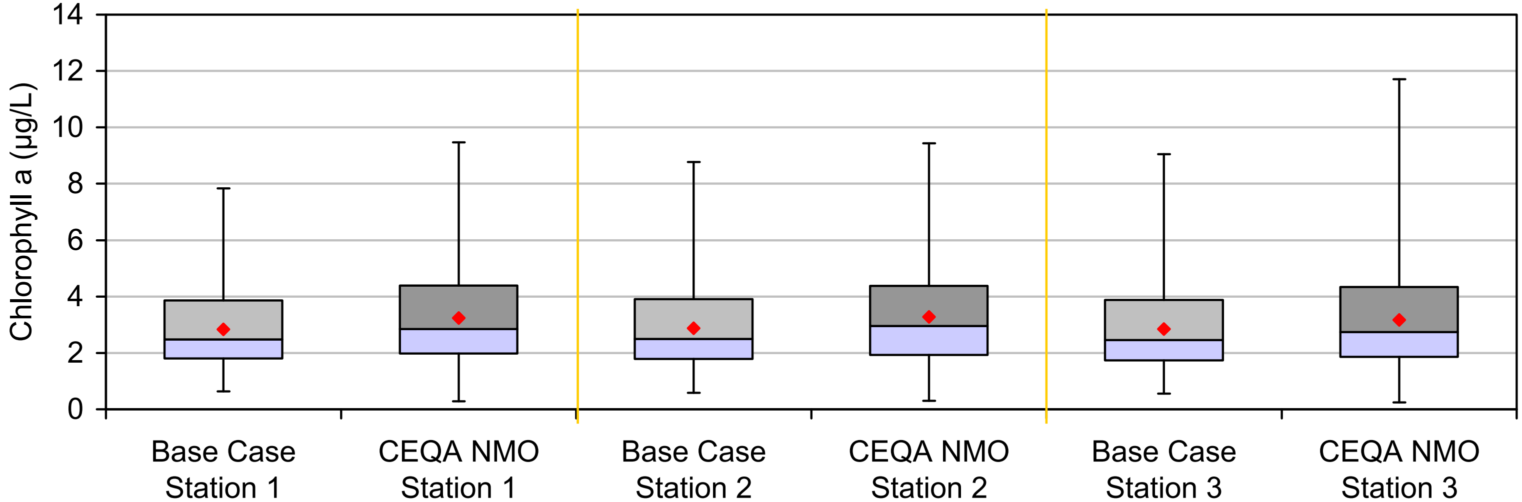


Figure 3.18

Box Plots Showing the Distribution of Chlorophyll *a* at the Stations for Different Scenarios

Moderate CAEDYM Parameters



High CAEDYM Parameters

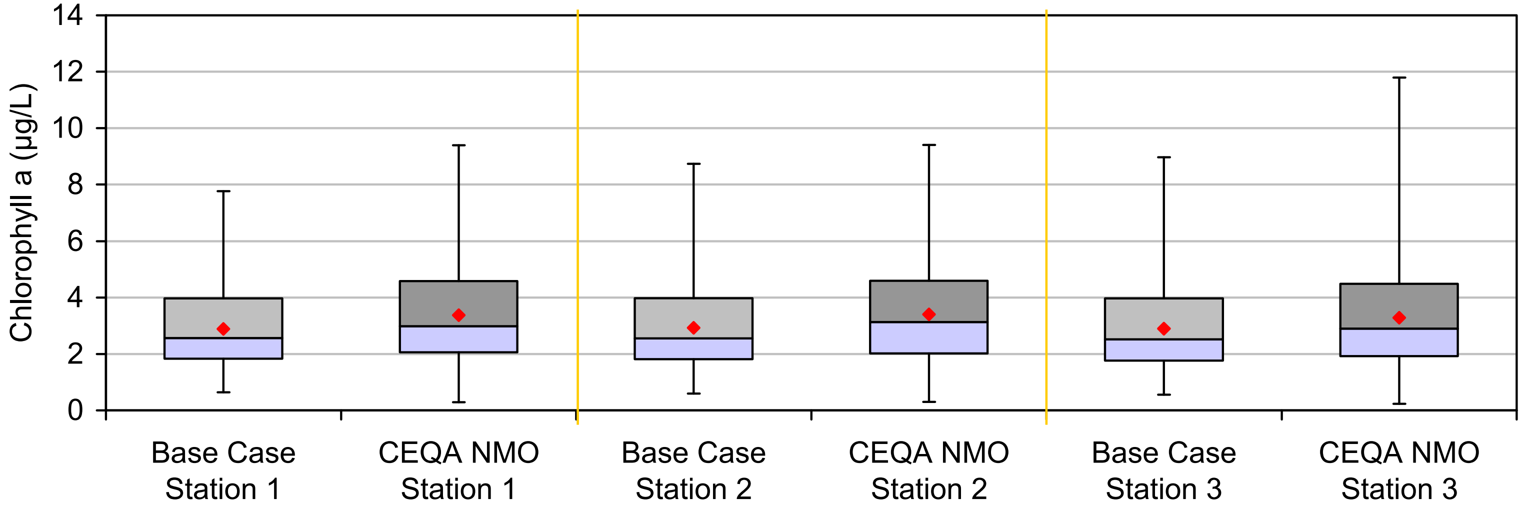
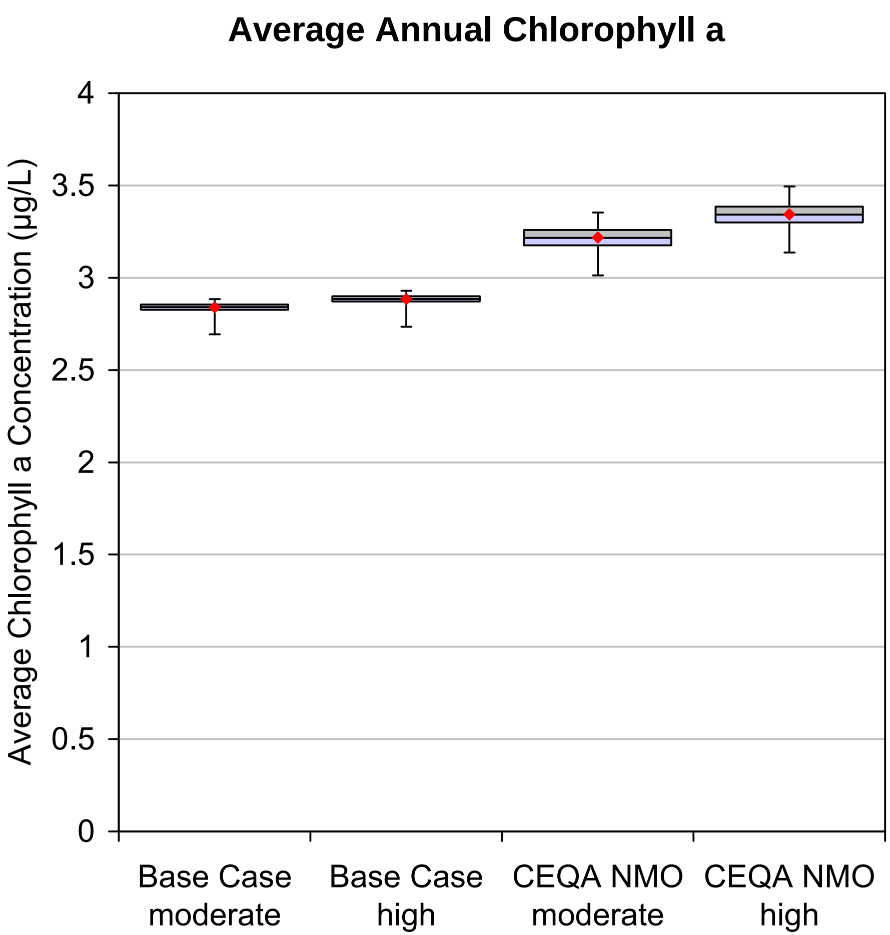


Figure 3.19

Box Plots Comparing Maximum and Average Chlorophyll *a* Concentrations for Different Simulations Scenarios



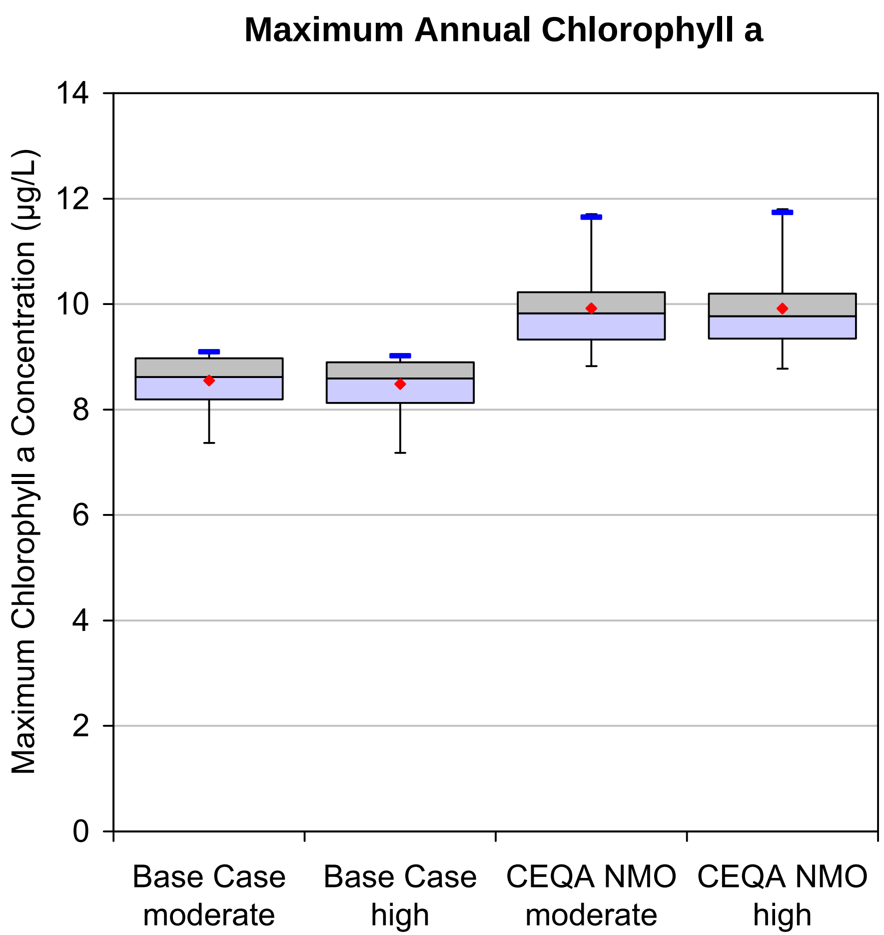
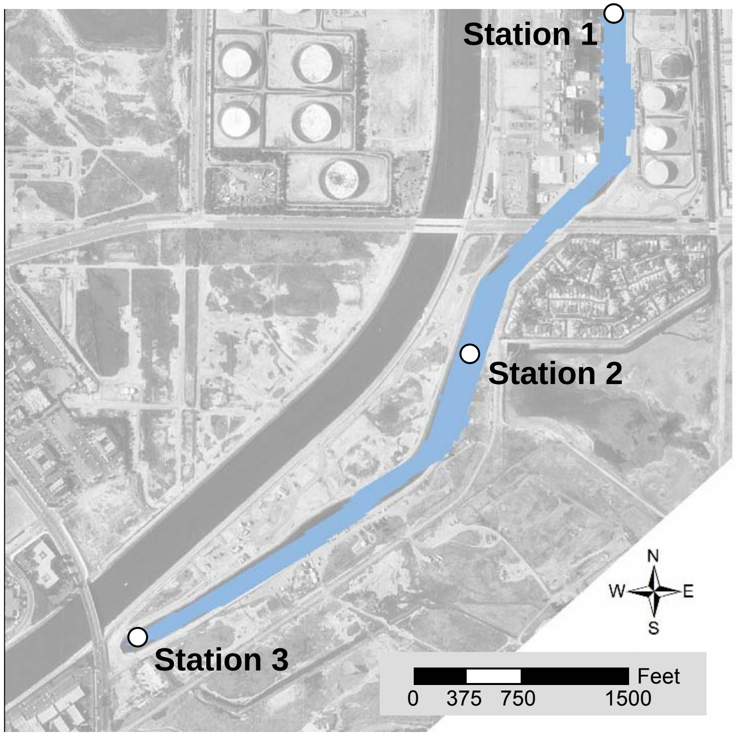


Figure 3.20

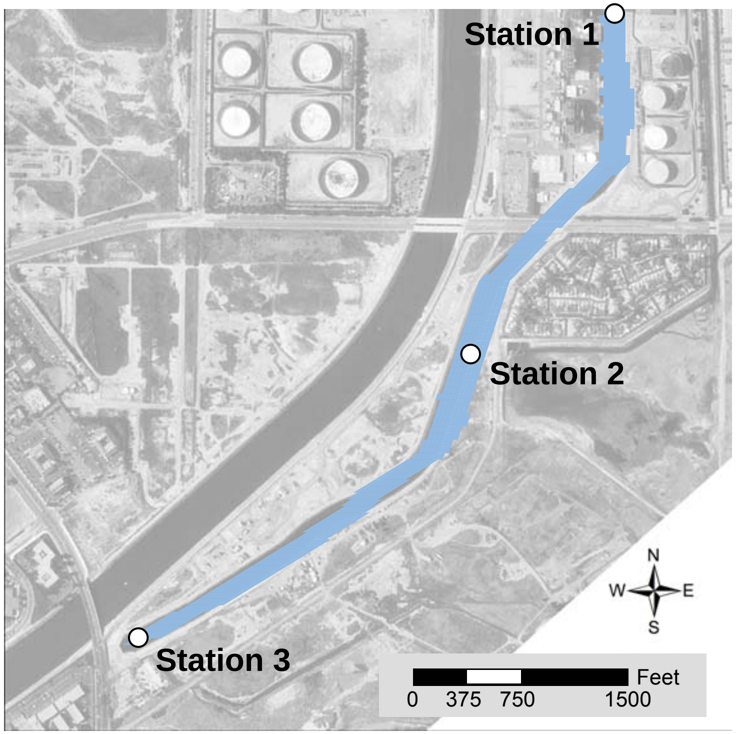
HnGS Intake Channel --- Annual Average Chlorophyll *a*

At Elevation 0 ft MLLW (near surface) - Moderate CAEDYM Parameter Values

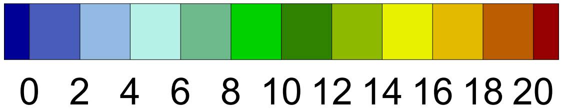
Base Case



CEQA Normal Minimum Operations



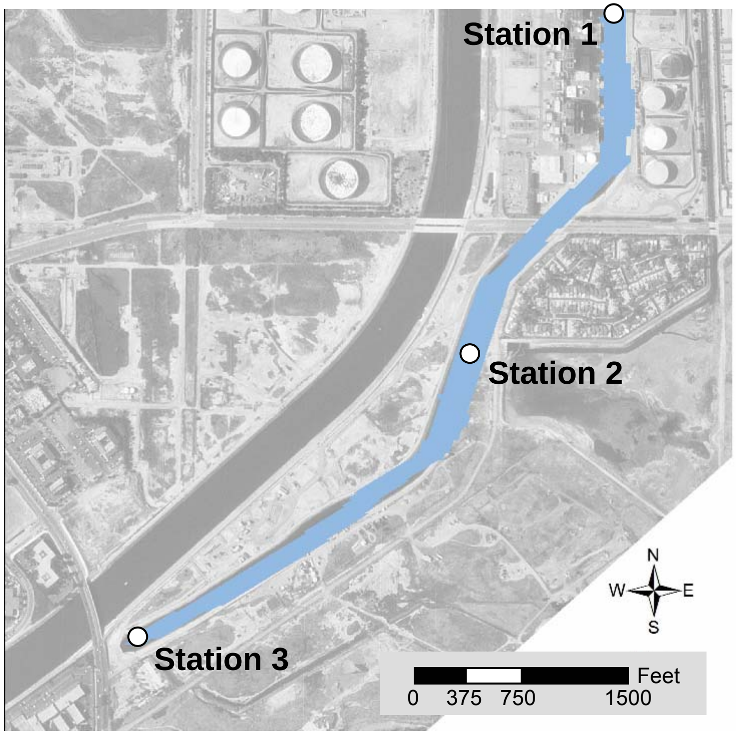
Chlorophyll a (μg/L)



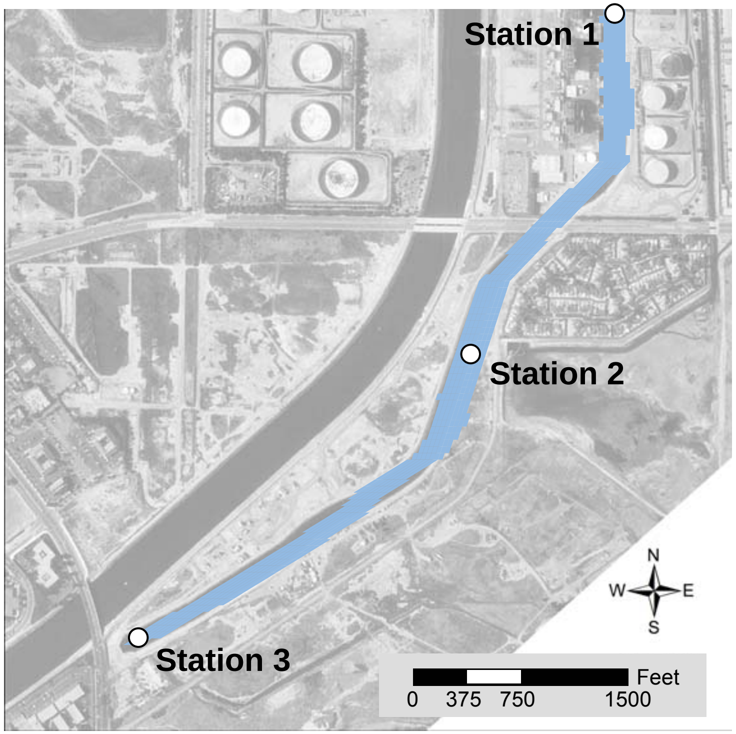
HnGS Intake Channel --- Annual Average Chlorophyll *a*

At Elevation 0 ft MLLW (near surface) - High CAEDYM Parameter Values

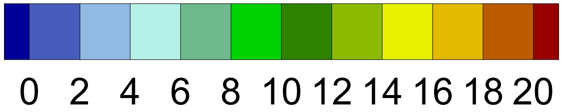
Base Case



CEQA Normal Minimum Operations



Chlorophyll a (μg/L)



HnGS Intake Channel --- Annual Average Chlorophyll *a*
At Elevation 0 ft MLLW (near surface) – CEQA Normal Minimum Operations

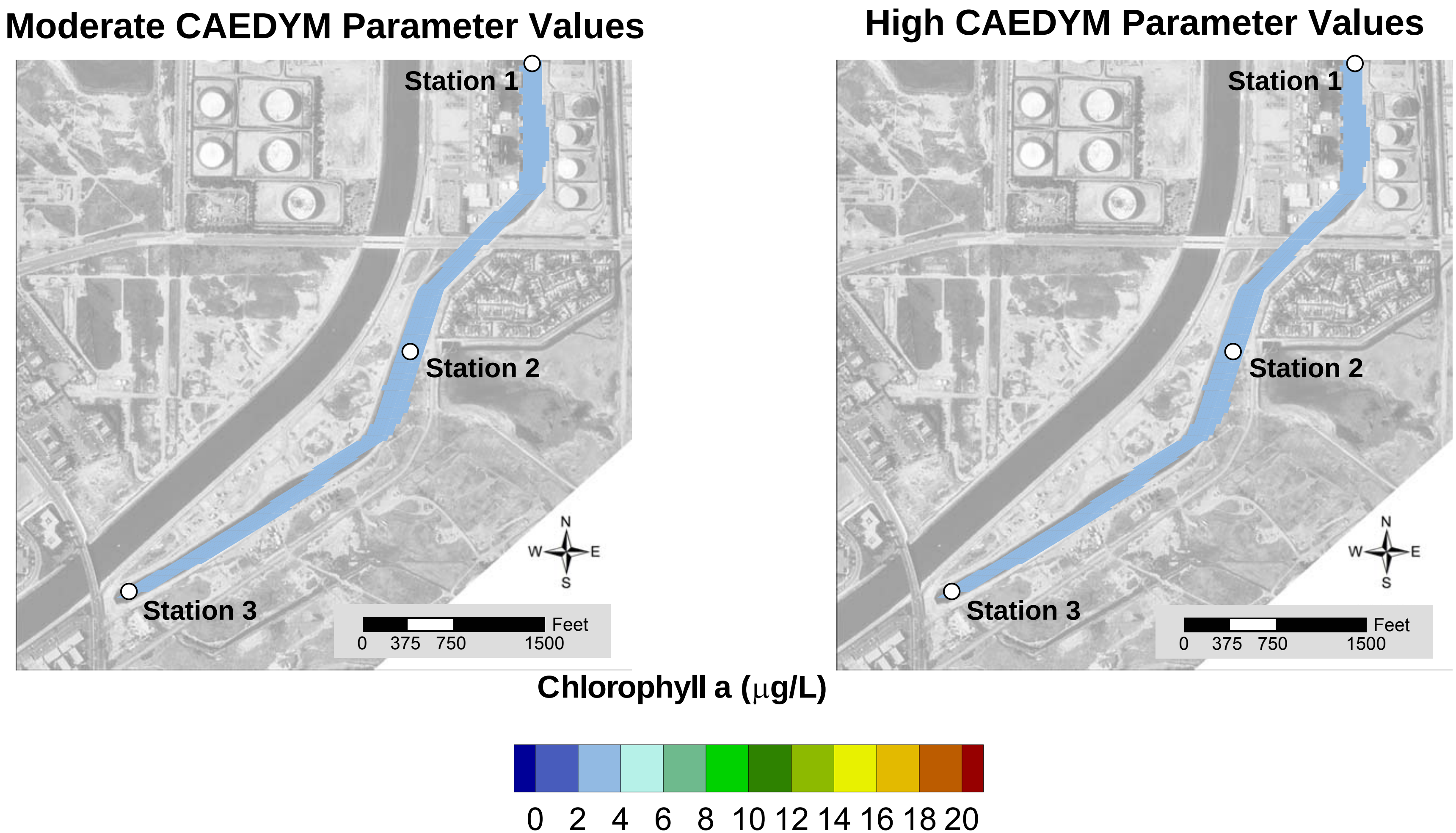


Figure 3.23

HnGS Intake Channel --- Annual Maximum Chlorophyll *a*

At Elevation 0 ft MLLW (near surface) – CEQA Normal Minimum Operations

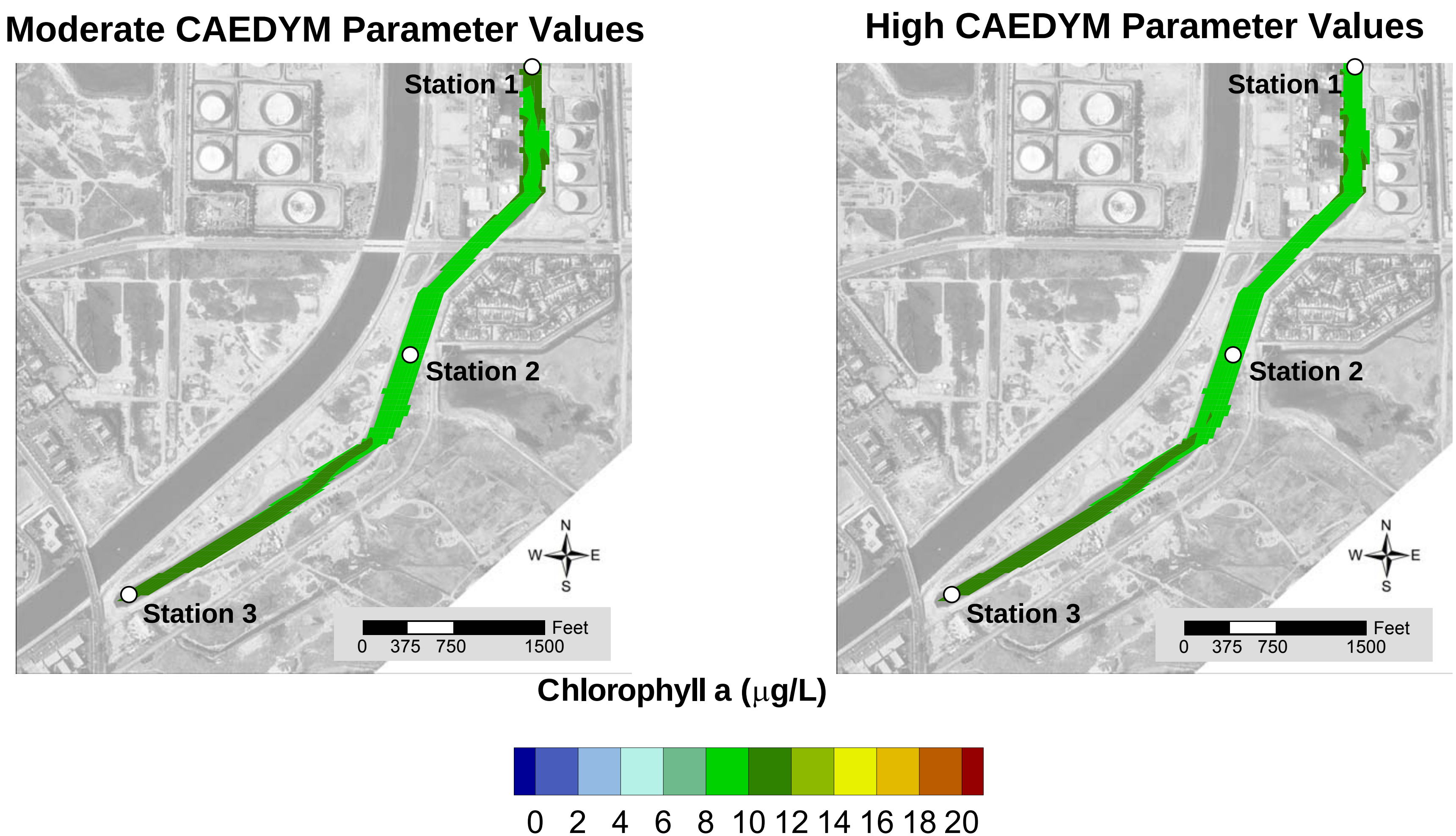


Figure 3.24

HnGS Intake Channel --- Chlorophyll *a*

At Elevation 0 ft MLLW (near surface) – High CAEDYM Parameter Values

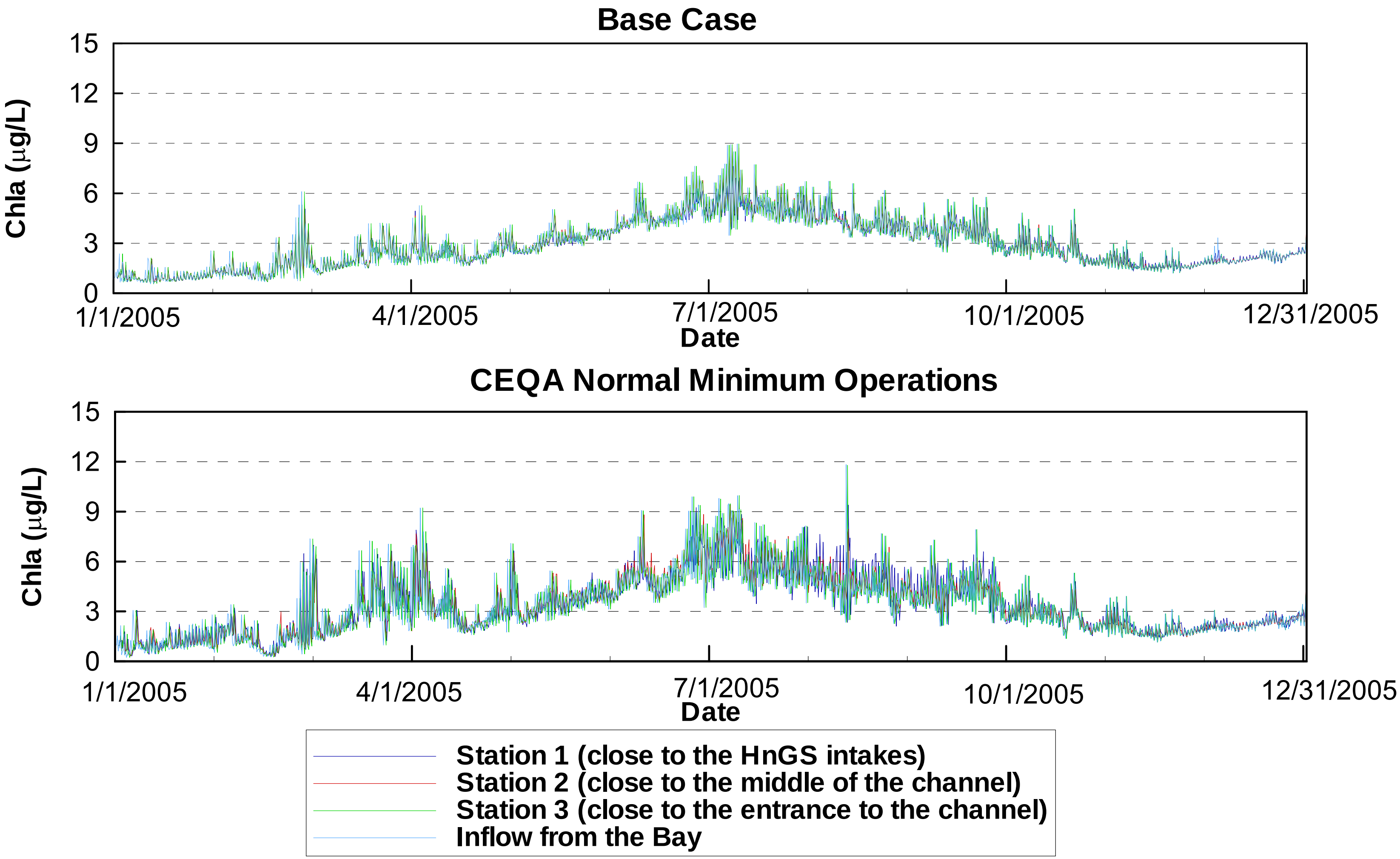
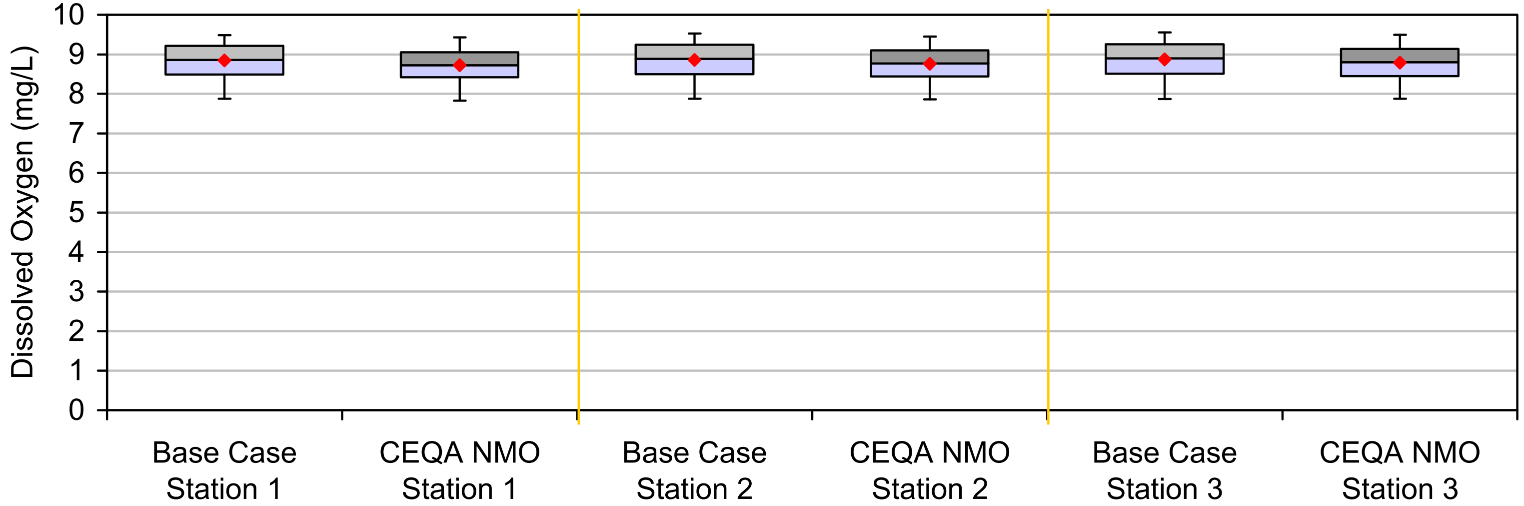


Figure 3.25

Box Plots Showing the Distribution of Dissolved Oxygen at the Stations for Different Scenarios

Moderate CAEDYM Parameters



High CAEDYM Parameters

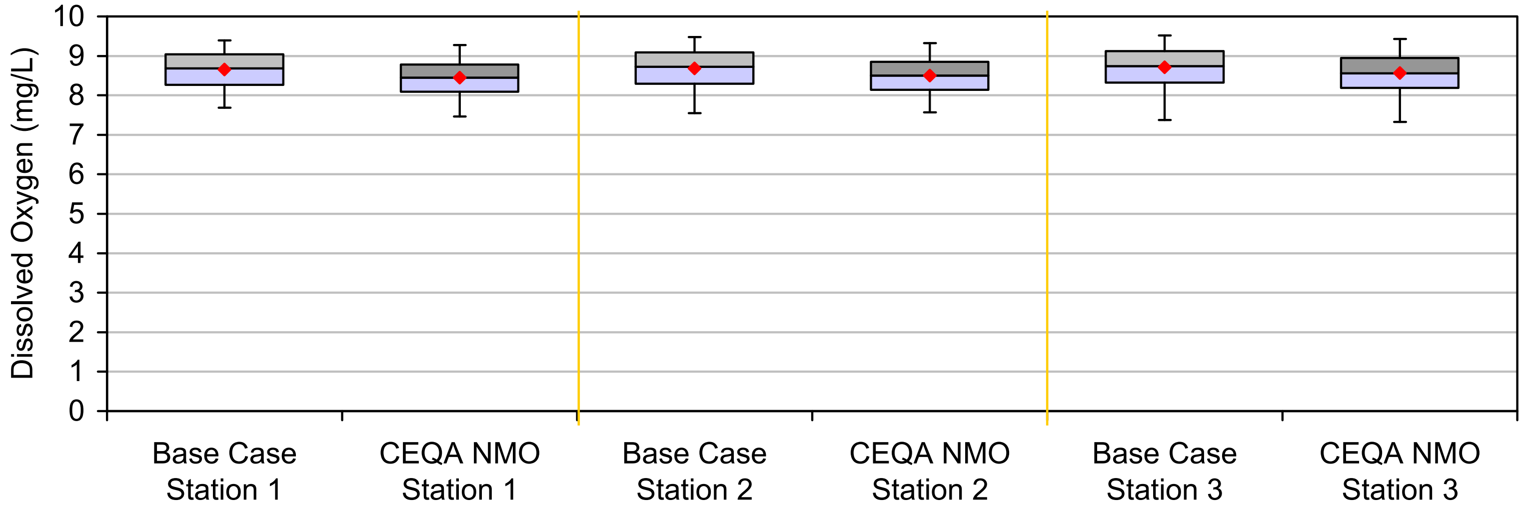
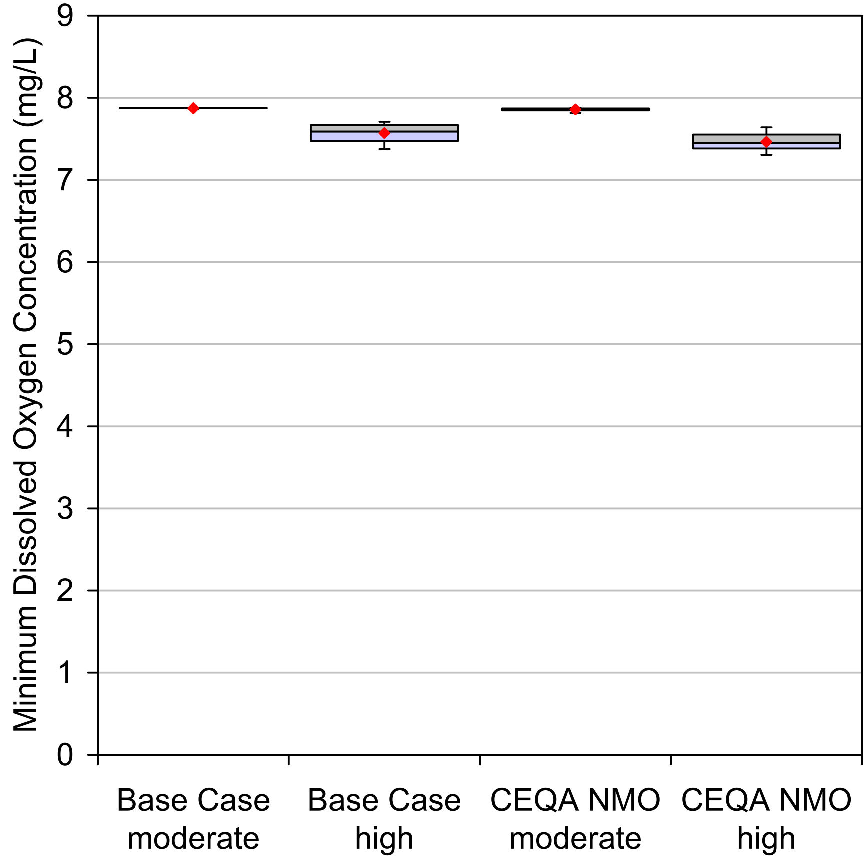


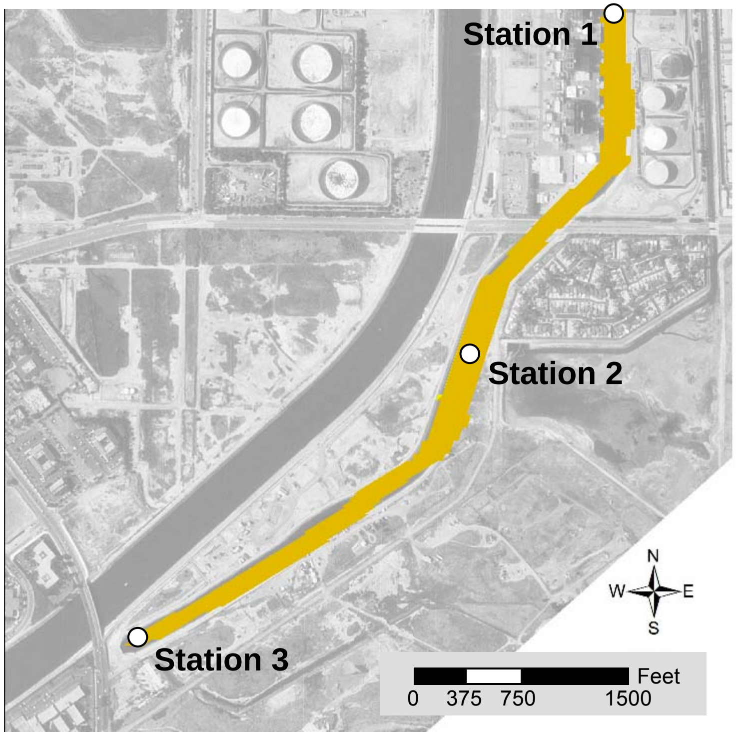
Figure 3.26

Box Plots Comparing Minimum Dissolved Oxygen Concentrations for Different Simulations Scenarios

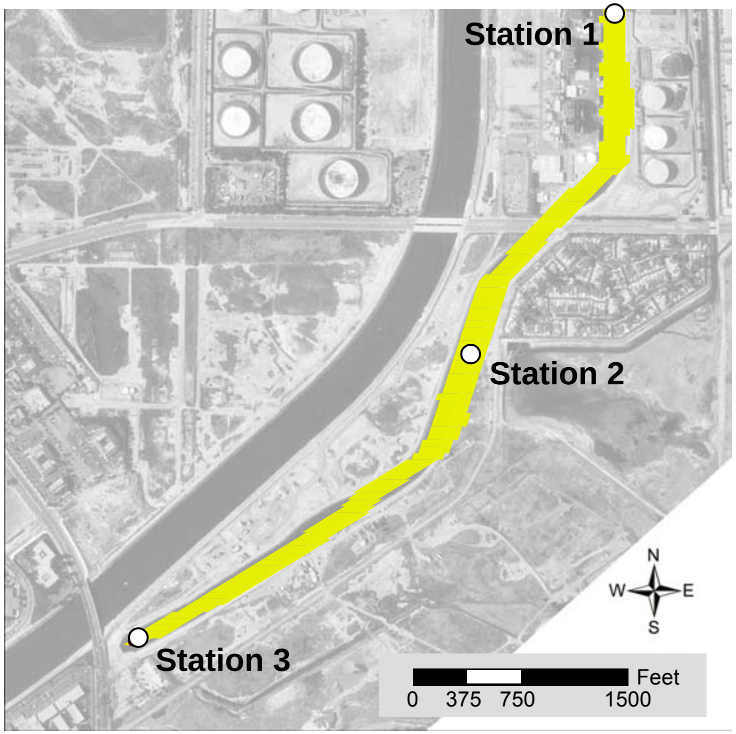


HnGS Intake Channel --- Annual Average Bottom Dissolved Oxygen
At Elevation 0 ft MLLW (near surface) - Moderate CAEDYM Parameter Values

Base Case



CEQA Normal Minimum Operations



DO (mg/L)

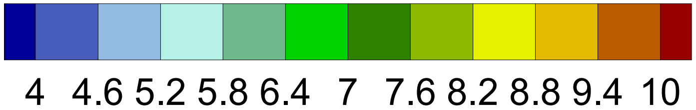


Figure 3.28

HnGS Intake Channel --- Annual Average Bottom Dissolved Oxygen

At Elevation 0 ft MLLW (near surface) - High CAEDYM Parameter Values

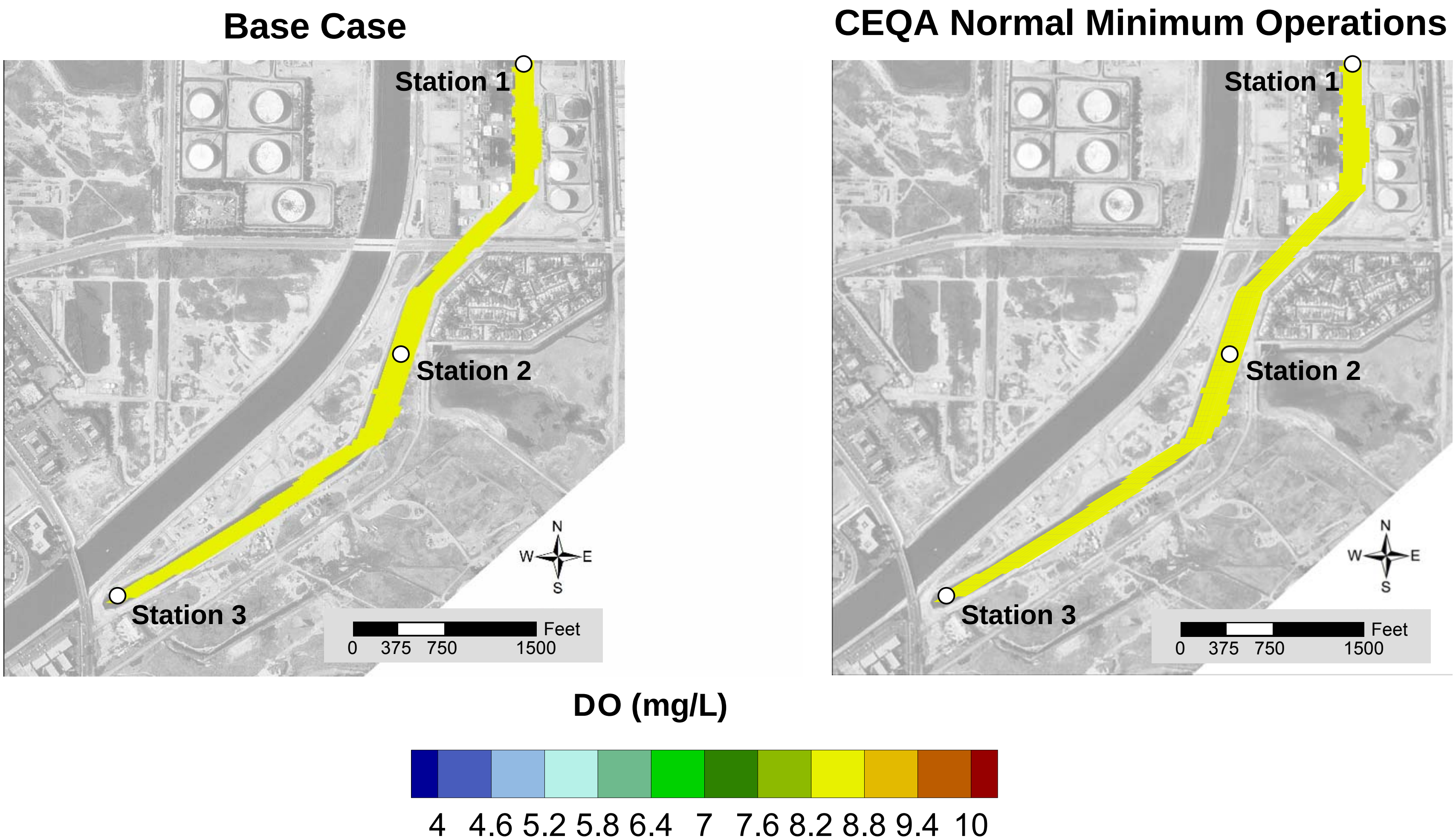
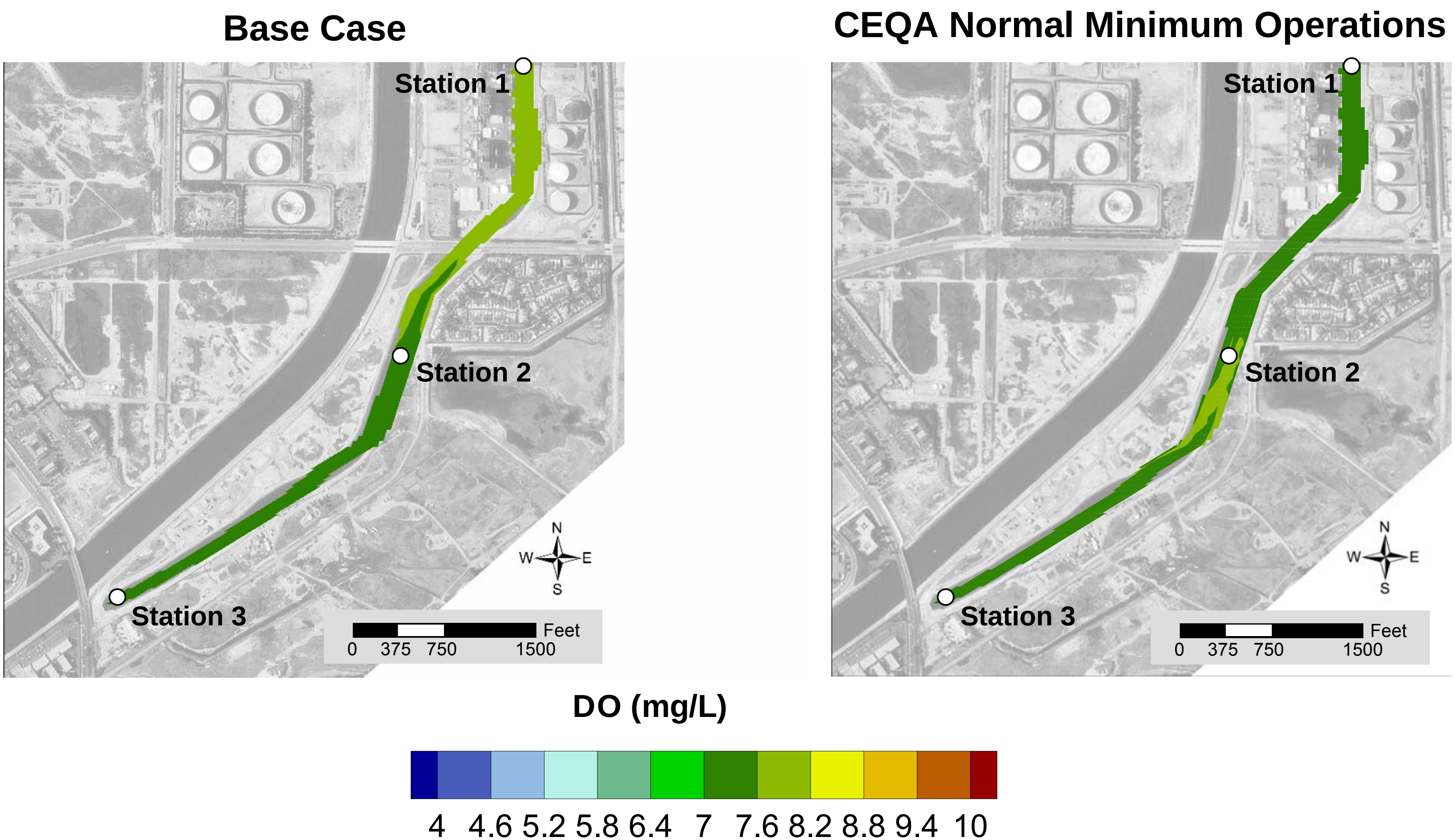


Figure 3.29

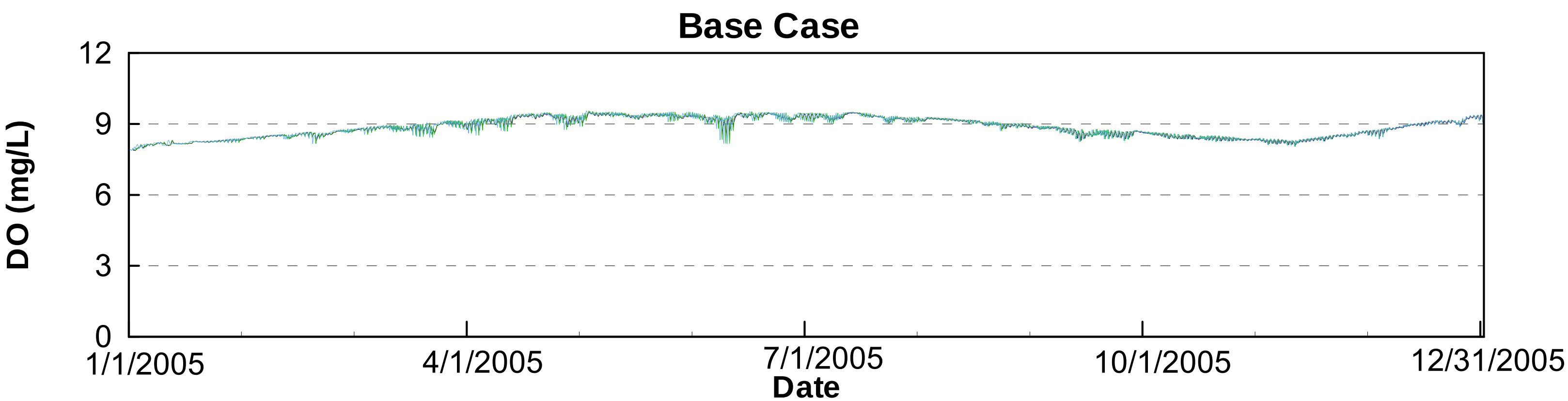
HnGS Intake Channel --- Annual Minimum Bottom Dissolved Oxygen

At Elevation 0 ft MLLW (near surface) - High CAEDYM Parameter Values



HnGS Intake Channel --- Dissolved Oxygen

At Channel Bottom – Moderate CAEDYM Parameter Values



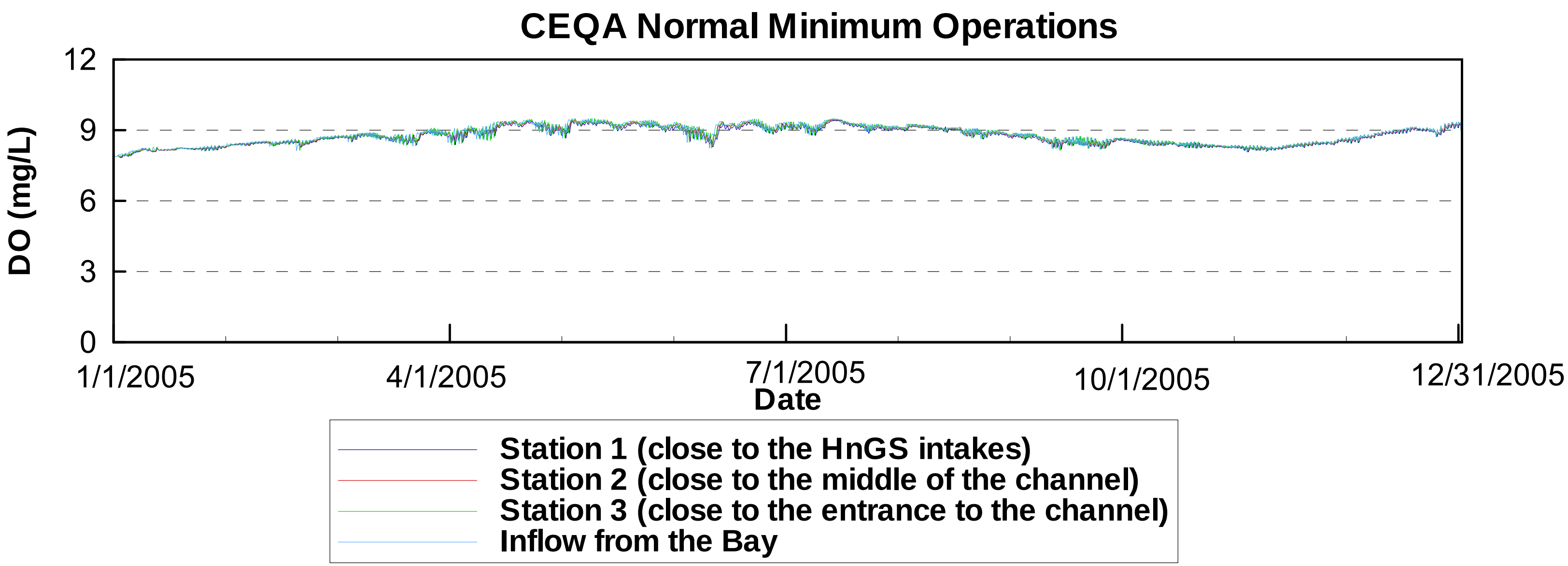
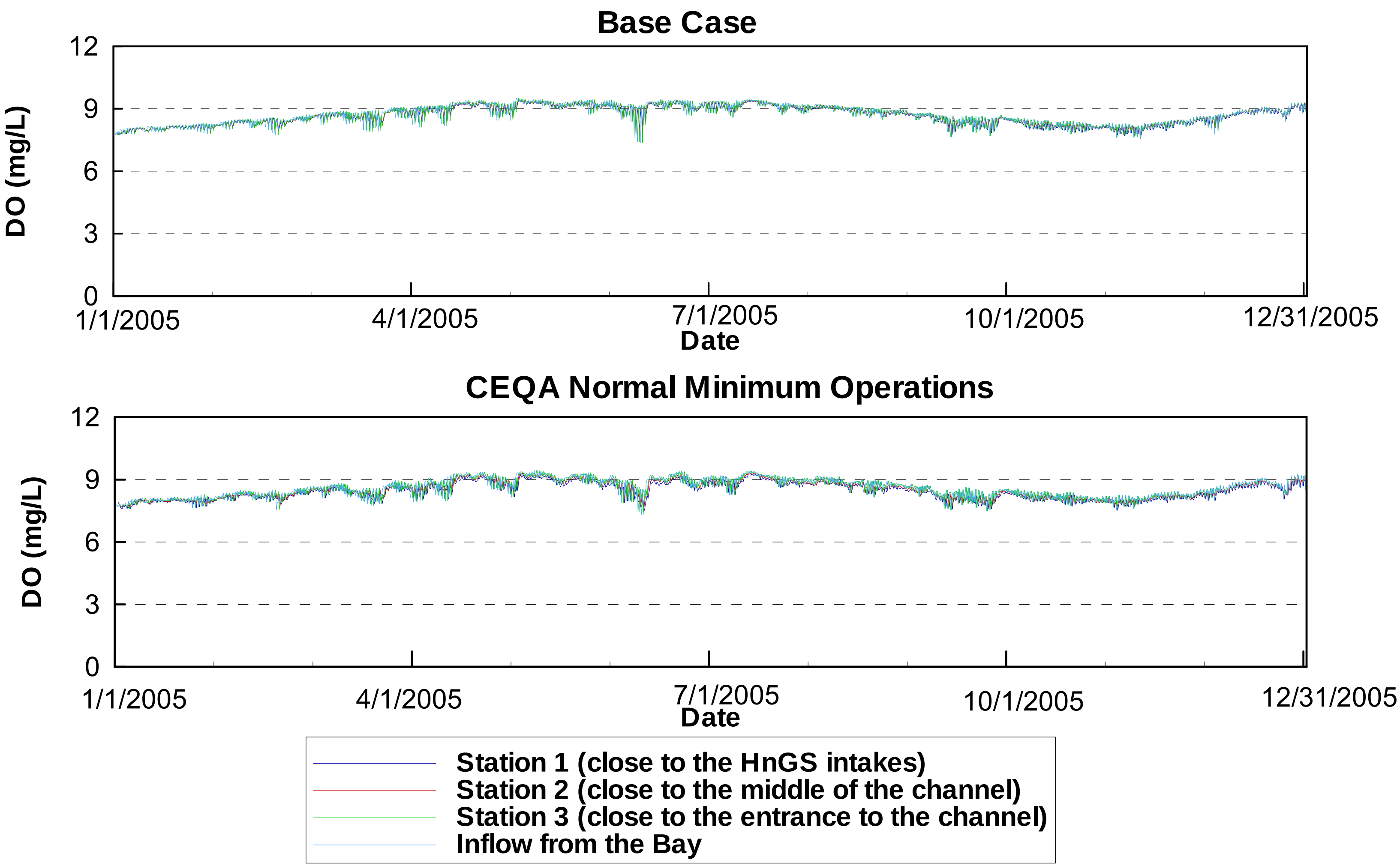


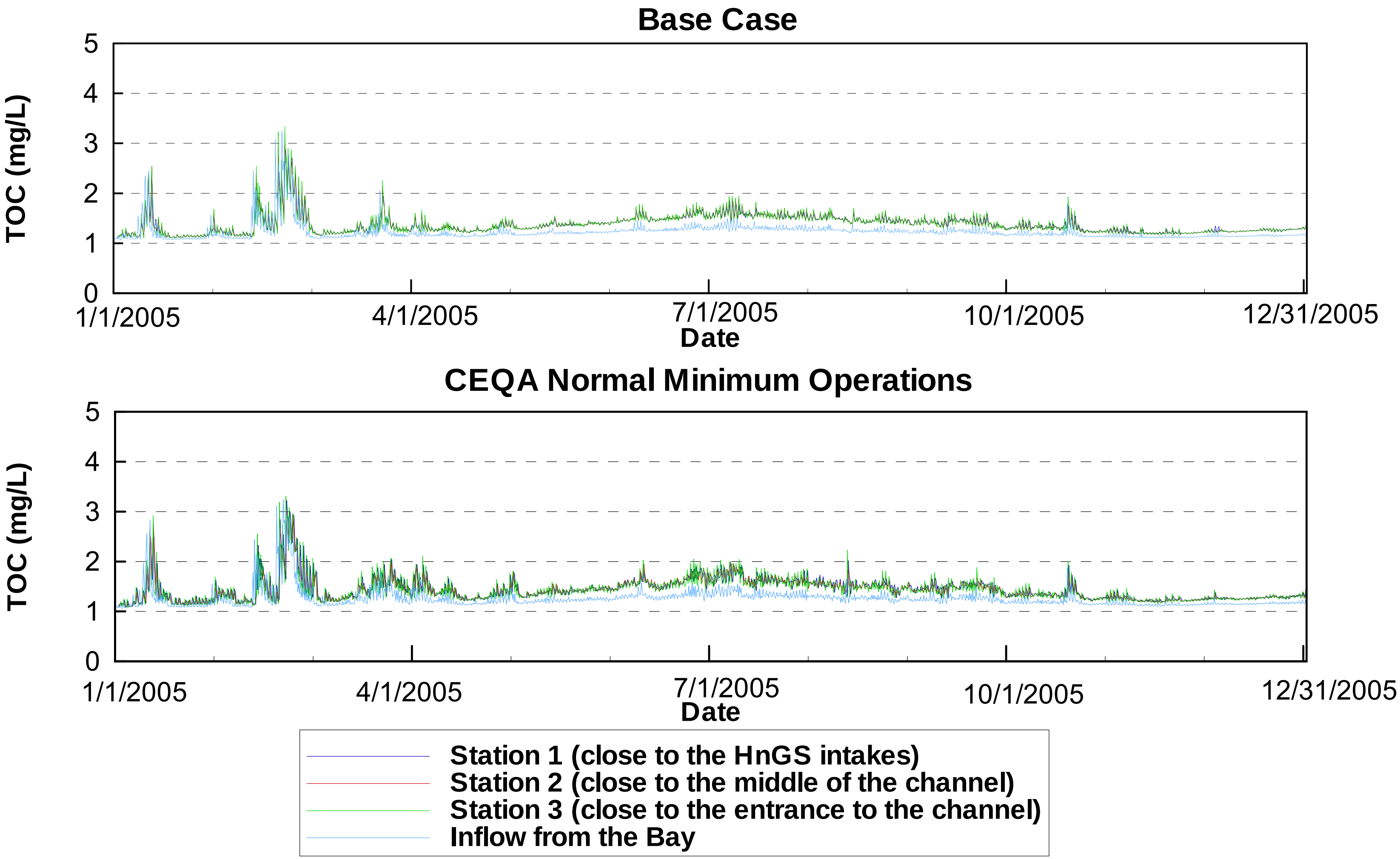
Figure 3.31

HnGS Intake Channel --- Dissolved Oxygen
At Channel Bottom – High CAEDYM Parameter Values



HnGS Intake Channel --- TOC

At Elevation 0 ft MLLW (near surface) – High CAEDYM Parameter Values



HnGS Intake Channel --- TOC

At Elevation 0 ft MLLW (near surface) – Moderate CAEDYM Parameter Values

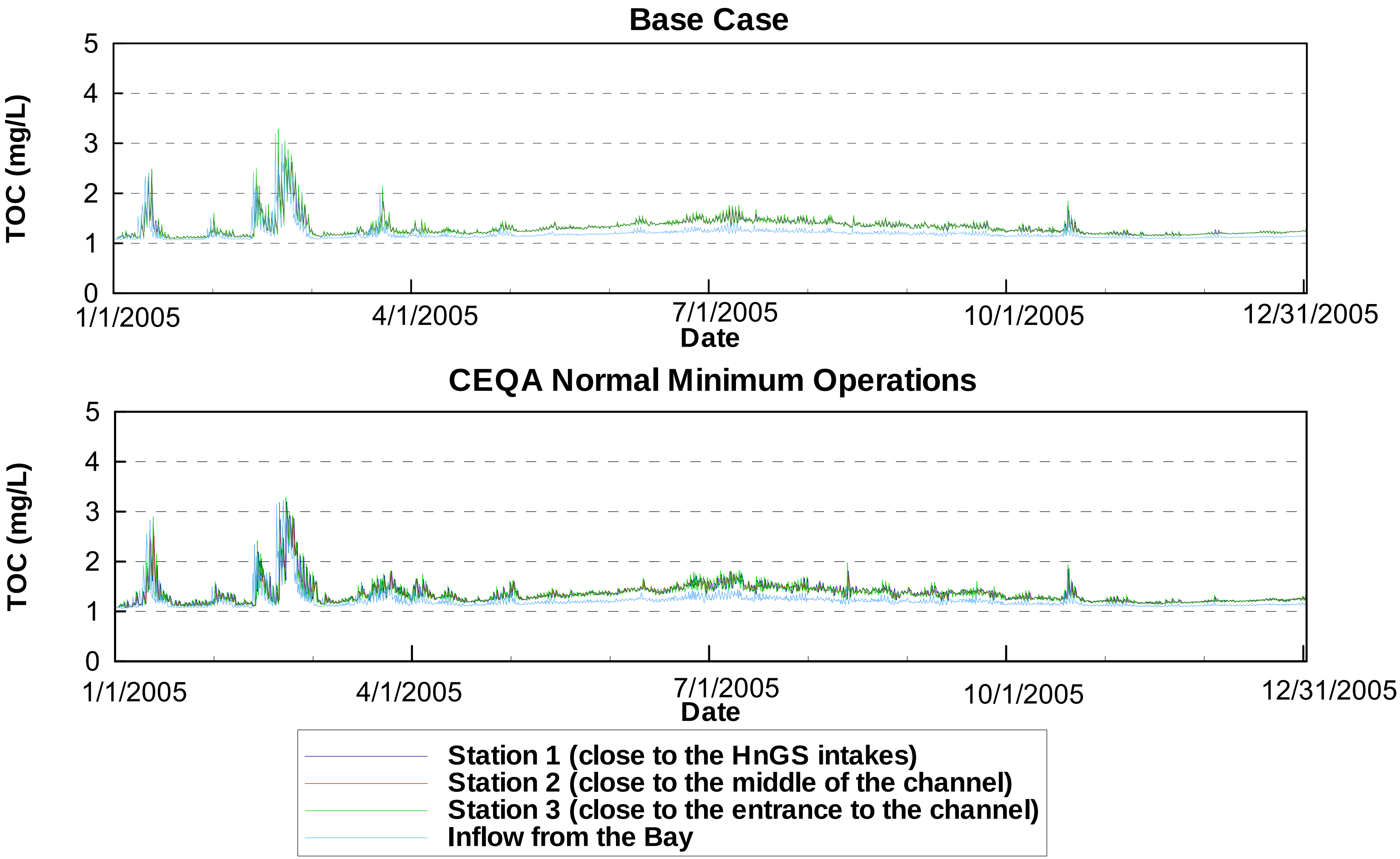
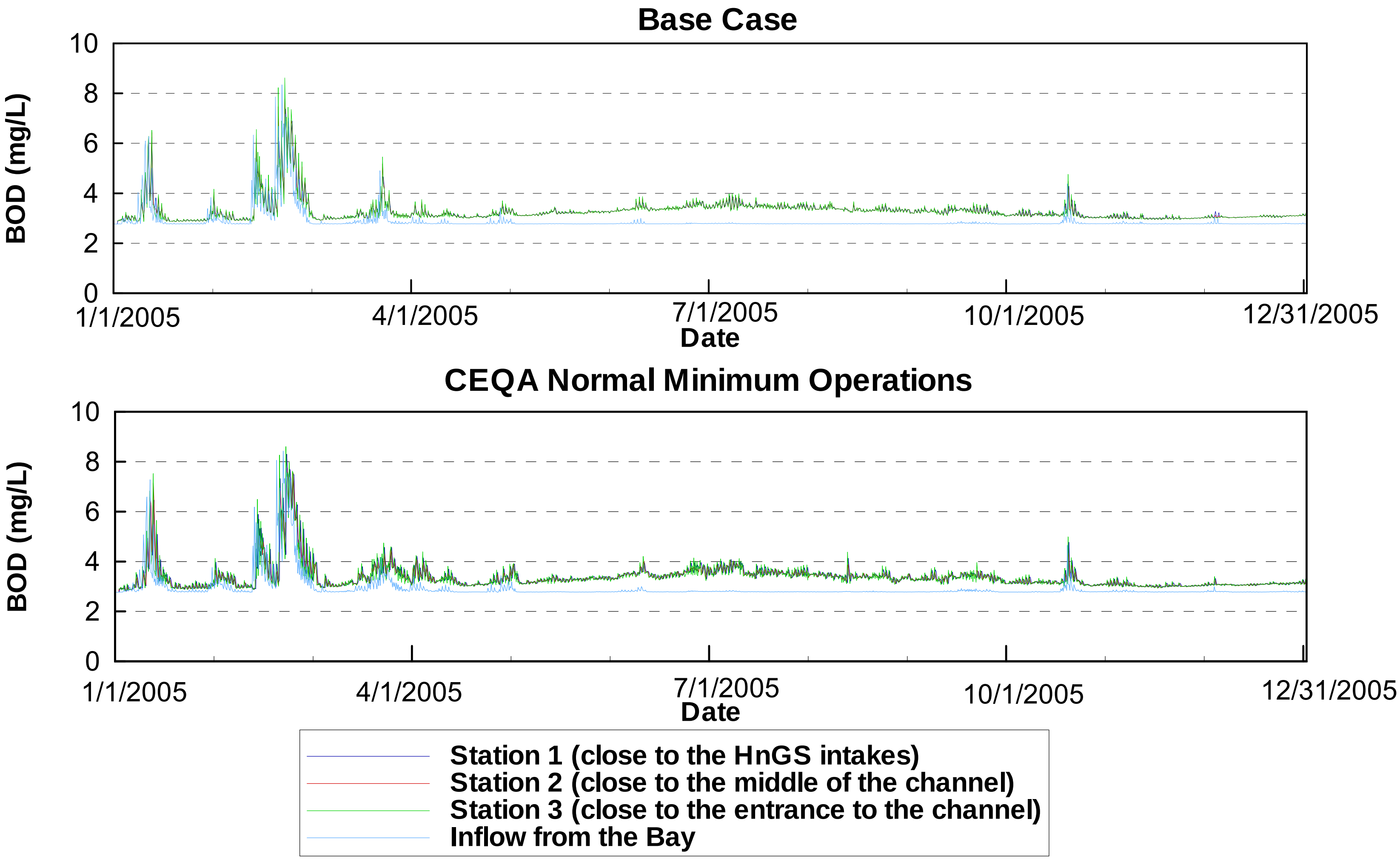


Figure 3.34

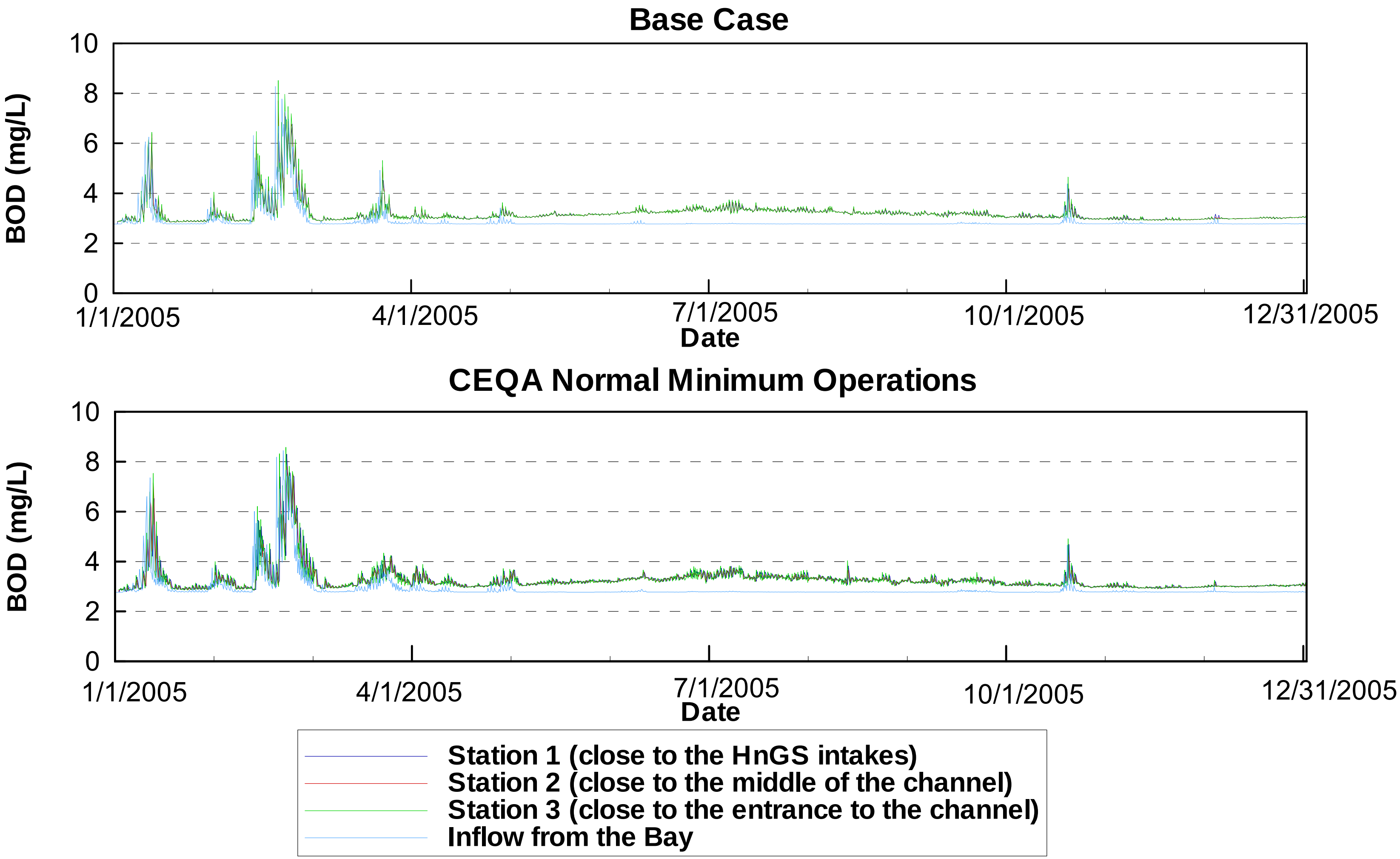
HnGS Intake Channel --- BOD

At Elevation 0 ft MLLW (near surface) – High CAEDYM Parameter Values



HnGS Intake Channel --- BOD

At Elevation 0 ft MLLW (near surface) – Moderate CAEDYM Parameter Values



HnGS Intake Channel --- pH

At Elevation 0 ftMLLW (near surface) – High CAEDYM Parameter Values

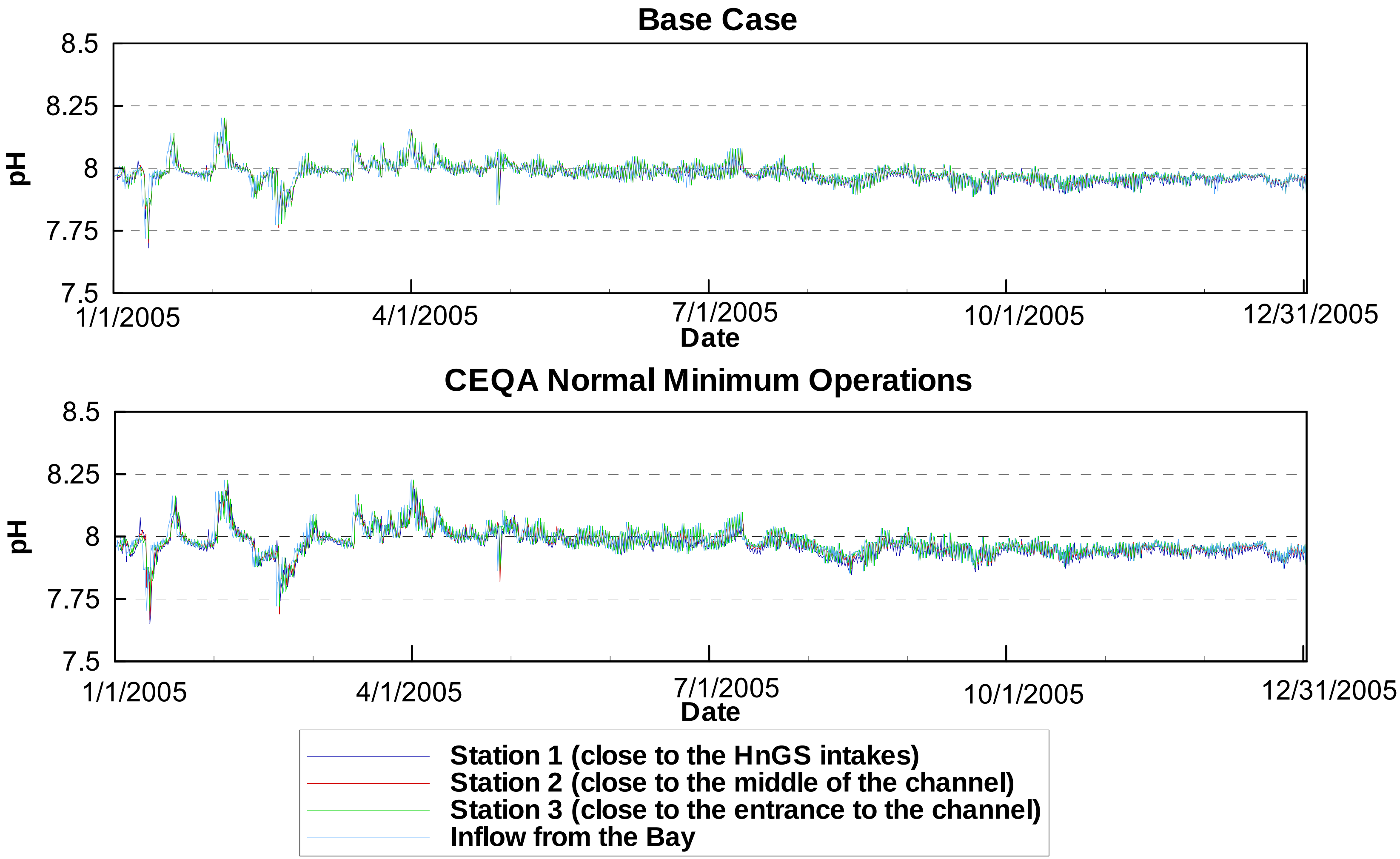
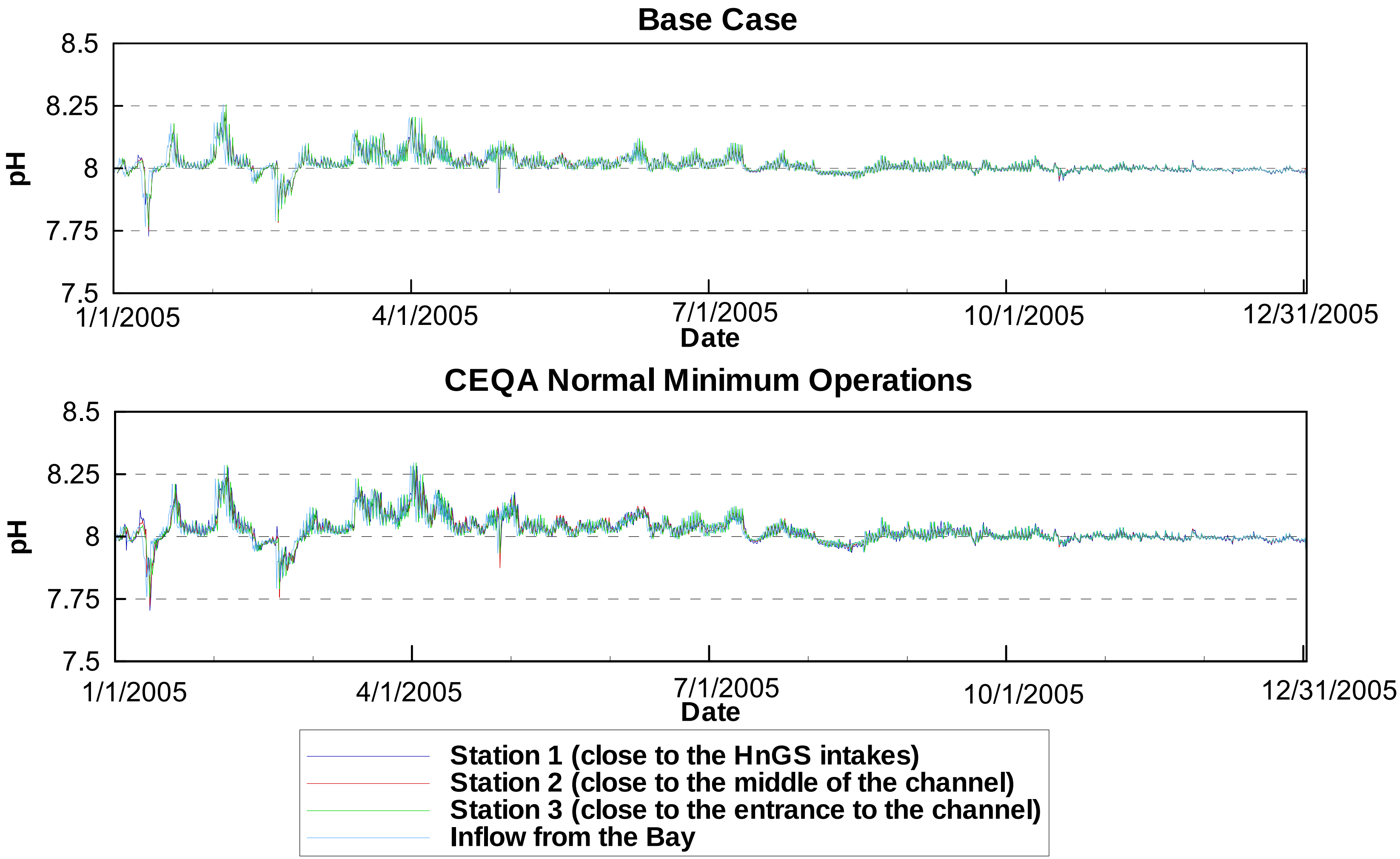
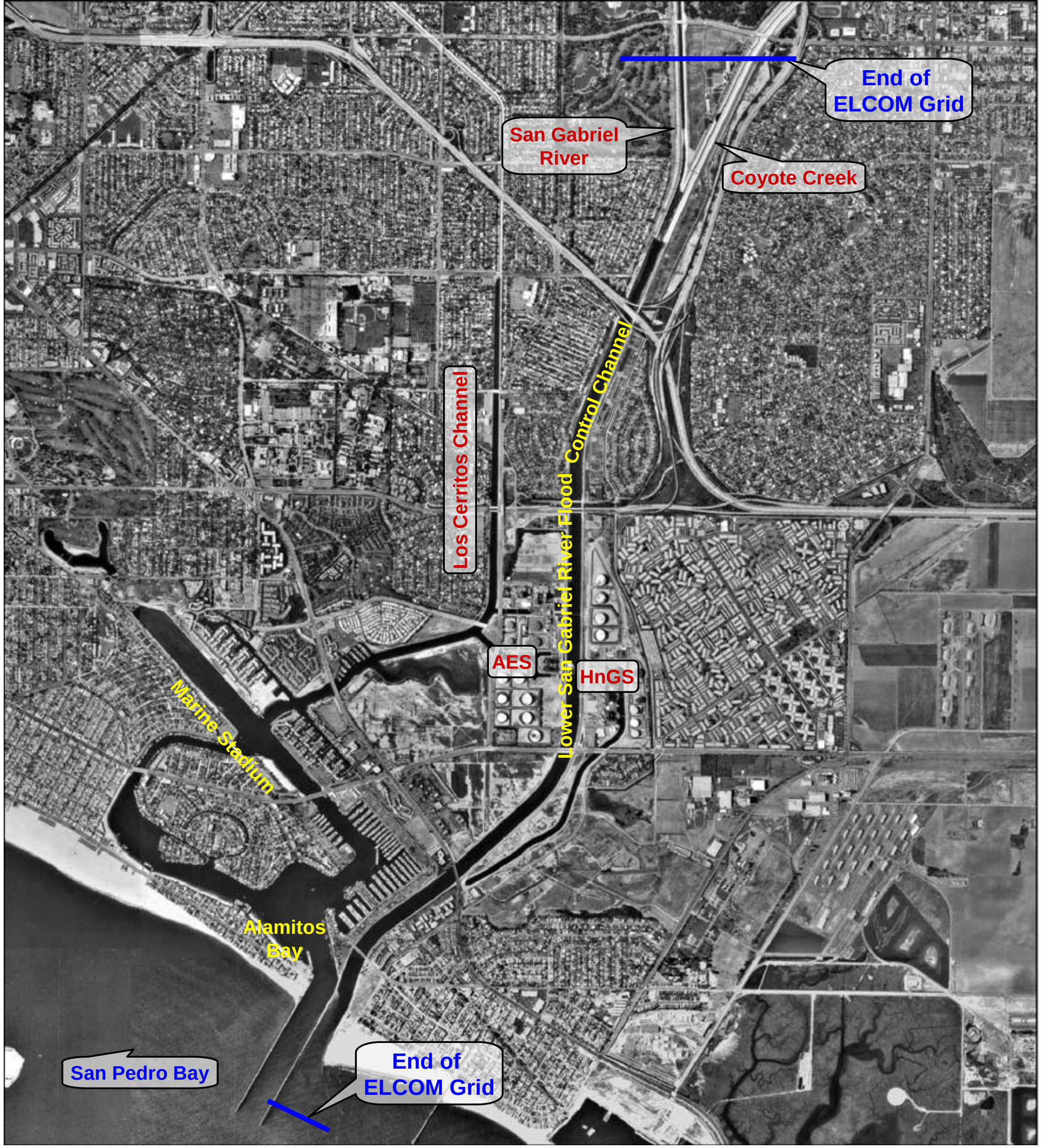


Figure 3.37

HnGS Intake Channel --- pH

At Elevation 0 ft MLLW (near surface) – Moderate CAEDYM Parameter Values





Lower San Gabriel River Model Domain

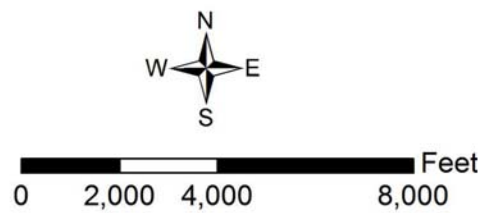
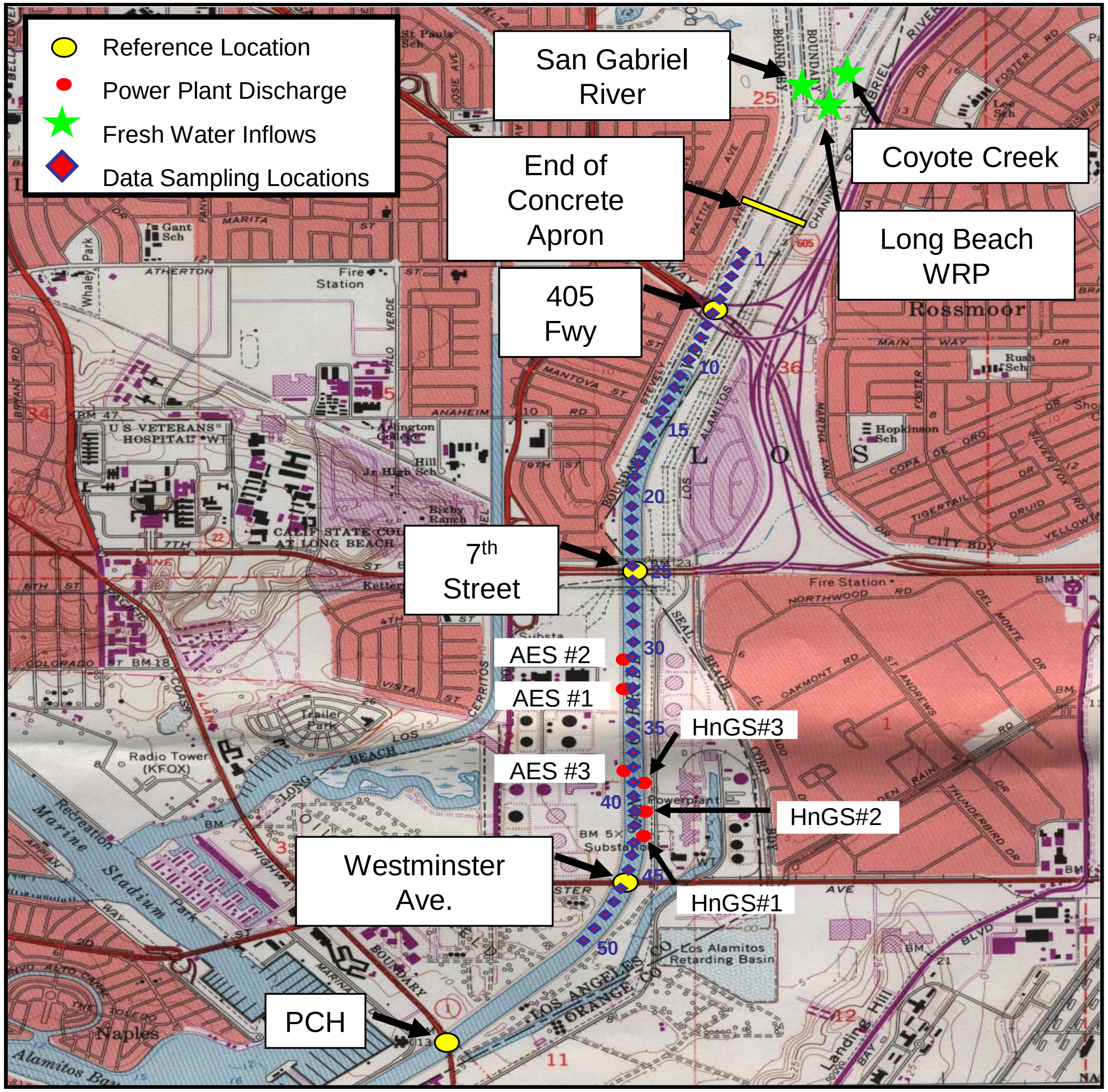


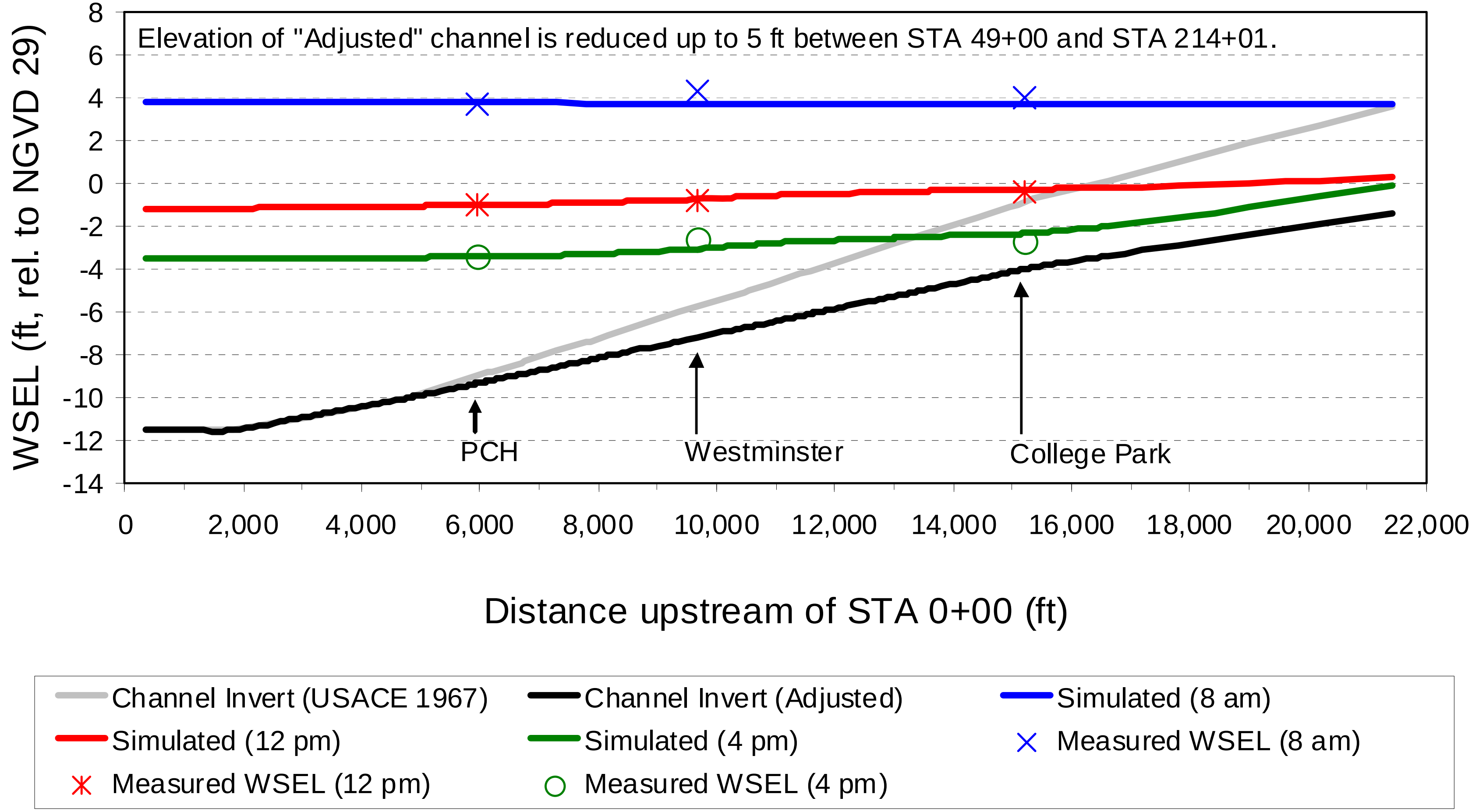
Figure 4.1

USGS Map of Lower San Gabriel River Flood Control Channel



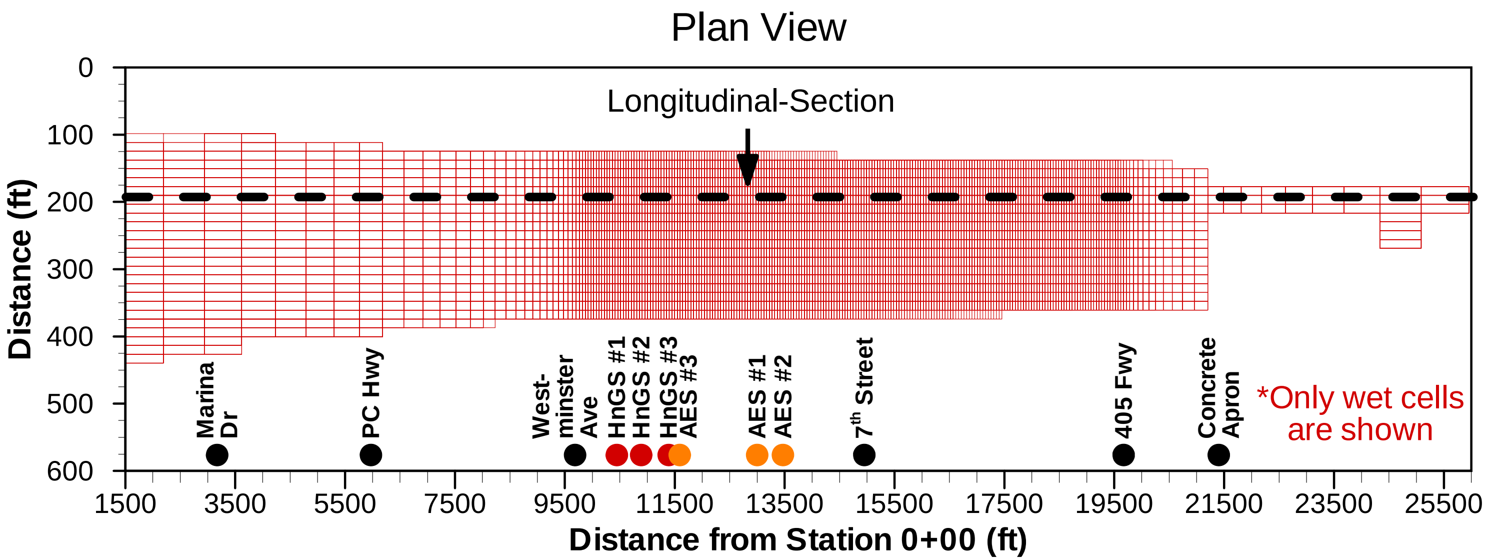
USGS 7.5" Quad – Los Alamitos, CA

Lower San Gabriel River Flood Control Channel
HEC-RAS Results
Comparison of Measured and Simulated WSEL along Channel (n = 0.025, adj. channel)



Lower San Gabriel River Flood Control Channel

Calibration/Validation and Simulation ELCOM Grid



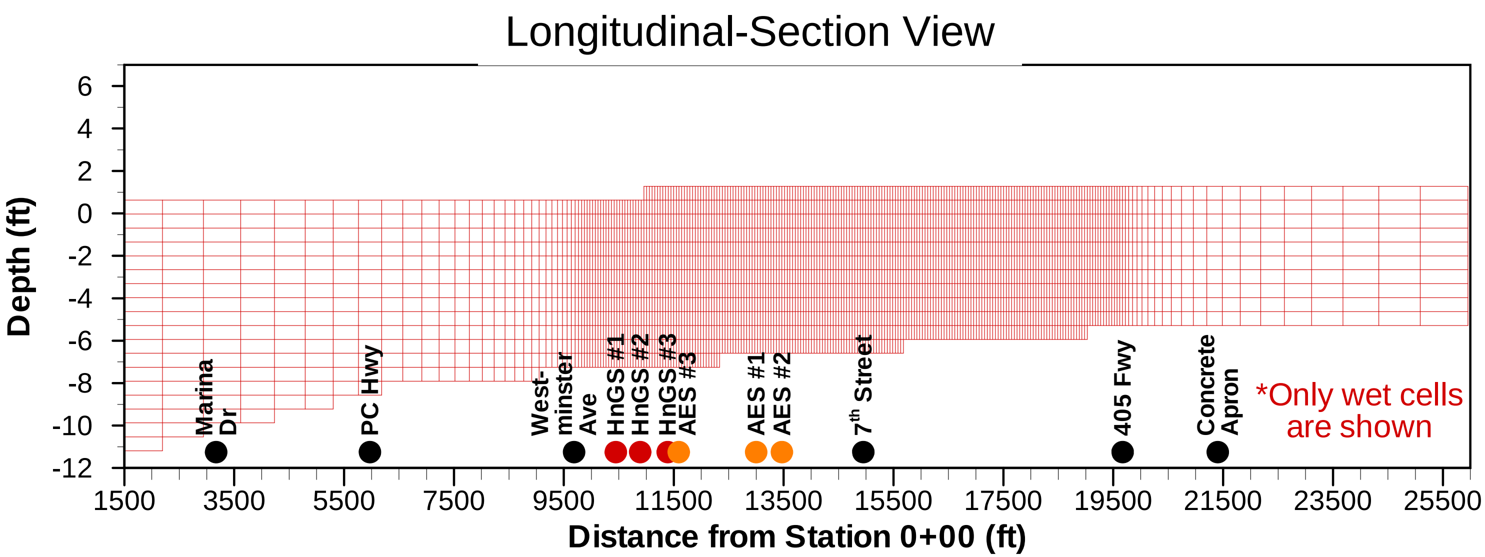
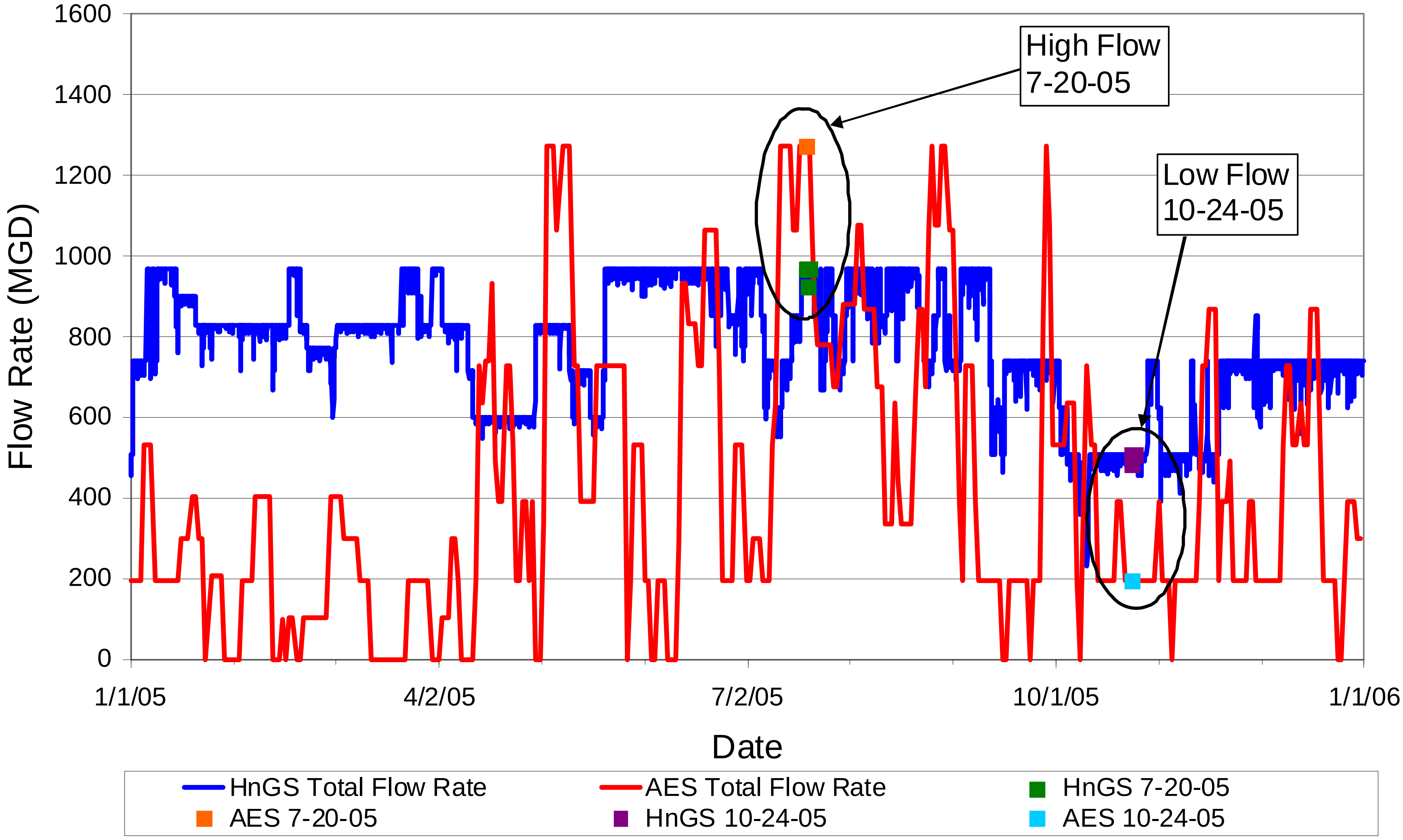


Figure 4.4

Haynes and Alamitos Generating Station Flow Rates



Alamitos Generating Station

Flow Rates and Maximum Daily Temperatures

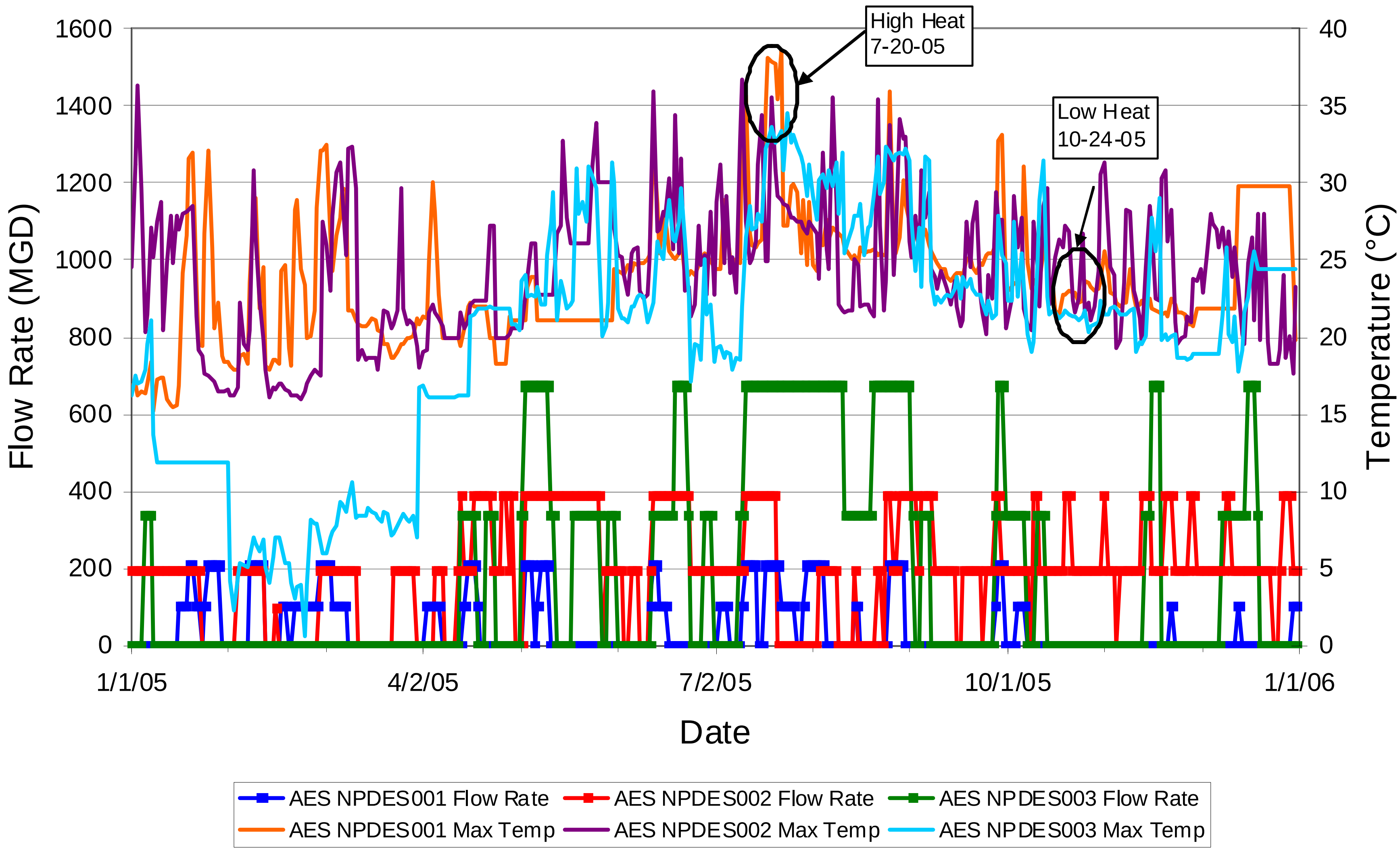
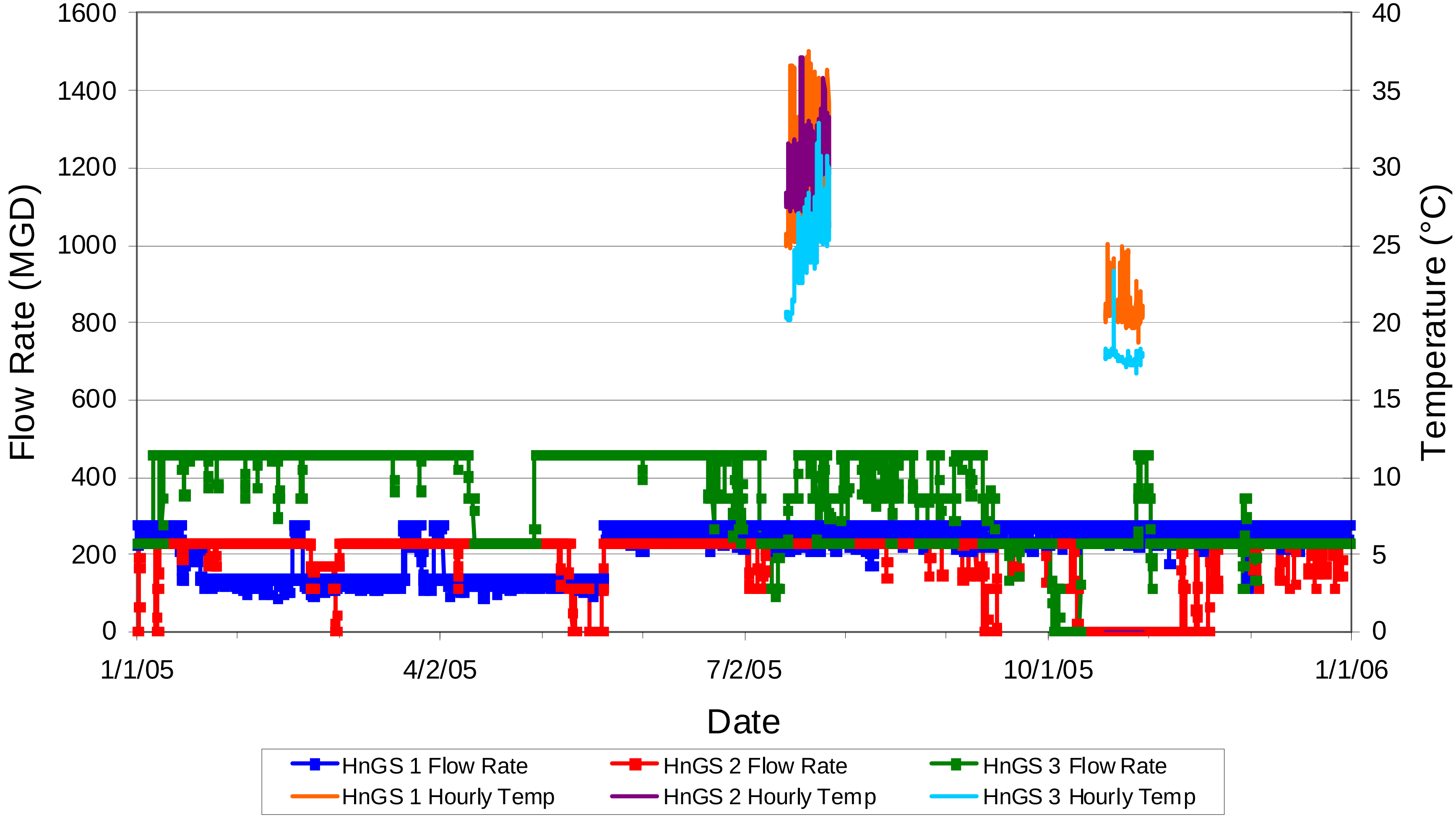


Figure 4.6

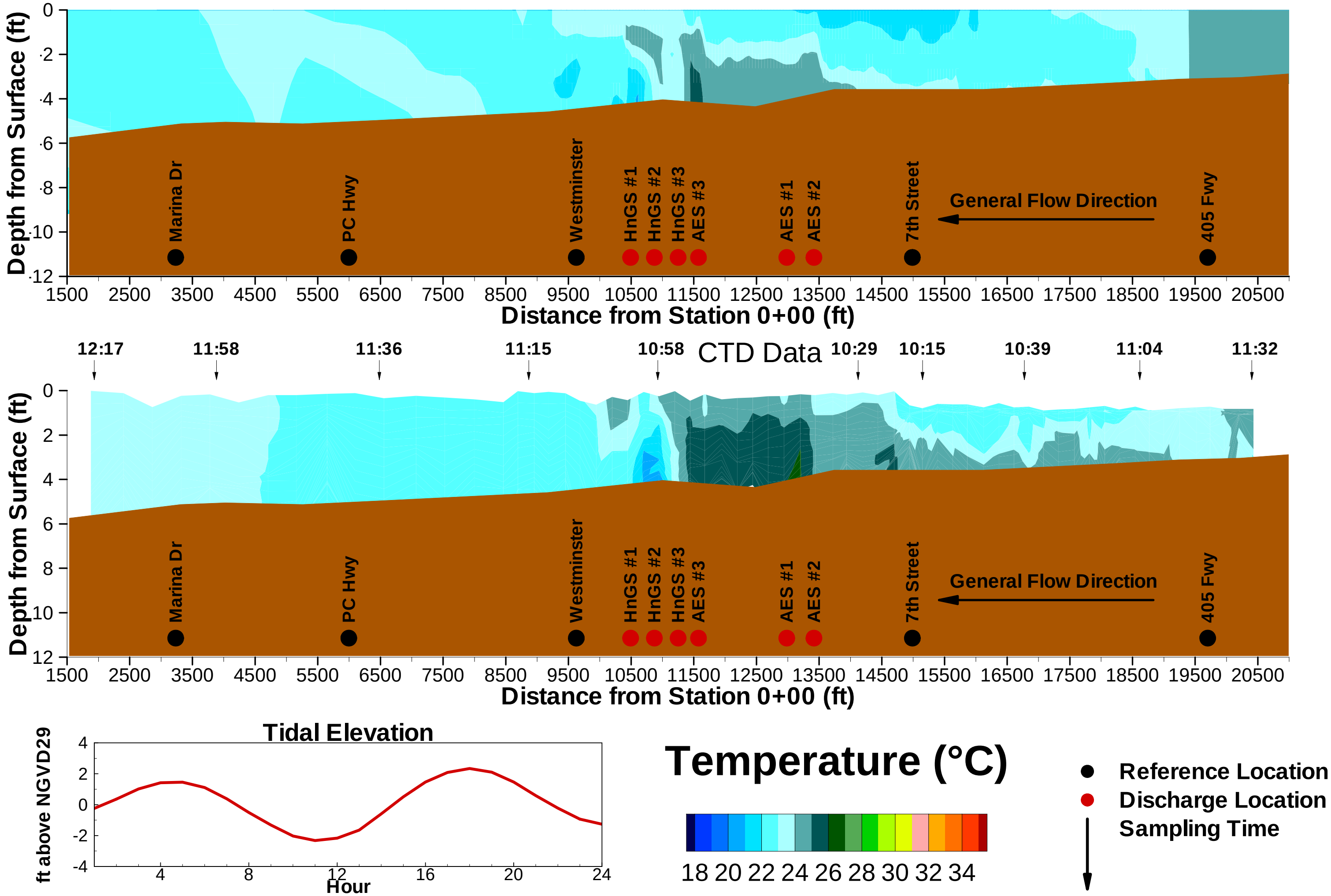
Haynes Generating Station
Flow Rates and Hourly Temperatures



Typical Conditions Temperature Calibration Comparison Contour

May 31, 2005 Low Tide

Simulation Composite



Typical Conditions Temperature Calibration Comparison Contour

May 31, 2005 Mid Tide

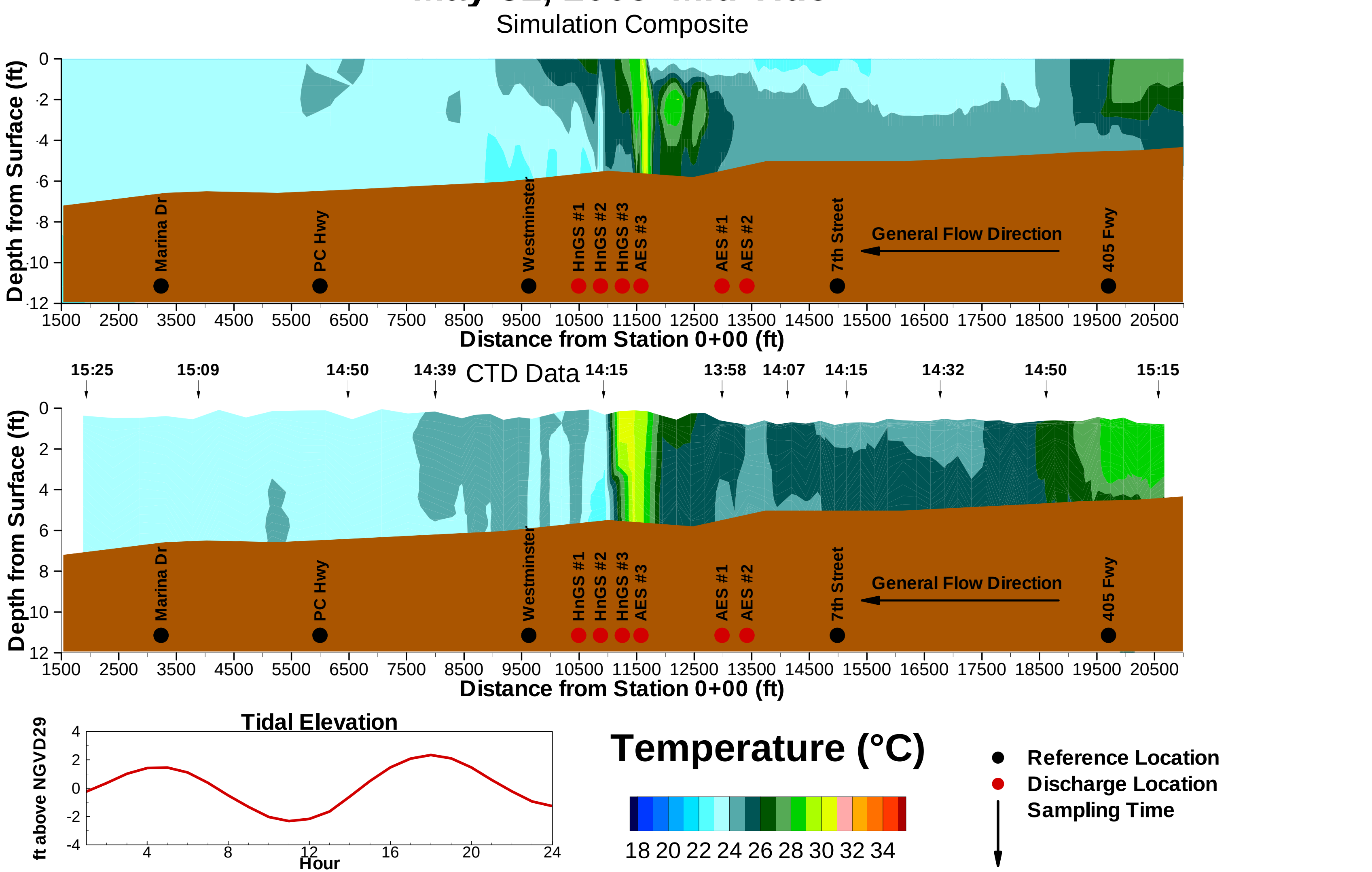
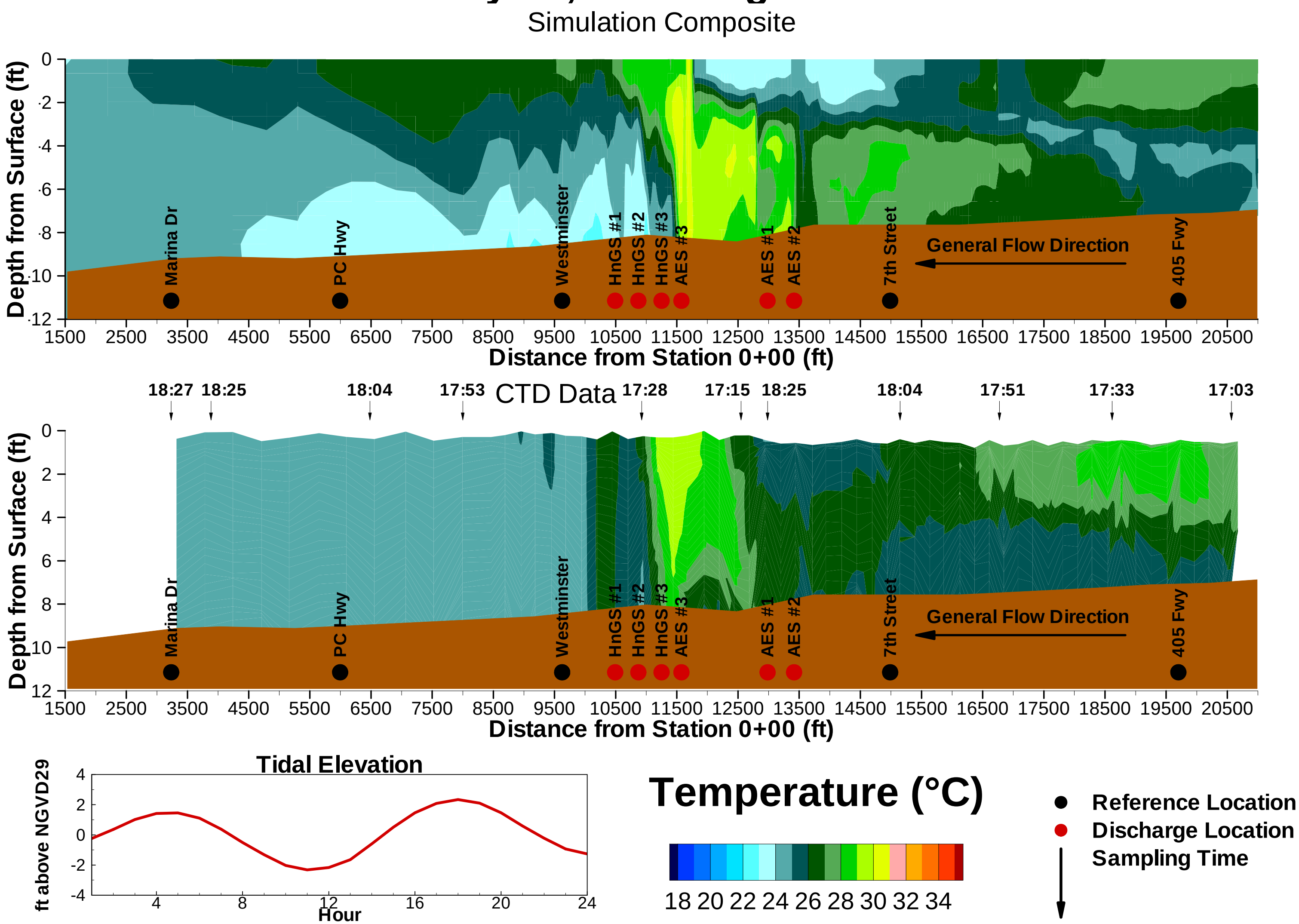


Figure 4.9

Typical Conditions Temperature Calibration Comparison Contour

May 31, 2005 High Tide



Typical Conditions Salinity Calibration Comparison Contour

May 31, 2005 Low Tide

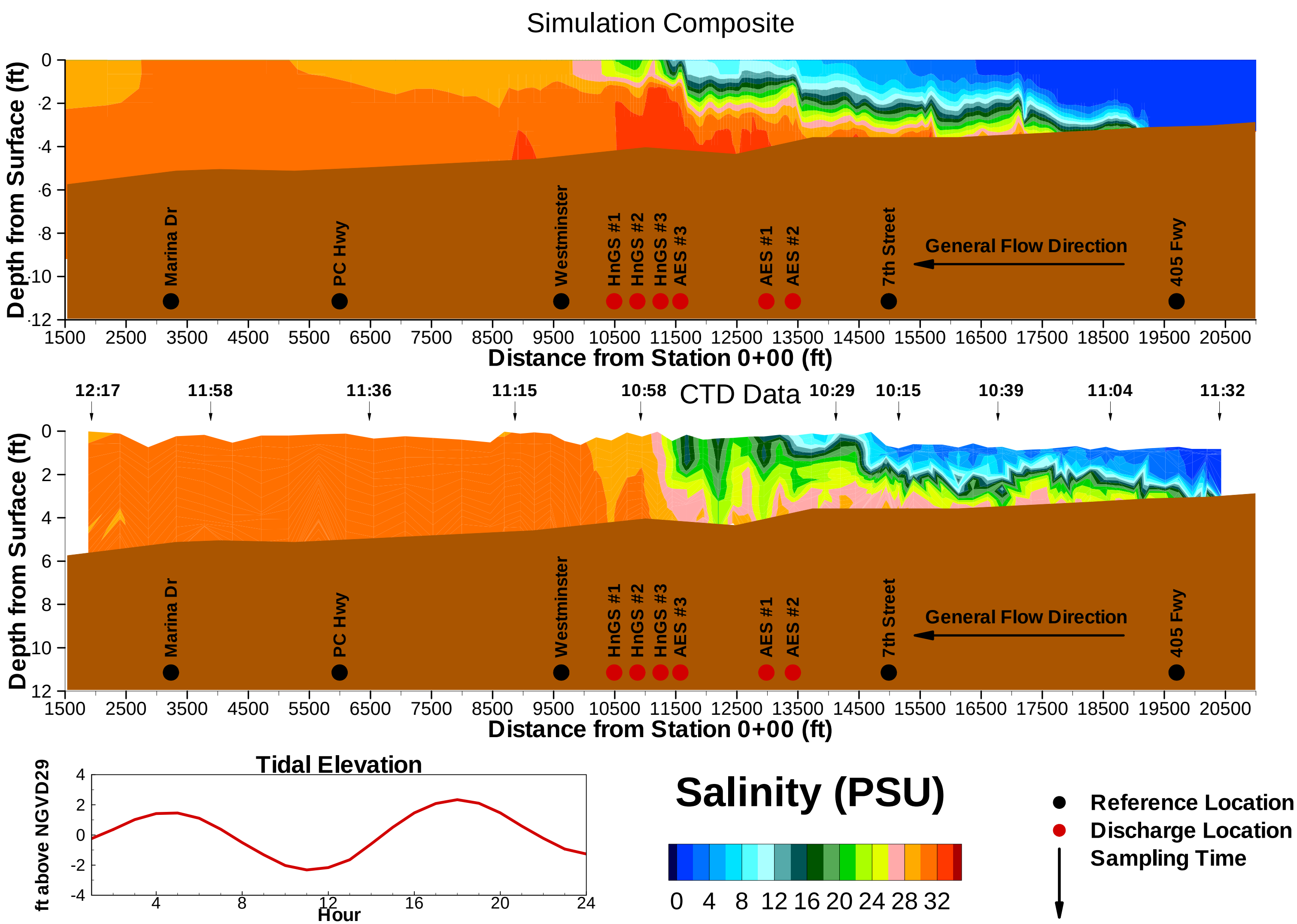
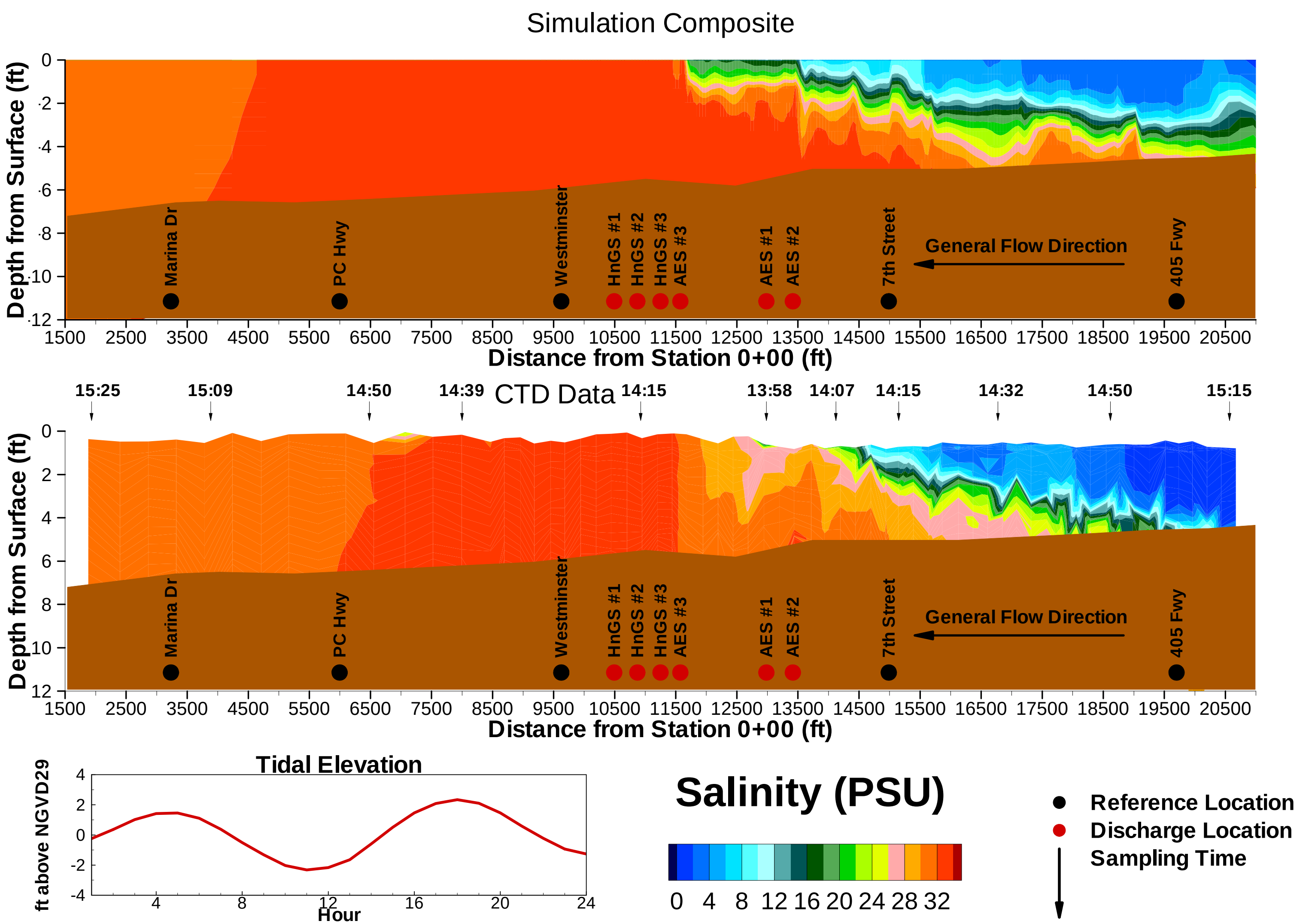


Figure 4.11

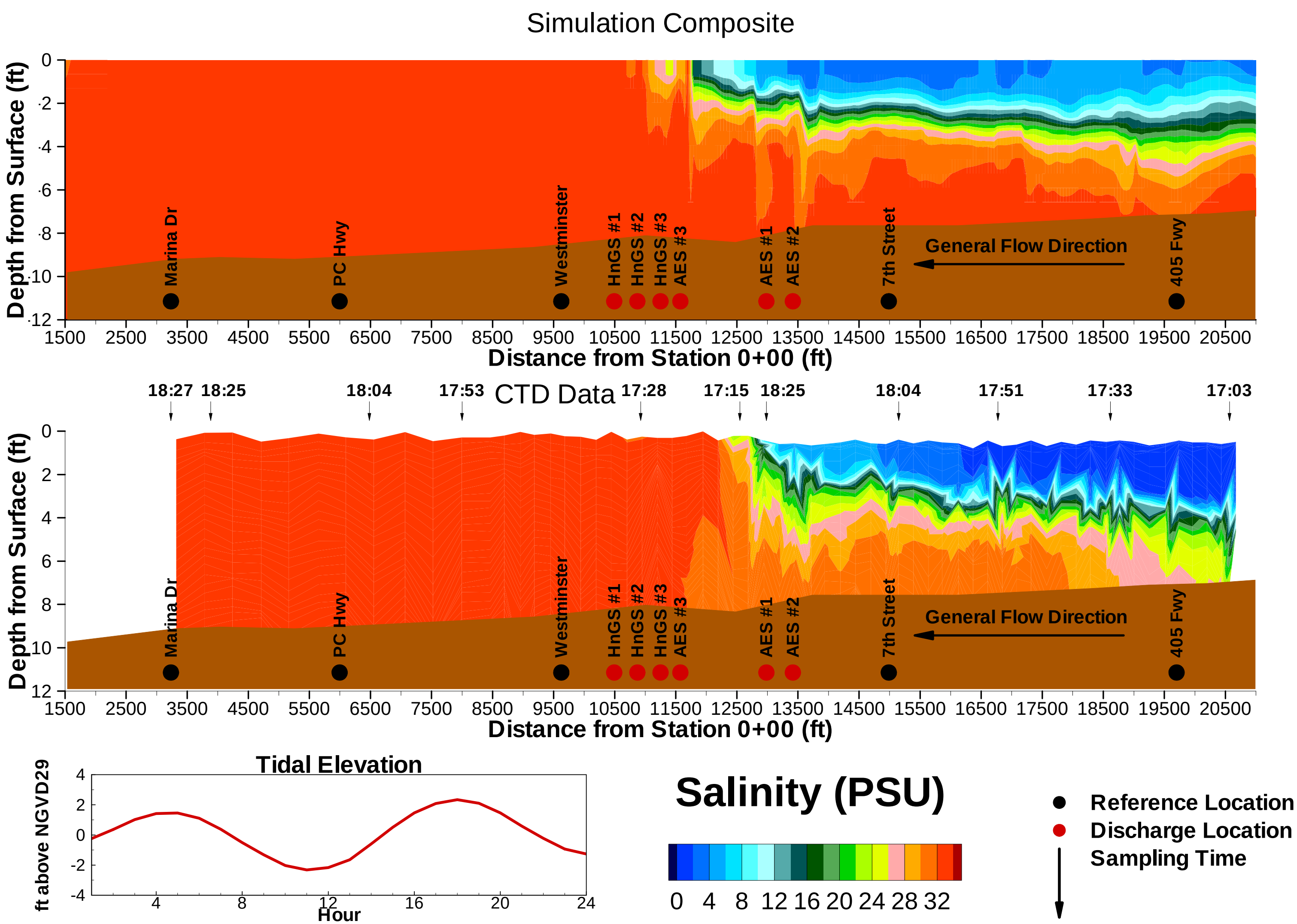
Typical Conditions Salinity Calibration Comparison Contour

May 31, 2005 Mid Tide



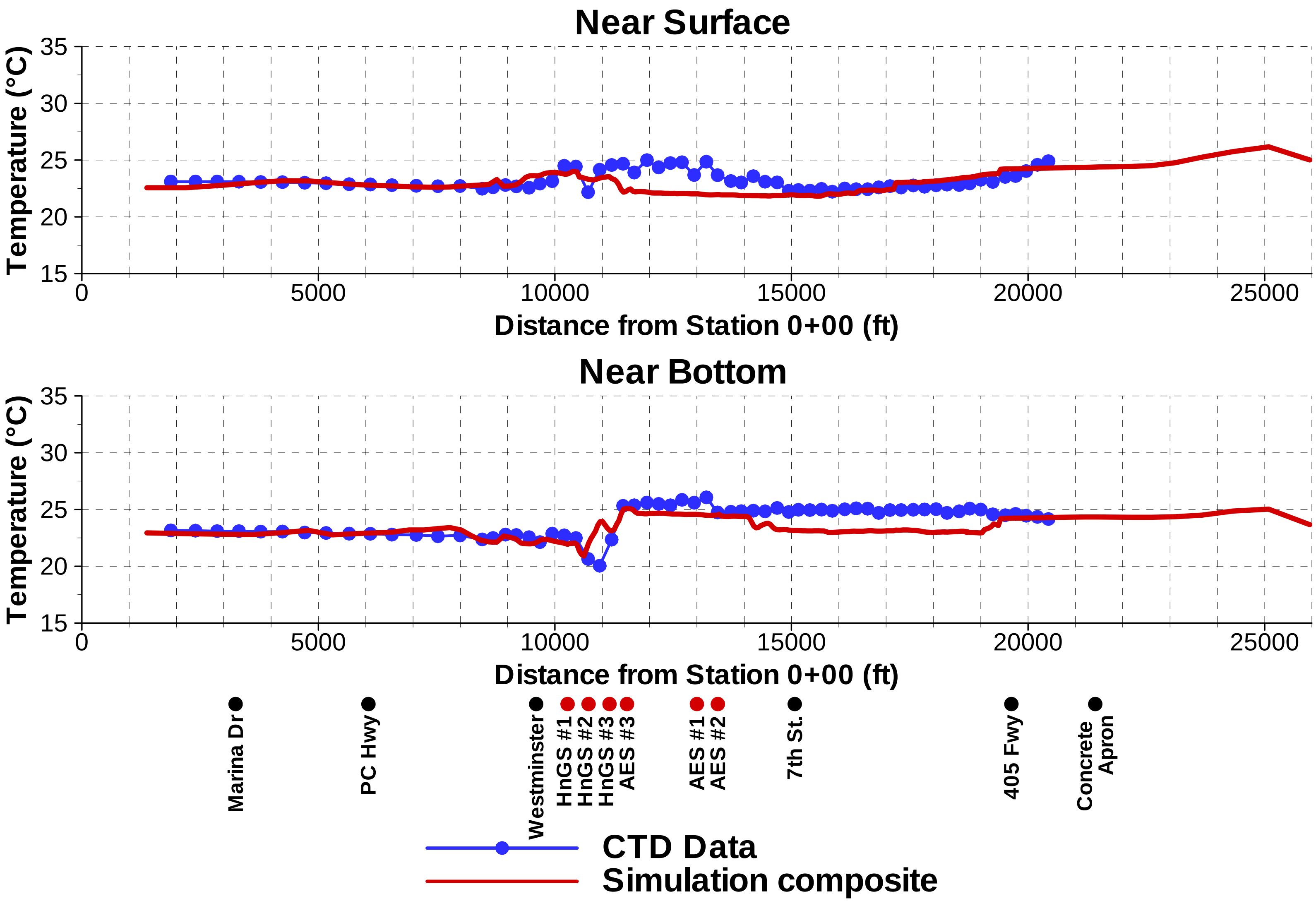
Typical Conditions Salinity Calibration Comparison Contour

May 31, 2005 High Tide



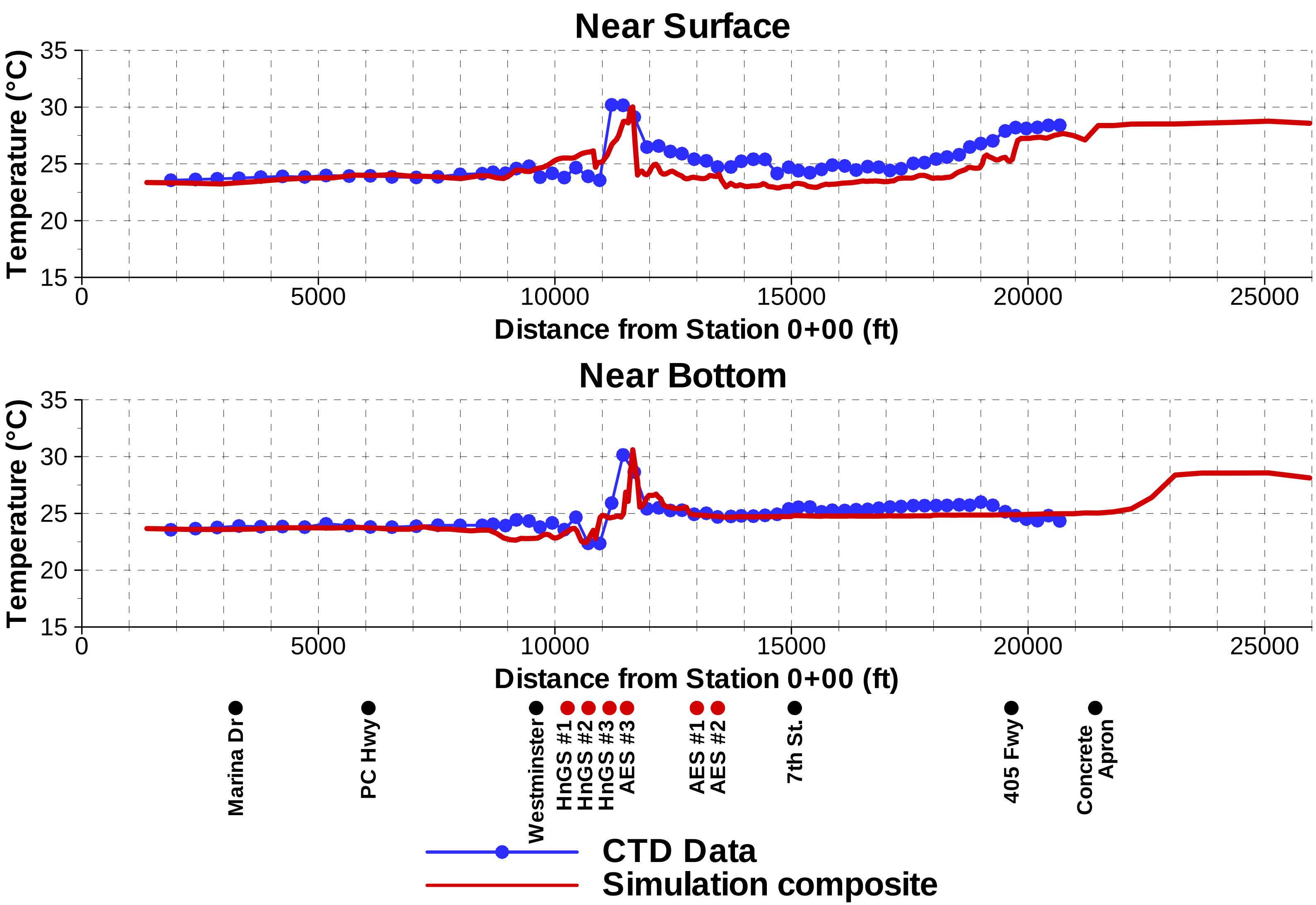
Typical Conditions Temperature Calibration Comparison

May 31, 2005 Low Tide



Typical Conditions Temperature Calibration Comparison

May 31, 2005 Mid Tide



Typical Conditions Temperature Calibration Comparison

May 31, 2005 High Tide

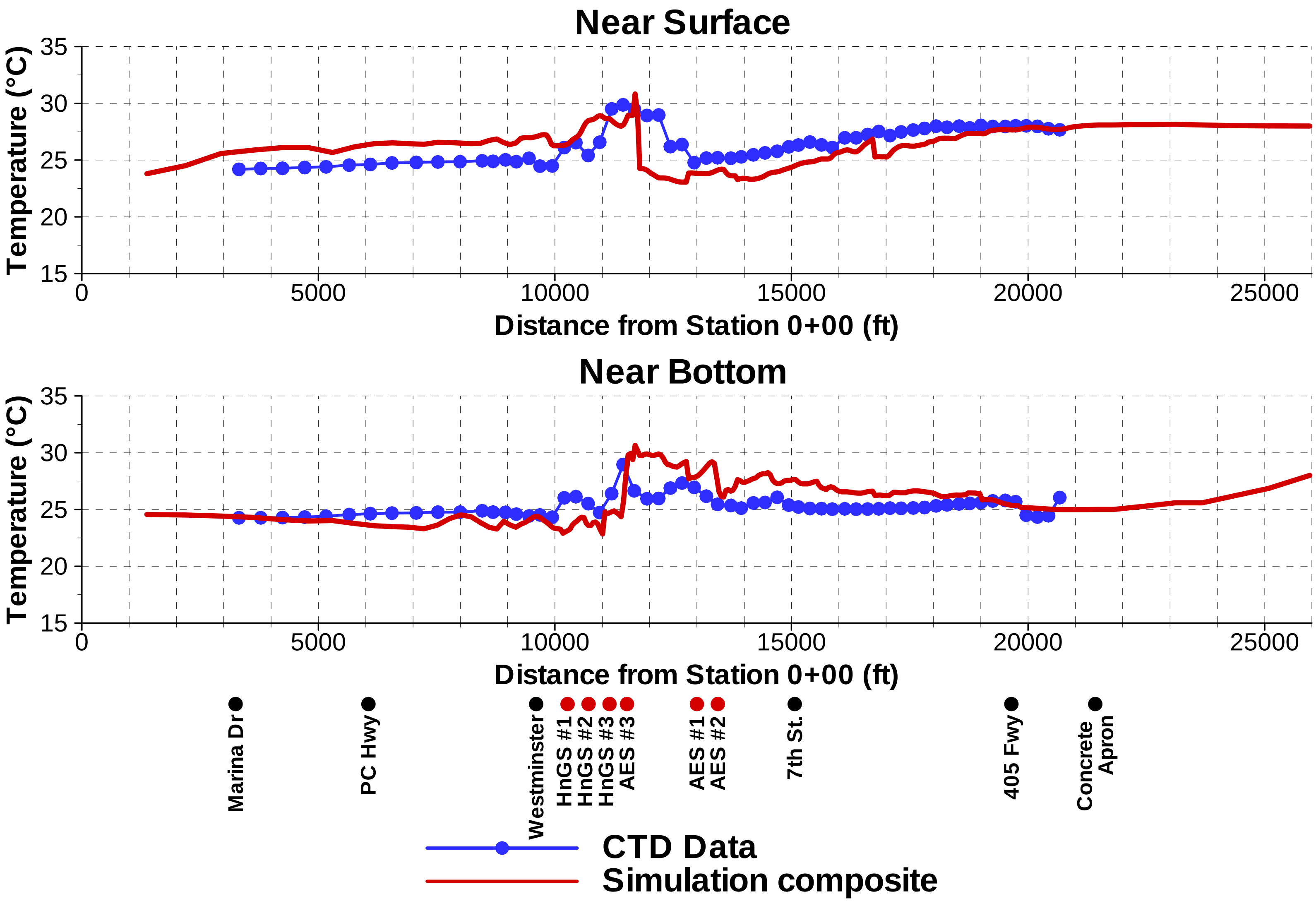
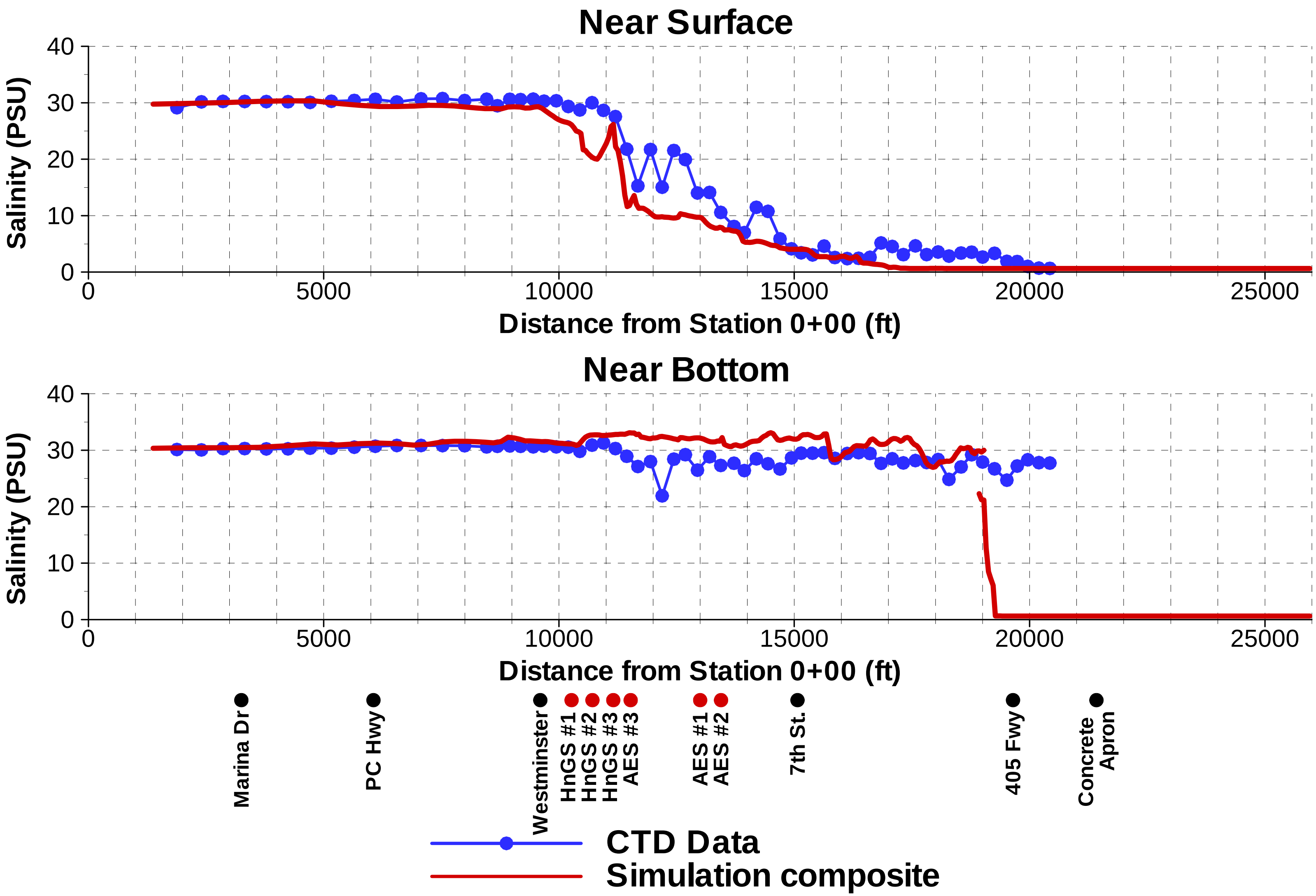


Figure 4.16

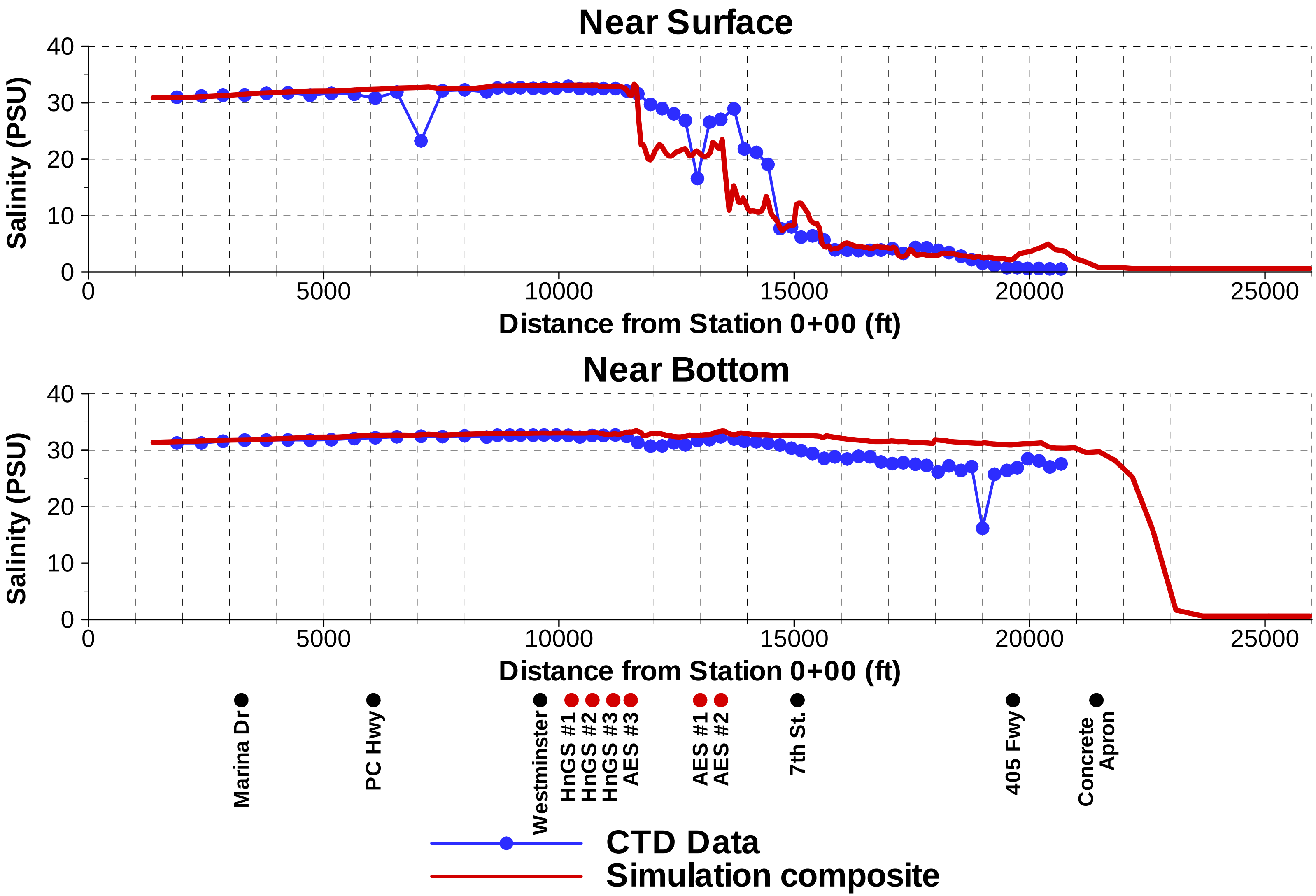
Typical Conditions Salinity Calibration Comparison

May 31, 2005 Low Tide



Typical Conditions Salinity Calibration Comparison

May 31, 2005 Mid Tide



Typical Conditions Salinity Calibration Comparison

May 31, 2005 High Tide

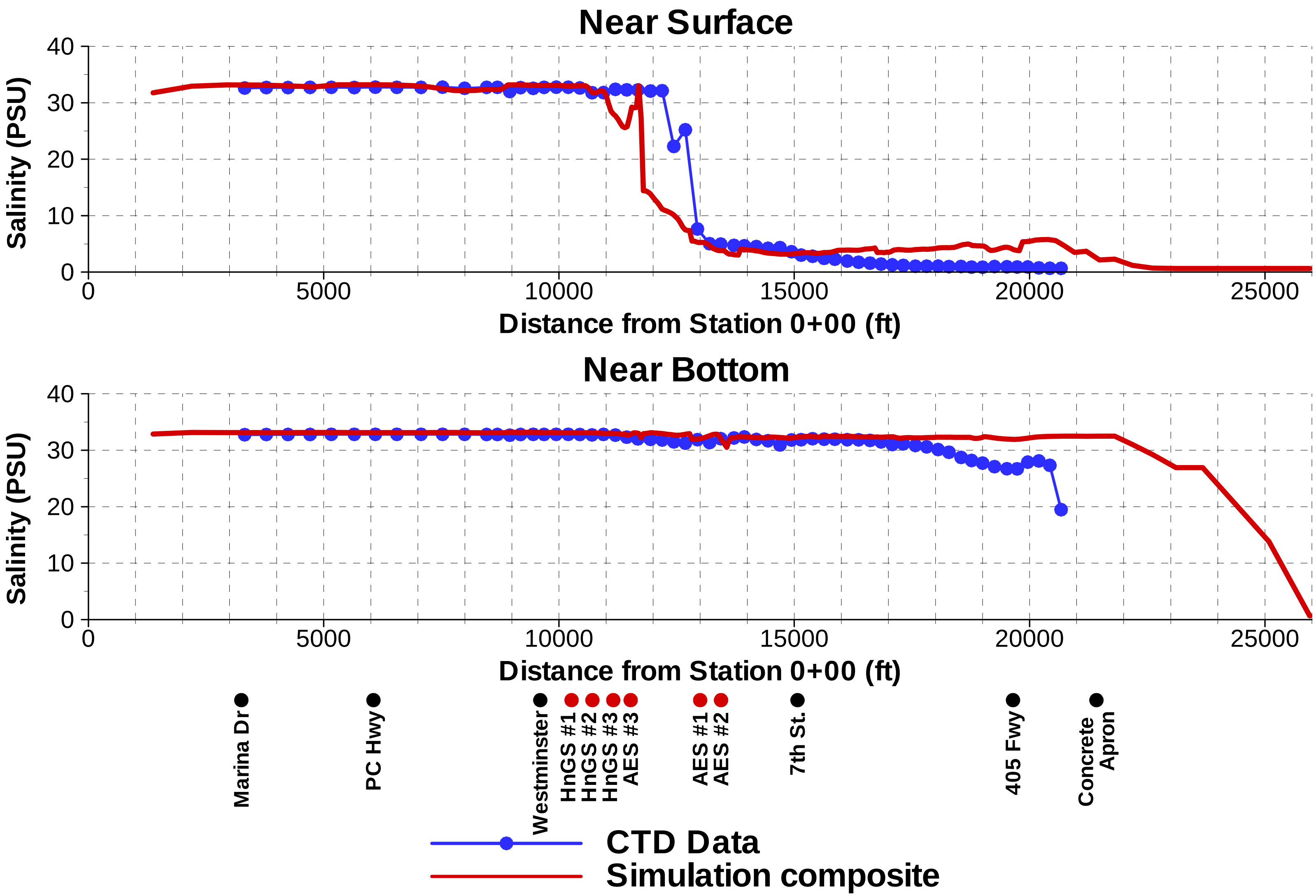
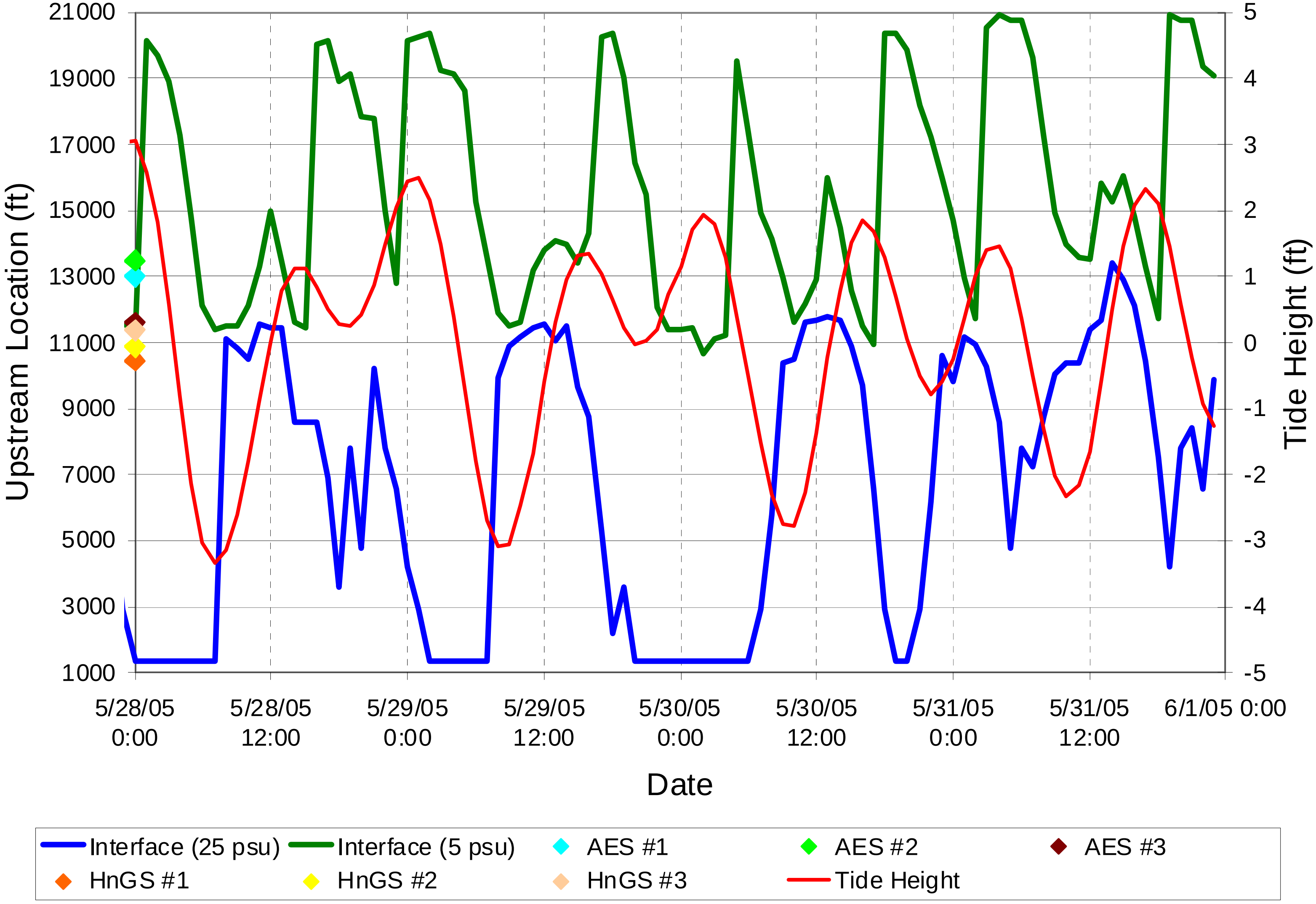


Figure 4.19

Typical Conditions Surface Salt/Fresh Water Interface Locations

May 31, 2005



Post-Rain Conditions Temperature Calibration Comparison Contour

October 22, 2004 Low Tide

Simulation Composite

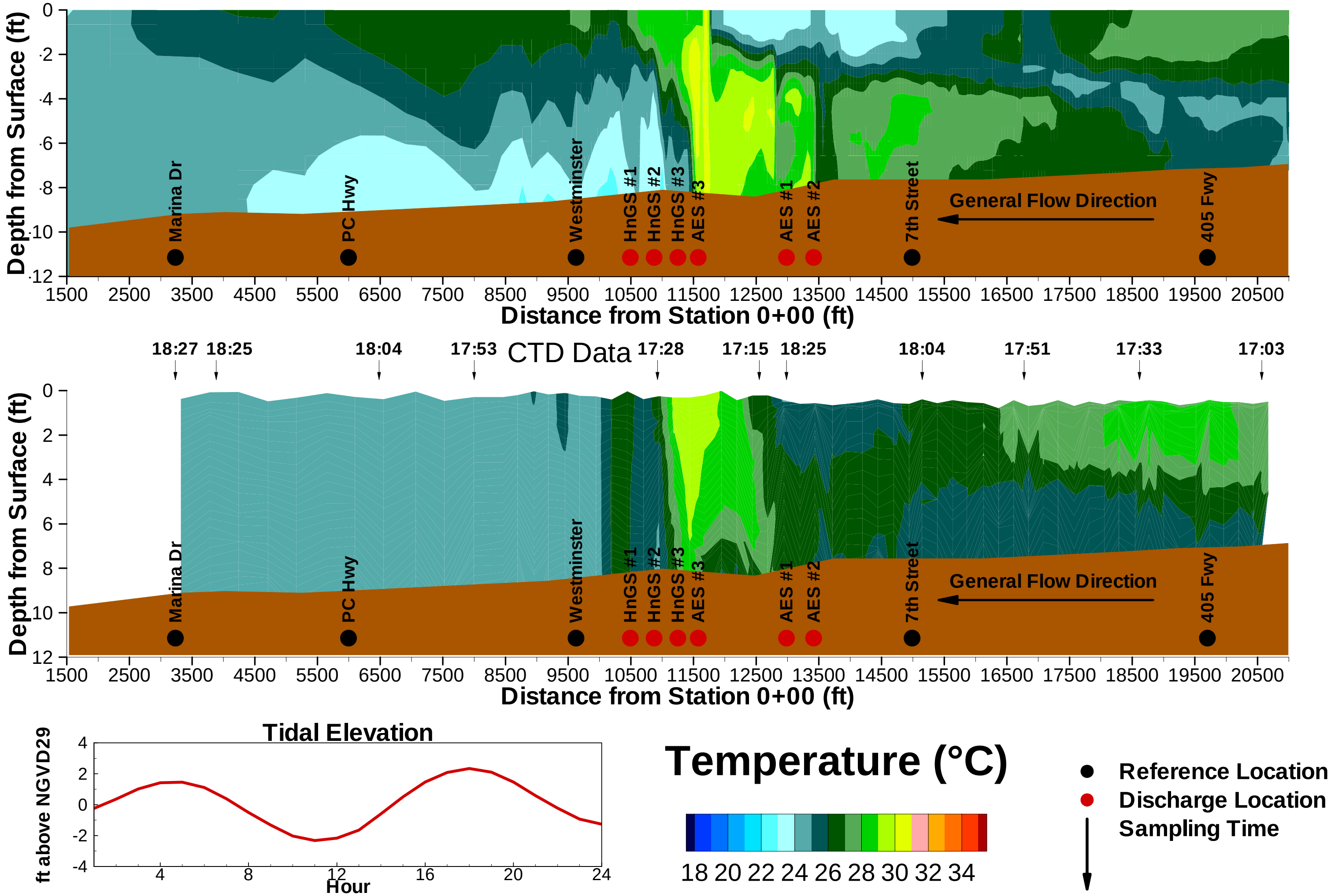


Figure 4.21

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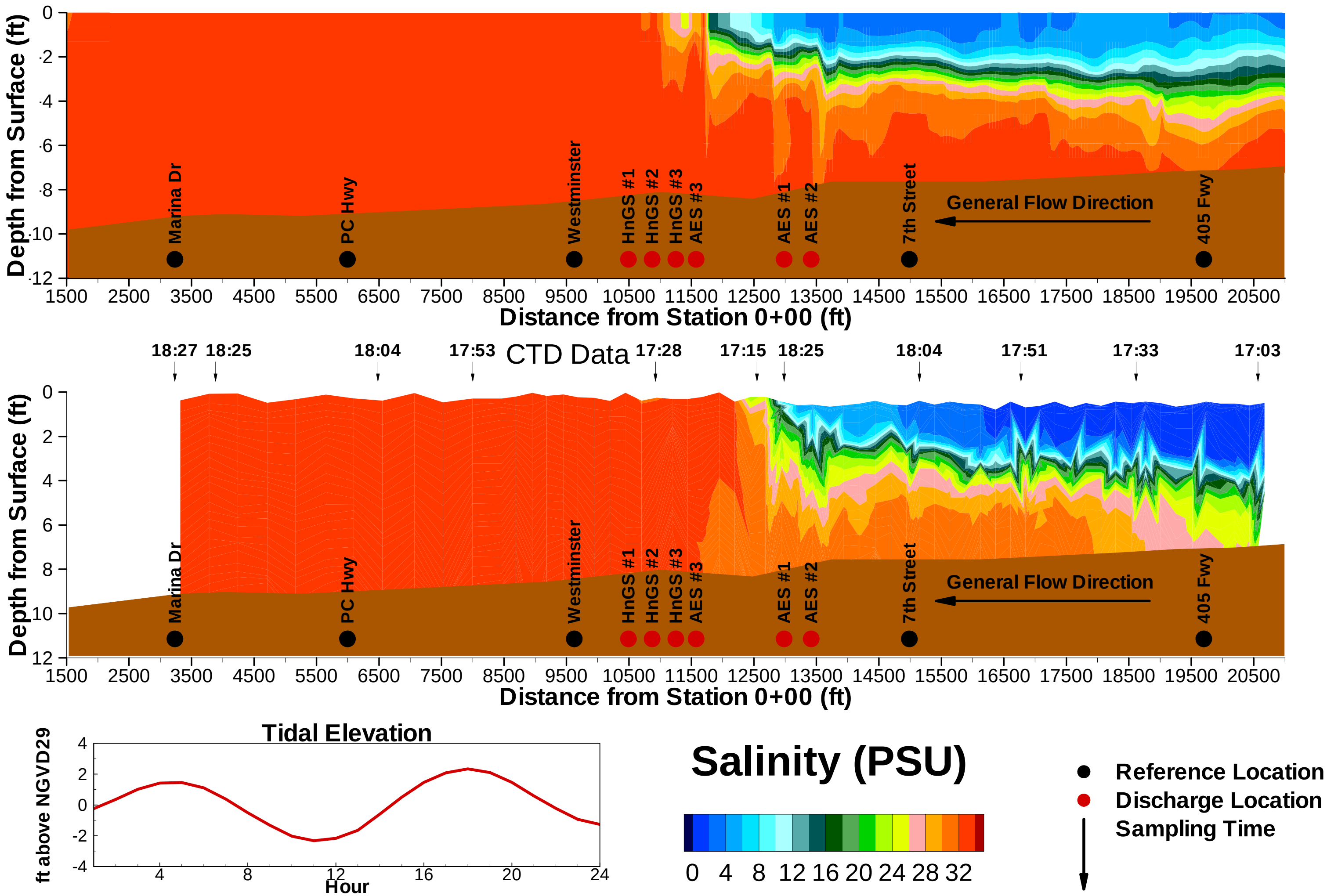
Post-Rain Conditions Salinity Calibration Comparison Contour

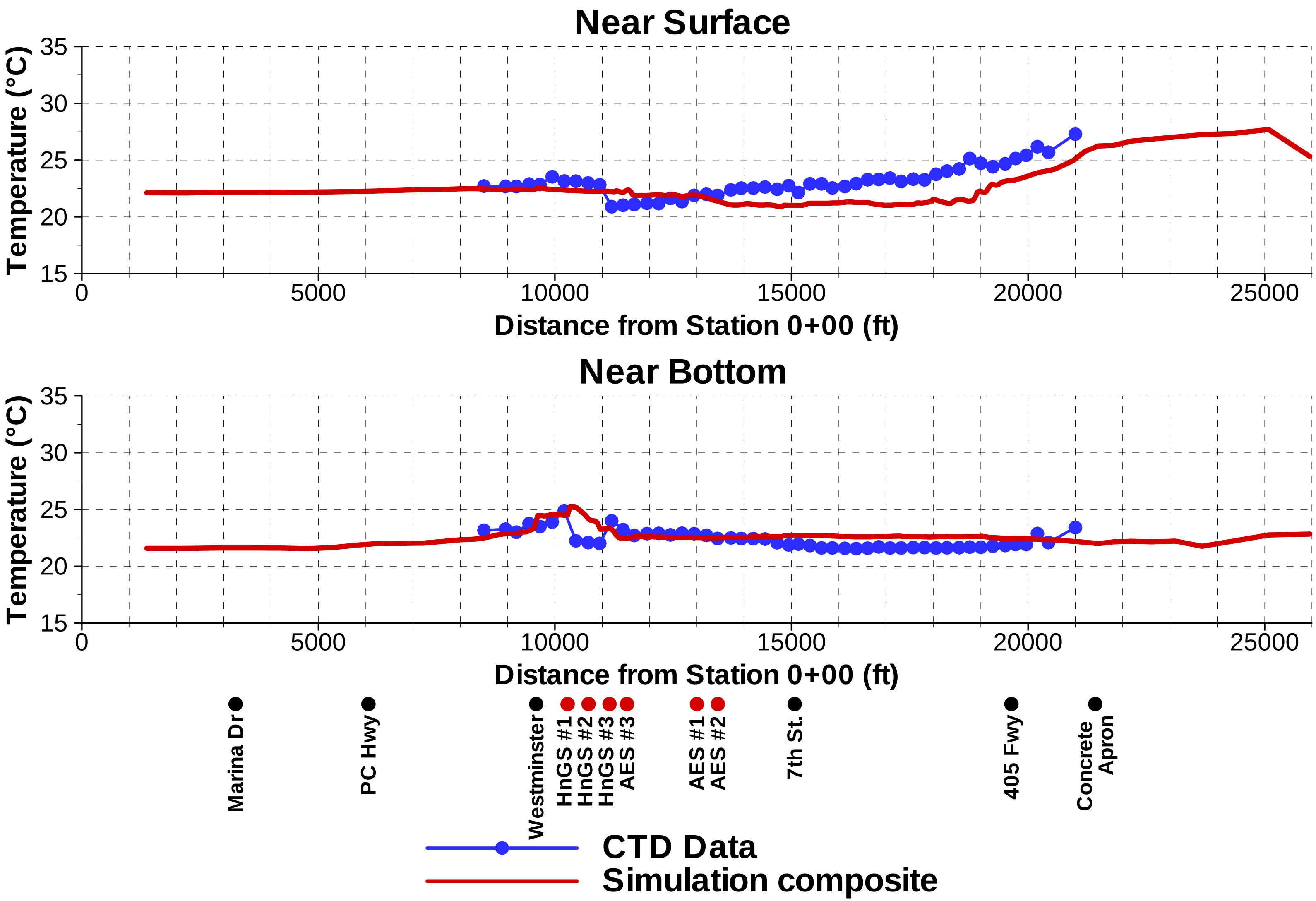
October 22, 2004 Low Tide

Simulation Composite



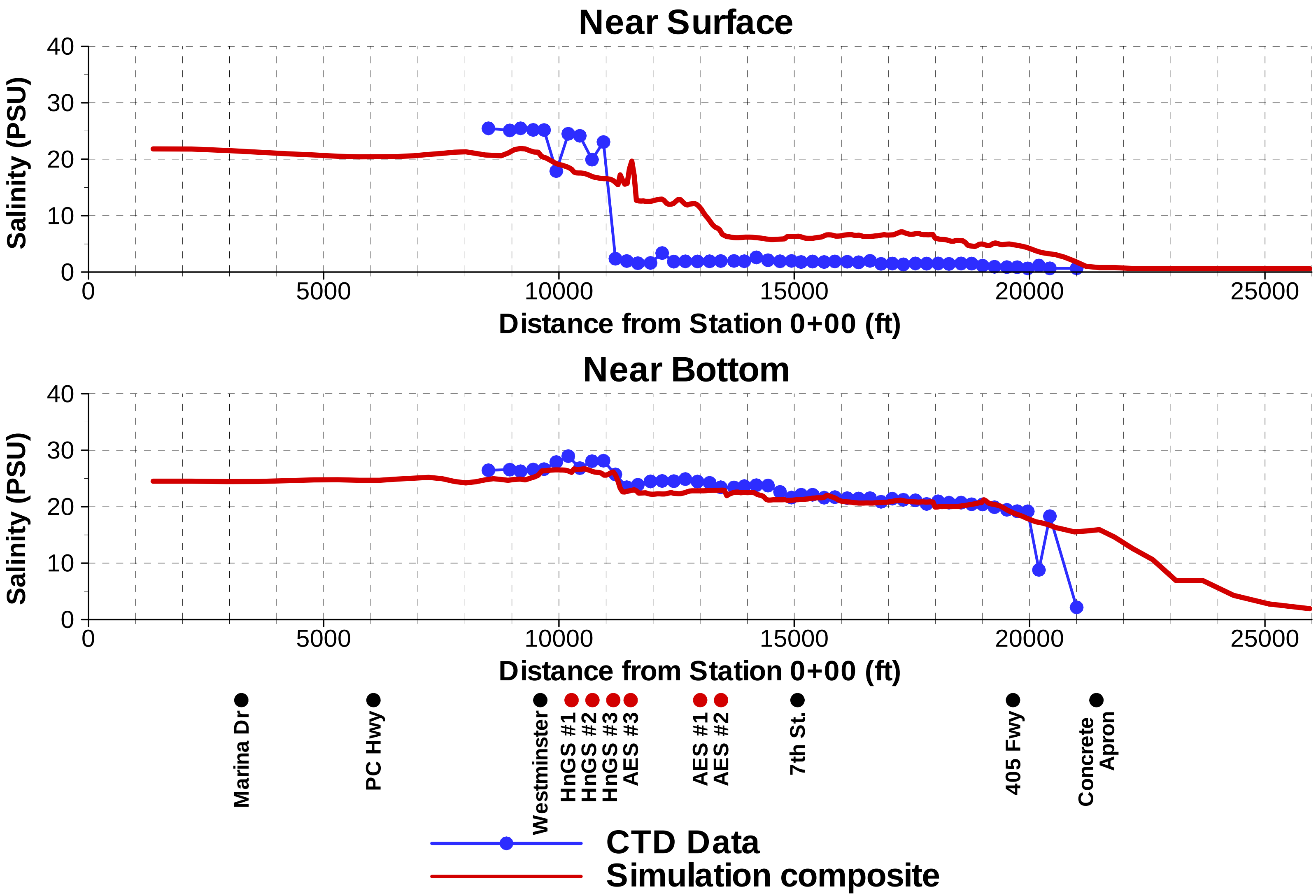
Post-Rain Conditions Temperature Calibration Comparison

October 22, 2004 Low Tide



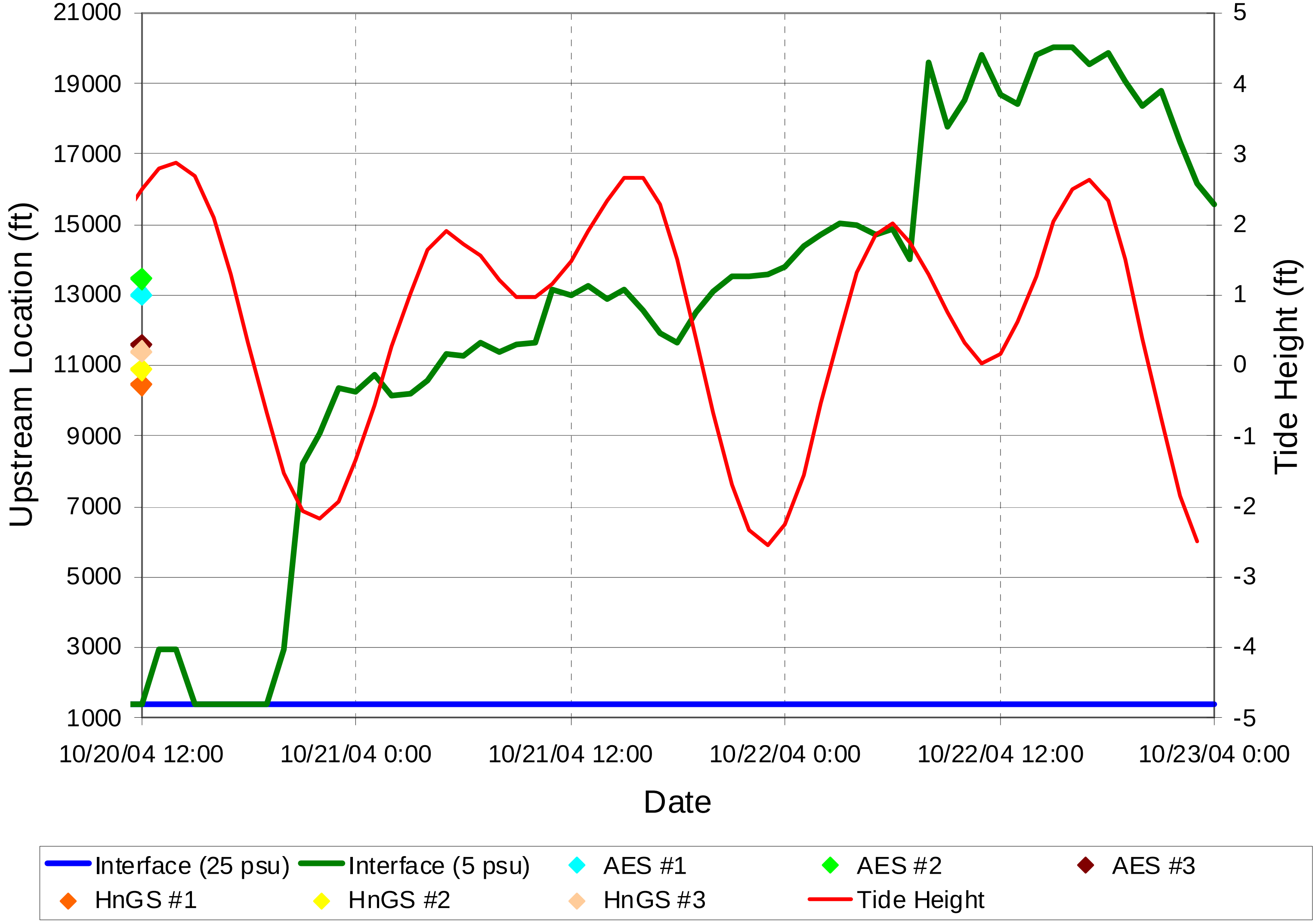
Post-Rain Conditions Salinity Calibration Comparison

October 22, 2004 Low Tide



Post-Rain Conditions Surface Salt/Fresh Water Interface Locations

October 22, 2004



Lower San Gabriel River Outfall Tracer

Low Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct

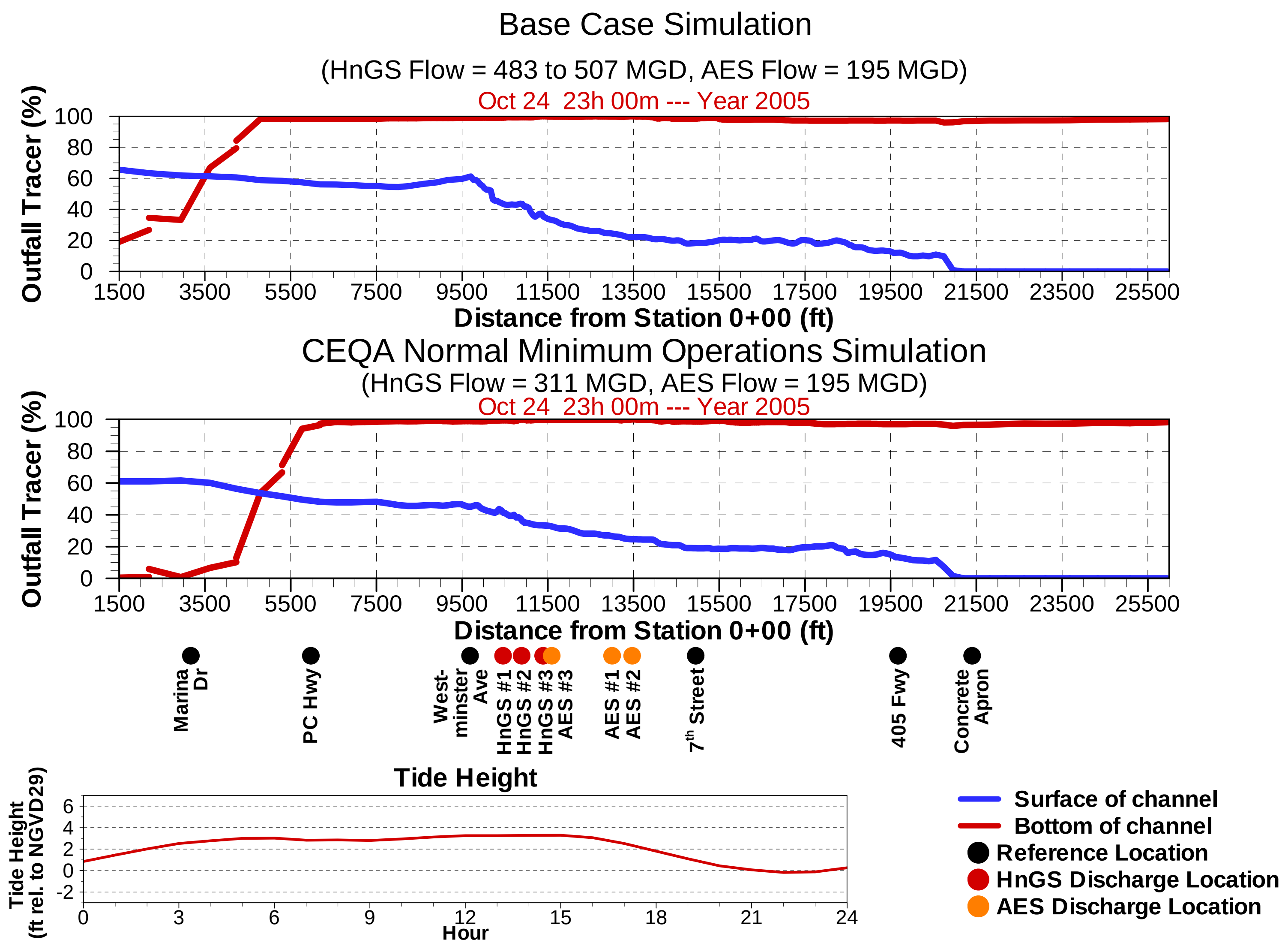


Figure 4.26

Lower San Gabriel River Outfall Tracer

High Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct

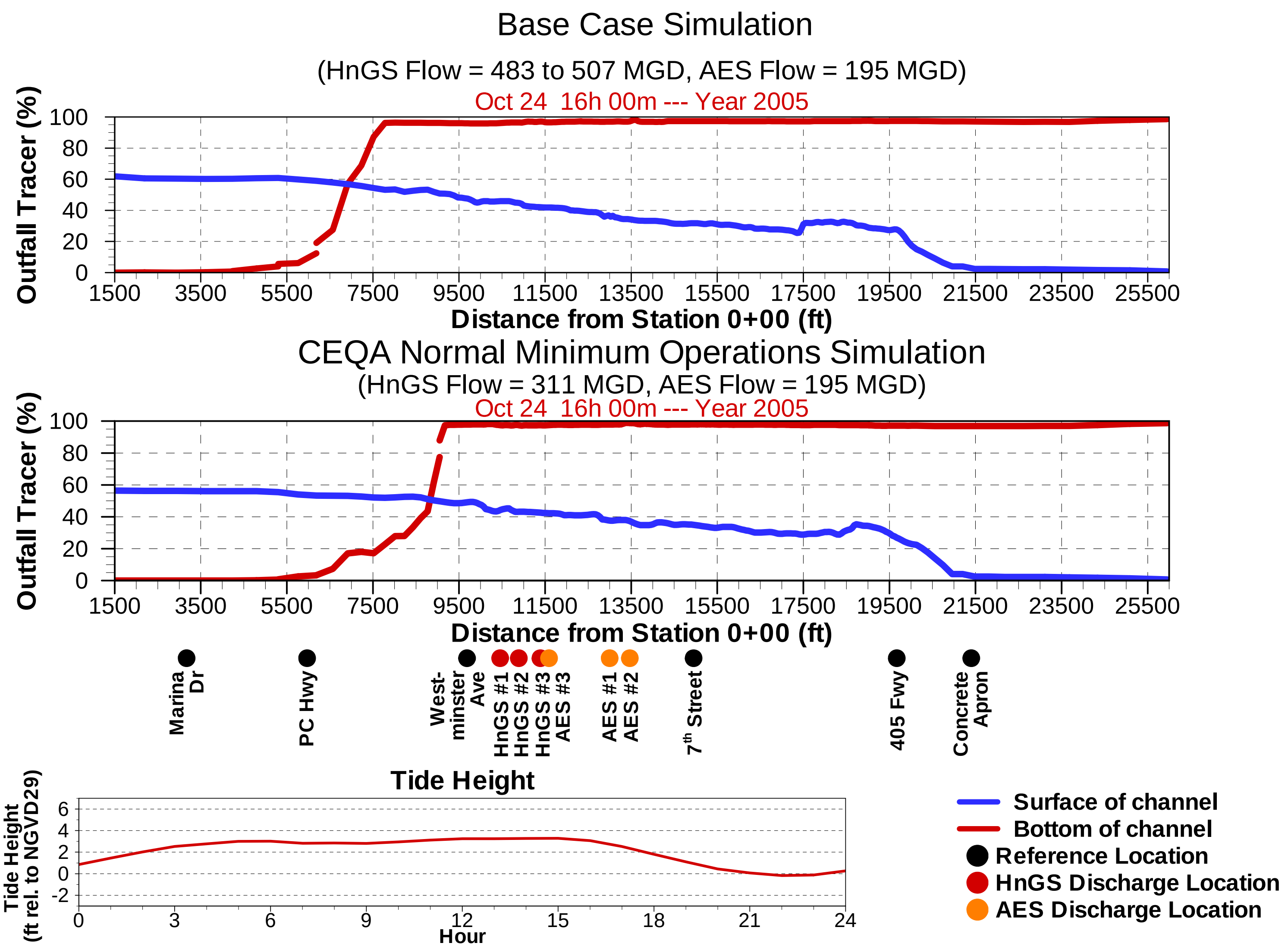
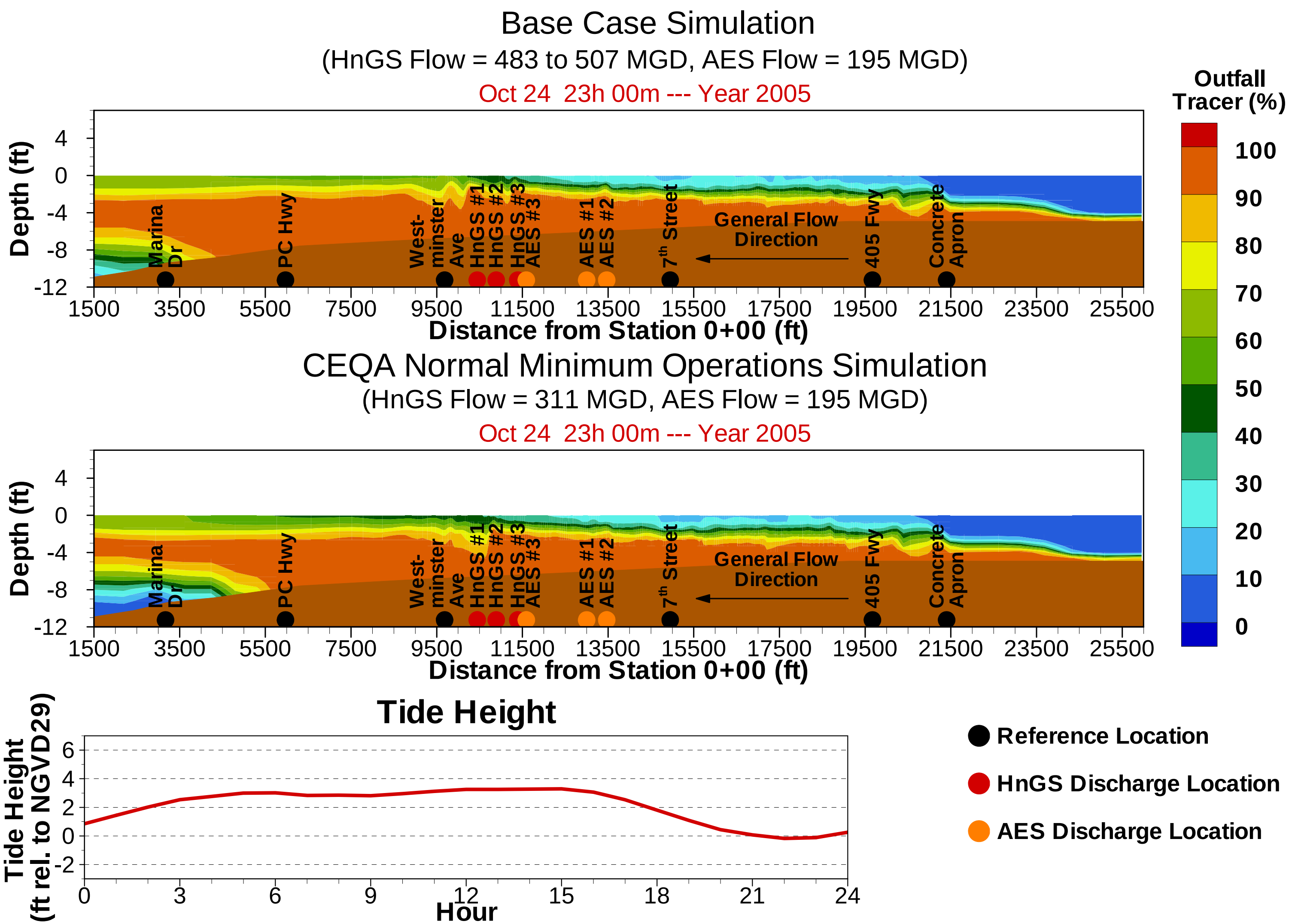


Figure 4.27

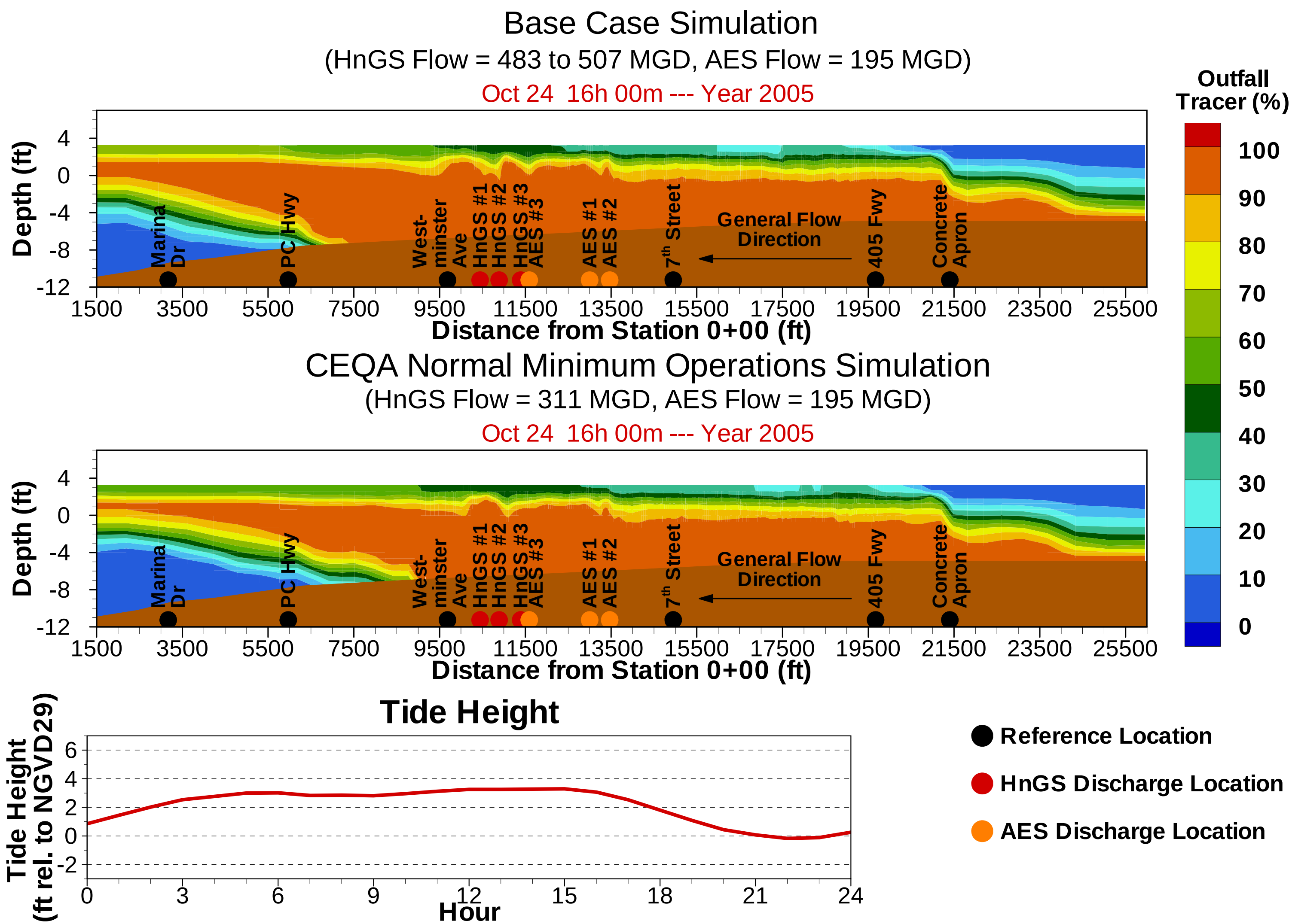
Lower San Gabriel River Outfall Tracer

Low Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct



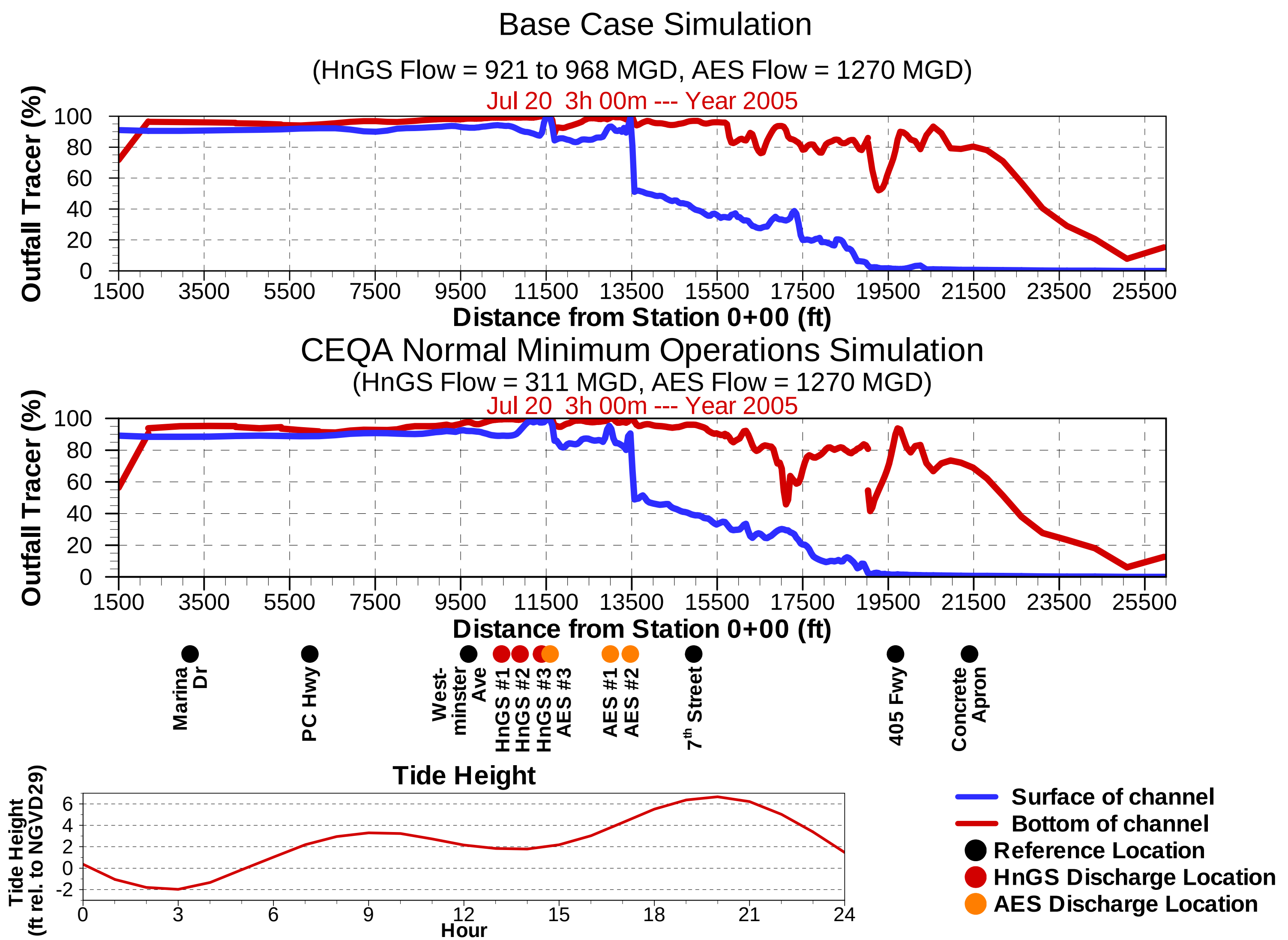
Lower San Gabriel River Outfall Tracer
High Tide October 24, 2005
Simulations: 2005 A1 & CEQA NMO Oct



Lower San Gabriel River Outfall Tracer

Low Tide July 20, 2005

Simulations: 2005 A2 & CEQA NMO July



Lower San Gabriel River Outfall Tracer

High Tide July 20, 2005

Simulations: 2005 A2 & CEQA NMO July

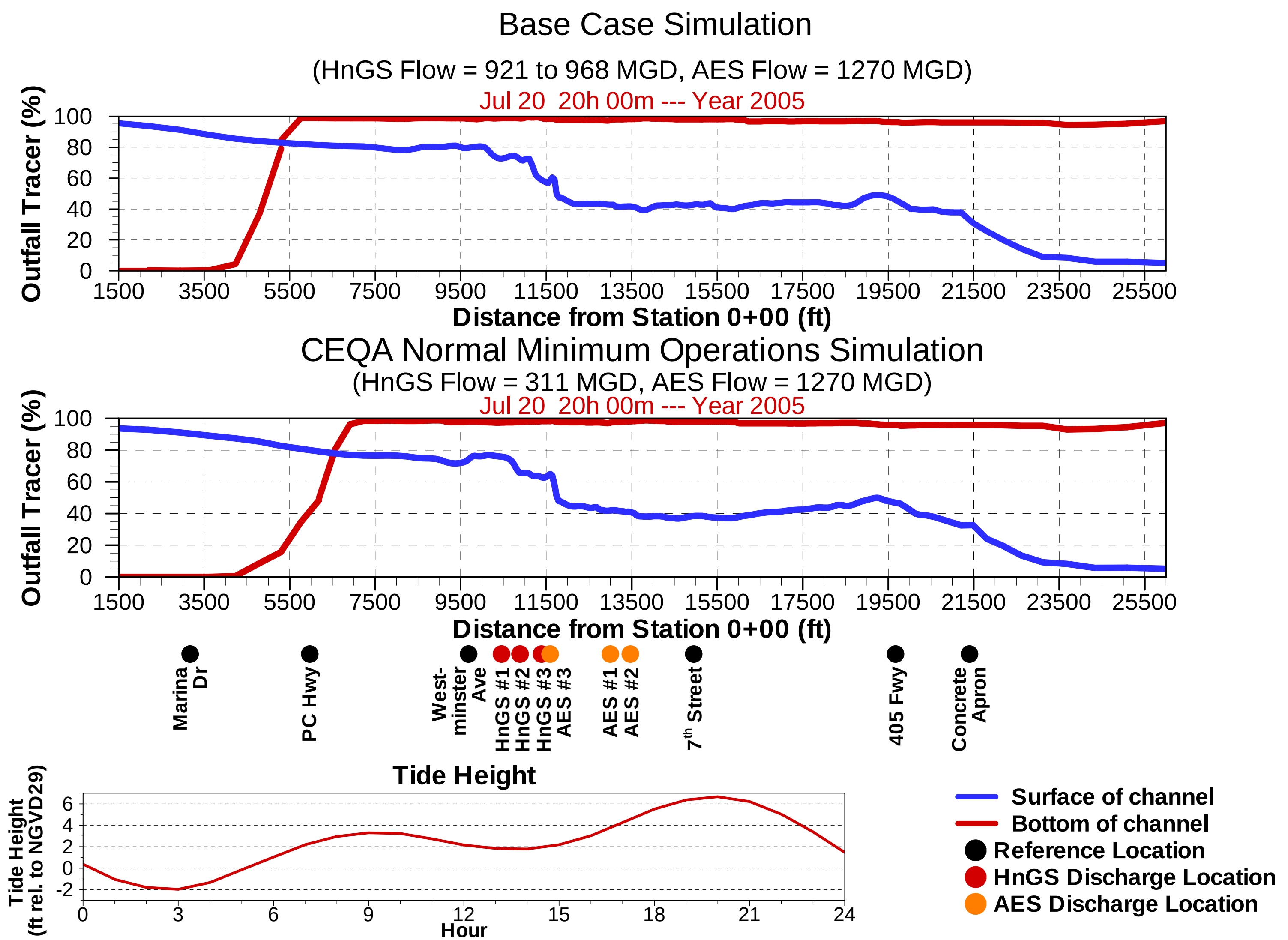


Figure 4.31

Lower San Gabriel River Outfall Tracer

Low Tide July 20, 2005

Simulations: 2005 A2 & CEQA NMO July

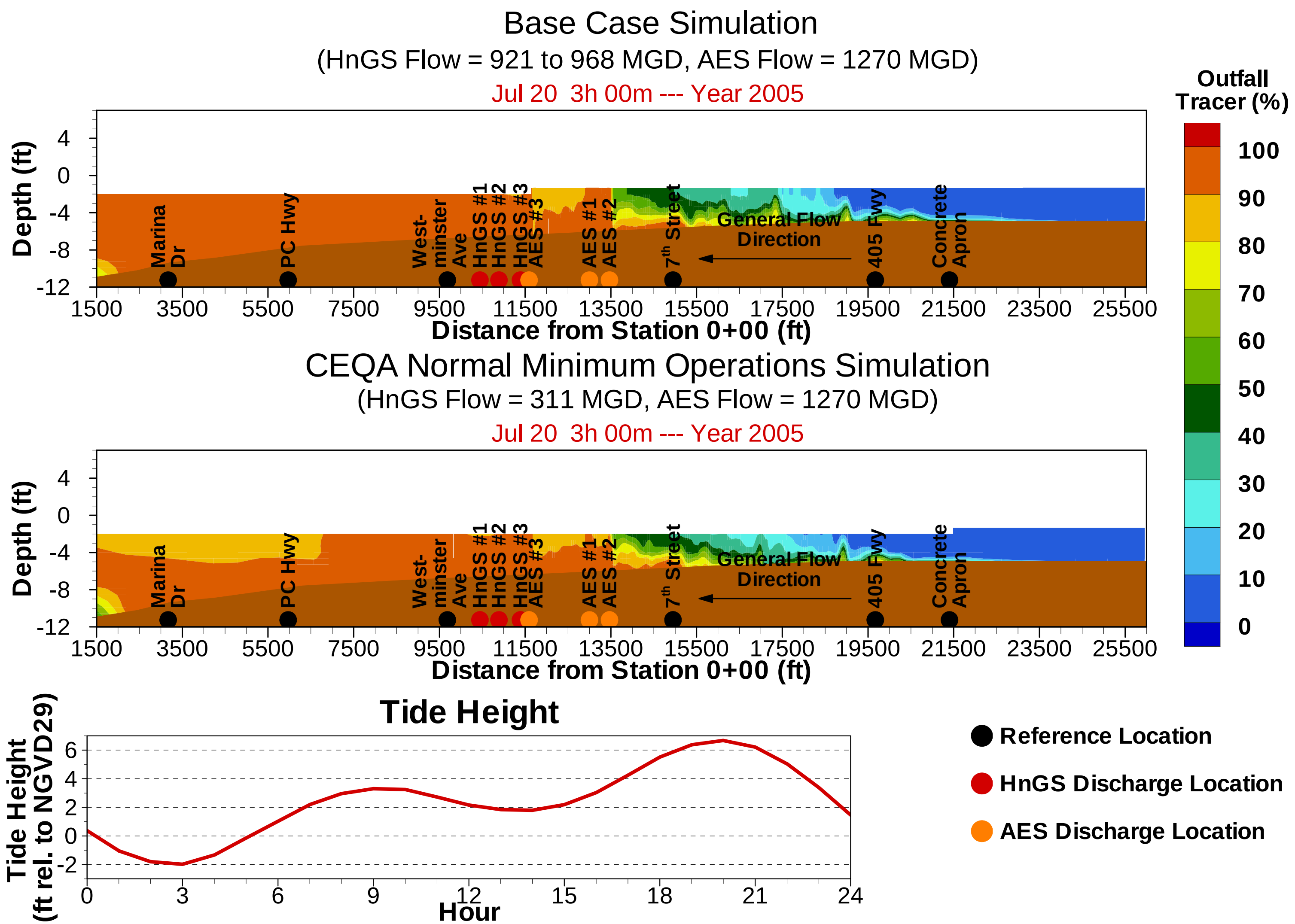


Figure 4.32

Lower San Gabriel River Outfall Tracer

High Tide July 20, 2005

Simulations: 2005 A2 & CEQA NMO July

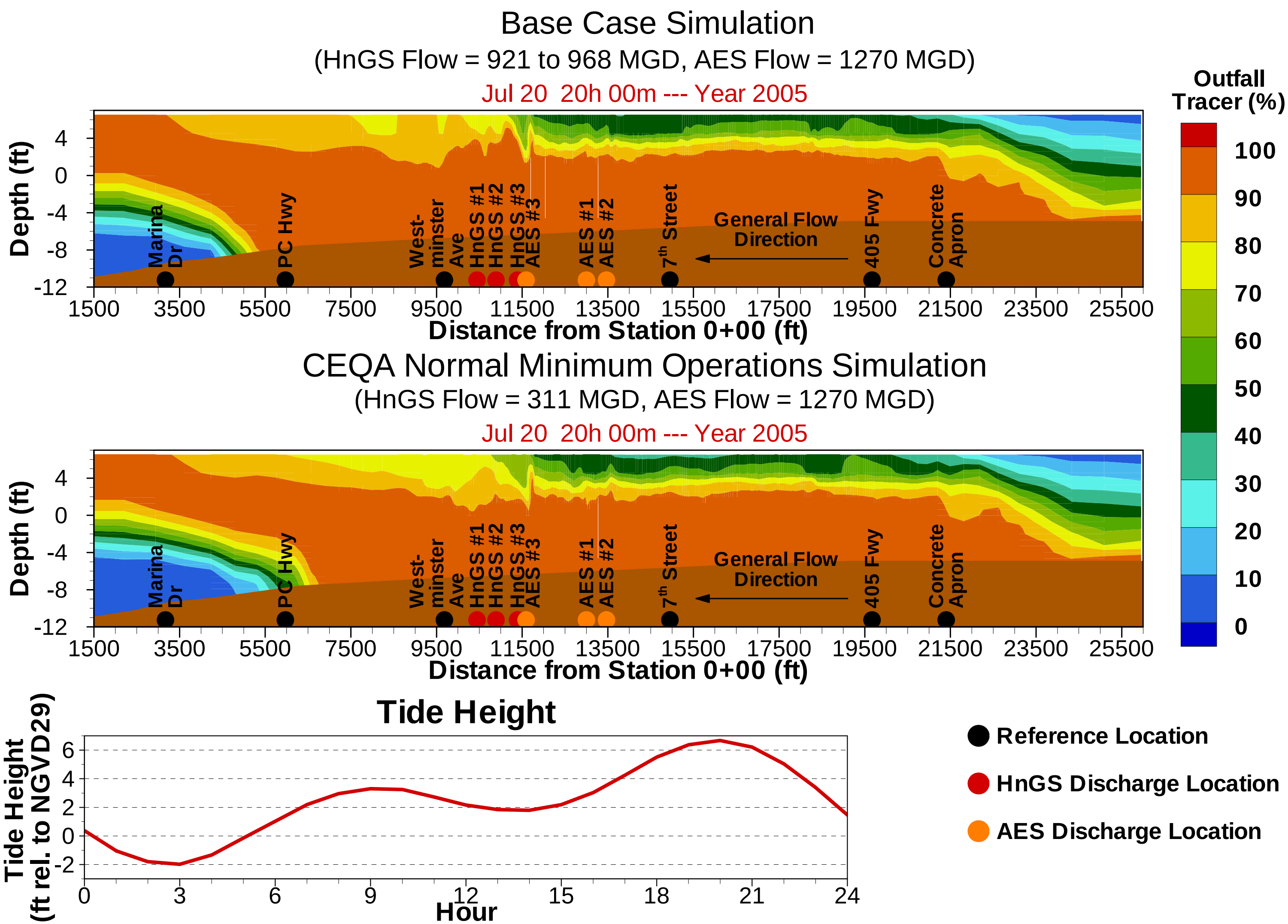
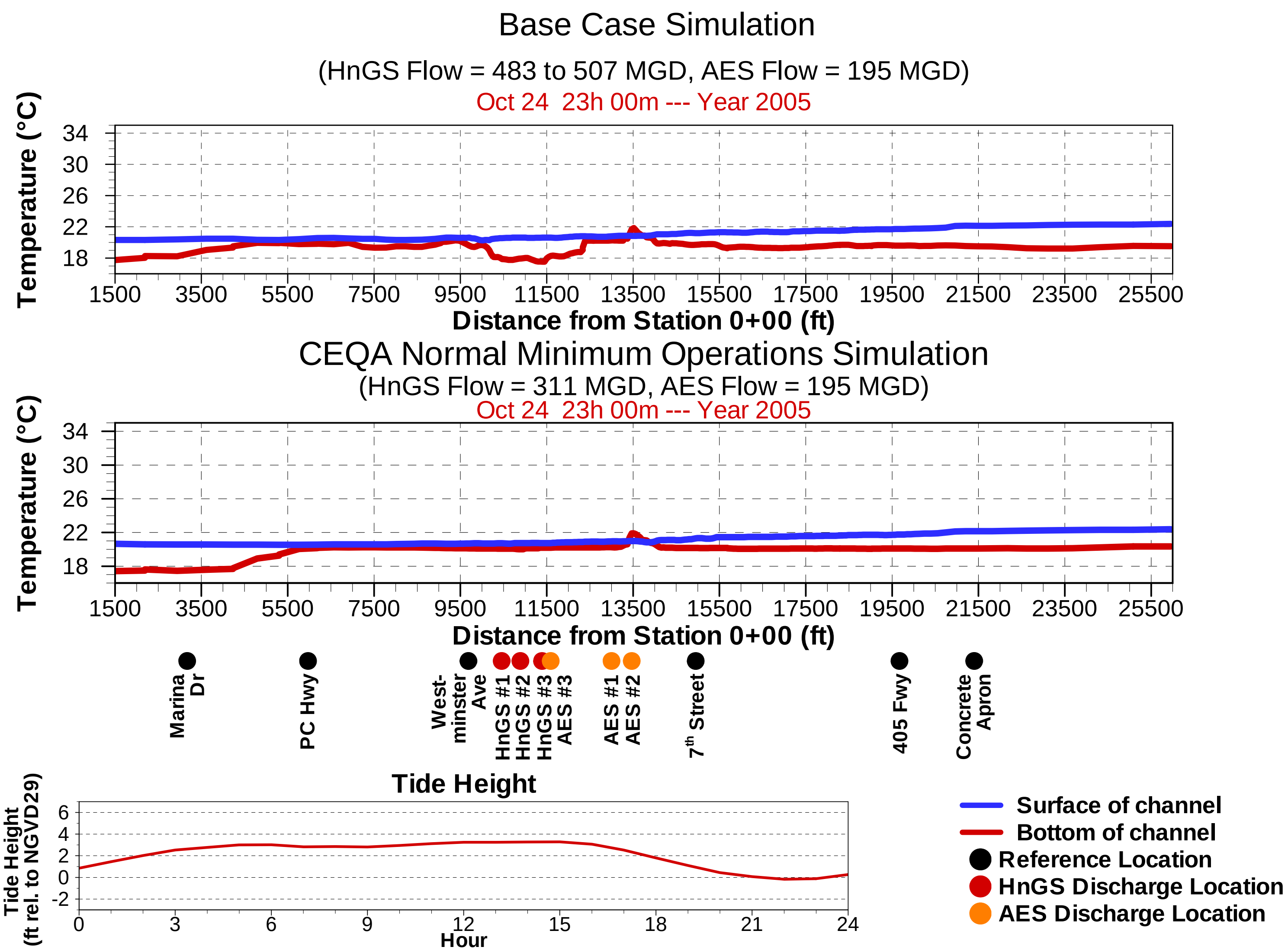


Figure 4.33

Lower San Gabriel River Water Temperature

Low Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct



Lower San Gabriel River Water Temperature

High Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct

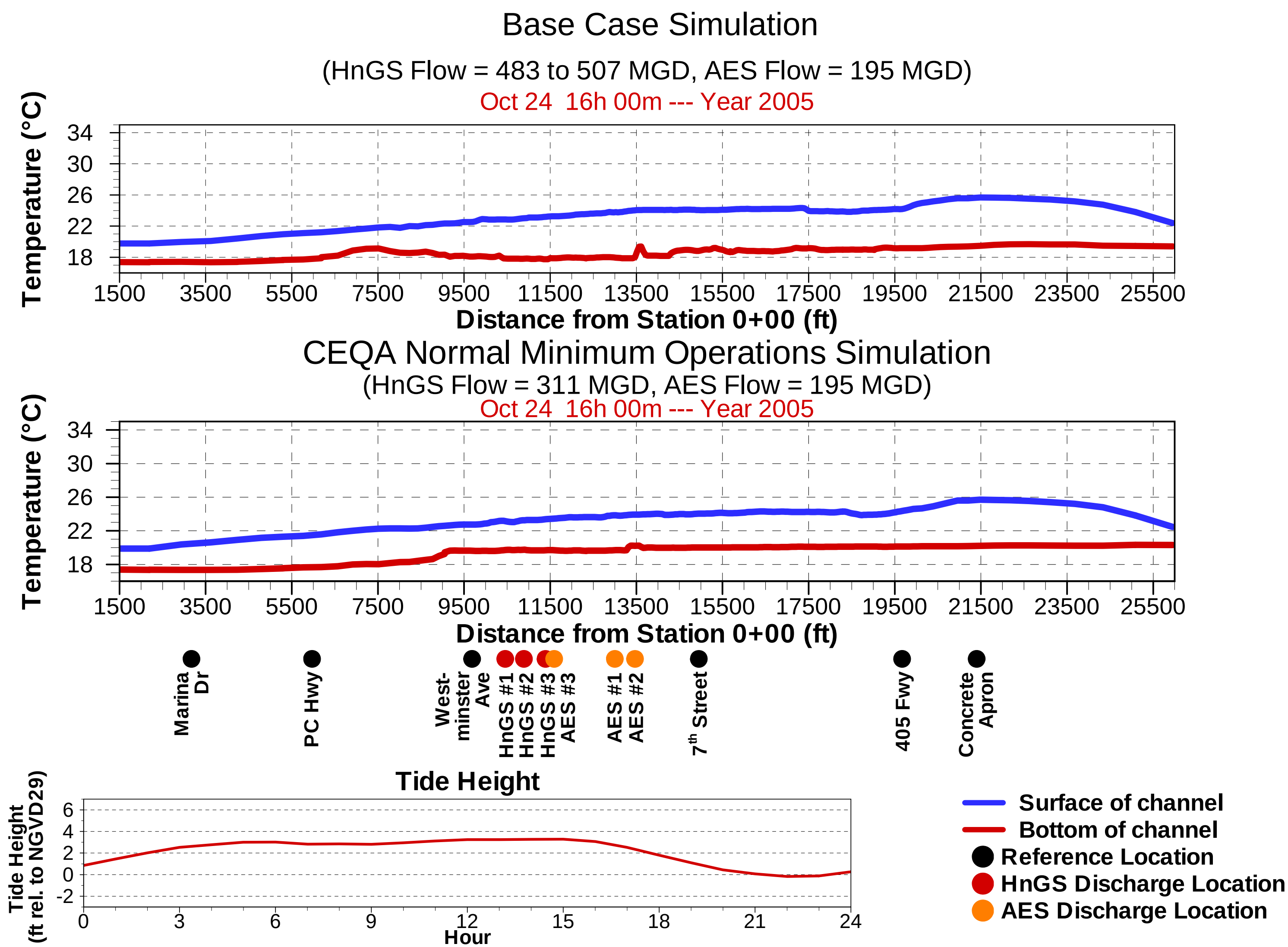


Figure 4.35

Lower San Gabriel River Water Temperature

Low Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct

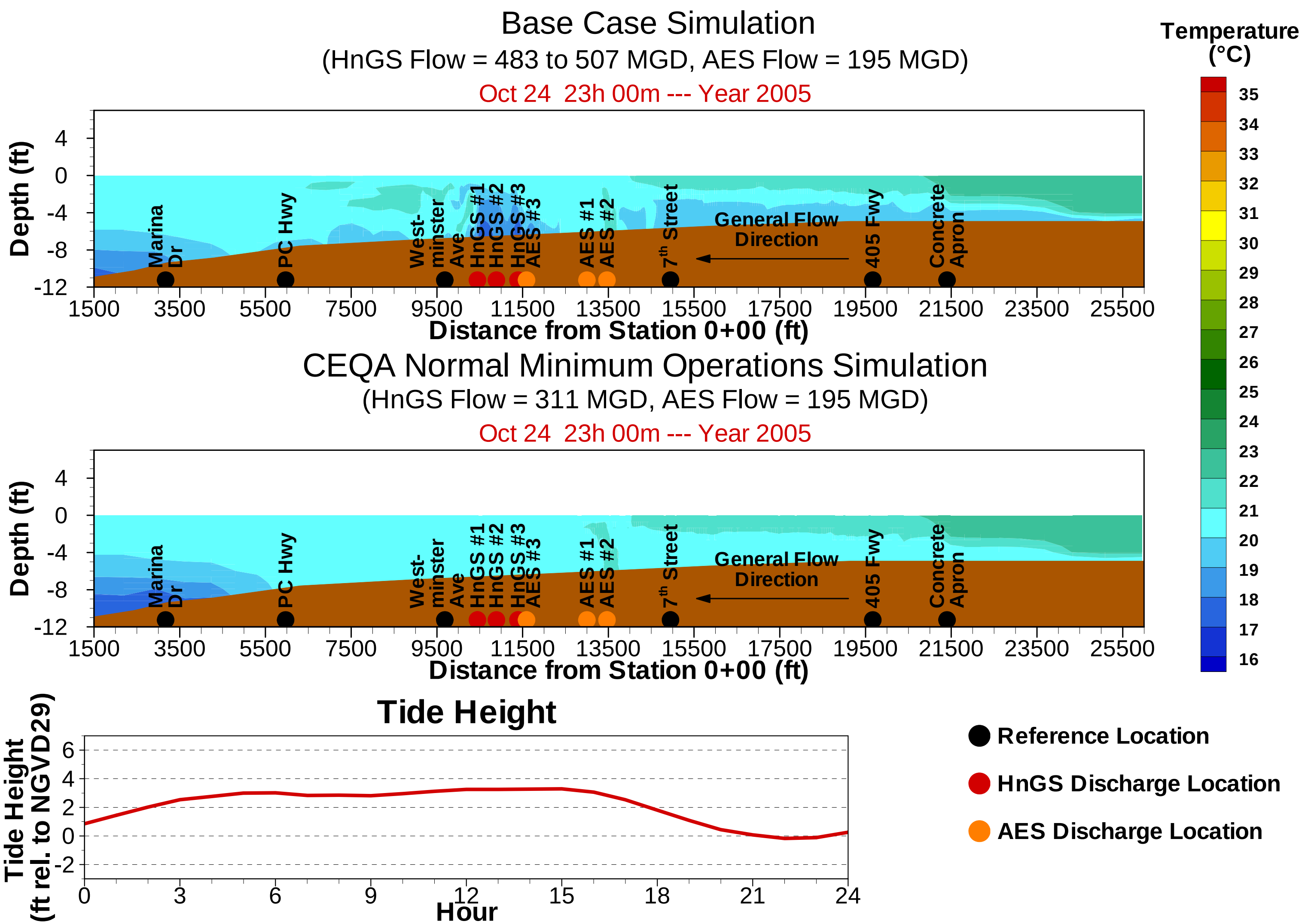


Figure 4.36

Lower San Gabriel River Water Temperature

High Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct

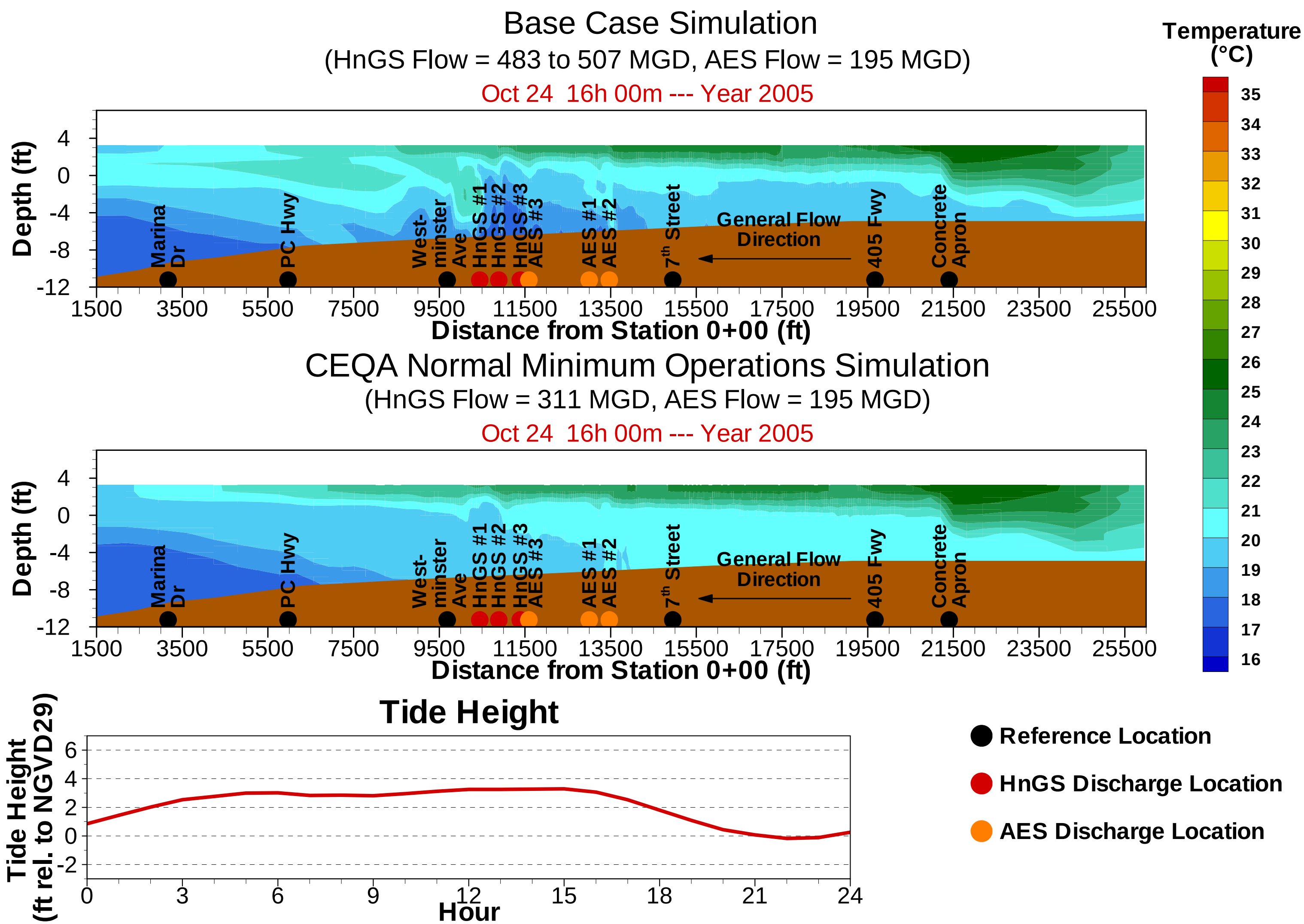


Figure 4.37

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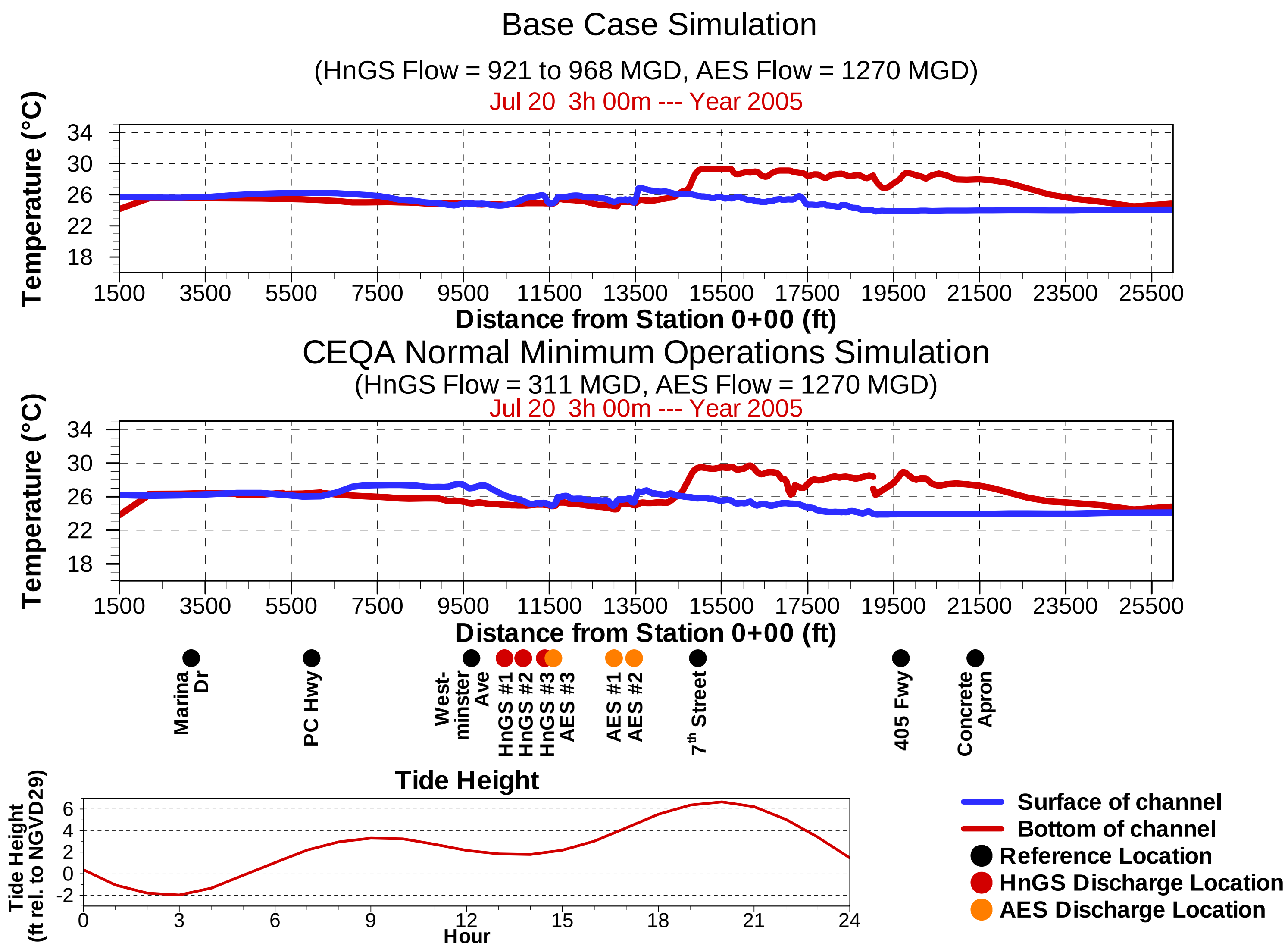
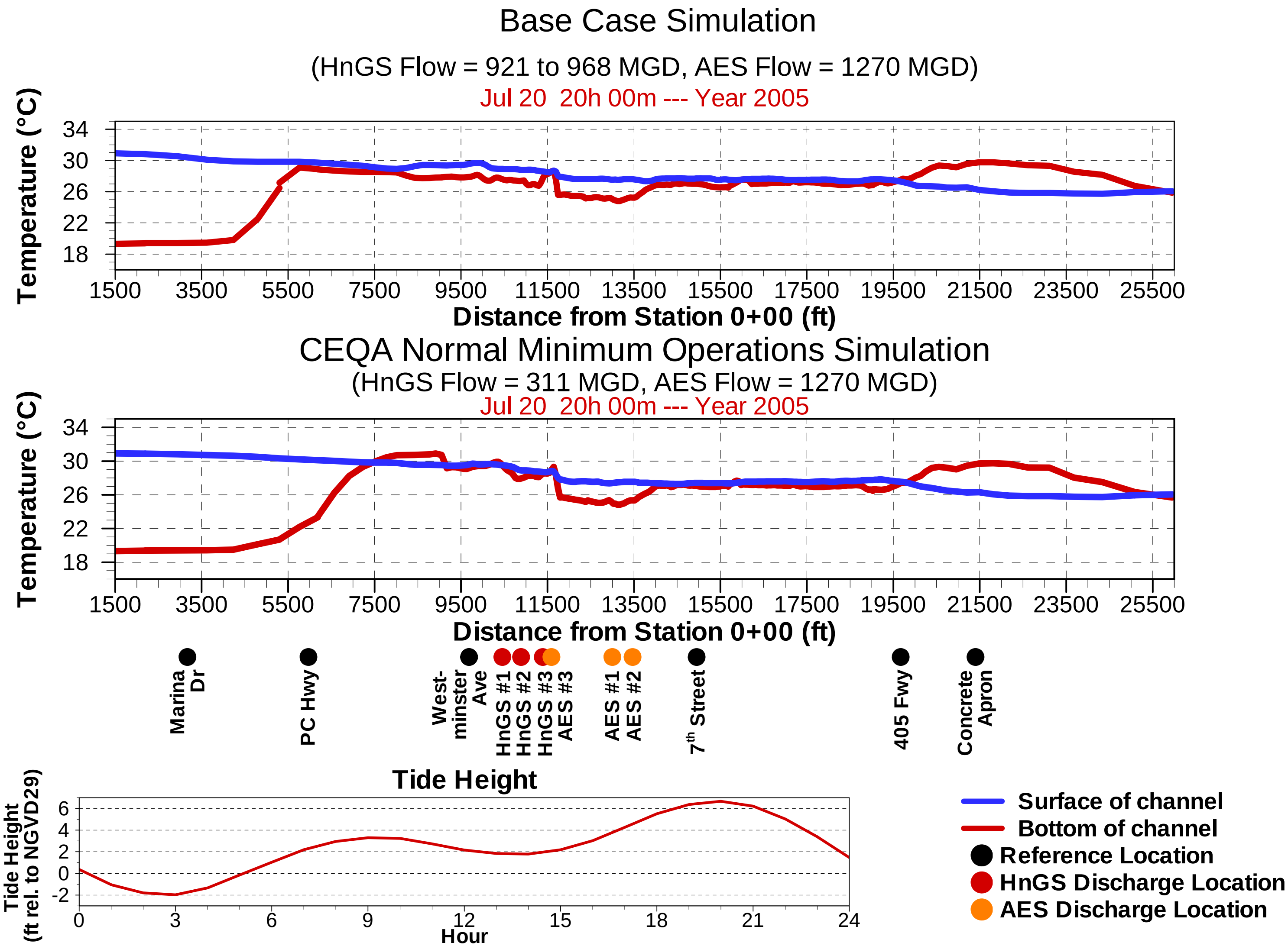
Lower San Gabriel River Water Temperature

Low Tide July 20, 2005

Simulations: 2005 A2 & CEQA NMO July



Lower San Gabriel River Water Temperature
High Tide July 20, 2005
Simulations: 2005 A2 & CEQA NMO July



Lower San Gabriel River Water Temperature

Low Tide July 20, 2005

Simulations: 2005 A2 & CEQA NMO July

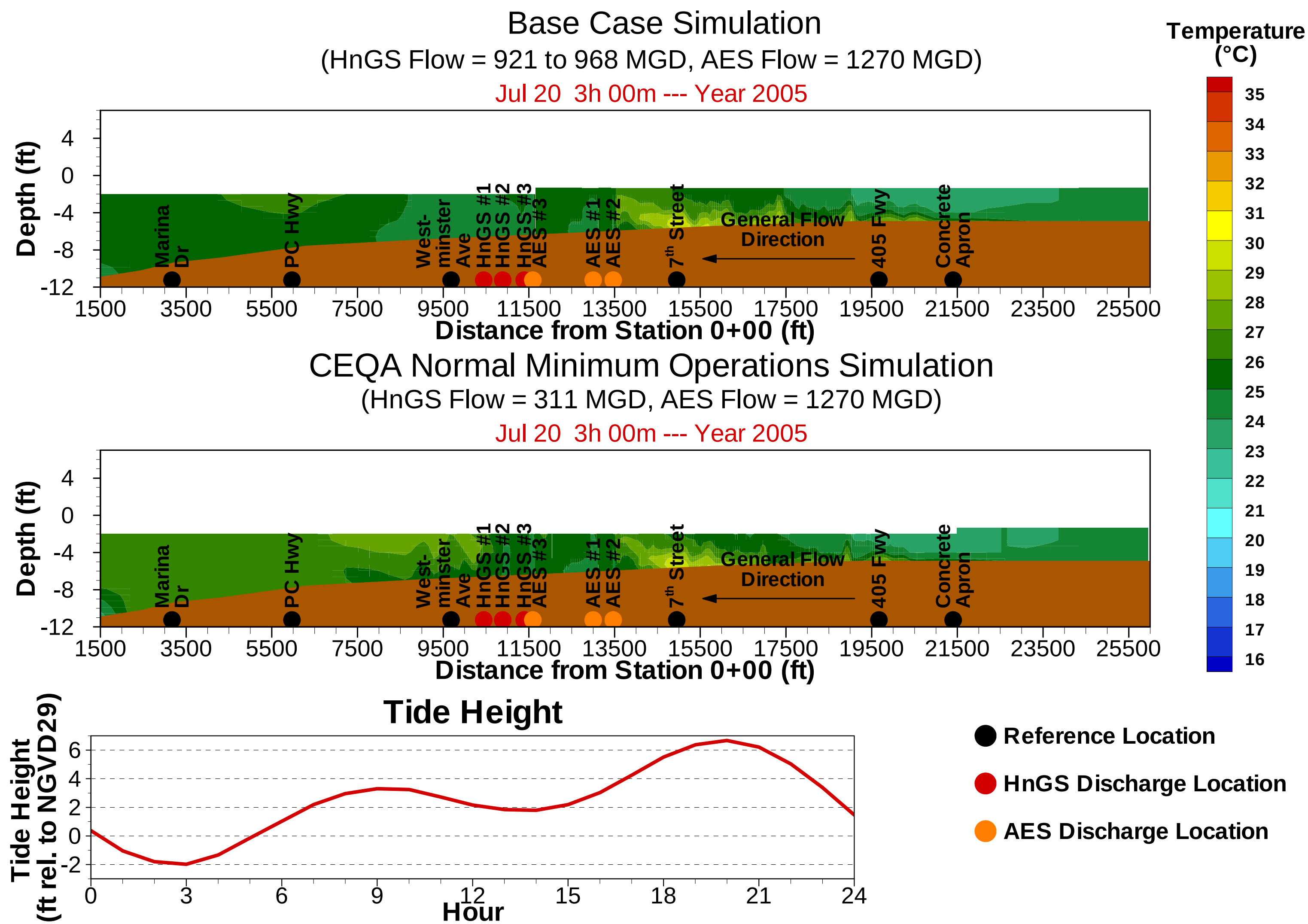
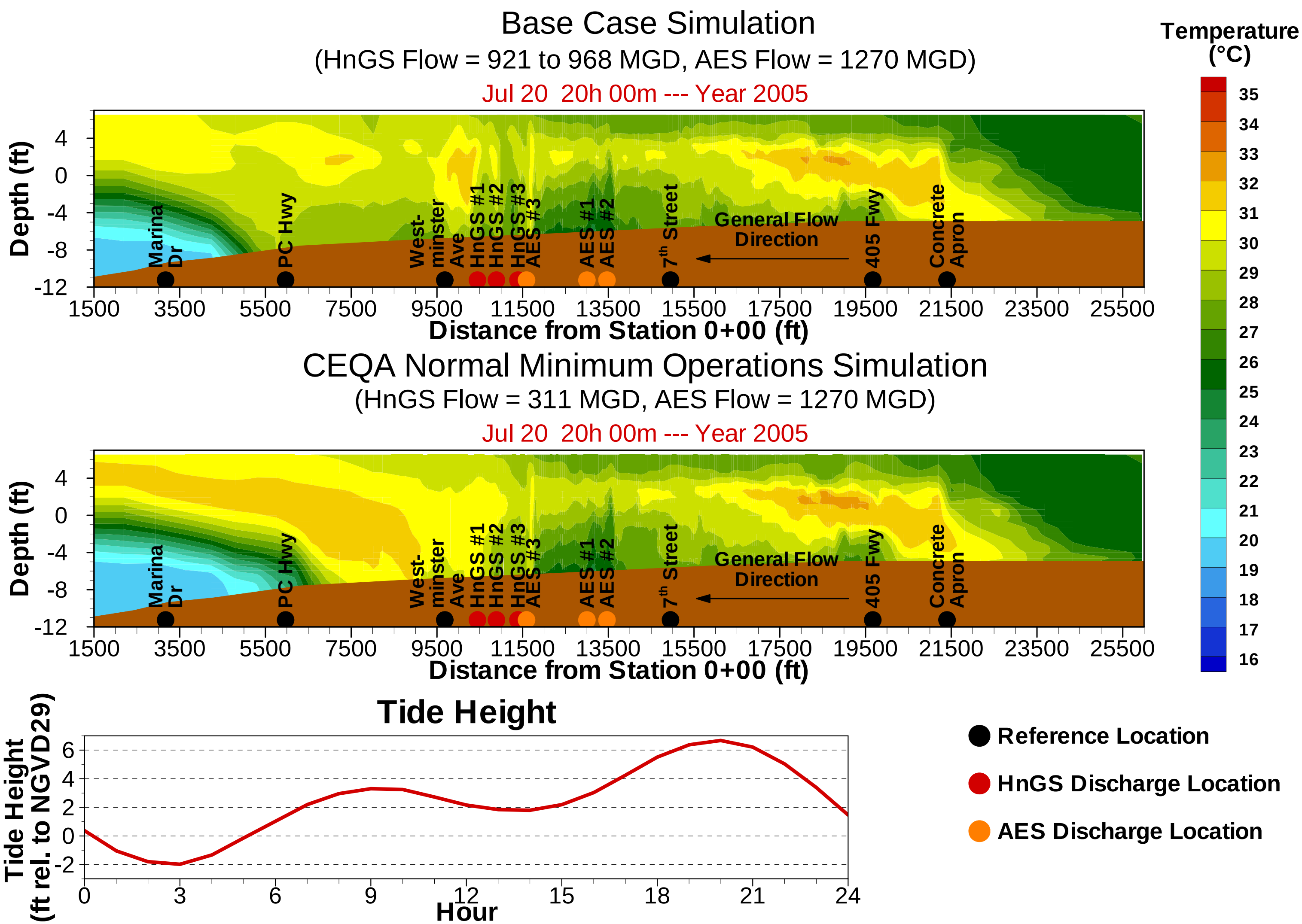


Figure 4.40

Lower San Gabriel River Water Temperature

Low Tide July 20, 2005

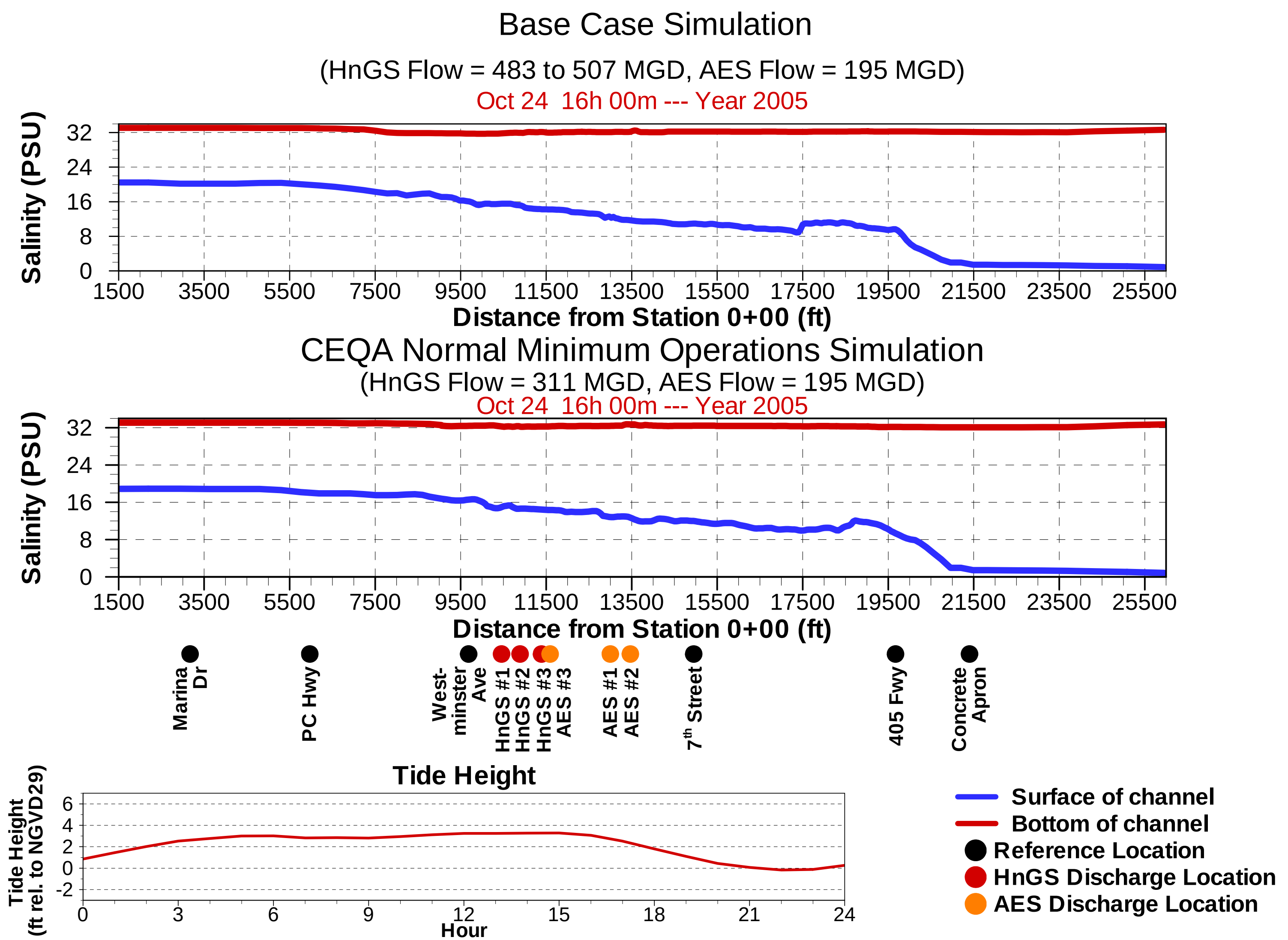
Simulations: 2005 A2 & CEQA NMO July



Lower San Gabriel River Salinity

Low Tide October 24, 2005

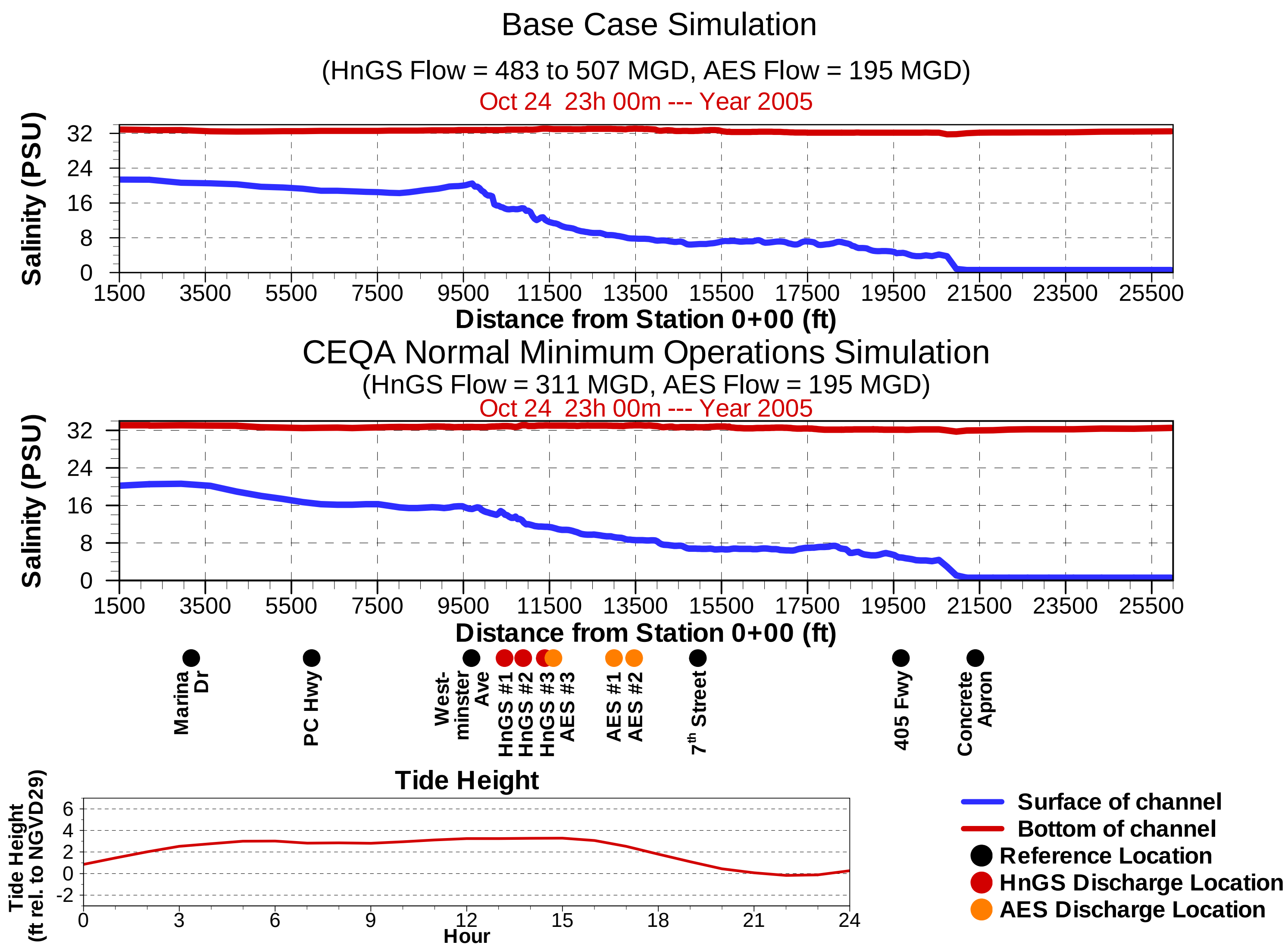
Simulations: 2005 A1 & CEQA NMO Oct



Lower San Gabriel River Salinity

High Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct



Lower San Gabriel River Salinity

Low Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct

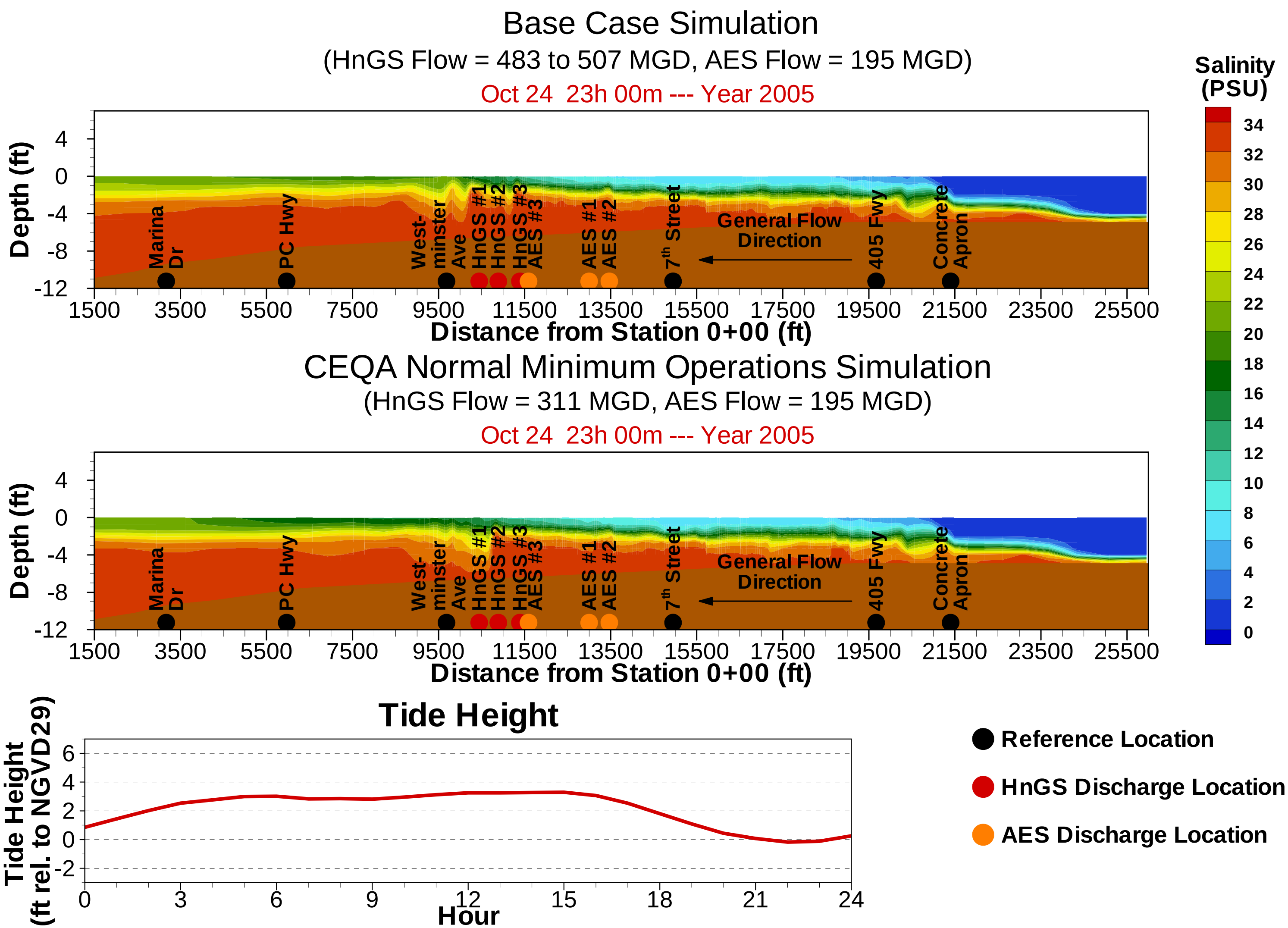


Figure 4.44

Lower San Gabriel River Salinity

High Tide October 24, 2005

Simulations: 2005 A1 & CEQA NMO Oct

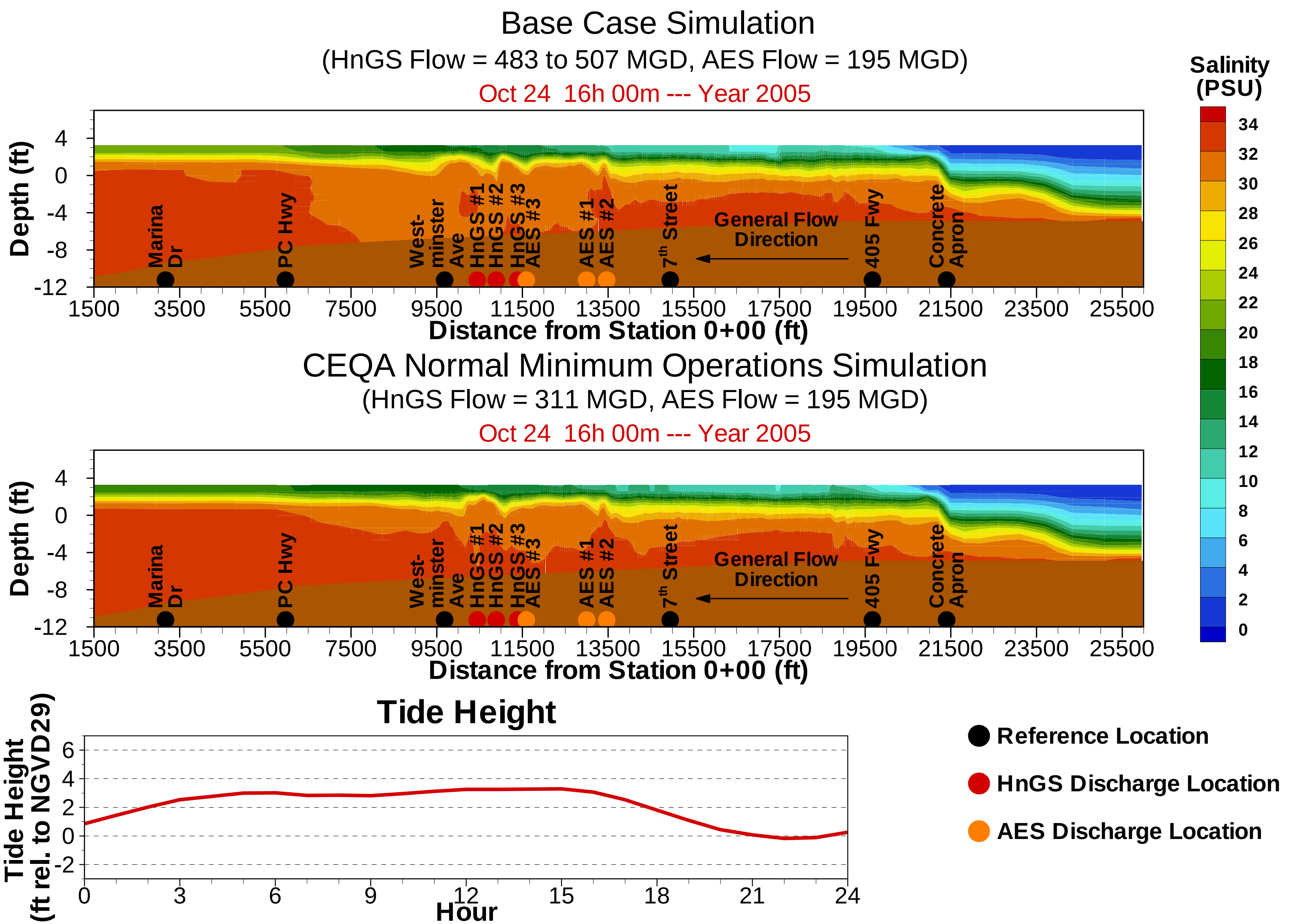


Figure 4.45

Lower San Gabriel River Salinity

Low Tide July, 2005

Simulations: 2005 A2 & CEQA NMO July

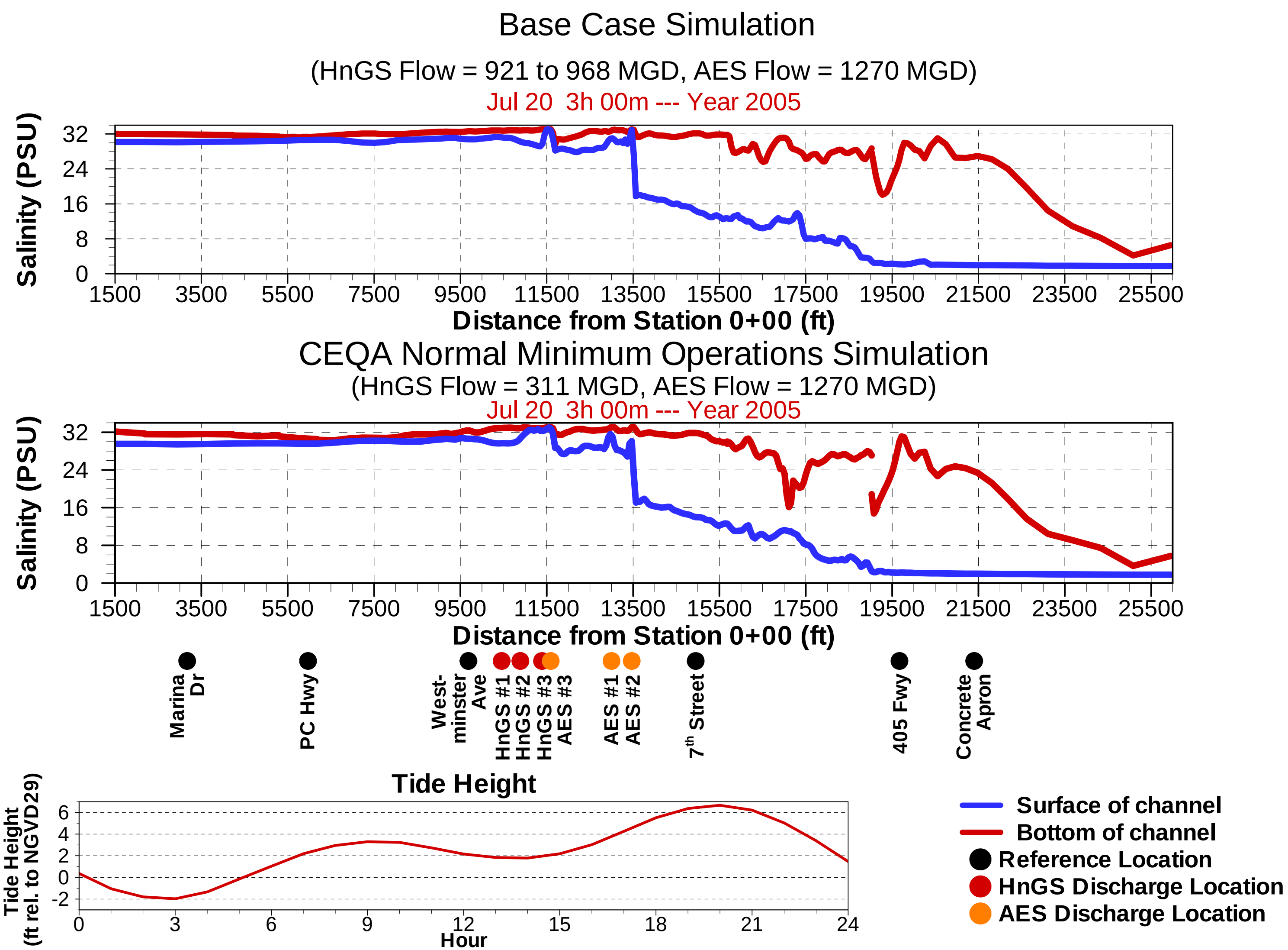
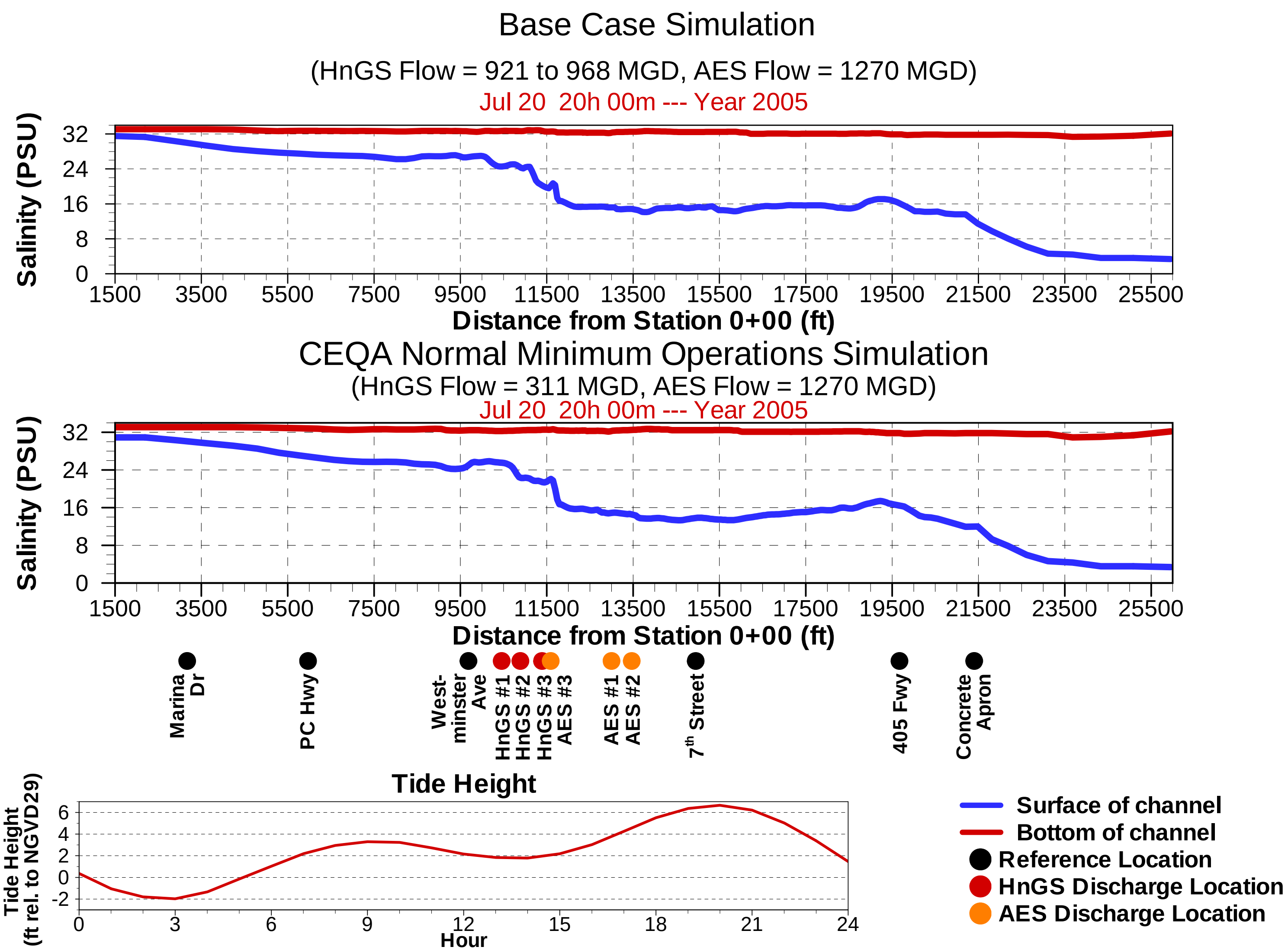


Figure 4.46

Lower San Gabriel River Salinity

High Tide July, 2005

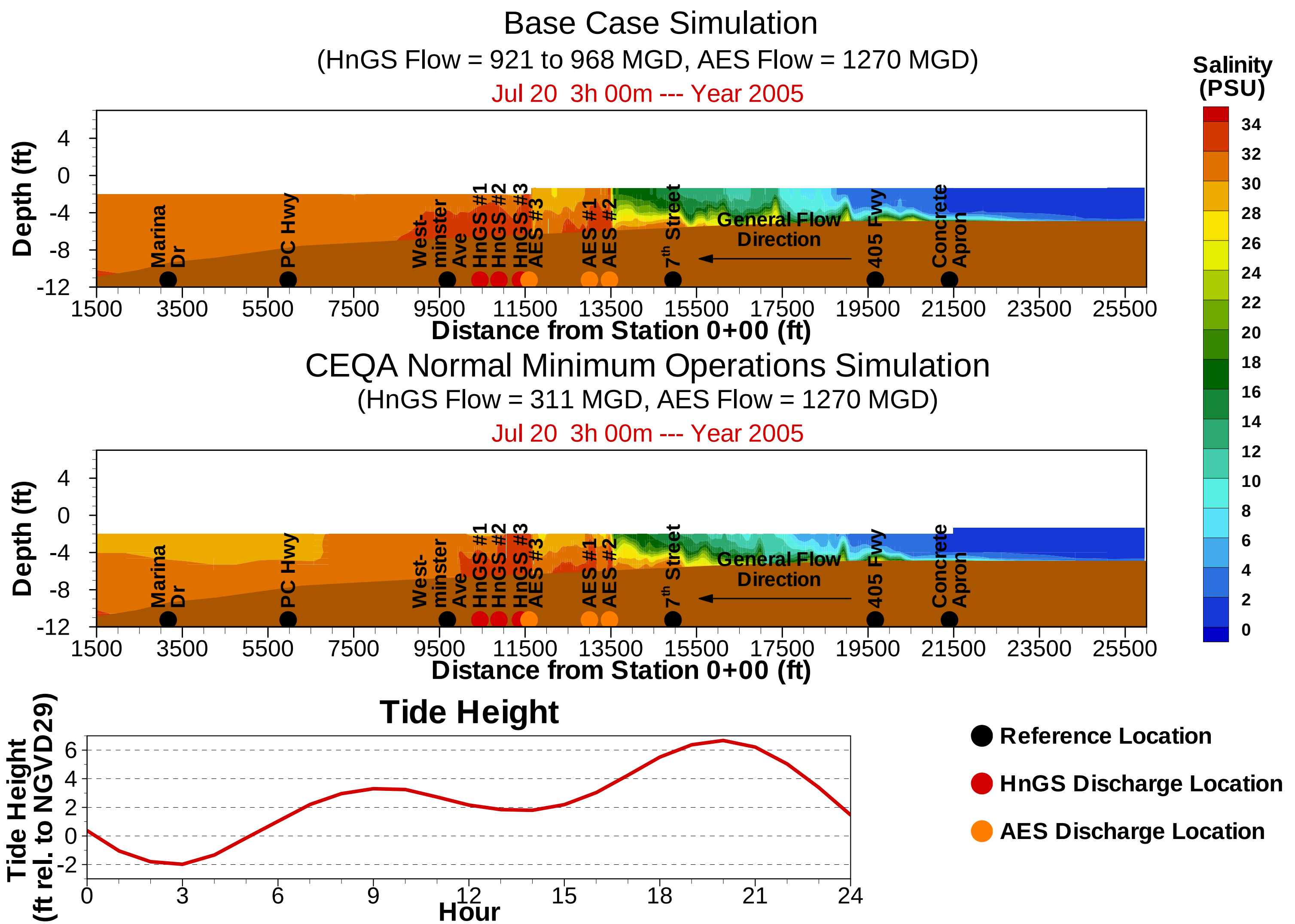
Simulations: 2005 A2 & CEQA NMO July



Lower San Gabriel River Salinity

Low Tide July, 2005

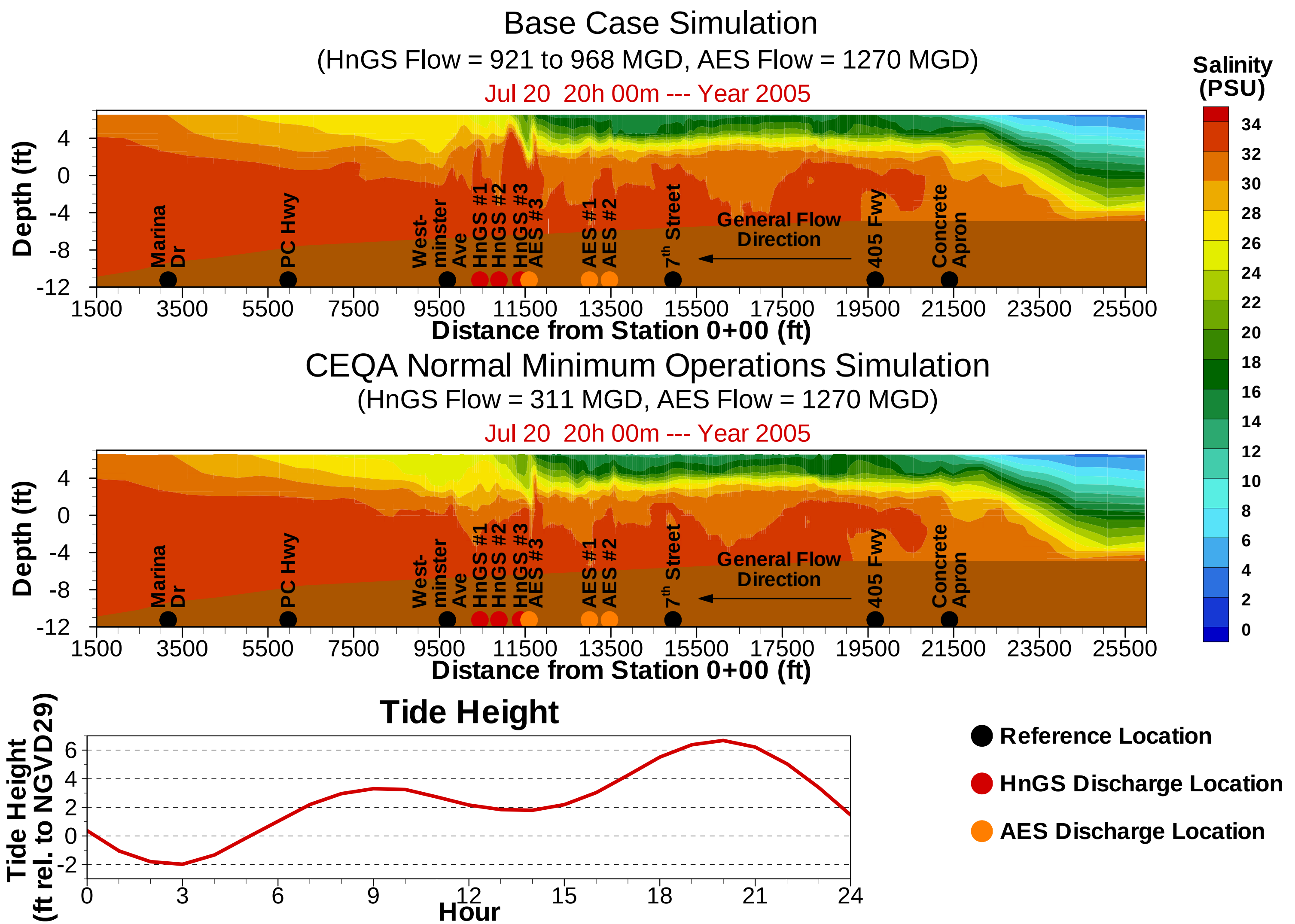
Simulations: 2005 A2 & CEQA NMO July



Lower San Gabriel River Salinity

High Tide July, 2005

Simulations: 2005 A2 & CEQA NMO July



APPENDIX A

Description of ELCOM and CAEDYM

APPENDIX A: DESCRIPTION OF ELCOM/CAEDYM MODELS AND EVIDENCE OF VALIDATION

1 INTRODUCTION

The purpose of this document is to demonstrate that the Estuary Lake and Coastal Ocean Model (ELCOM) is an accepted model that has been systematically tested and debugged, and then successfully validated in numerous applications. A history of the model is provided, followed by an outline of the general model methodology and evolution that emphasizes the basis of the ELCOM code in previously validated models and research. Then the process of code development, testing, and validation of ELCOM is detailed. Specific model applications are described to illustrate how the ELCOM model have been applied to coastal oceans, estuaries, lakes, and rivers throughout the world and the results successfully validated against field data. Finally, a general description of the governing equations, numerical models, and processes used in the models is provided along with an extensive bibliography of supporting material.

A comprehensive description of the equations and methods used in the model is provided in the "Estuary Lake and Coastal Ocean Model: ELCOM v2.2 Science Manual" by Hodges and Dallimore (2006) and "Estuary Lake and Coastal Ocean Model: ELCOM v2.2 User Manual" by Hodges and Dallimore (2007).

2 MODEL HISTORY

The ELCOM model was originally developed at the Centre for Water Research (CWR) at the University of Western Australia. It is an outgrowth of a hydrodynamic model developed earlier by Professor Vincenzo Casulli in Italy and now in use at Stanford University under the name TRIM-3D.

The original ELCOM model, as developed by CWR, was implemented in Fortran 90 (with F95 extensions) on a UNIX computer system platform. In 2001, the code was ported to a personal computer (PC) platform through an extensive recompiling and debugging effort by Flow Science Incorporated (Flow Science) in Pasadena, California.

3 MODEL METHODOLOGY

The numerical method used in ELCOM is based on the TRIM-3D model scheme of Casulli and Cheng (1992) with adaptations made to improve accuracy, scalar conversion, numerical diffusion, and implementation of a mixed-layer model. The ELCOM model also extends the TRIM-3D scheme by including conservative advection of scalars. The unsteady Reynolds-averaged, Navier-Stokes equations, and the scalar transport equations serve as the basis of ELCOM. The pressure distribution is assumed hydrostatic and density changes do not impact the inertia of the fluid (the Boussinesq approximation), but are considered in the fluid body forces. There is an eddy-viscosity approximation for the horizontal turbulence correlations that represent the turbulent momentum transfer. Vertical momentum transfer is handled by a Richardson number-based diffusion coefficient. Since numerical diffusion generally dominates molecular processes, molecular diffusion in the vertical direction is neglected in ELCOM.

Both ELCOM and TRIM-3D are three-dimensional, computational fluid dynamics (CFD) models. CFD modeling is a validated and well-established approach to solving the equations of fluid motions in a variety of disciplines. Prior to the development of TRIM-3D, there were difficulties in modeling density stratified flows and such flows required special numerical methods. With TRIM-3D, Casulli and Cheng (1992) developed the first such successful method to model density-stratified flows, such as occur in the natural environment. Since then, TRIM-3D has been validated by numerous publications. ELCOM is based on the same proven method, but incorporates additional improvements as described above. Furthermore, the ELCOM model is based on governing equations and numerical algorithms that have been used in the past (*e.g.*, in validated models such as TRIM-3D), and have been validated in refereed publications. For example:

- The hydrodynamic algorithms in ELCOM are based on the Euler-Lagrange method for advection of momentum with a conjugate gradient solution for the free-surface height (Casulli and Cheng, 1992).

- The free-surface evolution is governed by vertical integration of the continuity equation for incompressible flow applied to the kinematic boundary condition (*e.g.*, Kowalik and Murty, 1993).

- The numerical scheme is a semi-implicit solution of the hydrostatic Navier-Stokes equations with a quadratic Euler-Lagrange, or semi-Lagrangian (Staniforth and Côté, 1991).

- Passive and active scalars (*i.e.*, tracers, salinity, and temperature) are advected using a conservative ULTIMATE QUICKEST discretization (Leonard, 1991). The ULTIMATE QUICKEST approach has been implemented in two-dimensional format and demonstration of its effectiveness in estuarine flows has been documented by Lin and Falconer (1997).

- Heat exchange is governed by standard bulk transfer models found in the literature (e.g., Amorocho and DeVries, 1980; Imberger and Patterson, 1981; Jacquet, 1983).

- The vertical mixing model is based on an approach derived from the mixing energy budgets used in one-dimensional lake modeling as presented in Imberger and Patterson (1981), Spigel et al (1986), and Imberger and Patterson (1990). Furthermore, Hodges presents a summary of validation using laboratory experiments of Stevens and Imberger (1996). This validation exercise demonstrates the ability of the mixed-layer model to capture the correct momentum input to the mixed-layer and reproduce the correct basin-scale dynamics, even while boundary-induced mixing is not directly modeled.

- The wind momentum model is based on a mixed-layer model combined with a model for the distribution of momentum over depth (Imberger and Patterson, 1990).

The numerical approach and momentum and free surface discretization used in ELCOM are defined in more detail in Hodges, Imberger, Saggio, and Winters (1999). Further technical details on ELCOM are provided in Sections 5 below.

4 VALIDATION AND APPLICATION OF ELCOM

Since initial model development, testing and validation of ELCOM have been performed and numerous papers on model applications have been presented, written, and/or published as described in more detail below. In summary:

- ELCOM solves the full three-dimensional flow equations with small approximations.

- ELCOM was developed, tested, and validated over a variety of test cases and systems by CWR.

- Papers on ELCOM algorithms, methodology, and applications have been published in peer reviewed journals such as the *Journal of Geophysical Research*, the *Journal of Fluid Mechanics*, the *Journal of Hydraulic Engineering*, the *International Journal for Numerical Methods in Fluids*, and *Limnology and Oceanography*.

- ELCOM/CAEDYM (CAEDYM stands for the Computational Aquatic Ecosystem Dynamics Model and is a water quality module developed at CWR) was applied by Flow Science to Lake Mead, Nevada. As part of this application, mass balances were verified and results were presented to a model review panel over a two-year period. The model review panel, the National Park Service, the Bureau of Reclamation, the Southern Nevada Water Authority, and the Clean Water Coalition (a consortium of water and wastewater operators in the Las Vegas, Nevada, region) all accepted the ELCOM model use and validity.

- There are numerous applications of ELCOM/CAEDYM in the literature that compare the results to data, as summarized in Section 4.2.

The process of code development, testing, and validation of ELCOM by CWR, and the ongoing validation and refinement of the codes through further application of the models are detailed in the following subsections.

4.1 CWR CODE DEVELOPMENT, TESTING, AND VALIDATION

Initial development of the code by CWR occurred from March through December 1997 (Phase 1), followed by a period of testing and validation from January through April 1998 (Phases 2 and 3). Secondary code development by CWR occurred from September 1998 through February 1999 (Phase 4). Testing and validation were performed over a variety of test cases and systems to ensure that all facets of the code were tested. In addition, Phase 5 modeling of the Swan River since 1998 has been used to gain a better understanding of the requirements and limitations of the model (Hodges et al, 1999).

4.1.1 Phase 1: Initial Code Development

The ELCOM code was initially conceived by CWR as a Fortran 90/95 adaptation of the TRIM-3D model of Casulli and Cheng (1992) in order to: 1) link directly to the CAEDYM water quality module developed concurrently at CWR and 2) provide a basis for future development in a modern programming language. Although written in Fortran 77, TRIM-3D is considered a state-of-the-art numerical model for estuarine applications using a semi-implicit discretization of the Reynolds-averaged hydrostatic Navier-Stokes equations and an Euler-Lagrange method for momentum and scalar transport.

During development of ELCOM, it became clear that additional improvements to the TRIM-3D algorithm were required for accurate solution of density-stratified flows in estuaries. After the basic numerical algorithms were written in Fortran 90, subroutine-by-subroutine debugging was performed to ensure that each subroutine produced the expected results. Debugging and testing of the entire model used a series of test cases that exercised the individual processes in simplified geometries. This included test cases for the functioning of the open boundary condition (tidal forcing), surface wave propagation, internal wave propagation, scalar transport, surface thermodynamics, density underflows, wind-driven circulations, and flooding/drying of shoreline grid cells. Shortcomings identified in the base numerical algorithms were addressed during secondary code development (Phase 4).

Towards the end of the initial code development, ELCOM and CAEDYM were coupled and test simulations were run to calibrate the ability of the models to work together on some simplified problems. Results showing the density-driven currents induced by phytoplankton shading were presented at the Second International Symposium on Ecology and Engineering (Hodges and Herzfeld, 1997). Further details of modeling of density-driven currents due to combinations of topographic effects and phytoplankton shading were presented at a joint meeting of the American Geophysical Union (AGU) and the American Society of Limnology and Oceanography (ASLO) by Hodges et al. (1998), and at a special seminar at Stanford University (Hodges 1998). Additionally, presentations by Hamilton (1997), Herzfeld et al. (1997), and Herzfeld and Hamilton (1998) documented the concurrent development of the CAEDYM ecological model.

4.1.2 Phase 2: Testing and Validation

The simplified geometry tests of Phase I revealed deficiencies in the TRIM-3D algorithm including the inability of the TRIM-3D Euler-Lagrange method (ELM) to provide conservative transport of scalar concentrations (*e.g.*, salinity and temperature). Thus, a variety of alternate scalar transport methods were tested, with the best performance being a flux-conservative implementation of the ULTIMATE filter applied to third-order QUICKEST discretization based on the work of Leonard (1991).

Model testing and validation against simple test cases was again undertaken. In addition, a simulation of a winter underflow event in Lake Burragorang in New South Wales, Australia, was performed to examine the ability of the model to capture a density underflow in complex topography in comparison to field data taken during the inflow event. These tests showed that the ability to model underflows is severely constrained by the cross-channel grid resolution.

4.1.3 Phase 3: Swan River Destratification Model

Phase 3 involved examining a linked ELCOM/CAEDYM destratification model of the Swan River system during a period of destratification in 1997 when intensive field monitoring had been conducted. The preliminary results of this work were presented at the Swan-Canning Estuary Conference (Hertzfeld et al, 1998). More comprehensive results were presented at the Western Australian Estuarine Research Foundation (WAERF) Community Forum (Imberger, 1998).

4.1.4 Phase 4: Secondary Code Development

In conducting the Phase 3 Swan River destratification modeling, it became clear to CWR that long-term modeling of the salt-wedge propagation would require a better model for mixing dynamics than presently existed. Thus, the availability of an extensive field data set for Lake Kinneret, Israel, led to its use as a test case for development of an improved mixing algorithm for stratified flows (Hodges et al, 1999).

A further problem appeared in the poor resolution of momentum terms using the linear ELM discretization (*i.e.*, as used in the original TRIM-3D method). Since the conservative ULTIMATE QUICKEST method (used for scalar transport, see Phase 1 above) does not lend itself to efficient use for discretization of momentum terms in a semi-implicit method, a quadratic ELM approach was developed for more accurate discretization of the velocities.

4.1.5 Phase 5: Swan River Upper Reaches Model

Phases 1-4 developed and refined the ELCOM code for accurate modeling of three-dimensional hydrodynamics where the physical domain is well resolved. Phase 5 is an ongoing process of model refinement that concentrates on developing a viable approach to modeling longer-term evolution hydrodynamics and water quality in the Swan River where fine-scale resolution of the domain is not practical. The Swan River application is also used for ongoing testing and calibration of the CAEDYM water quality module.

The Swan River estuary is located on the Swan Coastal Plain, Western Australia. It is subject to moderate to high nutrient loads associated with urban and agricultural runoff and suffered from *Microcystis aeruginosa* blooms in January 2000. In an effort to find a viable means of conducting seasonal to annual simulations of the Swan River that retain the fundamental along-river physics and the cross-channel variability in water quality parameters, CWR has developed and tested ELCOM/CAEDYM extensively. A progress report by Hodges et al (1999) indicates that ELCOM is capable of accurately reproducing the hydrodynamics of the Swan River over long time scales with a reasonable computational time.

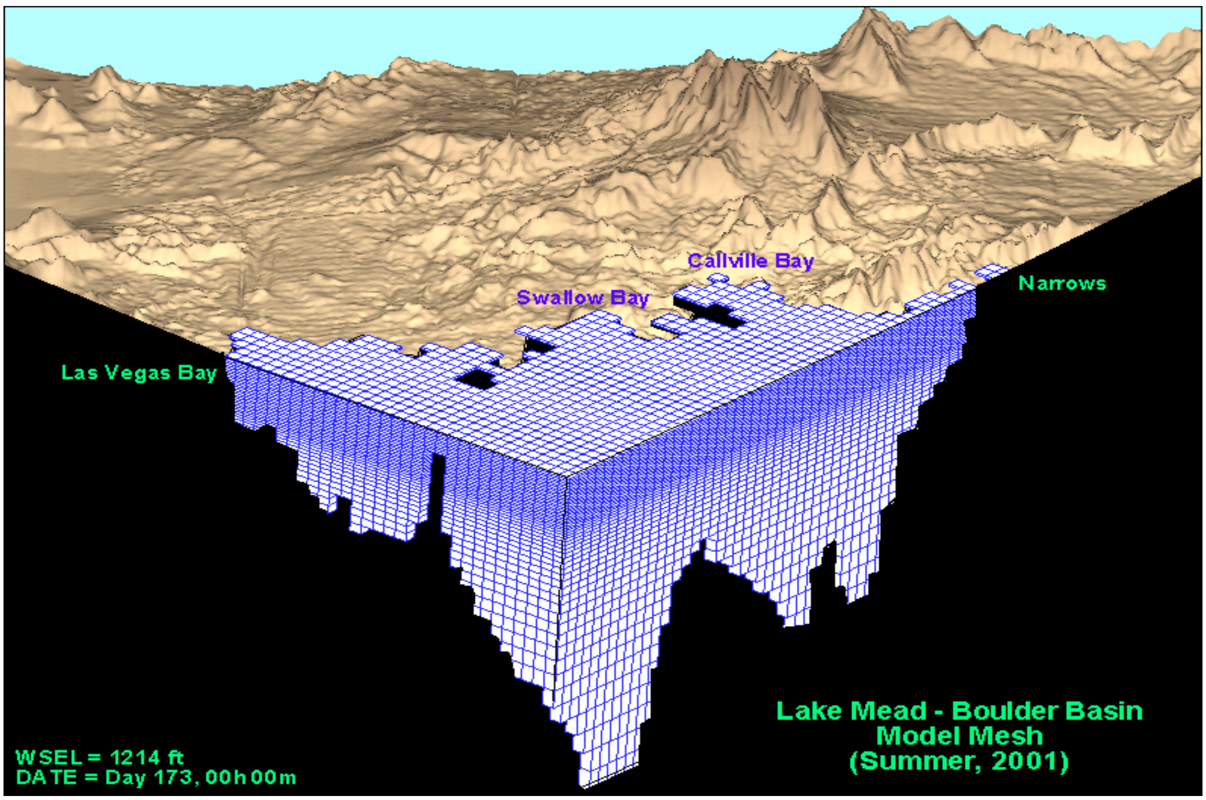
Furthermore, studies conducted by Robson and Hamilton (2002) proved that ELCOM/CAEDYM accurately reproduced the unusual hydrodynamic circumstances that occurred in January 2000 after a record maximum rainfall, and predicted the magnitude and timing of the *Microcystis* bloom. These studies show that better identification and monitoring procedures for potentially harmful phytoplankton species could be established with ELCOM/CAEDYM and will assist in surveillance and warnings for the future.

4.2 MODEL APPLICATIONS

In addition to the initial code development, testing, and validation by CWR, numerous other applications of ELCOM/CAEDYM have been developed by CWR and validated against field data. Additionally, Flow Science has applied ELCOM/CAEDYM extensively at Lake Mead (USA) and validated the results against measured data. The results of numerous ELCOM/CAEDYM model applications are presented below.

4.2.1 Lake Mead (Nevada, USA)

An ELCOM/CAEDYM model of Boulder Basin, Lake Mead near Las Vegas, Nevada, is being used to evaluate alternative discharge scenarios for inclusion in an Environmental Impact Statement (EIS) for the Clean Water Coalition (CWC), a consortium of water and wastewater operators in the Las Vegas region. **Figure B.1** is a cut-away of the three-dimensional model grid used for Boulder Basin, showing the varying grid spacing in the vertical direction. **Figure B.2** is an example of the model output, showing the isopleths of a tracer plume within the reservoir for a sample case.



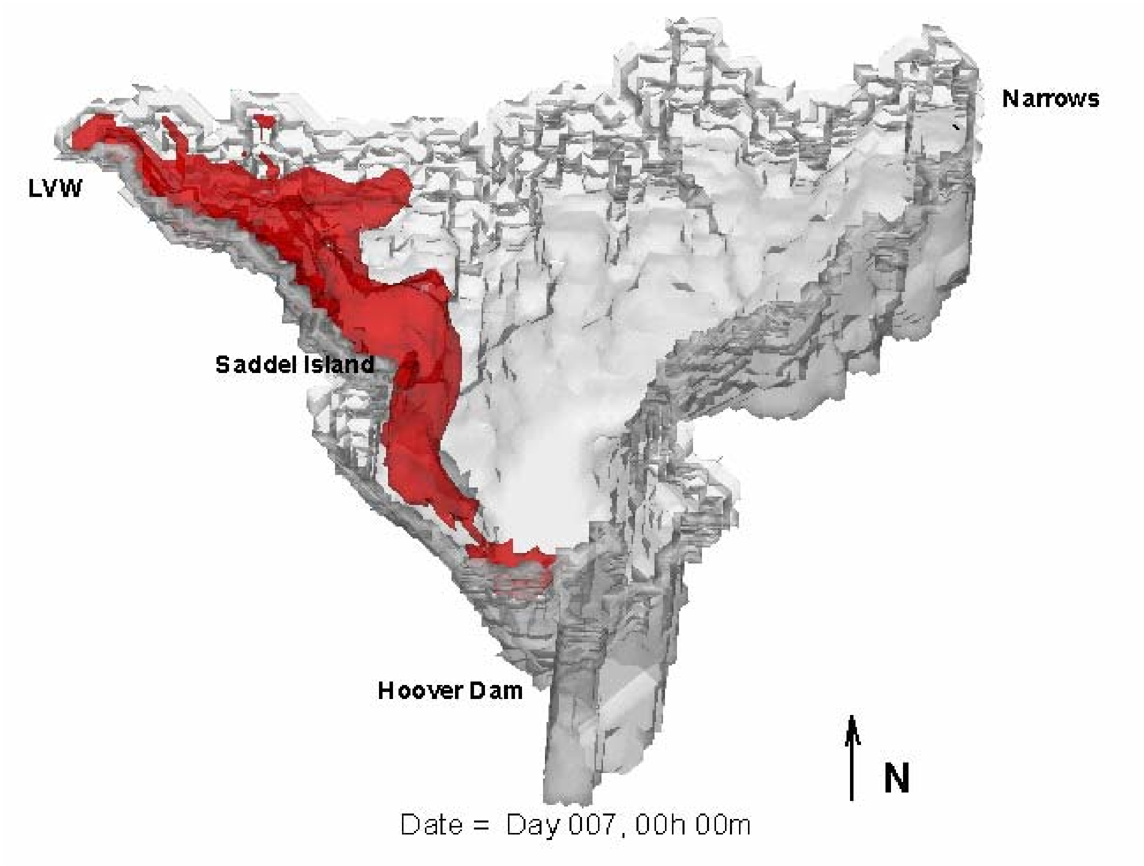


Figure B.2 Boulder Basin isopleths of tracer for a fall 2000 sample case.

As part of the EIS process, a model review panel met monthly for two years to review the validation of the ELCOM/CAEDYM model, its calibration against field data, and its application. The modeling committee approved the use of the model.

Subsequently, a scientific Water Quality Advisory Panel concluded that the ELCOM/CAEDYM model was applicable and acceptable. The members of the Water Quality Advisory Panel were diverse and included Jean Marie Boyer, Ph.D., P.E. (Water Quality Specialist/Modeler, Hydrosphere), Chris Holdren, Ph.D., CLM (Limnologist, United States Bureau of Reclamation), Alex Horne, Ph.D. (Ecological Engineer, University of California Berkeley), and Dale Robertson, Ph.D. (Research Hydrologist, United States Geological Survey).

More specifically, the Water Quality Advisory Panel agreed on the following findings:

- The ELCOM/CAEDYM model is appropriate for the project.

- There are few three-dimensional models available for reservoirs. ELCOM is one of the best hydrodynamic models and has had good success in the Boulder Basin of Lake Mead and other systems.

- The ELCOM model accurately simulates most physical processes.

- The algorithms used in CAEDYM are widely accepted (a biological consultant, Professor David Hamilton of The University of Waikato, New Zealand, has been retained to review the CAEDYM coefficients and algorithms).

The Boulder Basin ELCOM/CAEDYM model was calibrated against four years of measured data for numerous physical and water quality parameters including temperature, salinity, conductivity, DO, pH, nutrients (nitrogen and phosphorus), chlorophyll *a*, perchlorate, chloride, sulfate, bromide, and total organic carbon. Detailed results of this calibration and the subsequent evaluation of alternative discharge scenarios will be made available in late 2005 in the CWC EIS that is currently being prepared for this project.

In addition to the good agreement between the model and field data and the acceptance of the model by the review committees, Flow Science also performed a mass balance on the model to ensure conservation of tracer materials. As a result of such tests and debugging, Flow Science and the CWR have made continuous improvements to the model as necessary including refinements to the ULTIMATE QUICKEST scheme and boundary cell representations.

4.2.2 Lake Burragorang (New South Wales, Australia)

ELCOM was applied and validated for Lake Burragorang in order to rapidly assess the potential impacts on water quality during an underflow event (CWR). Underflows usually occur during the winter when inflow water temperature is low compared to the reservoir. This causes the upheaval of hypolimnetic water at the dam wall, and as a result it transports nutrient rich waters into the euphotic zone.

The thermal dynamics during the underflow event were reproduced accurately by ELCOM for the case with idealized bathymetry data with coarse resolutions (straightened curves and rotating the lake in order to bypass the resolution problem), but not for the simulation with the complex, actual bathymetry. This is because the model tests showed that the ability to model underflows is severely constrained by the cross-channel grid resolution. When the cross-channel direction is poorly resolved at bends and curves, an underflow is unable to propagate downstream without a significant loss of momentum. Nevertheless, the simulations with the coarse idealized domain certainly can be used as aids and tools to visualize the behavior of reservoirs. Particularly, ELCOM was able to capture the traversal of the underflow down the length of Lake Burragorang and then had sufficient momentum to break against the wall causing the injection of underflow waters into the epilimnion near the dam. This simulated dynamic was in agreement with what was measured in the field.

4.2.3 Lake Kinneret (Israel)

ELCOM was applied to model basin-scale internal waves that are seen in Lake Kinneret, Israel, since understanding of basin-scale internal waves behaviors provide valuable information on mixing and transport of nutrients below the wind-mixed layer in stratified lakes. In studies done by Hodges et al. (1999) and Laval et al (2003), the ELCOM simulation results were compared with field data under summer stratification conditions to identify and illustrate the spatial structure of the lowest-mode basin-scale Kelvin and Poincare waves that provide the largest two peaks in the internal wave energy spectra. The results demonstrated that while ELCOM showed quantitative differences in the amplitude and steepness of the waves as well as in the wave phases, the basin-scale waves were resolved very well by ELCOM. In particular, the model captures the qualitative nature of the peaks and troughs in the thermocline and the depth of the wind-mixed layer at relatively coarse vertical grid resolutions (Hodges et al, 1999).

4.2.4 Lake Pamvotis (Greece)

ELCOM/CAEDYM was applied to Lake Pamvotis, a moderately sized (22 km^2), shallow (4 m average depth) lake located in northwest Greece. Since the lake has undergone eutrophication over the past 40 years, many efforts are directed at understanding the characteristics of the lake and developing watershed management and restoration plans.

Romero and Imberger (1999) simulated Lake Pamvotis over a one month period during May to June, 1998, and compared the simulated thermal and advective dynamics of the lake with data obtained from a series of field experiments. The simulation results over-predicted heating; however, diurnal fluctuations in thermal structures were similar to those measured. Since the meteorological site was sheltered from the winds, the wind data used in the simulation was believed to be too low, causing insufficient evaporative heat-loss and subsequent over-heating by ELCOM. An increase in the wind speed by a factor of three gave temperature profiles in agreement with the field data. Moreover, the study demonstrated that the model is capable of predicting the substantial diurnal variations in the intensity and direction of both vertical and horizontal velocities. Romero and Imberger were also able to illustrate the functionality of ELCOM when coupled to the water quality model, CAEDYM, and confirmed that the model could be used to evaluate the effect of various strategies to improve poor water quality in localized areas in the lake.

4.2.5 Lake Constance (Germany, Austria, Switzerland)

Appt (2000) and Appt et al. (2004) applied ELCOM to characterize the internal wave structures and motions in Lake Constance since internal waves are a key factor in understanding the transport mechanisms for chemical and biological processes in a stratified lake such as Lake Constance. Lake Constance is an important source of drinking water and a major tourism destination for its three surrounding countries of Germany, Austria, and Switzerland. Due to anthropogenic activities and climatic changes, Lake Constance water quality has deteriorated and its ecosystem has changed.

It was shown that ELCOM was able to reproduce the dominant internal wave and major hydrodynamic processes occurring in Lake Constance. For instance, three types of basin-scale waves were found to dominate the wave motion: the vertical mode-one Kelvin wave, the vertical mode-one Poincare waves, and a vertical mode-two Poincare wave. Moreover, an upwelling event was also reproduced by ELCOM suggesting that the width and length ratio of the basin, spatial variations in the wind, and Coriolis effects play critical roles in the details of the upwelling event. This on-going research has shown that ELCOM can be used as a tool to predict and understand hydrodynamics and water quality in lakes.

4.2.6 Venice Lagoon (Italy)

ELCOM/CAEDYM is being used to develop a hydrodynamic and sediment transport model of Venice Lagoon, Italy, since future gate closures at the mouth of the lagoon are likely to impact flushing patterns. This project is an integral part of the Venice Gate Projects in Italy that was launched in May 2003 to prevent flooding.

ELCOM was validated for the tidal amplitude and phase using the data obtained from 12 tidal stations located throughout the lagoon (Yeates, 2004). Remaining tasks include model validation of temperature, salinity, and velocity against measurements made in the major channels of the lagoon.

4.2.7 Silvan Reservoir (Australia)

ELCOM is currently being applied to reproduce the circulation patterns observed in Silvan Reservoir, Australia, during a field experiment that was conducted in March 2004 to determine the transport pathways in the lake. This experiment confirmed the upwelling behavior of the lake and the strong role of the inflows in creating hydraulic flows in the reservoir (Antenucci, 2004).

4.2.8 Billings and Barra Bonita Reservoirs (Brazil)

ELCOM/CAEDYM is being applied to Billings and Barra Bonita Reservoirs in Brazil. Billings Reservoir is an upstream reservoir that feeds Barra Bonita via the Tiete River. The objective of the project is to develop an integrated management tool for these reservoirs and river reaches for use in the future planning of water resource utilization in Sao Paulo, Brazil (Romero and Antenucci, 2004).

4.2.9 Lake Coeur D'Alene (Idaho, USA)

ELCOM/CAEDYM is being applied to investigate the trade-off between reducing heavy metal concentrations and a potential increase in eutrophication due to remediation procedures in Lake Coeur D'Alene, Idaho. In order to investigate heavy metal fate and transport, CAEDYM is being improved further to include heavy metals and a feedback loop to phytoplankton based on metal toxicity (Antenucci, 2004).

4.2.10 Lake Perris (California, USA)

ELCOM was applied to Lake Perris in order to compare the impacts of several recreational use strategies on measured fecal coliform concentrations at the outlet tower. The physical results of the simulation were validated against measured temperature and salinity data over a one-year period. The comparison of fecal coliform concentrations against measured data was fair due to a lack of data describing the timing and magnitude of loading and the settling and re-suspension of fecal matter.

4.2.11 Other Applications

Other ELCOM/CAEDYM applications and development in on-going research at CWR include:

- Plume dynamics and horizontal dispersion (Marmion Marine Park, Australia).
- Inflow and pathogen dynamics (Helena, Myponga and Sugarloaf Reservoirs, Australia).
- Mixing and dissipation in stratified environments (Tone River, Japan, and Brownlee Reservoir, USA).
- Tidally forced estuaries and coastal lagoons (Marmion Marine Park and Barbamarco Lagoon, Italy).
- Three-dimensional circulation induced by wind and convective exchange (San Roque Reservoir, Argentina, and Prospect Reservoir, Australia).

- Sea-surface temperature fluctuation and horizontal circulation (Adriatic Sea).

- Response of bivalve mollusks to tidal forcing (Barbamarco Lagoon, Italy).

- Impacts of the additional withdrawals and brine discharge into the ocean from a proposed desalination facility co-located with an existing power plant in the City of Carlsbad (California, USA).

5 TECHNICAL DESCRIPTION OF ELCOM

As outlined above, ELCOM solves the unsteady, viscous Navier-Stokes equations for incompressible flow using the hydrostatic assumption for pressure. ELCOM can simulate the hydrodynamics and thermodynamics of a stratified system, including baroclinic effects, tidal forcing, wind stresses, heat budget, inflows, outflows, and transport of salt, heat and passive scalars. Through coupling with the CAEDYM water quality module, ELCOM can be used to simulate three-dimensional transport and interactions of flow physics, biology, and chemistry. The hydrodynamic algorithms in ELCOM are based upon the proven semi-Lagrangian method for advection of momentum with a conjugate-gradient solution for the free-surface height (Casulli and Cheng, 1992) and a conservative ULTIMATE QUICKEST transport of scalars (Leonard, 1991). This approach is advantageous for geophysical-scale simulations since the time step can be allowed to exceed the Courant-Friedrichs-Lewy (CFL) condition for the velocity without producing instability or requiring a fully-implicit discretization of the Navier-Stokes equations.

5.1 GOVERNING EQUATIONS

Significant governing equations and approaches used in ELCOM include:

- Three-dimensional simulation of hydrodynamics (unsteady Reynolds-averaged Navier-Stokes equations).

- Advection and diffusion of momentum, salinity, temperature, tracers, and water quality variables.

- Hydrostatic approximation for pressure.

- Boussinesq approximation for density effects.

- Surface thermodynamics module accounts for heat transfer across free surface.

- Wind stress applied at the free surface.

- Dirichlet boundary conditions on the bottom and sides.

5.2 NUMERICAL METHOD

Significant numerical methods used in ELCOM include:

- Finite-difference solution on staggered-mesh Cartesian grid.
- Implicit volume-conservative solution for free-surface position.
- Semi-Lagrangian advection of momentum allows time steps with CFL > 1.0.
- Conservative ULTIMATE QUICKEST advection of temperature, salinity, and tracers.
- User-selectable advection methods for water quality scalars using upwind, QUICKEST, or semi-Lagrangian to allow trade-offs between accuracy and computational speed.Solution mesh is Cartesian and allows non-uniformity (*i.e.* stretching) in horizontal and vertical directions.

The implementation of the semi-Lagrangian method in Fortran 90 includes sparse-grid mapping of three-dimensional space into a single vector for fast operation using array-processing techniques. Only the computational cells that contain water are represented in the single vector so that memory usage is minimized. This allows Fortran 90 compiler parallelization and vectorization without platform-specific modification of the code. A future extension of ELCOM will include dynamic pressure effects to account for nonlinear dynamics of internal waves that may be lost due to the hydrostatic approximation.

Because the spatial scales in a turbulent geophysical flow may range from the order of millimeters to kilometers, it is presently impossible to conduct a Direct Navier-Stokes (DNS) solution of the equations of motion (*i.e.* an exact solution of the equations). Application of a numerical grid and a discrete time step to a simulation of a geophysical domain is implicitly a filtering operation that limits the resolution of the equations. Numerical models (or closure schemes) are required to account for effects that cannot be resolved for a particular grid or time step. There are four areas of modeling in the flow

physics: (l) turbulence and mixing, (2) heat budgets, (3) hydrodynamic boundary conditions, and (4) sediment transport.

5.3 TURBULENCE MODELING AND MIXING

ELCOM presently uses uniform fixed eddy viscosity as the turbulence closure scheme in the horizontal plane (in future versions a Smagorinsky 1963 closure scheme will be implemented to represent subgrid-scale turbulence effects as a function of the resolves large-scale strain-rates). These methods are the classic "eddy viscosity" turbulence closure. With the implementation of the Smagorinsky closure, future extensions will allow the eddy-viscosity to be computed on a local basis to allow improvements in modeling local turbulent events and flow effects of biological organisms (*e.g.*, drag induced by macroalgae or seagrass).

In the present code, the user has the option to extend the eddy-viscosity approach to the vertical direction by setting different vertical eddy-viscosity coefficients for each grid layer. However, in a stratified system, this does not adequately account for vertical turbulent mixing that may be suppressed or enhanced by the stratification (depending on the stability of the density field and the magnitude of the shear stress). To model the effect of density stratification on turbulent mixing the CWR has developed a closure model based on computation of a local Richardson number to scale. The latter is generally smaller than the time step used in geophysical simulations, so the mixing is computed in a series of partial time steps. When the mixing time-scale is larger than the simulation time step, the mixing ratio is reduced to account for the inability to obtain mixing on very short time scales. This model has the advantage of computing consistent mixing effects without regard to the size of the simulation time-step (*i.e.* the model produces mixing between cells that is purely a function of the physics and not the numerical step size).

5.4 HEAT BUDGET

The heat balance at the surface is divided into short-wave (penetrative) radiation and a heat budget for surface heat transfer effects. The surface heat budget requires user input of the net loss or gain through conduction, convection, and long wave radiation in the first grid layer beneath the free surface. The short wave range is modeled using a user-prescribed input of solar radiation and an exponential decay with depth that is a function of a bulk extinction coefficient (a Beer's law formulation for radiation absorption). This coefficient is the sum of individual coefficients for the dissolved organics ("gilvin"), phytoplankton biomass concentration, suspended solids, and the water itself. The extinction coefficients can either be computed in the water quality module (CAEDYM) or provided as separate user input.

5.5 HYDRODYNAMIC BOUNDARY CONDITIONS

The hydrodynamic solution requires that boundary conditions on the velocity must be specified at each boundary. There are six types of boundary conditions: (1) free surface, (2) open edge, (3) inflow-outflow, (4) no-slip, (5) free-slip, and (6) a Chezy-Manning boundary stress model (the latter is presently not fully implemented). For the free surface, the stress due to wind and waves is required. The user can either input the wind/wave stress directly, or use a model that relates the surface stress to the local wind speed and direction *via* a bulk aerodynamic drag coefficient. Open boundaries (*e.g.* tidal inflow boundaries for estuaries) require the user to supply the tidal signature to drive the surface elevation. Transport across open boundaries is modeled by enforcing a Dirichlet condition on the free-surface height and allowing the inflow to be computed from the barotropic gradient at the boundary. Inflow-outflow boundary conditions (*e.g.* river inflows) are Dirichlet conditions that specify the flow either at a particular boundary location *or inside the domain*. Allowing an inflow-outflow boundary condition to be specified for an interior position (*i.e.* as a source or sink) allows the model to be used for sewage outfalls or water outlets that may not be located on a land boundary. Land boundaries can be considered zero velocity (no-slip), zero-flux (free-slip) or, using a Chezy-Manning model, assigned a computed stress.

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APPENDIX B : CAEDYM PARAMETER VALUES FROM LITERATURE

PHYTOPLANKTON

Assumptions

The following assumptions were made in the conversion of various parameters to the units used by CAEDYM. When these assumptions were used to compute a CAEDYM parameter the appropriate superscript appears in the tables below.

a. Dry mass ≈ 0.1 x wet mass [Chapra (1997), p. 528]

b. In the phytoplankton the mass of chlorophyll is approximately equal to the mass of phosphorus (*i.e.* IP ≈ 1 mg P / mg Chla) [assumed for phytoplankton in example in Chapra (1997), p. 529.].

c. Phosphorus makes up about 1% of the dry weight [Chapra (1997), p. 528, for phytoplankton. However, there is also an example for diatoms with high Si, which have the fractions 0.8% and 0.5%, p.530]. Using assumption d, this implies that carbon and nitrogen make up about 40% and 7.2% of the dry weight, and other components comprise the remaining 51.8%.

d. C:N:P ratio is approximately 106:16:1 (Redfield ratio).

Maximum Growth Rate, Pmax (/day)

Value	Value in ref.	Species	Reference	Notes
0.9		*Nodularia* sp.	CAEDYM "default"	
2.4[b,c]			Fong *et al.* (1994)	Model for Southern California lagoons. Pmax = UNmax / IN = 0.24 / 0.10 = 2.4 (IN assumed constant)
1.44	1.44	marine diatoms	Robson & Hamilton (2003)	Table 1.
0.66	0.66	dinoflagellates	Robson & Hamilton (2003)	Table 1.
2.2	2.2	unspecified	Trancoso *et al.* (2005)	Model for Vouga Estuary, Portugal. With max{f(T)}=1
1.8	1.8	unspecified	Trancoso (2002)	Model for Tagus Estuary, Portugal. With max{f(T)}=1
0.25 – 2.2			Hamilton (unpublished, 2006)	
1.3 – 3.9 (mostly 1.5 – 2.5)			Hamilton *et al.* (unpublished)	
1.0 – 2.0			Schnoor (1996)	

Ratio of C to Chla, Ycc (mg C/ mg Chla)

Value	Value in ref.	Species	Reference	Notes
40		*Nodularia* sp.	CAEDYM "default"	
42[b,d]			Assumptions b and d	106·12 / 31·1 = 42
40 - 150			Hamilton (unpublished, 2006)	
15 - 60			Hamilton *et al.* (unpublished)	sometimes up to 178 (skeletonema)
50 - 100			Wetzel (2001)	can be > 100 for severe P-limitation [Table 13-17 (converted units)]
35 - 100			Schnoor (1996)	

Light saturation for maximum production, Ist (μE/m²/s)

Value	Value in ref.	Species	Reference	Notes
200		*Nodularia* sp.	CAEDYM "default"	
444	100 W/m^2	unspecified	Trancoso *et al.* (2005)	Model for Vouga Estuary, Portugal. Conversion using 135 W/m^2 = 600 μmol/m^2/s (http://www.sunmastergrowlamps.com/SunmLightandPlants.html)
444	100 W/m^2	unspecified	Trancoso (2002)	Model for Tagus Estuary, Portugal. Conversion using 135 W/m^2 = 600 μmol/m^2/s (http://www.sunmastergrowlamps.com/SunmLightandPlants.html)
20 - 500			Hamilton (unpublished, 2006)	

Specific attenuation coefficient, Kep (/ µg Chla/m)

Value	Value in ref.	Species	Reference	Notes
0.014		*Nodularia* sp.	CAEDYM "default"	
0.0088 0.019 0.11	0.0088 0.019 0.11	Ocean Mediterranean Tagus Estuary	Trancoso (2002)	Model for Tagus Estuary, Portugal. Table 5.2.
0.02 – 0.08			Hamilton (unpublished, 2006)	

Half saturation constant for N, KN (mg N/L)

Value	Value in ref.	Species	Reference	Notes
0.045		*Nodularia* sp.	CAEDYM "default"	
0.2	0.2		Fong *et al.* (1994)	Model for Southern California lagoons. Relatively high compared with measured values (p.228).
0.022	0.022	marine diatoms	Robson & Hamilton (2003)	Table 1. No excess internal storage.
0.03	0.03	dinoflagellates	Robson & Hamilton (2003)	Table 1. No excess internal storage.
0.014	0.014		Trancoso *et al.* (2005)	Model for Vouga Estuary, Portugal.
0.014	0.014		Trancoso (2002)	Model for Tagus Estuary, Portugal.
0.015 – 0.1			Hamilton (unpublished, 2006)	
0.02 – 0.2			Hamilton *et al.* (unpublished)	
0.001 – 0.03			Schnoor (1996)	

Minimum internal N, INmin (mg N/mg Chla)

Value	Value in ref.	Species	Reference	Notes
2		*Nodularia* sp.	CAEDYM "default"	
0.10	0.10		Fong *et al.* (1994)	Model for Southern California lagoons. Constant N:Chla ratio (p.229). Not sure of units. If it is ratio of mass to mass, then this is inconsistent with assumptions e and g.
<7.5[b,d]	0.18 mg N/ mg C		Trancoso *et al.* (2005)	Model for Vouga Estuary, Portugal. No internal storage (INmin=INmax). Redfield ratio.
<7.5[b,d]	0.18 mg N/ mg C		Trancoso (2002)	Model for Tagus Estuary, Portugal. No internal storage (INmin=INmax). Redfield ratio.
≥3.0			Hamilton (unpublished, 2006)	
1.5 – 11.2			Hamilton *et al.* (unpublished)	
5.0			Schnoor (1996)	

Maximum internal N, INmax (mg N/mg Chla)

Value	Value in ref.	Species	Reference	Notes
4		*Nodularia* sp.	CAEDYM "default"	
0.10	0.10		Fong *et al.* (1994)	Model for Southern California lagoons. Constant N:Chla ratio (p.229). Not sure of units. If it is ratio of mass to mass, then this is inconsistent with assumptions e and g.
>7.5[b,d]	0.18 mg N/ mg C		Trancoso *et al.* (2005)	Model for Vouga Estuary, Portugal. No internal storage (INmin=INmax). Redfield ratio.
>7.5[b,d]	0.18 mg N/ mg C		Trancoso (2002)	Model for Tagus Estuary, Portugal. No internal storage (INmin=INmax). Redfield ratio.
>0.18·Ycc			Hamilton (unpublished, 2006)	Redfield ratio Ycc·(16·14) / (106·12) = 0.18·Ycc
7 - 12			Hamilton *et al.* (unpublished)	
20			Schnoor (1996)	

Maximum N uptake rate, UNmax (mg N/mg Chla/day)

Value	Value in ref.	Species	Reference	Notes
0.75		*Nodularia* sp.	CAEDYM "default"	
0.24[b,c]	0.1 mg / g dry wt. / hr		Fong *et al.* (1994)	Model for Southern California lagoons. Relatively high compared with measured values (p.228). Units in paper are sometimes /d and sometime /hr. Assume /hr is correct (based upon Fig. 11 for macroalgae). Assume IN = 0.10 mg N / mg Chla (p.229).
>0.18· Pmax·Ycc			Hamilton (unpublished, 2006)	Redfield ratio Pmax·Ycc·(16·14) / (106·12) = 0.18·Pmax·Ycc
0.96 – 5.0 (mostly 1.0 – 2.0)			Hamilton *et al.* (unpublished)	

Half saturation constant for P, KP (mg P/L)

Value	Value in ref.	Species	Reference	Notes
0.005		*Nodularia* sp.	CAEDYM "default"	
0.001			Trancoso (2002)	Model for Tagus Estuary, Portugal.
0.0005 – 0.01			Hamilton (unpublished, 2006)	
0.001 – 3 (mostly 0.15 – 0.4)			Hamilton *et al.* (unpublished)	
0.006 – 0.025			Schnoor (1996)	

Minimum internal P, IPmin (mg P/mg Chla)

Value	Value in ref.	Species	Reference	Notes
0.1		*Nodularia* sp.	CAEDYM "default"	
<1[b]	0.024 mg P / mg C		Trancoso (2002)	Model for Tagus Estuary, Portugal. No internal storage (IPmin=IPmax). Redfield ratio (C:N:P=106:16:1)
≥0.4			Hamilton (unpublished, 2006)	
0.1 – 1.0			Hamilton *et al.* (unpublished)	
0.5			Schnoor (1996)	

Maximum internal P, IPmax (mg P/mg Chla)

Value	Value in ref.	Species	Reference	Notes
0.6		*Nodularia* sp.	CAEDYM "default"	
>1[b]	0.024		Trancoso (2002)	Model for Tagus Estuary, Portugal. No internal storage (IPmin=IPmax).
>0.024·Ycc			Hamilton (unpublished, 2006)	Redfield ratio Ycc·(1·31) / (106·12) = 0.024·Ycc
0.95 – 10.9 (mostly 1.0 – 3.0)			Hamilton *et al.* (unpublished)	
2.0			Schnoor (1996)	

Maximum P uptake rate, UPmax (mg P/mg Chla/day)

Value	Value in ref.	Species	Reference	Notes
0.1		*Nodularia* sp.	CAEDYM "default"	
>0.024· Pmax·Ycc			Hamilton (unpublished, 2006)	Redfield ratio Pmax·Ycc·(1·31) / (106·12) = 0.024·Pmax·Ycc
0.14 – 1.0 (mostly 0.3 – 0.6)			Hamilton *et al.* (unpublished)	

Temperature multiplier for growth, vT (-)

Value	Value in ref.	Species	Reference	Notes
1.06		*Nodularia* sp.	CAEDYM "default"	
1.05 – 1.09			Hamilton (unpublished, 2006)	

Standard temperature, Tsta (°C)

Value	Value in ref.	Species	Reference	Notes
20		*Nodularia* sp.	CAEDYM "default"	
20 - 25			Hamilton (unpublished, 2006)	

Optimal temperature, Topt (°C)

Value	Value in ref.	Species	Reference	Notes
27		*Nodularia* sp.	CAEDYM "default"	
25 - 35			Hamilton (unpublished, 2006)	Topt "will reflect acclimation to the particular environment, *i.e.*, phytoplankton in the Arctic may have much lower Topt than those at tropical latitudes."

Maximum temperature, Tmax (°C)

Value	Value in ref.	Species	Reference	Notes
33.05		*Nodularia* sp.	CAEDYM "default"	
			Hamilton (unpublished, 2006)	"It would be unusual for acclimated phytoplankton to be in a temperature range from Topt to Tmax, and therefore the value of Tmax is usually of little significance."

Respiration rate coefficient, kr (/day)

Value	Value in ref.	Species	Reference	Notes
0.08		*Nodularia* sp.	CAEDYM "default"	This should be > 10% of the max growth rate.
0.19	0.19 wet wt. / day		Fong *et al.* (1994)	Model for Southern California lagoons.
0.09	K_{re}=0.0175/d m_{max}=0.02/d		Trancoso *et al.* (2005)	Model for Vouga Estuary, Portugal. Assume $T=T_{ref}$=20°C and high biomass ($>>K_m/\mu_{max}$): $\rightarrow kr=0.0175 \cdot \exp\{0.069 \cdot 20\}+0.02$ $=0.07+0.02=0.09$
0.14	K_{re}=0.0175/d K_{rp}=0.018 m_{max}=0.03/d		Trancoso (2002)	Model for Tagus Estuary, Portugal. Assume $T=T_{ref}$=20°C, μ_{max}=2.2/day and high biomass ($>>K_m/\mu_{max}$): $\rightarrow kr=0.0175 \cdot \exp\{0.069 \cdot 20\}+0.018 \cdot 2.2+0.03$ $=0.07+0.04+0.03=0.14$
≥ 0.2			Hamilton (unpublished, 2006)	"best to use a value of at least 10% of Pmax"
0.02 – 0.2 (mostly 0.05 – 0.1)			Hamilton *et al.* (unpublished)	
0.05 – 0.25			Schnoor (1996)	

Temperature multiplier for respiration, vR (-)

Value	Value in ref.	Species	Reference	Notes
1.05		*Nodularia* sp.	CAEDYM "default"	
1.0			Fong et. al. (1994)	Model for Southern California lagoons. No temperature dependence.
1.05 – 1.09			Hamilton (unpublished, 2006)	

Fraction of loss that is respiration, fres (-)

Value	Value in ref.	Species	Reference	Notes
0.7		*Nodularia* sp.	CAEDYM "default"	
0.78	K_{re}=0.0175/d m_{max}=0.02/d		Trancoso *et al.* (2005)	Model for Vouga Estuary, Portugal. 1 - 0.02 / 0.09 = 0.78
0.79	K_{re}=0.0175/d K_{rp}=0.018 m_{max}=0.03/d		Trancoso (2002)	Model for Tagus Estuary, Portugal. 1 - 0.03 / 0.14 = 0.78

Fraction of loss that goes to DOM, fDOM (-)

Value	Value in ref.	Species	Reference	Notes
0.7		*Nodularia* sp.	CAEDYM "default"	
1.0	1.0		Fong *et al.* (1994)	Model for Southern California lagoons. All N from decaying algae goes back into the water column immediately.

SEDIMENT OXYGEN DEMAND

Static sediment exchange rate, rSOs (g/m²/day)

Value	Value in ref.	Location	Reference	Notes
0.2			CAEDYM "default"	
1.5 1 – 2	1.5 1 – 2	Estuarine mud	Chapra (2001)	Table 25.1
0.5 0.2 – 1	0.5 0.2 – 1	Sandy bottom	Chapra (2001)	Table 25.1

Half saturation constant, KSOs (mg O/L)

Value	Value in ref.	Location	Reference	Notes
0.5			CAEDYM "default"	
0.7 1.4	0.7 1.4		Chapra (2001)	page 455.

SEDIMENT NUTRIENT FLUXES

Release rate of NH4, SmpNH4 (g N/m²/day)

Value	Value in ref.	Location	Reference	Notes
0.019			CAEDYM "default"	
0.03 – 0.09	30 – 90 mg $N/m^2/d$	Chesapeake Bay	Di Toro (2001)	Figure 4.14

Release rate of NO3, SmpNO3 (g N/m²/day)

Value	Value in ref.	Location	Reference	Notes
-0.01			CAEDYM "default"	
-0.01 - +0.008	-10 – +8 mg $N/m^2/d$	Chesapeake Bay	Di Toro (2001)	Figure 4.14

Release rate of PO4, SmpPO4 (g P/m^2/day)

Value	Value in ref.	Location	Reference	Notes
0.0026			CAEDYM "default"	
0.0002 – 0.1	0.2 – 100 mg P/m^2/d	Chesapeake Bay	Di Toro (2001)	Figure 4.14

The sediment flux models in Di Toro (2001) are more complex than the CAEDYM models. However, the static models in Di Toro generally have a release rate that multiplies the other terms, and as such can be used as a guide for the CAEDYM models.

The version of CAEDYM that we are using can not deal with the NO3 flux changing sign, and so the flux has been set it to zero. NH4 flux is generally much higher than NO3 flux, and is therefore a more important source of nitrogen.

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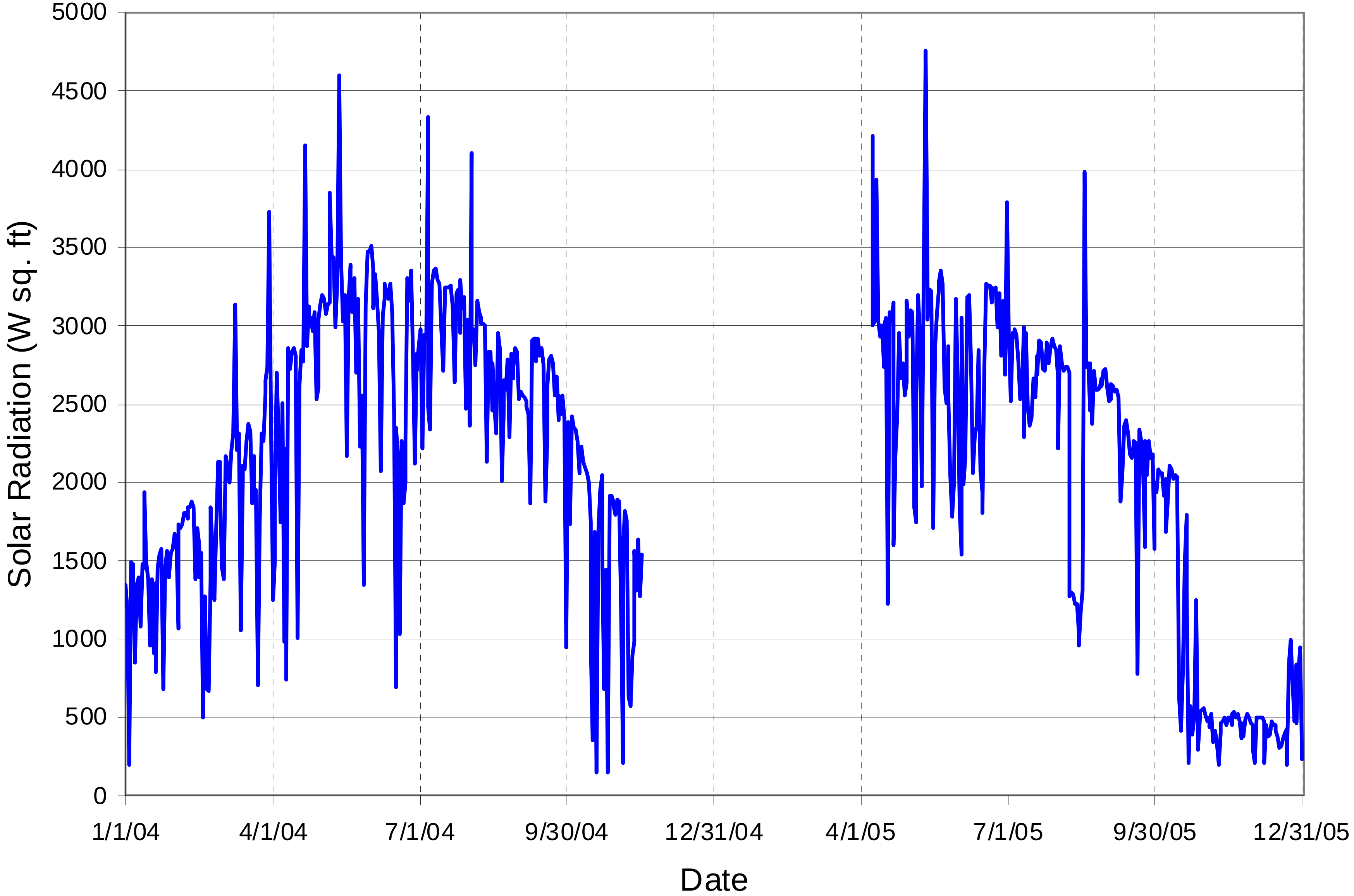
APPENDIX C : LOWER SAN GABRIEL RIVER FLOOD CONTROL CHANNEL – ADDITIONAL MODEL INPUT DATA AND MODEL CALIBRATION

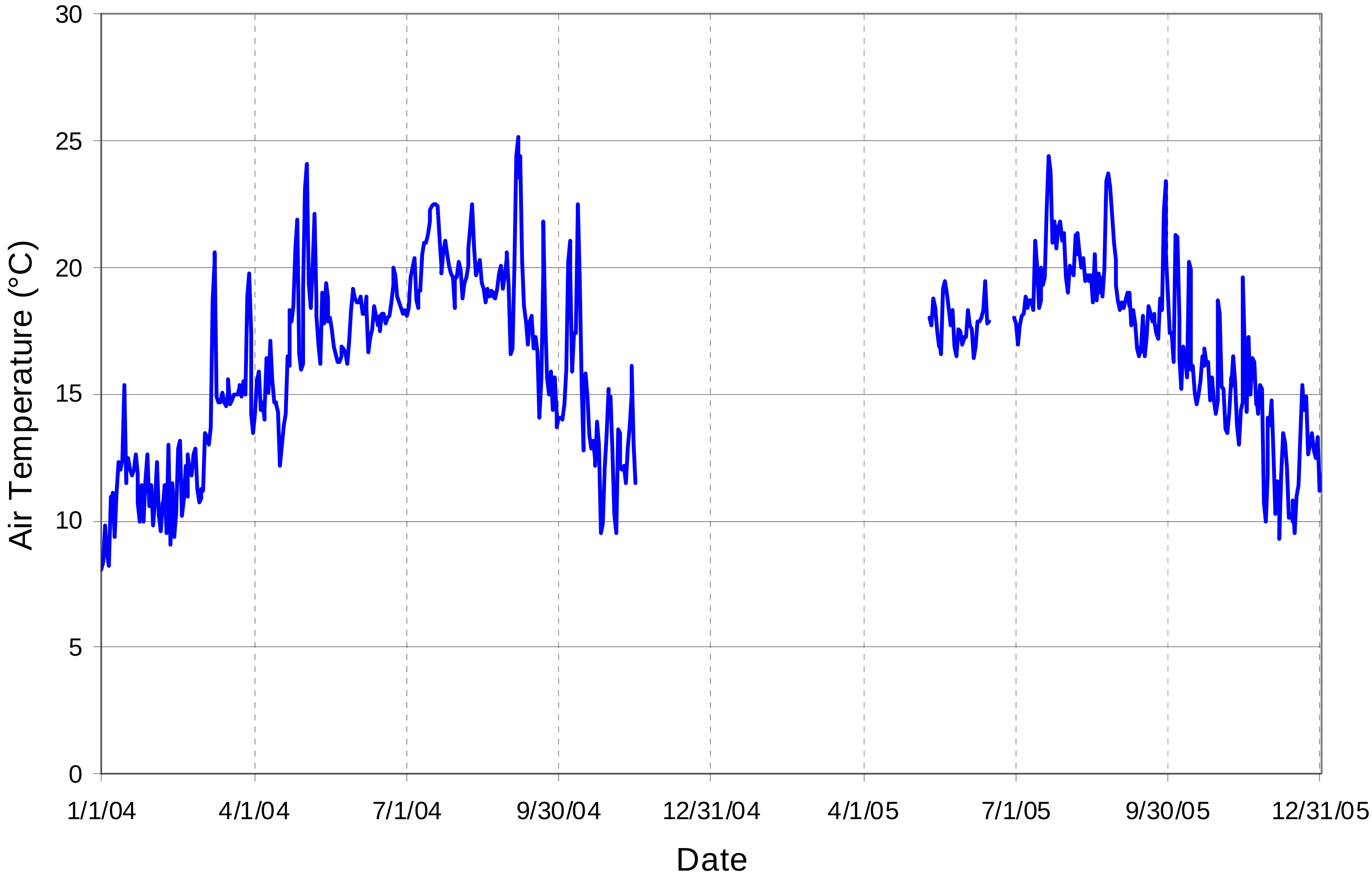
Meteorology Data

Daily Average Solar Radiation 2004 - 2005



Meteorology Data

Daily Average Air Temperatures 2004 - 2005



Meteorology Data

Hourly Wind Rose 2004 - 2005

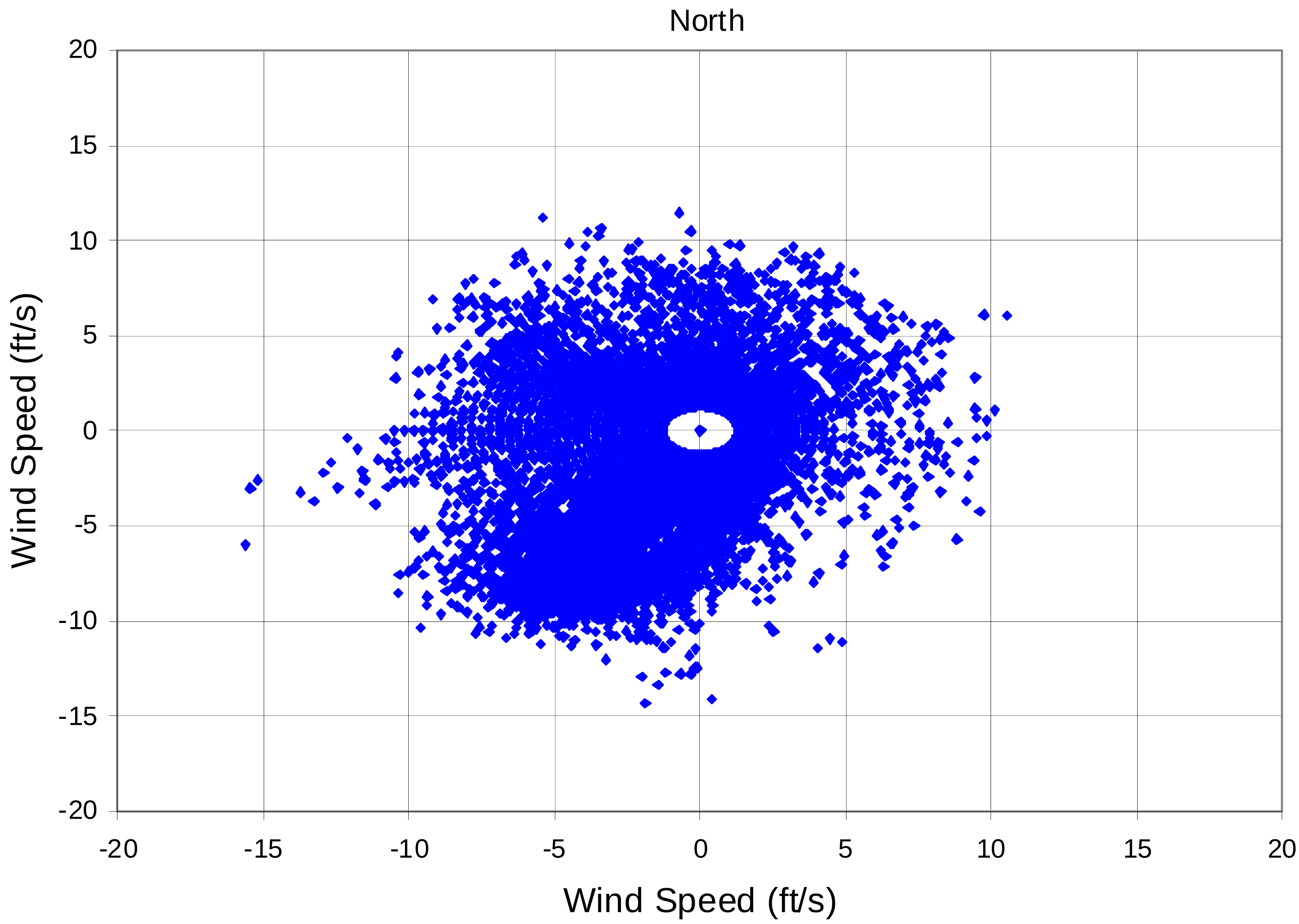
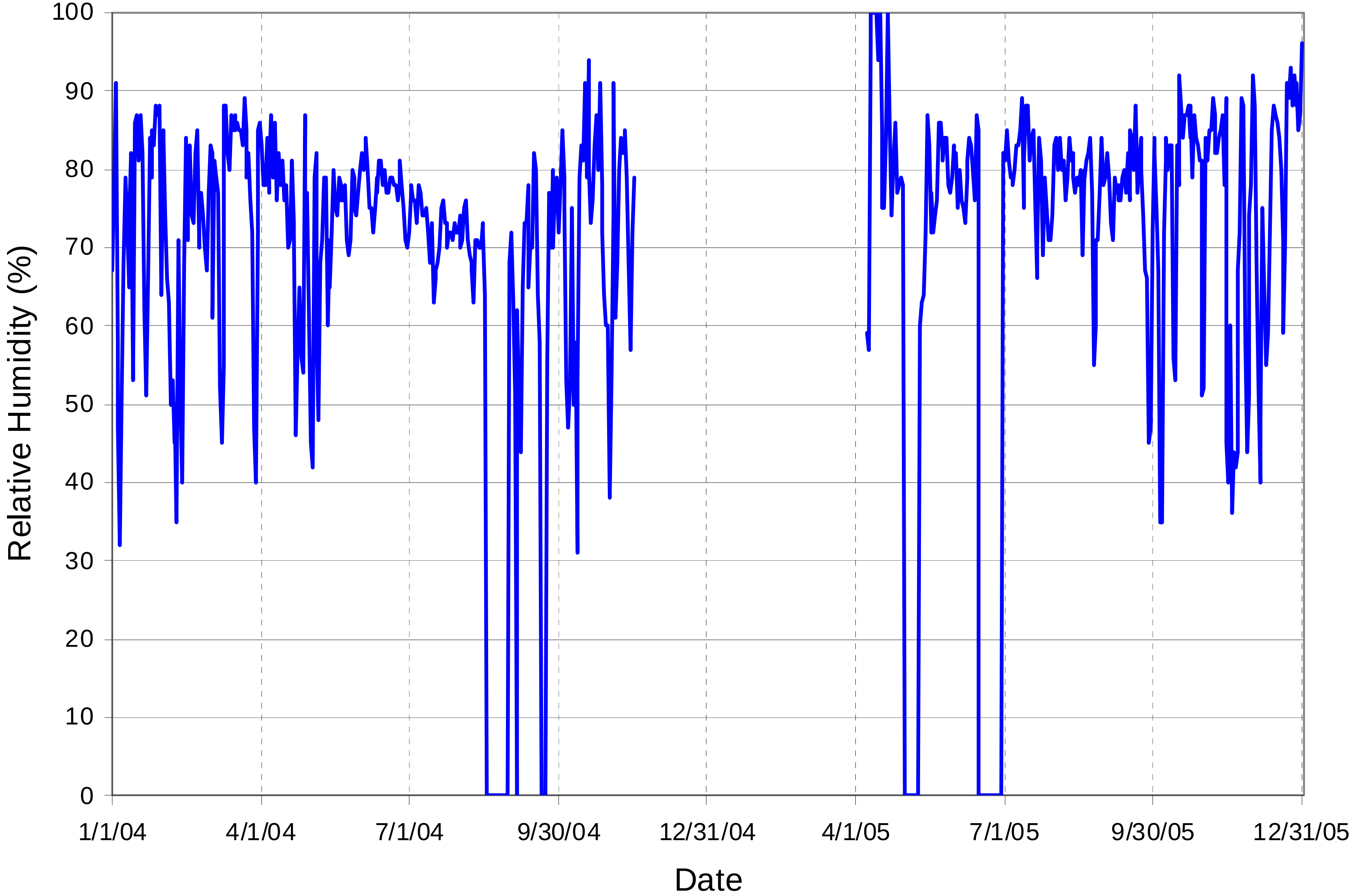


Figure C.3

Meteorology Data

Daily Average Relative Humidity 2004 - 2005



Meteorology Data

Daily Average Precipitation 2004 - 2005

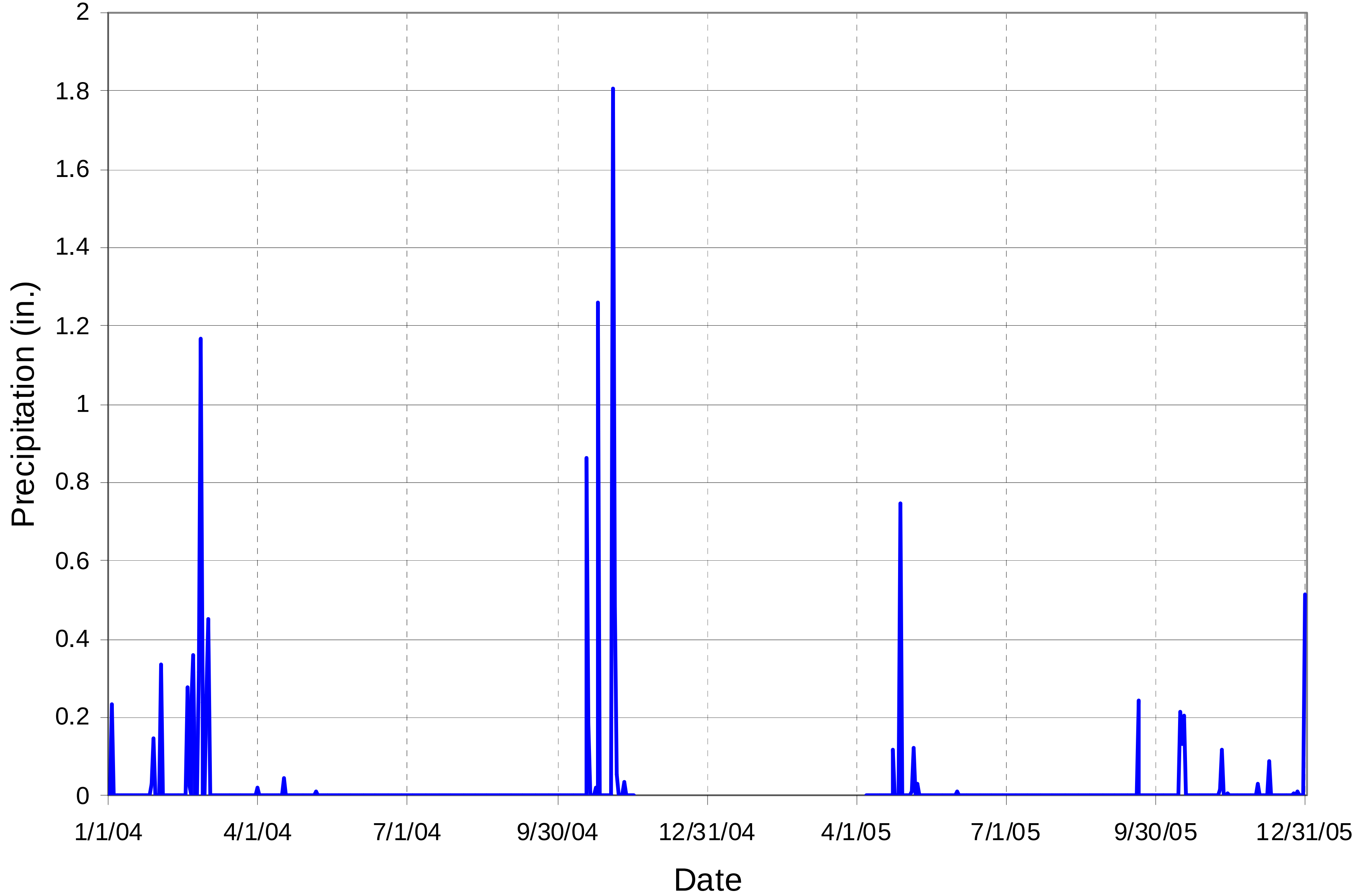
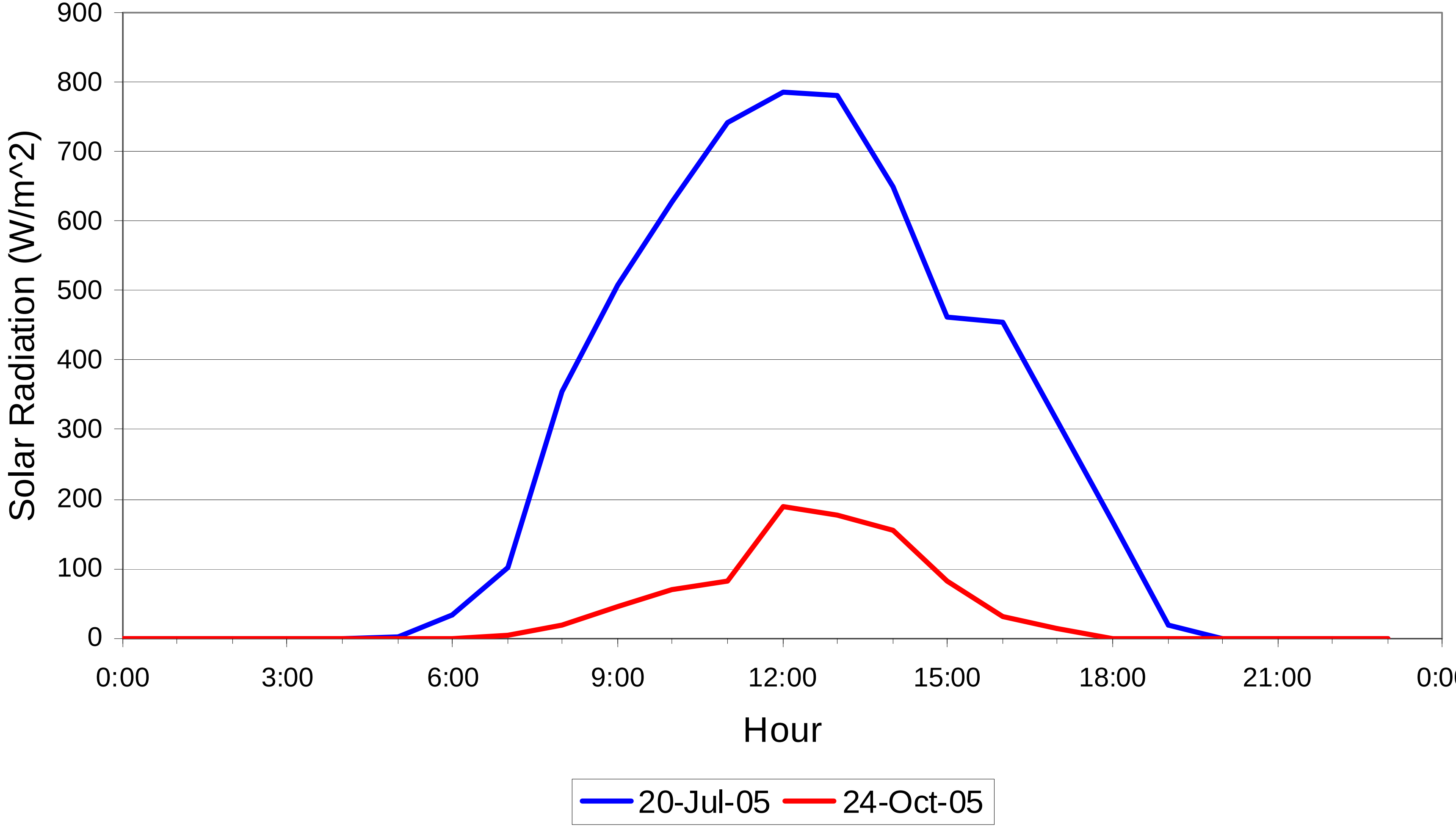


Figure C.5

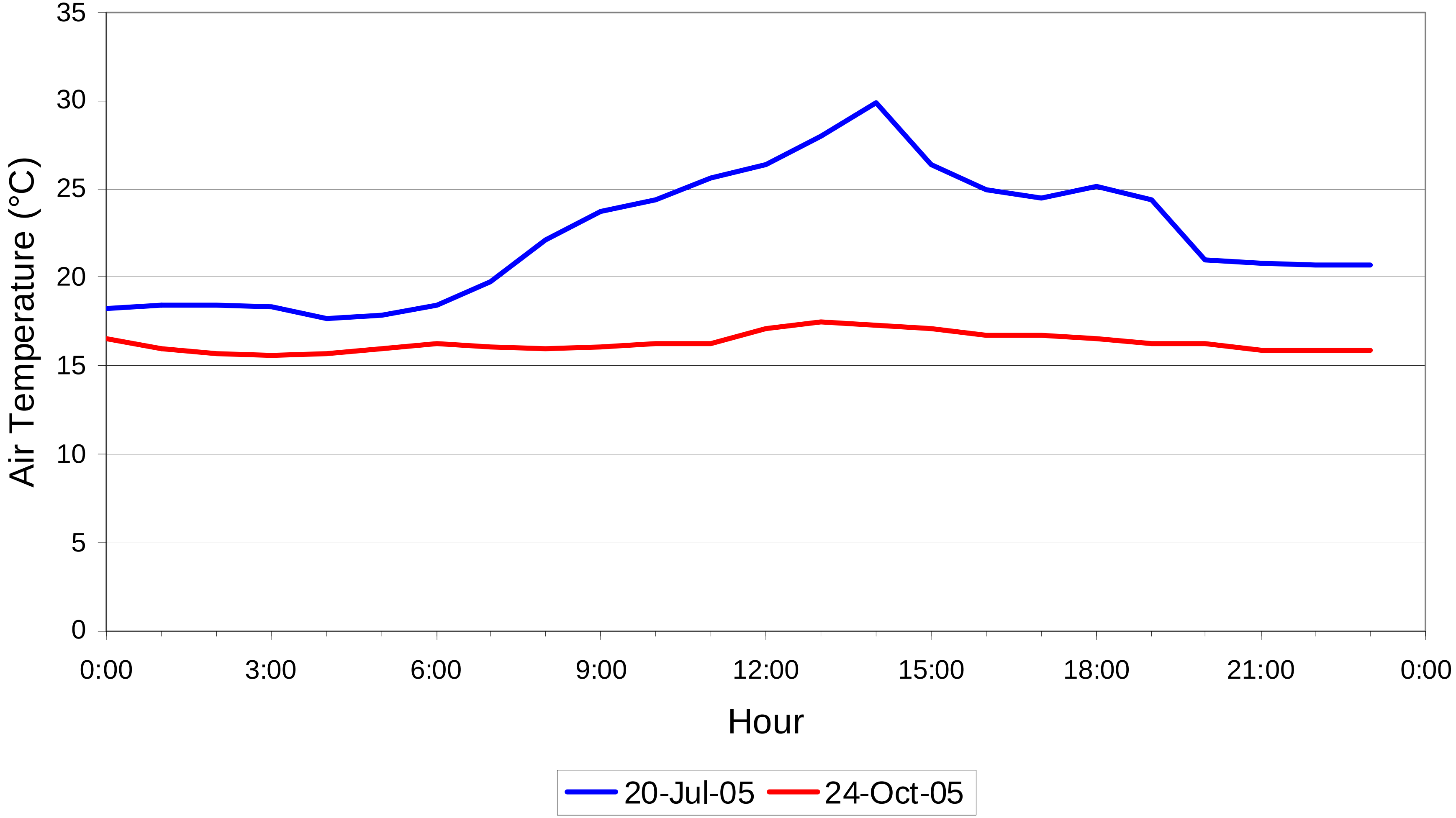
Meteorology Data

Hourly Solar Radiation

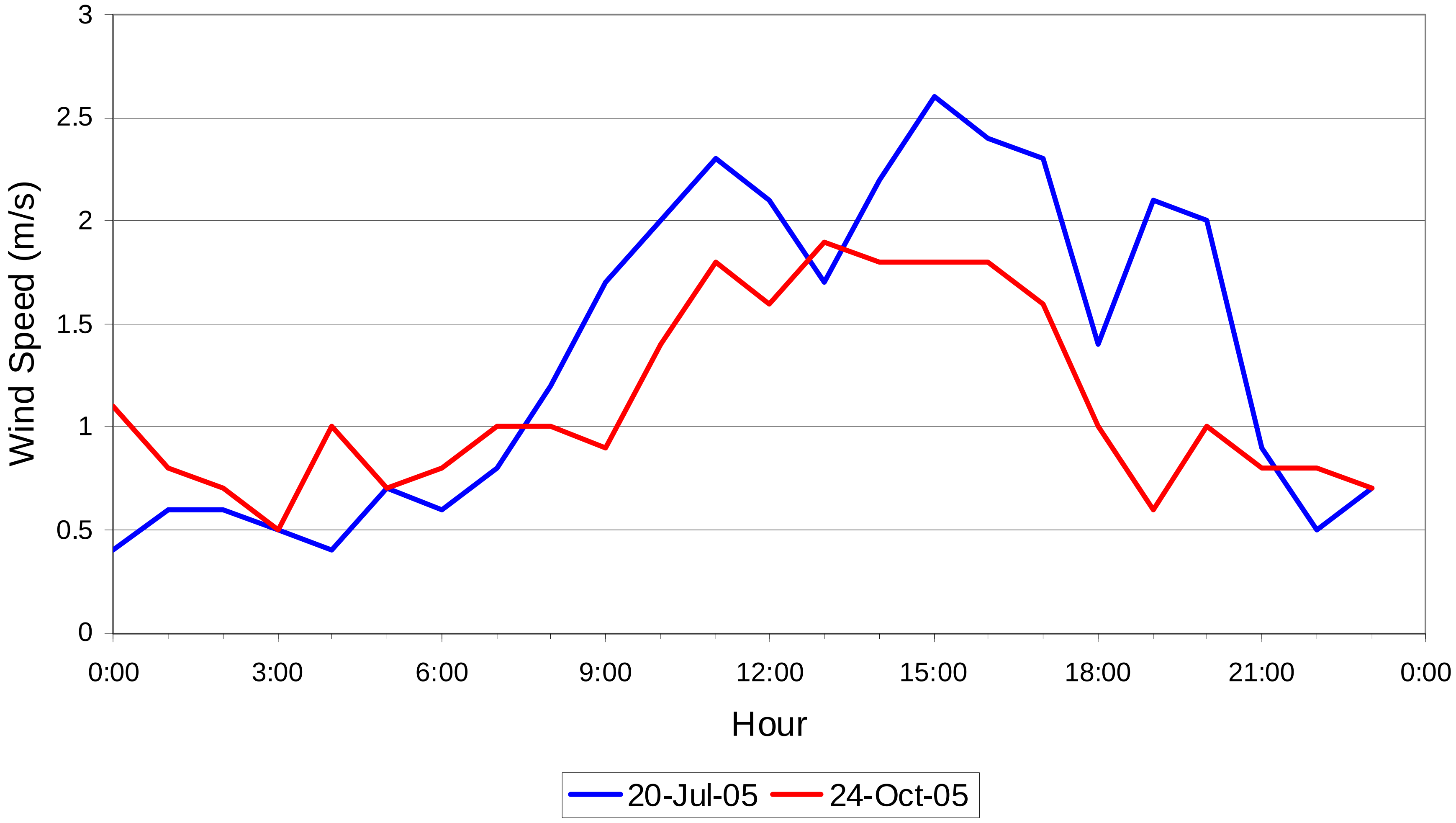
July 20, 2005 and October 24, 2005



Meteorology Data
Hourly Air Temperature
July 20, 2005 and October 24, 2005



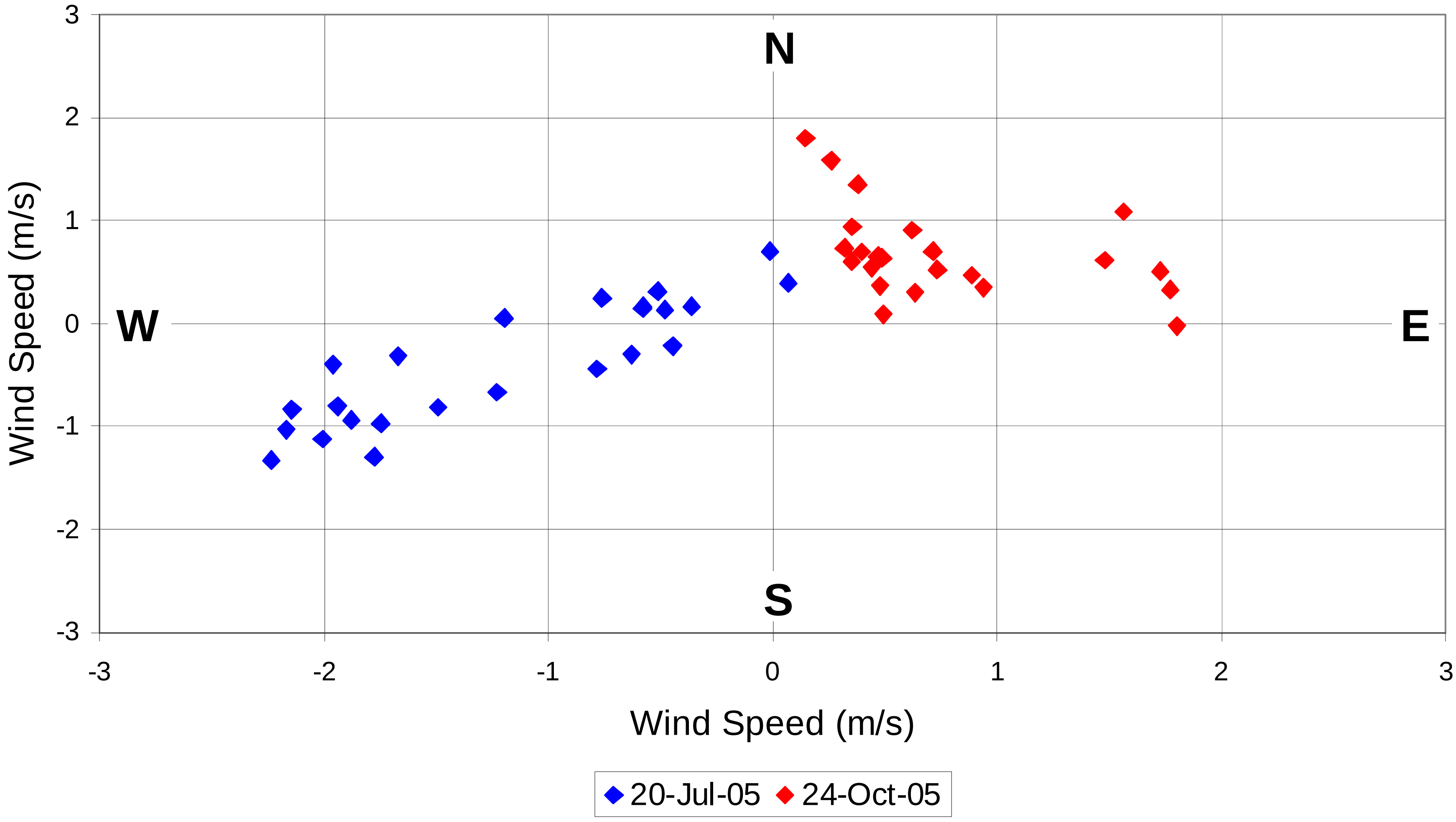
Meteorology Data
Hourly Wind Speed
July 20, 2005 and October 24, 2005



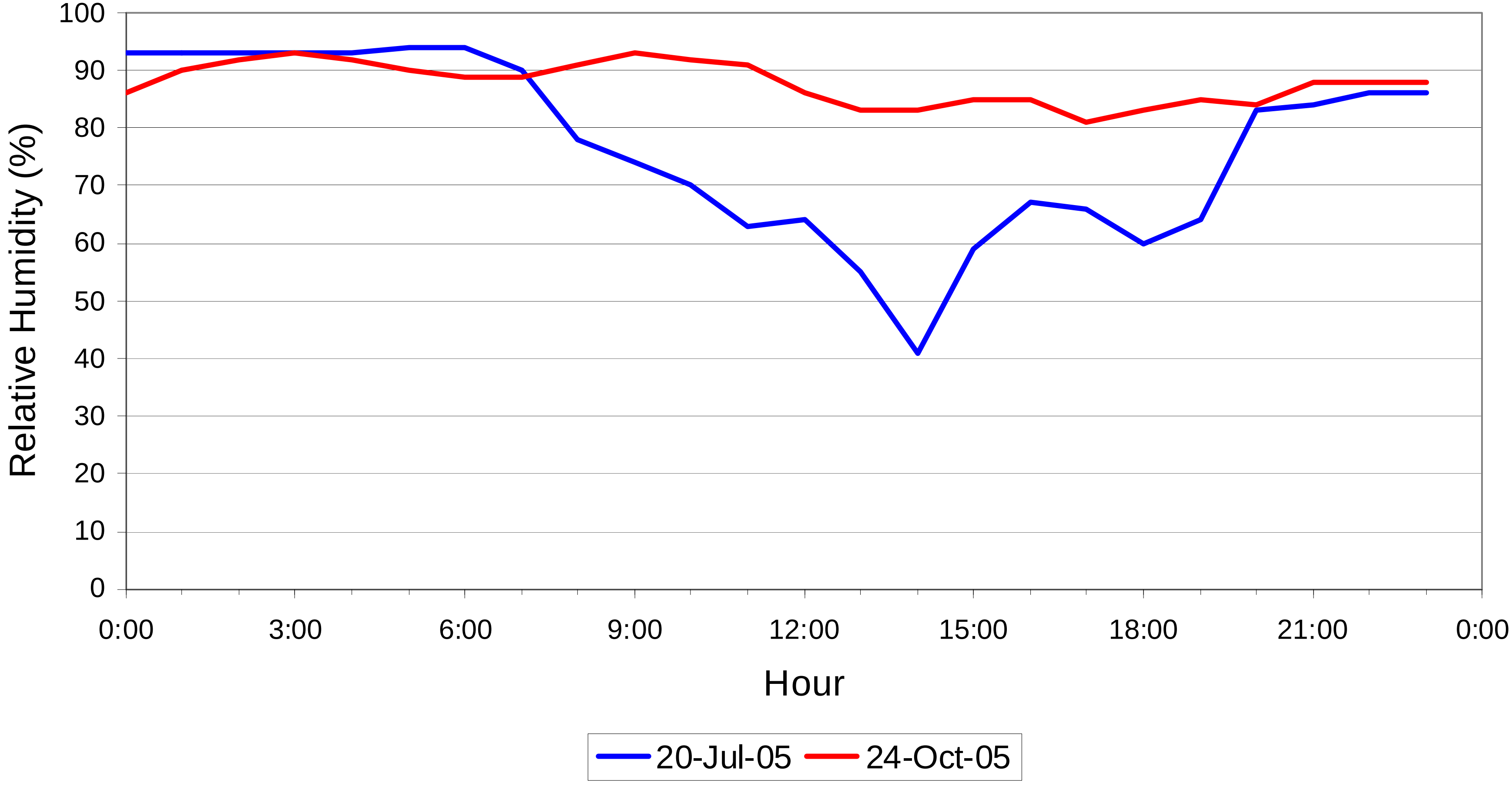
Meteorology Data

Hourly Wind Rose

July 20, 2005 and October 24, 2005



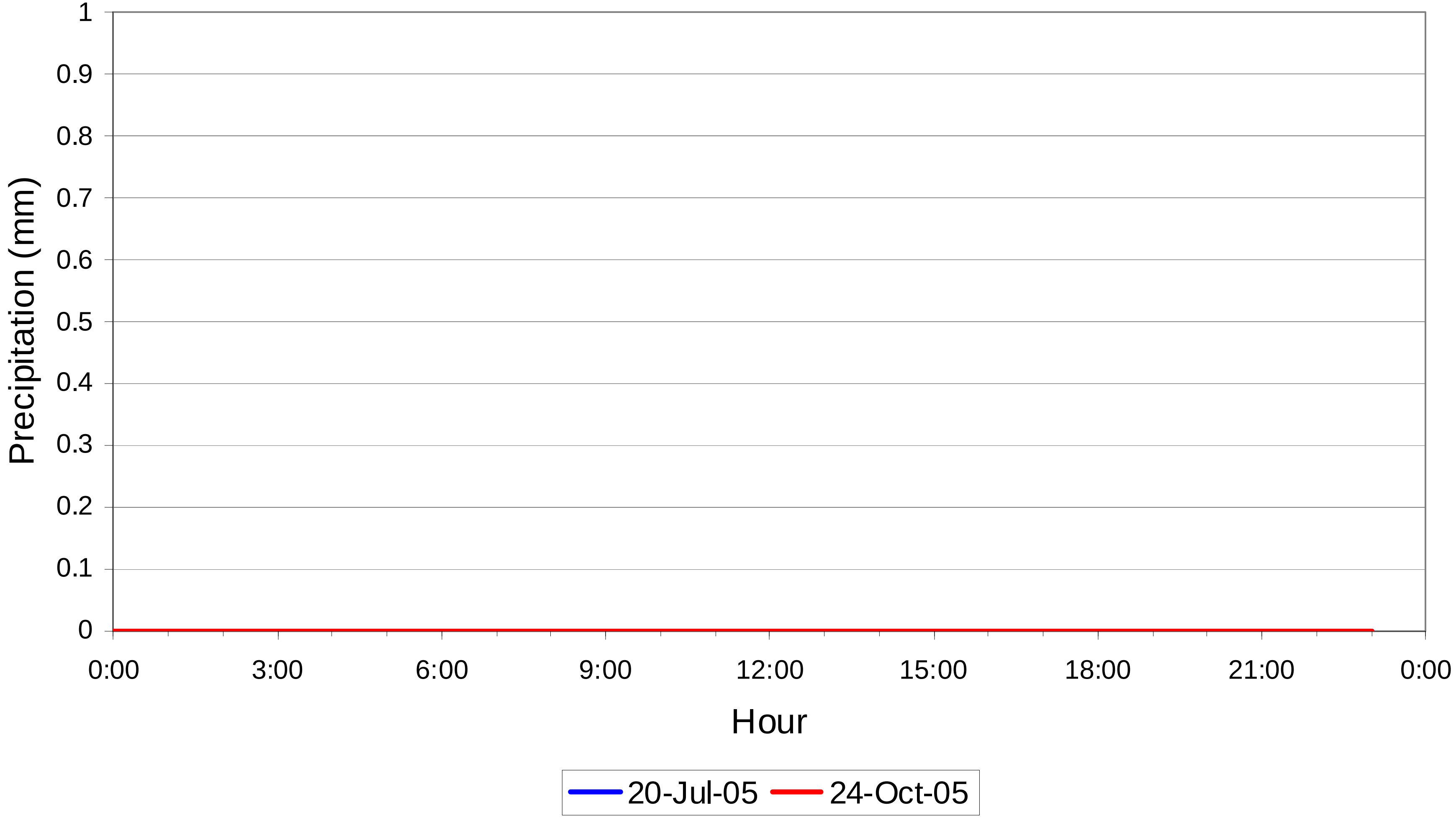
Meteorology Data
Hourly Relative Humidity
July 20, 2005 and October 24, 2005



Meteorology Data

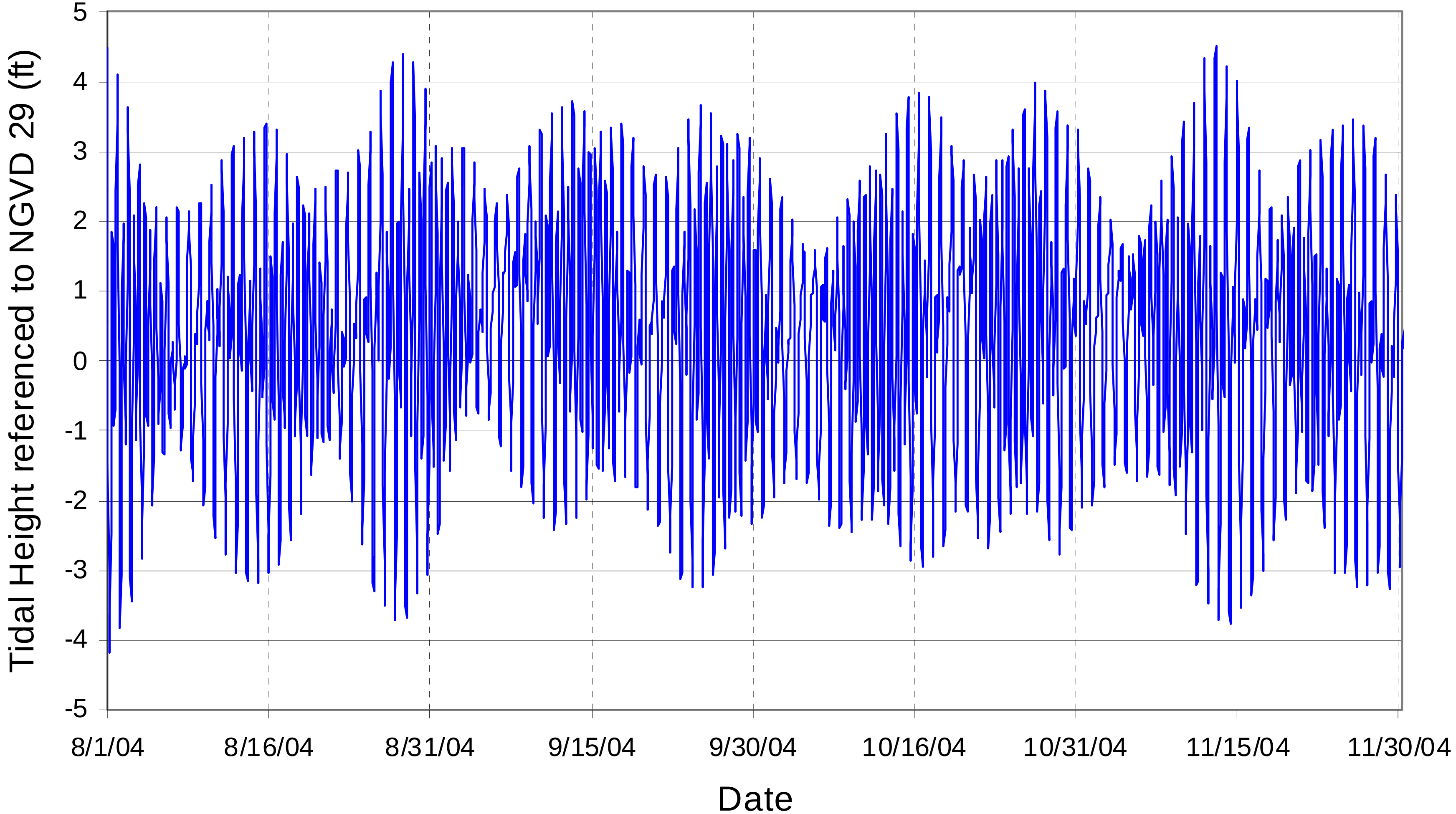
Hourly Precipitation

July 20, 2005 and October 24, 2005



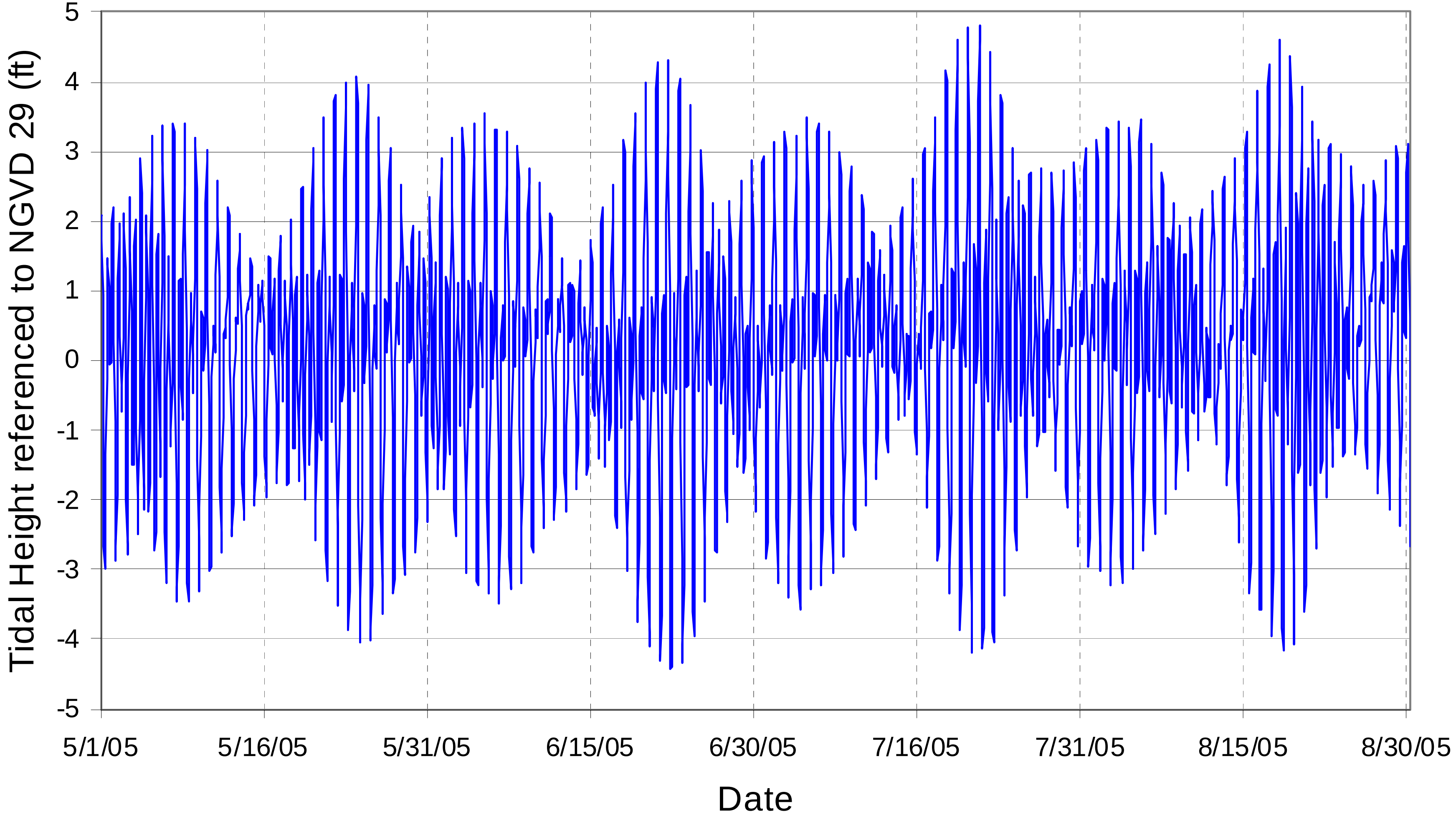
San Pedro Bay Oceanic Data

Tidal height late summer through fall 2004

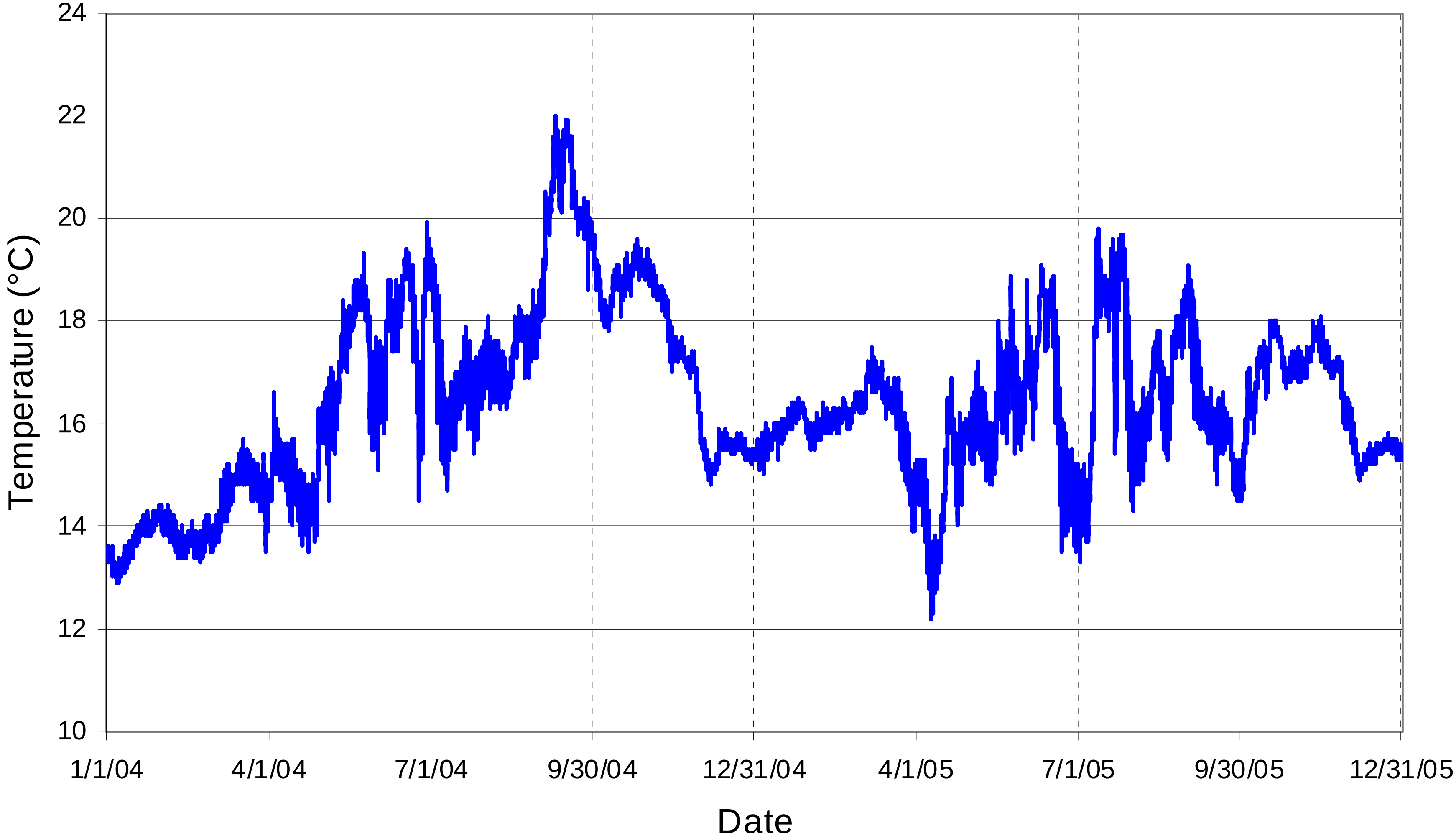


San Pedro Bay Oceanic Data

Tidal height late spring through summer 2005



San Pedro Bay Oceanic Data
Surface Water Temperatures 2004 - 2005



San Pedro Bay Oceanic Data

Tidal height July 20, 2005 and October 24, 2005

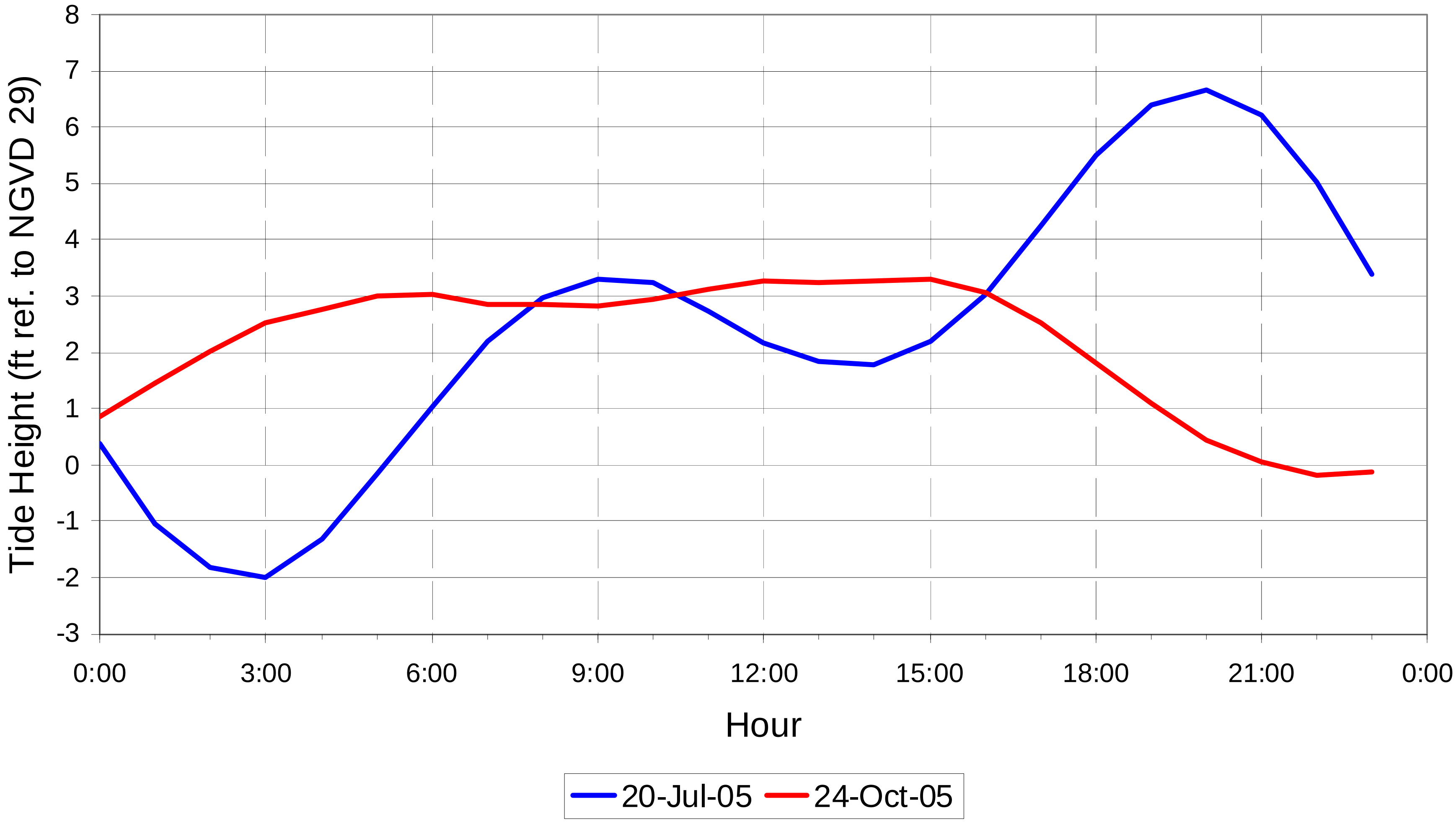
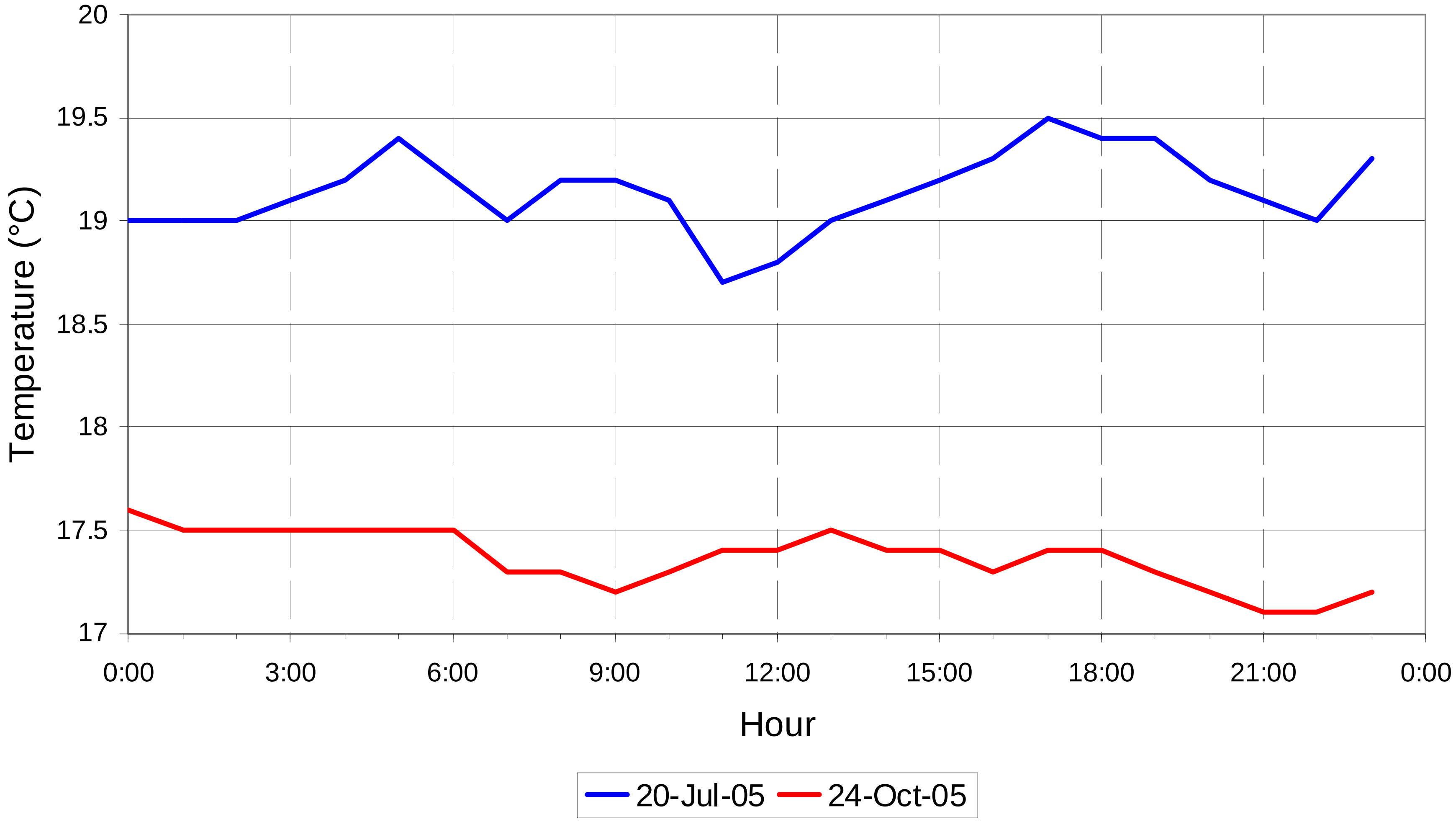


Figure C.15

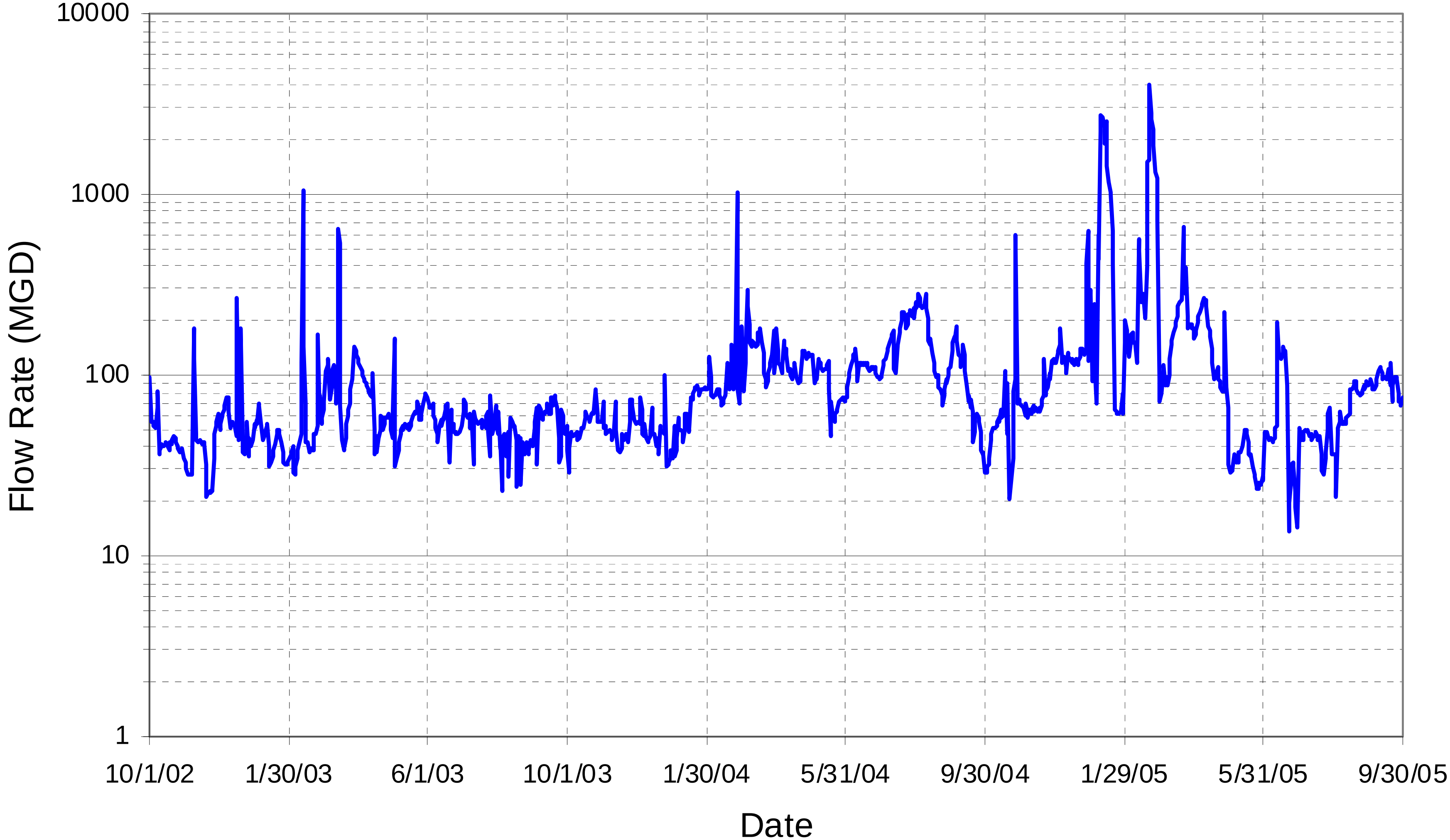
San Pedro Bay Oceanic Data

Surface water temperatures July 20, 2005 and October 24, 2005



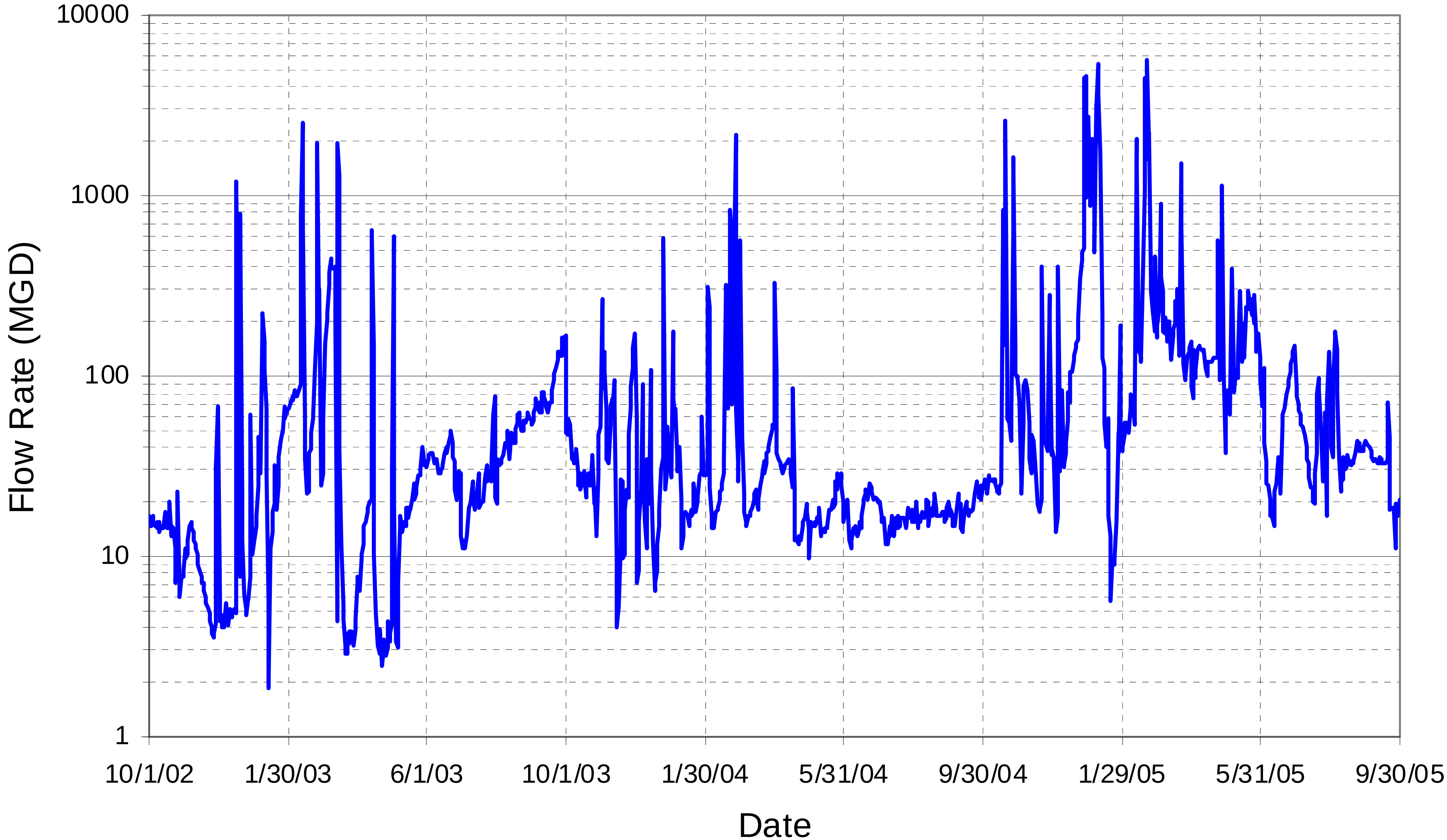
San Gabriel River Fresh Water Flow Rates

Daily Average Flow Rates



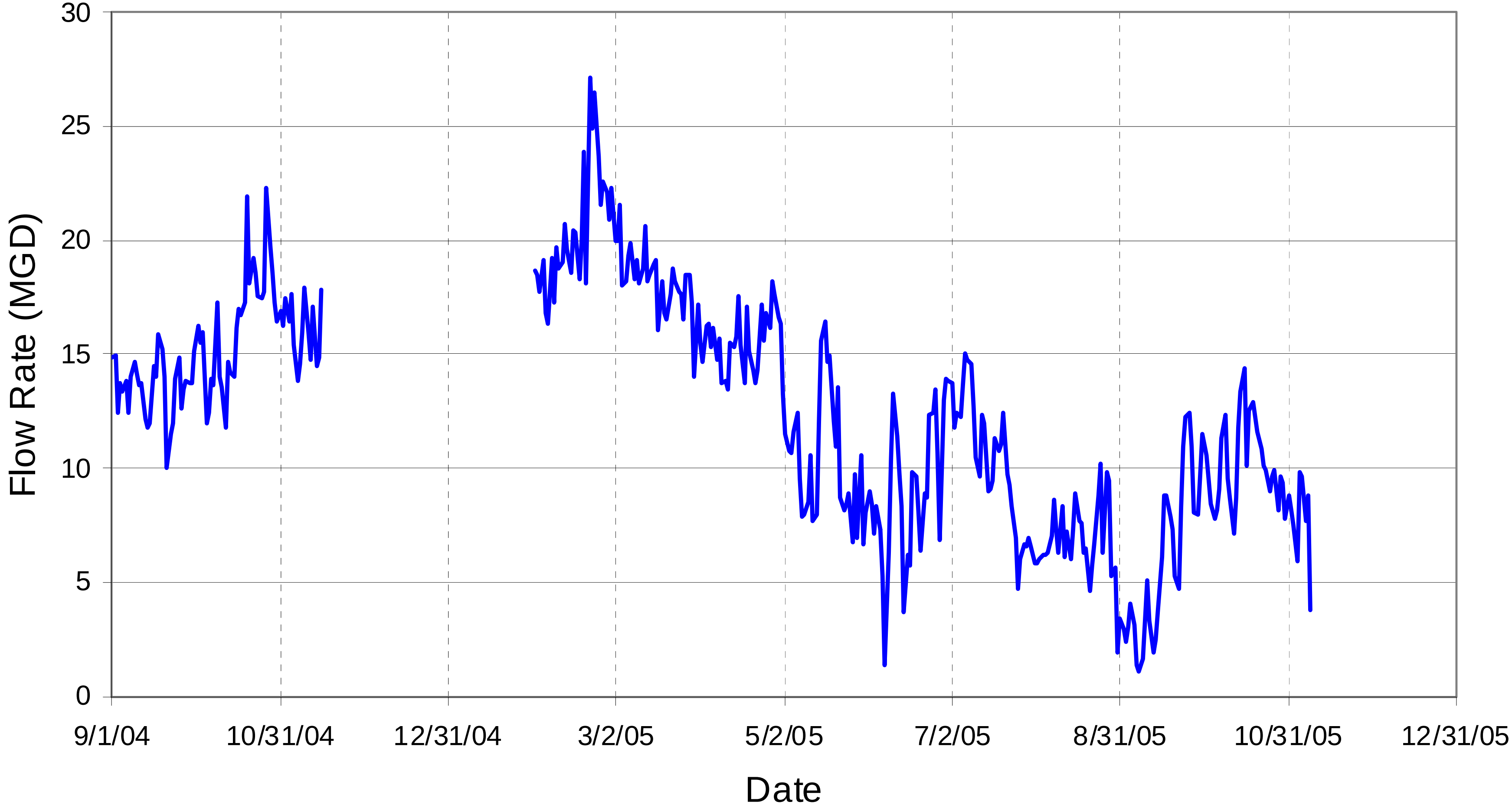
Coyote Creek Fresh Water Flow Rates

Daily Average Flow Rates



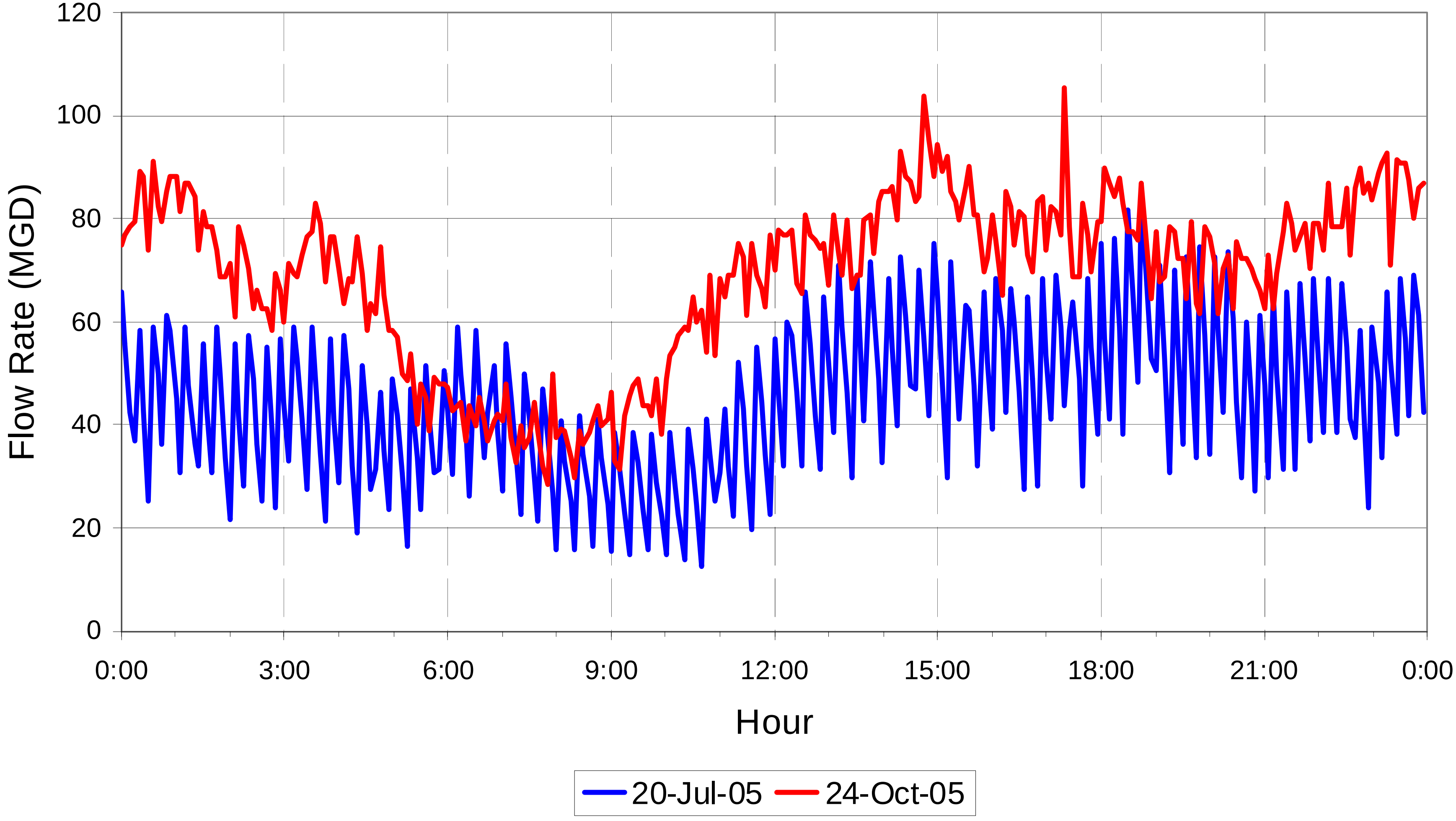
Long Beach Water Reclamation Plant Flow Rates

Daily Average Flow Rates

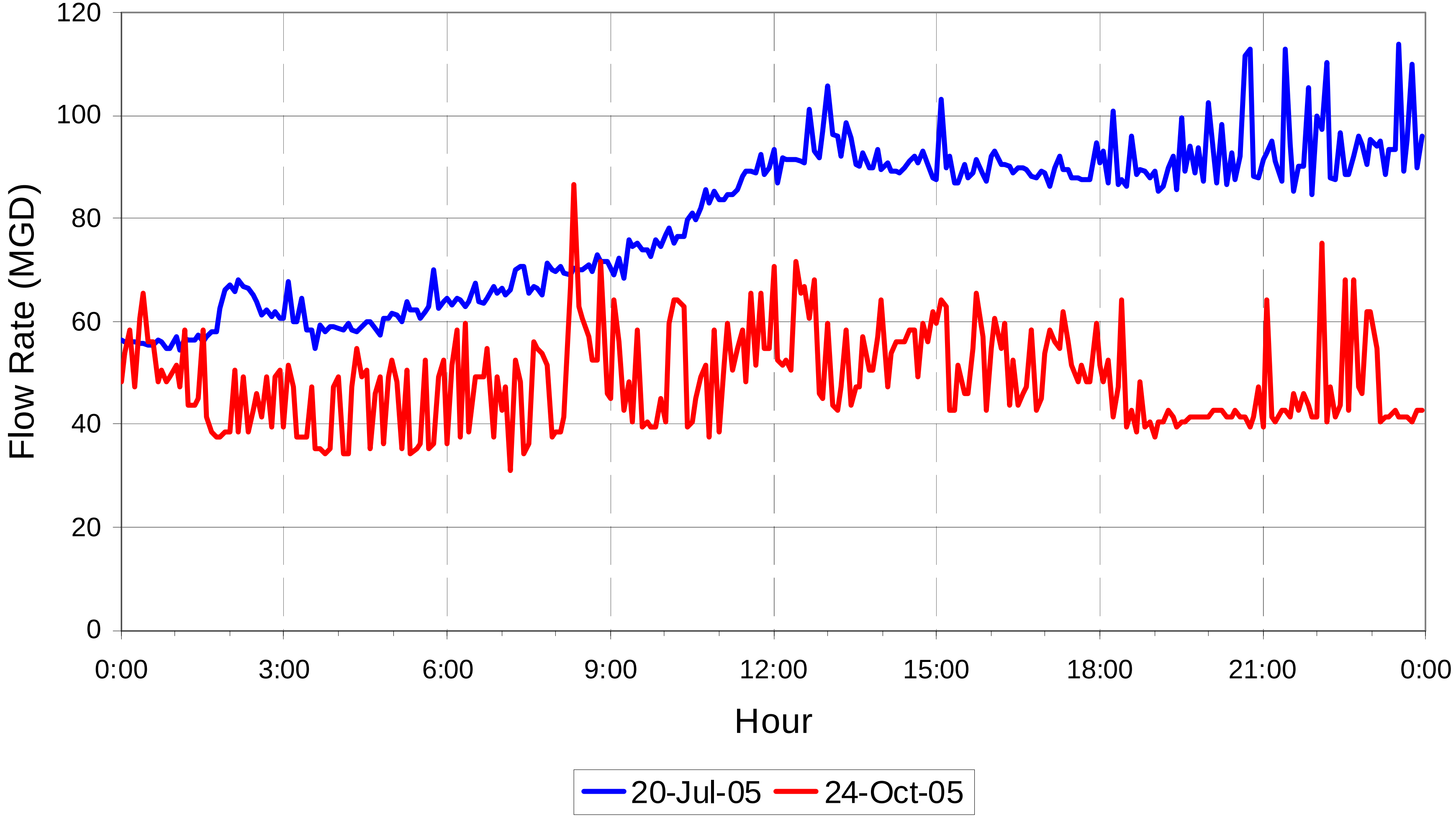


San Gabriel River Fresh Water Flow Rates

July 20, 2005 and October 24, 2005

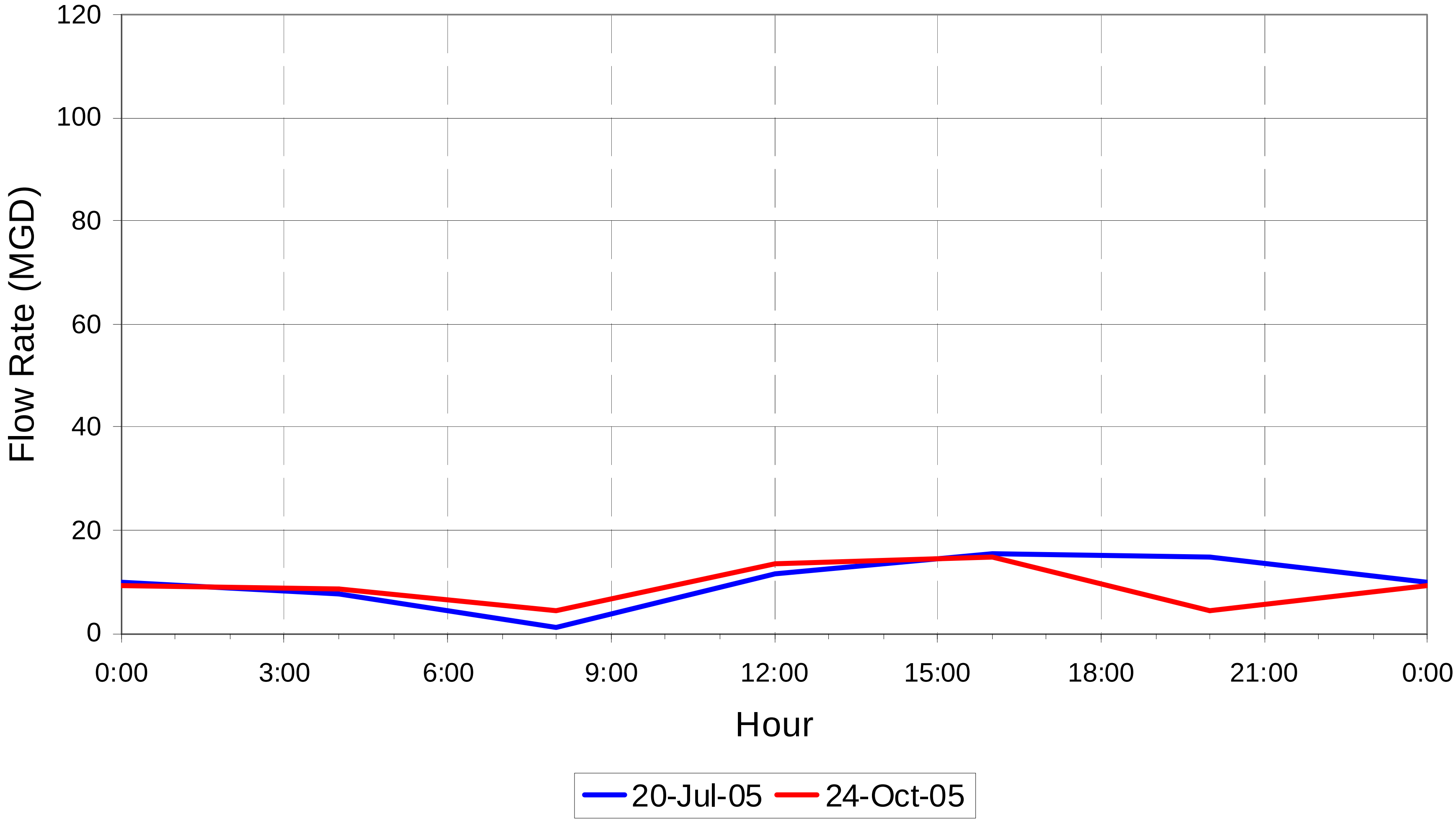


Coyote Creek Fresh Water Flow Rates
July 20, 2005 and October 24, 2005



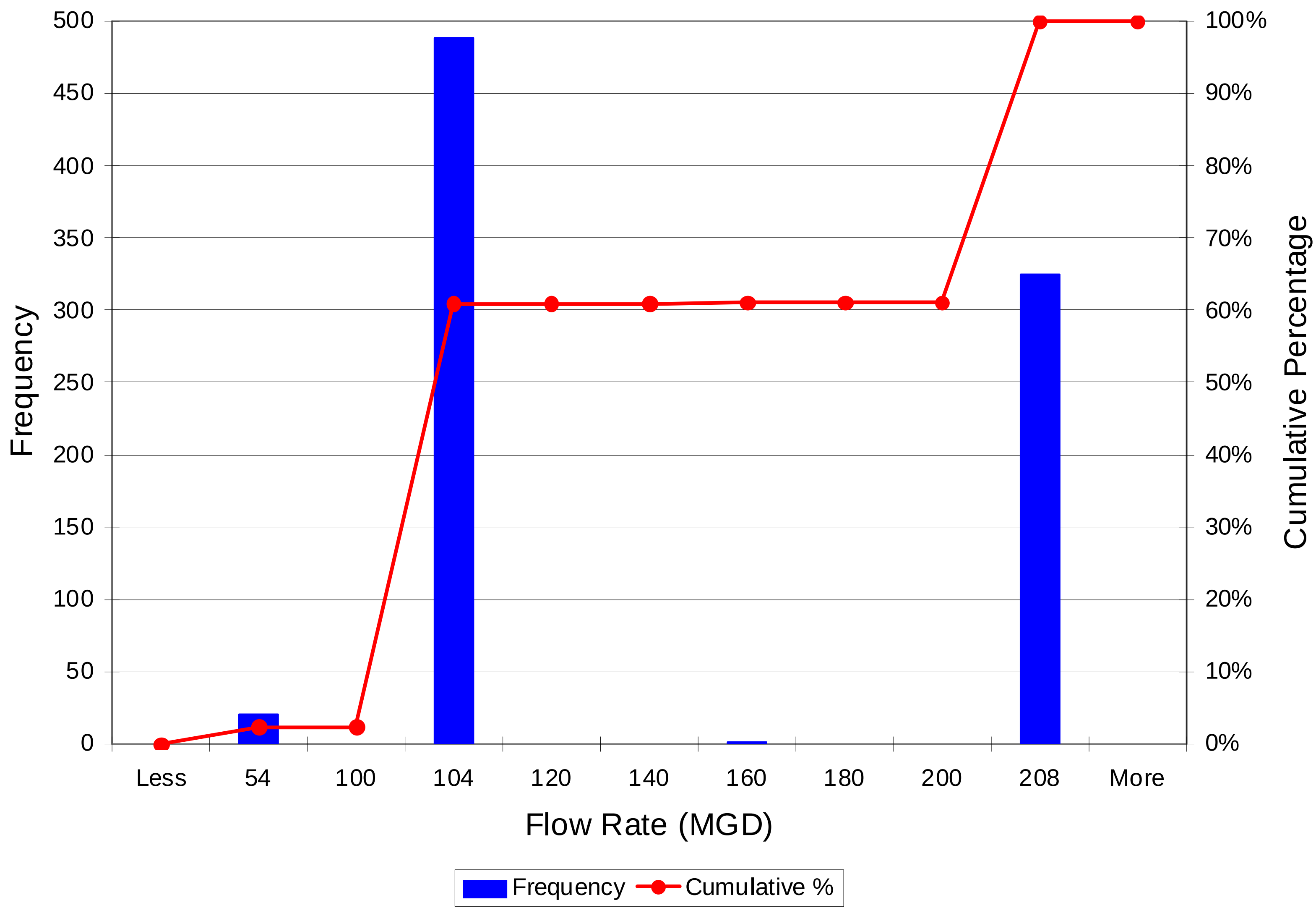
Long Beach Water Reclamation Plant Flow Rates

July 20, 2005 and October 24, 2005

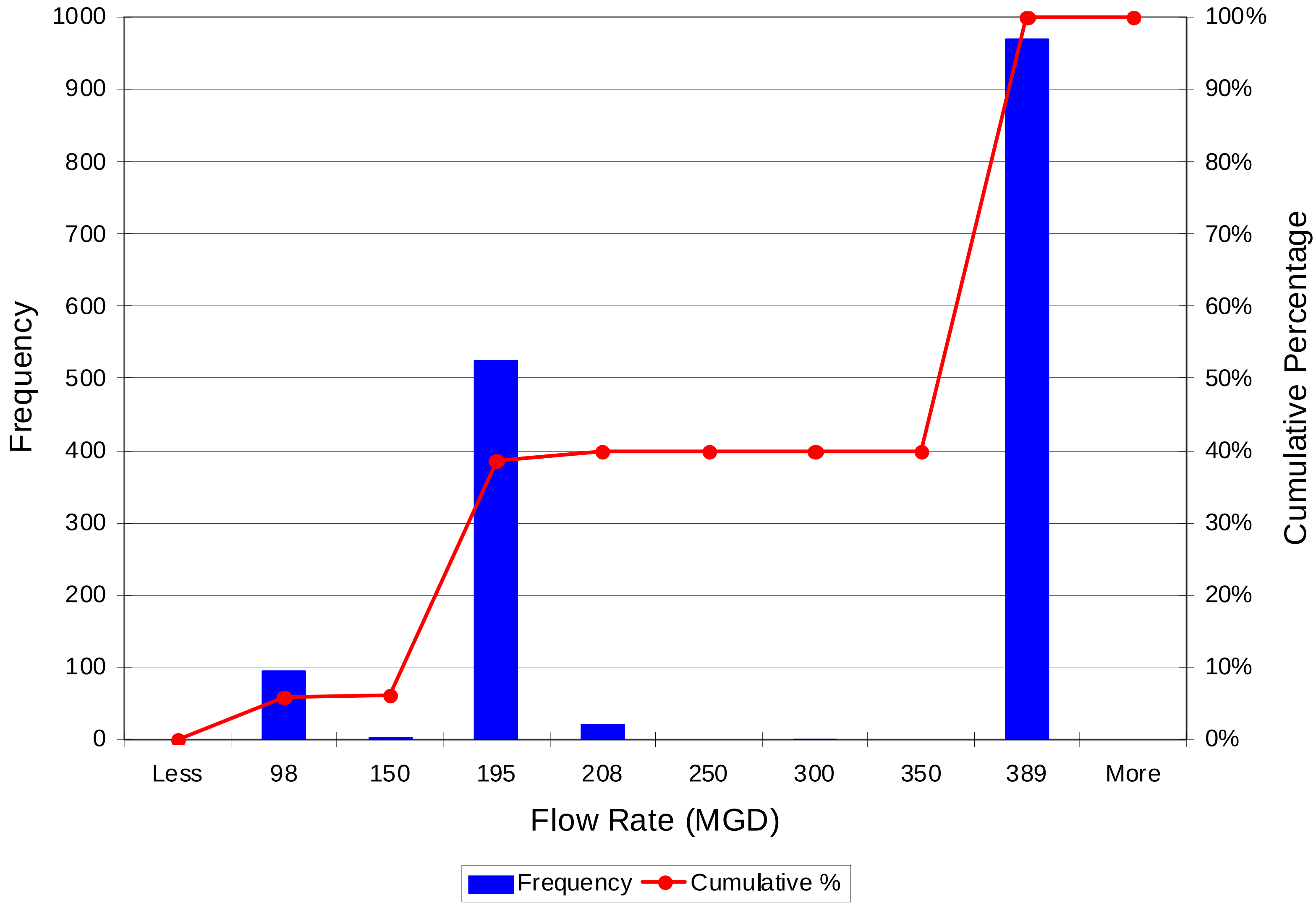


Alamitos Generating Station Outfall #1

Daily Average Flow Rate Histogram 2000 - 2005

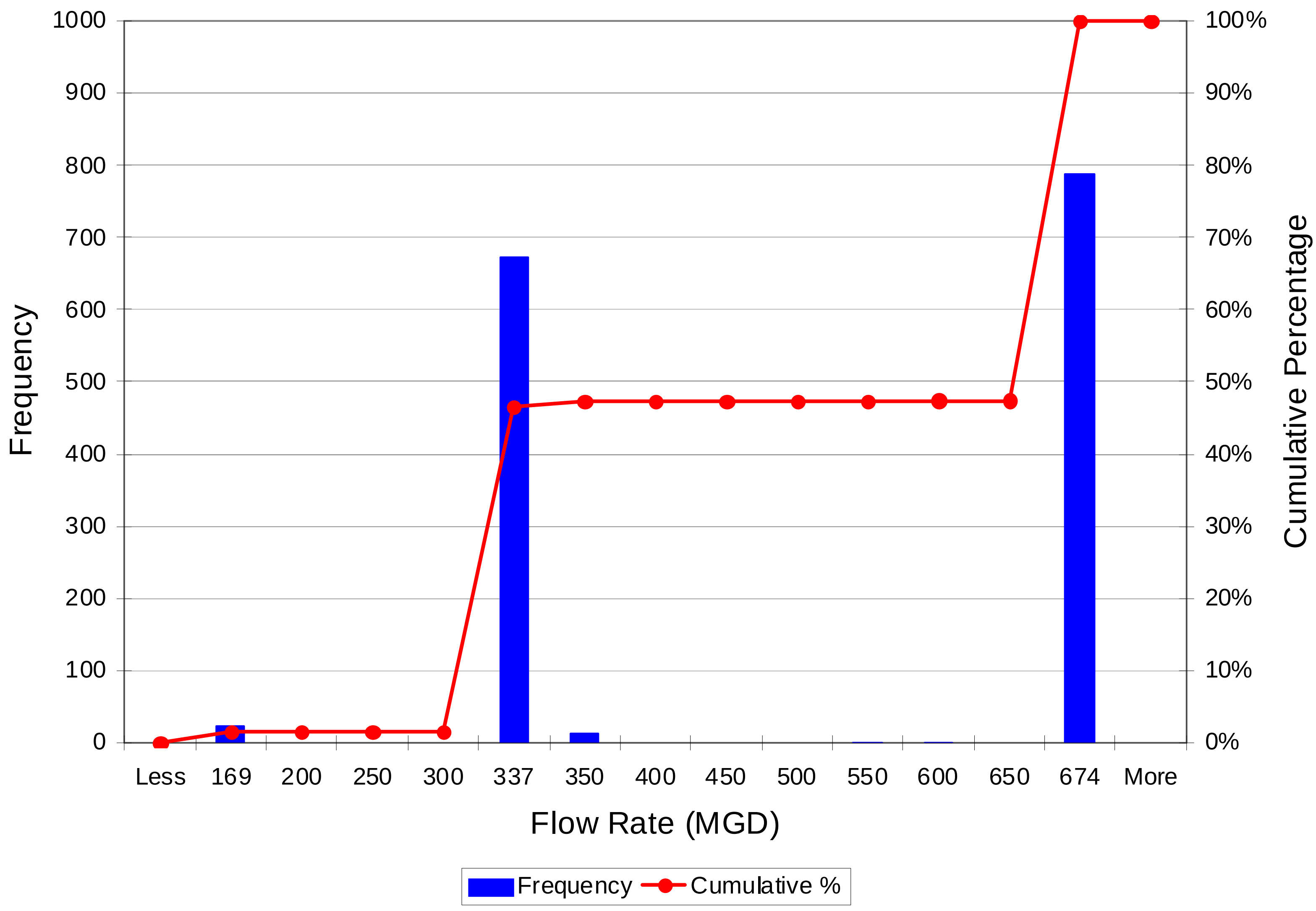


Alamitos Generating Station Outfall #2
Daily Average Flow Rate Histogram 2000 - 2005



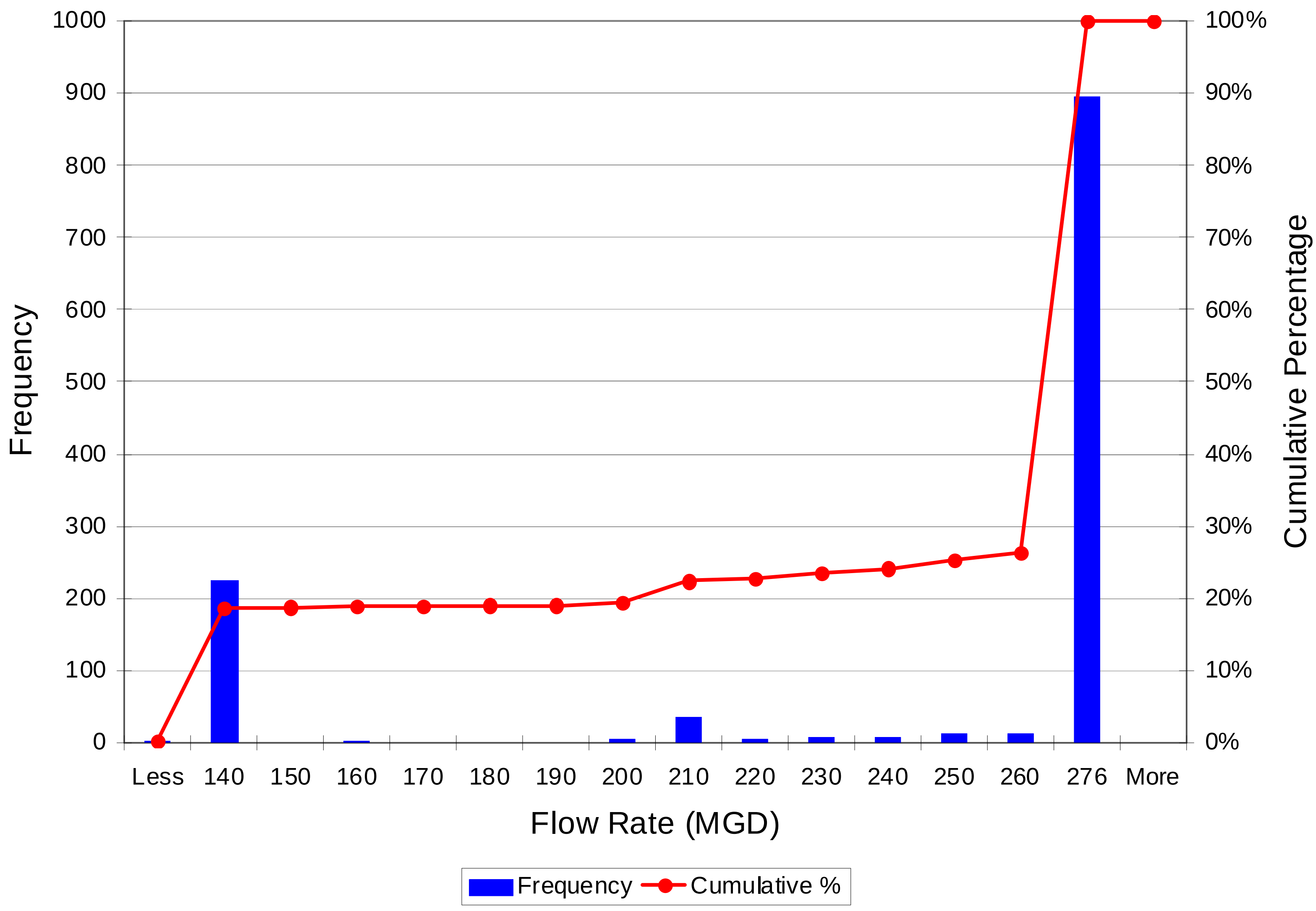
Alamitos Generating Station Outfall #3

Daily Average Flow Rate Histogram 2000 - 2005



Haynes Generating Station Outfall #1

Daily Average Flow Rate Histogram 2002 - 2005



Haynes Generating Station Outfall #2

Daily Average Flow Rate Histogram 2002 - 2005

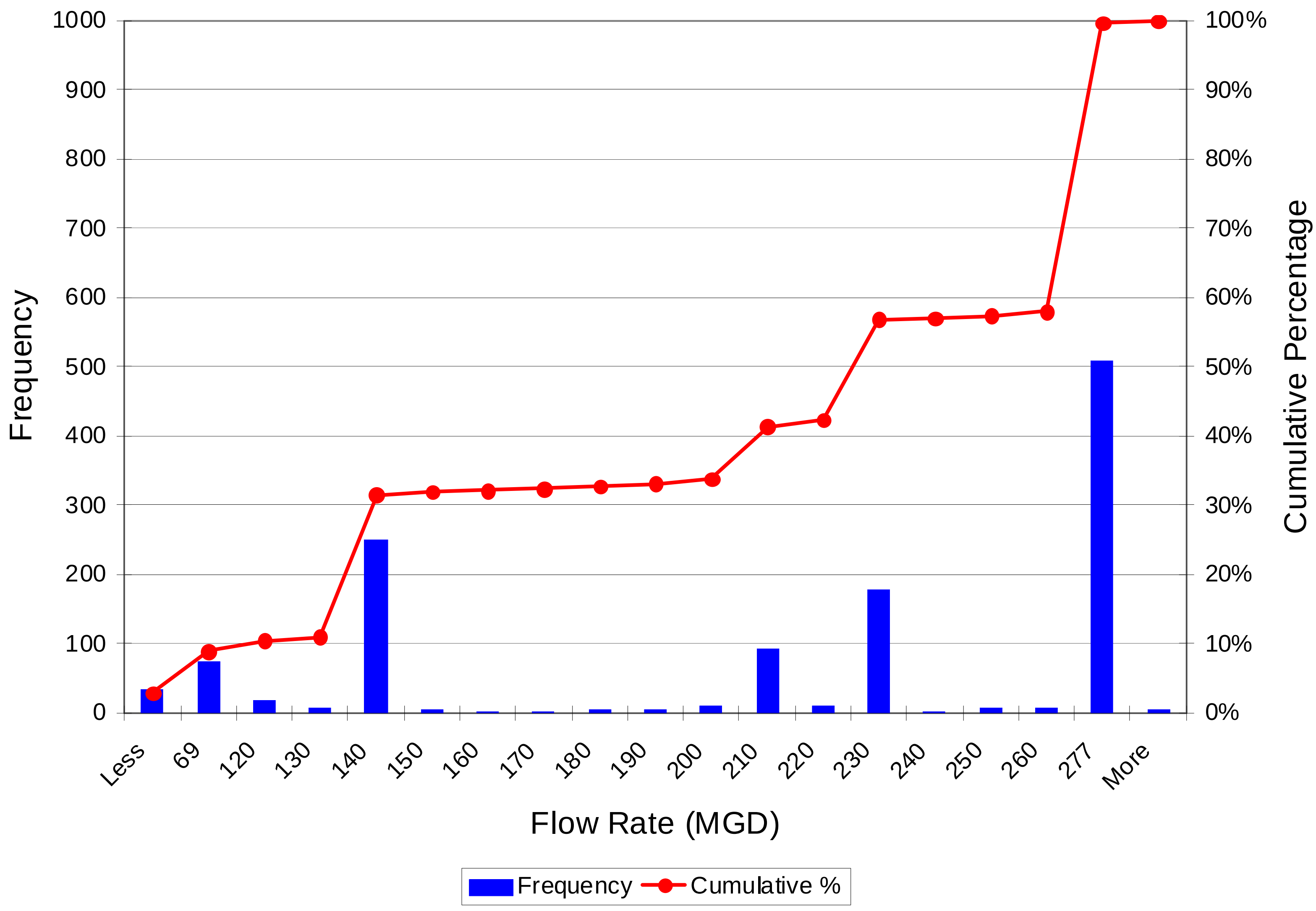
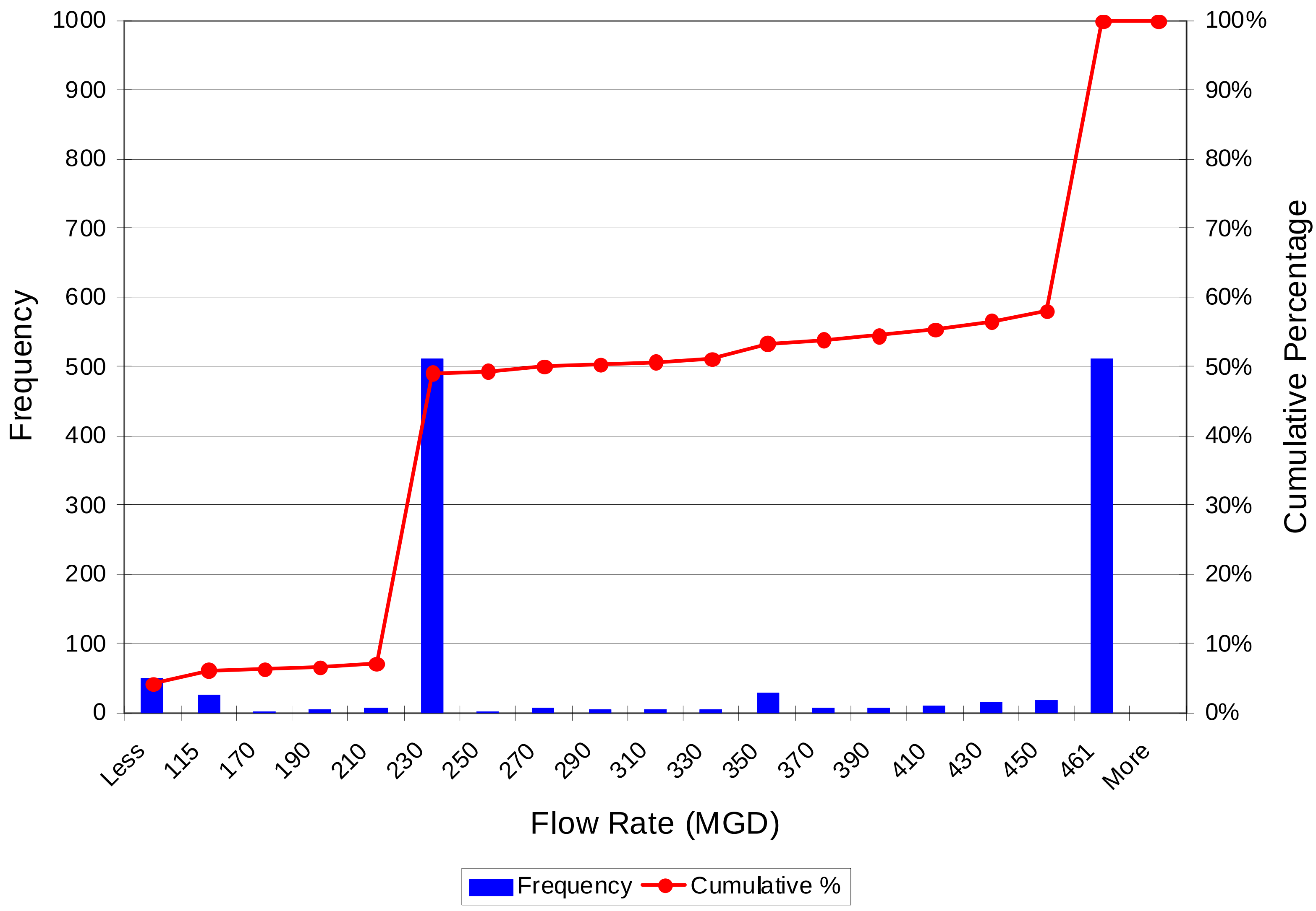


Figure C.27

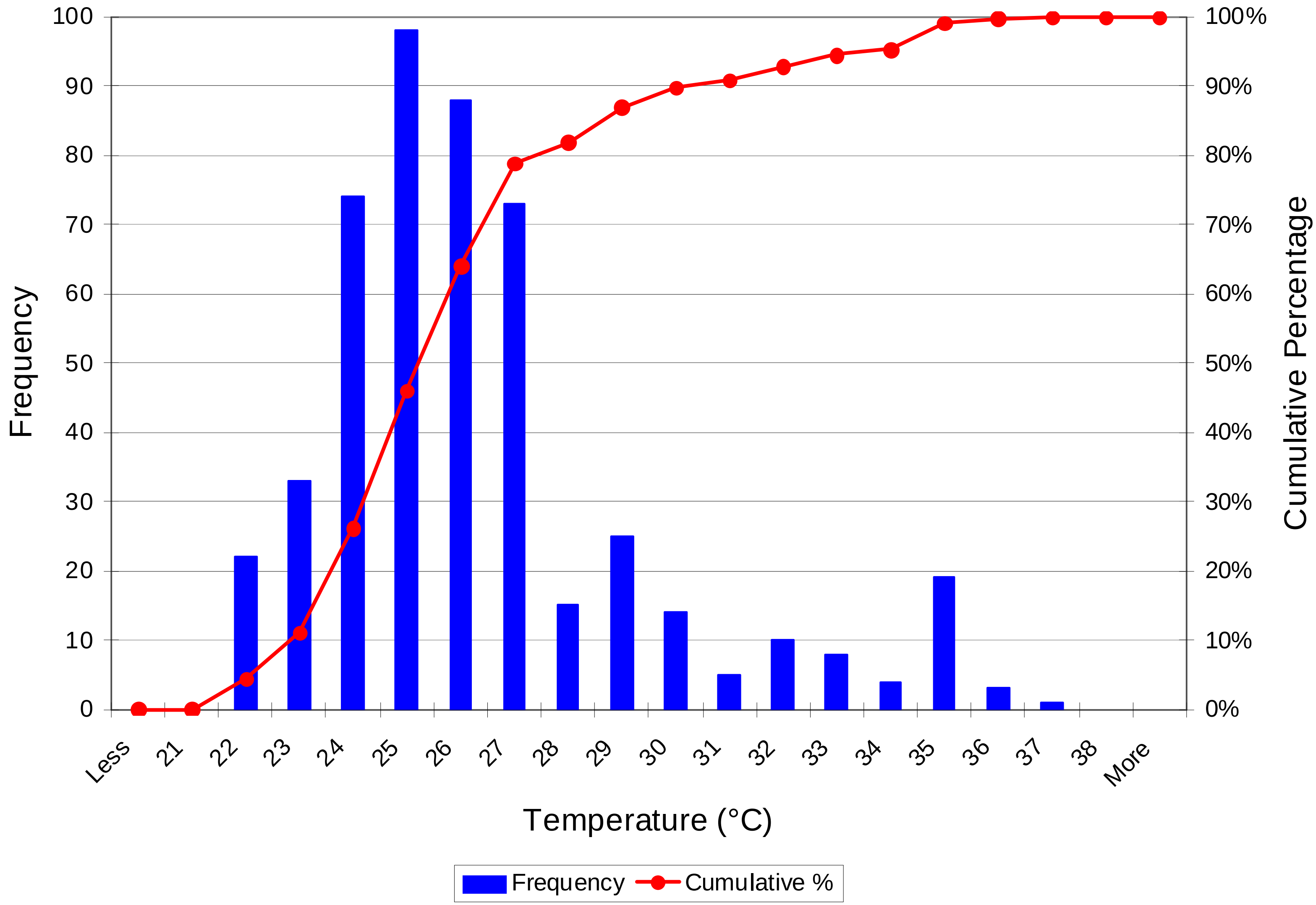
Haynes Generating Station Outfall #3

Daily Average Flow Rate Histogram 2002 - 2005



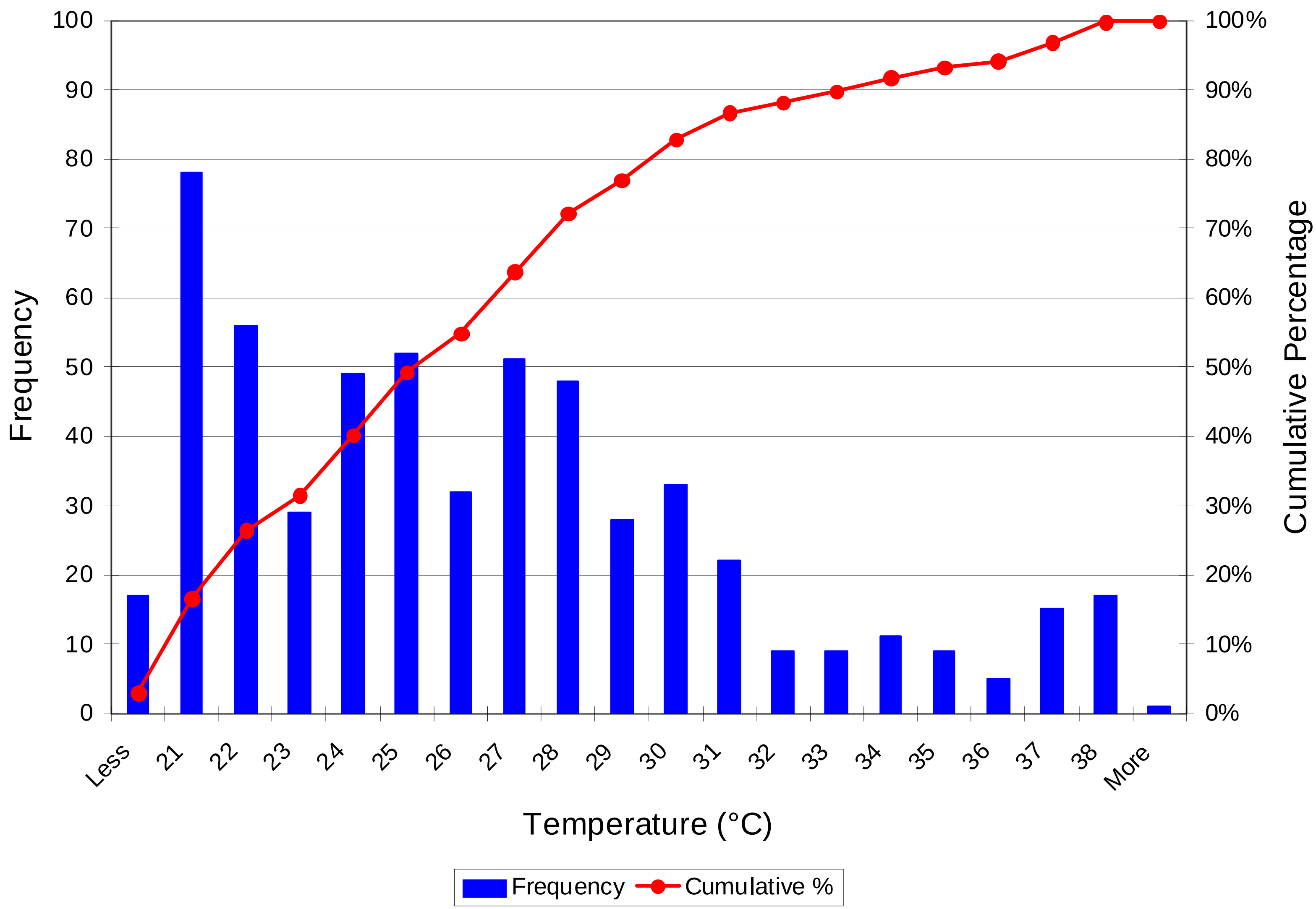
Alamitos Generating Station Outfall #1

Hourly Temperature Histogram around Sampling Events



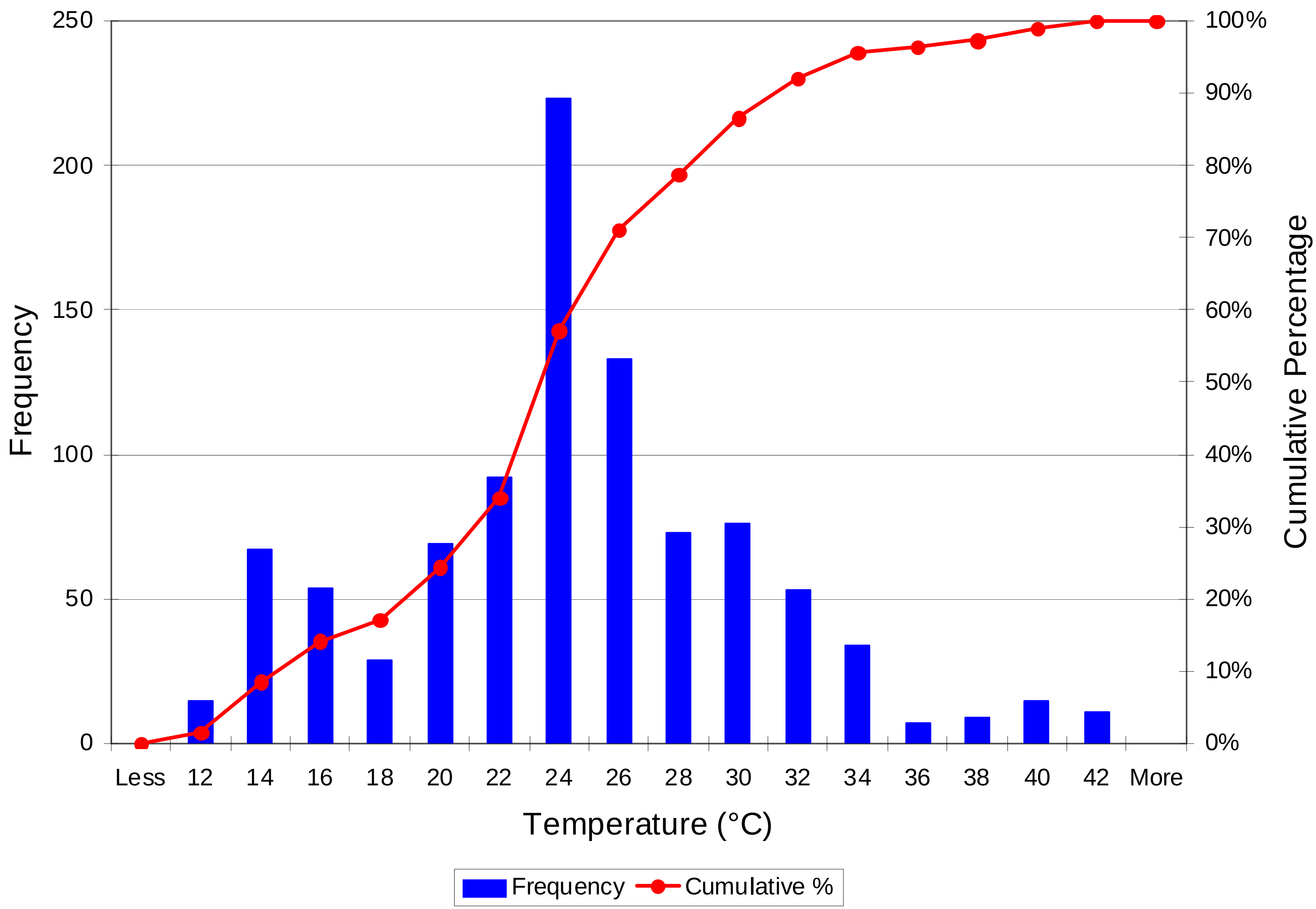
Alamitos Generating Station Outfall #2

Hourly Temperature Histogram around Sampling Events



Alamitos Generating Station Outfall #3

Hourly Temperature Histogram around Sampling Events



Haynes Generating Station Outfall #1

Hourly Temperature Histogram around Sampling Events

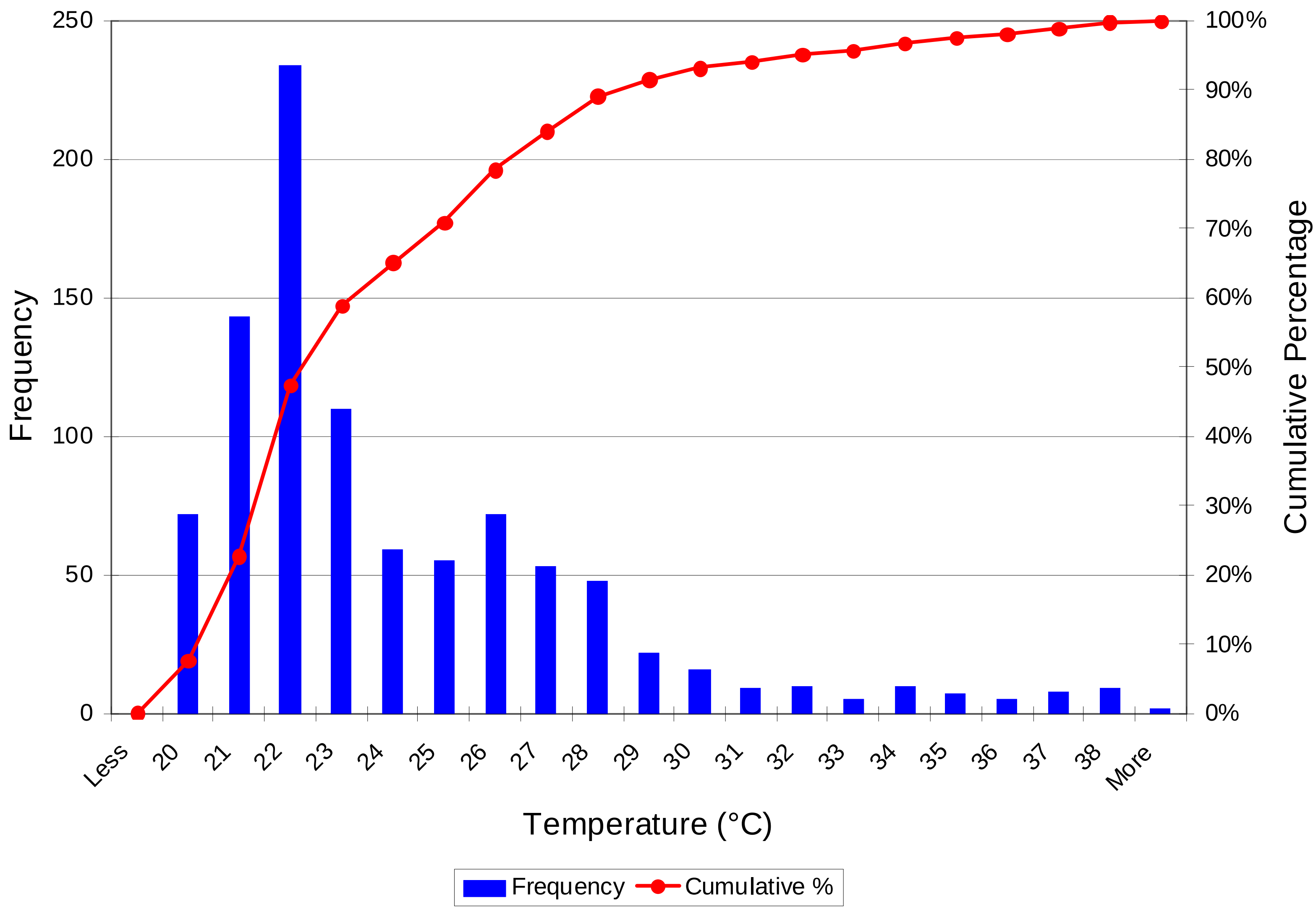
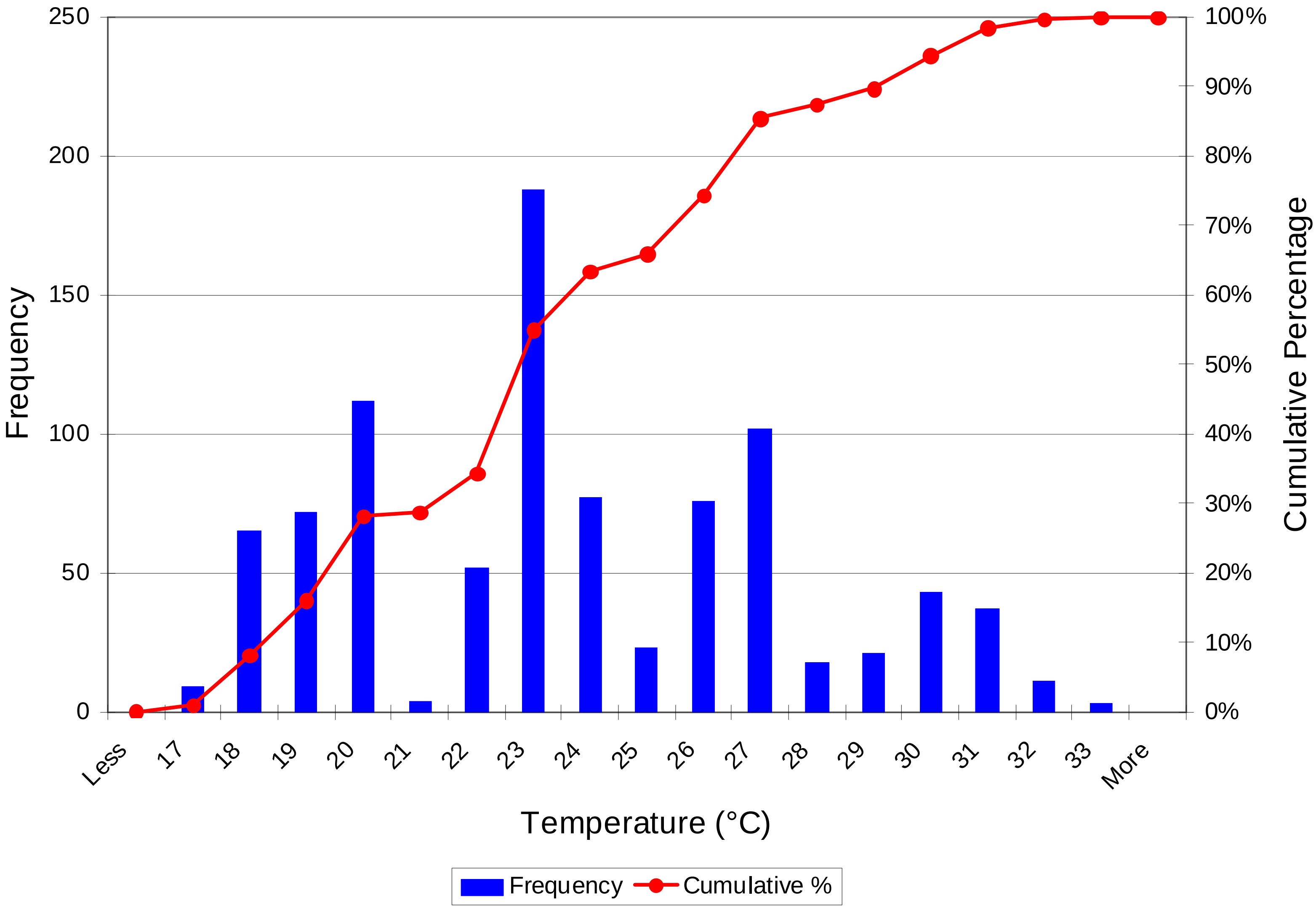


Figure C.32

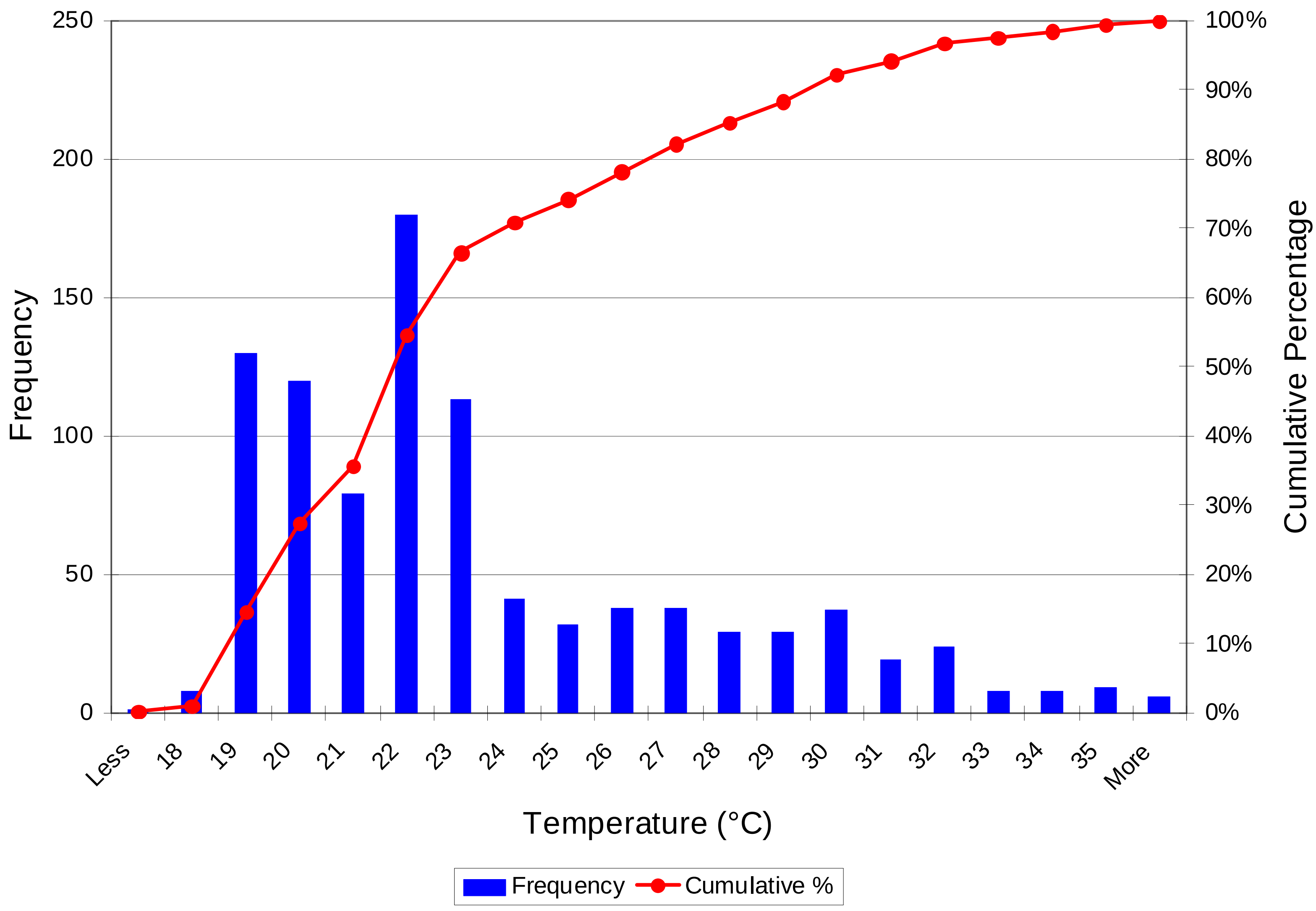
Haynes Generating Station Outfall #2

Hourly Temperature Histogram around Sampling Events



Haynes Generating Station Outfall #3

Hourly Temperature Histogram around Sampling Events



Generating Station Outfall Flow Rates
July 20, 2005

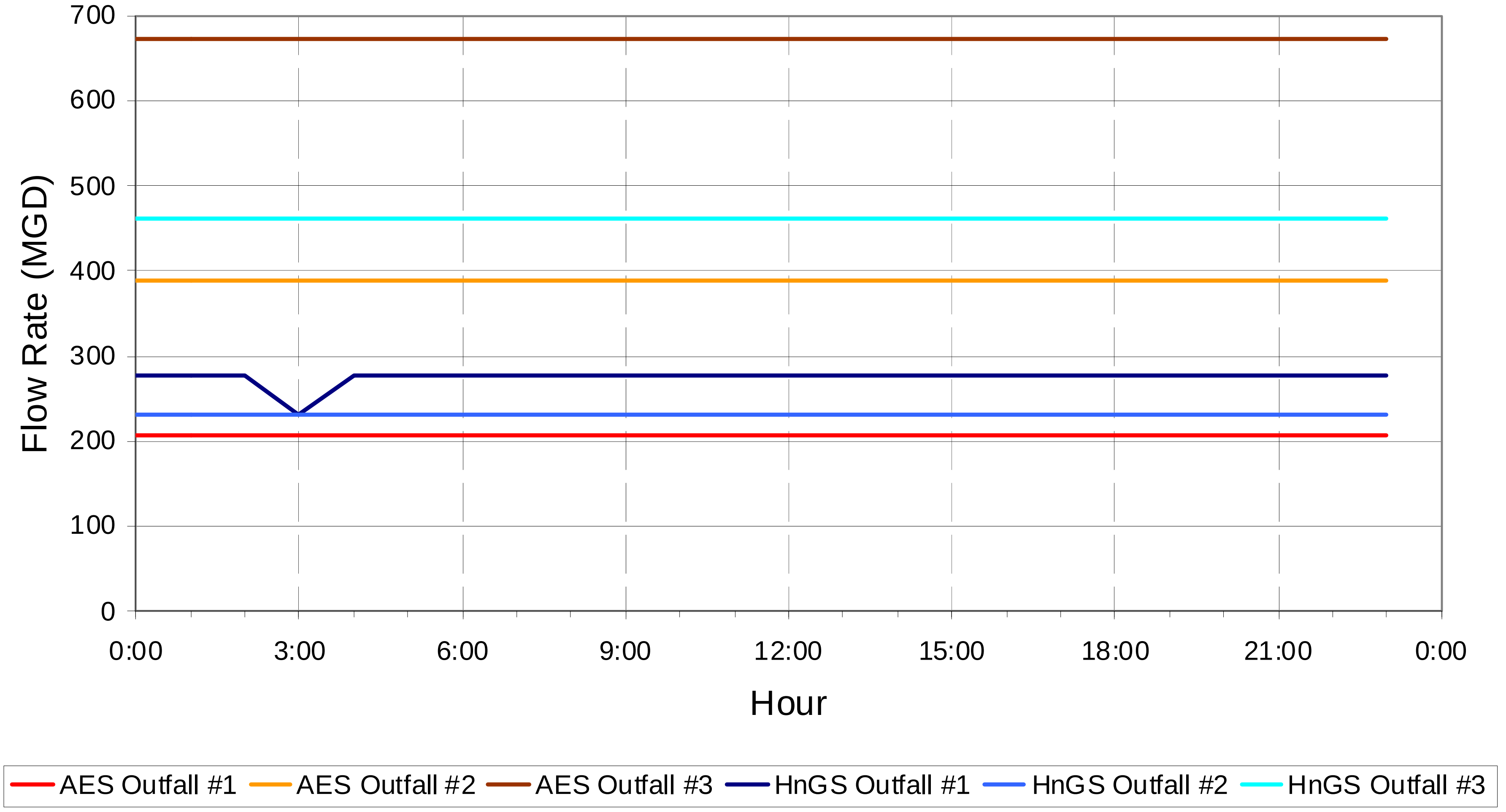
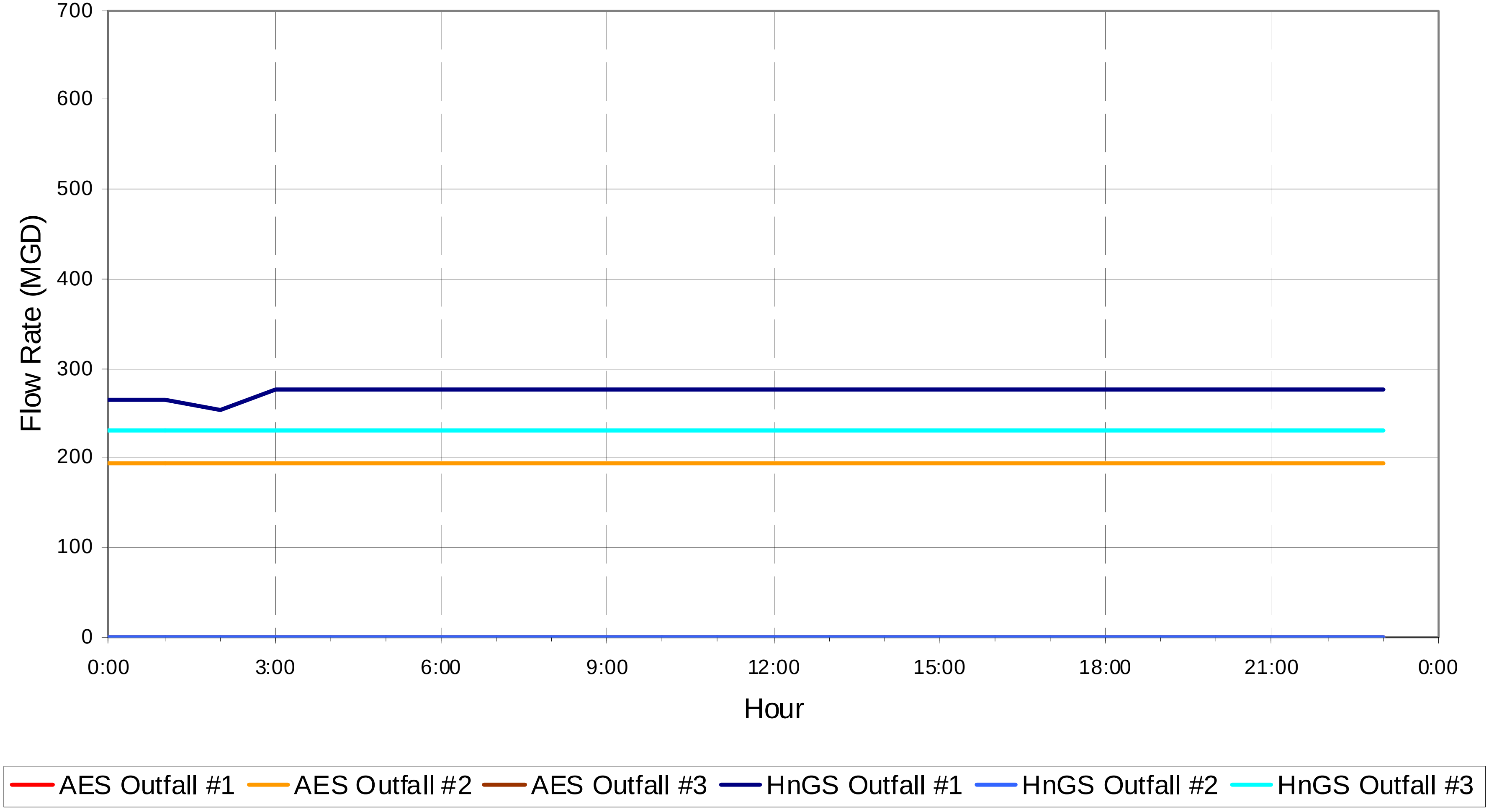


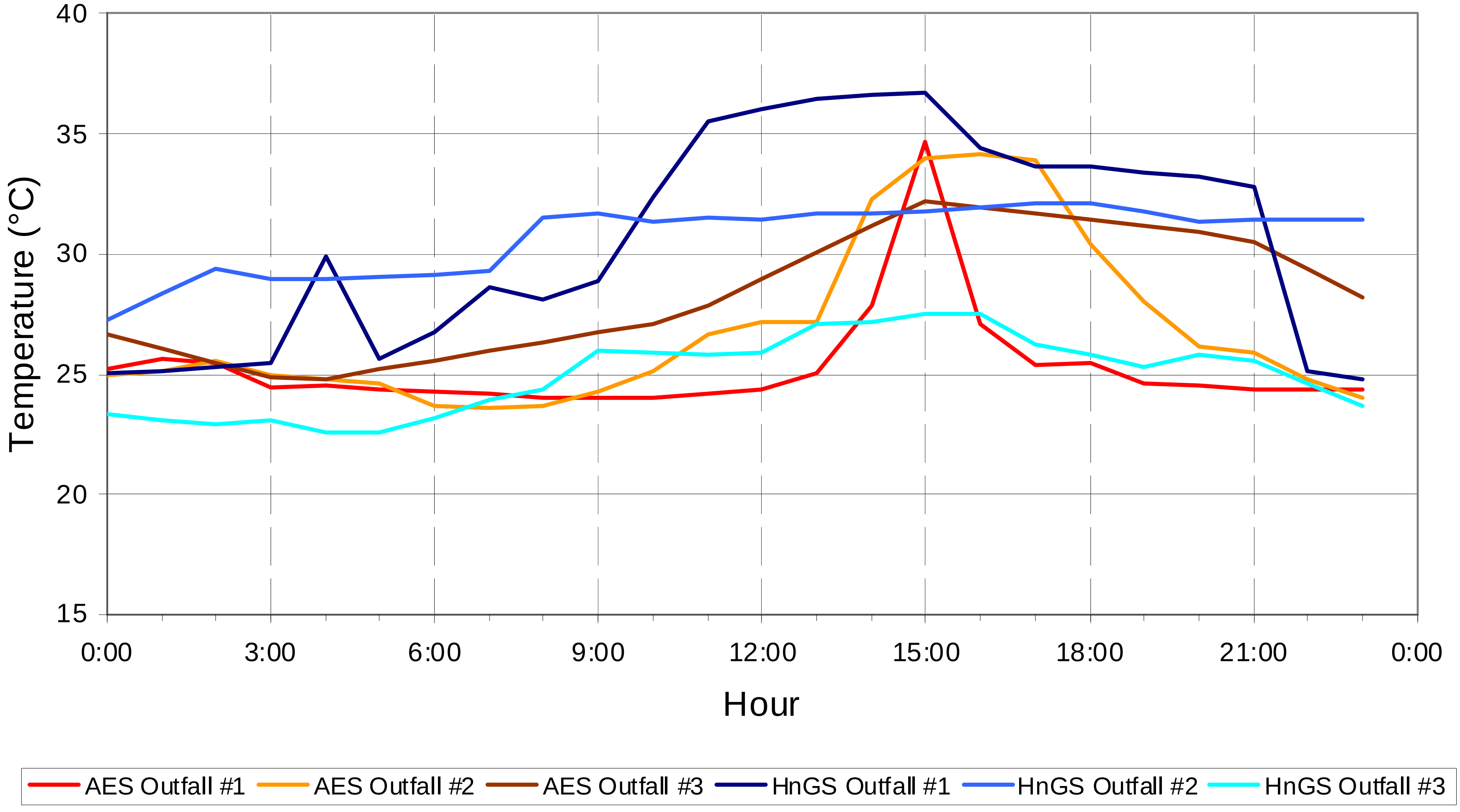
Figure C.35

Generating Station Outfall Flow Rates
October 24, 2005



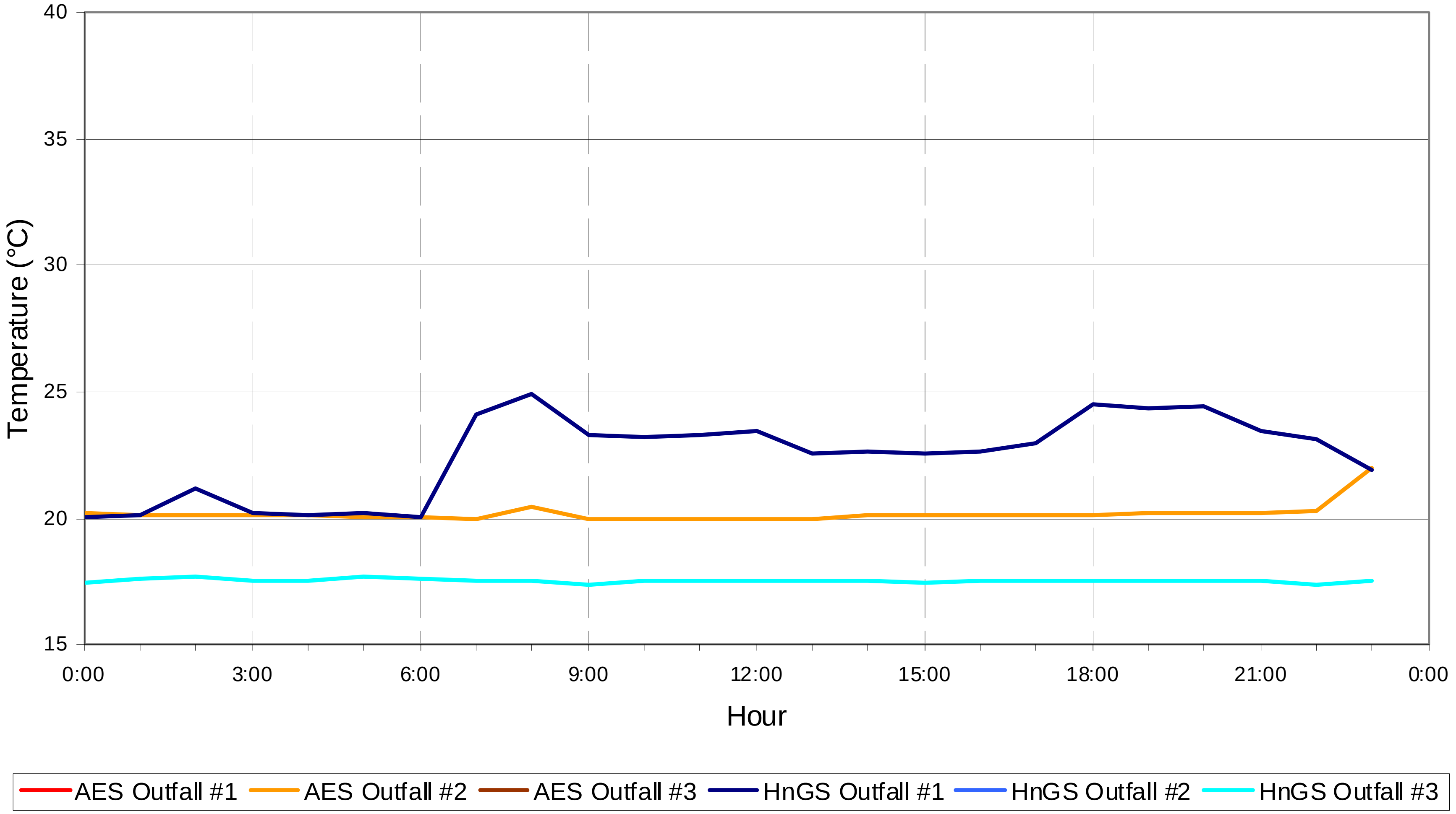
Generating Station Outfall Temperatures

July 20, 2005



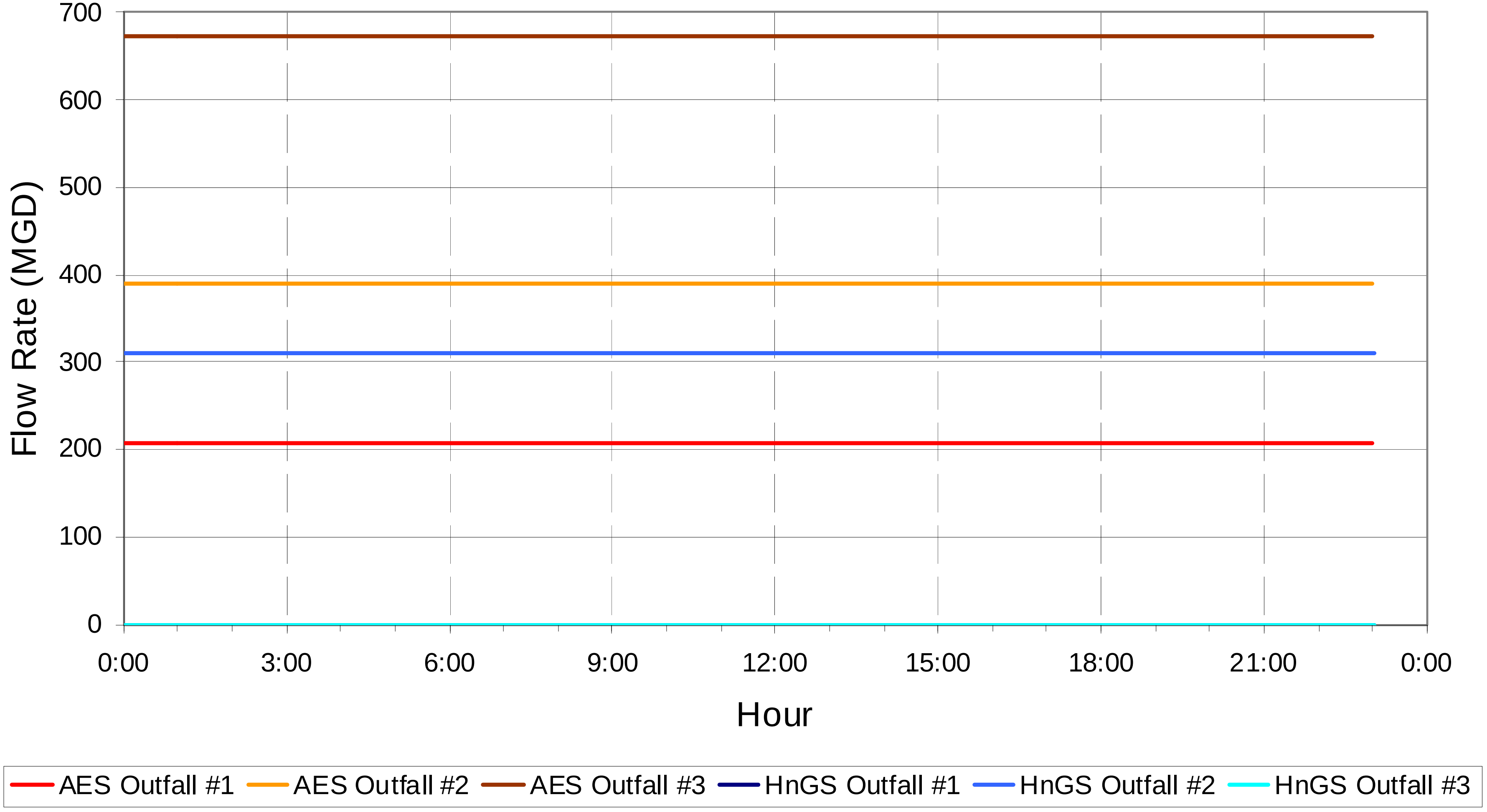
Generating Station Outfall Temperatures

October 24, 2005



Generating Station Outfall Flow Rates

CEQA Normal Minimum Operations July 20, 2005



Generating Station Outfall Flow Rates

CEQA Normal Minimum Operations October 24, 2005

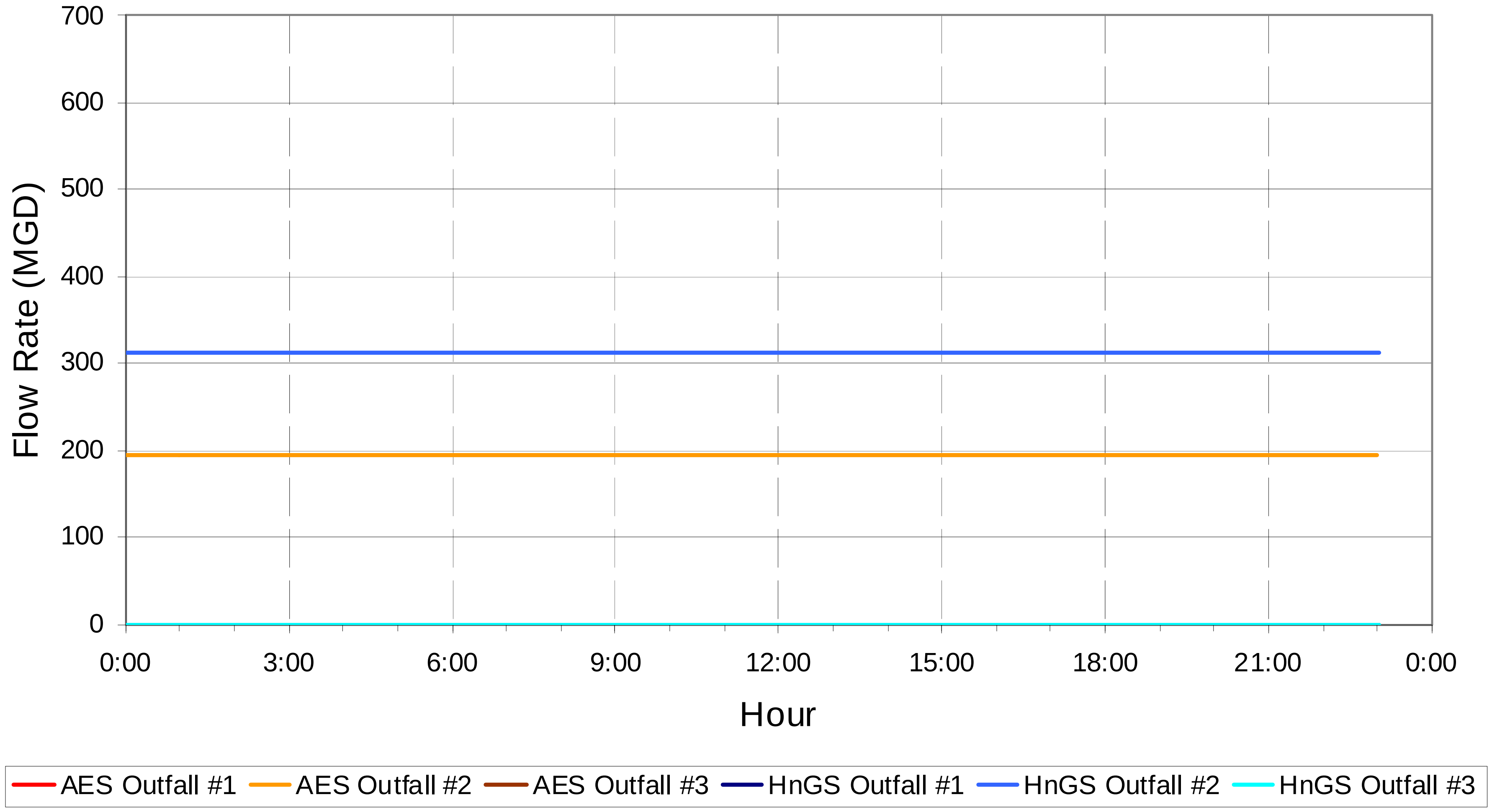
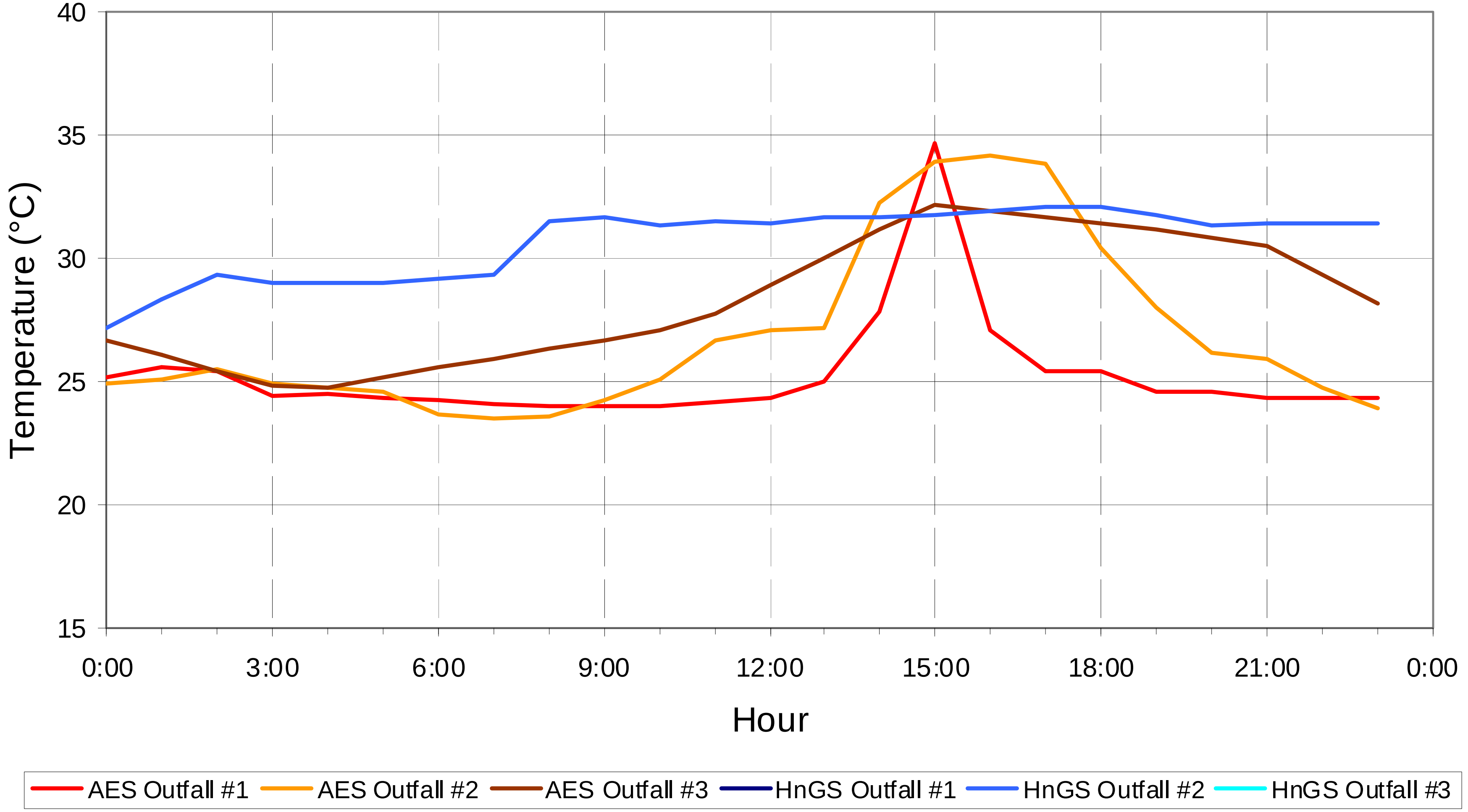
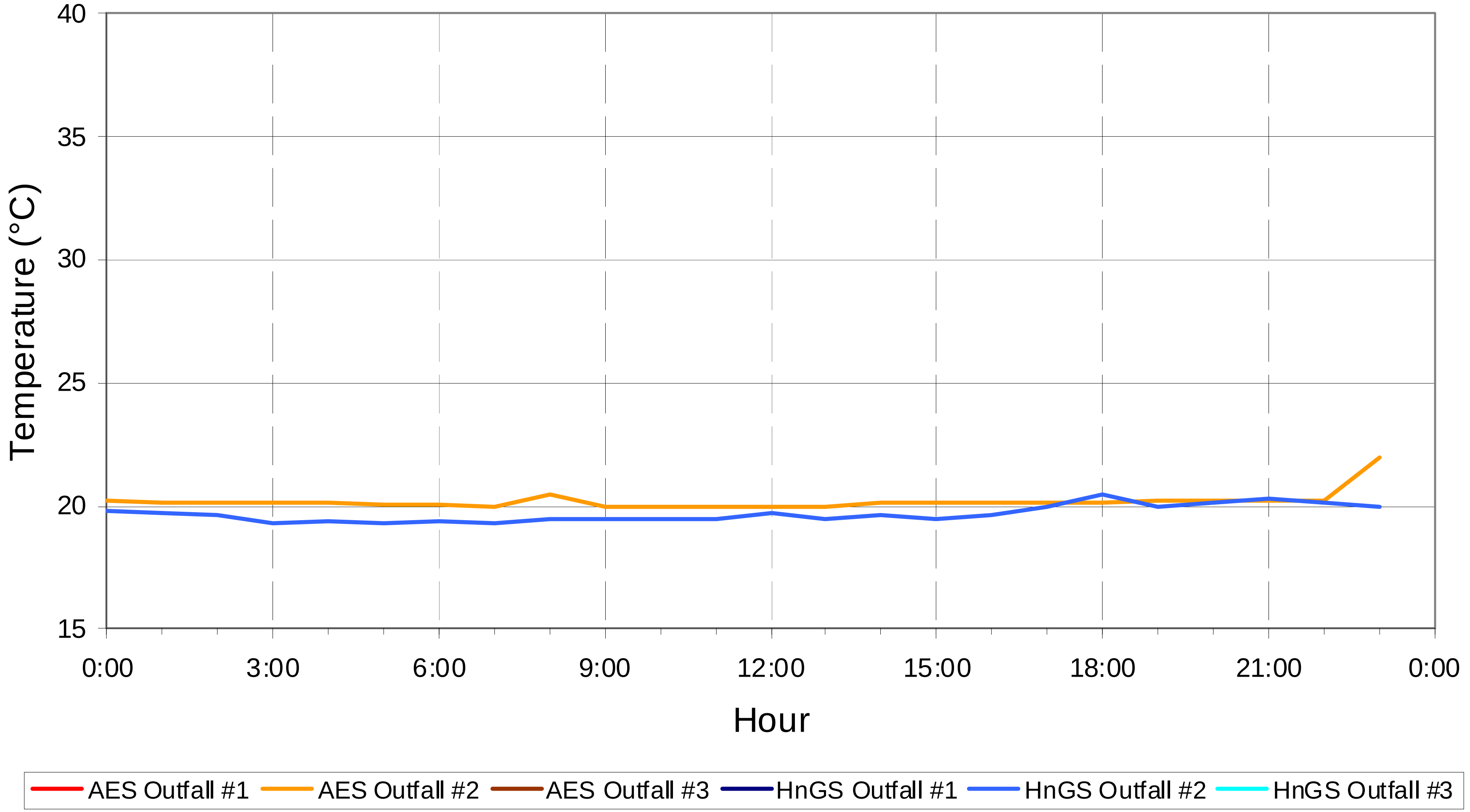


Figure C.40

Generating Station Outfall Temperatures
CEQA Normal Minimum Operations July 20, 2005

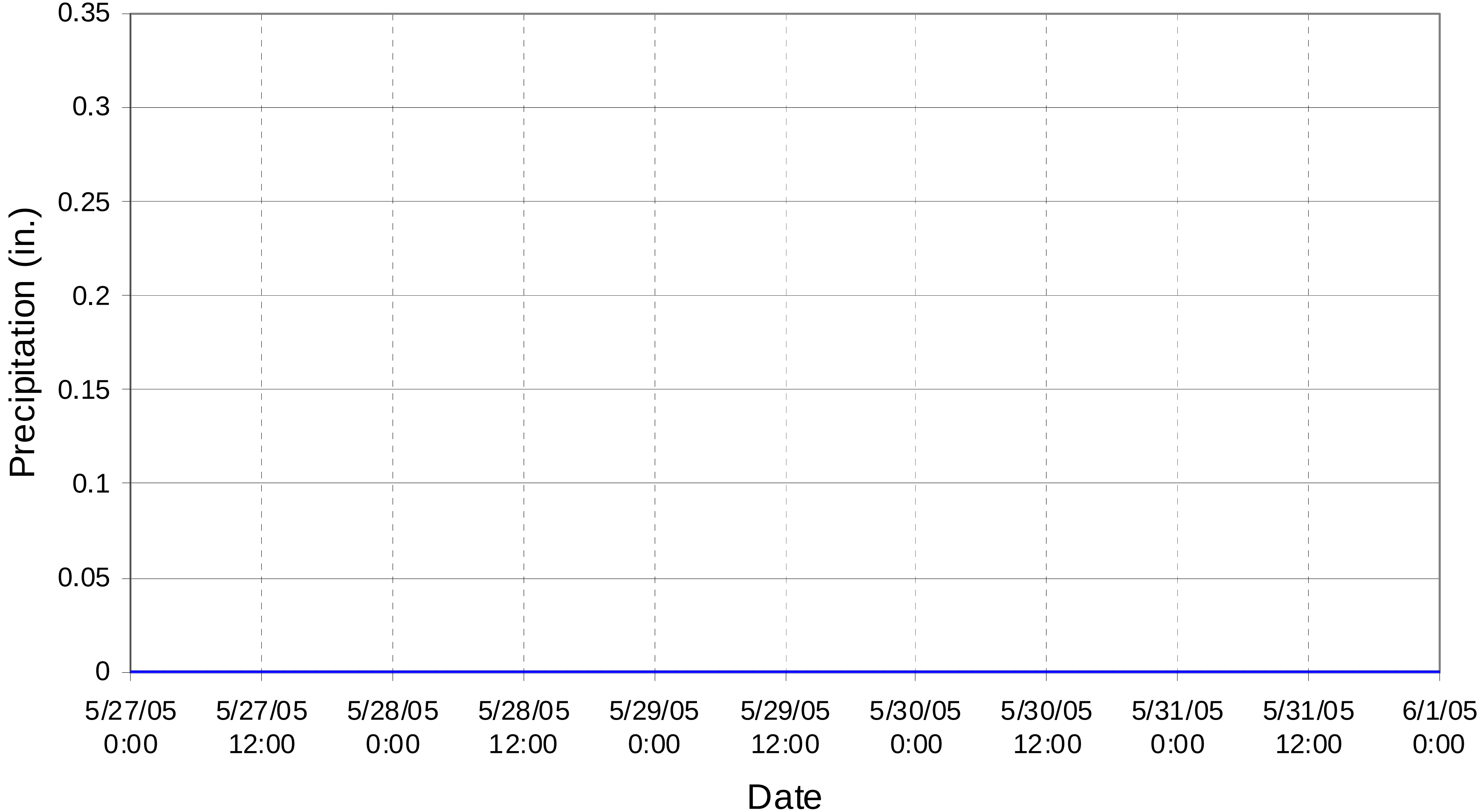


Generating Station Outfall Temperatures
CEQA Normal Minimum Operations October 24, 2005



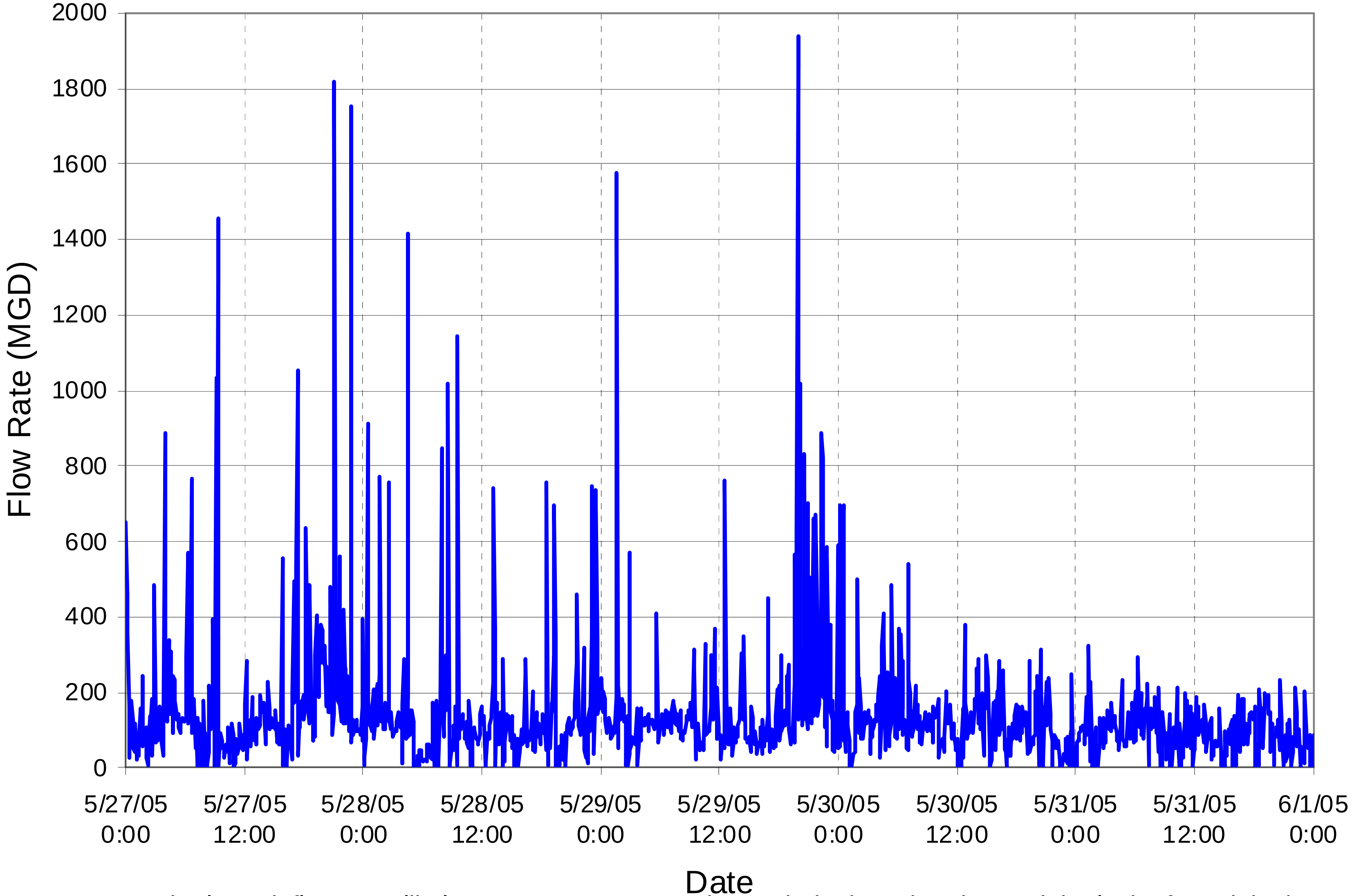
Hourly Precipitation May 27 – June 1, 2005

Sampling Event: May 31, 2005



Coyote Creek Flow Rates May 27 – June 1, 2005

Sampling Event: May 31, 2005

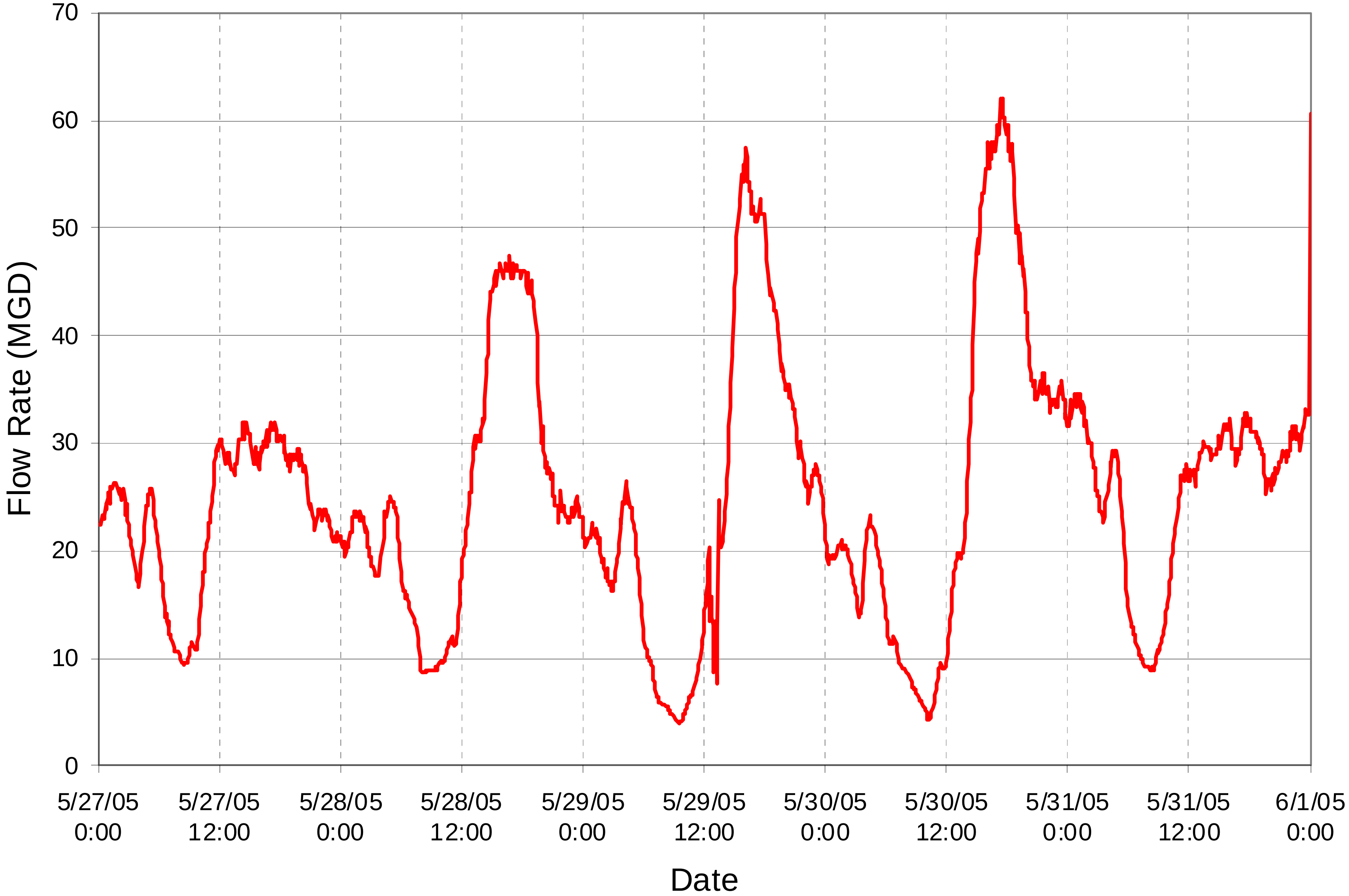


*The large inflows are likely measurement error due to their short duration and the lack of precipitation

Figure C.44

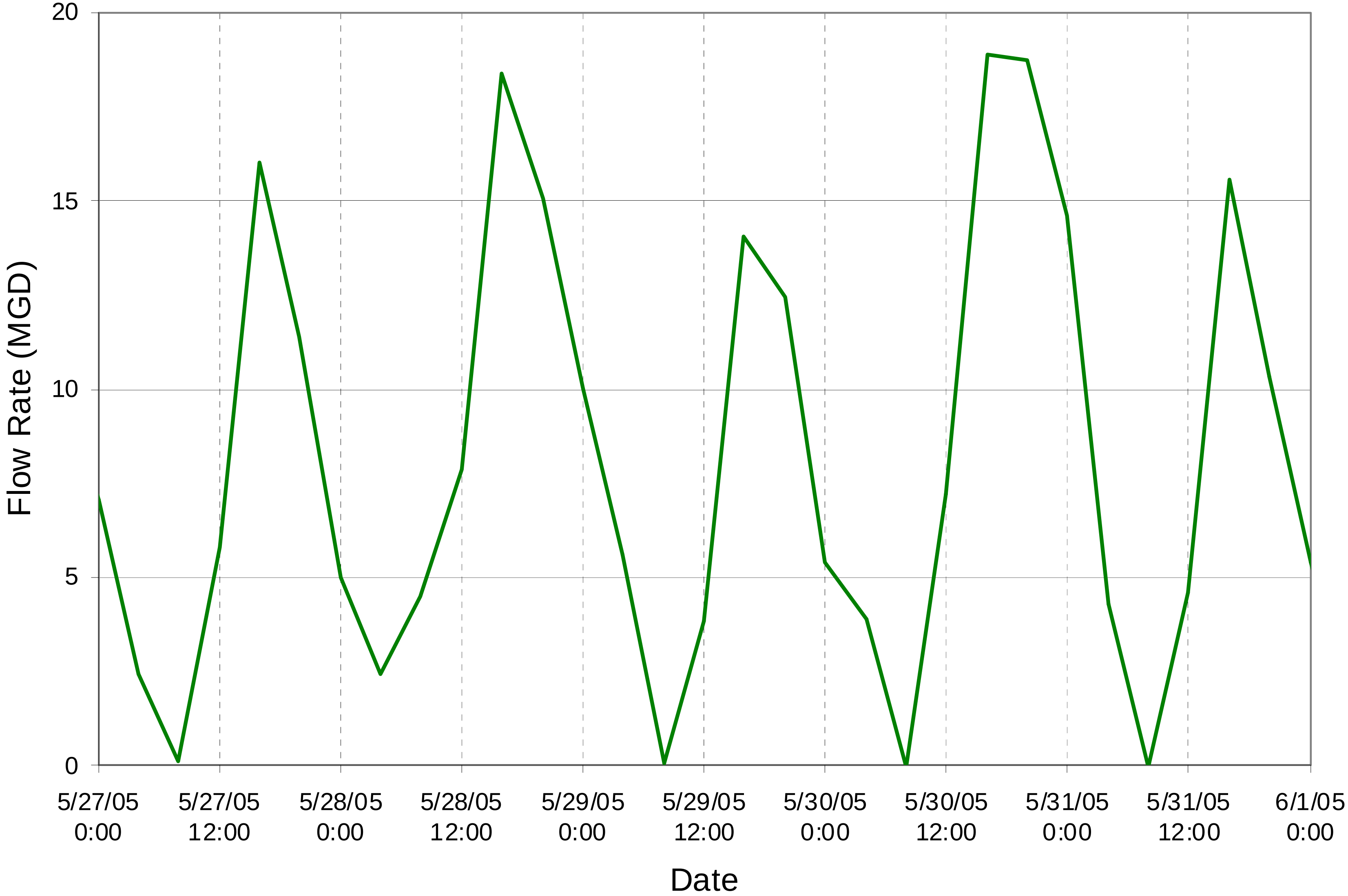
San Gabriel River Flow Rates May 27 – June 1, 2005

Sampling Event: May 31, 2005



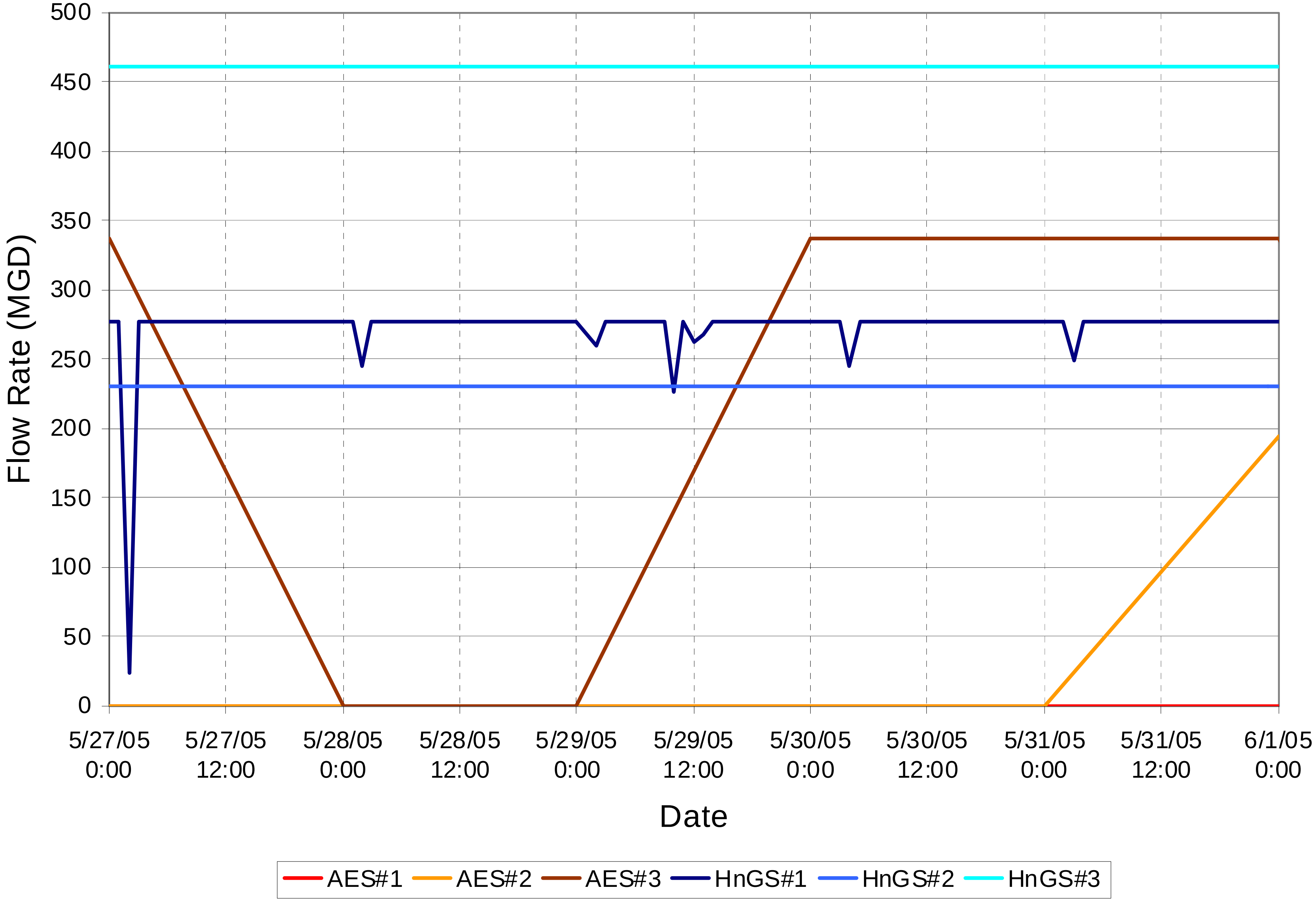
Long Beach WRP Flow Rates May 27 – June 1, 2005

Sampling Event: May 31, 2005



Lower San Gabriel Outfall Flows May 27 – June 1, 2005

Sampling Event: May 31, 2005



Lower San Gabriel Outfall Temperatures
May 27 – June 1, 2005
Sampling Event: May 31, 2005

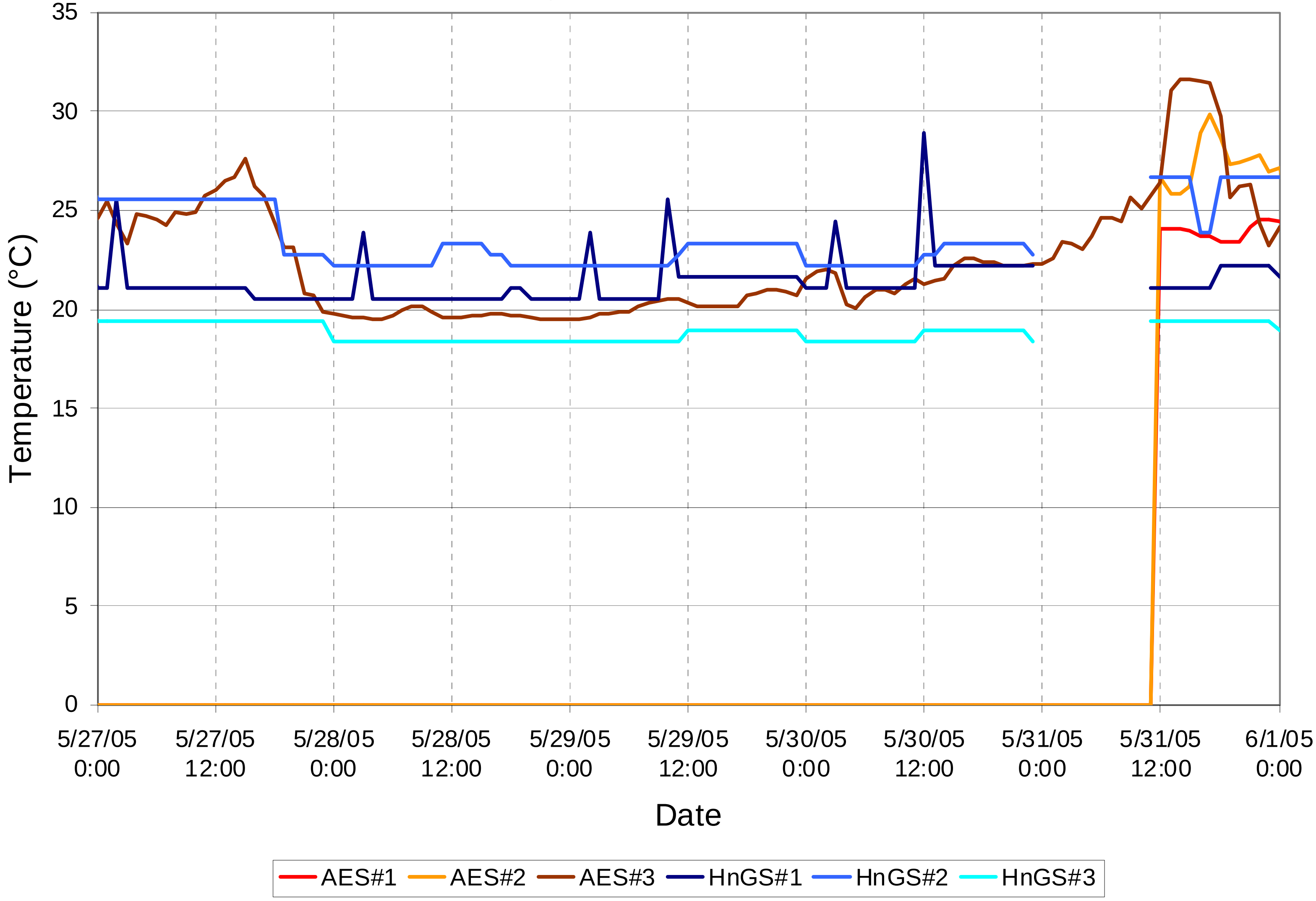
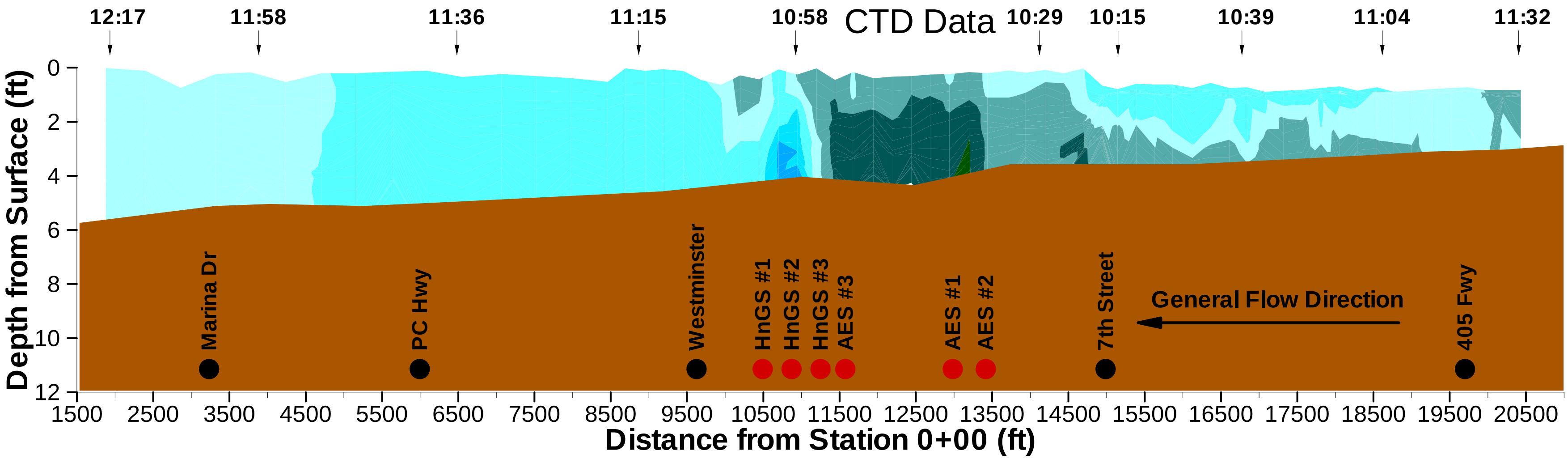
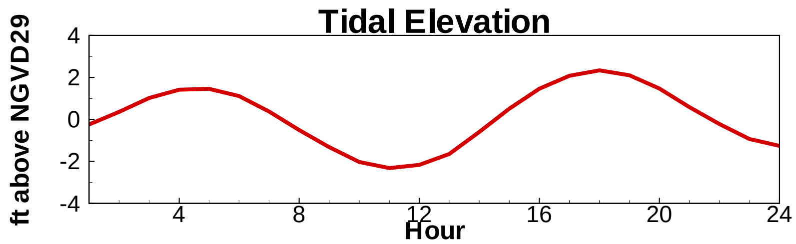
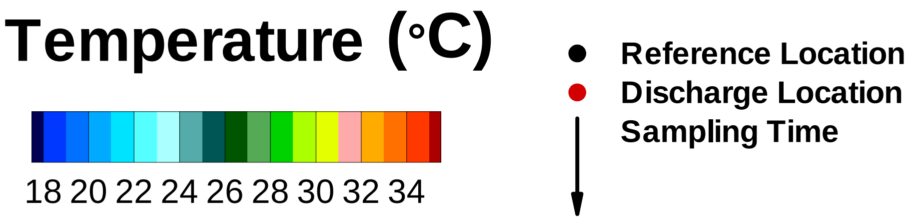


Figure C.48

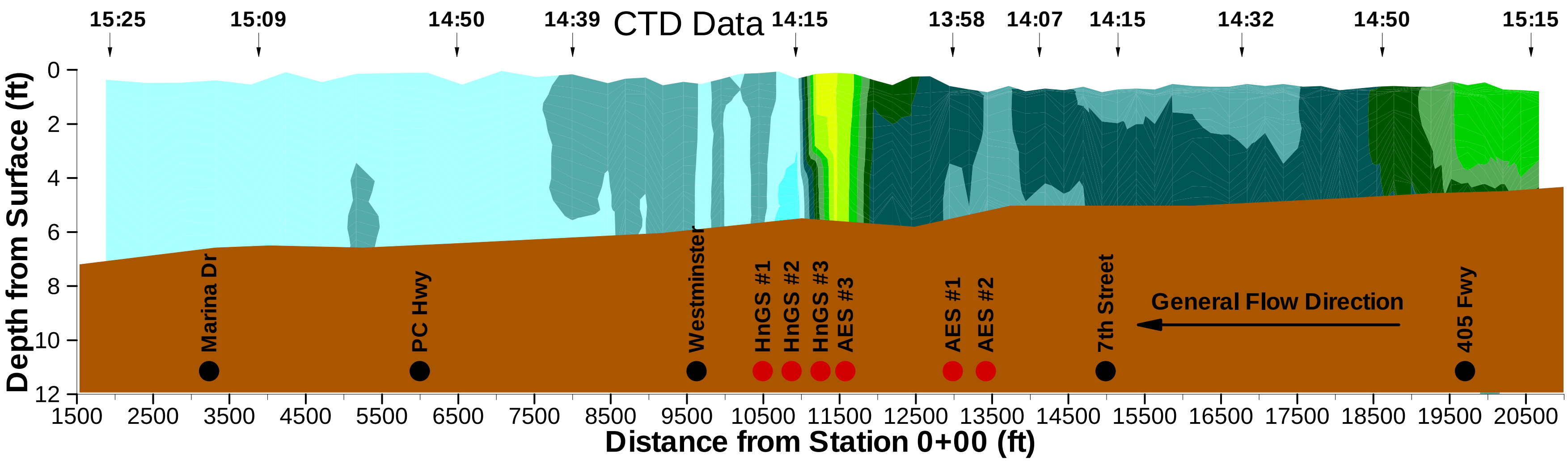
Lower San Gabriel River Temperature Profile
May 31, 2005 Low Tide

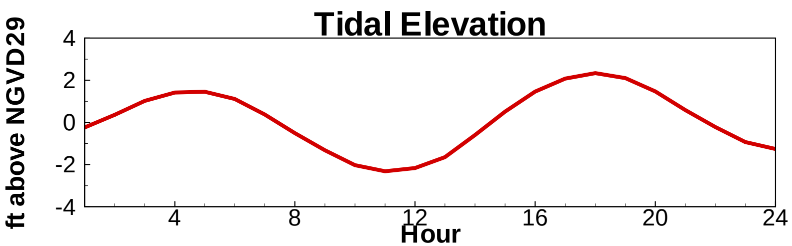


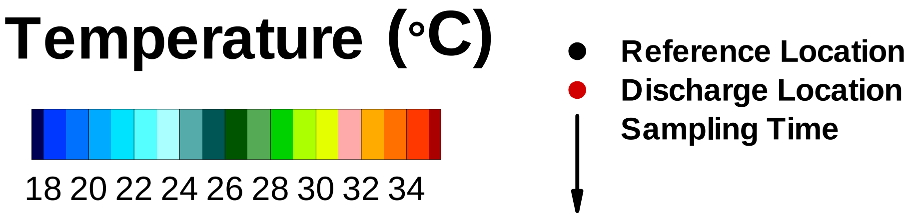




Lower San Gabriel River Temperature Profile
May 31, 2005 Mid Tide

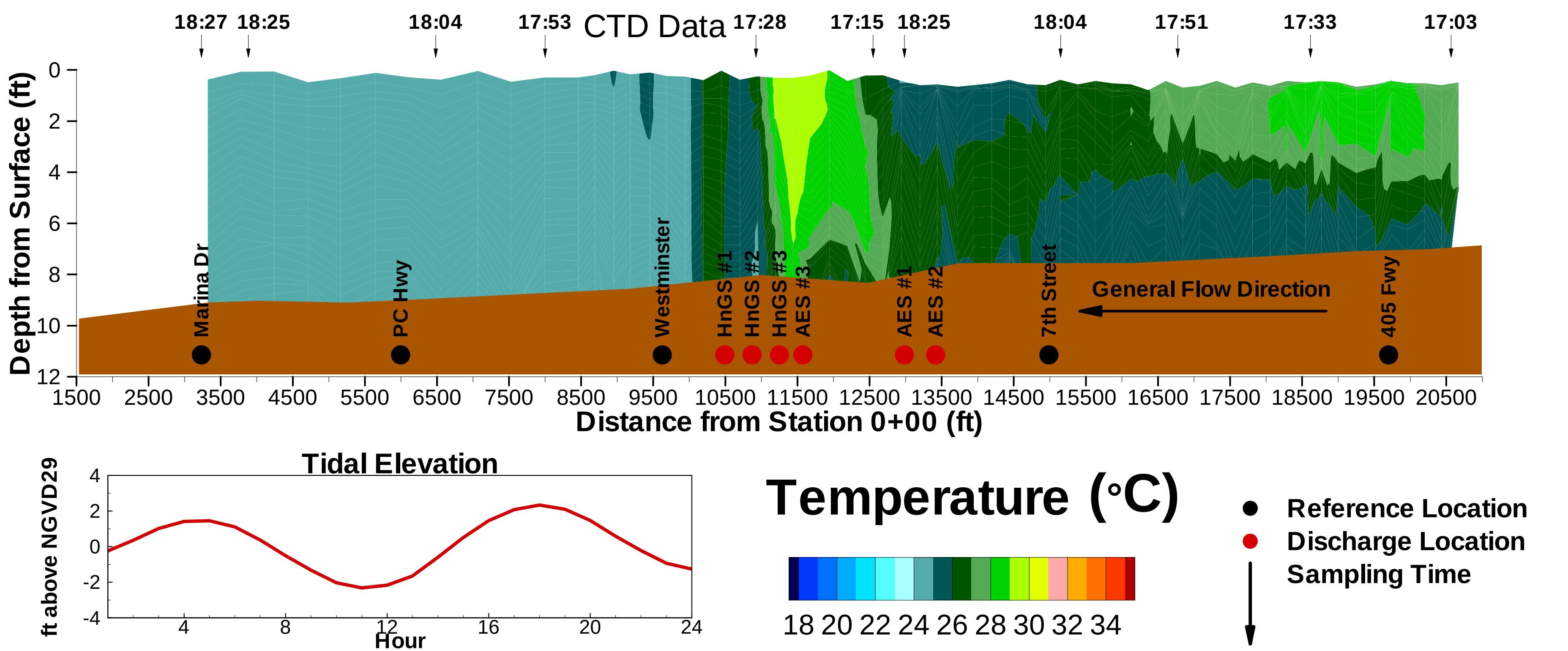






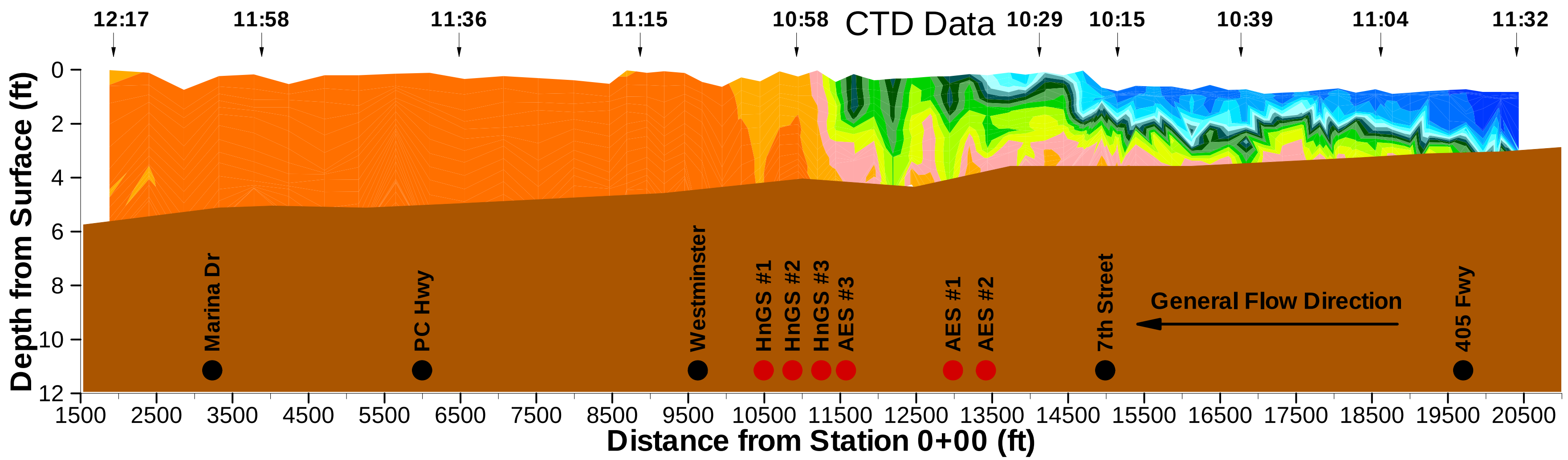
Lower San Gabriel River Temperature Profile

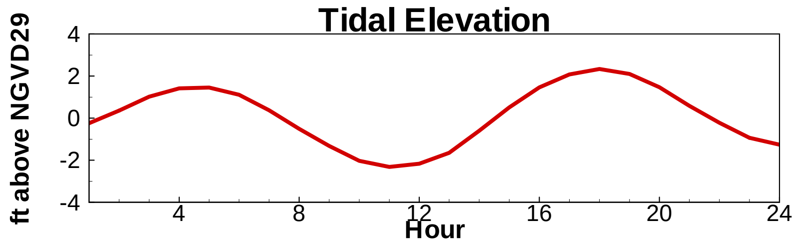
May 31, 2005 High Tide

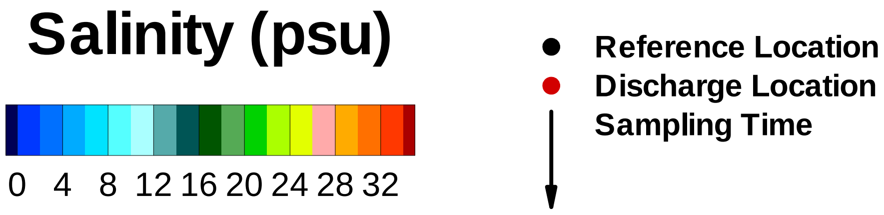


Lower San Gabriel River Salinity Profile

May 31, 2005 Low Tide

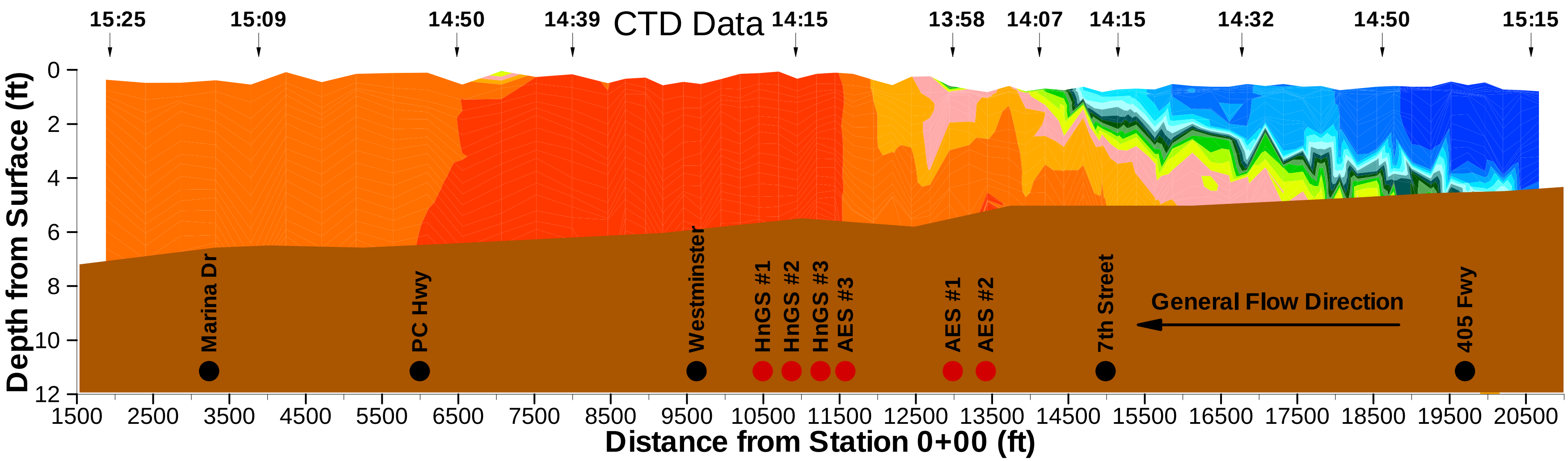


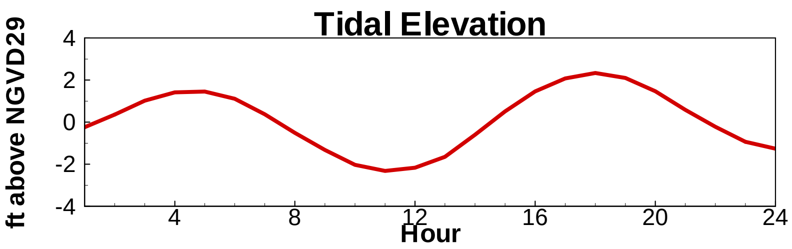


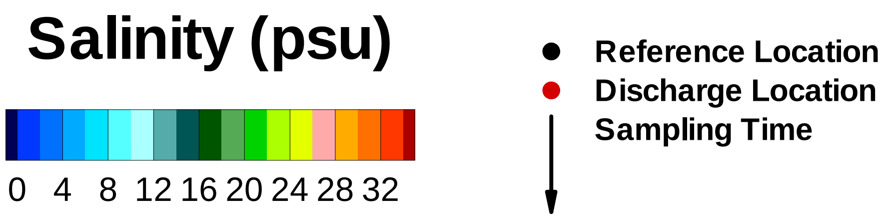


Lower San Gabriel River Salinity Profile

May 31, 2005 Mid Tide

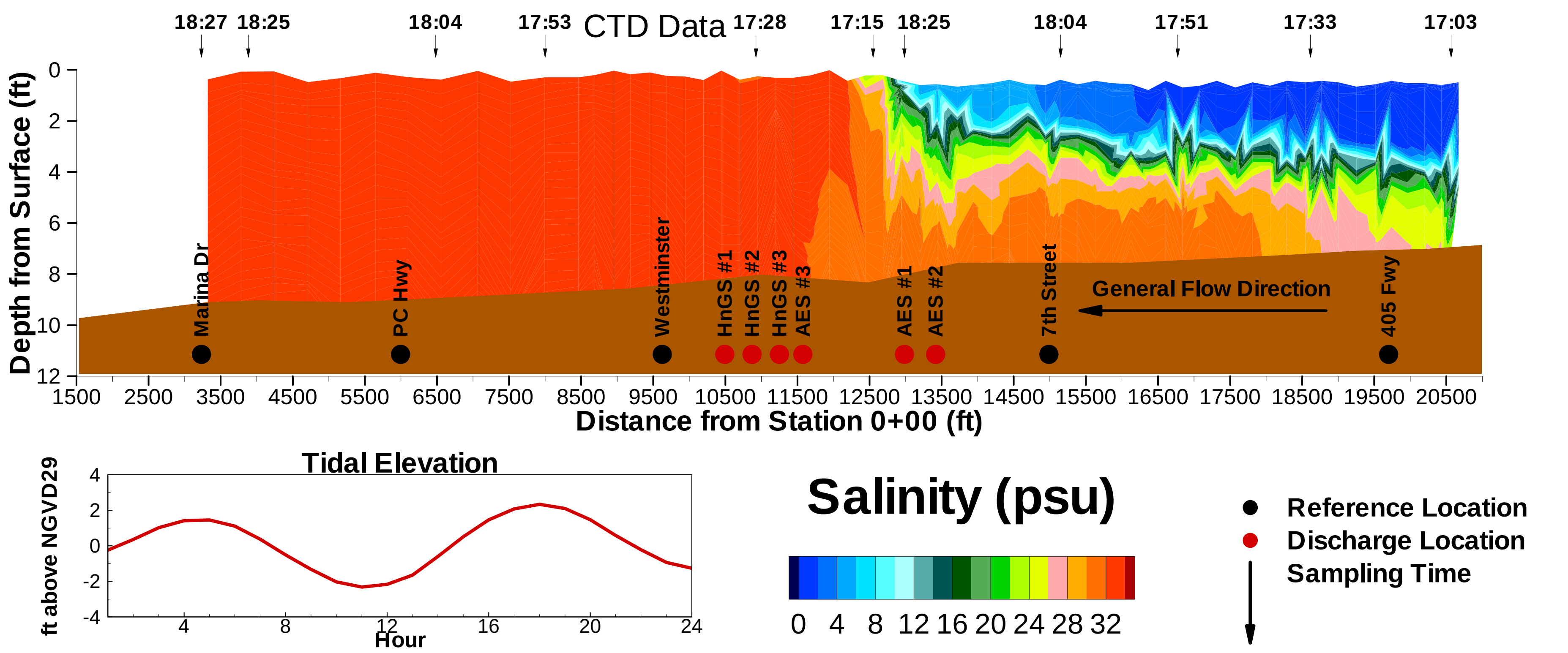






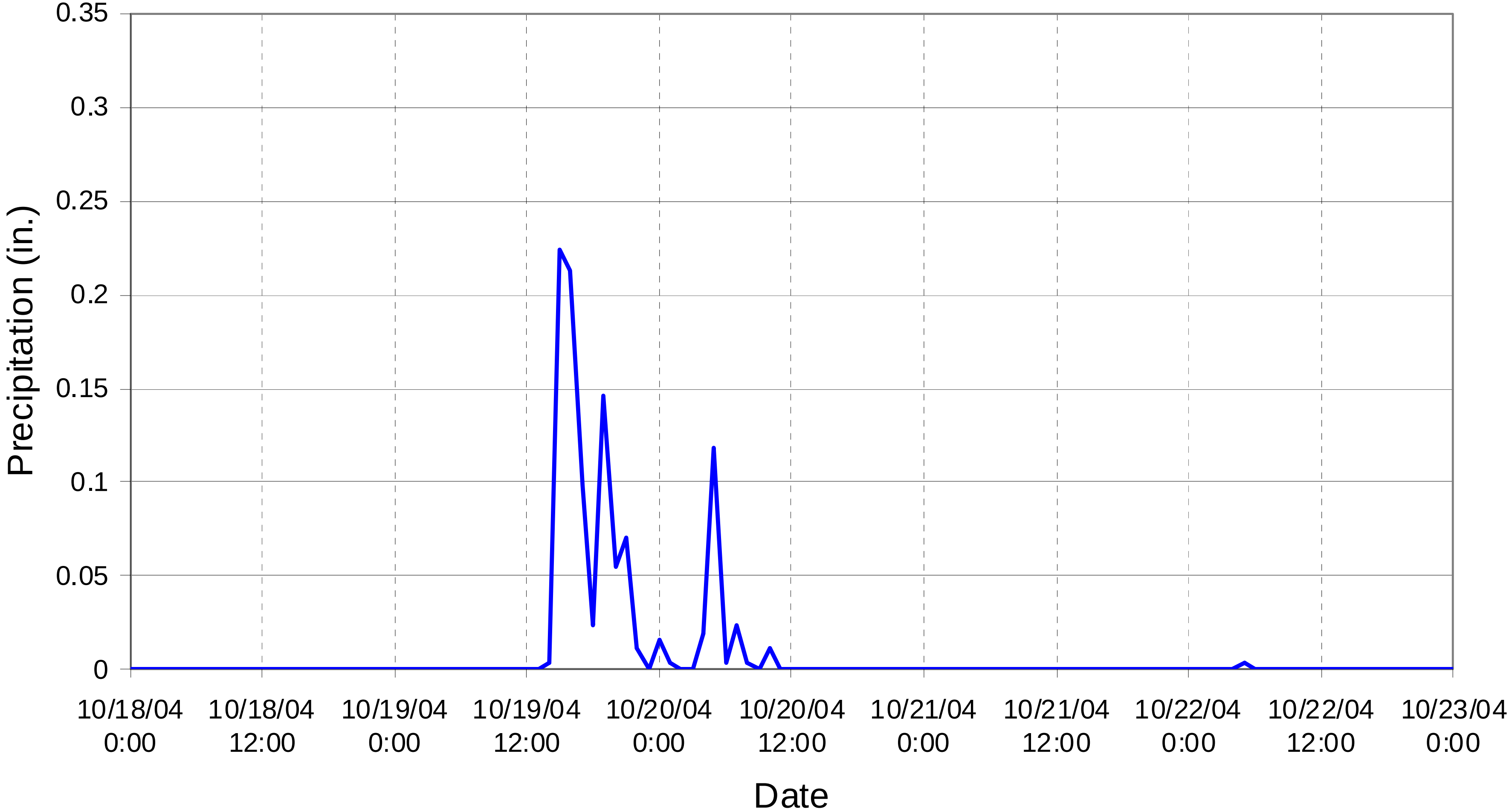
Lower San Gabriel River Salinity Profile

May 31, 2005 High Tide



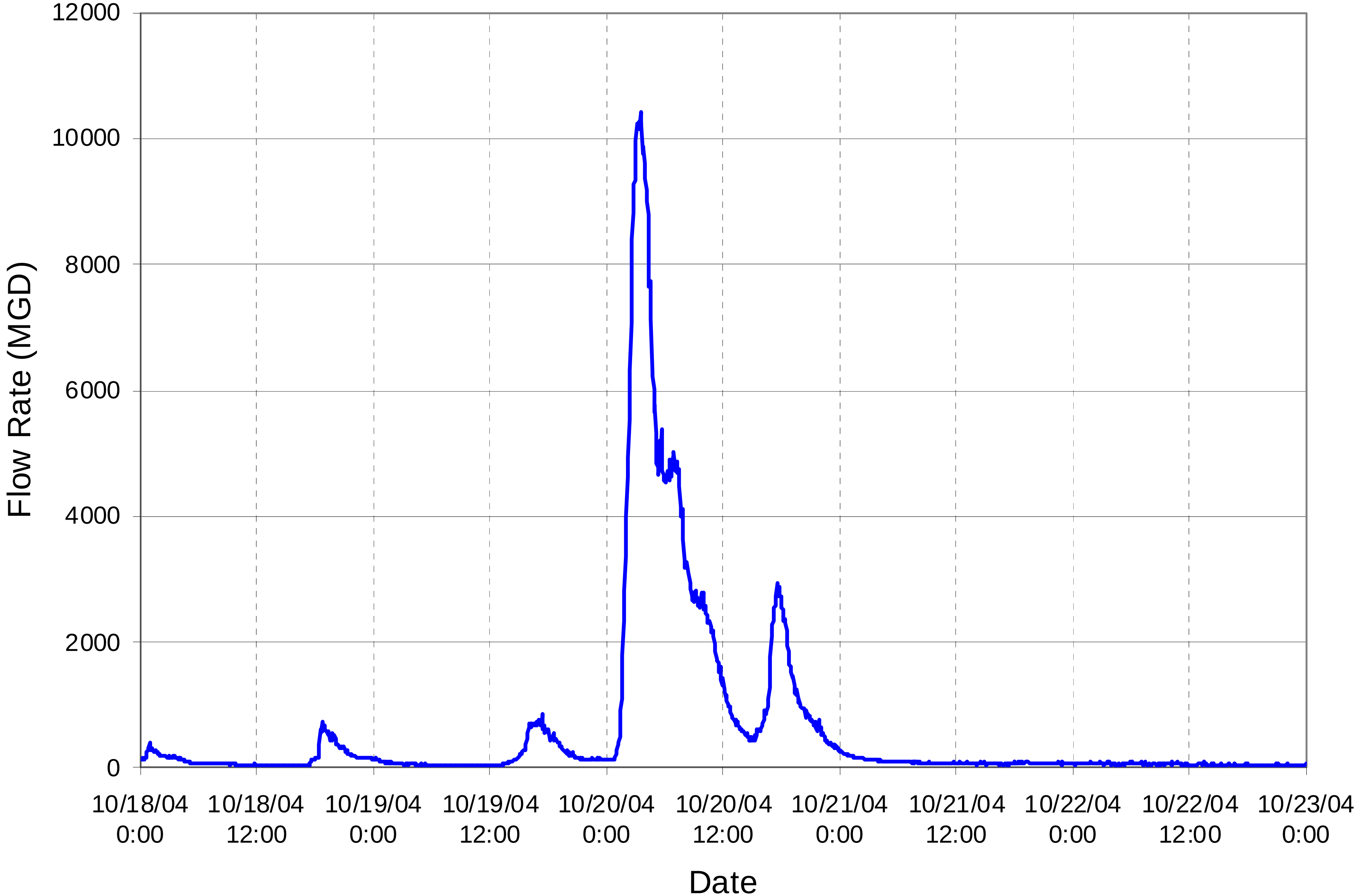
Hourly Precipitation October 18 – 23, 2004

Sampling Event: October 22, 2004



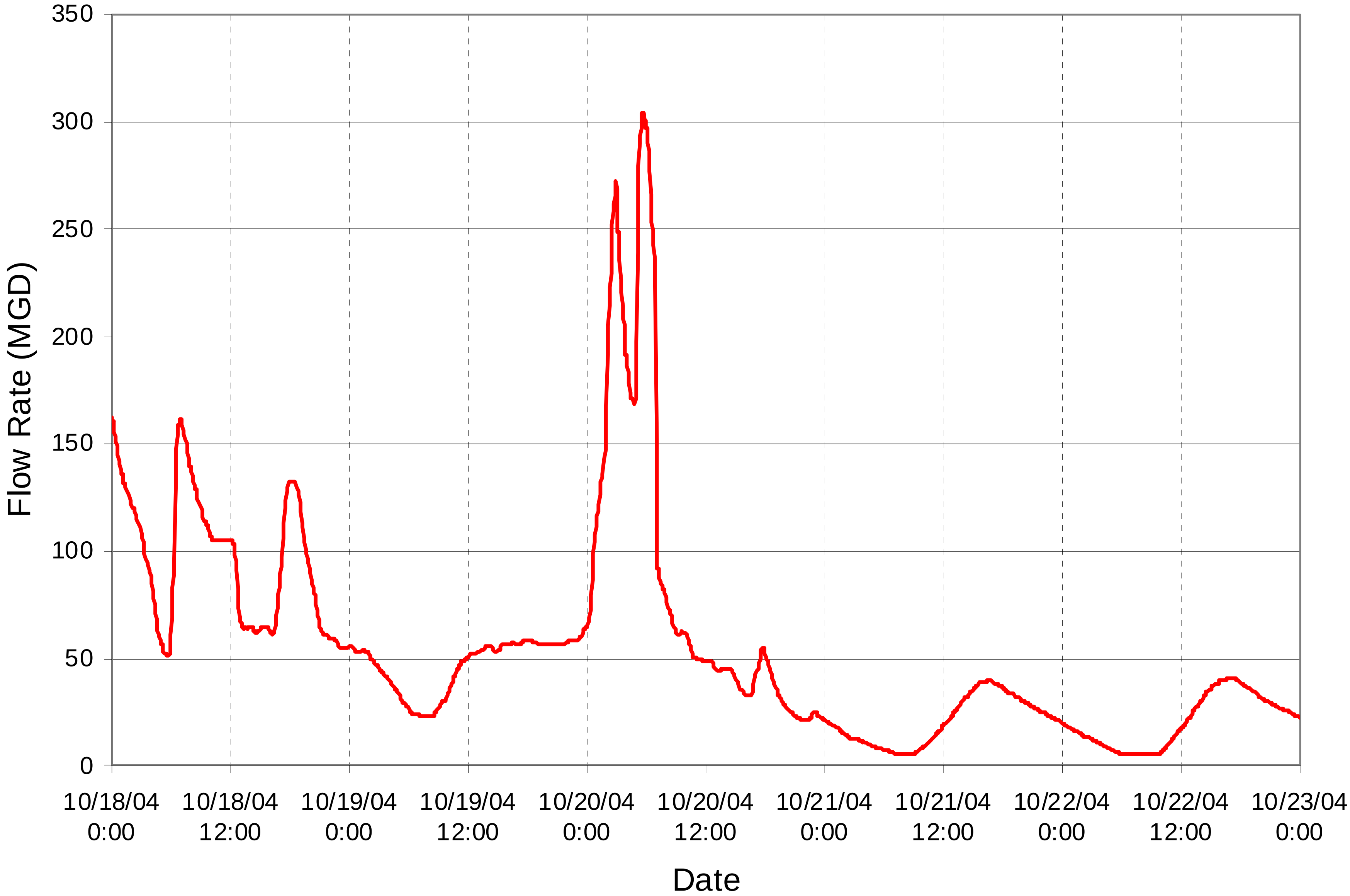
Coyote Creek Flow Rates October 18 – 23, 2004

Sampling Event: October 22, 2004



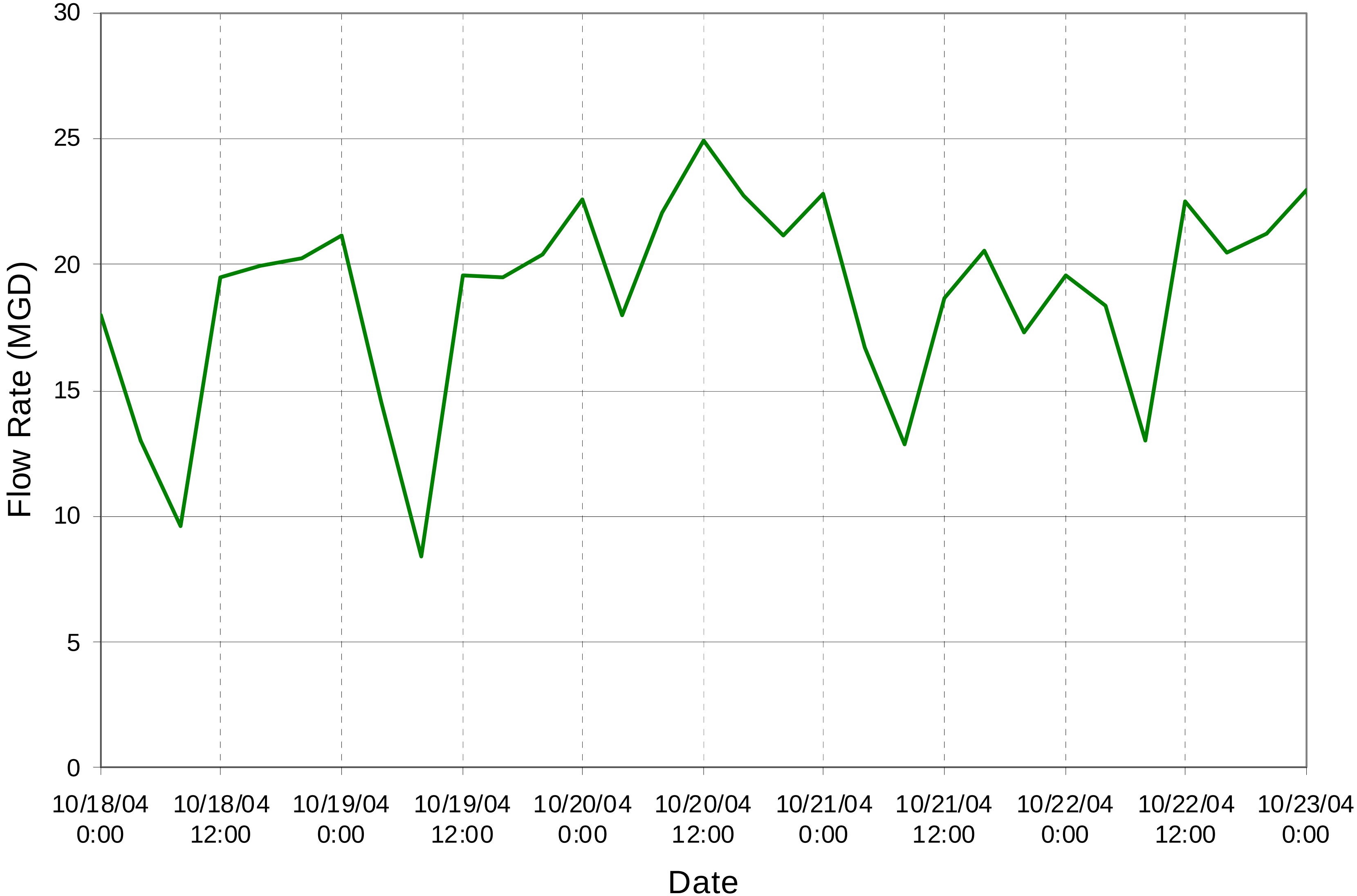
San Gabriel River Flow Rates October 18 – 23, 2004

Sampling Event: October 22, 2004



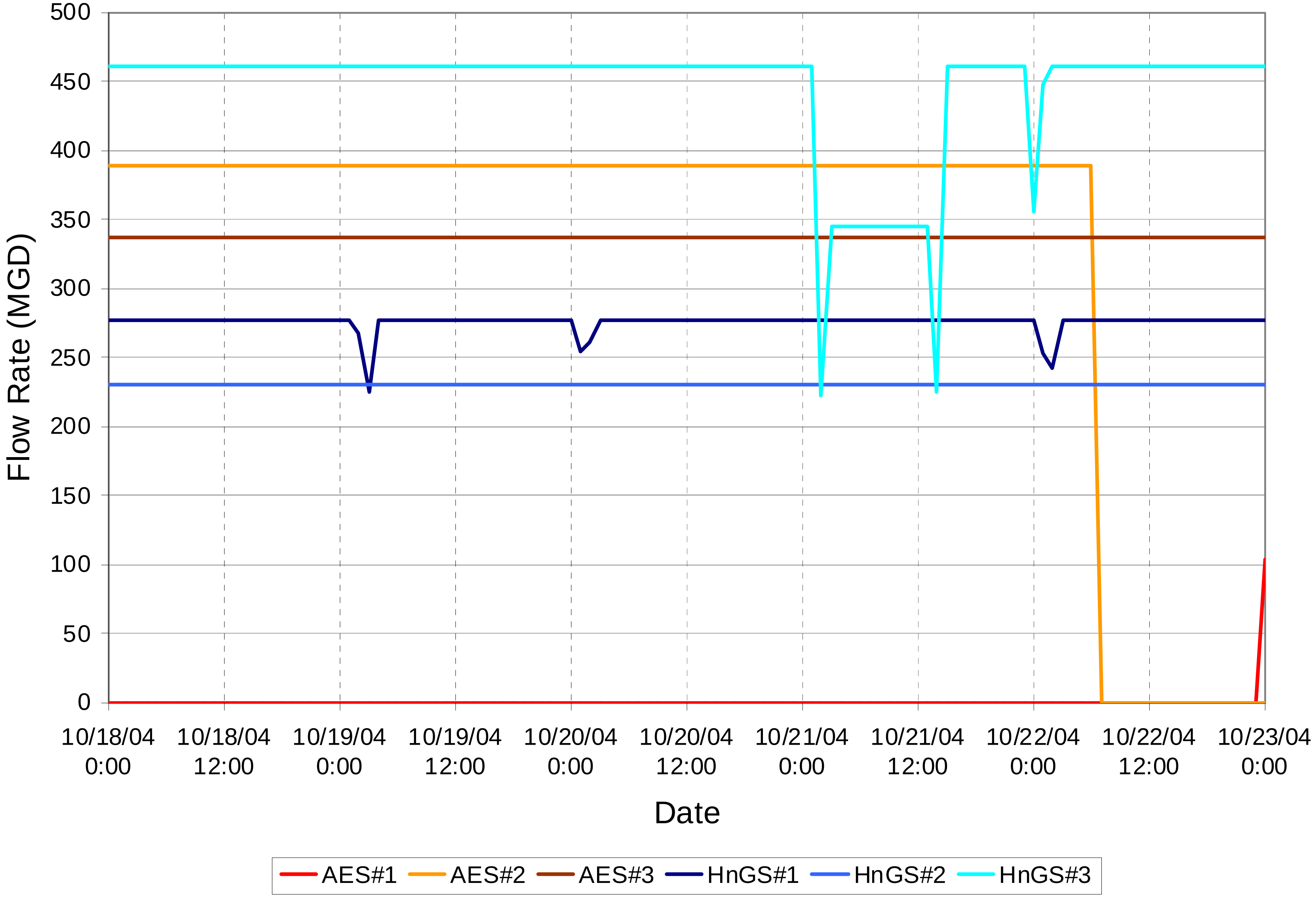
Long Beach WRP Flow Rates October 18 – 23, 2004

Sampling Event: October 22, 2004



Lower San Gabriel River Outfall Flows October 18 – 23, 2004

Sampling Event: October 22, 2004



Lower San Gabriel River Outfall Temperatures
October 18 – 23, 2004
Sampling Event: October 22, 2004

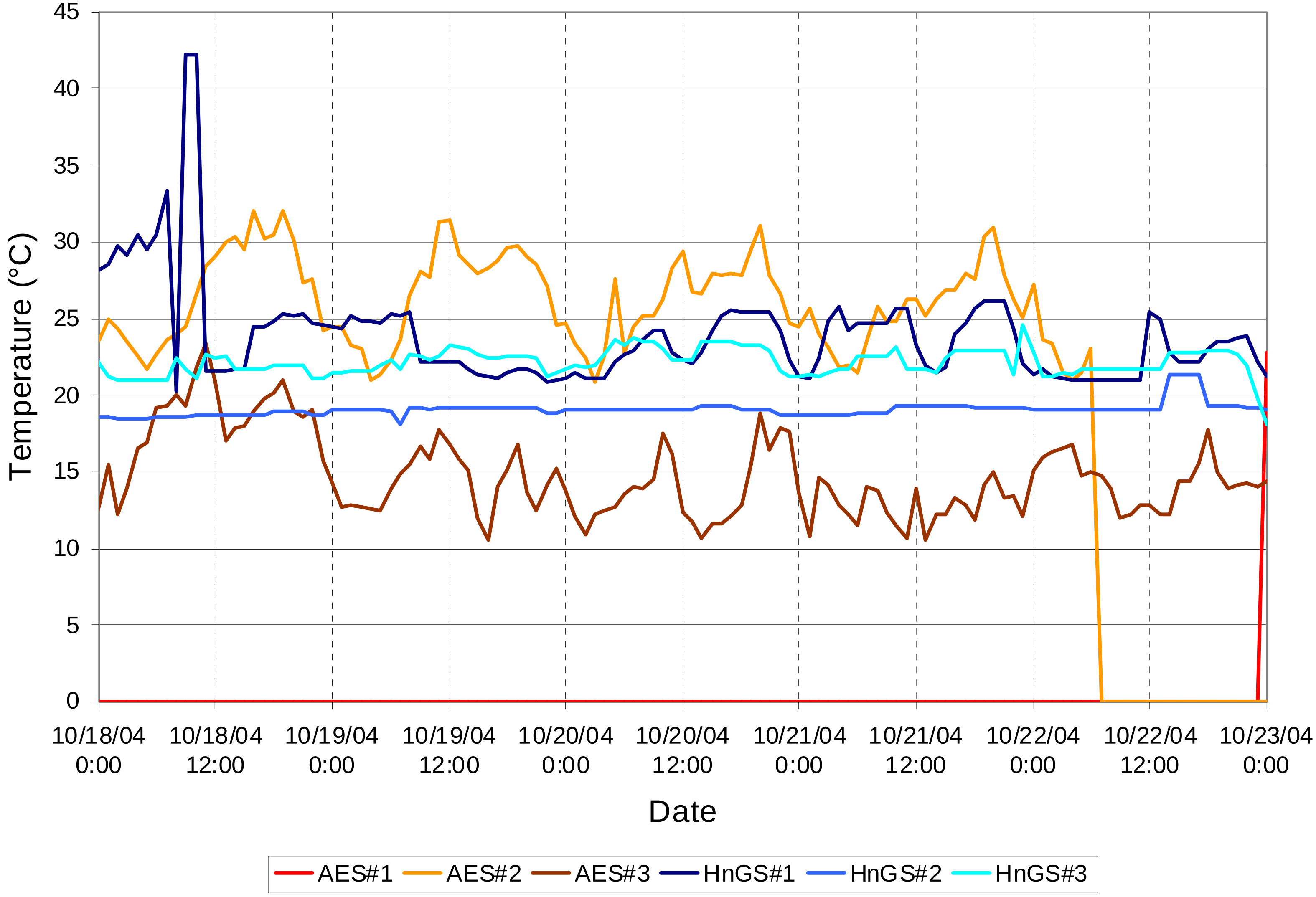
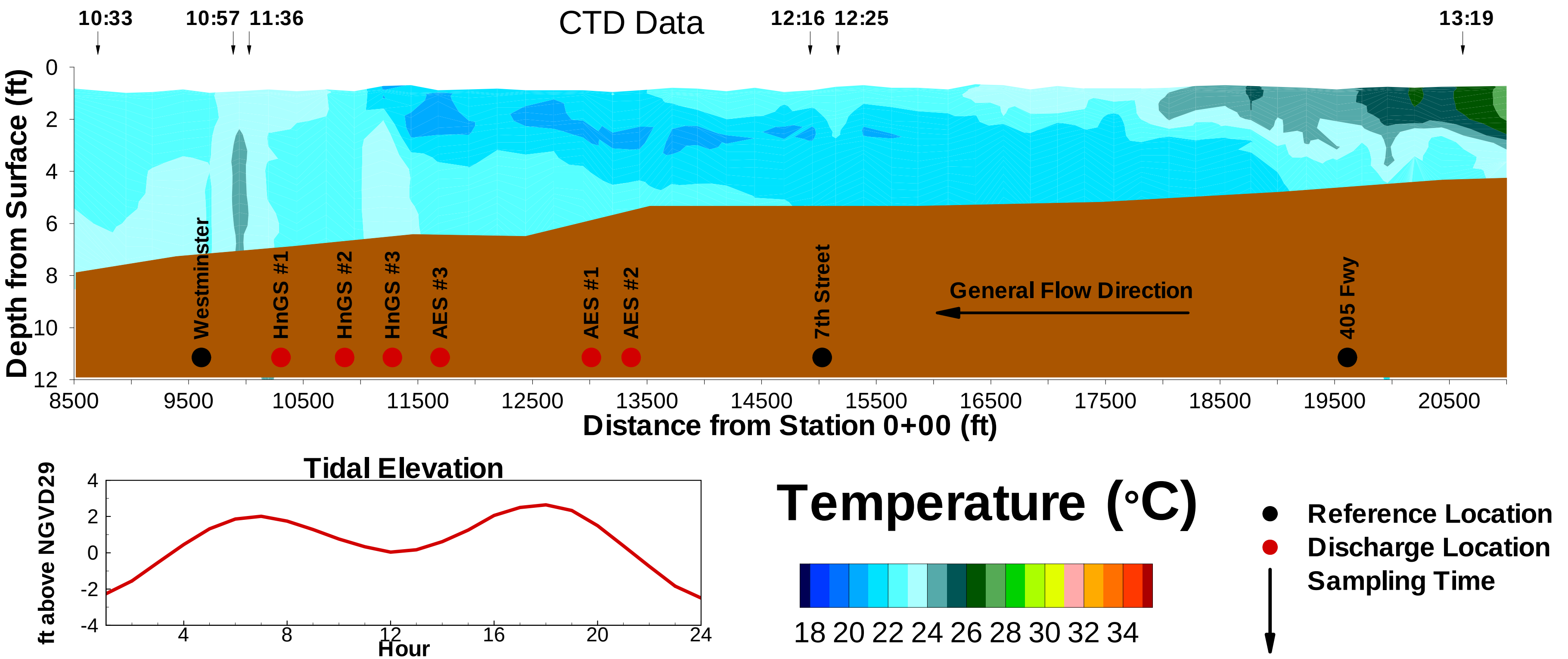


Figure C.60

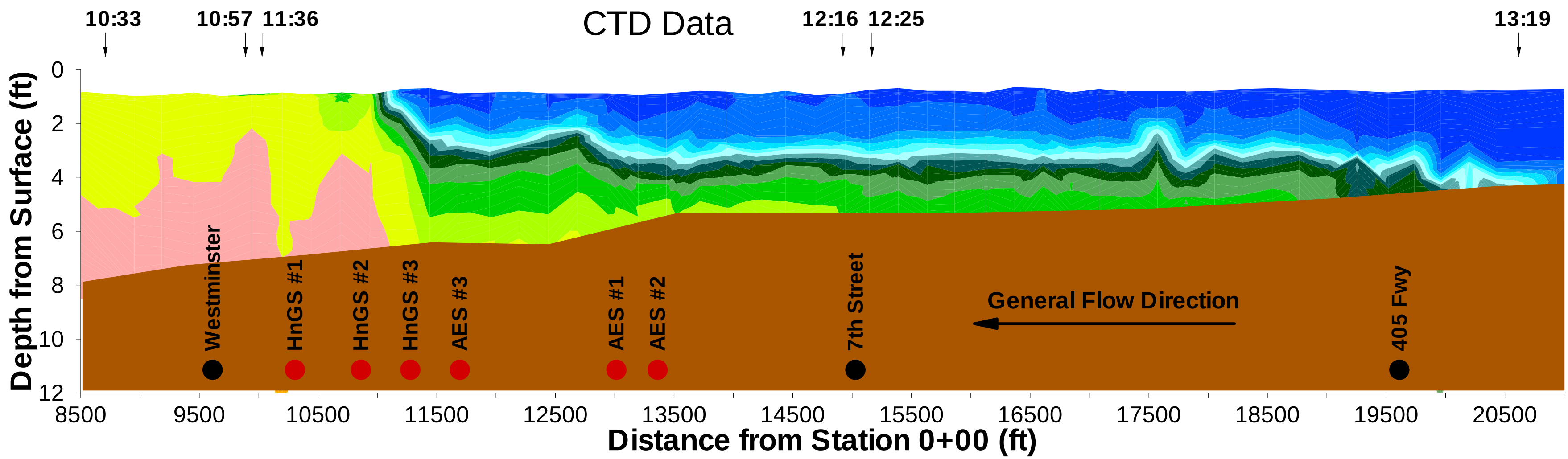
Lower San Gabriel River Temperature Profile

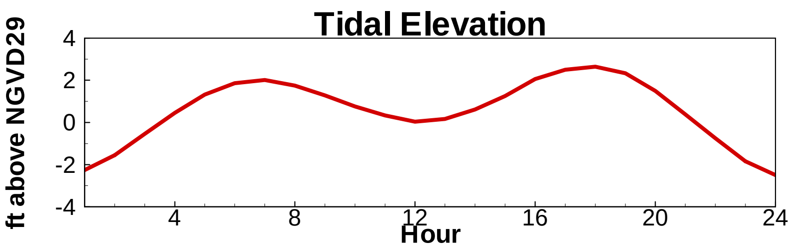
October 24, 2004 Low Tide

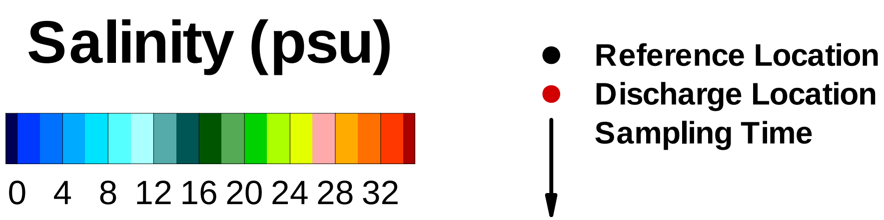


Lower San Gabriel River Salinity Profile

October 24, 2004 Low Tide







Typical Conditions Temperature Calibration Comparison Contour

September 15, 2004 High Tide

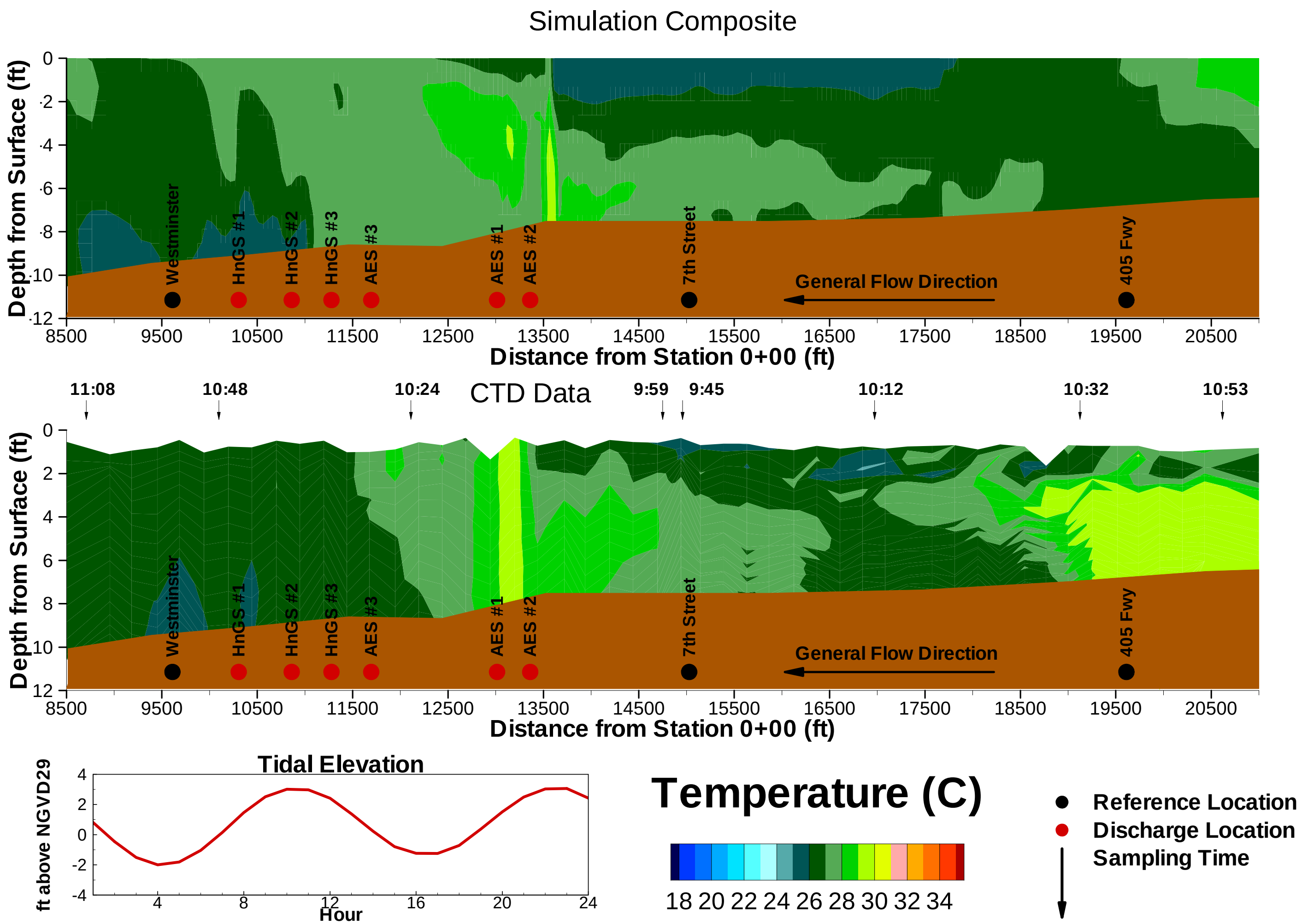


Figure C.63

Typical Conditions Temperature Calibration Comparison Contour

September 15, 2004 Low Tide

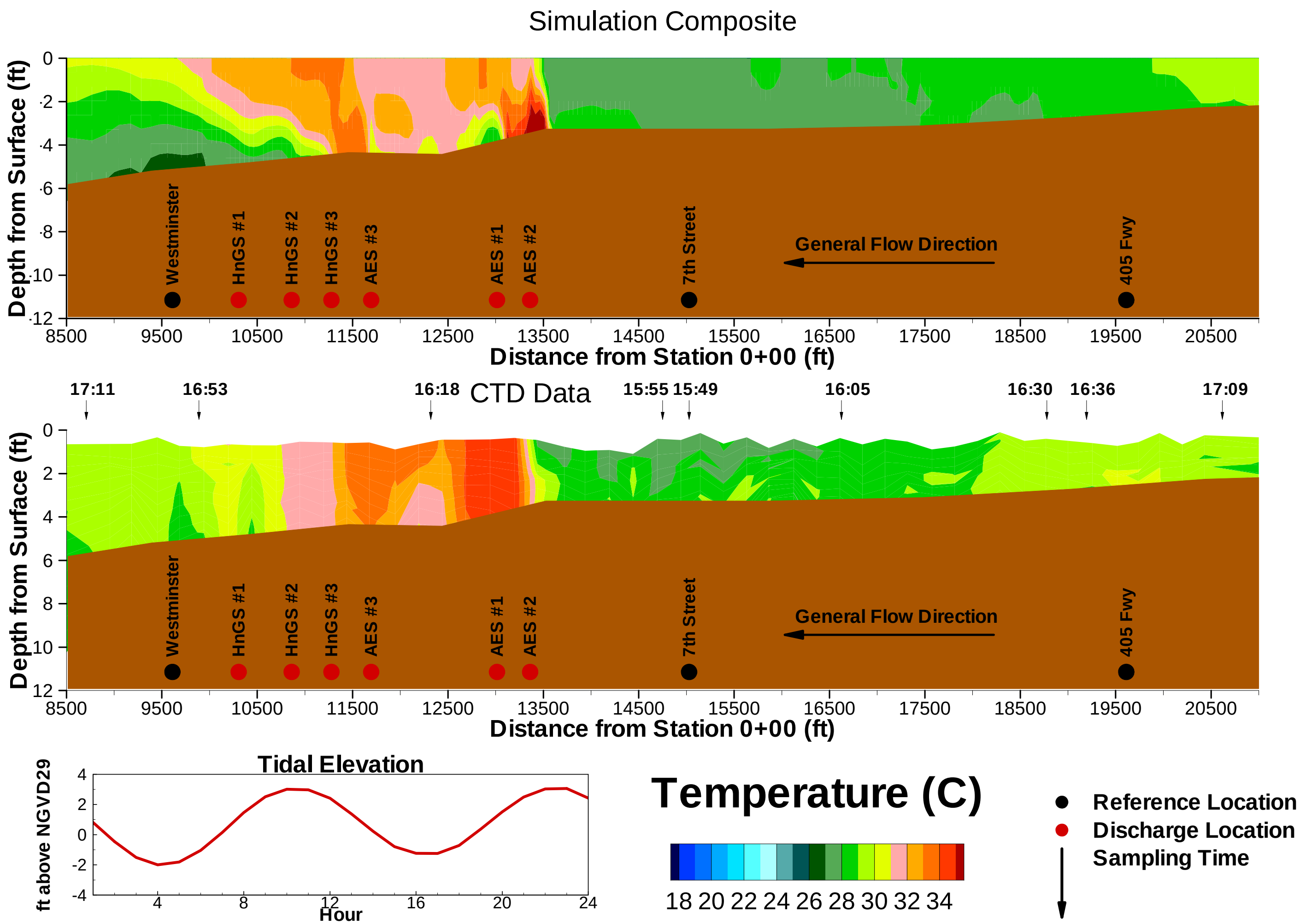


Figure C.64

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Typical Conditions Salinity Calibration Comparison Contour

September 15, 2004 High Tide

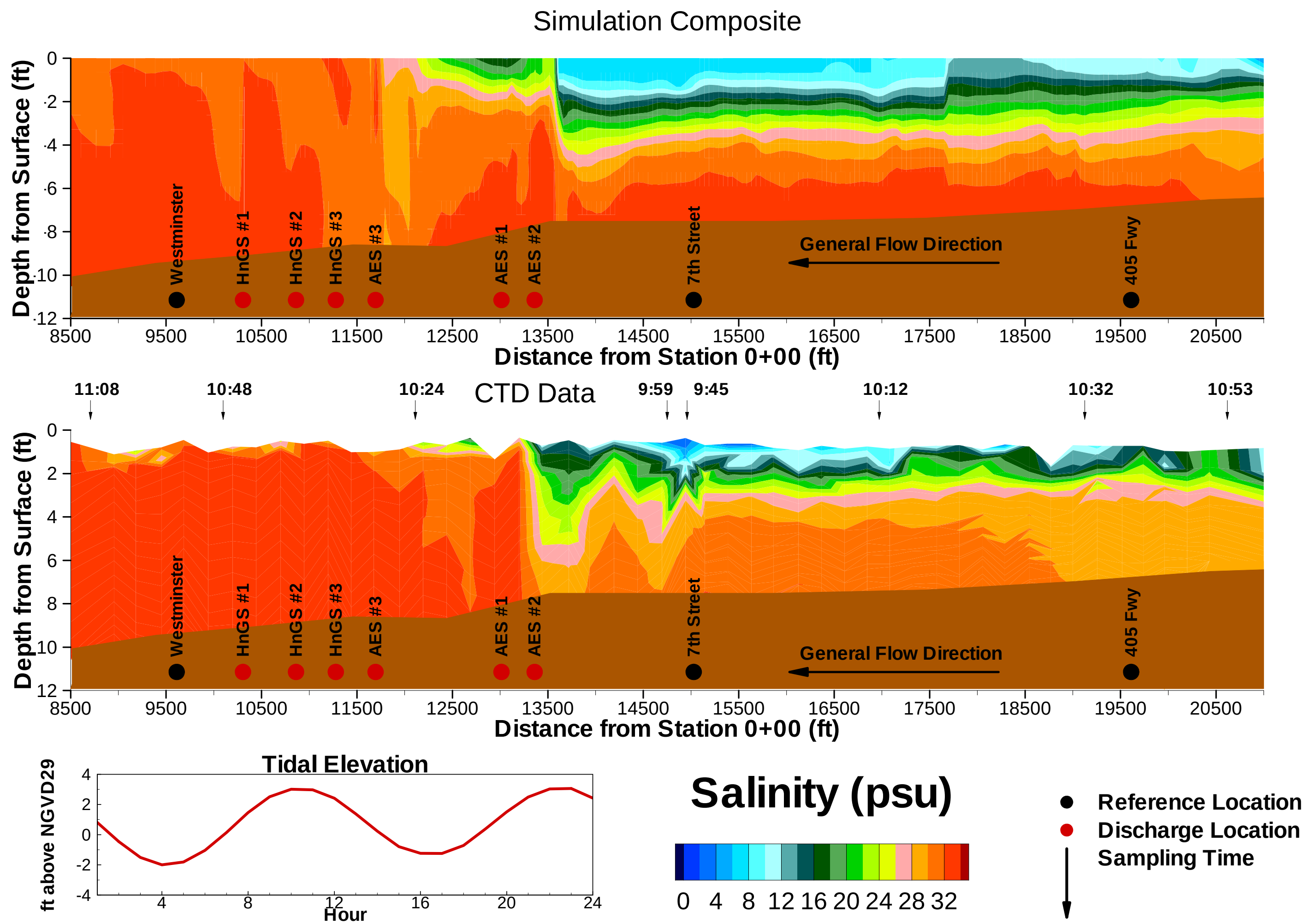
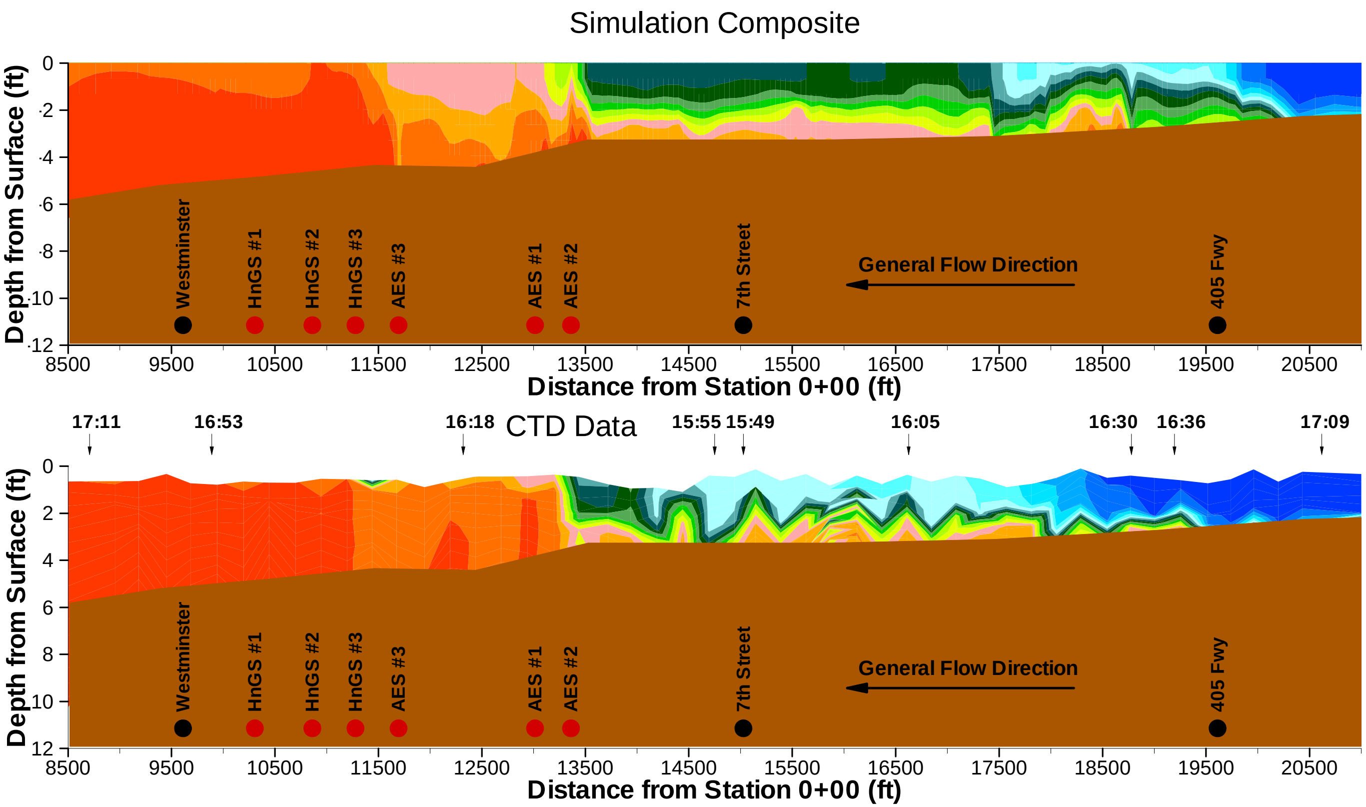
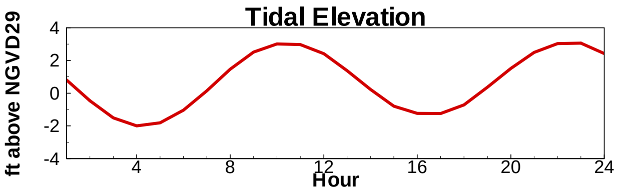


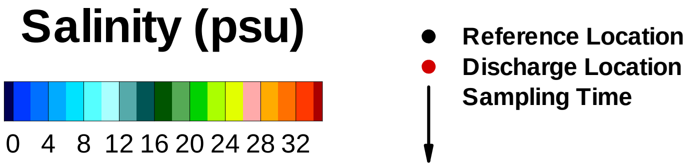
Figure C.65

Typical Conditions Salinity Calibration Comparison Contour

September 15, 2004 Low Tide

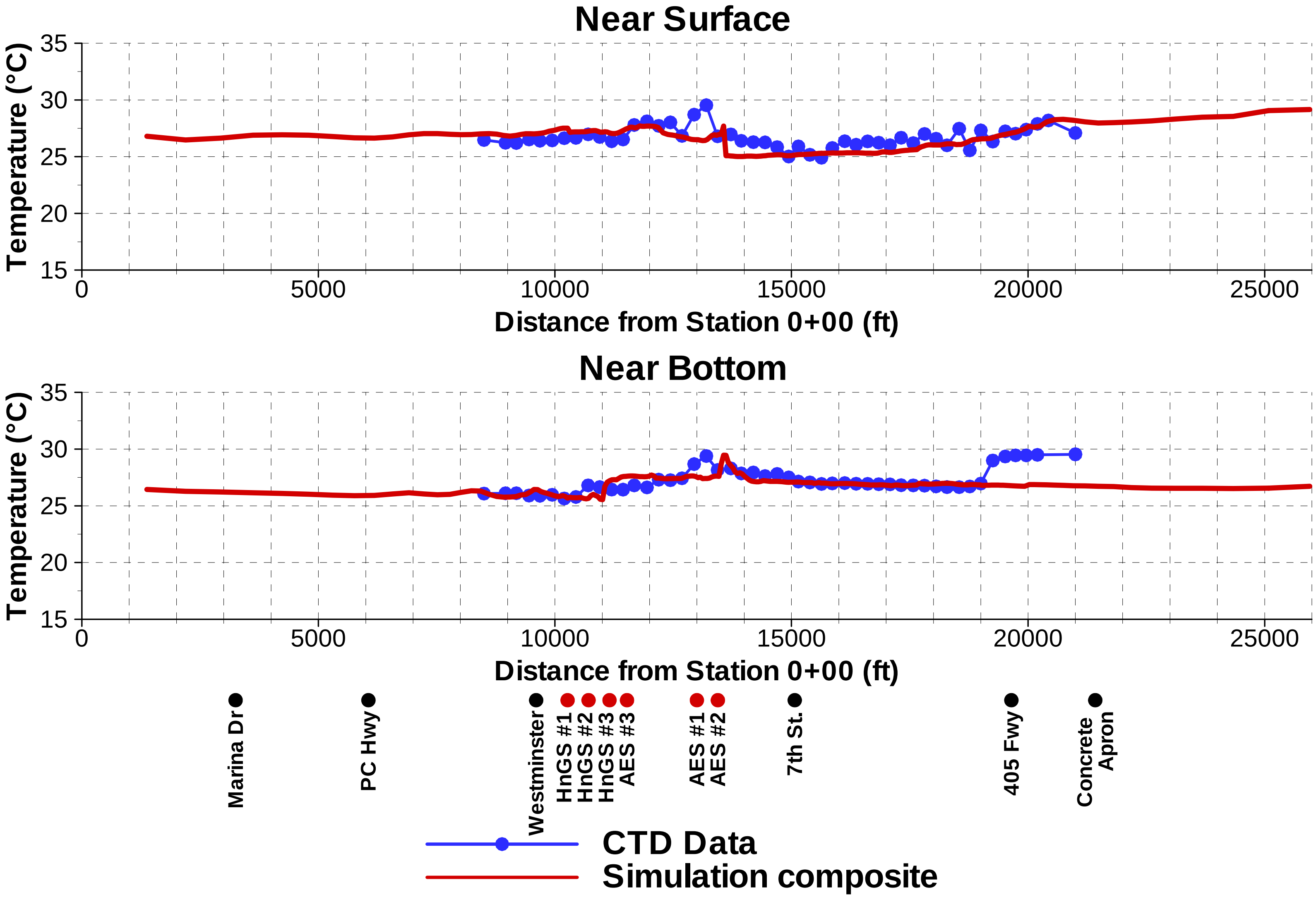






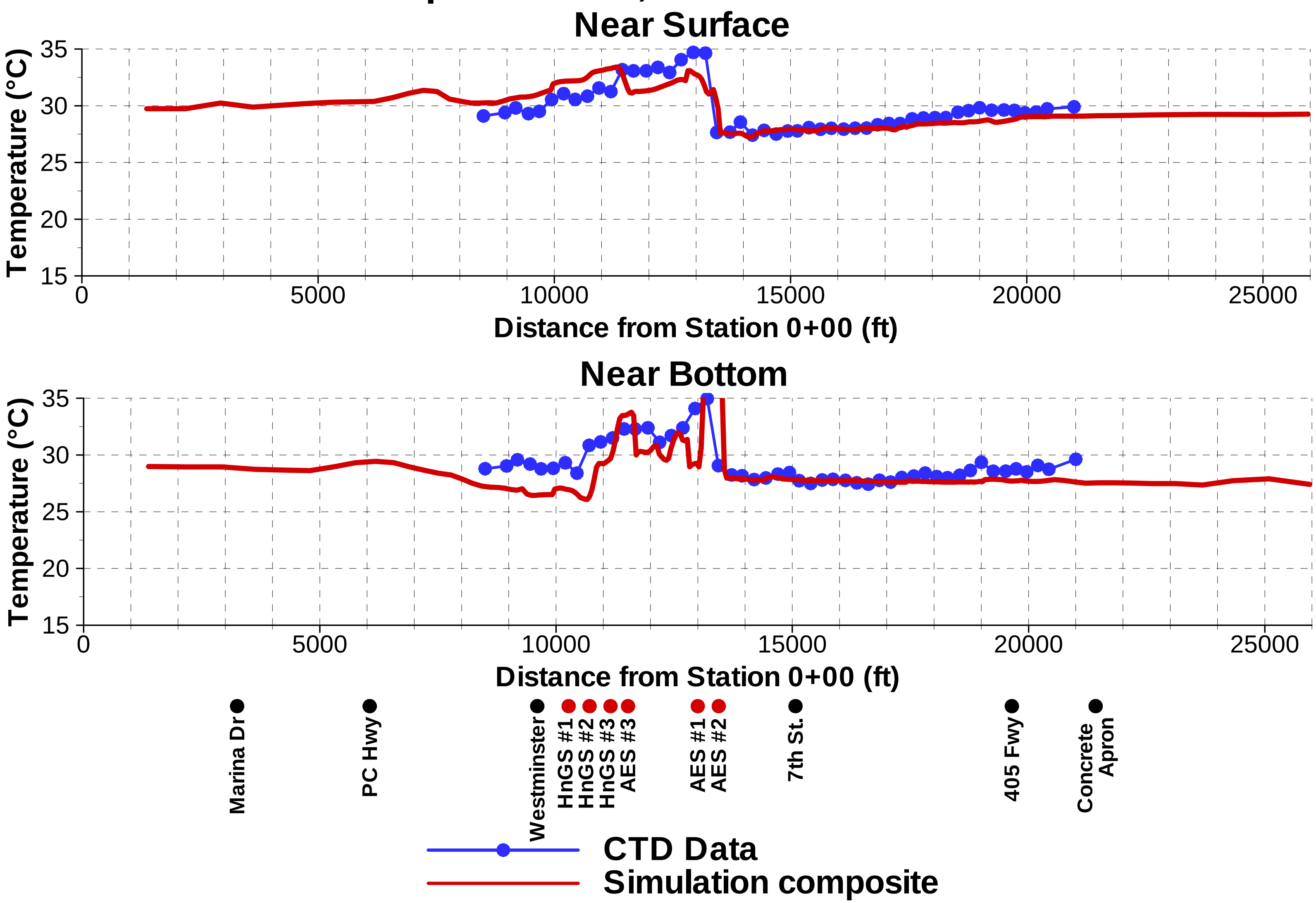
Typical Conditions Temperature Calibration Comparison

September 15, 2004 High Tide



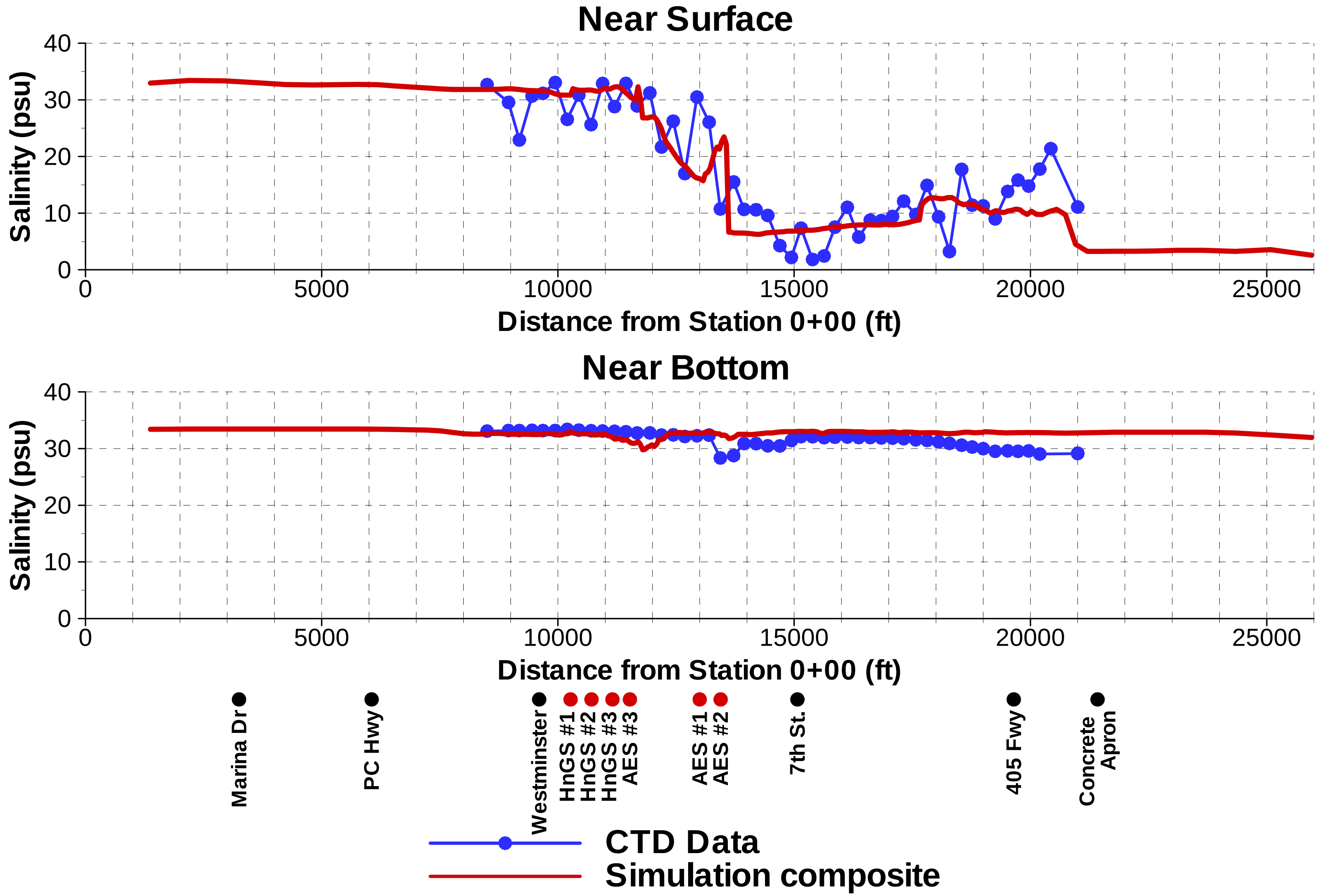
Typical Conditions Temperature Calibration Comparison

September 15, 2004 Low Tide



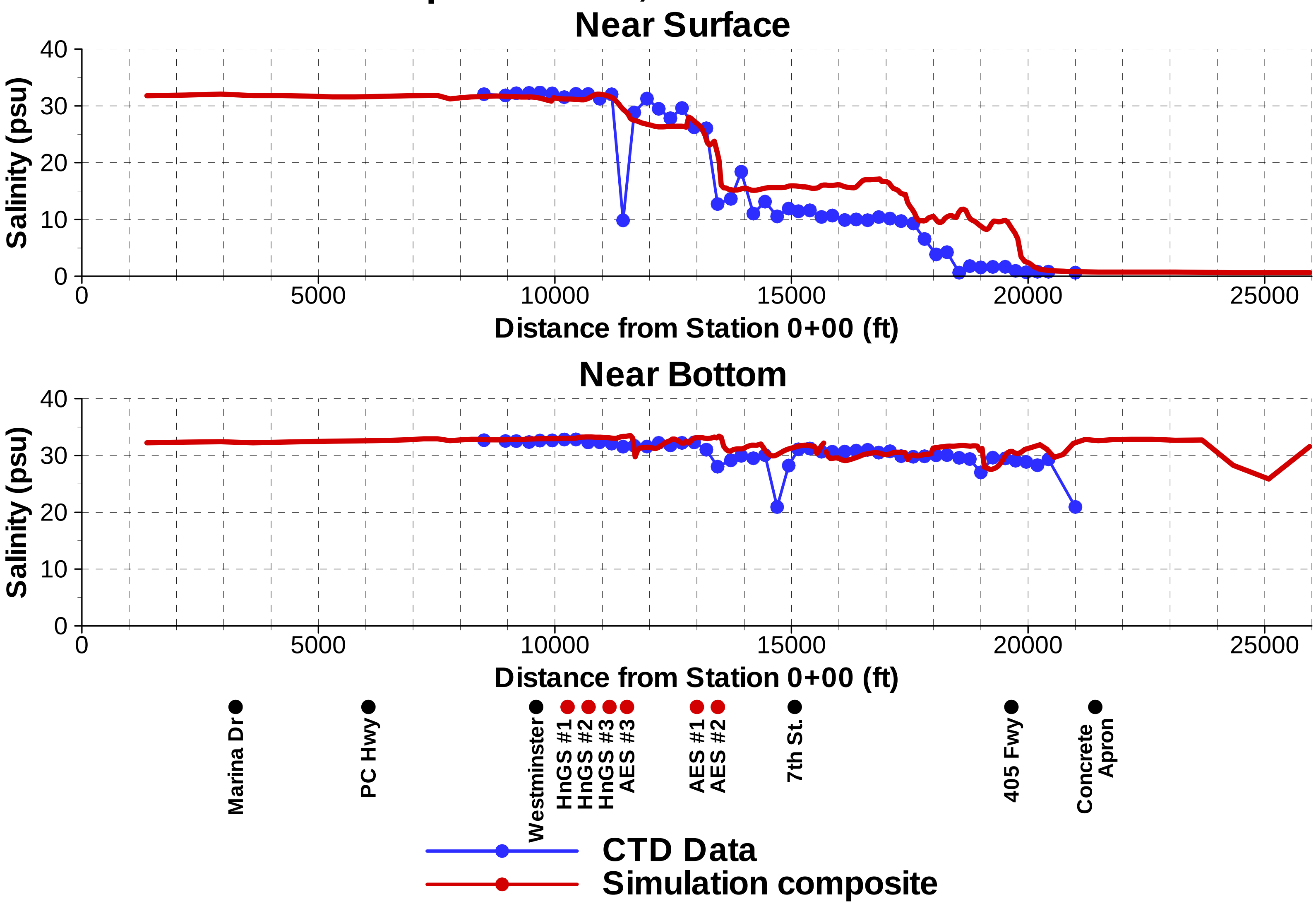
Typical Conditions Salinity Calibration Comparison

September 15, 2004 High Tide



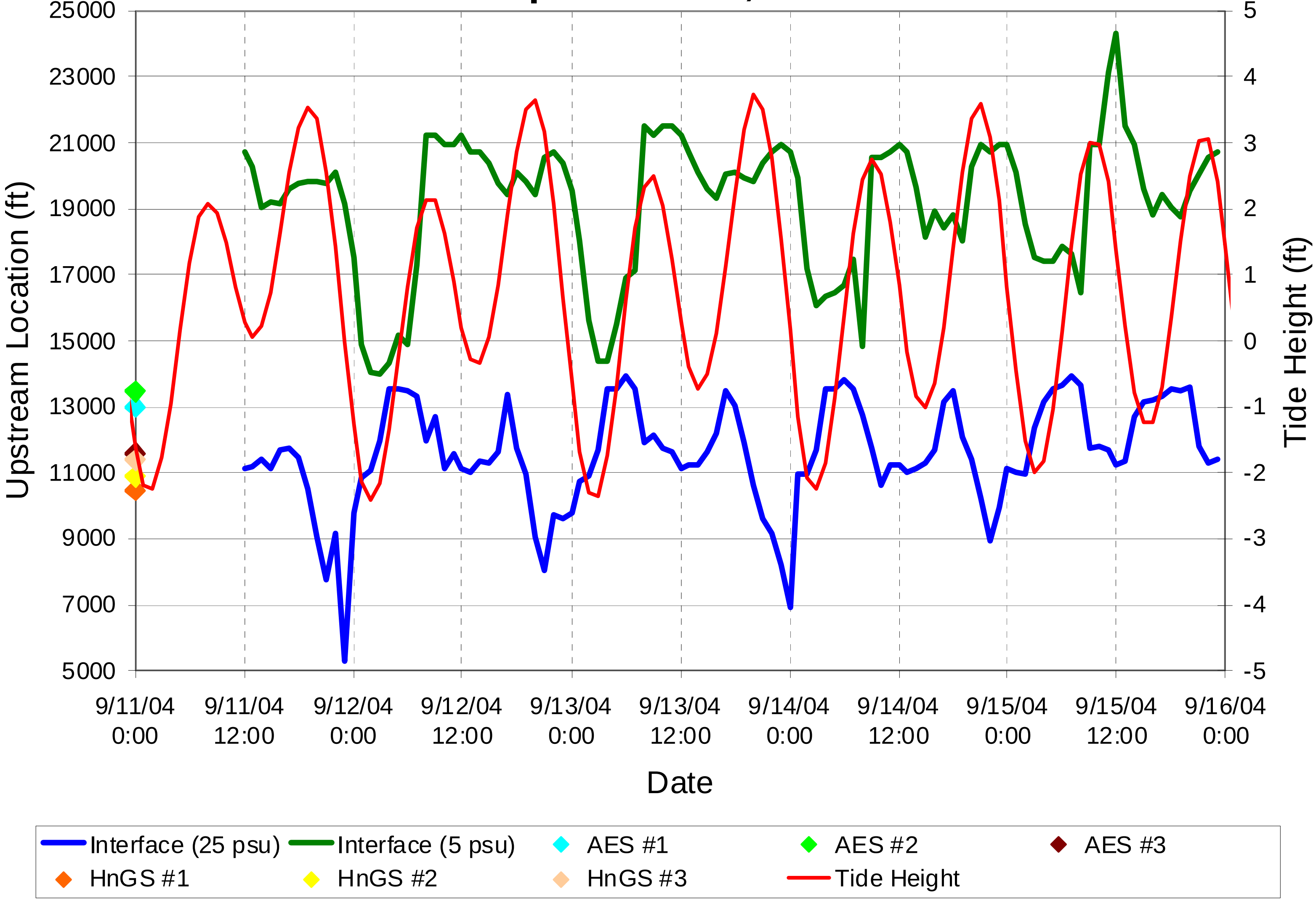
Typical Conditions Salinity Calibration Comparison

September 15, 2004 Low Tide



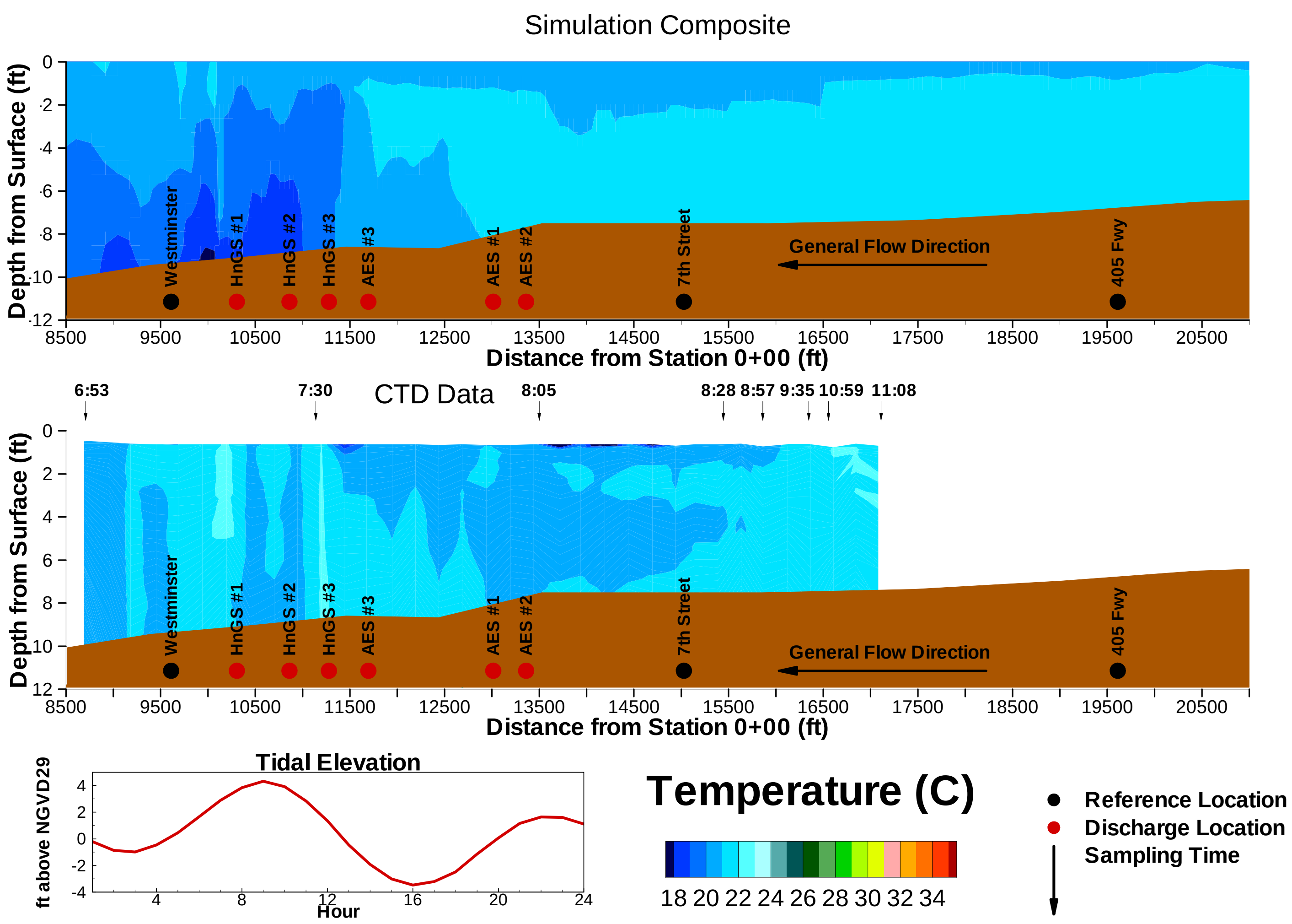
Typical Conditions Surface Salt/Fresh Water Interface Locations

September 15, 2004



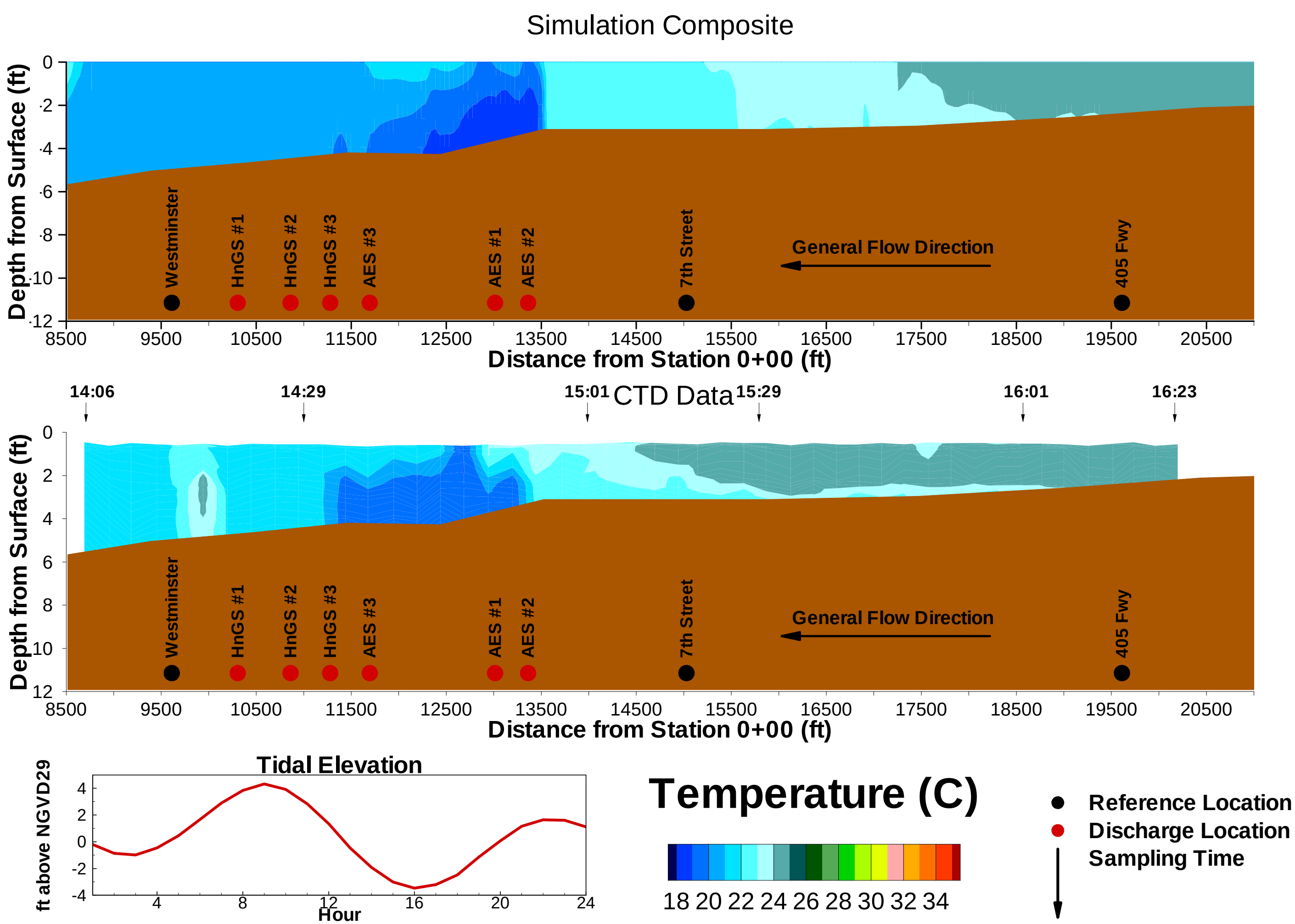
Typical Conditions Temperature Calibration Comparison Contour

November 12, 2004 High Tide



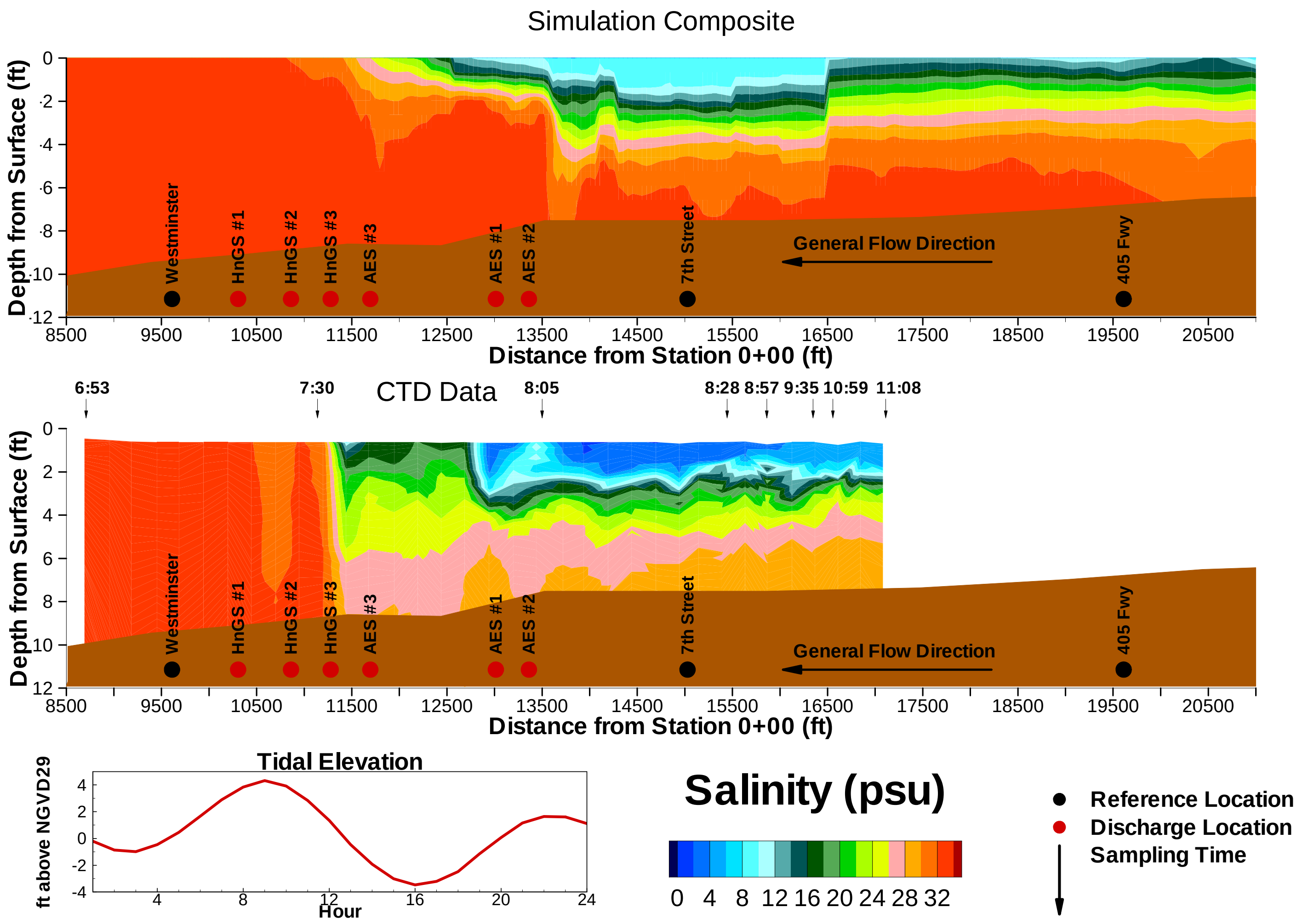
Typical Conditions Temperature Calibration Comparison Contour

November 12, 2004 Low Tide



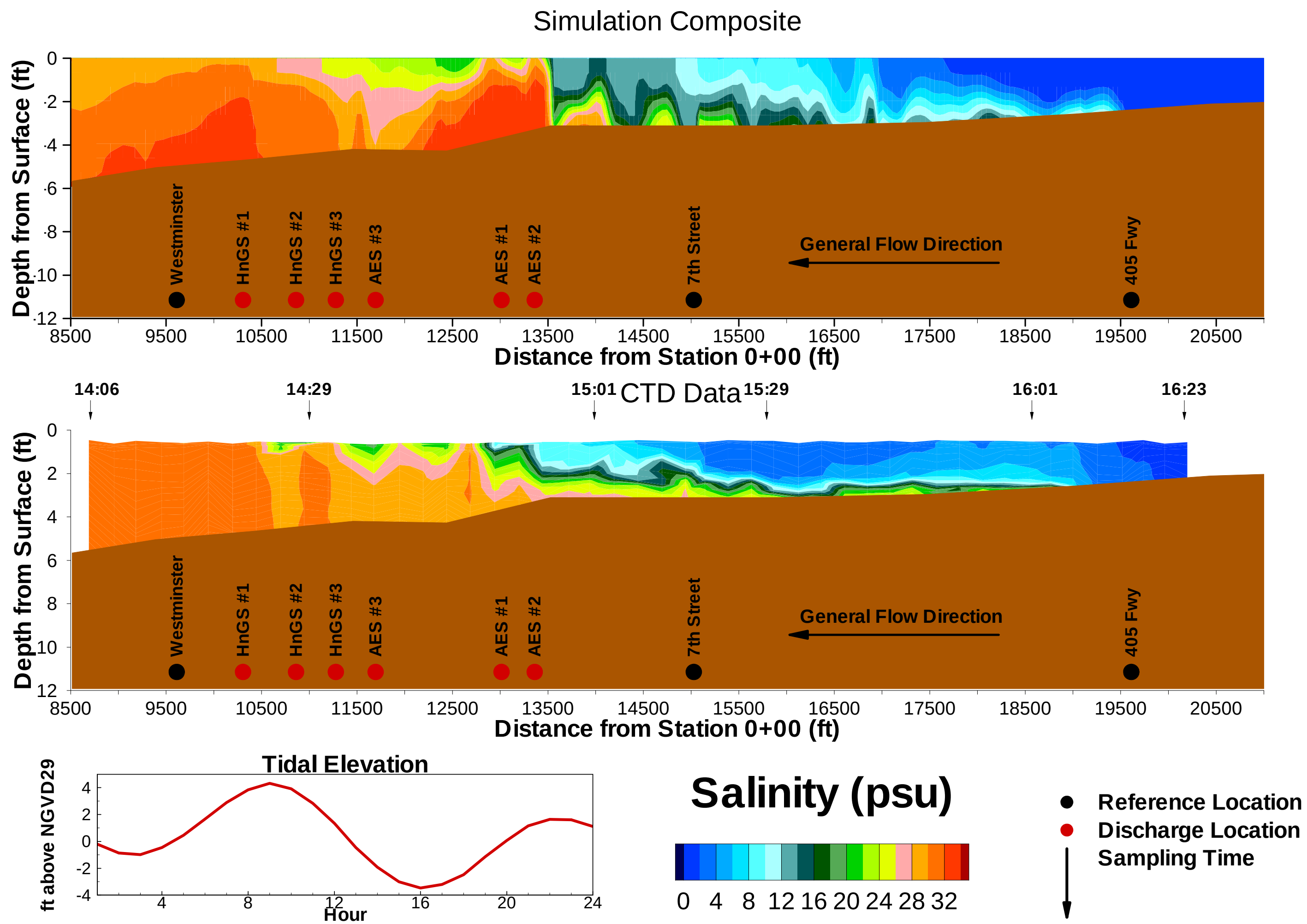
Typical Conditions Salinity Calibration Comparison Contour

November 12, 2004 High Tide



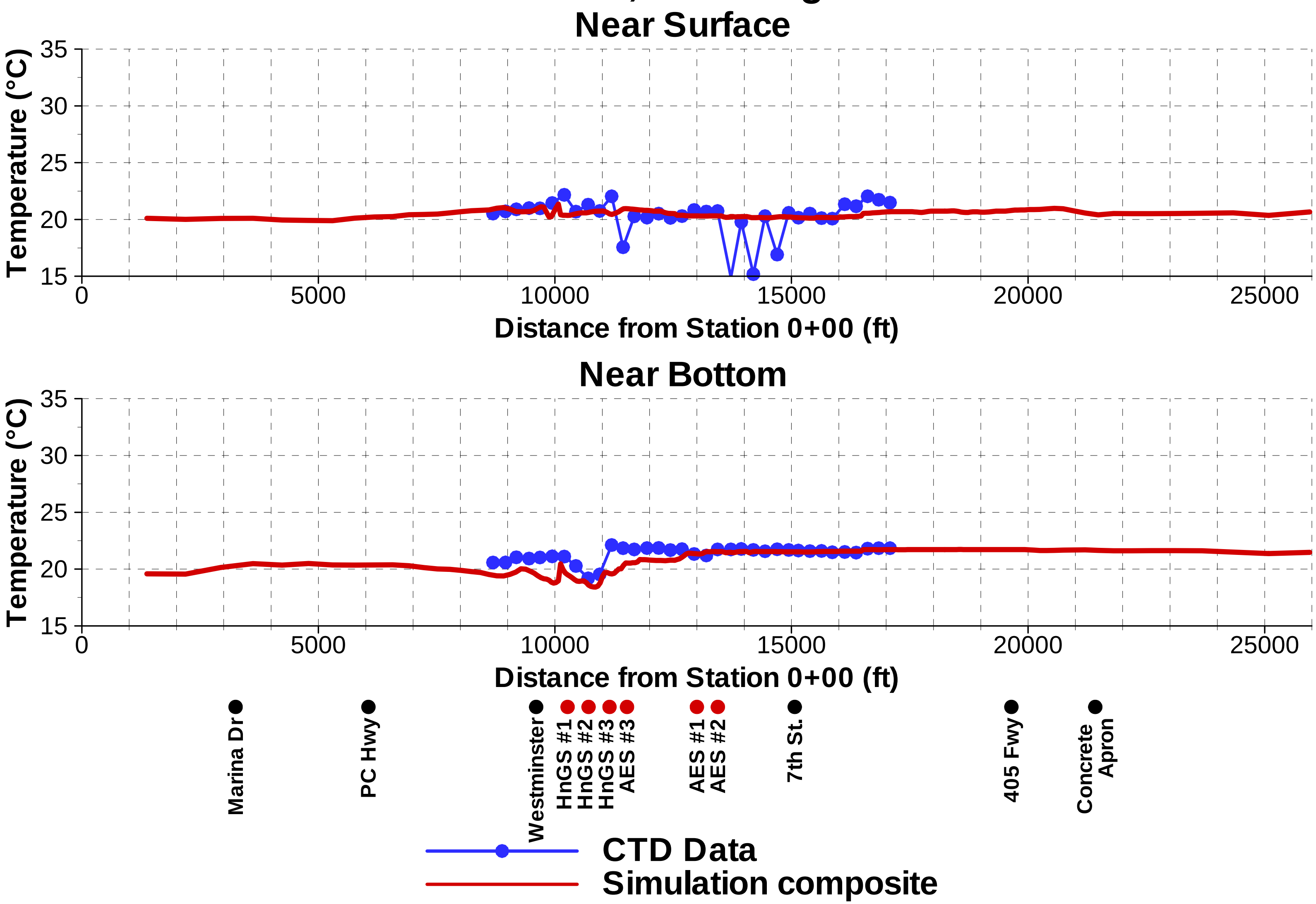
Typical Conditions Salinity Calibration Comparison Contour

November 12, 2004 Low Tide



Typical Conditions Temperature Calibration Comparison

November 12, 2004 High Tide



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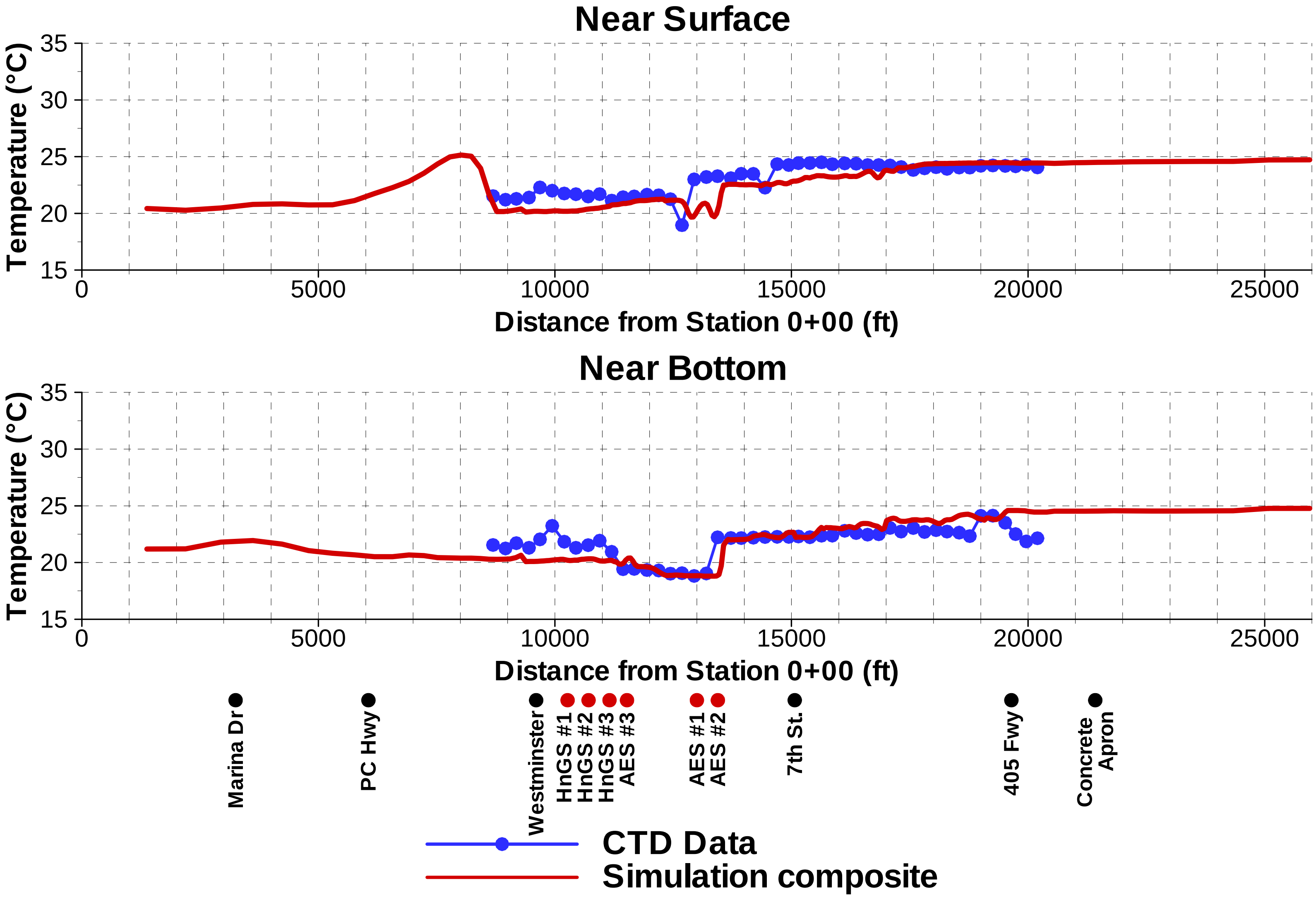
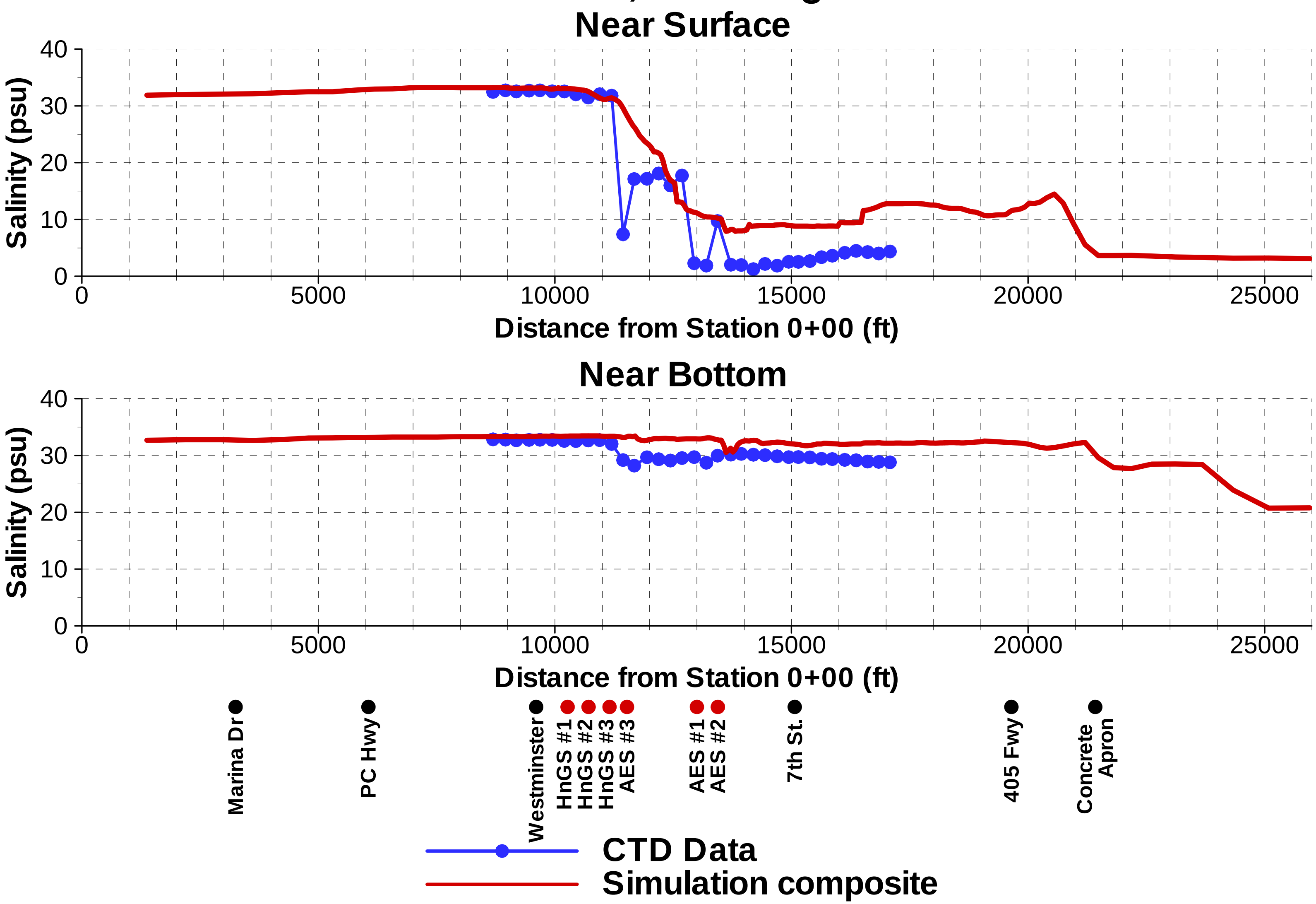
Typical Conditions Temperature Calibration Comparison

November 12, 2004 Low Tide



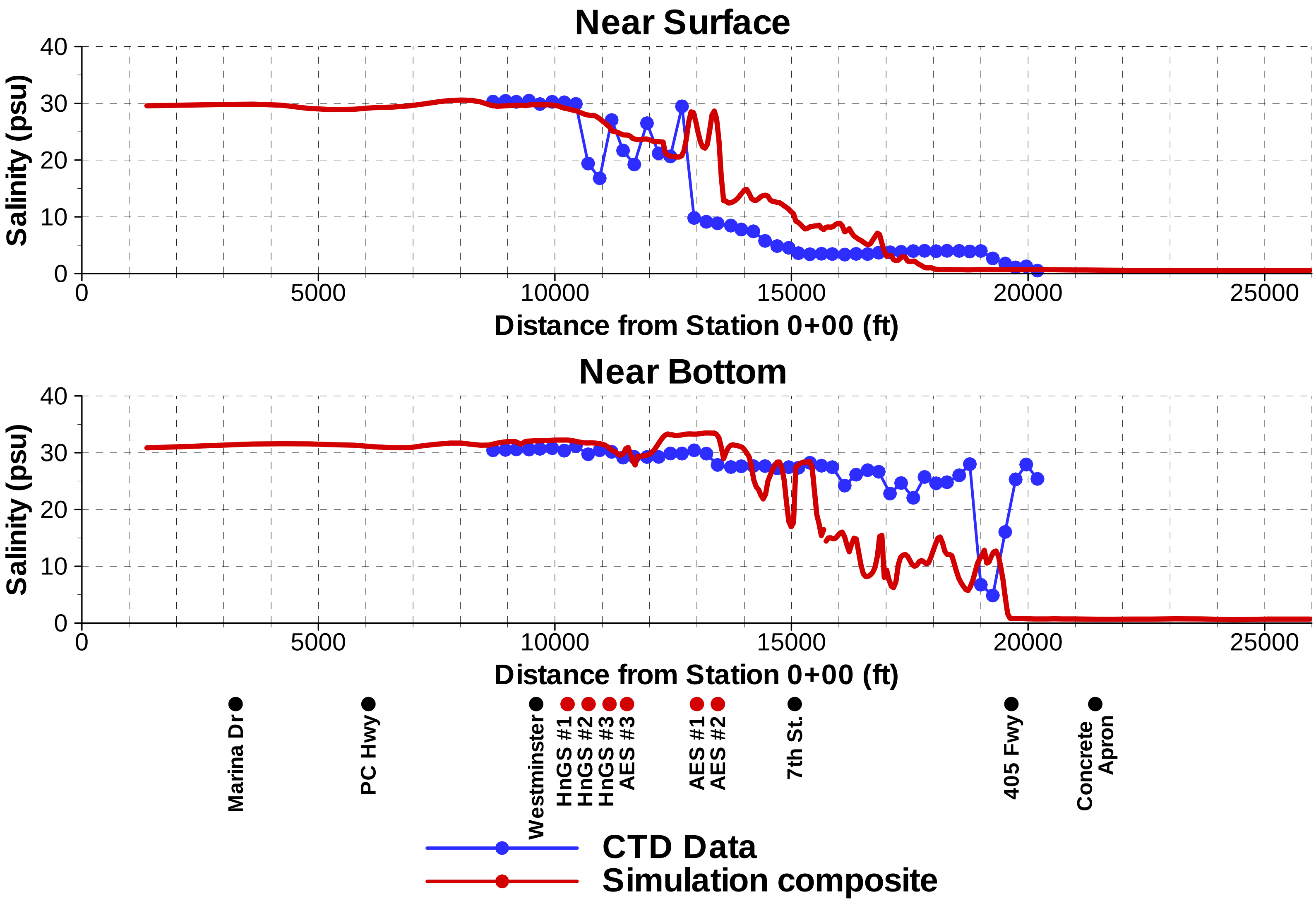
Typical Conditions Salinity Calibration Comparison

November 12, 2004 High Tide



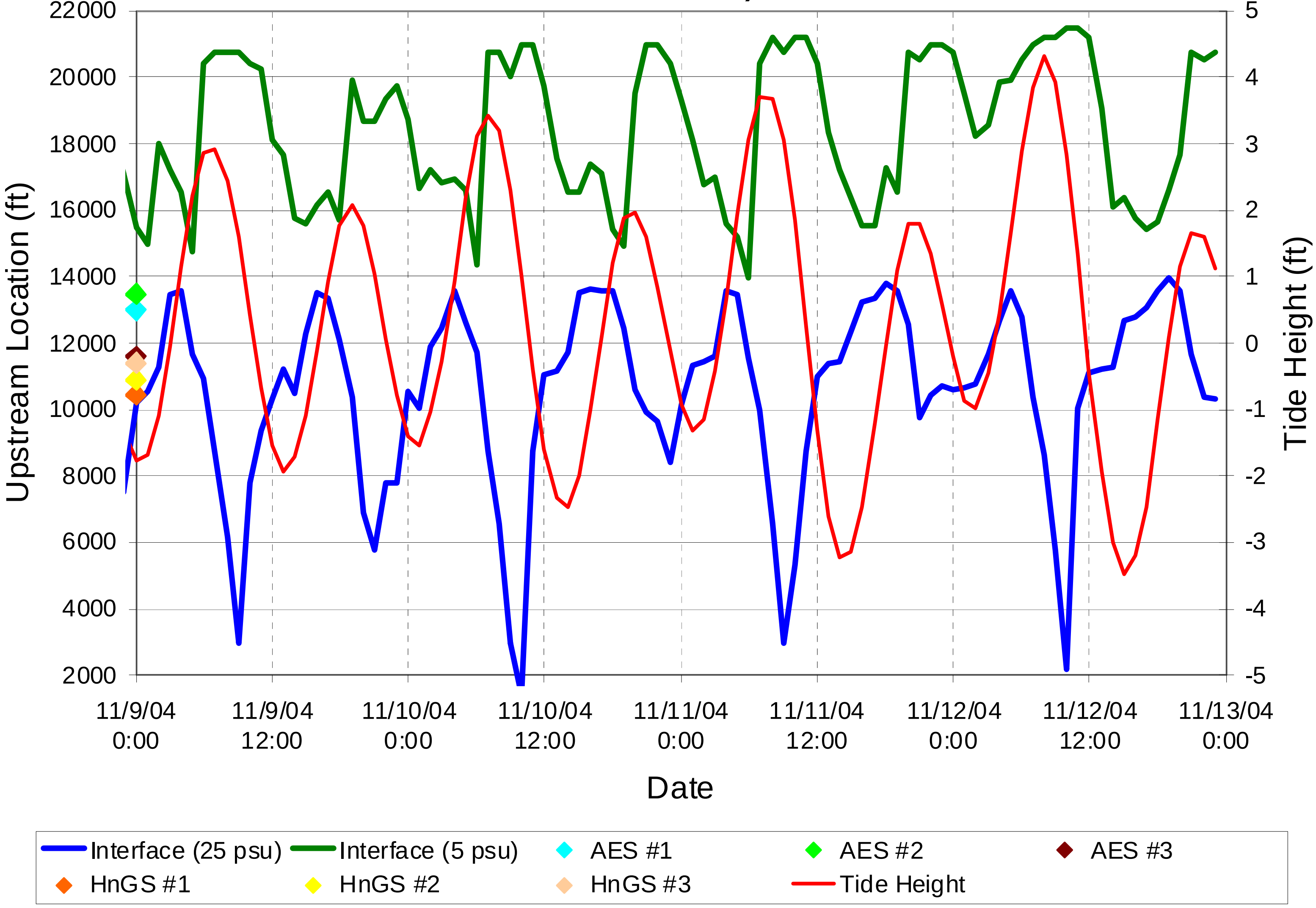
Typical Conditions Salinity Calibration Comparison

November 12, 2004 Low Tide



Typical Conditions Surface Salt/Fresh Water Interface Locations

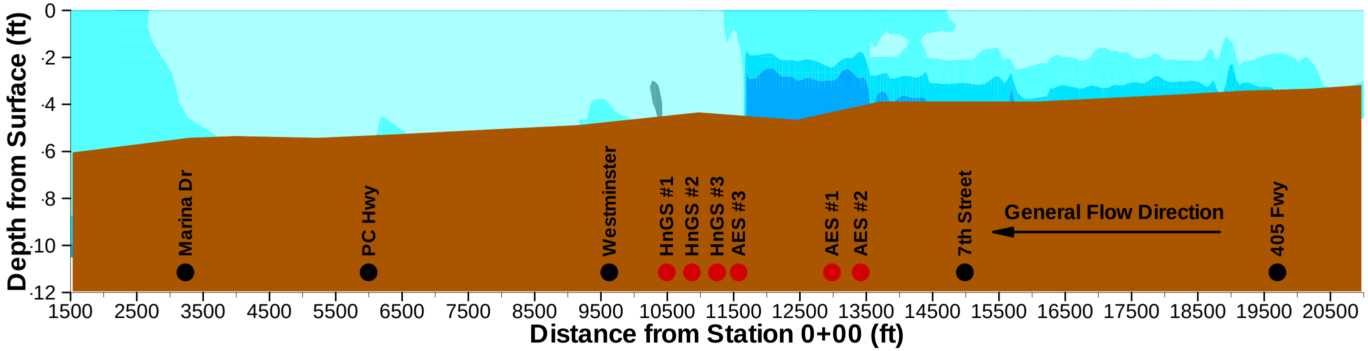
November 12, 2004



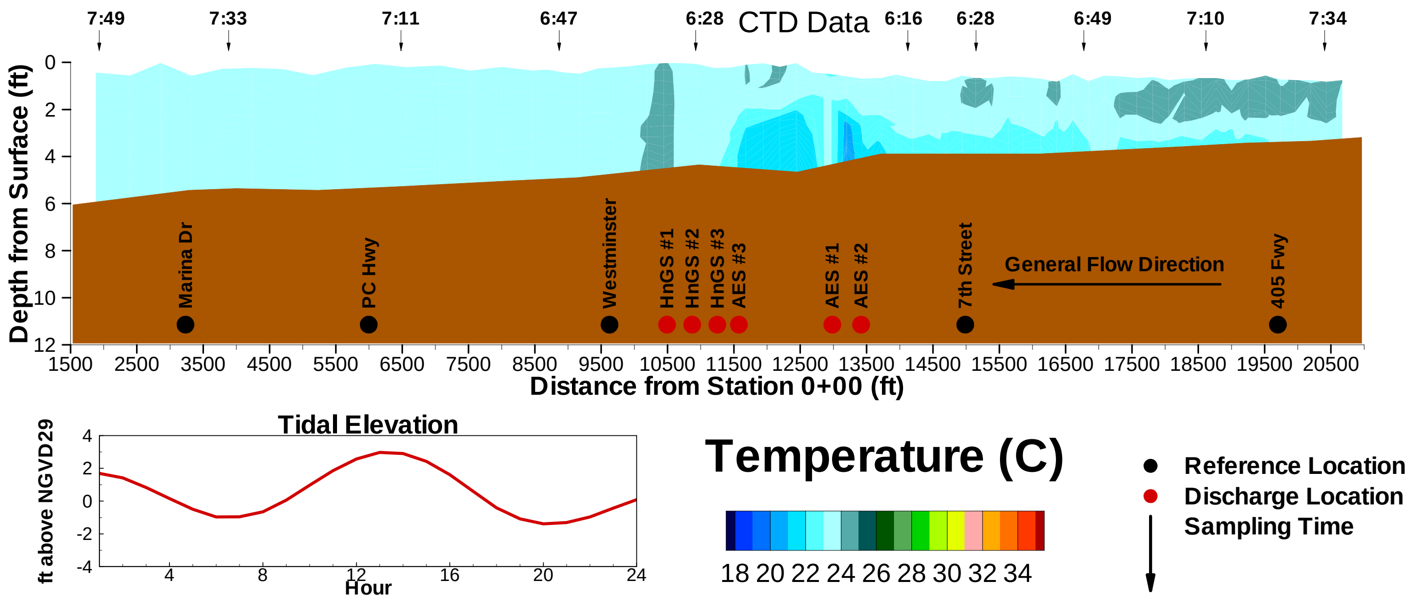
Typical Conditions Temperature Calibration Comparison Contour

August 24, 2005 Low Tide

Simulation Composite



CTD Data



Typical Conditions Temperature Calibration Comparison Contour

August 24, 2005 Mid Tide

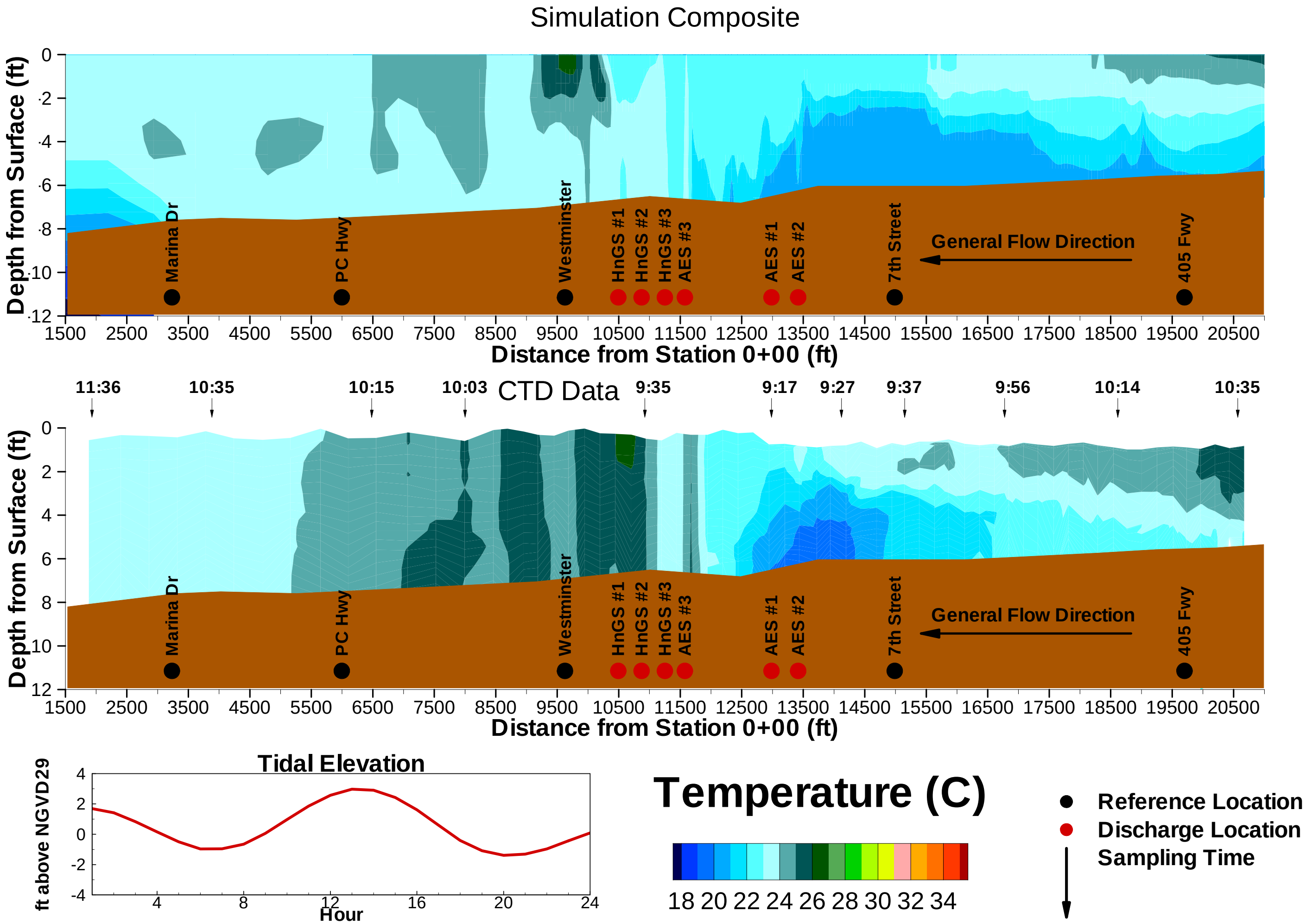
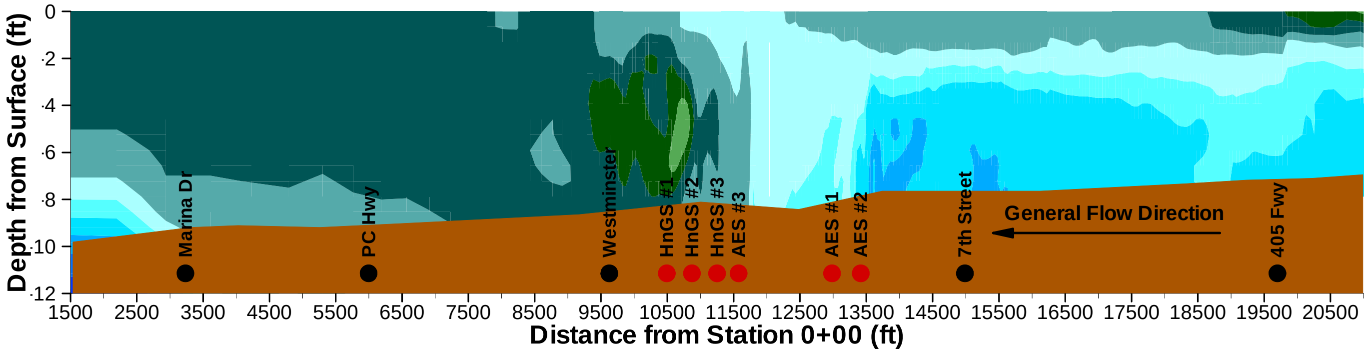


Figure C.82

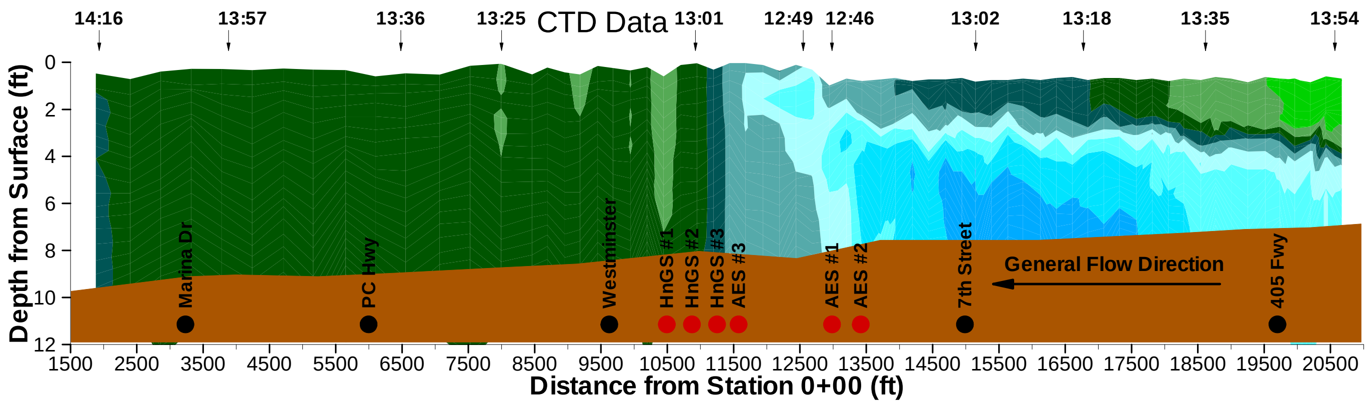
Typical Conditions Temperature Calibration Comparison Contour

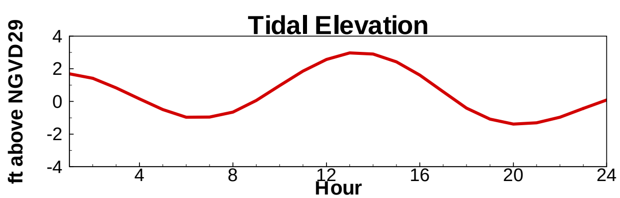
August 24, 2005 High Tide

Simulation Composite



CTD Data





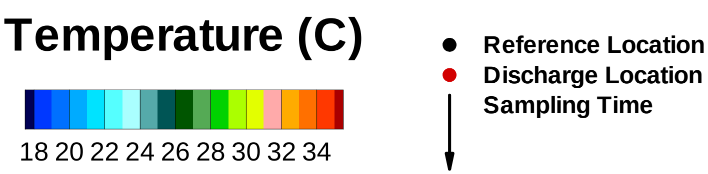
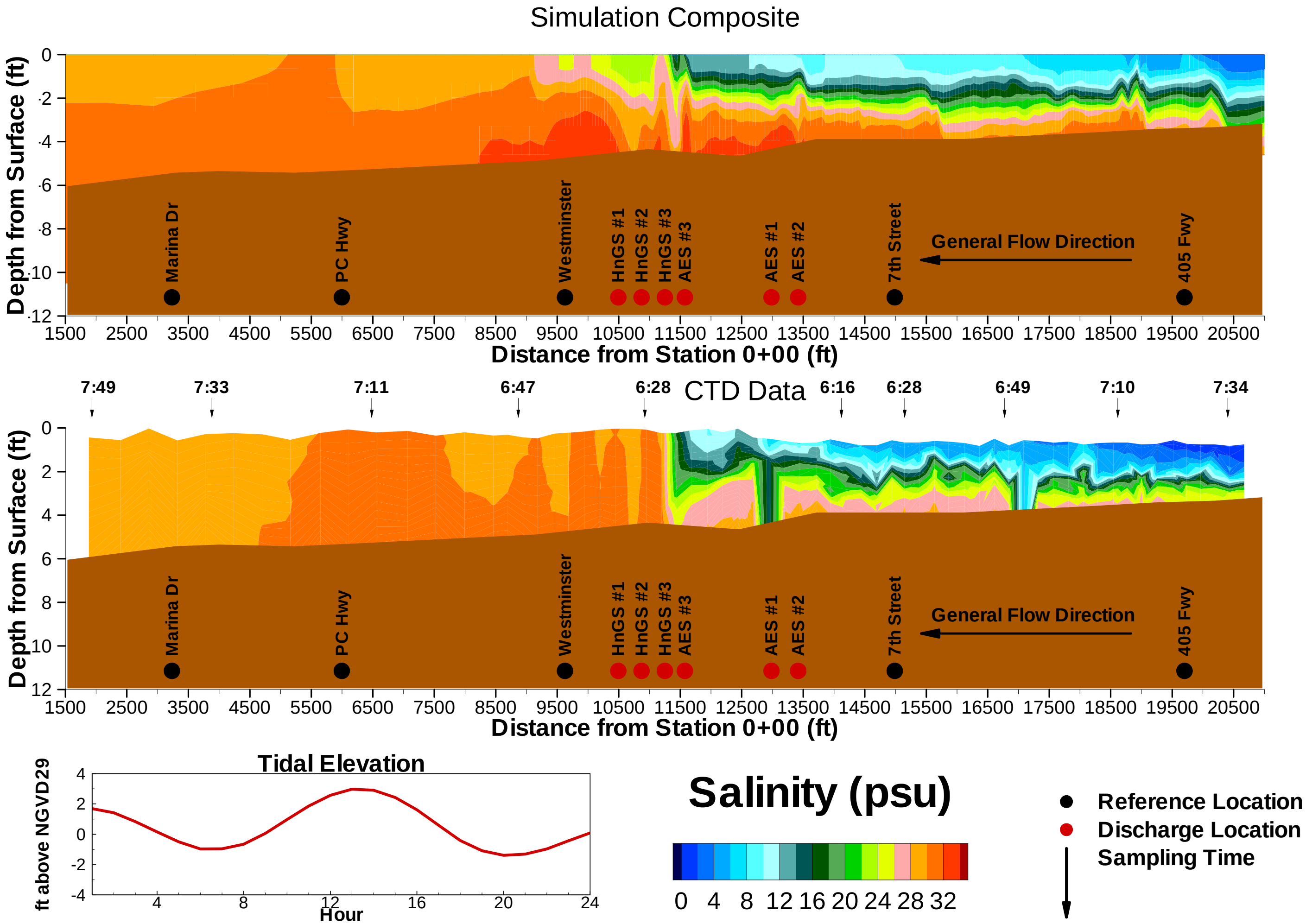


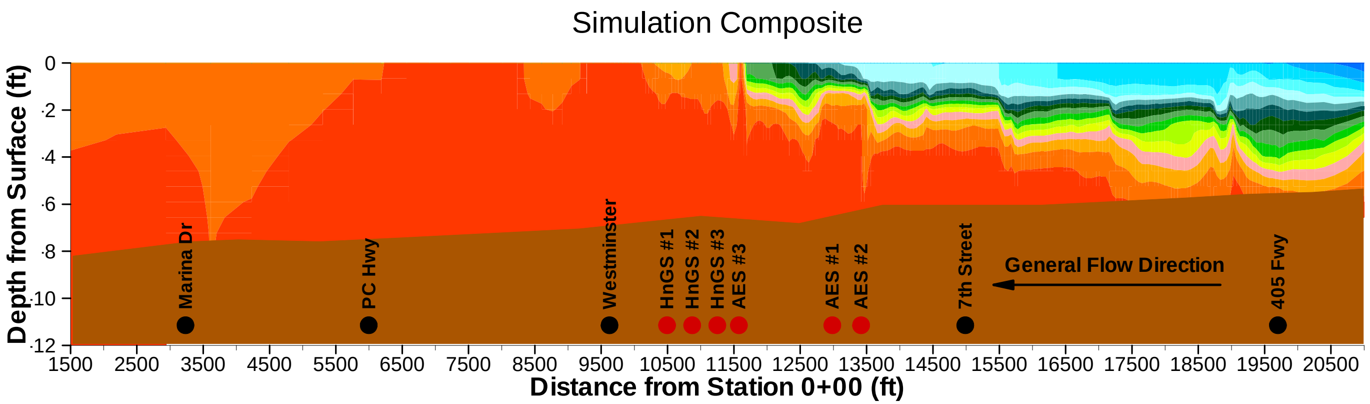
Figure C.83

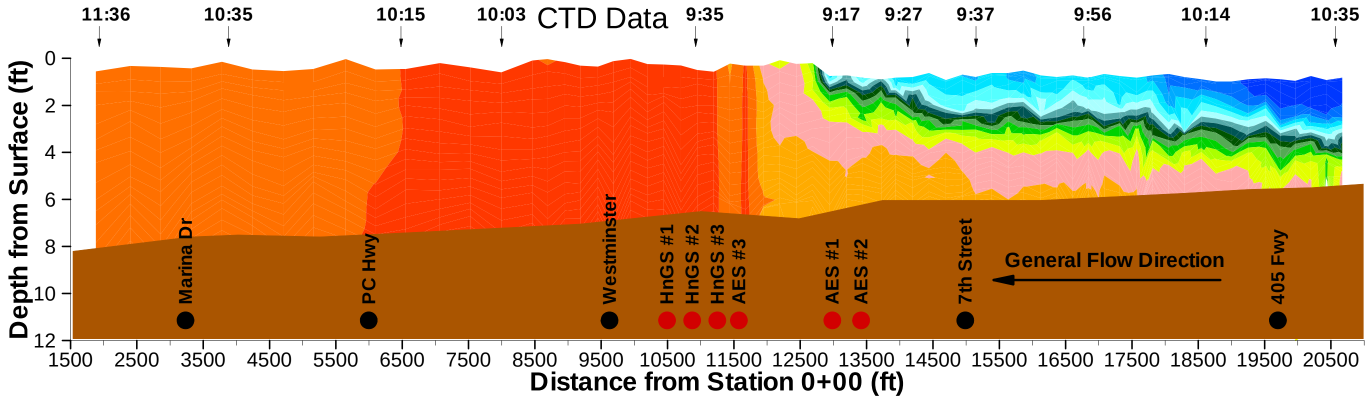
Typical Conditions Salinity Calibration Comparison Contour
August 24, 2005 Low Tide

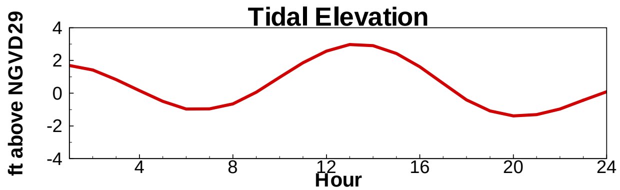


Typical Conditions Salinity Calibration Comparison Contour

August 24, 2005 Mid Tide







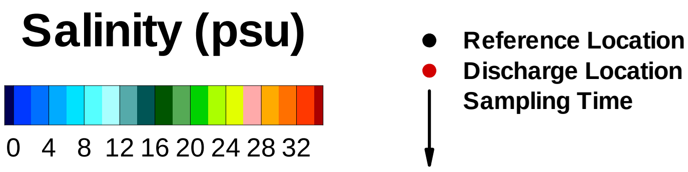


Figure C.85

Typical Conditions Salinity Calibration Comparison Contour

August 24, 2005 High Tide

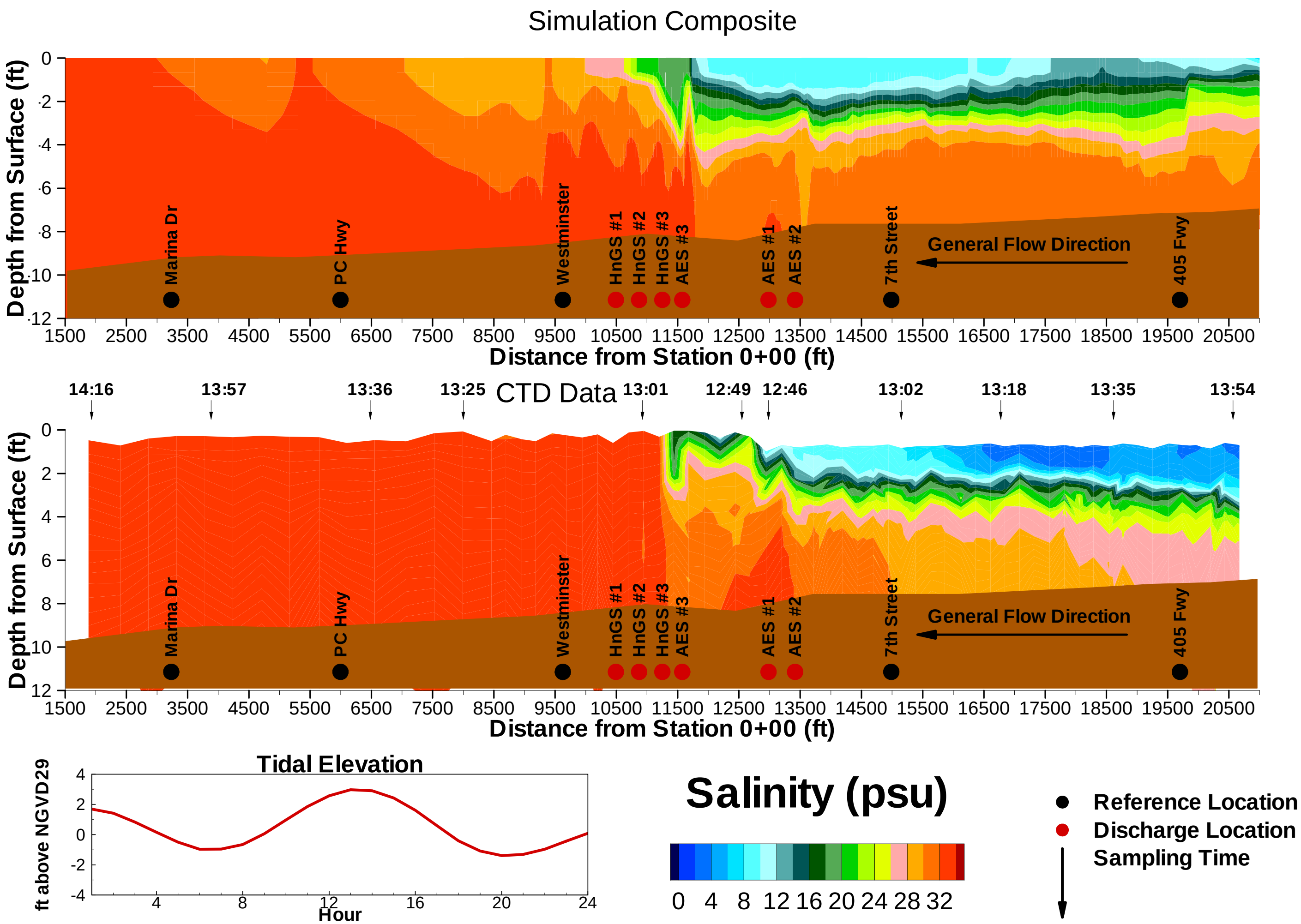
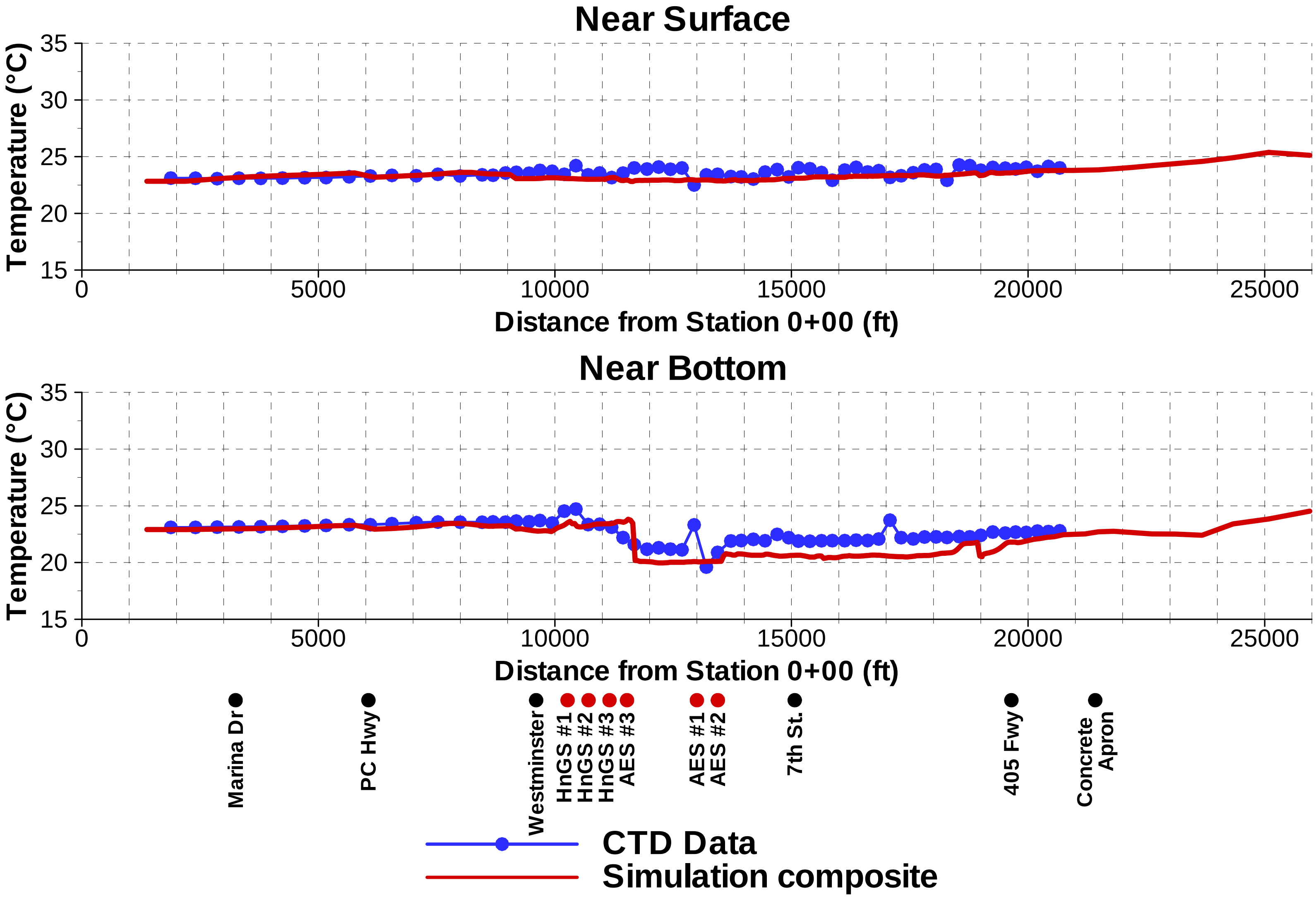


Figure C.86

Typical Conditions Temperature Calibration Comparison

August 24, 2005 Low Tide



Typical Conditions Temperature Calibration Comparison

August 24, 2005 Mid Tide

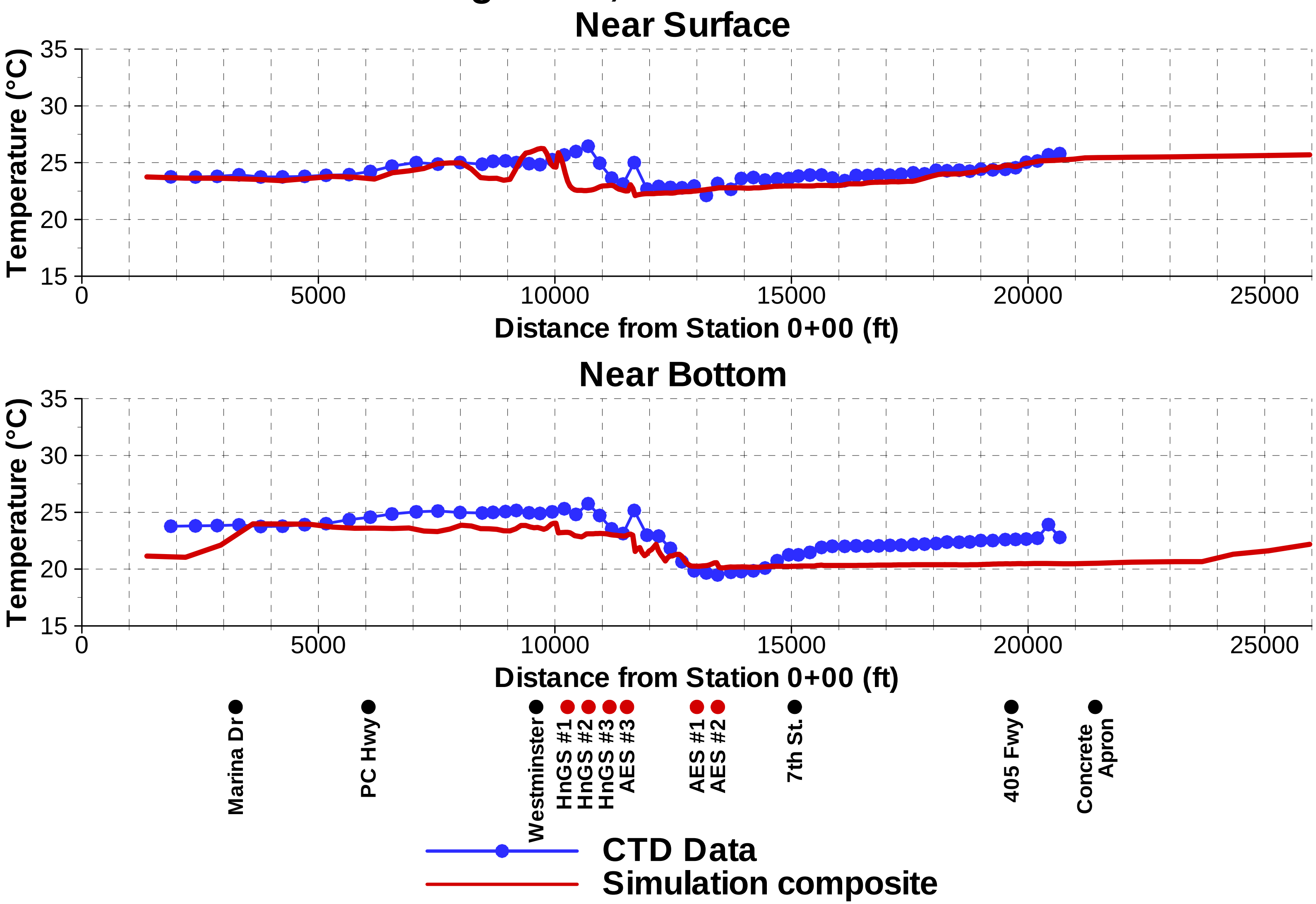
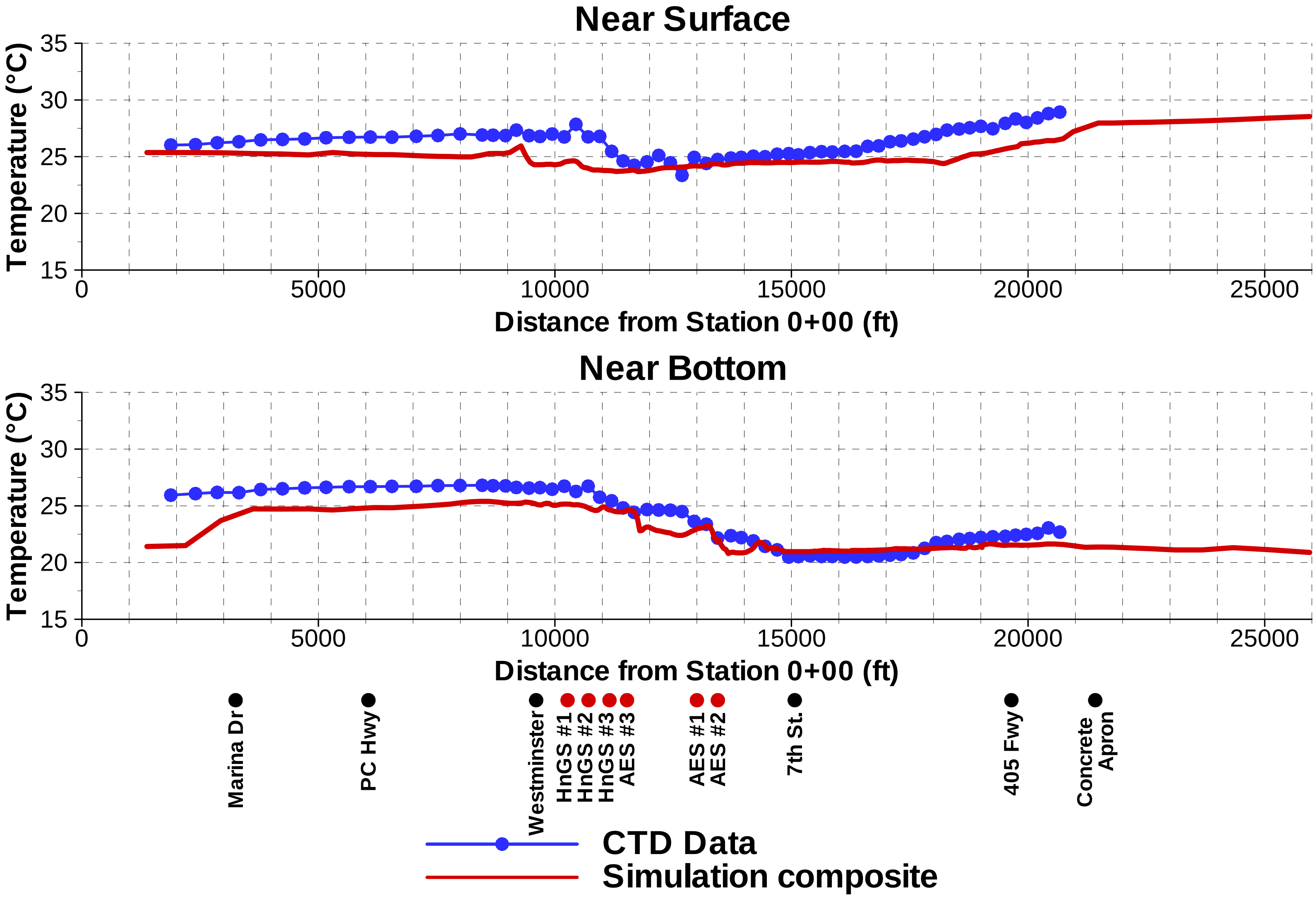


Figure C.88

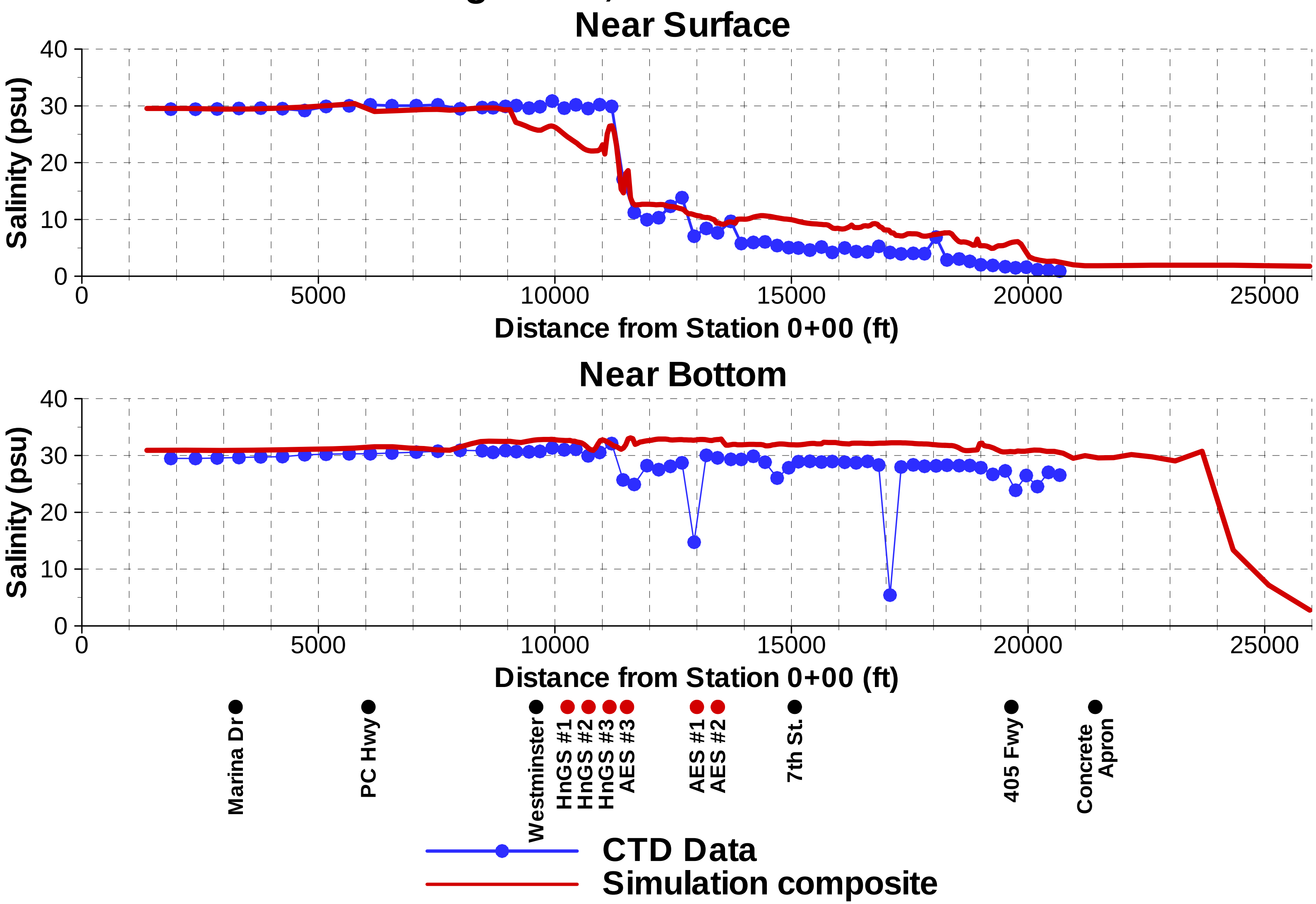
Typical Conditions Temperature Calibration Comparison

August 24, 2005 High Tide



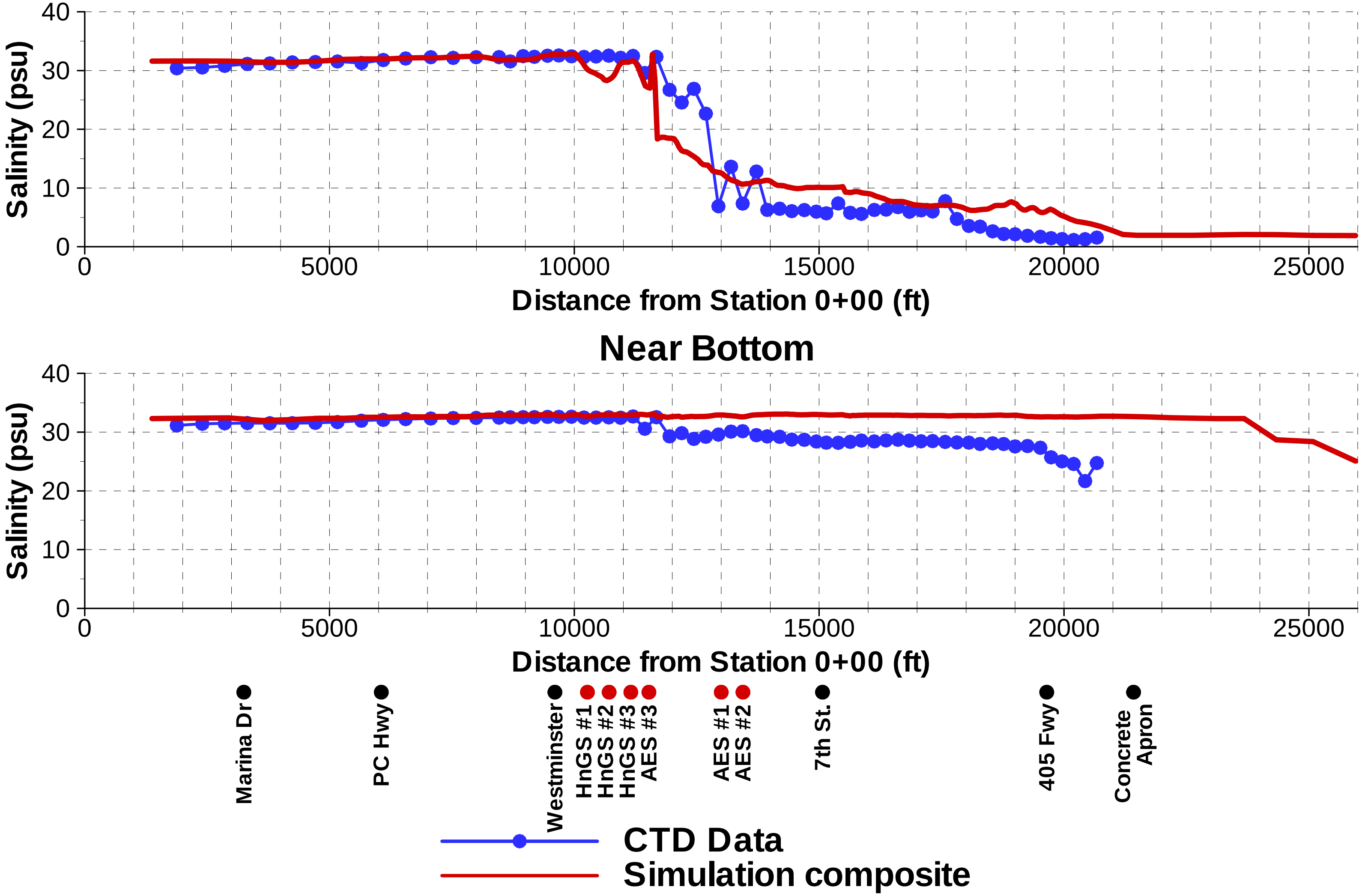
Typical Conditions Salinity Calibration Comparison

August 24, 2005 Low Tide



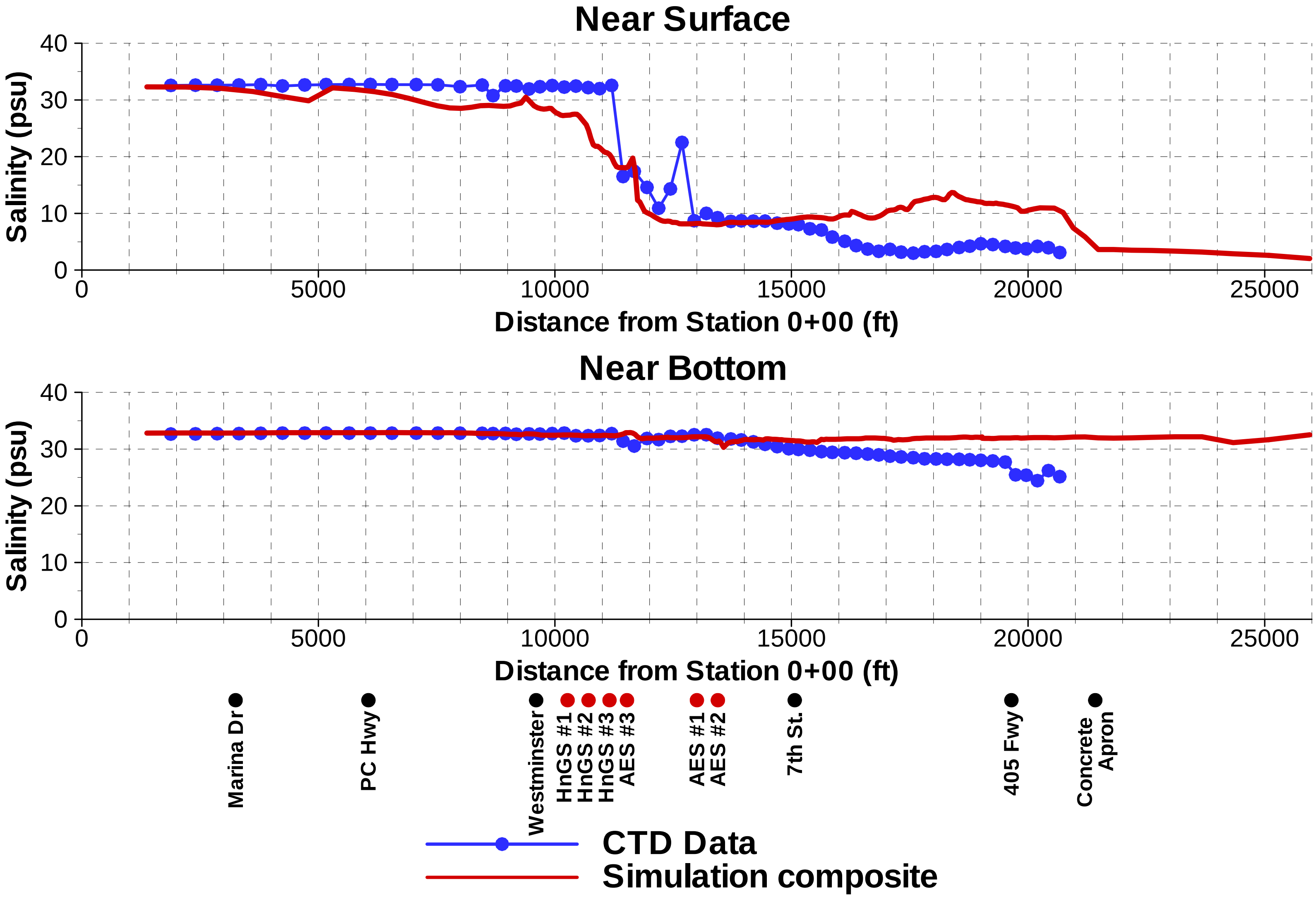
Typical Conditions Salinity Calibration Comparison

August 24, 2005 Mid Tide



Typical Conditions Salinity Calibration Comparison

August 24, 2005 High Tide



Typical Conditions Surface Salt/Fresh Water Interface Locations

August 24, 2005

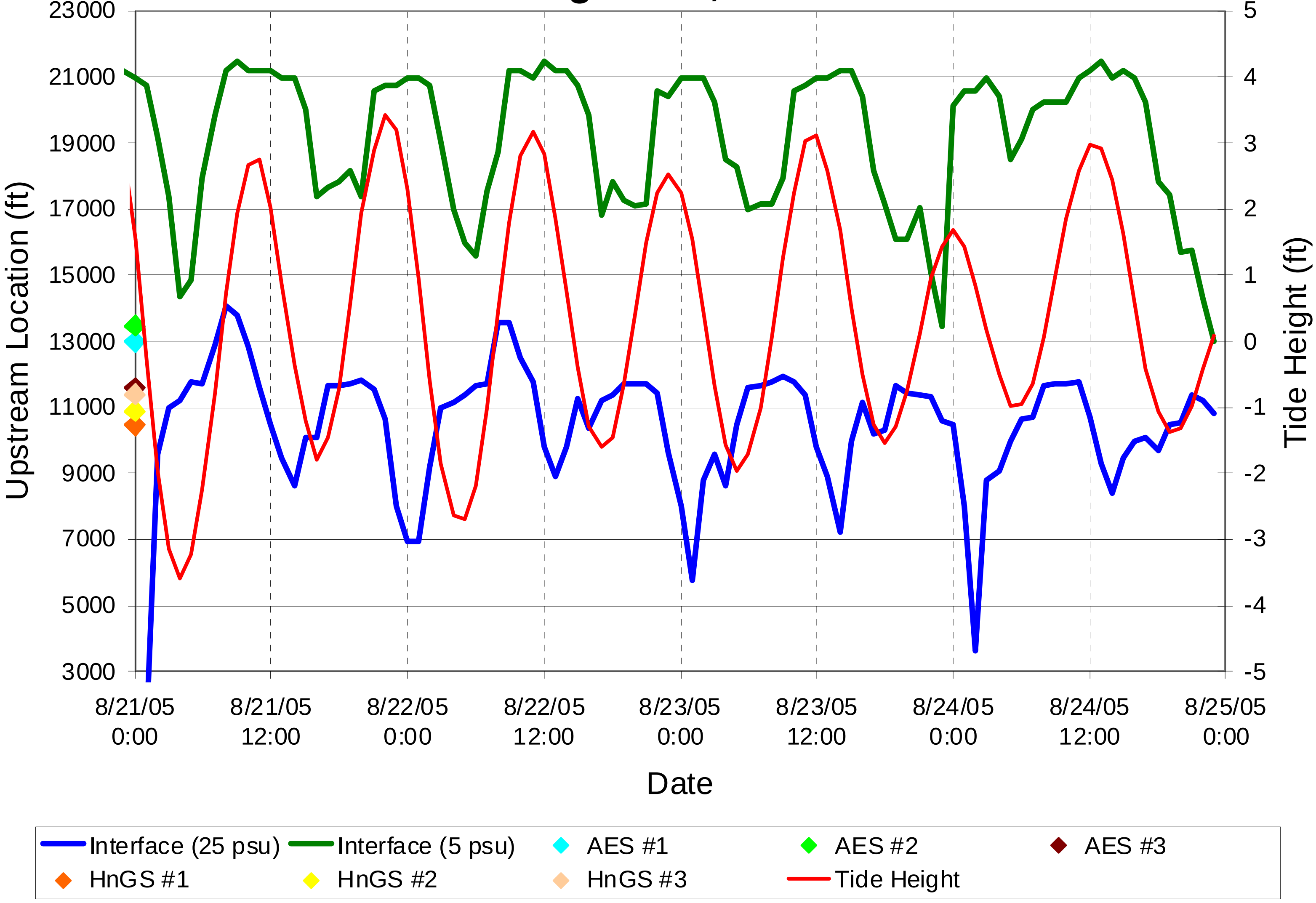


Figure C.93

APPENDIX D: LIST OF ANIMATIONS

INSTRUCTIONS FOR INSTALLING AND USING FRAMER TO VIEW ANIMATION FILES

Installation of Framer

Copy the files from the CD(s) to a directory on your computer.

Running Framer

1) In the Start Menu, choose "run." In this window, type "framer.exe." This should open a "Framer Open File" window, in which you find the proper directory and choose the file that you wish to view.

2) Commands for running the animation files are in the toolbar in the upper left corner of the framer window.

LIST OF ANIMATIONS

- **Chapter 2: Alamitos Bay**

1. Chapter2_AlamitosBay_Temperature_Daily_BaseCase.rm
2. Chapter2_AlamitosBay_Salinity_Daily_BaseCase.rm
3. Chapter2_AlamitosBay_WaterAge_Daily_BaseCase.rm
4. Chapter2_AlamitosBay_DO_Jul-Sep_BaseCase_Moderate.rm
5. Chapter2_AlamitosBay_DO_Jul-Sep_BaseCase_High.rm
6. Chapter2_AlamitosBay_Chla_Jul-Sep_BaseCase_Moderate.rm
7. Chapter2_AlamitosBay_Chla_Jul-Sep_BaseCase_High.rm
8. Chapter2_AlamitosBay_Temperature_Daily_CEQANMO.rm
9. Chapter2_AlamitosBay_Salinity_Daily_CEQANMO.rm
10. Chapter2_AlamitosBay_WaterAge_Daily_CEQANMO.rm
11. Chapter2_AlamitosBay_DO_Jul-Sep_CEQANMO_Moderate.rm
12. Chapter2_AlamitosBay_DO_Jul-Sep_CEQANMO_High.rm

13. Chapter2_AlamitosBay_Chla_Jul-Sep_CEQANMO_Moderate.rm
14. Chapter2_AlamitosBay_Chla_Jul-Sep_CEQANMO_High.rm

- **Chapter 3: Intake Channel**

15. Chapter3_HnGS_IntakeChannel_WaterAge_6hour_MarchStorm_BaseCase.rm
16. Chapter3_HnGS_IntakeChannel_WaterAge_6hour_MarchStorm_CEQANMO.rm
17. Chapter3_HnGS_IntakeChannel_Chla_July_High.rm
18. Chapter3_HnGs_IntakeChannel_Chla_Nov-Dec_High.rm
19. Chapter3_HnGs_IntakeChannel_DO_July_High.rm
20. Chapter3_HnGs_IntakeChannel_DO_Nov-Dec_High.rm

- **Chapter 4: Lower San Gabriel River Flood Control Channel**

21. Chapter4_LSGR_Calibration_May_31_2005_salinity_and_temperature.rm
22. Chapter4_LSGR_Calibration_May_31_2005_tracers.rm
23. Chapter4_LSGR_Calibration_Oct_22_2005_salinity_and_temperature.rm
24. Chapter4_LSGR_Calibration_Oct_22_2005_tracers.rm
25. Chapter4_LSGR_Calibration_Sept_15_2005_salinity_and_temperature.rm
26. Chapter4_LSGR_Calibration_Sept_15_2005_tracers.rm
27. Chapter4_LSGR_Calibration_Nov_12_2005_salinity_and_temperature.rm
28. Chapter4_LSGR_Calibration_Nov_12_2005_tracers.rm
29. Chapter4_LSGR_Calibration_Aug_24_2005_salinity_and_temperature.rm
30. Chapter4_LSGR_Calibration_Aug_24_2005_tracers.rm
31. Chapter4_LSGR_CEQANMO_vs_BaseCase_October_24_2005_tracer_concentrations.rm

32. Chapter4_LSGR_CEQANMO_vs_BaseCase_July_20_2005_tracer_concentrations.rm

33. Chapter4_LSGR_CEQANMO_vs_BaseCase_October_24_2005_water_temperature.rm

34. Chapter4_LSGR_CEQANMO_vs_BaseCase_July_20_2005_water_temperature.rm

35. October_24_2005_2005A1_CEQA_Oct_salinity.rm

36. July_20_2005_2005A2_CEQA_July_salinity.rm

APPENDIX E

HAYNES GENERATING STATION UNITS 5 & 6 REPOWERING PROJECT NOISE AND VIBRATION IMPACT REPORT

Terry A. Hayes Associates LLC

January 21, 2010

HAYNES GENERATING STATION UNITS 5 & 6 REPOWERING PROJECT NOISE AND VIBRATION IMPACT REPORT

taha
environmental planners

Prepared for

EDAW, INC.

Prepared by

TERRY A. HAYES ASSOCIATES LLC

January 21, 2010

TAHA 2008-076

HAYNES GENERATING STATION UNITS 5 & 6 REPOWERING PROJECT

NOISE AND VIBRATION IMPACT REPORT

Prepared for

EDAW, INC.
2737 Campus Drive
Irvine, CA 92612

Prepared by

TERRY A. HAYES ASSOCIATES LLC
8522 National Boulevard, Suite 102
Culver City, CA 90232

January 21, 2010

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1.0 SUMMARY OF FINDINGS

Terry A. Hayes Associates LLC completed a noise impact analysis for the proposed Haynes Generating Station Units 5 & 6 Repowering Project (proposed project). Key findings are listed below.

Construction Activity

1. General construction activity noise levels would result in a significant impact at Leisure World without mitigation. Mitigation measures would reduce noise levels to below the 10-decibel (dBA) threshold above ambient at Leisure World. General construction noise would not be discernible at the Island Village residential community. General construction activity would result in a less-than-significant noise impact after mitigation.

2. Pile driving activity noise levels would result in a significant impact at Leisure World without mitigation. Mitigation measures would reduce noise levels, but the increase in ambient noise levels at Leisure World would still exceed the 10-dBA threshold, and the impact would be significant and unavoidable. Pile driving activity would result in a less-than-significant impact at the Island Village residential community.

3. Construction delivery truck activity would generate a maximum noise level increase of 1.0 dBA L_{eq} at sensitive receptors. This would not exceed the 10-dBA significance threshold, and construction delivery truck noise levels would result in a less-than-significant impact at nearby sensitive receptors.

4. Construction activity would generate vibration at levels up to 0.004 inches per second peak particle velocity (PPV) from heavy equipment, and up to 0.032 inches per second PPV from pile driving activity at the nearest buildings. Construction vibration levels would not exceed the building damage threshold of 0.5 inches per second PPV and would result in a less-than-significant construction vibration impact.

Operational Activity

1. The operation of the proposed project would result in a less-than-significant operational noise impact regarding the Long Beach Municipal Code.

2. The operation of the proposed project would not include any significant sources of ground-borne vibration and would result in a less-than-significant vibration impact.

3. The operation of the proposed project would not significantly contribute to a cumulatively considerable noise or vibration impact.

2.0 INTRODUCTION

2.1 PURPOSE OF REPORT

The purpose of this report is to evaluate the potential noise and vibration impacts of the proposed Haynes Generating Station Units 5 & 6 Repowering Project (proposed project). Potential noise and vibration impacts are analyzed for construction and operation of the proposed project. Mitigation measures for noise and vibration are recommended, where necessary.

2.2 PROJECT DESCRIPTION

The proposed project includes the construction and operation of six new natural gas-fired combustion turbines and associated pollution control systems. The new simple cycle generating systems (SCGS) would be designated as Units 11, 12, 13, 14, 15, and 16.

The proposed project would remove existing steam boiler generation Units 5 and 6 from service. The plant's existing once-through cooling water circulation utilized by Units 5 and 6 would be decommissioned. The proposed project would use dry cooling units for cooling needs. The proposed project would also require the installation of ancillary equipment such as electrical transformers and switching equipment and gas compressors. A new control building, instrument shop, and maintenance shop and offices would also be provided. The project site boundaries are show in Figure 2-1.

2.3 DESCRIPTION OF CONSTRUCTION ACTIVITIES

General Construction Activities

Construction of the proposed project is scheduled to begin in the third quarter of 2010 and end in the last quarter of 2012. Construction activities, including mobilization, site preparation, component acquisition and fabrication, project erection, and system startup and commissioning, would last approximately 26 months. Construction activities would normally occur Mondays through Saturdays from approximately 7:00 a.m. to 3:30 p.m. To ensure that construction activities stay on schedule, two shifts per day may be necessary during the construction period, and occasional Sunday shifts may also be required. In addition, some construction activities must be conducted continuously until completed, such as welding activities that cannot be interrupted. Even though activities such as welding would continue throughout the night, they would produce less noise than typical construction activity.

Based on Los Angeles Department of Water and Power (LADWP) estimates, approximately 270 workers could be present at the site on the same day, in either one or two shifts, during the peak project construction period. This peak period is expected to occur for several months in 2011.

All construction workers would access the site through the main gate on 2nd Street, at the southwest corner of the Haynes Generating Station (HnGS) property, and worker vehicle parking would be accommodated within the property existing parking areas or in open areas along the western boundary. Construction equipment, materials, and components would generally be delivered through the main gate at the southwest corner of the property. However, some larger and heavier loads may be delivered through the industrial gate at the southeast corner of the HnGS property. Truck trips may average 25 loads per day during the peak construction materials delivery period of several months during 2011. During the balance/non-peak of the project, truck trips are expected to average less than 10 loads per day.

LEGEND:

Project Site

Generators

SOURCE: EDAW, INC.

taha

Haynes Generating Station Units 5 & 6 Repowering Project
Noise and Vibration Impact Report

EDAW, INC.

taha 2008-076

FIGURE 2-1

PROJECT SITE

The proposed project would be located in the west-central part of the HnGS property, immediately north of the existing HnGS generators. The total area for the proposed project would be approximately 16 acres and would include a 6-acre area for the new generator units, a 6.5-acres yard for the electrical switching equipment and transformers, and a 2-acre area for the cooling units. Construction activity for the proposed project would include minor grading and site preparation; construction of access roads; the driving of piles and the construction of foundations for the proposed project; installation of the generator units and dry cooling systems, and associated auxiliary equipment; turbine commissioning (testing and calibration prior to operation); and decommissioning existing Units 5 and 6. All required staging, storage, and laydown areas related to project construction would be located within the existing HnGS boundaries. Contractors would require temporary trailers on site for construction planning and management activities.

Site Preparation and Foundation Construction

Preparation of the project site will require removal of several existing berms and ground preparation for the proposed project's foundation. Grading is expected to balance on site; however, it may be necessary to temporarily stockpile excess dirt on site until it can be used during final grading. Equipment use during site grading would include push-pull scrapers, trackloaders, skiploader, water trucks, fuel trucks, pick-up trucks, excavators, backhoes, bulldozers, motor graders, and dump trucks.

Because soils at the HnGS property consist of marine tidal deposits and river alluvial deposits with low bearing capacity, foundation piles are required to adequately support the SCGS components. It is estimated that the generator units and other project elements may require up to 3,000 piles driven to depths of up to 80 feet, depending on site-specific geotechnical conditions. The pile driving operation would be restricted to between the hours of 8:00 a.m. and 6:00 p.m., Mondays through Fridays. The pile driving operation is anticipated to last up to four months, depending on the methods and equipment used. Concrete foundations would then be constructed over the piles. Equipment used during the foundation construction would include concrete vibrators, concrete pumps, and light plants.

Construction traffic related to the site preparation and foundation construction phase would include approximately 250 (one-way) truck trips over a four-month period to deliver the pre-cast concrete piles and 2,600 truck trips (one way) over a 12- to 15-month period to deliver concrete and the reinforcing steel required to construct the foundations for the proposed project. The entire site preparation phase, including grading, pile driving, and foundations, would last approximately 7 months.

Erection of the SCGS

Once the site is prepared and the foundations are constructed at a given location, the combustion turbine generator units would be erected. Many components of the SCGS, including the LMS-100 turbines, are prefabricated and would be delivered to the site by truck for assembly. The major components for the LMS-100 turbine generator systems would be delivered in a staged manner during the peak of construction activity. This would involve approximately 34 loads per combustion turbine generator, delivered over an approximately ten-month period. Some of these loads would be oversized, which would require a special transportation permit. Most would be expected to be delivered during normal work hours, but some heavier loads may be delivered at night to minimize traffic disruptions. The components and other materials required for the construction of the SCGS would be stored in various laydown areas at on the HnGS property until needed.

A number of cranes would be used during the SCGS erection to lift and place the heavy prefabricated components. These would include electric hoists and hydraulic cranes (for the heaviest loads). Additional equipment would include forklifts, compressors, light plants, welders, trenchers, and plate compactors.

Cooling System

The dry cooling units would consist of six banks of cooling equipment (one for each turbine) supported by a structural steel base. Each bank would have 11 bays of fans, with 3 fans in each bay. The bays come in one piece, weigh approximately 85,000 pounds (lbs) each and would require 66 truck deliveries. Approximately 400,000 lbs to 450,000 lbs of structural steel would be needed for the base of each bank, generating an additional 60 truck loads.

Transformers/Switchyard and Natural Gas Supply

A single step-up transformer would be installed for each pair of generator units of the proposed project. The transformers would be connected by pole-mounted electrical lines to a new switchyard that would be constructed in the area to the west of the SCGS facilities. From the switchyard, new lines would connect to an existing high-voltage transmission line that runs along the western edge of the HnGS property.

A new natural gas supply line would be constructed that will run to the combustion turbines from a new compressor station located just east of the SCGS facilities. New compressor units to support the SCGS facilities would be constructed at the compressor station. The construction of the transformers, switchyard, and natural gas supply system would occur concurrently with the erection of the proposed SCGS.

Start Up and Commissioning

After the proposed project is complete but prior to producing electrical energy for distribution to the LADWP service area, the SCGS would undergo a comprehensive commissioning program to evaluate and calibrate the various systems. This commissioning program includes testing and synchronizing the combustion turbine electrical and mechanical systems and completing simple cycle trial runs. The commissioning phase of the proposed project requires approximately three to four months and would require fewer than 100 workers.

Decommissioning of Units 5 and 6

Within 90 days of completion of the commissioning of the proposed SCGS, LADWP would remove existing Units 5 and 6 from service by surrendering the operating permits pursuant to SCAQMD Rule 2012. Units 5 and 6 would be left in place but permanently disabled.

3.0 NOISE & VIBRATION

This section evaluates noise and vibration impacts associated with the implementation of the proposed project. The noise and vibration analysis in this section assesses the following: existing noise and vibration conditions at the project site and in its vicinity, as well as short-term construction and long-term operational noise and vibration impacts associated with the project. Mitigation measures for potentially significant impacts are recommended, where appropriate.

3.1 NOISE AND VIBRATION CHARACTERISTICS AND EFFECTS

3.1.1 Noise

Characteristics of Sound

Sound is technically described in terms of the loudness (amplitude) and frequency (pitch) of the sound. The standard unit of measurement for sound is the decibel (dB). The human ear is not equally sensitive to sound at all frequencies. The "A-weighted scale," abbreviated dBA, reflects the normal hearing sensitivity range of the human ear. On this scale, the range of human hearing extends from approximately 3 to 140 dBA. **Figure 3-1** provides examples of A-weighted noise levels from common sounds.

Equivalent Noise Level

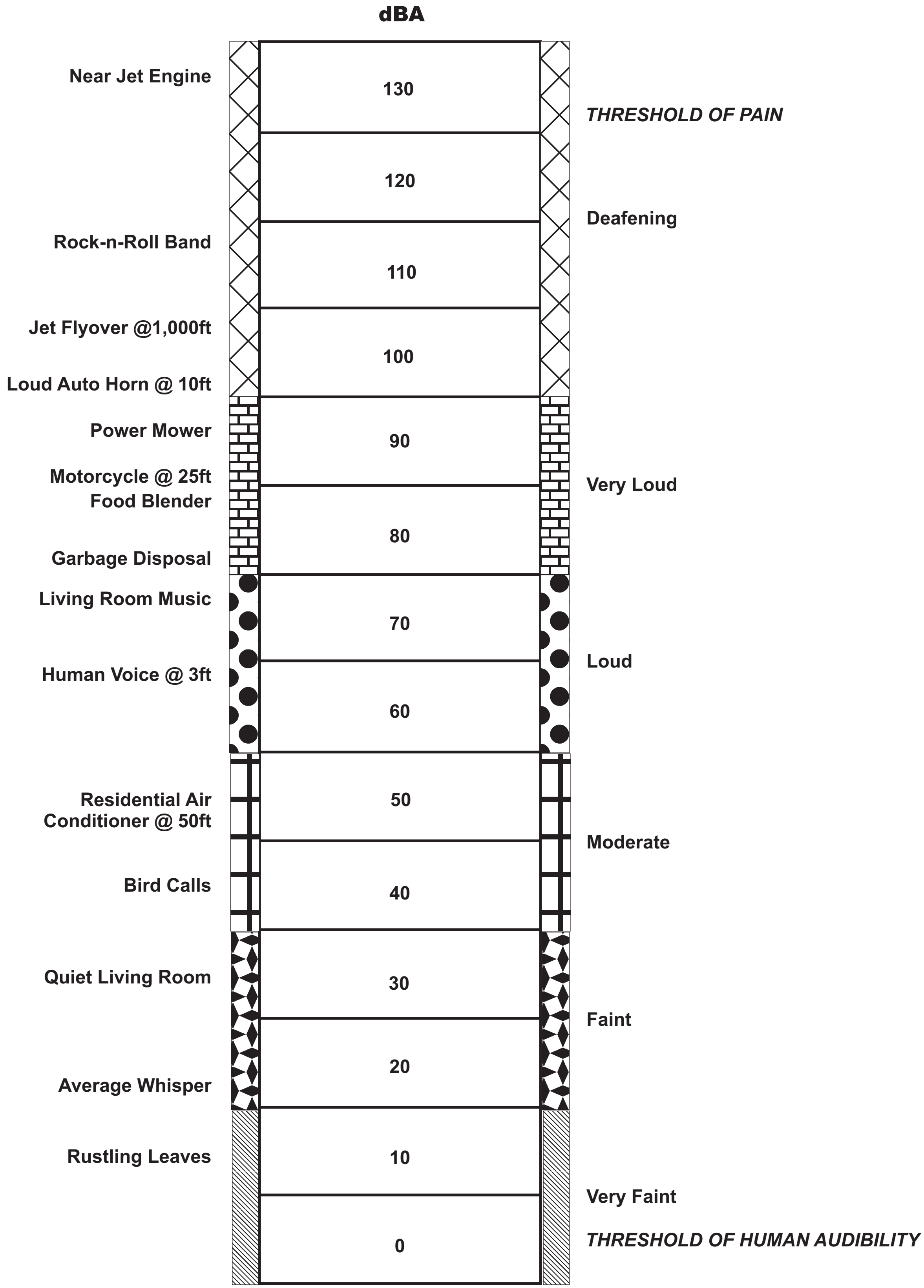
This noise analysis discusses sound levels in terms of the Equivalent Noise Level (L_{eq}). L_{eq} is the average noise level on an energy basis for any specific time period. The L_{eq} for one hour is the energy average noise level during the hour. The average noise level is based on the energy content (acoustic energy) of the sound. L_{eq} can be thought of as the level of a continuous noise which has the same energy content as the fluctuating noise level. The equivalent noise level is expressed in units of dBA.

Effects of Noise

Noise is generally defined as unwanted sound. The degree to which noise can impact the human environment ranges from levels that interfere with speech and sleep (annoyance and nuisance) to levels that cause adverse health effects (hearing loss and psychological effects). Human response to noise is subjective and can vary greatly from person to person. Factors that influence individual response include the intensity, frequency, and pattern of noise, the amount of background noise present before the intruding noise, and the nature of work or human activity that is exposed to the noise source.

Audible Noise Changes

Studies have shown that the smallest perceptible change in sound level for a person with normal hearing sensitivity is approximately 3 dBA. A change of at least 5 dBA would be noticeable and would likely evoke a community reaction. A 10-dBA increase is subjectively heard as a doubling in loudness and would cause a community response.



SOURCE: Cowan, James P., *Handbook of Environmental Acoustics*, 1993

FIGURE 3-1

A-WEIGHTED DECIBEL SCALE

Noise levels decrease as the distance from the noise source to the receiver increases. Noise generated by a stationary noise source, or "point source," will decrease by approximately 6 dBA over hard surfaces and 7.5 dBA over soft surfaces for each doubling of the distance. For example, if a noise source produces a noise level of 89 dBA at a reference distance of 50 feet, then the noise level would be 83 dBA at a distance of 100 feet from the noise source over a hard surface, 77 dBA at a distance of 200 feet, and so on. Noise generated by a mobile source will decrease by approximately 3 dBA over hard surfaces and 4.5 dBA over soft surfaces for each doubling of the distance.

Generally, noise is most audible when traveling by direct line-of-sight.[1] Barriers, such as walls, berms, or buildings that break the line-of-sight between the source and the receiver greatly reduce noise levels from the source since sound can only reach the receiver by bending over the top of the barrier (diffraction). Sound barriers can reduce sound levels by up to 20 dBA. However, if a barrier is not high or long enough to break the line-of-sight from the source to the receiver, its effectiveness is greatly reduced.

Applicable Regulations

The project site is situated in the City of Long Beach and adjacent to the City of Seal Beach.

Long Beach Municipal Code

The Long Beach Municipal Code (LBMC) has identified several policies on noise and acceptable noise levels.[2] These policies address unnecessary, excessive and annoying noise levels and sources, such as vehicles, construction, special sources (e.g., radios, musical instrument, animals, etc.), and stationary sources (e.g., heating and cooling systems, mechanical rooms, etc.). To implement these policies, the City adopted a Noise Ordinance, as discussed below.

The City of Long Beach has not adopted construction noise level standards. Instead, the City regulates construction noise by limiting activity to the hours identified in the LBMC. Section 8.80.202 defines the hours where construction activity may not take place:

- **Weekdays and federal holidays**. No person shall operate or permit the operation of any tools or equipment used for construction, alteration, repair, remodeling, drilling, demolition or any other related building activity which produce loud or unusual noise which annoys or disturbs a reasonable person of normal sensitivity between the hours of 7:00 p.m. and 7:00 a.m. the following day on weekdays, except for emergency work authorized by the building official. For purposes of this section, a federal holiday shall be considered a weekday.
- **Saturdays**. No person shall operate or permit the operation of any tools or equipment used for construction, alteration, repair, remodeling, drilling, demolition or any other related building activity which produce loud or unusual noise which annoys or disturbs a reasonable person of normal sensitivity between the hours of 7:00 p.m. on Friday and 9:00 a.m. on Saturday, and after 6:00 p.m. on Saturday, except for emergency work authorized by the building official.

[1] Line-of-sight is an unobstructed visual path between the noise source and the noise receptor.

[2] City of Long Beach Municipal Code, Chapter 8.80 – Noise, accessed September 2008.

- **Sundays**. No person shall operate or permit the operation of any tools or equipment used for construction, alteration, repair, remodeling, drilling, demolition or any other related building activity at any time on Sunday, except for emergency work authorized by the building official or except for work authorized by permit issued by the noise control officer.

The LBMC prohibits any unnecessary, excessive, or annoying noise in the City. Properties within the City are assigned a noise district based on their corresponding zoning district and uses. Predominantly residential districts are designated as Noise District One; predominately commercial districts are designated Noise District Two; and predominately manufacturing or industrial districts are designated as Noise Districts Three and Four; airports, freeways and waterways regulated by other agencies are designated Noise District Five. **Table 3-1** shows the allowable noise levels and corresponding times of day for each of the five identified noise zones. The project site lies within District Four. The district is bounded on the east by the Long Beach City limit, on the north by 7th Street/22 Freeway, on the west by Studebaker Road, and on the south by 2nd Street. It encompasses the HNGS property that lies within the Long Beach City limits, the AES generating station west of HnGS, and the portion of the San Gabriel River between the two generating stations. Section 8.80.150 subsection (B) of the Noise Ordinance specifies that no person shall operate or cause to be operated any source of sound at any location within the incorporated limits of the City or allow the creation of any noise on property owned, leased, occupied, or otherwise controlled by such person, which causes the noise level when measured from any other property, either incorporated or unincorporated, to exceed:

1. The noise standard for a land use district as specified in **Table 3-1** for a cumulative period of more than thirty minutes in any hour;
2. The noise standard plus five decibels for a cumulative period of more than fifteen minutes in any hour;
3. The noise standard plus ten decibels for a cumulative period of more than five minutes in any hour;
4. The noise standard plus fifteen decibels for a cumulative period of more than one minute in any hour; or
5. The noise standard plus twenty decibels or the maximum measured ambient, for any period of time.

Subsection C of Section 8.80.150 states, “If the measured ambient level exceeds that permissible within any of the first four noise limit categories in subsection B (listed above) of this section, the allowable noise exposure standard shall be increased in five decibels increments in each category as appropriate to encompass or reflect the ambient noise level. In the event the ambient noise level exceeds the fifth noise limit category in subsection B of this section, (listed above) the maximum allowable noise level under said category shall be increased to reflect the maximum ambient noise level.”

TABLE 3-1: CITY OF LONG BEACH EXTERIOR NOISE STANDARDS						
Noise District	**Time Interval**	**Allowable dBA L_{eq}**				
		Standard	**15 Mins/Hr**	**5 Mins/Hr**	**1 Min/Hr**	**Any Period**
One	10:00 p.m. to 7:00 a.m.	45	50	55	60	65
	7:00 a.m. to 10:00 p.m.	50	55	60	65	70
Two	10:00 p.m. to 7:00 a.m.	55	60	65	70	75
	7:00 a.m. to 10:00 p.m.	60	65	70	75	80
Three /a/	Anytime	65	70	75	80	85
Four /a/	Anytime	70	75	80	85	90
Five	*Regulated by Other Agencies or Laws*					

Note: The proposed project is located within Noise District Four.
/a/ Limits for Noise Districts Three and Four are intended for use on the boundaries of those districts, and not for noise control within the districts.
SOURCE: City of Long Beach Municipal Code, Section 8.80.160, accessed November 4, 2008.

Section 8.80.160 defines exterior noise level limits and any correction factors to be applied due to the nature or content of the sound. If a sound is a steady, audible tone (such as the HnGS facility), or is repetitive, or contains music or speech conveying information, the standard limits identified in **Table 3-1** should be reduced by 5 dBA. For steady, audible noise (such as that generated by the proposed project) the allowable operational noise level for the proposed project would be 65 dBA L_{eq}. Section 8.80.160 states that the limits for Noise Districts Three and Four are for use at the boundaries of those districts and not for noise control within those districts.

The LBMC also limits noise from mechanical equipment. Section 8.80.200 states that any motor, machinery, or pump shall be sufficiently enclosed or muffled and maintained so as not to create a noise disturbance.

Seal Beach Municipal Code

While the proposed project would not be required to adhere to noise regulations in the Seal Beach Municipal Code (SBMC), the analysis requires the acknowledgement of noise regulations contained in the SBMC. The City of Seal Beach Noise Ordinance is contained in Chapter 7.15 of the SBMC. The SBMC uses three noise zones which are based on land uses including residential, commercial, and industrial. Similar to the LBMC, noise level limits in the residential areas are time dependent. Between the hours of 10:00 p.m. and 7:00 a.m., noise limits are set 5 dBA lower than between the hours of 7:00 a.m. and 10:00 p.m. Section 7.15.025 (E) exempts noise generated by construction activity occurring between the hours of 7:00 a.m. and 8:00 p.m. on weekdays, and 8:00 a.m. and 8:00 p.m. on Saturdays.

3.1.2 Vibration

Characteristics of Vibration

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Vibration can be a serious concern, causing buildings to shake and rumbling sounds to be heard. In contrast to noise, vibration is not a common environmental problem. It is unusual for vibration from sources such as buses and trucks to be perceptible, even in locations close to major roads. Some common sources of vibration are trains, buses on rough roads, and construction activities, such as blasting, pile driving, and heavy earth-moving equipment.

Vibration Definitions

There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal. The PPV is most frequently used to describe vibration impacts to buildings and is usually measured in inches per second. The root mean square (RMS) amplitude is most frequently used to describe the effect of vibration on the human body. The RMS amplitude is defined as the average of the squared amplitude of the signal. Decibel notation (Vdb) is commonly used to measure RMS. The decibel notation acts to compress the range of numbers required to describe vibration.[3]

Effects of Vibration

High levels of vibration may cause physical personal injury or damage to buildings. However, ground-borne vibration levels rarely affect human health. Instead, most people consider ground-borne vibration to be an annoyance that may affect concentration or disturb sleep. In addition, high levels of ground-borne vibration may damage fragile buildings or interfere with equipment that is highly sensitive to ground-borne vibration (e.g., electron microscopes).

To counter the effects of ground-borne vibration, the Federal Railway Administration (FRA) has published guidance relative to vibration impacts. According to the FRA, fragile buildings can be exposed to ground-borne vibration levels of 0.5 inches per second without experiencing structural damage.[4]

Perceptible Vibration Changes

In contrast to noise, ground-borne vibration is not a phenomenon that most people experience every day. The background vibration velocity level in residential areas is usually 50 Vdb or lower, well below the threshold of perception for humans which is around 65 Vdb.[5] Most perceptible indoor vibration is caused by sources within buildings, such as operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If the roadway is smooth, the vibration from traffic is rarely perceptible.

Applicable Regulations

There are no adopted City of Long Beach standards for construction ground-borne vibration. For operational activity, Section 8.80.200 of the LBMC prohibits operating any device that creates vibration which is above the perception threshold of an individual at or beyond the property boundary of the source if on private property or at 150 feet from the source if on a public space or public right-of-way. The vibration perception threshold is defined as the minimum ground or structure-borne vibrational motion necessary to cause a normal person to be aware of the

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[3]Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, May 2006.

[4]Federal Railway Administration, *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, October 2005.

[5]Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, May 2006.

vibration by such direct means as, but not limited to, sensation by touch or visual observation of moving objects.

3.2 EXISTING ENVIRONMENTAL SETTING

3.2.1 Existing Noise Environment

The project area is bounded by an Orange County flood control channel and the City of Long Beach/City of Seal Beach boundary line to the east; the San Gabriel River to the west; the 22 Freeway to the north; and 2nd Street to the south. However, as described above, the Noise District Four boundaries within which the Long Beach portion of HnGS is located also encompass the AES generating station and the San Gabriel River to the west of HnGS. The existing noise environment of is characterized by noises typical to an industrial land use. The onsite generators are the primary source of noise in the project vicinity.

Sound measurements were taken using a SoundPro DL Sound Level Meter for a 24-hour period on January 27, 2009, and short-term measurements were taken on January 28, 2009, between the hours of 2:00 p.m. and 10:00 p.m. to determine existing ambient daytime and nighttime noise levels in the project vicinity. These readings were used to establish existing ambient noise conditions and to provide a baseline for evaluating operational noise impacts. Noise monitoring locations are shown in **Figure 3-2**. **Table 3-2** shows the existing ambient sound levels for both the 24-hour and short-term noise measurements and the distance from the noise source to the sound level meter.

Additional noise measurements were taken on September 4, 2008, at the HnGS facility during peak operation of the existing generators. Operational noise peaked at approximately 61.5 dBA at 250 feet, within line-of-site to Units 1 and 2, which were running near maximum capacity.

3.2.2 Existing Vibration Environment

Similar to the environmental setting for noise, the vibration environment is dominated by generator operation on the project site. Existing generators do not create perceptible vibration levels at nearby sensitive receptors.

LEGEND:

Noise Monitoring Locations

SOURCE: EDAW, INC.

Haynes Generating Station Units 5 & 6 Repowering Project
Noise and Vibration Impact Report

taha 2008-076

EDAW, INC.

FIGURE 3-2

NOISE MONITORING LOCATIONS

TABLE 3-2: EXISTING NOISE LEVELS			
Key to Figure 3-2	**Time/Duration**	**Distance from Noise Source (Feet) /a/**	**Sound Level (dBA, L_{eq})**
24-Hour Noise Measurement at Haynes Generating Station Facility /b/			
1 - Daytime	7:00 a.m. to 7:00 p.m.	240	54.3 /c/
1 - Nighttime	7:00 p.m. to 7:00 a.m.	240	55.8 /d/
Short-Term Noise Measurements Near Island Village Residences /e/			
2	2:10 p.m. to 2:25 p.m.	10	66.9
2	4:01 p.m. to 4:16 p.m.	10	70.7
2	6:12 p.m. to 6:27 p.m.	10	71.4
2	8:05 p.m. to 8:20 p.m.	10	65.8
2	10:01 p.m. to 10:16 p.m.	10	58.6
Short-Term Noise Measurements at Haynes Generating Station Facility /f/			
3	5 minutes	95	57.8
4	13 minutes	1,600	53.6
5	11 minutes	750	54.0
6	5 minutes	575	54.4
7	4 minutes	790	53.3
8	4 minutes	1,000	51.6
9	2 minutes	250	61.5

/a/ This column represents the distance between the sound level meter and the nearest significant noise source. The nearest noise source was not necessarily HnGS facilities. For example, the nearest noise source to Noise Measurement Location 3 was the 22 Freeway.
/b/ The 24-hour noise measurement was completed on January 27, 2009, to January 28, 2009. Noise sources included mechanical equipment on the project site.
/c/ Lowest ambient daytime noise level was logged at 3:45 p.m. on January 27, 2009.
/d/ Lowest ambient nighttime noise level was logged at 12:30 a.m. and 2:00 a.m. on January 28, 2009.
/e/ 15-minute noise measurements taken near the Island Village housing tract on the south side of 2nd Street. Noise sources included traffic on Second Street and mechanical noise on the HnGS site.
/f/ Noise measurements taken at the Haynes Generating Station facility. Durations listed for these measurements indicate the length of time it took for the noise meter to stabilize based on the ambient noise levels at each location. Location No. 9 is the most representative of maximum operational generator noise, as there was an unobstructed view to units 1 and 2, which were operating at near full capacity.
SOURCE: TAHA, 2009.

3.2.3 Sensitive Receptors

Noise- and vibration-sensitive land uses are locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Residences, schools, hospitals, guest lodging, libraries, and some passive recreation areas would each be considered noise- and vibration-sensitive and may warrant unique measures for protection from intruding noise. Sensitive receptors near the project site include the following:

- Leisure World, located approximately 400 feet east of the project site
- Island Village residential community, located approximately 2,400 feet south of the project site

3.3 METHODOLOGY AND SIGNIFICANCE CRITERIA

3.3.1 Methodology

The noise analysis considers construction, operational, and vibration sources. Construction noise levels are based on information obtained from the USEPA's *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*.[6] The noise level during the construction period at each receptor location was calculated by (1) making a distance adjustment to the construction source sound level and (2) logarithmically adding the adjusted construction noise source level to the ambient noise level. To provide a conservative basis for determining potential noise impacts, it was assumed that noise generated by existing and proposed HnGS facilities would travel over hard surfaces and therefore decrease by approximately 6 dBA for each doubling of the distance from the source (as opposed to a 7.5 dBA reduction for noise traveling over soft surfaces). In addition, construction noise levels were adjusted for intervening objects such as walls and other structures. General construction, pile driving, and construction delivery truck activity were calculated as separate phases utilizing equipment use estimates and other information provided by LADWP.

The proposed project would involve the development of several new stationary noise sources on the project site, including six combustion turbine generators (arranged in pairs from north to south), six cooling units (grouped together north of the combustion turbines), and a bank of six gas compressors (grouped together east of the combustion turbine generators). The noise analysis assumes that all six combustion turbine generators (and thus all six cooling units) would be running simultaneously at full load. While this may occur on rare occasion, it is a generally conservative assumption for determining potential noise impacts from the proposed project. Operational noise levels for the proposed generators, cooling units and gas compressors were provided by ATCO Noise Management.[7] Vibration levels were estimated based on information provided by the FTA on construction equipment vibration.[8]

3.3.2 Significance Criteria

The City of Long Beach has not adopted construction noise level standards. Instead, the City of Long Beach regulates construction noise by limiting activity to the hours identified in the municipal code. The California Environmental Quality Act requires that project impacts be analyzed relative to the change in existing conditions. Compliance with a municipal code alone does not constitute a comparison to existing conditions. Based on noise studies, a change of 10 dBA from existing conditions would cause a community response.

Construction Phase Significance Criteria

A significant construction noise impact would result if:

- Construction activity would conflict with the LBMC; and/or

[6] USEPA, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*, PM 206717, 1971.

[7] ATCO Noise Management, *LADWP Haynes Generating Station Units 4 & 5 Re-Powering Project, New Equipment Sound Levels*, January 4, 2010 (see Appendix C).

[8] Federal Transit Authority, *Transit Noise and Vibration Impact Assessment*, May 2006.

- Construction activity would exceed existing ambient noise levels by 10 dBA or more at a noise sensitive land use because a 10-dBA change would be loud enough to cause a community response.

Operational Phase Significance Criteria

A significant operational noise impact would result if:

- The proposed project causes the ambient noise level measured at the boundary line of Noise District Four to exceed the 65-dBA threshold defined in the LBMC.

Ground-borne Vibration Significance Criteria

There are no adopted State or City of Long Beach ground-borne vibration standards. Based on federal guidelines, the proposed project would result in a significant construction or operational vibration impact if:

- Construction activity would expose buildings to the FRA building damage threshold level of 0.5 inches per second; and/or
- Operational activity generates perceptible vibration at or beyond the boundary line of the property which contains the vibration source in accordance with the LBMC.

3.4 ENVIRONMENTAL IMPACTS

3.4.1 Construction Noise Impacts

Construction of the proposed project would result in temporary increases in ambient noise levels in the project area on an intermittent basis. The increase in noise would occur during the 26-month construction schedule. Noise levels would fluctuate depending on the construction phase, equipment type and duration of use, distance between the noise source and receptor, and presence or absence of noise attenuation barriers.

Construction activities typically require the use of numerous pieces of noise generating-equipment, such as jackhammers, pneumatic impact equipment, saws, and tractors. Typical noise levels from various types of equipment that may be used during construction are listed in **Table 3-3**. The table shows noise levels at distances of 50 and 100 feet from the construction noise source.

TABLE 3-3: MAXIMUM NOISE LEVELS OF COMMON CONSTRUCTION MACHINES		
	Noise Level (dBA) /a/	
Noise Source	**50 Feet**	**100 Feet**
Backhoe	83	77
Concrete Mixers	88	82
Concrete Pumps	86	80
Crane	88	82
Front-end Loader	79	73
Idling Haul Truck	72	66
Jackhammer	82	76
Pile Driving	101	95
Pumps	73	67
Welders	70	64

/a/ Assumes a 6-dBA drop-off rate for noise generated by a "point source" and traveling over hard surfaces.
SOURCE: USEPA, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*, PM 206717, 1971; FHWA Roadway Construction Model, December 8, 2008; TAHA, 2009.

Whereas **Table 3-3** shows the noise level of each piece of equipment, the noise levels shown in **Table 3-4** take into account the likelihood that more than one piece of construction equipment would be in operation at the same time and lists the typical overall noise levels that would be expected for each phase of construction. These noise levels are based on surveys conducted by the USEPA in the early 1970s. Since 1970, regulations have been enforced to improve noise generated by certain types of construction equipment to meet worker noise exposure standards. However, many older pieces of equipment are still in use. Thus, the construction phase noise levels indicated in **Table 3-4** represent worst-case conditions. As the table shows, the highest noise levels are expected to occur during the grading/excavation and finishing phases of construction. A typical piece of equipment is assumed to be active for 40 percent of the eight-hour workday (consistent with the USEPA studies of construction noise), generating a noise level of 89 dBA at a reference distance of 50 feet.

TABLE 3-4: OUTDOOR CONSTRUCTION NOISE LEVELS	
Construction Phase	**Noise Level At 50 Feet (dBA)**
Ground Clearing	84
Grading/Excavation	89
Foundations	78
Structural	85
Finishing	89

SOURCE: USEPA, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances,* PM 206717, 1971.

General Construction Noise Impacts

The noise level during the construction period at each receptor location was calculated by (1) making a distance adjustment to the construction source sound level and (2) logarithmically adding the adjusted construction noise source level to the ambient noise level. The majority of the noise created by construction activity would originate from the engines powering the heavy equipment on the construction site. Heavy equipment engines would be located at ground-level (e.g., cranes, bulldozers), and thus subject to noise attenuation from intervening objects and noise-attenuating materials (e.g., walls, sound blanks).

The estimated construction noise levels at sensitive receptors are shown in **Table 3-5**. Regarding Leisure World, daytime construction noise levels would exceed the 10-dBA threshold of significance, and would result in a significant impact without mitigation. Nighttime construction activity would include welding activity and other low noise activities. Nighttime activity was assumed to consist of six welders operating concurrently on the project site generating a noise level of 78 dBA at 50 feet. Nighttime wielding activity would not exceed the 10-dBA threshold of significance at Leisure World, and would result in a less-than-significant impact. Regarding the Island Village residential community, neither daytime nor nighttime construction noise levels would exceed the 10-dBA threshold of significance, resulting in a less-than-significant impact. Construction noise would not be discernible at the Island Village residential community.

TABLE 3-5: GENERAL CONSTRUCTION NOISE IMPACTS - UNMITIGATED

Sensitive Receptor	Distance (feet) /a/	Maximum Construction Noise Level (dBA) /b/	Existing Ambient (dBA, L_{eq}) /c/	New Ambient (dBA, L_{eq}) /d/	Increase /e/
Leisure World					
Daytime	400	65.9	48.9	66.0	17.1
Nighttime – Welding Activity	400	59.9	52.0	60.6	8.6
Island Village Residences					
Daytime	2,400	47.9	61.9	62.1	0.2
Nighttime – Welding Activity	2,400	44.4	53.6	54.1	0.5

/a/ Distance of noise source from receptor.
/b/ Construction noise source's sound level at receptor location, with distance and building adjustment. Leisure World includes a 5-dBA reduction for an existing wall which blocks line of sight to the HnGS. Island Village Residences includes a 7.5-dBA reduction for intervening existing generators and an existing wall.
/c/ Pre-construction activity ambient sound levels at Leisure World were attenuated for distance from the 24-hour noise measurement location (see Table 3-2, 24-Hour Noise Measurement at Haynes Generating Station Facility). Noise levels were attenuated from the 24-hour noise measurement location (240 feet from nearest noise source) to the Leisure World property line (400 feet). This lowered the levels of both daytime and nighttime existing ambient noise measures from 54.3 to 48.9 dBA for daytime levels, and from 55.8 to 52.0 dBA for nighttime levels.
/d/ New sound level at receptor location during the construction period, including noise from construction activity.
/e/ An incremental noise level increase of 10 dBA or more would result in a significant impact.
SOURCE: TAHA, 2009.

Pile Driving Activity Noise Impacts

Construction of the proposed project will require the driving of up to 3,000 piles up to 80 feet into the ground. Pile driving activity at the project site will include two impact hammer pile drivers, one hydraulic crane and several other pieces of equipment. The combined noise levels from all equipment present would produce a noise level of approximately 104 dBA at 50 feet. **Table 3-6** presents noise levels for pile driving activity at sensitive receptors. Regarding Leisure World, pile driving activity noise levels would exceed the 10-dBA threshold of significance, and would result in a significant impact without mitigation. Regarding the Island Village residential community, pile driving activity noise levels would not exceed the 10-dBA threshold of significance, and would result in a less-than-significant impact. Pile driving activity would take place during day time hours only, and would not occur during nighttime hours.

TABLE 3-6: PILE DRIVING NOISE IMPACTS – UNMITIGATED

Sensitive Receptor	Distance (feet) /a/	Maximum Construction Noise Level (dBA) /b/	Existing Ambient (dBA, L_{eq}) /c/	New Ambient (dBA, L_{eq}) /d/	Increase /e/
Leisure World	400	80.9	48.9	80.9	32.0
Island Village Residences	2,400	62.9	61.9	65.4	3.5

/a/ Distance of noise source from receptor.
/b/ Construction noise source's sound level at receptor location, with distance and building adjustment. Leisure World includes a 5-dBA reduction for an existing wall which blocks line of sight to the HnGS. Island Village Residences includes a 7.5-dBA reduction for intervening existing generators and an existing wall.
/c/ Pre-construction activity ambient sound level at receptor location attenuated for distance from 24-hour and short-term noise measurement locations.
/d/ New sound level at receptor location during the construction period, including noise from construction activity.
/e/ An incremental noise level increase of 10 dBA or more would result in a significant impact.
SOURCE: TAHA, 2009.

Construction Delivery Truck Activity Impacts

On-Road Delivery Trucks

Construction of the proposed project will require materials to be delivered to the construction site on a daily basis. Truck trips would average 25 loads per day during peak construction material delivery periods. As shown in **Table 3-7**, noise generated by construction delivery truck activity would not exceed the 10-dBA significance threshold for construction noise.

TABLE 3-7: ESTIMATED EQUIVALENT NOISE LEVEL WITH CONSTRUCTION DELIVERY TRUCKS /a/

Roadway Segment	Estimated dBA L_{eq}		
	Existing	During Construction	Increase /a/
2nd Street between Studebaker Road and Project Entrance	75.6	76.6	1.0
2nd Street between Project Entrance and Seal Beach Boulevard	75.9	76.9	1.0

/a/ An incremental noise level increase of 10 dBA or more would result in a significant impact.
SOURCE: TAHA, 2009.

On-site Truck Idling Noise Impacts

Delivery trucks may idle on site for short periods of time while loading and unloading materials. Typical truck idling generates approximately 72 dBA at a distance of 50 feet. During the short time where delivery trucks would idle on site, construction noise levels would increase by approximately 1.0 dBA. Truck idling would not substantially increase general construction and noise, and would result in a less-than-significant impact.

Long Beach Municipal Code Impacts

Construction activity is scheduled to begin during the third quarter of 2010, and continue to completion by the last quarter of 2012. Most daily construction activities would occur between the hours of 7:00 a.m. to 7:00 p.m., Monday through Saturday. However, the construction schedule specifies that some activities may continue throughout nighttime hours, and for extended periods on the weekends. Construction activities that would occur any time Saturday or Sunday, and during nighttime hours would consist of activities that generate less noise than the 89-dBA at 50 feet assumed for analysis purposes. The proposed project includes construction activity that would conflict with the LBMC. This may result in a significant impact without mitigation.

Construction Noise Mitigation Measures

N1 All construction equipment shall be properly maintained and equipped with mufflers and other suitable noise attenuation devices.

N2 A solid physical barrier shall be used on the perimeter of construction sites to block the line-of-sight from receptor to source, when feasible and necessary, to minimize noise to nearby noise-sensitive receptors. This perimeter fencing shall not have perforations or gaps.

N3 Grading and construction contractors shall endeavor to use quieter equipment as opposed to noisier equipment (such as rubber-tired equipment rather than track equipment).

N4 A public liaison for project construction shall be identified who shall be responsible for addressing public concerns about construction activities, including excessive noise. The liaison shall determine the cause of the concern (e.g., starting too early, bad muffler, etc.) and shall be required to implement reasonable measures to address the concern.

N5 The Leisure World residential community, which may potentially be affected by construction activity, shall be sent a notice regarding the construction schedule of the proposed project. The notice shall indicate the dates and duration of construction activities, as well as provide a telephone number where residents can inquire about the construction process and register concerns.

N6 The construction contractor shall ensure that all stockpiling and vehicle staging areas are located away from noise-sensitive receivers, to the extent feasible.

N7 The construction contractor shall plan work such that activities that generate high noise levels will not be started during the hours codified in the LBMC, and all reasonable efforts to conclude work in progress prior to the hours codified in the LBMC will be taken by the construction contractor.

Impacts After Mitigation

General Construction Noise Impacts after Mitigation

Mitigation Measure **N1** would reduce noise levels by approximately 3 dBA. Mitigation Measure **N2** would reduce noise levels by at least 5 dBA. Mitigation Measures **N3** through **N6** would further assist in attenuating construction noise levels. **Table 3-8** shows mitigated construction noise levels. Mitigated construction noise levels would not exceed the 10-dBA significance threshold at Leisure World, resulting in a less-than-significant impact. General construction noise would remain inaudible at the Island Village residential community, and would not result in a significant impact.

TABLE 3-8: GENERAL CONSTRUCTION NOISE IMPACTS - MITIGATED

Sensitive Receptor	Distance (feet) /a/	Maximum Construction Noise Level (dBA) /b/	Existing Ambient (dBA, L_{eq}) /c/	New Ambient (dBA, L_{eq}) /d/	Increase /e/
Leisure World					
Daytime	400	57.9	48.9	58.4	9.5
Nighttime	400	57.9	52.0	58.9	6.9
Nighttime – Welding Activity	400	45.4	52.0	52.9	0.9
Island Village Residences					
Daytime	2,400	39.9	61.9	61.9	<0.1
Nighttime	2,400	39.9	53.6	53.8	0.2
Nighttime – Welding Activity	2,400	20.9	53.6	53.6	<0.1

/a/ Distance of noise source from receptor.
/b/ Construction noise source's sound level at receptor location, with distance and building adjustment. Leisure World includes a 5-dBA reduction for an existing wall which blocks line of sight to the HnGS. Island Village Residences includes a 7.5-dBA reduction for intervening existing generators and an existing wall. This also includes mitigation measures which reduce construction noise by an additional 8 dBA.
/c/ Pre-construction activity ambient sound levels at Leisure World were attenuated for distance from the 24-hour noise measurement location (see Table 3-2, 24-Hour Noise Measurement at Haynes Generating Station Facility). Noise levels were attenuated from the 24-hour noise measurement location (240 feet from nearest noise source) to the Leisure World property line (400 feet). This lowered the levels of both daytime and nighttime existing ambient noise measures from 54.3 to 48.9 dBA for daytime levels, and from 55.8 to 52.0 dBA for nighttime levels.
/d/ New sound level at receptor location during the construction period, including noise from construction activity.
/e/ An incremental noise level increase of 10 dBA or more would result in a significant impact.
SOURCE: TAHA, 2009.

Pile Driving Noise Impacts after Mitigation

Mitigation Measure **N1** would reduce noise levels by approximately 3 dBA. Mitigation Measure **N2** would reduce noise levels by at least 5 dBA. Mitigation Measures **N4** through **N5** would further assist in attenuating pile driving noise levels. **Table 3-9** shows mitigated pile driving noise levels. Regarding Leisure World, mitigated pile driving noise levels would still exceed the 10-dBA significance threshold, and would result in a significant and unavoidable impact. Regarding the Island Village residential community, mitigated pile driving noise would not be discernible, and would result in a less-than-significant impact.

TABLE 3-9: PILE DRIVING NOISE IMPACTS - MITIGATED

Sensitive Receptor	Distance (feet) /a/	Maximum Construction Noise Level (dBA) /b/	Existing Ambient (dBA, L_{eq}) /c/	New Ambient (dBA, L_{eq}) /d/	Increase /e/
Leisure World	400	72.9	48.9	73.0	24.1
Island Village	2,400	54.9	61.9	62.7	0.8

/a/ Distance of noise source from receptor.
/b/ Construction noise source's sound level at receptor location, with distance and building adjustment.
/c/ Pre-construction activity ambient sound level at receptor location attenuated for distance from 24-hour and short-term noise measurement locations. Leisure World includes a 5-dBA reduction for an existing wall which blocks line of sight to the HnGS. Island Village Residences includes a 7.5-dBA reduction for intervening existing generators and an existing wall. This also includes mitigation measures which reduce construction noise by an additional 8 dBA.
/d/ New sound level at receptor location during the construction period, including noise from construction activity.
/e/ An incremental noise level increase of 10 dBA or more would result in a significant impact.
SOURCE: TAHA, 2009.

Long Beach Municipal Code Impacts after Mitigation

Mitigation Measure **N7** would require the construction contractor to use all reasonable efforts to comply with the LBMC. To the extent feasible, activities that generate high noise levels would not be started outside of the hours deemed acceptable in the Code. Based on this mitigation measure, the proposed project would result in a less-than-significant impact regarding the LBMC.

3.4.2 Operational Phase Noise Impacts

The proposed project would involve the development of several new stationary noise sources on the project site, including six combustion turbine generators (arranged in pairs from north to south), six cooling units (grouped together north of the combustion turbines), and a bank of six gas compressors (grouped together east of the combustion turbine generators). The proposed project would include design features to reduce noise levels. These features include exhaust silencing and other noise dampening features to the combustion turbine generators, low-noise fans for the cooling units, and an acoustic enclosure for the gas compressors.

The proposed combustion turbine generators would generate a noise level of approximately 65.4 dBA L_{eq} at 100 feet for a single generator. The analysis was based on a composite noise level for each pair of generators (north, middle, and south) of approximately 68.4 dBA L_{eq} at 100 feet. The proposed cooling units on the northern portion of the project site would generate a composite noise level of approximately 71 dBA at 100 feet. The proposed gas compressors on the eastern portion of the project site would generate a composite noise level of approximately 62 dBA at 100 feet. Based on short-term noise measurements taken at the project site on September 4, 2008, the existing HnGS facility generates a noise level of 69.5 dBA L_{eq} at 100 feet.

Operational noise is analyzed in relation to both the proposed cooling units and the proposed SCGS (gas combustion turbine) facility, which represent the potentially loudest elements of the proposed project. **Tables 3-10** and **3-11** show the existing facilities and proposed project facilities combined noise levels at each of the borders (north, south, east, and west) of the Noise District Four, within which HnGS is located. **Table 3-10** analyzes the operational noise at the loudest point of the Noise District Four boundary in relation to the proposed SCGS facility.

Table 3-11 analyzes operational noise at the loudest point of the Noise District Four Boundary in relation to the proposed cooling units.

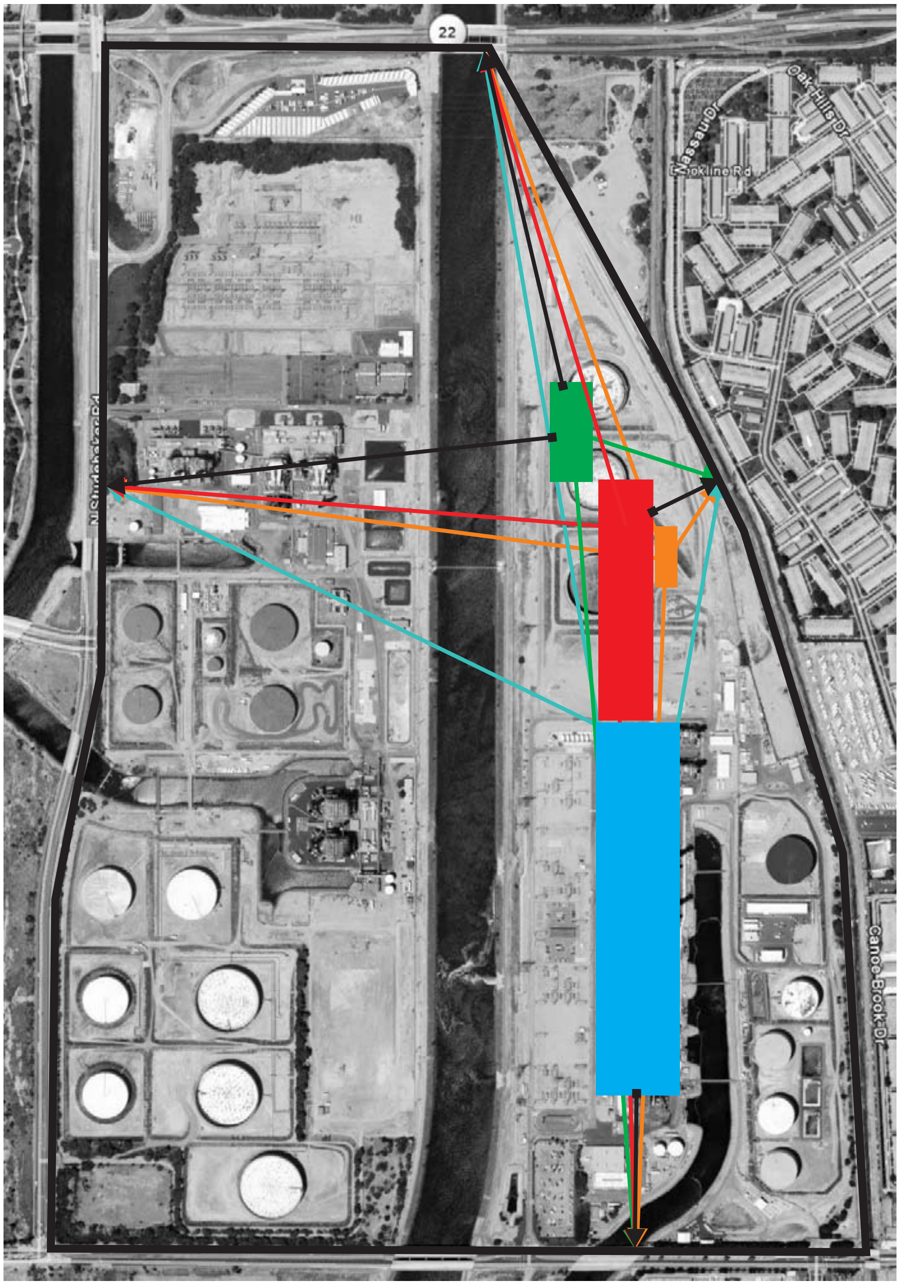
Noise levels were calculated by determining a point along the north, south, east, and west boundaries of the designated Noise District Four where the proposed project and existing facility noise sources would combine to be the loudest at that boundary line. The distances listed in **Tables 3-10** and **3-11** represent the closest (and therefore loudest) point along the boundary of Noise District Four from the SCGS and the cooling units, respectively. However, the distances do not necessarily represent the closest point along the boundaries from existing HnGS noise sources. For example, the existing HnGS generator facilities are approximately 460 feet from the eastern boundary line at their closest point. However, as shown in **Table 3-10**, the point along the eastern boundary line where the sum of noise levels from all three noise sources (proposed SCGS facility, proposed cooling units, and existing HnGS facility) would be highest is approximately 1,100 feet to the north of the existing HnGS generators. Operational noise vector lines for both the proposed SCGS facility and proposed cooling units are shown in **Figures 3-3** and **3-4**, respectively.

TABLE 3-10: OPERATIONAL NOISE RELATIVE TO PROPOSED SCGS FACILITY		
Sensitive Receptor	**Distance from Noise Source to Boundary Line (feet) /a, b/**	**Noise Level at Boundary Line (dBA)**
Proposed SCGS Facility Noise Levels /c/		
Northern Boundary	1,955	44.8
Southern Boundary	2,310	43.3
Eastern Boundary	335	60.0
Western Boundary	2,180 /d/	43.2
Proposed Cooling Units Noise Levels		
Northern Boundary	1,470	47.7
Southern Boundary	3,370	40.4
Eastern Boundary	595	55.5
Western Boundary	1,975 /d/	42.1
Proposed Gas Compressors		
Northern Boundary	2,210	35.1
Southern Boundary	2,880	29.8
Eastern Boundary	315	52.0
Western Boundary	2,430 /d/	31.3
Existing HnGS Facility Noise Levels		
Northern Boundary	3,055	39.8
Southern Boundary	550	54.7
Eastern Boundary	1,100	48.7
Western Boundary	2,430 /d/	38.8
TOTAL NOISE LEVELS /e/		
Northern Boundary	--	50.1
Southern Boundary	--	55.2
Eastern Boundary	--	62.0
Western Boundary	--	46.6

/a/ It should be noted that distances are not representative of the shortest distance between noise sources and boundary lines but to the point at which all proposed project and existing facility noise sources would combine to be the loudest at that boundary line.
/b/ Distance from noise source to boundary line of Noise District Four as defined in the LBMC.
/c/ The 'noise level at the boundary' is a composite of all six SCGS generators running simultaneously, attenuated from each pair of generators to the point along the boundaries where the loudest operation noise levels would occur. The distance listed is the shortest distance between that loudest point of operational noise to the nearest pair of generators.
/d/ Based on the Long Beach Municipal Code, the western boundary extends to the edge of Noise District Four. The western boundary of Noise District Four is along Studebaker Road.
/e/ To determine the noise level at each boundary, the composite noise levels were measured from a point on each boundary that yielded the most conservative (loudest) operational noise level.
SOURCE: TAHA, 2009.

TABLE 3-11: OPERATIONAL NOISE RELATIVE TO PROPOSED COOLING UNITS		
Sensitive Receptor	**Distance from Noise Source to Boundary Line (feet) /a, b/**	**Noise Level at Boundary Line (dBA)**
Proposed SCGS Facility Noise Levels /c/		
Northern Boundary	1,955	44.8
Southern Boundary	2,310	43.3
Eastern Boundary	480	56.6
Western Boundary	2,180 /d/	43.2
Proposed Cooling Units Noise Levels		
Northern Boundary	1,475	47.6
Southern Boundary	3,365	40.5
Eastern Boundary	375	59.5
Western Boundary	1,970 /d/	42.1
Proposed Gas Compressors		
Northern Boundary	2,215	35.1
Southern Boundary	2,905	29.7
Eastern Boundary	660	45.6
Western Boundary	2,430 /d/	31.3
Existing HnGS Facility Noise Levels		
Northern Boundary	3,055	39.8
Southern Boundary	570	54.4
Eastern Boundary	1,530	45.8
Western Boundary	2,465 /d/	38.7
TOTAL NOISE LEVELS /e/		
Northern Boundary	--	50.0
Southern Boundary	--	54.9
Eastern Boundary	--	61.5
Western Boundary	--	46.6

/a/ It should be noted that distances are not representative of the shortest distance between noise sources and boundary lines but to the point at which all proposed project and existing facility noise sources would combine to be the loudest at that boundary line.
/b/ Distance from noise source to boundary line of Noise District Four as defined in the LBMC.
/c/ The 'noise level at the boundary' is a composite of all six SCGS generators running simultaneously, attenuated from each pair of generators to the point along the boundaries where the loudest operation noise levels would occur. The distance listed is the shortest distance between that loudest point of operational noise to the nearest pair of generators.
/d/ Based on the Long Beach Municipal Code, the western boundary extends to the edge of Noise District Four. The western boundary of Noise District Four is along Studebaker Road.
/e/ To determine the noise level at each boundary, the composite noise levels were measured from a point on each boundary that yielded the most conservative (loudest) operational noise level.
SOURCE: TAHA, 2009.



LEGEND:

Long Beach Municipal Code Noise District Four

Proposed Cooling Units (71.0 dBA @ 100 ft)

Proposed SCGS Facility (68.4 dBA @ 100 ft)

Proposed Gas Compressors (62.0 dBA @ 100 ft)

Existing HnGS Facility (69.5 dBA @ 100 ft)

Loudest Noise Source Vector

Additive Noise from Proposed Cooling Units

Additive Noise from Proposed SCGS Facility

Additive Noise from Existing HnGS Facility

Additive Noise from Proposed Gas Compressors

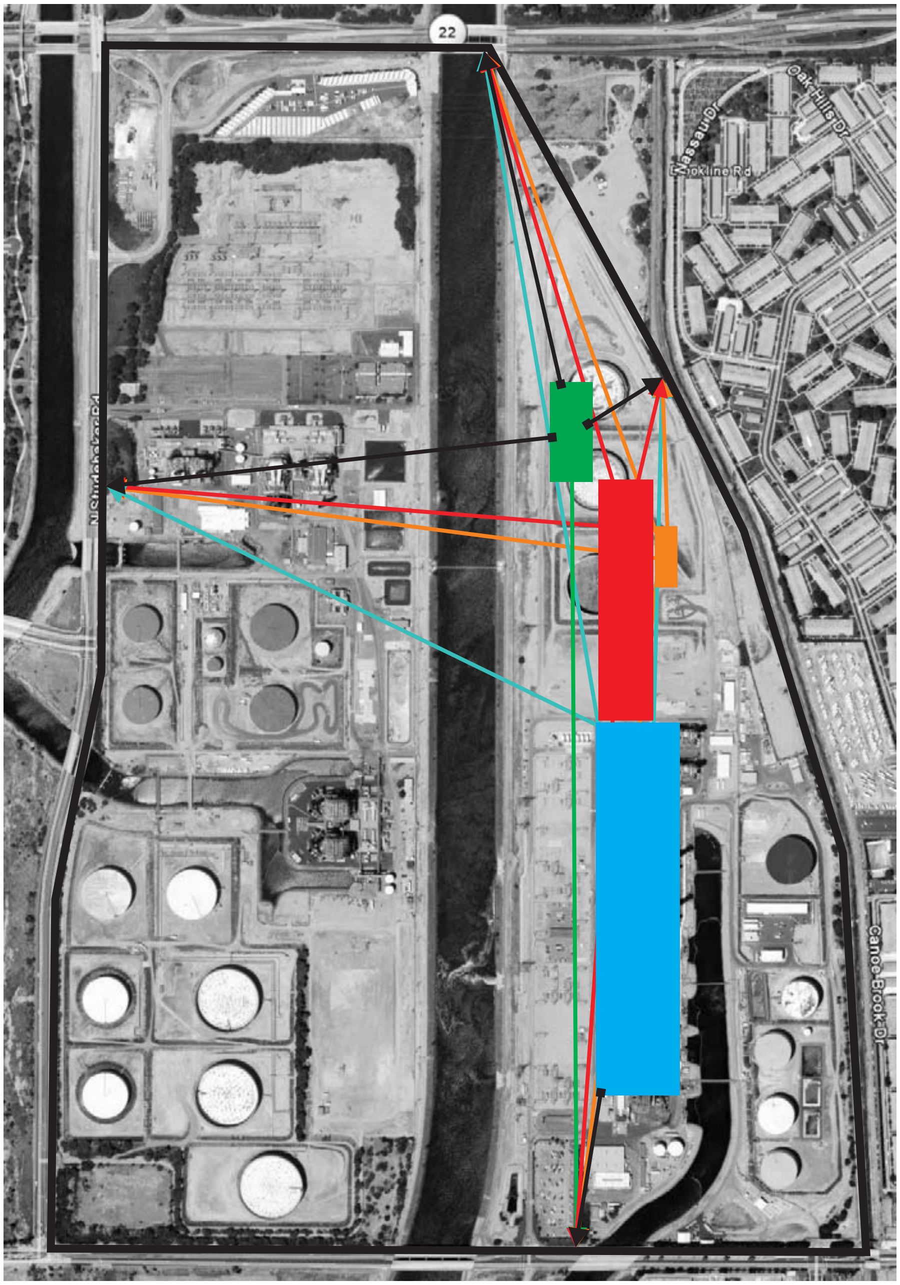
NOT TO SCALE

N

SOURCE: EDAW, INC.

FIGURE 3-3

OPERATIONAL NOISE VECTORS
RELEVANT TO THE PROPOSED SCGS FACILITY



LEGEND:

Long Beach Municipal Code Noise District Four

Proposed Cooling Units (71.0 dBA @ 100 ft)

Proposed Gas Compressors (62.0 dBA @ 100 ft)

Proposed SCGS Facility (68.4 dBA @ 100 ft)

Existing HnGS Facility (69.5 dBA @ 100 ft)

Loudest Noise Source Vector

Additive Noise from Proposed Cooling Units

Additive Noise from Proposed SCGS Facility

Additive Noise from Existing HnGS Facility

Additive Noise from Proposed Gas Compressors

NOT TO SCALE

N

SOURCE: AECOM

FIGURE 3-4

OPERATIONAL NOISE VECTORS
RELEVANT TO THE PROPOSED COOLING UNITS

Proposed SCGS Facility. The proposed SCGS facility would generate a noise level of approximately 68.4 dBA L_{eq} at 100 feet for each part of generators. As shown in **Table 3-10**, noise levels associated with the proposed SCGS facility would be 44.8 dBA L_{eq} at the northern boundary, 43.3 dBA L_{eq} at the southern boundary, 60.0 dBA L_{eq} at the eastern boundary, and 43.2 dBA L_{eq} at the western boundary. As shown in **Table 3-11**, noise levels associated with the proposed SCGS facility would be 44.8 dBA L_{eq} at the northern boundary, 43.3 dBA L_{eq} at the southern boundary, 56.6 dBA L_{eq} at the eastern boundary, and 43.2 dBA L_{eq} at the western boundary.

Proposed Cooling Units. The proposed cooling units would generate a noise level of approximately 71 dBA L_{eq} at 100 feet. As shown in **Table 3-10**, noise levels associated with the proposed cooling units would be 47.7 dBA L_{eq} at the northern boundary, 40.4 dBA L_{eq} at the southern boundary, 55.5 dBA L_{eq} at the eastern boundary, and 42.1 dBA L_{eq} at the western boundary. As shown in **Table 3-11**, noise levels associated with the proposed cooling units would be 47.6 dBA L_{eq} at the northern boundary, 40.5 dBA L_{eq} at the southern boundary, 59.5 dBA L_{eq} at the eastern boundary, and 42.1 dBA L_{eq} at the western boundary.

Proposed Gas Compressors. The proposed gas compressors would generate a noise level of approximately 62 dBA L_{eq} at 100 feet. As shown in **Table 3-10**, noise levels associated with the proposed gas compressors would be 35.1 dBA L_{eq} at the northern boundary, 29.8 dBA L_{eq} at the southern boundary, 52.0 dBA L_{eq} at the eastern boundary, and 31.3 dBA L_{eq} at the western boundary. As shown in **Table 3-11**, noise levels associated with the proposed gas compressors would be 35.1 dBA L_{eq} at the northern boundary, 29.7 dBA L_{eq} at the southern boundary, 45.6 dBA L_{eq} at the eastern boundary, and 31.3 dBA L_{eq} at the western boundary.

Existing HnGS Facility. The existing HnGS facility generates a noise level of approximately 69.5 dBA L_{eq} at 100 feet. As shown in **Table 3-10**, noise levels at each boundary line associated with the existing HnGS facility would be 39.8 dBA L_{eq} at the northern boundary, 54.7 dBA L_{eq} at the southern boundary, 48.7 dBA L_{eq} at the eastern boundary, and 38.8 dBA L_{eq} at the western boundary. As shown in **Table 3-11**, noise levels associated with the existing HnGS facility would be 39.8 dBA L_{eq} at the northern boundary, 54.4 dBA L_{eq} at the southern boundary, 45.8 dBA L_{eq} at the eastern boundary, and 38.7 dBA L_{eq} at the western boundary.

Total Operational Noise Levels. As shown in **Table 3-10**, noise levels associated with operation of the proposed project in relation to the SCGS facility would be 50.1 dBA L_{eq} at the northern boundary, 55.2 dBA L_{eq} at the southern boundary, 62.0 dBA L_{eq} at the eastern boundary, and 46.6 dBA L_{eq} at the western boundary. As shown in **Table 3-11**, noise levels associated with operation of the proposed project in relation to the cooling units would be 50.0 dBA L_{eq} at the northern boundary, 54.9 dBA L_{eq} at the southern boundary, 61.5 dBA L_{eq} at the eastern boundary, and 46.6 dBA L_{eq} at the western boundary. Noise at the boundaries of Noise District Four would be less than the 65-dBA threshold. Operational noise would result in a less-than-significant impact.

Operational Phase Noise Mitigation Measures

Operational noise impacts would be less than significant, and no mitigation measures are required.

Impacts After Mitigation

The project-related operational noise would result in a less-than-significant impact.

3.4.3 Ground-borne Vibration Impacts

Construction Phase Ground-borne Vibration Impacts

Construction Equipment

As shown in **Table 3-12**, use of heavy equipment (e.g., a large bulldozer) generates vibration levels of 0.089 inches per second PPV at a distance of 25 feet. The nearest residential structures to the project site would be approximately 400 feet from occasional heavy equipment activity and could experience vibration levels of 0.001 inches per second PPV. Vibration levels at these receptors would be perceptible but would not exceed the potential building damage threshold of 0.5 inches per second PPV.

TABLE 3-12: VIBRATION VELOCITIES FOR CONSTRUCTION EQUIPMENT	
Equipment	**PPV at 25 feet (Inches /Second) /a/**
Pile Driving (Impact)	0.644
Pile Driving (Sonic)	0.170
Large Bulldozer	0.089
Loaded Trucks	0.076

/a/ Fragile buildings can be exposed to ground-borne vibration levels of 0.5 inches per second PPV without experiencing structural damage.
SOURCE: Federal Transit Authority, *Transit Noise and Vibration Impact Assessment*, May 2006.

Pile Driving

The proposed project would require driven piles. Impact pile driving would generate a vibration level of 0.010 inches per second PPV at the nearest sensitive receptor, which would not exceed the potential building damage threshold of 0.5 inches per second PPV. The proposed project would result in a less-than-significant construction vibration impact.

Construction Phase Ground-borne Vibration Mitigation Measures

Construction ground-borne vibration impacts would be less than significant, and no mitigation measures are required.

Impacts After Mitigation

The project-related construction ground-borne vibration would result in a less-than-significant impact.

Operational Phase Ground-borne Vibration Impacts

The proposed project would not include significant stationary sources of ground-borne vibration, such as heavy equipment operations. The proposed SCGS would not generate any perceptible vibration. Vibration related to operational activity would not be perceptible at or beyond the property boundary, which would comply with Section 8.80.200 of the LBMC. Operational vibration would result in a less-than-significant impact.

Operational Phase Ground-borne Vibration Mitigation Measures

Operational ground-borne vibration impacts would be less than significant, and no mitigation measures are required.

Impacts After Mitigation

The project-related operational ground-borne vibration would result in a less-than-significant impact.

3.5 CUMULATIVE IMPACTS

Cumulative impacts related to noise and vibration would result if the proposed project, in conjunction with other projects in the area, would contribute to a significant increase in ambient noise and vibration levels at nearby sensitive receptors.

Construction Noise Impacts

The City of Long Beach Department of Development Services' website does not list any projects within a one-mile radius of the project site.[9] As there are no construction projects near to the project site, a cumulative increase in construction noise levels would not occur. This would result in a less-than-significant cumulative construction noise impact.

Operational Noise Impacts

The primary source of operational noise at the project site would the proposed project operating in concert with the existing HnGS generators. As discussed in Section 3.4.2 of this report, operational noise levels, including both the proposed project and existing facilities, would not exceed the levels codified in the LBMC at the property boundary. In addition, the proposed project would not add any additional trips to the roadway system and, therefore, would not increase mobile noise in the region. This would result in a less-than-significant cumulative operational noise impact.

Construction and Operational Ground-borne Vibration Impacts

The predominant vibration source at the project site would be construction activity and operation of the SCGS and existing generator facilities. As discussed in Section 3.4.3 of this report, the proposed project would not exceed the significance thresholds for vibration past the property line during either the construction or operational phases of the SCGS facility. In addition, since the City of Long Beach does not list any upcoming projects within one-mile, no cumulative increase in vibration levels is anticipated. This would result in a less-than-significant cumulative ground-borne vibration impact.

[9] City of Long Beach – Department of Development Services' website, accessed January 4, 2010.

Appendix A

Construction Traffic Noise Calculations

Noise Estimates - Based on AM Peak Hour

Existing

ROAD SEGMENT	from:	to:	TOT. # VEH.	D1	D2	Eq. Dis.	Auto %	Auto	MT %	MT	HT %	HT	Auto speed	k/h	MT speed	k/h	HT speed	k/h	Noise Level Auto (dBA)	Noise Level MT (dBA)	Noise Level HT (dBA)	CALC. NOISE LEV. (15 m from rdwy ctr)	Eq. Dis. Leq (dBA)	Eq. Dis. CNEL (dBA)	50 ft ROW Leq (dBA)	50 ft ROW CNEL (dBA)	75 ft ROW CNEL (dBA)	100 ft ROW CNEL (dBA)
2nd st	studebaker	project driveway	1755	6	42	16	91	1597	6	105	3	52.7	35	56	35	56	35	56	66.3	64.3	66.5	70.6	75.6	75.5	69.4	69.4	68.0	66.9
2nd st	project driveway	seal beach blvd	1882	6	42	16	91	1712	6	113	3	56.4	35	56	35	56	35	56	66.6	64.6	66.8	70.9	75.9	75.8	69.7	69.7	68.3	67.2

Existing With Construction Truck Traffic

ROAD SEGMENT	from:	to:	TOT. # VEH.	D1	D2	Eq. Dis.	Auto %	Auto	MT %	MT	HT %	HT	Auto speed	k/h	MT speed	k/h	HT speed	k/h	Noise Level Auto (dBA)	Noise Level MT (dBA)	Noise Level HT (dBA)	CALC. NOISE LEV. (15 m from rdwy ctr)	Eq. Dis. Leq (dBA)	Eq. Dis. CNEL (dBA)	50 ft ROW Leq (dBA)	50 ft ROW CNEL (dBA)	75 ft ROW CNEL (dBA)	100 ft ROW CNEL (dBA)
2nd st	studebaker	project driveway	1790	6	42	16	91	1629	6	107	3	88.7	35	56	35	56	35	56	66.4	64.3	68.7	71.6	76.6	76.6	70.4	70.4	69.0	68.0
2nd st	project driveway	seal beach blvd	1917	6	42	16	91	1744	6	115	3	92.5	35	56	35	56	35	56	66.7	64.6	68.9	71.9	76.9	76.8	70.7	70.7	69.3	68.2

Noise Estimates - Based on PM Peak Hour

Existing

ROAD SEGMENT	from:	to:	TOT. # VEH.	EQUIVALENT LANE DISTANCE D1	D2	Eq. Dis.	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALC. NOISE LEV. (15 m from rdwy ctr)	Eq. Dis. Leq (dBA)	Eq. Dis. CNEL (dBA)	50 ft ROW Leq (dBA)	50 ft ROW CNEL (dBA)	75 ft ROW CNEL (dBA)	100 ft ROW CNEL (dBA)
2nd st	studebaker	project driveway	2450	6	42	16	91	2230	6	147	3	73.5	35	56	35	56	35	56	67.8	65.7	67.9	72.0	77.0	77.0	70.8	70.8	69.4	68.4
2nd st	project driveway	seal beach blvd	2314	6	42	16	91	2106	6	139	3	69.4	35	56	35	56	35	56	67.5	65.5	67.7	71.8	76.8	76.7	70.6	70.6	69.2	68.1

Existing With Construction Truck Traffic

ROAD SEGMENT	from:	to:	TOT. # VEH.	EQUIVALENT LANE DISTANCE D1	D2	Eq. Dis.	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALC. NOISE LEV. (15 m from rdwy ctr)	Eq. Dis. Leq (dBA)	Eq. Dis. CNEL (dBA)	50 ft ROW Leq (dBA)	50 ft ROW CNEL (dBA)	75 ft ROW CNEL (dBA)	100 ft ROW CNEL (dBA)
2nd st	studebaker	project driveway	2450	6	42	16	91	2230	6	147	3	109	35	56	35	56	35	56	67.8	65.7	69.6	72.8	77.7	77.7	71.6	71.5	70.1	69.1
2nd st	project driveway	seal beach blvd	2314	6	42	16	91	2106	6	139	3	104	35	56	35	56	35	56	67.5	65.5	69.4	72.5	77.5	77.5	71.3	71.3	69.9	68.9

Appendix B

Operational Noise Calculations

Operational Noise - Relative to the Proposed SCGS Facility - MITIGATED

Proposed SCGS North

Reference Noise Distance	**100**
Reference Noise Level	**68.4**

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
NORTH	1955	0	0	**42.6**
SOUTH	3015	0	3	**35.8**
EAST	335	0	0	**57.9**
WEST	2180	0	3	**38.6**

Proposed SCGS Middle

Reference Noise Distance	**100**
Reference Noise Level	**68.4**

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
NORTH	2285	0	3	**38.2**
SOUTH	2675	0	3	**36.9**
EAST	500	0	0	**54.4**
WEST	2210	0	3	**38.5**

Proposed SCGS South

Reference Noise Distance	**100**
Reference Noise Level	**68.4**

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
NORTH	2610	0	3	**37.1**
SOUTH	2310	0	0	**41.1**
EAST	765	0	0	**50.7**
WEST	2290	0	3	**38.2**

OPERATIONAL NOISE CALCULATIONS
Haynes Generating Station Units 5 6 Repowering Project

Proposed Cooling Tower

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
Reference Noise Distance	**100**			
Reference Noise Level	**71**			
NORTH	1470	0	0	**47.7**
SOUTH	3,370	0	0	**40.4**
EAST	595	0	0	**55.5**
WEST	1,975	0	3	**42.1**

Existing HnGS Facility

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
Reference Noise Distance	**100**			
Reference Noise Level	**69.5**			
NORTH	3055	0	0	**39.8**
SOUTH	550	0	0	**54.7**
EAST	1100	0	0	**48.7**
WEST	2430	0	3	**38.8**

Proposed Gas Compressor

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
Reference Noise Distance	**100**			
Reference Noise Level	**62**			
NORTH	2,210	0	0	**35.1**
SOUTH	2,880	0	3	**29.8**
EAST	315	0	0	**52.0**
WEST	2,430	0	3	**31.3**

SUMMARY - Operational Noise Relevant to Proposed SCGS Facility

Operational Noise Levels	SCGS North	SCGS Middle	SCGS South	Cooling Towers	HnGS Facility	Gas Compressors	Combined Noise Level (dBA)
North	42.6	38.2	37.1	47.7	39.8	35.1	50.1
South	35.8	36.9	41.1	40.4	54.7	29.8	55.2
East	57.9	54.4	50.7	55.5	48.7	52.0	62.0
West	38.6	38.5	38.2	42.1	38.8	31.3	46.6

Operational Noise Levels	Combined SCGS
North	**44.8**
South	**43.3**
East	**60.0**
West	**43.2**

Operational Noise - Relative to the Proposed Cooling Towers - MITIGATED

Proposed SCGS North

Reference Noise Distance	**100**
Reference Noise Level	**68.4**

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
NORTH	1955	0	0	**42.6**
SOUTH	3020	0	3	**35.8**
EAST	480	0	0	**54.8**
WEST	2180	0	3	**38.6**

Proposed SCGS Middle

Reference Noise Distance	**100**
Reference Noise Level	**68.4**

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
NORTH	2280	0	3	**38.2**
SOUTH	2680	0	3	**36.8**
EAST	815	0	0	**50.2**
WEST	2210	0	3	**38.5**

Proposed SCGS South

Reference Noise Distance	**100**
Reference Noise Level	**68.4**

Boundary of Noise District Four	Distance (feet)	Mitigation Factors	Attenuation Factors	Maximum Noise Level (dBA)
NORTH	2615	0	3	**37.1**
SOUTH	2310	0	0	**41.1**
EAST	1155	0	0	**47.1**
WEST	2285	0	3	**38.2**

OPERATIONAL NOISE CALCULATIONS
Haynes Generating Station Units 5 6 Repowering Project

Proposed Cooling Tower

Reference Noise Distance	**100**			
Reference Noise Level	**71**			
Boundary of Noise District Four	**Distance (feet)**	**Mitigation Factors**	**Attenuation Factors**	**Maximum Noise Level (dBA)**
NORTH	1475	0	0	**47.6**
SOUTH	3365	0	0	**40.5**
EAST	375	0	0	**59.5**
WEST	1970	0	3	**42.1**

Existing HnGS Facility

Reference Noise Distance	**100**			
Reference Noise Level	**69.5**			
Boundary of Noise District Four	**Distance (feet)**	**Mitigation Factors**	**Attenuation Factors**	**Maximum Noise Level (dBA)**
NORTH	3055	0	0	**39.8**
SOUTH	570	0	0	**54.4**
EAST	1530	0	0	**45.8**
WEST	2465	0	3	**38.7**

Proposed Gas Compressor

Reference Noise Distance	**100**			
Reference Noise Level	**62**			
Boundary of Noise District Four	**Distance (feet)**	**Mitigation Factors**	**Attenuation Factors**	**Maximum Noise Level (dBA)**
NORTH	2,215	0	0	**35.1**
SOUTH	2,905	0	3	**29.7**
EAST	660	0	0	**45.6**
WEST	2,430	0	3	**31.3**

SUMMARY - Operational Noise Relevant to Proposed Cooling Towers

Operational Noise Levels	SCGS North	SCGS Middle	SCGS South	Cooling Towers	HnGS Facility	Gas Compressors	Combined Noise Level (dBA)
North	42.6	38.2	37.1	47.6	39.8	35.1	50.0
South	35.8	36.8	41.1	40.5	54.4	29.7	54.9
East	54.8	50.2	47.1	59.5	45.8	45.6	61.5
West	38.6	38.5	38.2	42.1	38.7	31.3	46.6

Operational Noise Levels	Combined SCGS
North	**44.8**
South	**43.3**
East	**56.6**
West	**43.2**

Appendix C

ATCO Noise Management Memorandum RE: LADWP Haynes Generating Station Units 4 & 5 Re-Powering Project, New Equipment Sound Levels

DATE: January 4, 2010

TO: Ralph Wagner, Worley Parsons

FROM: Chris Giesbrecht, ATCO Noise Management

SUBJECT: LADWP Haynes Generating Station Units 4 & 5 Re-powering project, New Equipment Sound Levels

Here is a summary of equipment sound levels. This summary includes equipment noise information used by ATCO to determine the noise control measures necessary to comply with the City of Long Beach exterior noise standards. Also, included are the far field noise levels for the equipment with noise control measures applied.

1) Far-field noise levels from each project component before noise control measures are applied:
   - Composite noise from a single generator unit: 61.3 dBA @ 400.2 ft. (Source: GE Energy)
   - Composite noise from one single gas compressor: 76.5 dBA @ 99.2 ft. (Source: ATCO Measurement of similar unit 10/12/09)
   - Composite Noise from the bank of six (standard) cooling tower units: 68 dBA @ 250 ft. (Source: SPX datasheet 06/01/09)

2) Far-field noise levels from project components after noise control measures are applied:
   - Composite noise from a single generator unit: 53.4 dBA @ 400.2 ft. (Source: ATCO, Calculated using ISO 9613 noise propagation model)
   - Composite noise from the bank of six gas compressors: 62.1 dBA @ 99.2 ft. (Source: ATCO, Calculated based on room effect & Sabine absorption calculation & ISO 9613 noise propagation model)
   - Composite noise from the bank of six (six low-noise fans) cooling towers: 63 dBA @ 250 ft. (Source: SPX, via email to Ralph Wagner 07/14/09)

Please note that these sound levels are indicative of far-field noise levels in the east direction according to the intended site layout for the project. Exhaust system noise is not included in the generator sound levels supplied. Calculated levels include the effects of source directivity and atmospheric conditions conducive to sound propagation over level terrain.

3) The noise levels shown here and used in the ISO 9613 noise propagation model developed by ATCO were collected from the following sources:
   - LMS100 Package and Intake: GE supplied (Aug 29 2009, full load steady state
   - Exhaust (Gas Path): GE full load stack emitted sound power level (01/09/06, 3 Sigma uncertainty not included)
   - Exhaust (Breakout): ANM Measured (Groton S. Dakota 10/11/08)
   - Fuel Gas Compressors: (ANM Measured – existing fuel gas compressor unit)
   - Coolers: SPX supplied fan Lw

4) ATCO recommendations include the following noise control measures to be incorporated into the project:
- **Low Noise Coolers.** Low noise coolers are modeled based on the fan sound power level specified by GEA to achieve 63 dBA at 250’ using SX fans.
- **Fuel Gas Compressor Building.** Fuel gas compressors are modeled in an acoustic enclosure with an absorptive interior surface with the sound transmission loss values shown in Table 1.
- **VBV Silencer Diffuser Pipe Lagging.** Noise reduction for this source is required. Lagging is suggested. Transmission loss values required are shown in Table 1.
- **Basic Exhaust Silencing.** The exhaust system modeled is based on a standard system with nominal gas path silencing and including SCR attenuation and casing breakout. The specification for exhaust system noise contribution is shown in Table 2 below. This specification is balanced with noise contribution from other equipment sources and includes all exhaust noise and breakout noise from the expansion joint to the stack top.

Table 1: Noise Abatement Acoustic Performance Specifications

Item	Octave Band Center Frequency, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
Fuel Gas Compressor Building Transmission Loss, dB	5	9	14	19	29	38	46	52	58
VBV Silencer Diffuser Pipe Lagging Transmission Loss, dB	-	-	-	5	9	9	15	15	3

Table 2: Exhaust System Noise Specification

	Octave Band Center Frequency, Hz									dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Exhaust System Noise Specification, Sound Pressure Level at 350’, dB	71	70	64	57	51	49	48	44	34	56

APPENDIX F

TRAFFIC STUDY FOR THE HAYNES GENERATING STATION SIMPLE CYCLE GENERATING SYSTEM (SCGS) IN THE CITY OF LONG BEACH, CALIFORNIA

KOA Corporation
July 29, 2009

Traffic Study for
The Haynes Generating Station
Simple Cycle Generating System (SCGS)
in the
City of Long Beach, California

July 29, 2009

Prepared For:
EDAW, Inc.
2737 Campus Drive
Irvine, California 92612
(949) 660-8044

Prepared by:

KOA CORPORATION
PLANNING & ENGINEERING

1055 Corporate Center Drive, Suite 300
Monterey Park, California 91754
(323) 260-4703

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Appendices

1. Introduction

The purpose of this traffic study is to assess the impacts of proposed construction activities at the Haynes Generating Station (HnGS), related to development of the Simple Cycle Generating System (SCGS), on the surrounding roadway system. Figure 1 illustrates the project location.

The study quantitatively assesses project impacts on weekday AM and PM peak hour operations at thirteen key intersections near the project site. All major signalized intersections along employee vehicle and construction truck routes to and from the project site were included in the study area.

The list below provided the locations of the eleven study intersections:

1. Studebaker Road/SR-22 Westbound Ramps*
2. Studebaker Road/SR-22 Eastbound Ramps*
3. Studebaker Road/AES Plant Driveway
4. Studebaker Road/Loynes Drive
5. Studebaker Road/2nd Street
6. PCH/7th Street*+
7. PCH/Bellflower Boulevard*
8. PCH/Loynes Drive*
9. PCH/2nd Street*+
10. PCH/Studebaker Road*
11. Loynes Drive/Bixby Village Drive
12. Seal Beach Boulevard/Westminster Avenue
13. 2nd Street/Project Entrance

** State (Caltrans) Facility*
+ CMP Monitoring Intersection for Los Angeles County

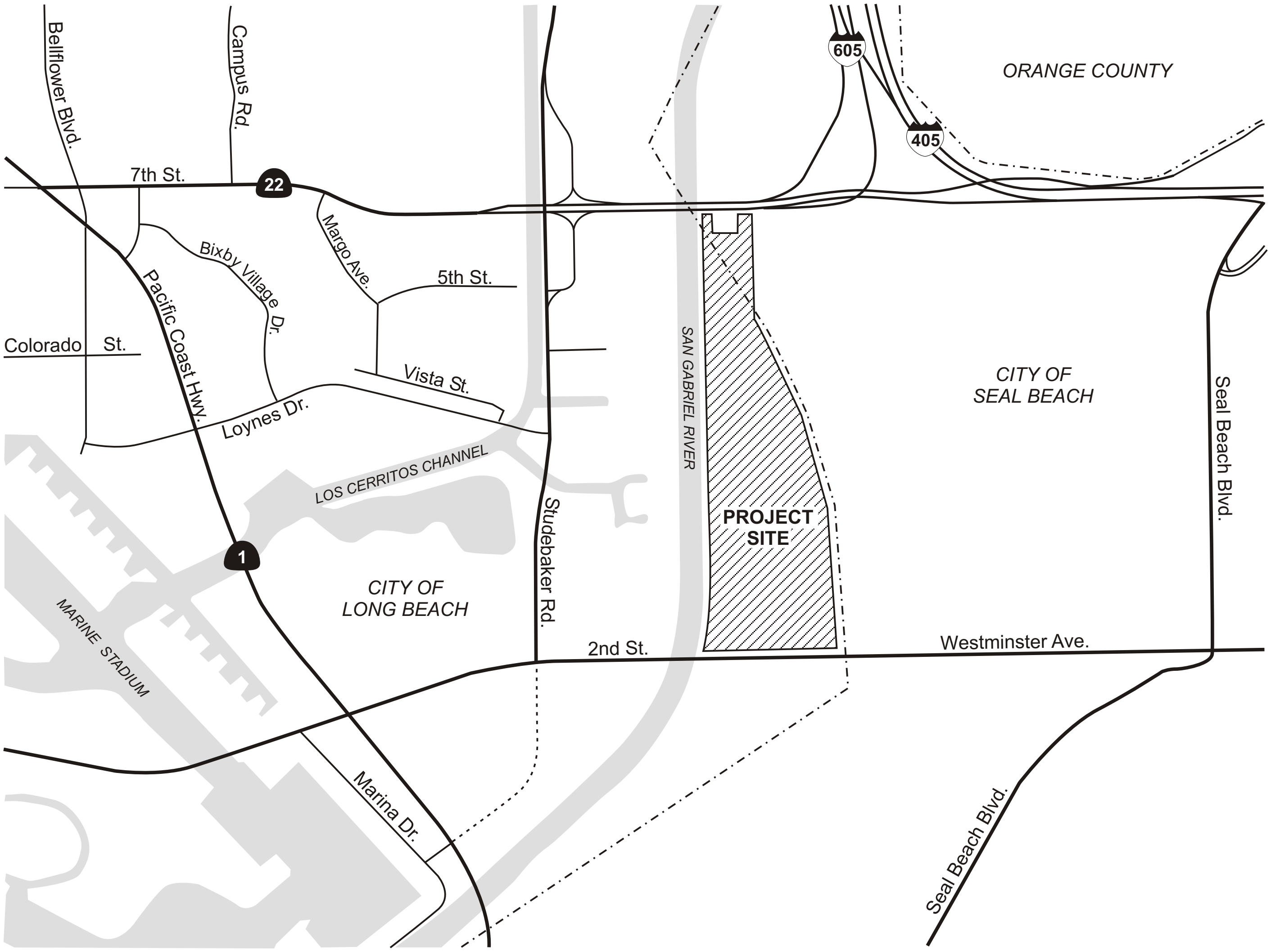
The scope and methodologies used in this traffic analysis are generally consistent with previous analysis efforts undertaken for earlier construction projects at the HnGS. The appendices of this report contain background materials for this analysis. These materials include manual traffic counts, analysis worksheets, and other details. Figure 2 illustrates the locations of the study intersections.

Once the SCGS project is completed, the trip generation from the project site is expected to return to existing levels. Any potential traffic impacts from this proposed project are expected to occur during project construction. This traffic study assesses the impacts of construction-generated traffic on adjacent area roadways.

Project Location

The HnGS facility is located at 6801 East 2nd Street in the City of Long Beach, immediately south of State Highway 22 (7th Street) and approximately one mile east of State Highway 1 (Pacific Coast Highway). Access to HnGS is provided from 2nd Street, which forms the southern property boundary. State Highway 22 serves as the northern site boundary, although only emergency access is provided from this street. On the west, the project site is bordered by the San Gabriel River channel, and the eastern boundary is formed by an Orange County flood control channel.

The HnGS property consists of approximately 122 acres, the majority of which are located in the City of Long Beach, within the County of Los Angeles.



LEGEND

Project Site

City Boundary

N

No Scale

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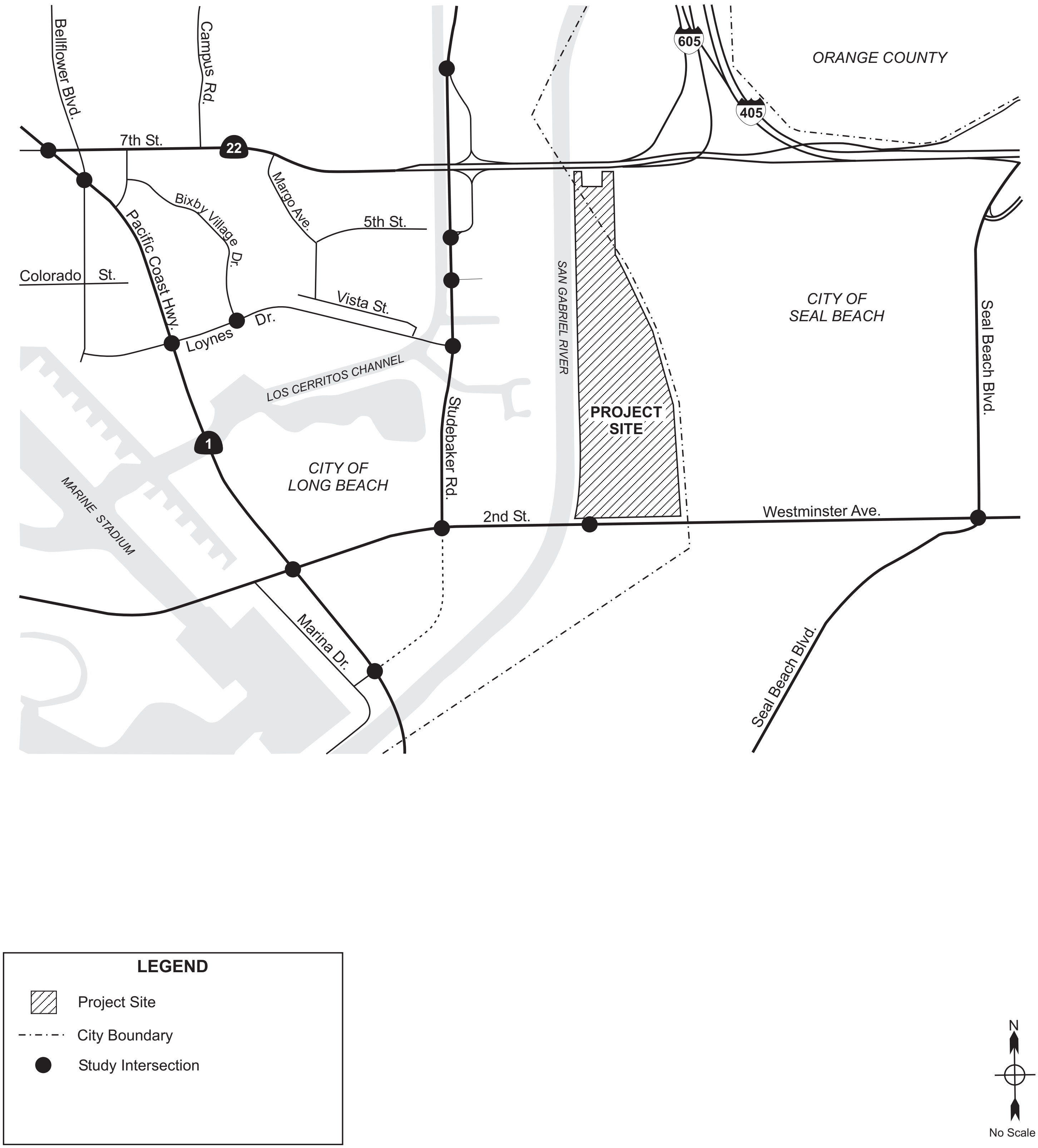
Haynes Generating Station SCGS Project

Figure 1

Project Location



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Haynes Generating Station SCGS Project

Figure 2

Location of Study Intersections

Construction Description

Construction of the proposed project is scheduled to begin in the second quarter of 2010 and continue to completion at the end of June 2012. The duration of construction activities would be approximately 26 months and would normally take place six days per week, Monday through Saturday. To insure that construction activities stay on schedule, Sunday shifts may be required at times during the construction period, and two shifts per day may also be necessary at times.

During peak project construction periods, a total of approximately 270 workers could be present at the site on the same day (although not necessarily at the same time), in either one or two shifts. The work day would begin at 7:00 a.m. Therefore, a large majority of construction employees (at least 50% based on LADWP estimates) would arrive before 7:00 a.m. A commensurate reduction was made to the analyzed trip generation for the analyzed peak-hour of traffic.

Construction Activities

Construction activities for the proposed project would include minor grading and site preparation, construction of access roads, driving of piles and construction of foundations for the SCGS, construction of the combustion turbine (CT) generator units, construction of the dry cooling towers, extension of the existing electrical switch yard, turbine commissioning (testing and calibration of SCGS prior to operations), and the decommissioning of existing HnGS generation Units 5 & 6. All required construction staging, storage, and laydown areas related to project construction would be located within the existing HnGS boundaries. New generating equipment would be brought to the site on trucks, and oversize loads are anticipated. In addition, contractors would require temporary trailers on site for construction planning and management activities.

Construction Employee Access

All construction workers would access the site through the main gate on 2nd Street, at the southwest corner of the HnGS property, and worker private vehicle parking would be accommodated within the property in open areas along the western boundary. Construction equipment, materials, and components would also generally be delivered through the main gate at the southwest corner of the property.

However, some of the larger and heavier loads may be delivered through the industrial gate at the southeast corner of the HnGS property, which is across East 2nd Street from the entrance to the Island Village residential community.

Truck trips may average 25 loads per day during the peak construction materials delivery period of several months. During the balance/non-peak of the project, truck trips are expected to average less than 10 loads per day, but could be up to 15 loads per day for some non-peak periods.

Construction Area

The proposed SCGS would be located in the west-central part of the HnGS property, immediately north of the existing CCGS. The total area for the proposed new facilities is approximately 16 acres.

Site Preparation and Foundation Construction

A portion of the site for the proposed SCGS served briefly as a temporary staging area during the construction of the CCGS (Units 3 and 4 repowering project) and is essentially clear; fuel oil storage tanks and associated protective berms are located on the majority of the rest of the project site (however, these tanks will be demolished prior to the start of project construction as part of an ongoing site maintenance program). Though the Haynes site is essentially flat, some grading is required to eliminate berms and prepare for foundations. Grading activities are not expected to create excess material that would need to be hauled off site, nor is the importation of substantial soil material from off site anticipated. However, it may be necessary to temporarily stockpile dirt on site during grading operations.

Foundation piles are required to adequately support the SCGS components. It is estimated that the generator units and other project elements would require a total of approximately 3,000 piles.

Construction traffic related to the site preparation and foundation construction phase would include approximately 250 (one-way) truck trips over a four-month period to deliver the pre-cast concrete piles and 2,600 (one-way) truck trips over a 12- to 15-month period to deliver concrete and the reinforcing steel required for construction. The entire site preparation phase, including grading, pile driving, and foundations, would last approximately 7 months and would require up to 100 personnel on site during a peak work day.

Erection of the SCGS

Once the site is prepared and the foundations are constructed, the SCGS would be erected and assembled. Peak daily workforce during this phase is estimated at approximately 270 persons per day for the four peak construction months. Many components of the SCGS, including the LMS-100 turbines, are prefabricated and would be delivered to the site by truck for assembly. The major components would be delivered in a staged manner over an approximate timeframe of 5 months beginning near the end of the foundation construction period.

Construction of the transformers, switchyard, and natural gas supply system would take place concurrently. The components and other materials required for the construction of the SCGS would be stored in various laydown areas within the HnGS property until needed.

Dry Cooling System

The dry cooling towers would consist of 6 banks of cooling equipment (one for each turbine) supported by a structural steel base. Each bank would have 11 bays of fans. The delivery of bays would require 66 truck deliveries. The deliveries may be staged to allow direct placement of the bays at the site without having to temporarily store them.

Roughly 400,000 lbs to 450,000 lbs of structural steel would be needed for the base of each bank, generating about 60 additional truck loads.

Start Up and Commissioning

After the SCGS construction is complete but prior to producing electrical energy for distribution to the LADWP service area, the SCGS would undergo a comprehensive commissioning program to evaluate and calibrate the various systems. The commissioning phase of the proposed project requires approximately four months and generally involves a total on-site work force of 100 or fewer personnel. This effort would not require additional truck trips.

Decommissioning of Units 5 and 6

Within 90 days of completion of the commissioning of the proposed SCGS, LADWP would remove existing Units 5 and 6 from service. Units 5 and 6 would be left in place but permanently disabled. This effort would not require additional truck trips.

Traffic Analysis Methodologies

This report was prepared in conformance with traffic study guidelines set forth by the City of Long Beach, for those intersections within the City. The City of Seal Beach does not have published traffic impact study guidelines but rather recognizes the Congestion Management Plan (CMP) traffic impact guidelines defined by the County of Orange. CMP impact guidelines for Orange County were considered in the impact analysis for the Seal Beach study intersection. Section 7 of this report also details Orange County CMP requirements and conformance for this study intersection.

In the sections that follow, the project-only and cumulative impacts of this development on study area roadways and intersections are discussed. Two separate future-period traffic analysis timeframes are reviewed for this project, as shown below:

- Year 2008 Existing Conditions
- Year 2012 "No Project" Conditions
- Year 2012 "With Project Construction" Conditions

Existing traffic volumes were defined by peak-period intersection turn movement counts conducted for this report. From the two-hour peak period volume totals, peak-hour periods for each intersection and for each peak hour (AM and PM) were defined by the four highest consecutive 15-minute periods. This methodology allows for the true peak-hour of each analyzed intersection to be examined. For this reason, volumes across adjacent intersections may vary, but the analysis provides peak conditions for each single study intersection.

Project construction is anticipated to be completed in the year 2012. The Year 2012 was selected for the future analysis year in order to provide a conservative estimate of area annual traffic growth during the construction year. The use of the year 2012, therefore, for the future analysis period is conservative in terms of the definition of future baseline volumes.

The TRAFFIX software program was used to perform the level of service analysis for the surface street network. Intersection analysis was performed using Intersection Capacity Utilization methodology. Based on City of Long Beach guidelines, an intersection is generally considered impacted when the resulting level of service (LOS) is "E" or "F" and project generated traffic causes the volume to capacity (V/C) ratio to increase by a value of 0.020 or higher.

CMP guidelines for the County of Orange were applied at the Seal Beach Boulevard/Westminster Avenue intersection, based on traffic impact analysis policies of the City of Seal Beach. Orange County CMP traffic impact standards are based on volume increases that represent a three percent or greater increase in the design capacity, or a 0.030 increase in V/C values.

An impact may also be significant where specific traffic safety issues have been identified. Appendix A provides further explanation of the level-of-service definitions and the methodologies used in this traffic study.

2. Existing Roadway Network

This section documents the existing conditions in the study area. The discussion presented here is limited to major roadways and intersections in the project study area. Figure 3 illustrates the lane configurations and intersection control at the study intersections.

Interstate 405, the San Diego Freeway, is generally a north-south freeway that connects to Interstate 5 to the north of the project site. North of the project site, Interstate 405 serves as the primary Interstate freeway though the western portion of the Los Angeles Metropolitan Area. Project traffic may utilize freeway ramps located on Westminster Avenue at Interstate 405 to access the project site and connect to the regional transportation network to the south.

State Route 22 (SR-22). SR-22 is located to the northeast of the project site. This extension of 7th Street becomes a State Route at Pacific Coast Highway and extends east-west through the western half of Orange County. Access to the project site from the SR-22 Freeway is provided via eastbound and westbound on/off ramps at Studebaker Road. SR-22 is also classified as a State Freeway in the Los Angeles County CMP.

Pacific Coast Highway (PCH). PCH is located west of the project site and is a Regional Corridor that extends throughout Los Angeles and Orange Counties. Access to the project site from PCH is provided via 2nd Street and Loynes Drive. This arterial is classified as a Regional Corridor in the City's Transportation Element. PCH is also classified as a State Highway (Arterial) in the Los Angeles County CMP. Long Beach Transit and Orange County Transit Authority (OCTA) run various lines along PCH in the project vicinity.

Studebaker Road. Studebaker Road is a four-lane north-south roadway located adjacent to the project site and parallel to the Los Cerritos Channel. Orange County Transportation Authority (OCTA) bus stops are located along northbound and southbound Studebaker Road. This road is served by OCTA Routes 1 and 60. Studebaker Road is classified as a Major Arterial.

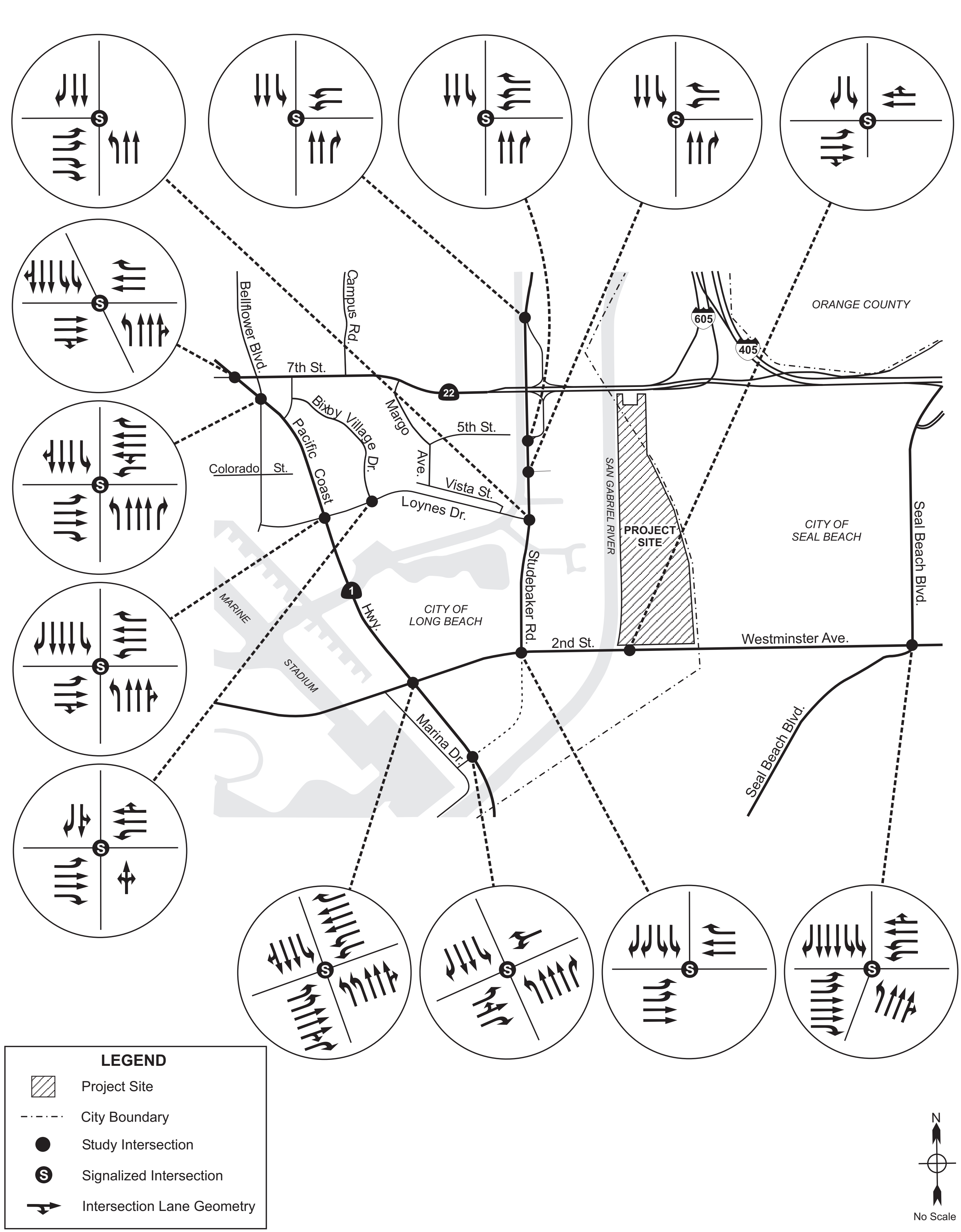
Loynes Drive. Loynes Drive is a four-lane east-west roadway located to the west of the project site. This roadway terminates at Studebaker Road, west of the project site. Loynes Drive is classified as a Collector Street.

2nd Street. 2nd Street is a four-lane east-west arterial located to the south of the project site. 2nd Street is classified as a Major Arterial (Scenic Route) in the City limits. This arterial is named Westminster Avenue to the east of the Orange County line.

7th Street. 7th Street is a six-lane east-west arterial located to the northwest of the project site. This arterial transitions into SR-22 at PCH. 7th Street is classified as a Major Arterial.

Bellflower Boulevard. Bellflower Boulevard is a six-lane north-south arterial located northwest of the project site. This roadway is classified as a Major Arterial in the City's Transportation element.

Seal Beach Boulevard is a six-lane north-south arterial roadway located to the east of the project site.



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Haynes Generating Station SCGS Project

Figure 3

2008 Intersection Geometries and Control

3. Year 2008 Existing Conditions

Data Collection

Traffic volume data was collected on Tuesday, December 2, 2008, and on Thursday, December 4, 2008. Figures 4 and 5 illustrate the existing AM and PM peak hour traffic volumes at the study intersections. Appendix B contains the traffic count worksheets.

Level-of-Service Analysis for Year 2008 Existing Conditions

Level-of-service calculations were performed to document existing peak period intersection performance. Table 1 shows the results of this analysis.

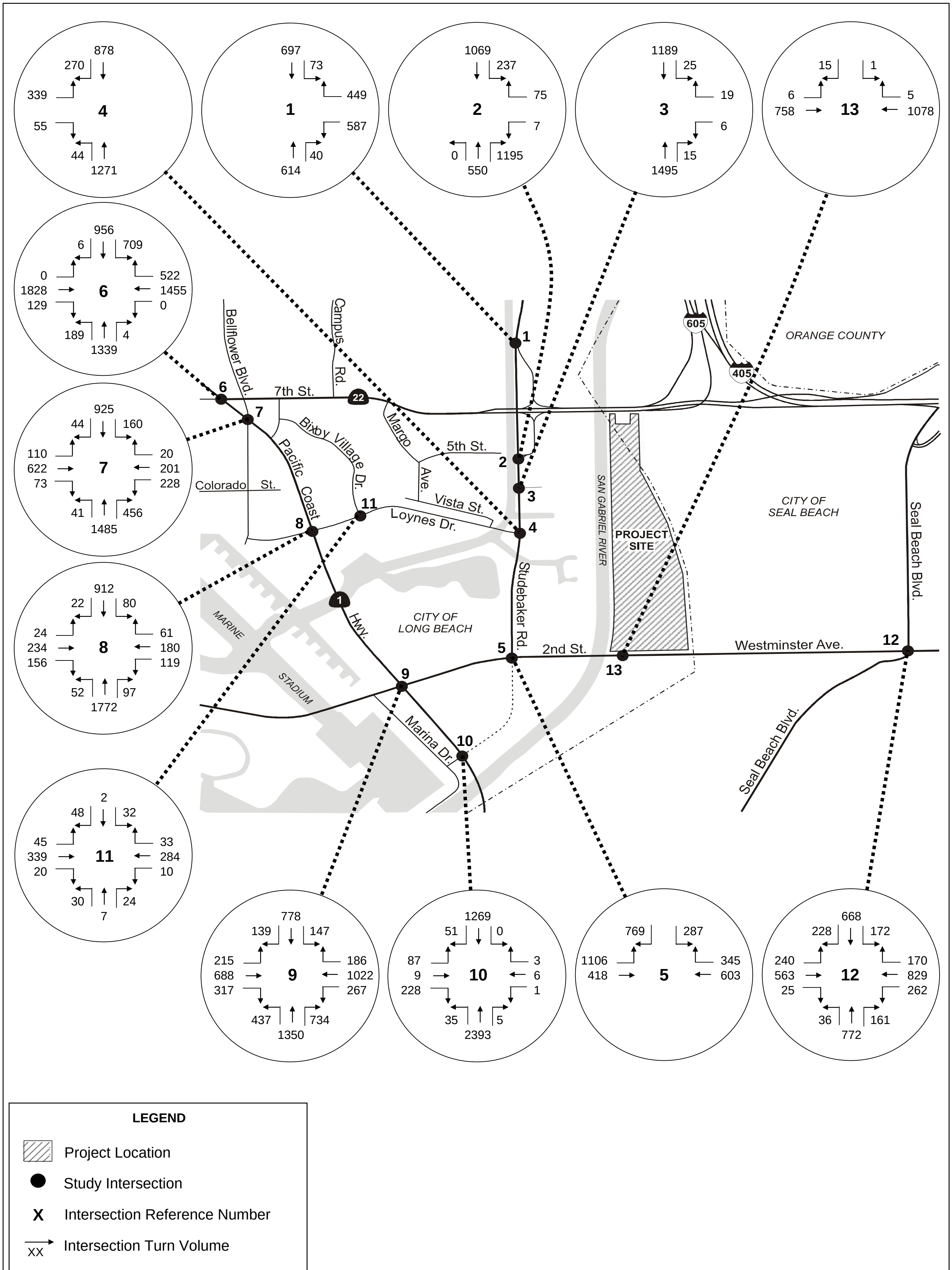
Table 1 – Level-of-Service Calculations for Year 2008 Existing Conditions

		Weekday AM Peak		Weekday PM Peak	
	Intersections	V/C	LOS	V/C	LOS
1.	Studebaker Road & SR-22 Westbound Ramps*	0.571	A	0.889	D
2.	Studebaker Road & SR-22 Eastbound Ramps*	0.486	A	0.802	D
3.	Studebaker Road & AES Plant Driveway	0.645	B	0.743	C
4.	Studebaker Road & Loynes Drive	0.665	B	0.718	C
5.	Studebaker Road & 2nd Street	0.963	E	1.068	F
6.	PCH & 7th Street*+	1.131	F	1.102	F
7.	PCH & Bellflower Boulevard*	0.833	D	0.758	C
8.	PC & /Loynes Drive*	0.786	C	0.835	D
9.	PCH & 2nd Street*+	1.018	F	1.015	F
10.	PCH & Studebaker Road*	0.805	D	1.052	F
11.	Bixby Village Drive & Loynes Drive	0.285	A	0.370	A
12.	Seal Beach Boulevard & Westminster Avenue	0.648	B	0.718	C
13.	2nd Street & Project Entrance	0.502	A	0.591	A

** State (Caltrans) Facility*
+ CMP Monitoring Intersection for County of Los Angeles

As shown on Table 1, the Studebaker Road/2nd Street, PCH/7th Street and PCH/2nd Street intersections operate at poor levels of service (LOS E or F) during both the AM and PM peak hours. The PCH/Studebaker Road intersection operates at a poor level of service during the PM peak hour.

The level-of-service calculations are provided in Appendix C.



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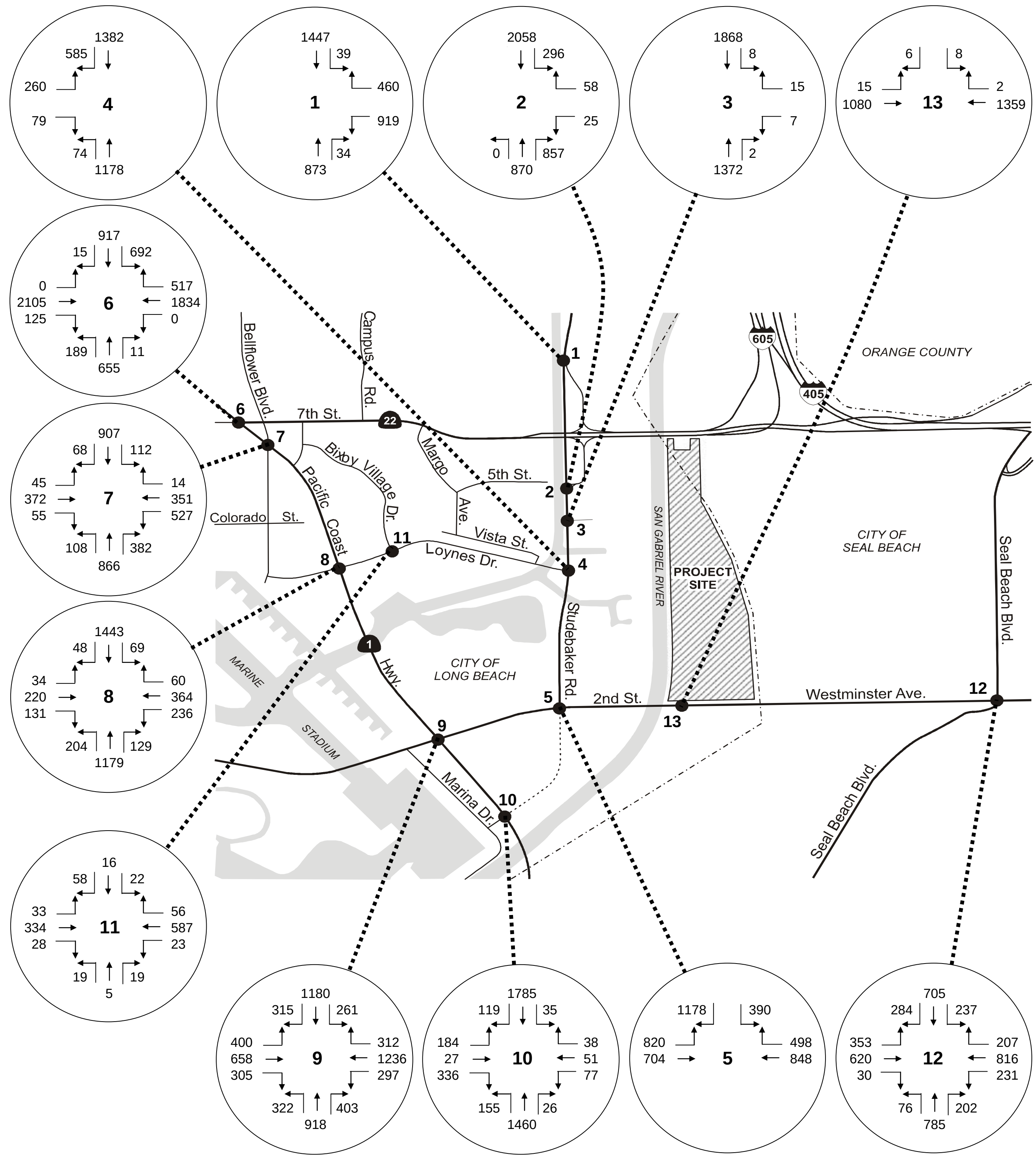
Haynes Generating Station SCGS Project — Figure 4

Year 2008 Existing AM Peak Hour Traffic Volumes



LEGEND

- Project Location
- Study Intersection
- X Intersection Reference Number
- XX Intersection Turn Volume

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Haynes Generating Station SCGS Project | Figure 5

Year 2008 Existing PM Peak Hour Traffic Volumes

4. Year 2012 "No Project" Conditions

This section provides the analysis of "No Project" Conditions in the study area with ambient growth and area project trips. Project construction is anticipated to be completed within the year 2012. The future analysis year was defined as 2012, in order to provide the most conservative estimate of background traffic growth within the construction timeframe for the project analysis.

Year 2012 Baseline Traffic Volume Forecast

In order to forecast Year 2012 baseline traffic volumes, Year 2008 peak hour volumes were increased by an ambient growth rate of 2% per year (8%). This methodology is consistent with data provided in the Los Angeles County CMP. The City of Long Beach and the City of Seal Beach were contacted to determine if any planned development projects should be included in the future pre-project analysis. Based on the published City of Long Beach pending projects list and conversations with planning staff at the City of Seal Beach, it was determined that there would not be any planned projects within or near to the study area.

The results Year 2012 baseline "no project" AM and PM peak hour traffic volumes are provided on Figures 6 and 7.

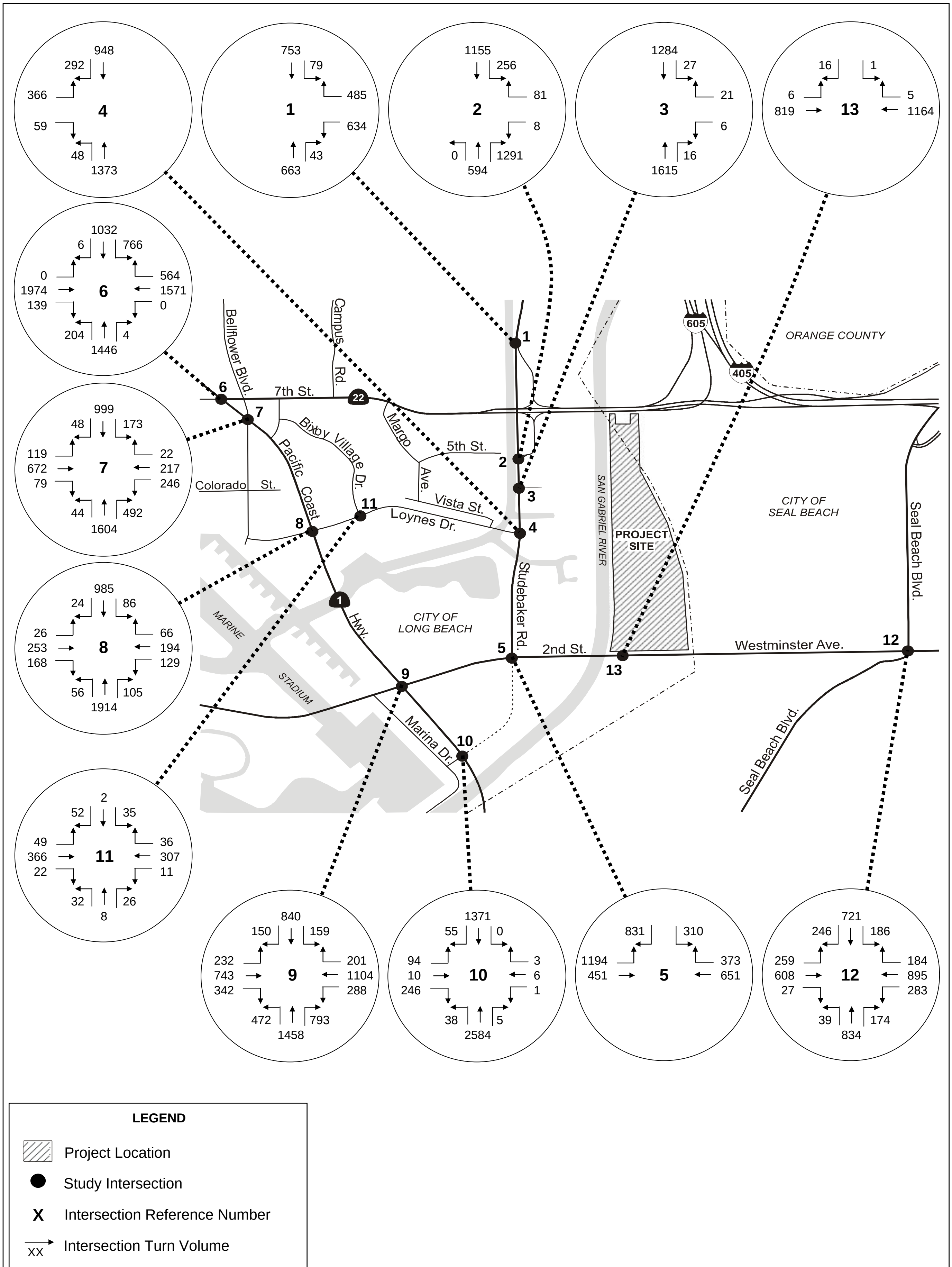
Level-of-Service Analysis for Year 2012 "No Project" Conditions

Level-of-service calculations were performed to assess forecast Year 2012 "no project" peak hour conditions. Table 2 provides the results of this analysis.

Table 2 – Level-of-Service Calculations for Year 2012 "No Project" Conditions

	Intersections	Weekday AM Peak		Weekday PM Peak	
		V/C	LOS	V/C	LOS
1.	Studebaker Road & SR-22 Westbound Ramps*	0.605	B	0.949	E
2.	Studebaker Road & SR-22 Eastbound Ramps*	0.513	A	0.854	D
3.	Studebaker Road & AES Plant Driveway	0.684	B	0.791	C
4.	Studebaker Road & Loynes Drive	0.706	C	0.764	C
5.	Studebaker Road & 2nd Street	1.028	F	1.141	F
6.	PCH & 7th Street*+	1.209	F	1.178	F
7.	PCH & Bellflower Boulevard*	0.888	D	0.807	D
8.	PC & /Loynes Drive*	0.836	D	0.890	D
9.	PCH & 2nd Street*+	1.085	F	1.081	F
10.	PCH & Studebaker Road*	0.855	D	1.121	F
11.	Bixby Village Drive & Loynes Drive	0.300	A	0.391	A
12.	Seal Beach Boulevard & Westminster Avenue	0.696	B	0.771	C
13.	2nd Street & Project Entrance	0.530	A	0.626	B

** State (Caltrans) Facility*
+ CMP Monitoring Intersection



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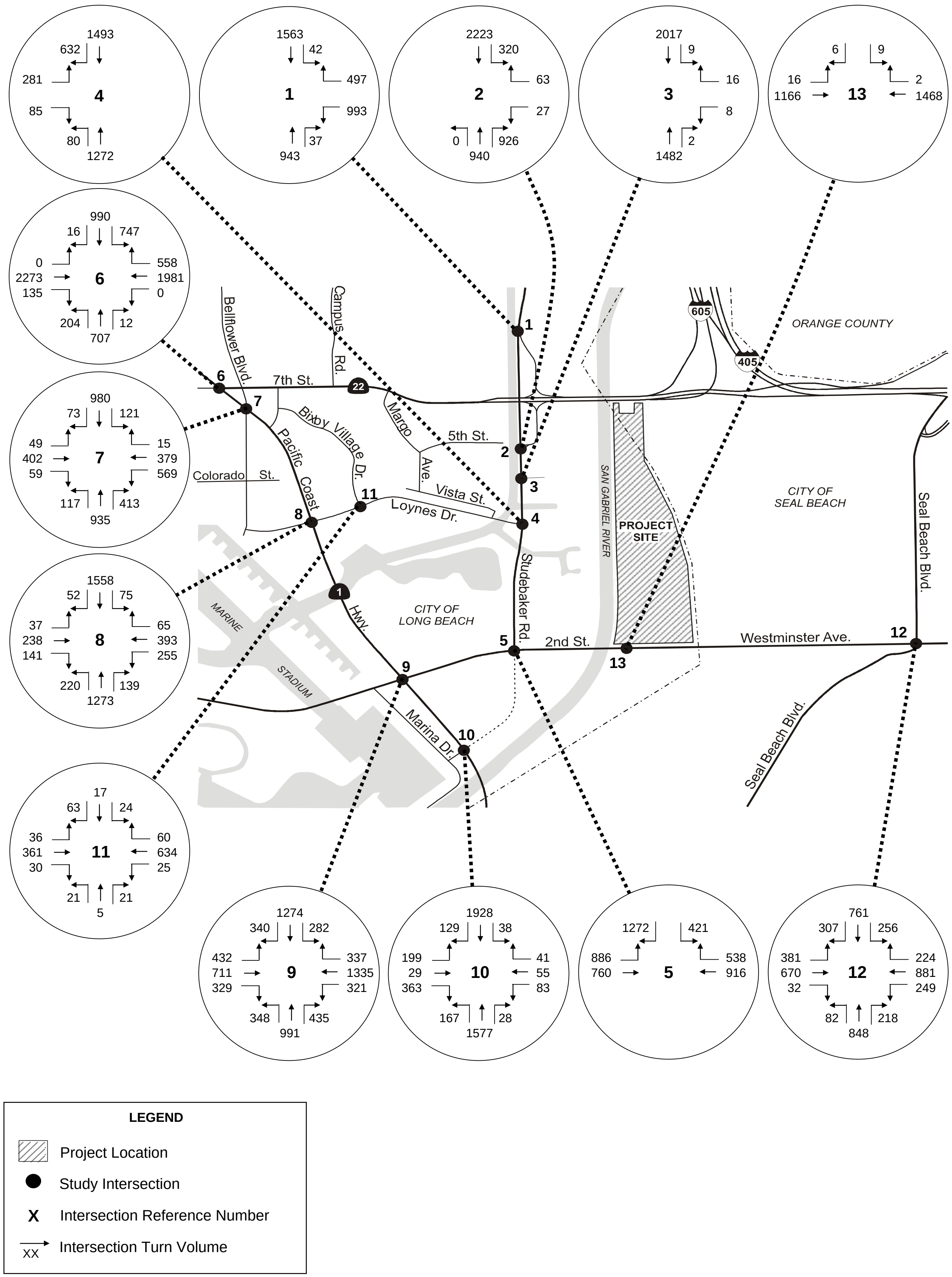
Haynes Generating Station SCGS Project

Figure 6

Year 2012 "No Project" AM Peak Hour Traffic Volumes



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Haynes Generating Station SCGS Project

Figure 7

Year 2012 "No Project" PM Peak Hour Traffic Volumes

As shown on Table 2, the Studebaker Road/2nd Street, PCH/7th Street and PCH/2nd Street intersections are forecast to operate at poor levels of service (LOS E or F) during both the AM and PM peak hours. The Studebaker Road/SR-22Westbound Ramps and PCH/Studebaker Road intersections are forecast to operate at a poor level of service during the PM peak hour.

The level-of-service calculations are provided in Appendix D.

5. Construction Project Trip Generation Forecast

This section focuses on the characteristics of the proposed project construction.

Project Trip Generation

Prior to initiating construction, a detailed construction plan will be developed by the plant operator to identify necessary resources and to define the construction supervisory and technical field organization and staffing levels required for the project. The methods and procedures for sequencing and implementing construction operations will also be detailed in the construction plan. In addition, a project safety program will be developed by the operator, consistent with federal and state requirements. This is a standard LADWP requirement.

Empirical data for use in calculating peak hour and daily trip generation rates for construction sites is not generally available. Therefore, the methodology provided below is intended to develop trip generation forecasts that represent a worst-case scenario. The maximum number of employees on site per day during the peak construction would be 270 employees. The maximum truck trip activity would also occur during this time with 25 round-trip truck loads per day.

In the trip generation discussion that follows, it is assumed that daily construction activities will occur in a single eight-hour shift that begins at 7:00 AM. Depending on the hours utilized for a second shift, there may or may not be additional traffic generated during the AM and PM peak hours of adjacent street traffic. Operation of a second shift would not change the total number of workers on site per day, but would change the directional split during the PM peak hour, as some workers arrive on site and some workers depart during that period. However, assuming a single shift of up to 270 employees establishes a conservative baseline from which to determine potential impacts to traffic from the proposed project.

The peak-hour construction trip generation forecast methodology was based on the number of employees that would generate peak-hour trips to and from the HnGS repowering site. Truck trips were included in the daily trip generation totals, but excluded from the peak-hour totals due to negligible number of truck trips that would overlap the peak hours, versus the entire day of construction.

AM Trip Generation for the Project

The AM peak hour of the project is expected to occur primarily before the traditional peak period of adjacent street traffic (generally a period within the 7:00 AM to 9:00 AM timeframe), since the construction day will start at 7:00 AM. Most construction workers would be expected to arrive prior to 7:00 AM.

In calculating AM peak hour trips for the project, it is assumed that employees arrive by vehicles with an average vehicle occupancy of 1.2 passengers. This is a conservative rate that assumes that approximately one out of every six employees would carpool or use alternative modes of transport to reach the project site. It would be likely that some employees would carpool and others would be dropped off thereby creating one vehicle trip arriving at the site and one vehicle trip departing. In addition, construction activities generate trips during both peak and off-peak periods that are the result of direct construction activities, rather than the result of employee commuting.

To estimate the number of vehicles departing the site during the AM peak hour, KOA Corporation used the inbound/outbound vehicle split from the *Institute of Transportation Engineers Trip Generation Manual* for a General Office Building (Land Use 710) where 88% of the trips during the AM Peak Hour are inbound trips and 12% of the trips are outbound trips. The General Office Building land use was selected since most trips during peak periods would tend to be commuter-generated.

Using this methodology including the assumption that 50% of employee trips would occur before 7:00 AM, employee commuters would generate 113 inbound trips (135/1.2) and 15 outbound trips (113/0.88 - 113). The inbound calculations include all estimated employee vehicles trips inbound to the construction site based on the vehicle occupancy assumptions of 1.2. The outbound calculations include the 12% outbound trips based on a factored total of inbound and outbound trips. This methodology provides for the assumptions that all employee-generated vehicle trips would arrive during the peak hour and some would depart the site within the same hour.

Typical non-employee trip generation during the AM peak hour would be the result of activities such as movement by supervisory personnel, delivery of supplies, and the movement of equipment. As deliveries and equipment movement will occur both throughout the day and could be scheduled to avoid peak periods, the additional trips generated by such activities are anticipated to be negligible and were accounted for in the conservative method that was used to calculate employee commuter trips. For purposes of analysis it was assumed that truck trips would be scheduled during off-peak hours.

PM Trip Generation for the Project

It is assumed that the PM peak hour traffic generation for the project would coincide with the PM peak hour of the adjacent street traffic. The same trip generation methodology was used for this peak period as that utilized for the AM peak period. It is assumed that each employee departs by car alone and does so during the PM peak hour of adjacent street traffic. Again, it would be likely that some employees would carpool and others would be picked up, thereby creating one vehicle trip departing at the site and one vehicle trip arriving. Vehicle trip generation activity may differ between the morning peak period and the afternoon peak period, as it would for a typical office use or any job work site.

To estimate the number of vehicles departing the site during the PM peak hour, KOA Corporation used the inbound/outbound vehicle split from the *Institute of Transportation Engineers Trip Generation Manual* for a General Office Building (Land Use 710) where 83% of the trips during the PM Peak Hour are outbound trips and 17% of the trips are inbound trips. The General Office Building land use was selected since most trips during peak periods would tend to be commuter-generated.

Using this methodology, employee commuters generate 225 (270/1.2) outbound and 46 inbound trips (225/0.83)-225).

Following the discussion provided for the AM peak hour, the additional trips generated during the PM peak hour for non-commuter activities are expected to be minimal and accounted for in the conservative methodology used to calculate commuter trips.

Table 3 summarizes the forecast AM and PM peak hour trip generation for the project construction activities.

Table 3 - Peak Hour Construction-Related Trip Generation Forecast

Generator	AM Peak Hour		PM Peak Hour	
	Inbound	Outbound	Inbound	Outbound
Construction Activities	113	15	46	225

Daily Trip Generation

Daily trips include trips made during the day by employees in the performance of the construction effort including lunch-hour and other mid-day trips and those made by construction trucks for delivery of equipment and goods to the construction site.

Truck Trips

During peak construction periods, the project is expected to generate 25 two-way daily truck trips. Assuming all trucks were of the larger type (articulated, double-unit), a Passenger Car Equivalent (PCE) factor of 3.0 was used to calculate the daily truck trip passenger car equivalent as shown below:

25 truck trips x 2 (to account for in and out trips) x 3.0 = 150 daily PCE trips.

Employee Midday Trips (Lunch)

Construction workers tend to bring lunches to work and remain on site. However, it would be expected that some employees would leave the site for lunch. Assuming 20% of the employees leave and then return to the site for lunch, employee midday trips would be as shown below:

20% of 270 employees x 2 trips (inbound/outbound) = 108 trips.

Total Daily Trips

The total number of forecast daily trips is summarized in Table 4 below and includes the conversion of truck trips to Passenger Car Equivalent (PCE) trips:

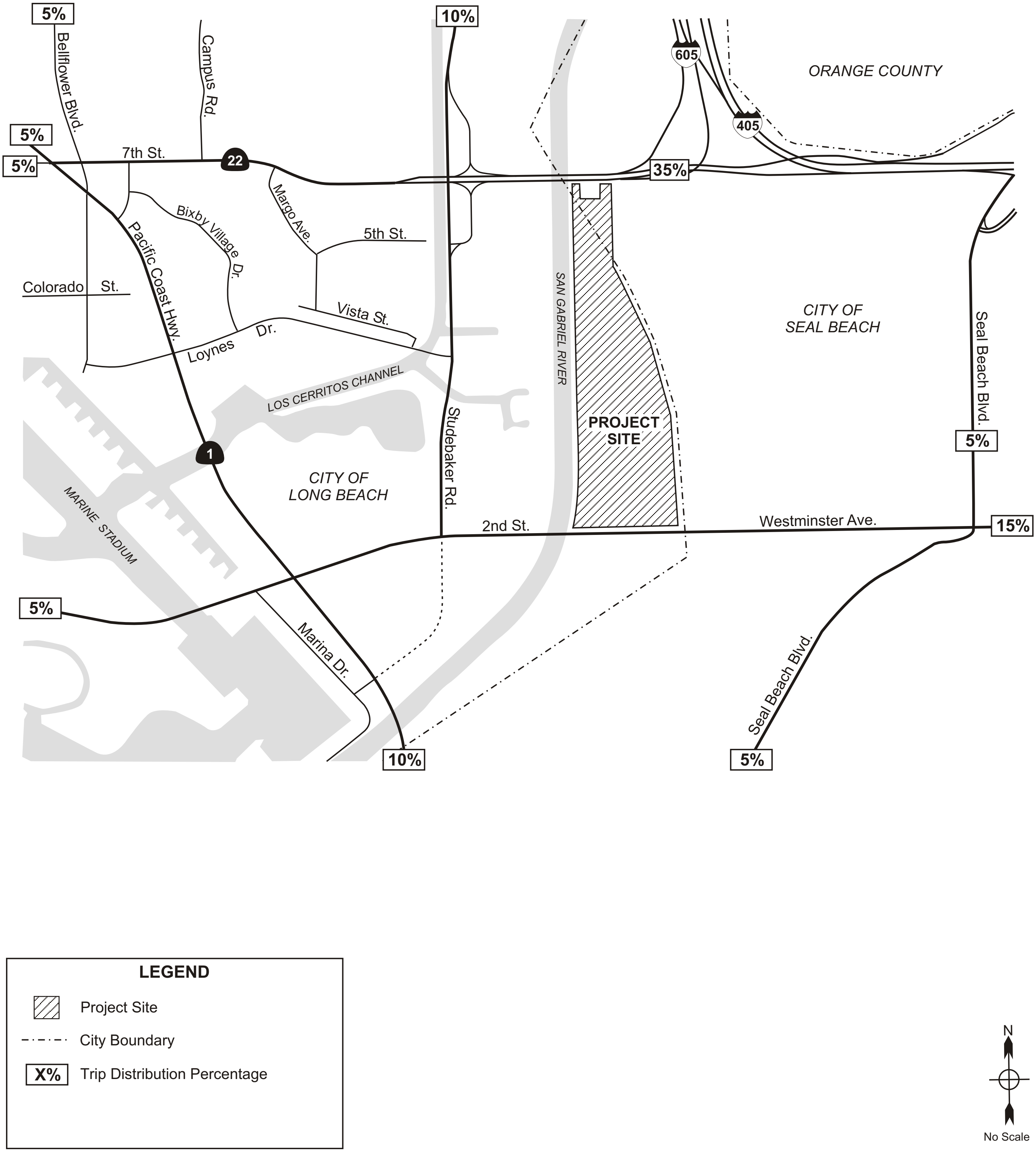
Table 4 - Forecast Daily Trips (One Shift)

Trip Type	Trips
AM Peak Hour Trips	128
PM Peak Hour Trips	271
Truck Trips (PCE)	150
Employee Midday Trips (Lunch)	108
Total Daily Trips	**657**

Project Trip Distribution

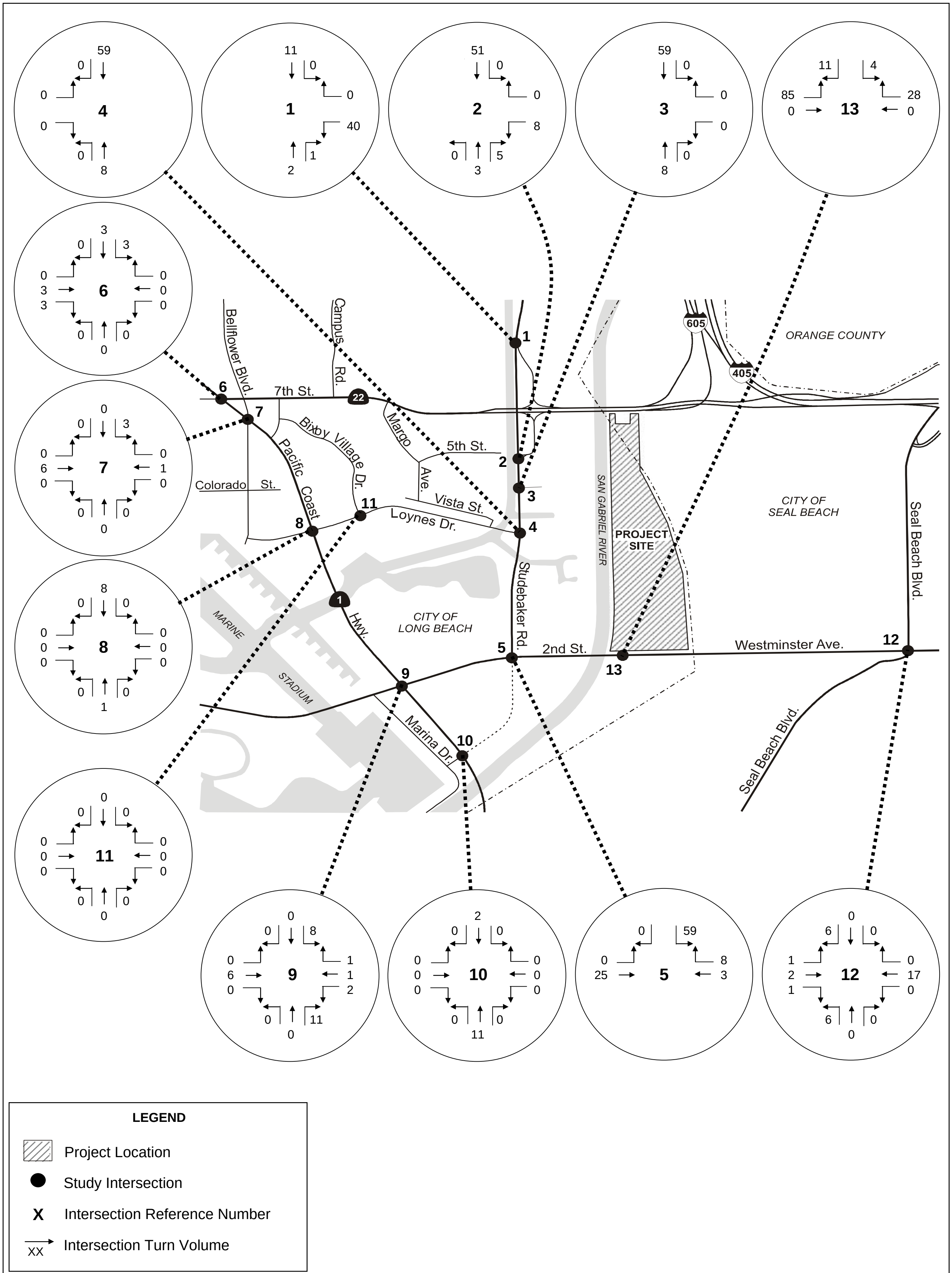
Since the project is the actual construction of improvements to the Haynes Generating Station, it is assumed that the pool of employees working at the site and the deliveries made to the site would utilize the regional freeway network. Construction employees, unlike office employees, would not generally live near the site. Since the entrance to the site is currently signalized, construction traffic will be able to make direct turning movements to and from the east or west.

KOA Corporation developed the project trip distribution illustrated in Figure 8. The trip distribution was based on travel patterns observed during the peak-hour counts and local area knowledge. Figures 9 and 10 show the project-related trips for the AM and PM peak hours of the adjacent streets, respectively.



KOA CORPORATION
PLANNING & ENGINEERING

Haynes Generating Station SCGS Project	Figure 8
	Construction Project Trip Distribution

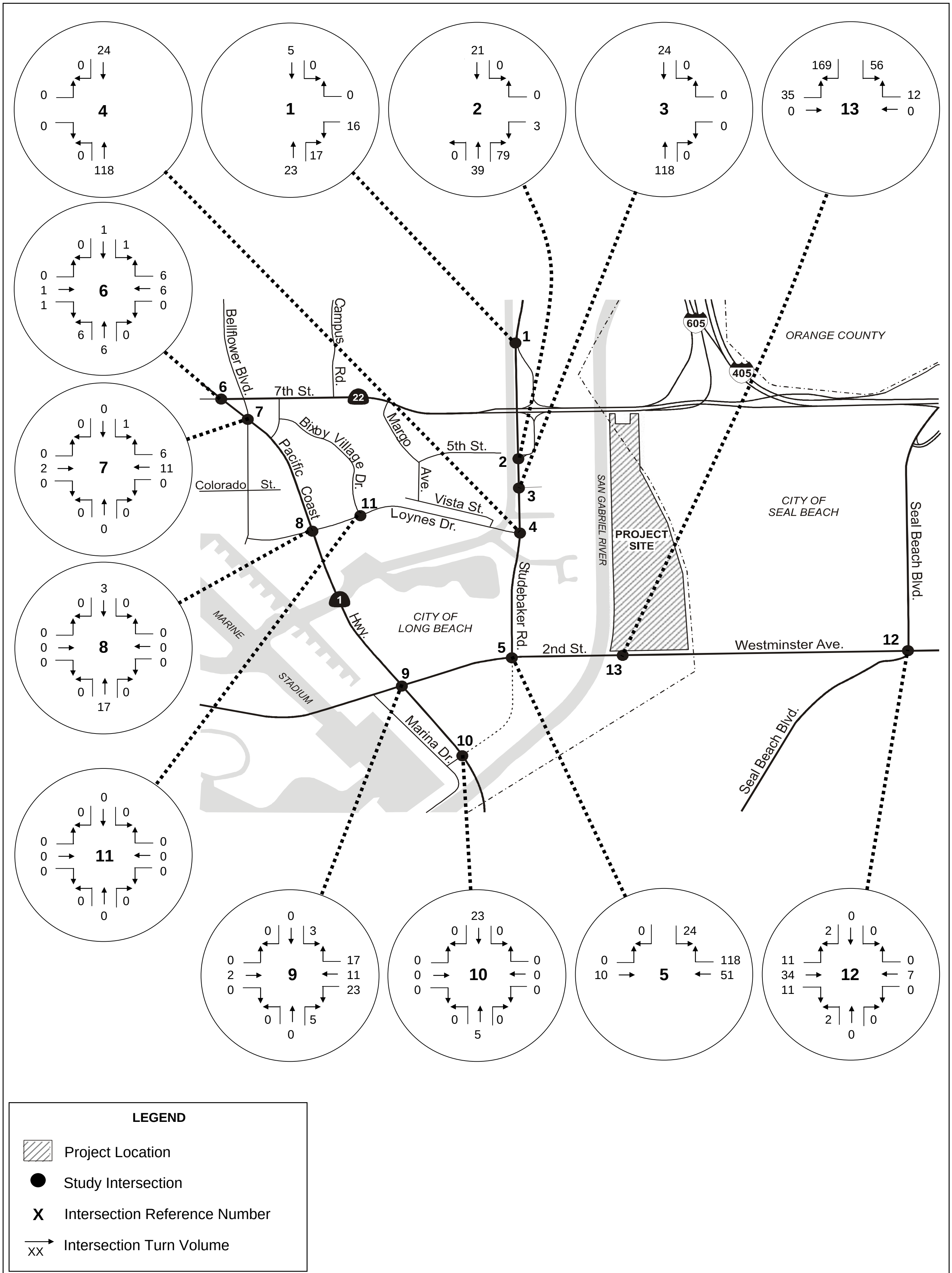


KOA CORPORATION PLANNING & ENGINEERING

Haynes Generating Station SCGS Project

Figure 9

AM Peak Hour Project Volumes



KOA CORPORATION
PLANNING & ENGINEERING

Haynes Generating Station SCGS Project

Figure 10

PM Peak Hour Project Volumes

6. Year 2012 "With Project Construction" Conditions

The Year 2012 "With Project Construction" traffic volumes were derived by adding the project trips to the Year 2012 "No Project" Condition traffic volumes defined within Section 4 of this report. Figures 11 and 12 illustrate the resulting peak-hour volumes.

Peak Hour Intersection Level of Service

Table 5 summarizes the results of the level of service analysis for the future conditions with the project.

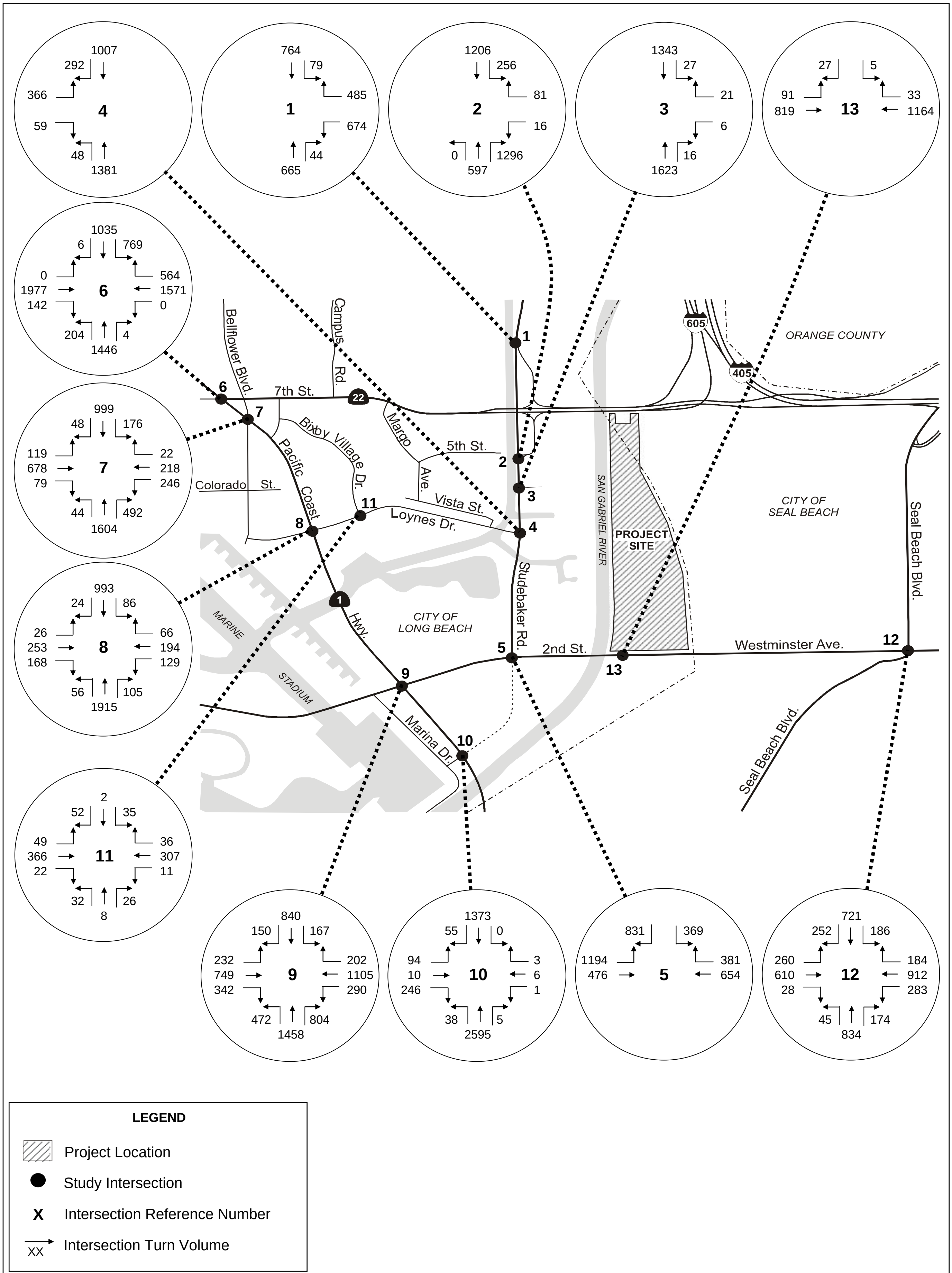
Table 5 – Level-of-Service Calculation for Year 2012 "With Project Construction" Conditions

	Intersections	Weekday AM Peak		Weekday PM Peak	
		V/C	LOS	V/C	LOS
1.	Studebaker Road & SR-22 Westbound Ramps*	0.618	B	0.955	E
2.	Studebaker Road & SR-22 Eastbound Ramps*	0.532	A	0.862	D
3.	Studebaker Road & AES Plant Driveway	0.687	B	0.798	C
4.	Studebaker Road & Loynes Drive	0.709	C	0.771	C
5.	Studebaker Road & 2nd Street	1.029	F	1.157	F
6.	PCH & 7th Street*+	1.210	F	1.182	F
7.	PCH & Bellflower Boulevard*	0.891	D	0.808	D
8.	PC & /Loynes Drive*	0.837	D	0.891	D
9.	PCH & 2nd Street*+	1.097	F	1.087	F
10.	PCH & Studebaker Road*	0.858	D	1.128	F
11.	Bixby Village Drive & Loynes Drive	0.300	A	0.391	A
12.	Seal Beach Boulevard & Westminster Avenue	0.701	C	0.777	C
13.	2nd Street & Project Entrance	0.598	A	0.756	C

** State (Caltrans) Facility*
+ CMP Monitoring Intersection

The addition of project traffic further degrades the levels of service at the study intersections identified to operate at poor levels of service for future Year 2012 "no project" conditions (the Studebaker Road/2nd Street, PCH/7th Street and PCH/2nd Street intersections during both the AM and PM peak hours and the PCH/Studebaker Road and Studebaker Road/SR-22 Westbound Ramps intersections during the PM peak hour). The addition of project construction traffic does not result in any intersections changing during one or both peak hours from good levels of service (LOS A, B, C and D) to poor levels of service (LOS E and F).

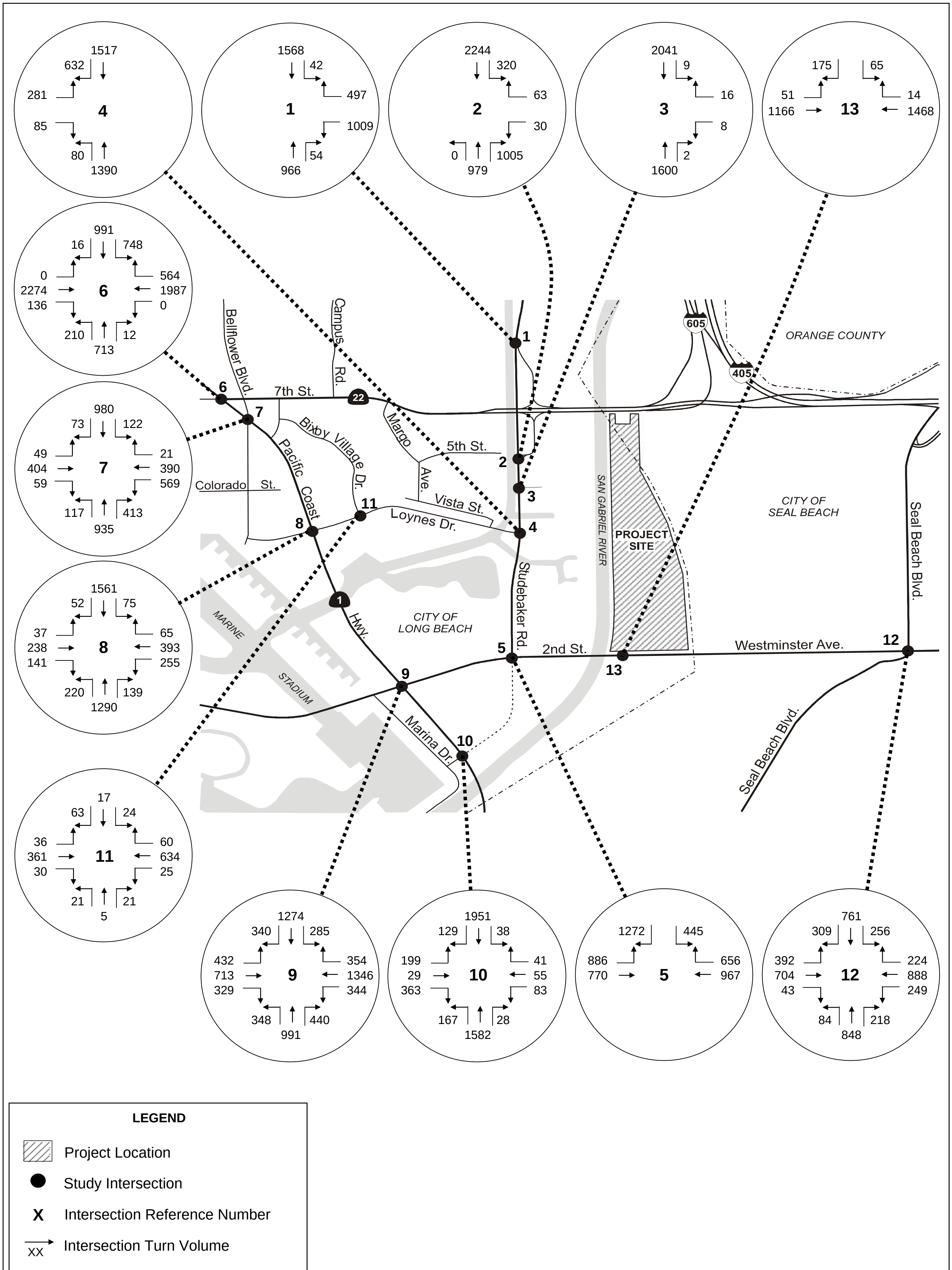
The level of service calculations are provided in Appendix E.



KOA CORPORATION
PLANNING & ENGINEERING

Haynes Generating Station SCGS Project — Figure 11

Year 2012 "With Project Construction" AM Peak Hour Traffic Volumes



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Haynes Generating Station SCGS Project | Figure 12

Year 2012 "With Project Construction" PM Peak Hour Traffic Volumes

Significant Impact Guidelines

Based on City of Long Beach guidelines, an intersection is generally considered impacted when the resulting level of service (LOS) is "E" or "F" and project generated traffic caused the volume to capacity (V/C) ratio to increase by 0.020 or higher, or the project traffic causes the intersection to deteriorate from LOS D to LOS E or F. An impact may also be significant where specific traffic safety issues have been identified.

At the intersection of Seal Beach Boulevard and Westminster Avenue, which is located within the City of Seal Beach and the County of Orange, CMP impact standards for the County of Orange were applied (a V/C ratio increase of 0.030 or more).

Table 6 displays a comparison of the study scenarios. Traffic impacts created by the project can be calculated by comparing the "Year 2012 No Project" conditions to the "Year 2012 With Project Construction" conditions.

Table 6 - AM/PM Peak Hour Significant Traffic Impact Determination

ID#	Intersection	Existing (2008) Conditions		Future (2012) Pre-Project Conditions		Future (2012) Post-Project Conditions		Diff vs. Pre-Proj.	Signif?
Weekday AM Peak Hour Intersection Conditions									
		V/C	LOS	V/C	LOS	V/C	LOS		
1	Studebaker Road & SR-22 Westbound Ramps*	0.571	A	0.605	B	0.618	B	0.013	No
2	Studebaker Road & SR-22 Eastbound Ramps*	0.486	A	0.513	A	0.532	A	0.019	No
3	Studebaker Road & AES Plant Driveway	0.645	B	0.684	B	0.687	B	0.003	No
4	Studebaker Road & Loynes Drive	0.665	B	0.706	C	0.709	C	0.003	No
5	Studebaker Road & 2nd Street	0.963	E	1.028	F	1.029	F	0.001	No
6	PCH & 7th Street*+	1.131	F	1.209	F	1.210	F	0.001	No
7	PCH & Bellflower Boulevard*	0.833	D	0.888	D	0.891	D	0.003	No
8	PC & /Loynes Drive*	0.786	C	0.836	D	0.837	D	0.001	No
9	PCH & 2nd Street*+	1.018	F	1.085	F	1.097	F	0.012	No
10	PCH & Studebaker Road*	0.805	D	0.855	D	0.858	D	0.003	No
11	Bixby Village Drive & Loynes Drive	0.285	A	0.300	A	0.300	A	0.000	No
12	Seal Beach Boulevard & Westminster Avenue	0.648	B	0.696	B	0.701	C	0.005	No
13	2nd Street & Project Entrance	0.502	A	0.530	A	0.598	A	0.068	No
Weekday PM Peak Hour Intersection Conditions									
ID#	Intersection	Existing (2008) Conditions		Future (2012) Pre-Project Conditions		Future (2012) Post-Project Conditions		Diff vs. Pre-Proj.	Signif?
		V/C	LOS	V/C	LOS	V/C	LOS		
1	Studebaker Road & SR-22 Westbound Ramps*	0.889	D	0.949	E	0.955	E	0.006	No
2	Studebaker Road & SR-22 Eastbound Ramps*	0.802	D	0.854	D	0.862	D	0.008	No
3	Studebaker Road & AES Plant Driveway	0.743	C	0.791	C	0.798	C	0.007	No
4	Studebaker Road & Loynes Drive	0.718	C	0.764	C	0.771	C	0.007	No
5	Studebaker Road & 2nd Street	1.068	F	1.141	F	1.157	F	0.016	No
6	PCH & 7th Street*+	1.102	F	1.178	F	1.182	F	0.004	No
7	PCH & Bellflower Boulevard*	0.758	C	0.807	D	0.808	D	0.001	No
8	PC & /Loynes Drive*	0.835	D	0.890	D	0.891	D	0.001	No
9	PCH & 2nd Street*+	1.015	F	1.081	F	1.087	F	0.006	No
10	PCH & Studebaker Road*	1.052	F	1.121	F	1.128	F	0.007	No
11	Bixby Village Drive & Loynes Drive	0.370	A	0.391	A	0.391	A	0.000	No
12	Seal Beach Boulevard & Westminster Avenue	0.718	C	0.771	C	0.777	C	0.006	No
13	2nd Street & Project Entrance	0.591	A	0.626	B	0.756	C	0.130	No

** State (Caltrans) Facility*
+ CMP Monitoring Intersection

As shown in Table 6, the project will not create any significant impacts during the AM and PM peak hours. At the study intersection within the City of Seal Beach, Seal Beach Boulevard at Westminster Avenue, the project construction was determined to not have an impact based on County of Orange CMP criteria.

7. Congestion Management Plan Conformance

This section briefly demonstrates the ways in which this traffic study was prepared to be in conformance with the procedures mandated by the Congestion Management Programs of the County of Los Angeles and County of Orange.

The Congestion Management Program (CMP) was created statewide because of Proposition 111 and has been implemented locally by the Los Angeles County Metropolitan Transportation Authority (LACMTA) and the OCTA.

County of Los Angeles Congestion Management Program Conformance

The CMP for Los Angeles County requires that the traffic impact of individual development projects of potentially regional significance be analyzed. A specific system of arterial roadways plus all freeways comprises the CMP system. Approximately160 intersections are identified for monitoring on the system. This section describes the project-related analysis of the CMP system. The analysis has been conducted according to the guidelines set forth in the 1997 CMP for Los Angeles County. Per CMP Transportation Impact Analysis (TIA) Guidelines, a traffic impact analysis is conducted where:

- At CMP arterial monitoring intersections, including freeway on- or off-ramps, where the proposed project will add 50 or more trips during either AM or PM weekday peak hours.

- At CMP mainline freeway-monitoring locations, where the project will add 150 or more trips, in either direction, during the either the AM or PM weekday peak hours.

The intersection of Pacific Coast Highway and 2nd Streets and 7th Streets are CMP intersections. It is anticipated that the project will add less than 50 peak hour trips to both the Pacific Coast Highway/7th street intersection and the Pacific Coast Highway/2nd Street intersection.

There are no Los Angeles County freeway monitoring locations in the project vicinity.

County of Orange Congestion Management Program Conformance

The Orange County CMP States the following:

> *The TIA process recommendation is to require a TIA for any project generating 2,400 or more daily trips. This number is based on the desire to analyze any impacts which will be 3% or more of the existing capacity. Since most CMP Highway System will be four lanes or more, the capacity used to derive the threshold is a generalized capacity of 40,000 vehicles/day. The calculations are as follows:*
>
> *40,000 veh./day x 3% = 1,200 veh./day*
> *Assuming 50/50 distribution of project traffic on a CMP link*
> *1,200 x 2 = 2,400 veh./day total generation*
>
> *As can be seen, a project which will generate 2,400 trips/day will have an expected maximum link impact on the CMP system of 1,200 trips/day based on a reasonably balanced distribution of project*

> *traffic. On a peak-hour basis, the 3% level of impact would be 120 peak-hour trips. For intersections, a 3% level of impact applied to the sum of critical volume (1,700 veh./hr.) would be 51 vehicles per hour.*

The OCTA CMP also states that the following projects are exempt from CMP Traffic Impact Analysis:

> *Any development application generating vehicular trips below the Average Daily Trip (ADT) threshold for CMP Traffic Impact Analysis, specifically, any project generating less than 2,400 ADT total, or any project generating less than 1,600 ADT directly onto the CMPHS.*

There are no CMP intersections within the City of Seal Beach. The project will add 33 AM and 78 PM peak hour trips at the Seal Beach Boulevard/Westminster Avenue intersection during peak construction periods. Adjusted as a sum of the critical intersection volumes, these volumes would fall below the significant impact threshold.

Due to the project's forecast peak daily trip generation forecast, the project is exempt from further analysis that the County of Orange CMP would otherwise require for roadway segments or freeway segments.

8. Conclusions

The HnGS facility is located at 6801 East 2nd Street, within the City of Long Beach. The construction of the project is scheduled to begin in the second quarter of 2010 and would be completed by the end of June 2012. The duration of construction activities would span a 26-month timeframe. During the construction period, the facility would generate 657 daily trips, including 128 trips during the a.m. peak hour and 271 trips during the p.m. peak hour.

Based on the City of Long Beach and Orange County CMP significant impact criteria, the project will not create significant traffic impacts at any of the study intersections.

The project is not expected to generate increases in vehicle trips once project construction is completed. The project is therefore not expected to have long-term traffic impacts.

APPENDIX A
Level-of-Service Definitions

DEFINITIONS OF LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS

LEVEL OF SERVICE DEFINITIONS FOR SIGNALIZED INTERSECTIONS
(Source: County of Los Angeles Traffic Studies Policies and Procedures, November 1993)

Level of Service	Volume/Capacity Ratio	Definition
A	0.000 - 0.600	EXCELLENT. No vehicle waits longer than one Red light and no approach phase is fully used.
B	0.601 - 0.700	VERY GOOD. An occasional approach phase is fully utilized; many drivers begin to feel somewhat restricted within groups of vehicles.
C	0.701 – 0.800	GOOD. Occasionally, drivers may have to wait through more than one red light; backups may develop behind turning vehicles.
D	0.801 – 0.900	FAIR. Delays may be substantial during portions of the rush hours, but enough lower volume periods occur to permit clearing of developing lines, preventing excessive backups.
E	0.900 – 1.00	POOR. Represents the most vehicles that intersection approaches can accommodate; may be long lines of waiting vehicles through several signal cycles.
F	Greater than 1.000	FAILURE. Backups from nearby intersections or on cross streets may restrict or prevent movement of vehicles out of the intersection approaches. Tremendous delays with continuously increasing queue lengths.

Consistent with the City of Long Beach requirements for traffic studies, the ICU calculations utilize a lane capacity value of 1,600 vehicles per hour per lane (vphpl), and a dual turn-lane capacity of 2,880 vehicles per hour (VPH). Based on the City's requirements, a clearance adjustment factor (ranging from 0.100 to 0.18) was added to each LOS calculation. The clearance and lost-time factors for the different critical phases are summarized below.

Number of Critical Phases	**Left-turn Phasing Type**	**Clearance and Loss Time Factor**
2	Permissive	0.10
3	Protected-Permissive	0.12
3	Fully Protected	0.15
4	Protected-Permissive	0.14
4	Fully Projected	0.18

APPENDIX B
Traffic Count Data

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET:	Studebaker Rd	DATE:	12/4/2008	LOCATION:	City of Long Beach
E-W STREET:	SR-22 WB Ramps/ Studebaker	DAY:	THURSDAY	PROJECT#	08-2375-007

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	2	1	1	2	0	0	0	0	2	0	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM		143	5	24	289					67		64	592
7:15 AM		138	9	15	209					95		88	554
7:30 AM		131	11	20	230					135		98	625
7:45 AM		184	6	18	205					141		111	665
8:00 AM		155	6	20	115					157		115	568
8:15 AM		144	17	15	147					154		125	602
8:30 AM		153	9	15	135					145		143	600
8:45 AM		138	14	12	141					135		140	580
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	1186	77	139	1471	0	0	0	0	1029	0	884	4786

AM Peak Hr Begins at: 730 AM

PEAK VOLUMES =	0	614	40	73	697	0	0	0	0	587	0	449	2460
PEAK HR. FACTOR:		0.861			0.770			0.000			0.928		0.925

CONTROL: Signal
WR are before the intersection

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd DATE: 12/4/2008 LOCATION: City of Long Beach

E-W STREET: SR-22 WB Ramps/ Studebaker DAY: THURSDAY PROJECT# 08-2375-007

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	2	1	1	2	0	0	0	0	2	0	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM		150	9	7	389					145		114	814
4:15 PM		148	8	8	284					230		128	806
4:30 PM		182	6	10	297					254		125	874
4:45 PM		176	12	11	372					210		130	911
5:00 PM		281	8	8	433					240		114	1084
5:15 PM		234	8	10	345					215		91	903
5:30 PM		203	8	11	297					238		90	847
5:45 PM		145	10	15	331					237		96	834
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	1519	69	80	2748	0	0	0	0	1769	0	888	7073

PM Peak Hr Begins at: 430 PM

PEAK VOLUMES =	0	873	34	39	1447	0	0	0	0	919	0	460	3772
PEAK HR. FACTOR:		0.785			0.842			0.000			0.910		0.870

CONTROL: Signal
WR are before the intersection

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd | DATE: 12/4/2008 | LOCATION: City of Long Beach

E-W STREET: SR-22 EB Ramps | DAY: THURSDAY | PROJECT# 08-2375-008

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	2	1	1	3	0	0	0	0	1	0	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM		141	332	60	203					2		7	745
7:15 AM		123	281	59	253					3		16	735
7:30 AM		132	284	75	300					0		14	805
7:45 AM		154	298	43	313					2		38	848
8:00 AM		139	261	38	239					3		19	699
8:15 AM		136	281	34	287					6		26	770
8:30 AM		134	253	43	260					2		26	718
8:45 AM		126	199	48	263					5		26	667
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL VOLUMES =	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
	0	1085	2189	400	2118	0	0	0	0	23	0	172	5987

AM Peak Hr Begins at: 700 AM

PEAK VOLUMES =	0	550	1195	237	1069	0	0	0	0	7	0	75	3133
PEAK HR. FACTOR:		0.922			0.871			0.000			0.513		0.924

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd　　DATE: 12/4/2008　　LOCATION: City of Long Beach

E-W STREET: SR-22 EB Ramps　　DAY: THURSDAY　　PROJECT# 08-2375-008

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	2	1	1	3	0	0	0	0	1	0	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM		145	200	94	440					0		14	893
4:15 PM		139	228	79	432					6		17	901
4:30 PM		178	210	76	479					5		12	960
4:45 PM		177	186	65	519					4		9	960
5:00 PM		270	235	102	573					4		17	1201
5:15 PM		222	220	80	480					7		22	1031
5:30 PM		201	216	49	486					10		10	972
5:45 PM		141	196	65	503					4		14	923
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	1473	1691	610	3912	0	0	0	0	40	0	115	7841

PM Peak Hr Begins at: 445 PM

PEAK VOLUMES =	0	870	857	296	2058	0	0	0	0	25	0	58	4164
PEAK HR. FACTOR:		0.855			0.872			0.000			0.716		0.867

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd — DATE: 12/4/2008 — LOCATION: City of Long Beach

E-W STREET: AES Plant Dwy — DAY: THURSDAY — PROJECT# 08-2375-009

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	2	1	1	2	0	0	0	0	0	2	0	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM		397	3	4	206					1		0	611
7:15 AM		361	1	6	243					0		4	615
7:30 AM		393	5	9	305					1		5	718
7:45 AM		391	7	7	335					3		8	751
8:00 AM		340	2	5	258					1		4	610
8:15 AM		371	1	4	291					1		2	670
8:30 AM		336	1	4	266					0		1	608
8:45 AM		279	3	4	277					1		3	567
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	2868	23	43	2181	0	0	0	0	8	0	27	5150

AM Peak Hr Begins at: 730 AM

PEAK VOLUMES =	0	1495	15	25	1189	0	0	0	0	6	0	19	2749
PEAK HR. FACTOR:		0.948			0.887			0.000			0.568		0.915

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd   DATE: 12/4/2008   LOCATION: City of Long Beach

E-W STREET: AES Plant Dwy   DAY: THURSDAY   PROJECT# 08-2375-009

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	2	1	1	2	0	0	0	0	0	2	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM		274	0	1	399					0		3	677
4:15 PM		292	0	0	393					2		3	690
4:30 PM		299	0	2	434					2		16	753
4:45 PM		287	0	2	470					1		6	766
5:00 PM		400	1	1	521					3		4	930
5:15 PM		352	0	2	435					1		2	792
5:30 PM		333	1	3	442					2		3	784
5:45 PM		269	1	3	455					1		2	731
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	2506	3	14	3549	0	0	0	0	12	0	39	6123

PM Peak Hr Begins at: 445 PM

PEAK VOLUMES =	0	1372	2	8	1868	0	0	0	0	7	0	15	3272
PEAK HR. FACTOR:		0.857			0.898			0.000			0.786		0.880

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd   DATE: 12/2/2008   LOCATION: City of Long Beach

E-W STREET: Loynes Dr   DAY: TUESDAY   PROJECT# 08-2375-010

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	0	2	1	2	0	2	0	0	0	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	4	299			194	34	64		6				601
7:15 AM	8	370			186	42	73		7				686
7:30 AM	15	299			215	59	86		16				690
7:45 AM	12	288			247	107	86		21				761
8:00 AM	9	314			230	62	94		11				720
8:15 AM	7	290			235	47	75		9				663
8:30 AM	12	306			205	60	80		20				683
8:45 AM	16	198			191	57	40		9				511
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	83	2364	0	0	1703	468	598	0	99	0	0	0	5315

AM Peak Hr Begins at: 715 AM

PEAK VOLUMES =	44	1271	0	0	878	270	339	0	55	0	0	0	2857
PEAK HR. FACTOR:		0.870			0.811			0.921			0.000		0.939

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd | DATE: 12/2/2008 | LOCATION: City of Long Beach

E-W STREET: Loynes Dr | DAY: TUESDAY | PROJECT# 08-2375-010

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	0	2	1	2	0	2	0	0	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	10	197			262	96	53		16				634
4:15 PM	18	200			265	96	56		16				651
4:30 PM	21	258			350	117	86		10				842
4:45 PM	19	297			378	148	70		30				942
5:00 PM	16	338			380	162	73		21				990
5:15 PM	18	285			274	158	31		18				784
5:30 PM	21	182			308	108	76		13				708
5:45 PM	18	225			379	141	98		13				874
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	141	1982	0	0	2596	1026	543	0	137	0	0	0	6425

PM Peak Hr Begins at: 430 PM

PEAK VOLUMES =	74	1178	0	0	1382	585	260	0	79	0	0	0	3558
PEAK HR. FACTOR:		0.884			0.907			0.848			0.000		0.898

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd   DATE: 12/4/2008   LOCATION: City of Long Beach

E-W STREET: 2nd St   DAY: THURSDAY   PROJECT# 08-2375-011

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	2	0	2	2	2	0	0	2	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM				53		113	157	118			146	33	620
7:15 AM				59		117	238	128			169	89	800
7:30 AM				89		128	236	120			177	88	838
7:45 AM				88		190	343	121			169	105	1016
8:00 AM				88		187	298	93			122	76	864
8:15 AM				54		180	201	98			134	86	753
8:30 AM				57		212	264	106			178	78	895
8:45 AM				46		120	191	93			200	55	705
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	0	0	534	0	1247	1928	877	0	0	1295	610	6491

AM Peak Hr Begins at: 745 AM

PEAK VOLUMES =	0	0	0	287	0	769	1106	418	0	0	603	345	3528
PEAK HR. FACTOR:		0.000			0.950			0.821			0.865		0.868

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Studebaker Rd DATE: 12/4/2008 LOCATION: City of Long Beach

E-W STREET: 2nd St DAY: THURSDAY PROJECT# 08-2375-011

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	0	0	2	0	2	2	2	0	0	2	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM				39		168	92	138			148	38	623
4:15 PM				45		223	129	143			175	98	813
4:30 PM				78		271	154	167			140	95	905
4:45 PM				99		288	170	149			186	91	983
5:00 PM				94		312	207	172			204	182	1171
5:15 PM				98		272	216	187			237	118	1128
5:30 PM				99		306	227	196			221	107	1156
5:45 PM				77		294	173	163			151	86	944
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	0	0	0	629	0	2134	1368	1315	0	0	1462	815	7723

PM Peak Hr Begins at: 445 PM

PEAK VOLUMES =	0	0	0	390	0	1178	820	704	0	0	848	498	4438
PEAK HR. FACTOR:		0.000			0.966			0.901			0.872		0.947

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Pacific Coast Hwy DATE: 12/4/2008 LOCATION: City of Long Beach

E-W STREET: 7th St DAY: THURSDAY PROJECT# 08-2375-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	2	3	0	0	3	0	0	2	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	47	324	1	162	158	3		422	32		328	91	1568
7:15 AM	54	342	3	148	150	6		408	21		341	111	1584
7:30 AM	50	338	2	188	247	2		433	38		372	125	1795
7:45 AM	50	374	1	191	271	1		429	28		356	133	1834
8:00 AM	44	333	0	167	270	2		468	31		362	138	1815
8:15 AM	45	294	1	163	168	1		498	32		365	126	1693
8:30 AM	49	284	2	151	180	3		388	20		316	121	1514
8:45 AM	60	305	3	161	162	1		278	34		321	108	1433
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	399	2594	13	1331	1606	19	0	3324	236	0	2761	953	13236

AM Peak Hr Begins at: 730 AM

PEAK VOLUMES =	189	1339	4	709	956	6	0	1828	129	0	1455	522	7137
PEAK HR. FACTOR:		0.901			0.902			0.923			0.989		0.973

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Pacific Coast Hwy   DATE: 12/4/2008   LOCATION: City of Long Beach

E-W STREET: 7th St   DAY: THURSDAY   PROJECT# 08-2375-001

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	2	3	0	0	3	0	0	2	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	60	187	3	167	232	3		378	39		467	121	1657
4:15 PM	48	150	5	163	210	5		516	38		467	134	1736
4:30 PM	38	181	1	187	242	2		525	41		468	148	1833
4:45 PM	48	131	3	152	204	2		512	24		429	110	1615
5:00 PM	55	193	2	190	261	6		552	22		470	125	1876
5:15 PM	45	172	2	153	234	2		508	22		391	95	1624
5:30 PM	45	172	4	143	155	1		458	19		386	119	1502
5:45 PM	60	113	1	155	274	1		598	35		424	126	1787
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	399	1299	21	1310	1812	22	0	4047	240	0	3502	978	13630

PM Peak Hr Begins at: 415 PM

PEAK VOLUMES =	189	655	11	692	917	15	0	2105	125	0	1834	517	7060
PEAK HR. FACTOR:		0.855			0.888			0.971			0.954		0.941

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Pacific Coast Hwy   DATE: 12/4/2008   LOCATION: City of Long Beach

E-W STREET: Bellflower Blvd   DAY: THURSDAY   PROJECT# 08-2375-002

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	1	1	3	0	1	2	1	1	3	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	9	318	84	23	131	9	18	46	14	44	31	5	732
7:15 AM	11	308	76	22	121	7	16	70	15	41	24	4	715
7:30 AM	10	378	95	28	228	12	26	198	19	45	65	6	1110
7:45 AM	8	426	141	56	295	15	35	216	23	52	32	3	1302
8:00 AM	11	366	121	45	245	11	27	121	18	74	68	5	1112
8:15 AM	12	315	99	31	157	6	22	87	13	57	36	6	841
8:30 AM	23	328	108	23	167	9	20	92	11	77	39	5	902
8:45 AM	23	338	114	13	168	11	22	106	8	89	57	4	953
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	107	2777	838	241	1512	80	186	936	121	479	352	38	7667

AM Peak Hr Begins at: 730 AM

PEAK VOLUMES =	41	1485	456	160	925	44	110	622	73	228	201	20	4365
PEAK HR. FACTOR:		0.862			0.771			0.734			0.764		0.838

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET:	Pacific Coast Hwy	DATE:	12/4/2008	LOCATION:	City of Long Beach
E-W STREET:	Bellflower Blvd	DAY:	THURSDAY	PROJECT#	08-2375-002

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	1	1	3	0	1	2	1	1	3	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	30	201	81	15	165	11	9	92	7	94	53	3	761
4:15 PM	21	152	67	23	224	14	9	81	6	83	85	7	772
4:30 PM	24	239	107	22	243	28	13	76	9	119	102	5	987
4:45 PM	22	153	87	20	189	15	7	92	10	112	80	5	792
5:00 PM	24	290	113	33	261	19	10	97	13	151	91	6	1108
5:15 PM	34	168	102	31	178	13	15	102	13	113	94	4	867
5:30 PM	28	179	85	26	238	21	12	77	14	133	92	0	905
5:45 PM	22	229	82	22	230	15	8	96	15	130	74	4	927
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	205	1611	724	192	1728	136	83	713	87	935	671	34	7119

PM Peak Hr Begins at: 500 PM

PEAK VOLUMES =	108	866	382	112	907	68	45	372	55	527	351	14	3807
PEAK HR. FACTOR:		0.794			0.868			0.908			0.899		0.859

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET:	Pacific Coast Hwy	DATE:	12/4/2008	LOCATION:	City of Long Beach
E-W STREET:	Loynes Dr	DAY:	THURSDAY	PROJECT#	08-2375-003

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	3	1	1	2	0	1	2	1	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	7	444	15	4	201	1	8	43	40	17	24	12	816
7:15 AM	18	391	29	10	225	2	6	65	42	28	26	10	852
7:30 AM	22	379	22	13	233	5	8	57	44	22	33	12	850
7:45 AM	12	393	21	17	230	4	4	65	41	25	46	12	870
8:00 AM	17	527	27	26	253	3	6	33	38	32	43	15	1020
8:15 AM	10	448	24	17	214	5	4	58	32	20	31	14	877
8:30 AM	13	404	25	20	215	10	10	78	45	42	60	20	942
8:45 AM	20	426	21	16	230	7	8	26	18	22	52	13	859
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	119	3412	184	123	1801	37	54	425	300	208	315	108	7086

AM Peak Hr Begins at: 745 AM

PEAK VOLUMES =	52	1772	97	80	912	22	24	234	156	119	180	61	3709
PEAK HR. FACTOR:		0.841			0.899			0.778			0.738		0.909

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Pacific Coast Hwy DATE: 12/4/2008 LOCATION: City of Long Beach

E-W STREET: Loynes Dr DAY: THURSDAY PROJECT# 08-2375-003

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	2	0	1	3	1	1	2	0	1	2	1	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	52	313	20	21	255	9	9	41	34	55	47	15	871
4:15 PM	45	287	22	18	249	10	6	32	36	53	52	13	823
4:30 PM	45	307	34	9	397	13	10	40	39	78	58	11	1041
4:45 PM	53	234	32	12	339	16	10	39	40	55	82	16	928
5:00 PM	39	329	30	7	331	15	5	44	36	64	82	12	994
5:15 PM	61	264	34	22	396	14	11	97	27	57	94	17	1094
5:30 PM	68	261	36	25	315	10	9	42	34	53	89	15	957
5:45 PM	36	325	29	15	401	9	9	37	34	62	99	16	1072
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	399	2320	237	129	2683	96	69	372	280	477	603	115	7780

PM Peak Hr Begins at: 500 PM

PEAK VOLUMES =	204	1179	129	69	1443	48	34	220	131	236	364	60	4117
PEAK HR. FACTOR:		0.950			0.903			0.713			0.932		0.941

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Pacific Coast Hwy — DATE: 12/4/2008 — LOCATION: City of Long Beach

E-W STREET: 2nd St — DAY: THURSDAY — PROJECT# 08-2375-004

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	3	0	1	3	0	2	2.5	1.5	1	3	2	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	105	319	220	31	183	27	37	201	83	63	312	50	1631
7:15 AM	110	347	215	40	217	25	34	135	86	86	292	48	1635
7:30 AM	132	356	156	38	201	41	65	164	85	58	200	45	1541
7:45 AM	90	328	143	38	177	46	79	188	63	60	218	43	1473
8:00 AM	115	319	158	54	204	67	63	139	84	74	181	41	1499
8:15 AM	124	289	118	33	193	52	57	113	69	62	166	36	1312
8:30 AM	100	235	134	36	177	42	85	137	77	48	228	53	1352
8:45 AM	67	247	130	33	198	53	67	126	49	98	166	31	1265
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	843	2440	1274	303	1550	353	487	1203	596	549	1763	347	11708

AM Peak Hr Begins at: 700 AM

PEAK VOLUMES =	437	1350	734	147	778	139	215	688	317	267	1022	186	6280
PEAK HR. FACTOR:		0.938			0.943			0.924			0.866		0.960

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Pacific Coast Hwy | DATE: 12/4/2008 | LOCATION: City of Long Beach

E-W STREET: 2nd St | DAY: THURSDAY | PROJECT# 08-2375-004

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	2	3	0	1	3	0	2	2.5	1.5	1	3	2	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	69	177	90	65	280	123	56	191	84	106	311	50	1602
4:15 PM	79	217	95	75	266	119	116	180	114	88	326	74	1749
4:30 PM	61	161	68	54	276	111	93	135	72	76	263	57	1427
4:45 PM	99	234	90	66	293	112	126	157	89	70	332	63	1731
5:00 PM	68	253	115	56	295	68	83	127	48	67	252	80	1512
5:15 PM	77	216	106	67	296	72	91	186	87	73	289	82	1642
5:30 PM	78	215	92	72	296	63	100	188	81	87	363	87	1722
5:45 PM	95	202	105	58	272	97	90	169	90	110	330	78	1696
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL VOLUMES =	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
	626	1675	761	513	2274	765	755	1333	665	677	2466	571	13081

PM Peak Hr Begins at: 445 PM

PEAK VOLUMES =	322	918	403	261	1180	315	400	658	305	297	1236	312	6607
PEAK HR. FACTOR:		0.942			0.932			0.916			0.859		0.954

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Pacific Coast Hwy   DATE: 12/4/2008   LOCATION: City of Long Beach

E-W STREET: Studebaker Rd   DAY: THURSDAY   PROJECT# 08-2375-005

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	1	1	2	1	1.5	0.5	1	0	1	0	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	4	633	2	0	348	4	34	0	51	0	1	0	1077
7:15 AM	9	611	0	0	335	10	17	0	57	0	0	1	1040
7:30 AM	9	589	1	0	290	10	20	3	52	1	2	0	977
7:45 AM	13	560	2	0	296	27	16	6	68	0	3	2	993
8:00 AM	17	486	6	3	320	27	19	3	57	5	1	1	945
8:15 AM	18	502	5	4	338	26	23	3	56	6	1	2	984
8:30 AM	21	556	5	3	318	25	26	3	54	7	1	1	1020
8:45 AM	5	439	4	4	289	19	25	3	41	1	4	3	837
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	96	4376	25	14	2534	148	180	21	436	20	13	10	7873

AM Peak Hr Begins at: 700 AM

PEAK VOLUMES =	35	2393	5	0	1269	51	87	9	228	1	6	3	4087
PEAK HR. FACTOR:		0.952			0.938			0.900			0.500		0.949

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET:	Pacific Coast Hwy	DATE:	12/4/2008	LOCATION:	City of Long Beach
E-W STREET:	Studebaker Rd	DAY:	THURSDAY	PROJECT#	08-2375-005

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	1	1	2	1	1.5	0.5	1	0	1	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	7	200	4	5	270	21	53	10	62	13	20	5	670
4:15 PM	25	290	15	11	365	28	17	9	71	28	21	9	889
4:30 PM	14	284	2	12	418	21	36	8	59	17	17	7	895
4:45 PM	30	408	8	10	480	32	36	12	84	20	10	11	1141
5:00 PM	42	439	8	6	516	36	74	8	110	26	15	11	1291
5:15 PM	33	281	0	10	350	20	26	3	56	10	12	6	807
5:30 PM	50	332	10	9	439	31	48	4	86	21	14	10	1054
5:45 PM	41	382	6	8	385	28	44	6	85	21	10	4	1020
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	242	2616	53	71	3223	217	334	60	613	156	119	63	7767

PM Peak Hr Begins at: 445 PM

PEAK VOLUMES =	155	1460	26	35	1785	119	184	27	336	77	51	38	4293
PEAK HR. FACTOR:		0.839			0.869			0.712			0.798		0.831

CONTROL: Signalized

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Bixby Village Dr — DATE: 12/2/2008 — LOCATION: City of Long Beach

E-W STREET: Loynes Dr — DAY: TUESDAY — PROJECT# 08-2375-006

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	.5	.5	1	1	2	1	1	2	0	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	4	0	2	5	0	10	1	66	0	1	35	8	132
7:15 AM	11	0	5	4	0	11	3	70	0	1	47	2	154
7:30 AM	4	1	3	6	0	11	7	99	2	2	53	4	192
7:45 AM	10	4	5	16	0	14	12	91	5	2	89	8	256
8:00 AM	4	2	4	5	1	5	12	80	7	4	75	5	204
8:15 AM	11	1	7	8	0	16	9	84	5	2	58	12	213
8:30 AM	5	0	8	3	1	13	12	84	3	2	62	8	201
8:45 AM	11	3	1	7	0	14	10	55	8	3	64	6	182
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	60	11	35	54	2	94	66	629	30	17	483	53	1534

AM Peak Hr Begins at: 745 AM

PEAK VOLUMES =	30	7	24	32	2	48	45	339	20	10	284	33	874
PEAK HR. FACTOR:		0.803			0.683			0.935			0.826		0.854

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Bixby Village Dr　　DATE: 12/2/2008　　LOCATION: City of Long Beach

E-W STREET: Loynes Dr　　DAY: TUESDAY　　PROJECT# 08-2375-006

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	.5	.5	1	1	2	1	1	2	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	5	2	6	3	4	20	11	59	12	4	108	6	240
4:15 PM	6	1	2	3	6	15	10	63	13	7	116	8	250
4:30 PM	1	0	5	2	4	9	10	78	10	5	101	12	237
4:45 PM	4	3	1	2	0	16	3	65	5	10	130	10	249
5:00 PM	6	3	2	5	7	21	8	78	5	7	152	13	307
5:15 PM	7	0	4	7	5	14	7	90	5	8	148	11	306
5:30 PM	2	0	9	2	1	9	10	84	10	2	142	18	289
5:45 PM	4	2	4	8	3	14	8	82	8	6	145	14	298
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	35	11	33	32	30	118	67	599	68	49	1042	92	2176

PM Peak Hr Begins at: 500 PM

PEAK VOLUMES =	19	5	19	22	16	58	33	334	28	23	587	56	1200
PEAK HR. FACTOR:		0.977			0.727			0.950			0.968		0.977

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Seal Beach Blvd — DATE: 12/4/2008 — LOCATION: City of Long Beach

E-W STREET: 2nd S/Westminster Ave — DAY: THURSDAY — PROJECT# 08-2375-013

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	2	3	1	2	3	0	2	2	0	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	8	144	16	29	139	42	41	114	5	44	209	35	826
7:15 AM	8	186	32	35	155	48	50	124	8	74	253	49	1022
7:30 AM	13	211	46	52	186	44	67	150	3	67	222	29	1090
7:45 AM	6	182	45	41	158	72	57	178	9	71	216	54	1089
8:00 AM	9	193	38	44	169	64	66	111	5	50	138	38	925
8:15 AM	8	146	19	34	100	42	38	87	3	59	116	35	687
8:30 AM	17	197	46	49	116	49	67	97	4	41	122	29	834
8:45 AM	6	129	36	39	109	39	30	62	3	41	92	27	613
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	75	1388	278	323	1132	400	416	923	40	447	1368	296	7086

AM Peak Hr Begins at: 715 AM

PEAK VOLUMES =	36	772	161	172	668	228	240	563	25	262	829	170	4126
PEAK HR. FACTOR:		0.897			0.947			0.848			0.838		0.946

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Seal Beach Blvd DATE: 12/4/2008 LOCATION: City of Long Beach

E-W STREET: 2nd S/Westminster Ave DAY: THURSDAY PROJECT# 08-2375-013

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	1	3	0	2	3	1	2	3	0	2	2	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	13	161	35	43	168	63	66	116	7	40	134	79	925
4:15 PM	24	183	36	55	179	60	79	107	7	43	144	33	950
4:30 PM	18	187	55	59	158	72	87	141	12	59	170	62	1080
4:45 PM	22	226	46	59	178	74	74	143	8	66	174	47	1117
5:00 PM	20	181	58	59	157	67	100	175	6	41	240	60	1164
5:15 PM	16	191	43	60	212	71	92	161	4	65	232	38	1185
5:30 PM	11	196	40	40	147	78	75	169	4	41	223	44	1068
5:45 PM	13	176	39	35	138	67	69	161	3	39	216	35	991
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	137	1501	352	410	1337	552	642	1173	51	394	1533	398	8480

PM Peak Hr Begins at: 430 PM

PEAK VOLUMES =	76	785	202	237	705	284	353	620	30	231	816	207	4546
PEAK HR. FACTOR:		0.904			0.894			0.892			0.919		0.959

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Driveway DATE: 12/4/2008 LOCATION: City of Long Beach

E-W STREET: 2nd S/Westminster Ave DAY: THURSDAY PROJECT# 08-2375-012

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	1	0	1	1	2	0	0	2	0	
6:00 AM													
6:15 AM													
6:30 AM													
6:45 AM													
7:00 AM	0		0	1		3	1	186	0		126	0	317
7:15 AM	0		0	0		0	2	189	0		289	3	483
7:30 AM	0		1	1		5	1	196	0		278	1	483
7:45 AM	0		0	0		6	1	204	0		289	1	501
8:00 AM	0		0	0		4	2	169	0		222	0	397
8:15 AM	0		0	0		3	6	156	1		246	1	413
8:30 AM	1		0	0		5	6	145	0		262	1	420
8:45 AM	0		0	1		2	3	134	0		187	1	328
9:00 AM													
9:15 AM													
9:30 AM													
9:45 AM													
10:00 AM													
10:15 AM													
10:30 AM													
10:45 AM													
11:00 AM													
11:15 AM													
11:30 AM													
11:45 AM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	1	0	1	3	0	28	22	1379	1	0	1899	8	3342

AM Peak Hr Begins at: 715 AM

PEAK VOLUMES =	0	0	1	1	0	15	6	758	0	0	1078	5	1864
PEAK HR. FACTOR:		0.250			0.667			0.932			0.927		0.930

CONTROL: SIGNALIZED

Intersection Turning Movement

Prepared by:

National Data & Surveying Services

N-S STREET: Driveway DATE: 12/4/2008 LOCATION: City of Long Beach

E-W STREET: 2nd S/Westminster Ave DAY: THURSDAY PROJECT# 08-2375-012

	NORTHBOUND			SOUTHBOUND			EASTBOUND			WESTBOUND			
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
LANES:	0	1	0	1	0	1	1	2	0	0	2	0	
1:00 PM													
1:15 PM													
1:30 PM													
1:45 PM													
2:00 PM													
2:15 PM													
2:30 PM													
2:45 PM													
3:00 PM													
3:15 PM													
3:30 PM													
3:45 PM													
4:00 PM	0			2		2	3	162	0		174	0	343
4:15 PM	0			6		9	1	158	0		172	0	346
4:30 PM	0			2		6	0	248	0		241	0	497
4:45 PM	0			2		0	3	247	0		306	0	558
5:00 PM	2			2		2	3	262	0		390	0	661
5:15 PM	0			3		3	2	294	0		341	2	645
5:30 PM	0			1		1	7	277	0		322	0	608
5:45 PM	0			1		4	7	221	1		272	1	507
6:00 PM													
6:15 PM													
6:30 PM													
6:45 PM													

TOTAL	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL
VOLUMES =	2	0	0	19	0	27	26	1869	1	0	2218	3	4165

PM Peak Hr Begins at: 445 PM

PEAK VOLUMES =	2	0	0	8	0	6	15	1080	0	0	1359	2	2472
PEAK HR. FACTOR:		0.250			0.583			0.925			0.872		0.935

CONTROL: SIGNALIZED

KOA CORPORATION
PLANNING & ENGINEERING

APPENDIX C
Intersection Level-of-Service Worksheets
Year 2008 Existing Conditions

```
Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10              Page 3-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #1 Studebaker Road / SR-22 WB Ramps
********************************************************************************
Cycle (sec):          100              Critical Vol./Cap.(X):        0.571
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:         47              Level Of Service:                 A
********************************************************************************
Street Name:         Studebaker Road                     SR-22 WB Ramps
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:         Permitted        Protected        Protected        Protected
Rights:           Ignore           Include          Include           Ignore
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   1  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0  614    40    73  697     0    0    0     0   587    0   449
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0  614    40    73  697     0    0    0     0   587    0   449
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  614     0    73  697     0    0    0     0   587    0     0
Reduct Vol:     0    0     0     0    0     0    0    0     0     0    0     0
Reduced Vol:    0  614     0    73  697     0    0    0     0   587    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  614     0    73  697     0    0    0     0   587    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  0.00
Final Sat.:     0 3200  1600  1600 3200     0    0    0     0  3200    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.19  0.00  0.05 0.22  0.00  0.00 0.00  0.00  0.18 0.00  0.00
Crit Moves:       ****        ****                                ****
********************************************************************************
```

```
Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10              Page 4-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #2 Studebaker Road / SR-22 EB Ramps
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.486
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        55                Level Of Service:                 A
********************************************************************************
Street Name:         Studebaker Road                     SR-22 EB Ramps
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected       Split Phase      Split Phase
Rights:           Ignore          Include          Include          Ignore
Min. Green:     0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    2  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0  550  1195   237 1069    0     0    0    0     7    0    75
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0  550  1195   237 1069    0     0    0    0     7    0    75
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  550     0   237 1069    0     0    0    0     7    0     0
Reduct Vol:     0    0     0     0    0    0     0    0    0     0    0     0
Reduced Vol:    0  550     0   237 1069    0     0    0    0     7    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  550     0   237 1069    0     0    0    0     7    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  2880    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.17  0.00  0.15 0.33  0.00  0.00 0.00  0.00  0.00 0.00  0.00
Crit Moves:                        ****                          ****
********************************************************************************
```

```
Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10                Page 5-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                         Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #3 Studebaker Road / AES Plant Driveway
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):         0.645
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         53                 Level Of Service:                  B
********************************************************************************
Street Name:          Studebaker Road                  AES Plant Driveway
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:          Permitted        Permitted      Split Phase      Split Phase
Rights:            Include          Include          Include          Include
Min. Green:     0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0 1495   15    25 1189    0     0    0    0     6    0   19
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0 1495   15    25 1189    0     0    0    0     6    0   19
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0 1495   15    25 1189    0     0    0    0     6    0   19
Reduct Vol:     0    0    0     0    0    0     0    0    0     0    0    0
Reduced Vol:    0 1495   15    25 1189    0     0    0    0     6    0   19
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0 1495   15    25 1189    0     0    0    0     6    0   19
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  1.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  1600    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.47  0.01  0.02 0.37  0.00  0.00 0.00  0.00  0.00 0.00  0.01
Crit Moves:       ****        ****                                          ****
********************************************************************************
```

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Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10               Page 6-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #4 Studebaker Road / Loynes Drive
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.665
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        56                Level Of Service:                  B
********************************************************************************
Street Name:         Studebaker Road                     Loynes Drive
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted       Split Phase      Split Phase
Rights:          Include          Include          Include          Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  2  0  0    0  0  2  0  1    2  0  0  0  2    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 2 Dec 2008 <<
Base Vol:      44 1271     0     0  878   270   339    0    55     0    0     0
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   44 1271     0     0  878   270   339    0    55     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    44 1271     0     0  878   270   339    0    55     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   44 1271     0     0  878   270   339    0    55     0    0     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   44 1271     0     0  878   270   339    0    55     0    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.00  0.00  0.00 2.00  1.00  2.00 0.00  2.00  0.00 0.00  0.00
Final Sat.:  1600 3200     0     0 3200  1600  2880    0  3200     0    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.40  0.00  0.00 0.27  0.17  0.12 0.00  0.02  0.00 0.00  0.00
Crit Moves:       ****        ****             ****
********************************************************************************
```

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Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10               Page 7-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                         Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #5 Studebaker Road / 2nd Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.963
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       144                Level Of Service:                 E
********************************************************************************
Street Name:         Studebaker Road                      2nd Street
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected         Permitted
Rights:           Include           Ovl            Include           Ovl
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  0  0  0   2  0  0  0  2   2  0  2  0  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0    0     0   287    0   769  1106  418     0     0  603   345
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0    0     0   287    0   769  1106  418     0     0  603   345
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0    0     0   287    0   769  1106  418     0     0  603   345
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0    0     0   287    0   769  1106  418     0     0  603   345
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0    0     0   287    0   769  1106  418     0     0  603   345
OvlAdjVol:                                                                  186
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  2.00 0.00  2.00  2.00 2.00  0.00  0.00 2.00  1.00
Final Sat.:     0    0     0  2880    0  3200  2880 3200     0     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.10 0.00  0.24  0.38 0.13  0.00  0.00 0.19  0.22
OvlAdjV/S:                                                                 0.12
Crit Moves:                              ****  ****                   ****
********************************************************************************
```

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Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10               Page 8-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                         Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #6 PCH / 7th Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        1.131
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       180                Level Of Service:                 F
********************************************************************************
Street Name:                 PCH                           7th Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Permitted        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0   2  0  2  1  0   0  0  2  1  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     189 1339     4   709  956     6     0 1828   129     0 1455   522
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:  189 1339     4   709  956     6     0 1828   129     0 1455   522
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   189 1339     4   709  956     6     0 1828   129     0 1455   522
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  189 1339     4   709  956     6     0 1828   129     0 1455   522
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  189 1339     4   709  956     6     0 1828   129     0 1455   522
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.99  0.01  2.00 2.98  0.02  0.00 2.80  0.20  0.00 2.00  1.00
Final Sat.:  1600 4786    14  2880 4770    30     0 4484   316     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.12 0.28  0.28  0.25 0.20  0.20  0.00 0.41  0.41  0.00 0.45  0.33
Crit Moves:       ****        ****              ****                   ****
********************************************************************************
```

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Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10                Page 9-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #7 PCH / Bellflower Boulevard
********************************************************************************
Cycle (sec):         100               Critical Vol./Cap.(X):         0.833
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        85               Level Of Service:                  D
********************************************************************************
Street Name:                  PCH                       Bellflower Boulevard
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:         Permitted        Permitted      Split Phase      Split Phase
Rights:           Include          Include         Include          Ignore
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  3  0  1   1  0  2  1  0   1  0  2  0  1   1  1  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      41 1485   456   160  925    44   110  622    73   228  201    20
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   41 1485   456   160  925    44   110  622    73   228  201    20
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:    41 1485   456   160  925    44   110  622    73   228  201     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   41 1485   456   160  925    44   110  622    73   228  201     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:   41 1485   456   160  925    44   110  622    73   228  201     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.86  0.14  1.00 2.00  1.00  2.00 2.00  1.00
Final Sat.:  1600 4800  1600  1600 4582   218  1600 3200  1600  2880 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.31  0.28  0.10 0.20  0.20  0.07 0.19  0.05  0.08 0.06  0.00
Crit Moves:       ****        ****                   ****        ****
********************************************************************************
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--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #8 PCH / Loynes Drive
********************************************************************************
Cycle (sec):          100                Critical Vol./Cap.(X):         0.786
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         74                Level Of Service:                  C
********************************************************************************
Street Name:                  PCH                            Loynes Drive
Approach:      North Bound      South Bound       East Bound        West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted         Permitted
Rights:           Include          Include           Include           Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  2  1  0    1  0  3  0  1    1  0  1  1  0    1  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      52 1772    97    80  912    22    24  234   156   119  180    61
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   52 1772    97    80  912    22    24  234   156   119  180    61
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    52 1772    97    80  912    22    24  234   156   119  180    61
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   52 1772    97    80  912    22    24  234   156   119  180    61
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   52 1772    97    80  912    22    24  234   156   119  180    61
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.84  0.16  1.00 3.00  1.00  1.00 1.20  0.80  1.00 2.00  1.00
Final Sat.:  1600 4551   249  1600 4800  1600  1600 1920  1280  1600 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.39  0.39  0.05 0.19  0.01  0.02 0.12  0.12  0.07 0.06  0.04
Crit Moves:       ****        ****                   ****        ****
********************************************************************************
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Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10               Page 11-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #9 PCH / 2nd Street
********************************************************************************
Cycle (sec):          100                Critical Vol./Cap.(X):        1.018
Loss Time (sec):       18 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        180                Level Of Service:                 F
********************************************************************************
Street Name:                 PCH                            2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include          Include          Include           Ovl
Min. Green:     0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        2  0  2  1  0   1  0  2  1  0   2  0  2  1  1   2  0  3  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     437 1350   734   147  778   139   215  688   317   267 1022   186
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:  437 1350   734   147  778   139   215  688   317   267 1022   186
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   437 1350   734   147  778   139   215  688   317   267 1022   186
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  437 1350   734   147  778   139   215  688   317   267 1022   186
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  437 1350   734   147  778   139   215  688   317   267 1022   186
OvlAdjVol:                                                                   39
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  0.90 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00
Lanes:       2.00 2.00  1.00  1.00 2.55  0.45  2.00 2.74  1.26  2.00 3.00  1.00
Final Sat.:  2880 3200  1600  1600 4072   728  2880 4381  2019  2880 4800  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.15 0.42  0.46  0.09 0.19  0.19  0.07 0.16  0.16  0.09 0.21  0.12
OvlAdjV/S:                                                                 0.02
Crit Moves:             ****  ****             ****                   ****
********************************************************************************
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Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10                Page 12-1
--------------------------------------------------------------------------------

                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------

                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #10 PCH / Studebaker Road
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.805
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        83                Level Of Service:                  D
********************************************************************************
Street Name:                 PCH                           Studebaker Road
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Split Phase      Split Phase
Rights:           Include          Include            Ovl             Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  3  0  1    1  0  2  0  1    1  1  0  0  1    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      35 2393     5     0 1269    51    87    9   228     1    6     3
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   35 2393     5     0 1269    51    87    9   228     1    6     3
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    35 2393     5     0 1269    51    87    9   228     1    6     3
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   35 2393     5     0 1269    51    87    9   228     1    6     3
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   35 2393     5     0 1269    51    87    9   228     1    6     3
OvlAdjVol:                                                 193
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.00  1.00  1.81 0.19  1.00  0.10 0.60  0.30
Final Sat.:  1600 4800  1600  1600 3200  1600  2900  300  1600   160  960   480
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.02 0.50  0.00  0.00 0.40  0.03  0.03 0.03  0.14  0.01 0.01  0.01
OvlAdjV/S:                                                0.12
Crit Moves:       ****        ****                        ****        ****
********************************************************************************
```

```
Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10              Page 13-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #11 Bixby Village Road / Loynes Drive
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):        0.285
Loss Time (sec):       10 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         25                 Level Of Service:                 A
********************************************************************************
Street Name:         Bixby Village Road                 Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted        Permitted        Permitted
Rights:          Include          Include          Include          Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        0  0  1! 0  0   0  1  0  0  1   1  0  2  0  1   1  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 2 Dec 2008 <<
Base Vol:      30    7    24    32    2    48    45  339    20    10  284    33
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   30    7    24    32    2    48    45  339    20    10  284    33
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    30    7    24    32    2    48    45  339    20    10  284    33
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   30    7    24    32    2    48    45  339    20    10  284    33
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   30    7    24    32    2    48    45  339    20    10  284    33
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.50 0.11  0.39  0.94 0.06  1.00  1.00 2.00  1.00  1.00 1.79  0.21
Final Sat.:   787  184   630  1506   94  1600  1600 3200  1600  1600 2867   333
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.02 0.04  0.04  0.02 0.02  0.03  0.03 0.11  0.01  0.01 0.10  0.10
Crit Moves:       ****        ****             ****                   ****
********************************************************************************
```

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Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10             Page 14-1
--------------------------------------------------------------------------------
                          Haynes Power Station EIR
                       Existing Conditions (Year 2008)
                                AM Peak Hour
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #12 Seal Beach Blvd. / Westminster Ave
********************************************************************************
Cycle (sec):          100              Critical Vol./Cap.(X):         0.648
Loss Time (sec):        5 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         32              Level Of Service:                  B
********************************************************************************
Street Name:          Seal Beach Blvd.                  Westminster Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include           Ovl            Ignore           Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0   2  0  3  0  1   2  0  3  0  1   2  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      36  772   161   172  668   228   240  563    25   262  829   170
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   36  772   161   172  668   228   240  563    25   262  829   170
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Volume:    36  772   161   172  668   228   240  563     0   262  829   170
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   36  772   161   172  668   228   240  563     0   262  829   170
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
FinalVolume:   36  772   161   172  668   228   240  563     0   262  829   170
OvlAdjVol:                                108
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06
Lanes:       1.00 2.48  0.52  2.00 3.00  1.00  2.00 3.00  1.00  2.00 1.66  0.34
Final Sat.:  1700 4220   880  3400 5100  1700  3400 5100  1700  3400 2821   579
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.02 0.18  0.18  0.05 0.13  0.13  0.07 0.11  0.00  0.08 0.29  0.29
OvlAdjV/S:                                0.06
Crit Moves:       ****        ****              ****                 ****
********************************************************************************
```

```
Existing AM (Year 2008)    Tue Jan 6, 2009 11:39:10                Page 15-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #13 2nd Street / Project Entrance
********************************************************************************
Cycle (sec):         100               Critical Vol./Cap.(X):         0.502
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        42               Level Of Service:                  A
********************************************************************************
Street Name:              2nd Street                   Project Entrance
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected         Permitted
Rights:           Include          Include          Include          Include
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  0  0  0    1  0  0  0  1    1  0  2  0  0    0  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      0    0     0     1    0    15     6  758     0     0 1078     5
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   0    0     0     1    0    15     6  758     0     0 1078     5
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    0    0     0     1    0    15     6  758     0     0 1078     5
Reduct Vol:    0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   0    0     0     1    0    15     6  758     0     0 1078     5
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   0    0     0     1    0    15     6  758     0     0 1078     5
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  1.00 0.00  1.00  1.00 2.00  0.00  0.00 1.99  0.01
Final Sat.:    0    0     0  1600    0  1600  1600 3200     0     0 3185    15
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.00 0.00  0.01  0.00 0.24  0.00  0.00 0.34  0.34
Crit Moves:                              ****  ****                  ****
********************************************************************************
```

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Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45                 Page 3-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                       Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #1 Studebaker Road / SR-22 WB Ramps
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):         0.889
Loss Time (sec):       15 (Y+R=4.0 sec)   Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        180                 Level Of Service:                  D
********************************************************************************
Street Name:          Studebaker Road                    SR-22 WB Ramps
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:         Permitted       Protected         Protected         Protected
Rights:           Ignore          Include           Include           Ignore
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    1  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0  873    34    39 1447     0     0    0     0   919    0   460
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0  873    34    39 1447     0     0    0     0   919    0   460
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  873     0    39 1447     0     0    0     0   919    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0  873     0    39 1447     0     0    0     0   919    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  873     0    39 1447     0     0    0     0   919    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  0.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  3200    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.27  0.00  0.02 0.45  0.00  0.00 0.00  0.00  0.29 0.00  0.00
Crit Moves:                        ****                          ****
********************************************************************************
```

```
Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45               Page 4-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #2 Studebaker Road / SR-22 EB Ramps
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.802
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                Level Of Service:                  D
********************************************************************************
Street Name:         Studebaker Road                    SR-22 EB Ramps
Approach:      North Bound      South Bound       East Bound        West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted       Protected       Split Phase      Split Phase
Rights:          Ignore           Include          Include          Ignore
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   2  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0  870   857   296 2058     0     0    0     0    25    0    58
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0  870   857   296 2058     0     0    0     0    25    0    58
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  870     0   296 2058     0     0    0     0    25    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0  870     0   296 2058     0     0    0     0    25    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  870     0   296 2058     0     0    0     0    25    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  2880    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.27  0.00  0.19 0.64  0.00  0.00 0.00  0.00  0.01 0.00  0.00
Crit Moves:                        ****                         ****
********************************************************************************
```

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Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45                Page 5-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #3 Studebaker Road / AES Plant Driveway
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.743
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        66                Level Of Service:                  C
********************************************************************************
Street Name:         Studebaker Road                  AES Plant Driveway
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:         Permitted        Permitted      Split Phase      Split Phase
Rights:           Include          Include          Include          Include
Min. Green:    0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0 1372    2    8 1868    0    0    0    0    7    0   15
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0 1372    2    8 1868    0    0    0    0    7    0   15
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0 1372    2    8 1868    0    0    0    0    7    0   15
Reduct Vol:     0    0    0    0    0    0    0    0    0    0    0    0
Reduced Vol:    0 1372    2    8 1868    0    0    0    0    7    0   15
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0 1372    2    8 1868    0    0    0    0    7    0   15
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  1.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  1600    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.43  0.00  0.01 0.58  0.00  0.00 0.00  0.00  0.00 0.00  0.01
Crit Moves:  ****                    ****                                   ****
********************************************************************************
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Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45                Page 6-1
-------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
-------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #4 Studebaker Road / Loynes Drive
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.718
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        63                Level Of Service:                 C
********************************************************************************
Street Name:         Studebaker Road                      Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted      Split Phase      Split Phase
Rights:          Include          Include         Include          Include
Min. Green:    0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  2  0  0    0  0  2  0  1    2  0  0  0  2    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      74 1178     0     0 1382   585   260    0    79     0    0     0
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   74 1178     0     0 1382   585   260    0    79     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    74 1178     0     0 1382   585   260    0    79     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   74 1178     0     0 1382   585   260    0    79     0    0     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   74 1178     0     0 1382   585   260    0    79     0    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.00  0.00  0.00 2.00  1.00  2.00 0.00  2.00  0.00 0.00  0.00
Final Sat.:  1600 3200     0     0 3200  1600  2880    0  3200     0    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.05 0.37  0.00  0.00 0.43  0.37  0.09 0.00  0.02  0.00 0.00  0.00
Crit Moves:  ****                  ****        ****
********************************************************************************
```

```
Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45              Page 7-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                       Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #5 Studebaker Road / 2nd Street
********************************************************************************
Cycle (sec):          100                Critical Vol./Cap.(X):         1.068
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        180                Level Of Service:                  F
********************************************************************************
Street Name:          Studebaker Road                      2nd Street
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected        Permitted
Rights:           Include           Ovl             Include           Ovl
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  0  0  0   2  0  0  0  2   2  0  2  0  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      0    0     0   390    0  1178   820  704     0     0  848   498
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   0    0     0   390    0  1178   820  704     0     0  848   498
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    0    0     0   390    0  1178   820  704     0     0  848   498
Reduct Vol:    0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   0    0     0   390    0  1178   820  704     0     0  848   498
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   0    0     0   390    0  1178   820  704     0     0  848   498
OvlAdjVol:                                                                  281
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  2.00 0.00  2.00  2.00 2.00  0.00  0.00 2.00  1.00
Final Sat.:    0    0     0  2880    0  3200  2880 3200     0     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.14 0.00  0.37  0.28 0.22  0.00  0.00 0.27  0.31
OvlAdjV/S:                                                                 0.18
Crit Moves:                               ****  ****                 ****
********************************************************************************
```

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Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45                 Page 8-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #6 PCH / 7th Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         1.102
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                Level Of Service:                  F
********************************************************************************
Street Name:                  PCH                           7th Street
Approach:      North Bound      South Bound       East Bound        West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted         Permitted
Rights:           Include          Include           Include           Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  2  1  0    2  0  2  1  0    0  0  2  1  0    0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     189  655    11   692  917    15     0 2105   125     0 1834   517
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:  189  655    11   692  917    15     0 2105   125     0 1834   517
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   189  655    11   692  917    15     0 2105   125     0 1834   517
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  189  655    11   692  917    15     0 2105   125     0 1834   517
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  189  655    11   692  917    15     0 2105   125     0 1834   517
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.95  0.05  2.00 2.95  0.05  0.00 2.83  0.17  0.00 2.00  1.00
Final Sat.:  1600 4721    79  2880 4723    77     0 4531   269     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.12 0.14  0.14  0.24 0.19  0.19  0.00 0.46  0.46  0.00 0.57  0.32
Crit Moves:       ****        ****             ****                   ****
********************************************************************************
```

```
Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45                Page 9-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #7 PCH / Bellflower Boulevard
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         0.758
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        69                 Level Of Service:                 C
********************************************************************************
Street Name:                 PCH                       Bellflower Boulevard
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:         Permitted        Permitted      Split Phase      Split Phase
Rights:           Include          Include         Include          Ignore
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  3  0  1    1  0  2  1  0    1  0  2  0  1    1  1  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     108  866   382   112  907    68    45  372    55   527  351    14
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:  108  866   382   112  907    68    45  372    55   527  351    14
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:   108  866   382   112  907    68    45  372    55   527  351     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  108  866   382   112  907    68    45  372    55   527  351     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:  108  866   382   112  907    68    45  372    55   527  351     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.79  0.21  1.00 2.00  1.00  2.00 2.00  1.00
Final Sat.:  1600 4800  1600  1600 4465   335  1600 3200  1600  2880 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.07 0.18  0.24  0.07 0.20  0.20  0.03 0.12  0.03  0.18 0.11  0.00
Crit Moves:             ****  ****                   ****        ****
********************************************************************************
```

```
Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45                 Page 10-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #8 PCH / Loynes Drive
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):         0.835
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         86                 Level Of Service:                  D
********************************************************************************
Street Name:                  PCH                            Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  2  1  0    1  0  3  0  1    1  0  1  1  0    1  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     204 1179   129    69 1443    48    34  220   131   236  364    60
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:  204 1179   129    69 1443    48    34  220   131   236  364    60
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   204 1179   129    69 1443    48    34  220   131   236  364    60
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  204 1179   129    69 1443    48    34  220   131   236  364    60
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  204 1179   129    69 1443    48    34  220   131   236  364    60
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.70  0.30  1.00 3.00  1.00  1.00 1.25  0.75  1.00 2.00  1.00
Final Sat.:  1600 4327   473  1600 4800  1600  1600 2006  1194  1600 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.13 0.27  0.27  0.04 0.30  0.03  0.02 0.11  0.11  0.15 0.11  0.04
Crit Moves:  ****                  ****              ****        ****
********************************************************************************
```

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Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45              Page 11-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #9 PCH / 2nd Street
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):         1.015
Loss Time (sec):       18 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        180                 Level Of Service:                  F
********************************************************************************
Street Name:                  PCH                            2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include          Include          Include           Ovl
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        2  0  2  1  0   1  0  2  1  0   2  0  2  1  1   2  0  3  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     322  918   403   261 1180   315   400  658   305   297 1236   312
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:  322  918   403   261 1180   315   400  658   305   297 1236   312
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   322  918   403   261 1180   315   400  658   305   297 1236   312
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  322  918   403   261 1180   315   400  658   305   297 1236   312
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  322  918   403   261 1180   315   400  658   305   297 1236   312
OvlAdjVol:                                                                  51
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  0.90 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00
Lanes:       2.00 2.08  0.92  1.00 2.37  0.63  2.00 2.73  1.27  2.00 3.00  1.00
Final Sat.:  2880 3336  1464  1600 3789  1011  2880 4373  2027  2880 4800  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.11 0.28  0.28  0.16 0.31  0.31  0.14 0.15  0.15  0.10 0.26  0.20
OvlAdjV/S:                                                                0.03
Crit Moves:       ****        ****              ****                 ****
********************************************************************************
```

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Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45               Page 12-1
--------------------------------------------------------------------------------

                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------

                       Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #10 PCH / Studebaker Road
********************************************************************************
Cycle (sec):          100                Critical Vol./Cap.(X):         1.052
Loss Time (sec):       18 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        180                Level Of Service:                  F
********************************************************************************
Street Name:                 PCH                           Studebaker Road
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected       Split Phase      Split Phase
Rights:           Include          Include           Ovl            Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  3  0  1    1  0  2  0  1    1  1  0  0  1    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     155 1460    26    35 1785   119   184   27   336    77   51    38
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:  155 1460    26    35 1785   119   184   27   336    77   51    38
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   155 1460    26    35 1785   119   184   27   336    77   51    38
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  155 1460    26    35 1785   119   184   27   336    77   51    38
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  155 1460    26    35 1785   119   184   27   336    77   51    38
OvlAdjVol:                                                 181
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.00  1.00  1.74 0.26  1.00  0.46 0.31  0.23
Final Sat.:  1600 4800  1600  1600 3200  1600  2791  409  1600   742  492   366
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.10 0.30  0.02  0.02 0.56  0.07  0.07 0.07  0.21  0.10 0.10  0.10
OvlAdjV/S:                                                0.11
Crit Moves:  ****                  ****                   ****  ****
********************************************************************************
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Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45               Page 13-1
--------------------------------------------------------------------------------

                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------

                      Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #11 Bixby Village Road / Loynes Drive
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):         0.370
Loss Time (sec):       10 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         27                 Level Of Service:                  A
********************************************************************************
Street Name:          Bixby Village Road                 Loynes Drive
Approach:       North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:         Permitted        Permitted        Permitted        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        0  0  1! 0  0    0  1  0  0  1    1  0  2  0  1    1  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 2 Dec 2008 <<
Base Vol:      19    5    19    22   16    58    33  334    28    23  587    56
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   19    5    19    22   16    58    33  334    28    23  587    56
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    19    5    19    22   16    58    33  334    28    23  587    56
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   19    5    19    22   16    58    33  334    28    23  587    56
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   19    5    19    22   16    58    33  334    28    23  587    56
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.44 0.12  0.44  0.58 0.42  1.00  1.00 2.00  1.00  1.00 1.83  0.17
Final Sat.:   707  186   707   926  674  1600  1600 3200  1600  1600 2921   279
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.01 0.03  0.03  0.01 0.02  0.04  0.02 0.10  0.02  0.01 0.20  0.20
Crit Moves:  ****                        ****  ****                    ****
********************************************************************************
```

```
Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45             Page 14-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                        Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #12 Seal Beach Blvd. / Westminster Ave
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.718
Loss Time (sec):       5 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        39                Level Of Service:                  C
********************************************************************************
Street Name:         Seal Beach Blvd.                  Westminster Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include           Ovl             Ignore           Include
Min. Green:    0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  2  1  0    2  0  3  0  1    2  0  3  0  1    2  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      76  785   202   237  705   284   353  620    30   231  816   207
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:   76  785   202   237  705   284   353  620    30   231  816   207
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Volume:    76  785   202   237  705   284   353  620     0   231  816   207
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   76  785   202   237  705   284   353  620     0   231  816   207
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
FinalVolume:   76  785   202   237  705   284   353  620     0   231  816   207
OvlAdjVol:                                107
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06
Lanes:       1.00 2.39  0.61  2.00 3.00  1.00  2.00 3.00  1.00  2.00 1.60  0.40
Final Sat.:  1700 4056  1044  3400 5100  1700  3400 5100  1700  3400 2712   688
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.04 0.19  0.19  0.07 0.14  0.17  0.10 0.12  0.00  0.07 0.30  0.30
OvlAdjV/S:                                0.06
Crit Moves:       ****        ****             ****                   ****
********************************************************************************
```

```
Existing PM (Year 2008)    Tue Jan 6, 2009 11:39:45              Page 15-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                        Existing Conditions (Year 2008)
                                 PM Peak Hour
--------------------------------------------------------------------------------
                         Level Of Service Computation Report
        ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)
********************************************************************************
Intersection #13 2nd Street / Project Entrance
********************************************************************************
Cycle (sec):          100              Critical Vol./Cap.(X):         0.591
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         48              Level Of Service:                  A
********************************************************************************
Street Name:                2nd Street                    Project Entrance
Approach:       North Bound      South Bound       East Bound       West Bound
Movement:      L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Split Phase      Split Phase       Protected         Permitted
Rights:            Include          Include          Include          Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:         1  0  0  0  0    1  0  0  0  1    1  0  2  0  0    0  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       2    0     0     8    0     6    15 1080     0     0 1359     2
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    2    0     0     8    0     6    15 1080     0     0 1359     2
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     2    0     0     8    0     6    15 1080     0     0 1359     2
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    2    0     0     8    0     6    15 1080     0     0 1359     2
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    2    0     0     8    0     6    15 1080     0     0 1359     2
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 0.00  0.00  1.00 0.00  1.00  1.00 2.00  0.00  0.00 1.99  0.01
Final Sat.:  1600    0     0  1600    0  1600  1600 3200     0     0 3195     5
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.01 0.00  0.00  0.01 0.34  0.00  0.00 0.43  0.43
Crit Moves:  ****              ****              ****                   ****
********************************************************************************
```

APPENDIX D
Intersection Level-of-Service Worksheets
Year 2012 "No Project" Conditions

```
AM Peak No Project (Year 20Tue Jan 20, 2009 16:07:43                Page 3-1
--------------------------------------------------------------------------------
                          Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                AM Peak Hour
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Studebaker Road / SR-22 WB Ramps
********************************************************************************
Cycle (sec):         100               Critical Vol./Cap.(X):        0.605
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        50               Level Of Service:                 B
********************************************************************************
Street Name:          Studebaker Road                    SR-22 WB Ramps
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected        Protected        Protected
Rights:           Ignore          Include          Include           Ignore
Min. Green:     0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    1  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0  614   40    73  697    0     0    0    0   587    0  449
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0  663   43    79  753    0     0    0    0   634    0  485
Added Vol:      0    0    0     0    0    0     0    0    0     0    0    0
PasserByVol:    0    0    0     0    0    0     0    0    0     0    0    0
Initial Fut:    0  663   43    79  753    0     0    0    0   634    0  485
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  663    0    79  753    0     0    0    0   634    0    0
Reduct Vol:     0    0    0     0    0    0     0    0    0     0    0    0
Reduced Vol:    0  663    0    79  753    0     0    0    0   634    0    0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  663    0    79  753    0     0    0    0   634    0    0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  0.00
Final Sat.:     0 3200  1600  1600 3200    0     0    0    0  3200    0    0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.21  0.00  0.05 0.24  0.00  0.00 0.00  0.00  0.20 0.00  0.00
Crit Moves:       ****        ****                                ****
********************************************************************************
```

```
AM Peak No Project (Year 20Tue Jan 20, 2009 16:07:43              Page 4-1
--------------------------------------------------------------------------------
                          Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                AM Peak Hour
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
      ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #2 Studebaker Road / SR-22 EB Ramps
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.513
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        60                Level Of Service:                 A
********************************************************************************
Street Name:          Studebaker Road                     SR-22 EB Ramps
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted       Protected       Split Phase      Split Phase
Rights:           Ignore          Include         Include           Ignore
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   2  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0  550  1195   237 1069     0    0    0     0    7    0    75
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08 1.08 1.08  1.08 1.08 1.08  1.08
Initial Bse:    0  594  1291   256 1155     0    0    0     0    8    0    81
Added Vol:      0    0     0     0    0     0    0    0     0    0    0     0
PasserByVol:    0    0     0     0    0     0    0    0     0    0    0     0
Initial Fut:    0  594  1291   256 1155     0    0    0     0    8    0    81
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  0.00
PHF Volume:     0  594     0   256 1155     0    0    0     0    8    0     0
Reduct Vol:     0    0     0     0    0     0    0    0     0    0    0     0
Reduced Vol:    0  594     0   256 1155     0    0    0     0    8    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  0.00
FinalVolume:    0  594     0   256 1155     0    0    0     0    8    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600 1600 1600  1600 1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00 0.90 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00 0.00 0.00  0.00 2.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0    0    0     0 2880    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.19  0.00  0.16 0.36  0.00 0.00 0.00  0.00 0.00 0.00  0.00
Crit Moves:                        ****                         ****
********************************************************************************
```

```
AM Peak No Project (Year 20Tue Jan 20, 2009 16:07:43            Page 5-1
--------------------------------------------------------------------------------
                          Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                AM Peak Hour
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #3 Studebaker Road / AES Plant Driveway
********************************************************************************
Cycle (sec):          100                Critical Vol./Cap.(X):        0.684
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:         58                Level Of Service:                 B
********************************************************************************
Street Name:          Studebaker Road                  AES Plant Driveway
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted      Split Phase      Split Phase
Rights:          Include          Include          Include          Include
Min. Green:    0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      0 1495    15    25 1189    0    0    0    0    6    0   19
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   0 1615    16    27 1284    0    0    0    0    6    0   21
Added Vol:     0    0    0    0    0    0    0    0    0    0    0    0
PasserByVol:   0    0    0    0    0    0    0    0    0    0    0    0
Initial Fut:   0 1615    16    27 1284    0    0    0    0    6    0   21
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    0 1615    16    27 1284    0    0    0    0    6    0   21
Reduct Vol:    0    0    0    0    0    0    0    0    0    0    0    0
Reduced Vol:   0 1615    16    27 1284    0    0    0    0    6    0   21
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   0 1615    16    27 1284    0    0    0    0    6    0   21
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  1.00 0.00  1.00
Final Sat.:    0 3200  1600  1600 3200    0    0    0    0  1600    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.50  0.01  0.02 0.40  0.00  0.00 0.00  0.00  0.00 0.00  0.01
Crit Moves:       ****        ****                                          ****
********************************************************************************
```

```
AM Peak No Project (Year 20Tue Jan 20, 2009 16:07:43                 Page 6-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Studebaker Road / Loynes Drive
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.706
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        61                Level Of Service:                 C
********************************************************************************
Street Name:         Studebaker Road                      Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted       Split Phase      Split Phase
Rights:          Include          Include          Include          Include
Min. Green:     0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        1  0  2  0  0   0  0  2  0  1   2  0  0  0  2   0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 2 Dec 2008 <<
Base Vol:      44 1271    0     0  878   270   339    0    55     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   48 1373    0     0  948   292   366    0    59     0    0     0
Added Vol:      0    0    0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0    0     0    0     0     0    0     0     0    0     0
Initial Fut:   48 1373    0     0  948   292   366    0    59     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    48 1373    0     0  948   292   366    0    59     0    0     0
Reduct Vol:     0    0    0     0    0     0     0    0     0     0    0     0
Reduced Vol:   48 1373    0     0  948   292   366    0    59     0    0     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   48 1373    0     0  948   292   366    0    59     0    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.00  0.00  0.00 2.00  1.00  2.00 0.00  2.00  0.00 0.00  0.00
Final Sat.:  1600 3200     0     0 3200  1600  2880    0  3200     0    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.43  0.00  0.00 0.30  0.18  0.13 0.00  0.02  0.00 0.00  0.00
Crit Moves:       ****        ****             ****
********************************************************************************
```

```
AM Peak No Project (Year 20Tue Jan 20, 2009 16:07:43                Page 7-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #5 Studebaker Road / 2nd Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        1.028
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       180                Level Of Service:                 F
********************************************************************************
Street Name:         Studebaker Road                      2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected        Permitted
Rights:           Include          Ovl             Include          Ovl
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  0  0  0   2  0  0  0  2   2  0  2  0  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0    0     0  287    0   769  1106  418     0    0  603   345
Growth Adj:  1.08 1.08  1.08 1.08 1.08  1.08  1.08 1.08  1.08 1.08 1.08  1.08
Initial Bse:    0    0     0  310    0   831  1194  451     0    0  651   373
Added Vol:      0    0     0    0    0     0    0    0     0    0    0     0
PasserByVol:    0    0     0    0    0     0    0    0     0    0    0     0
Initial Fut:    0    0     0  310    0   831  1194  451     0    0  651   373
User Adj:    1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00
PHF Volume:     0    0     0  310    0   831  1194  451     0    0  651   373
Reduct Vol:     0    0     0    0    0     0    0    0     0    0    0     0
Reduced Vol:    0    0     0  310    0   831  1194  451     0    0  651   373
PCE Adj:     1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00
FinalVolume:    0    0     0  310    0   831  1194  451     0    0  651   373
OvlAdjVol:                                                               200
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600 1600 1600  1600  1600 1600  1600 1600 1600  1600
Adjustment:  1.00 1.00  1.00 0.90 1.00  1.00  0.90 1.00  1.00 1.00 1.00  1.00
Lanes:       0.00 0.00  0.00 2.00 0.00  2.00  2.00 2.00  0.00 0.00 2.00  1.00
Final Sat.:     0    0     0 2880    0  3200  2880 3200     0    0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00 0.11 0.00  0.26  0.41 0.14  0.00 0.00 0.20  0.23
OvlAdjV/S:                                                              0.13
Crit Moves:                             ****  ****                 ****
********************************************************************************
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                           Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
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--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #6 PCH / 7th Street
********************************************************************************
Cycle (sec):          100               Critical Vol./Cap.(X):         1.209
Loss Time (sec):       15 (Y+R=4.0 sec) Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        180               Level Of Service:                  F
********************************************************************************
Street Name:                  PCH                            7th Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0   2  0  2  1  0   0  0  2  1  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     189 1339     4   709  956     6     0 1828   129     0 1455   522
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  204 1446     4   766 1032     6     0 1974   139     0 1571   564
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  204 1446     4   766 1032     6     0 1974   139     0 1571   564
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   204 1446     4   766 1032     6     0 1974   139     0 1571   564
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  204 1446     4   766 1032     6     0 1974   139     0 1571   564
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  204 1446     4   766 1032     6     0 1974   139     0 1571   564
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.99  0.01  2.00 2.98  0.02  0.00 2.80  0.20  0.00 2.00  1.00
Final Sat.:  1600 4786    14  2880 4770    30     0 4484   316     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.13 0.30  0.30  0.27 0.22  0.22  0.00 0.44  0.44  0.00 0.49  0.35
Crit Moves:       ****        ****             ****                   ****
********************************************************************************
```

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                           Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
      ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #7 PCH / Bellflower Boulevard
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.888
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       103                Level Of Service:                 D
********************************************************************************
Street Name:                  PCH                       Bellflower Boulevard
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted      Split Phase      Split Phase
Rights:          Include          Include         Include          Ignore
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  3  0  1   1  0  2  1  0   1  0  2  0  1   1  1  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      41 1485   456   160  925    44   110  622    73   228  201    20
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   44 1604   492   173  999    48   119  672    79   246  217    22
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   44 1604   492   173  999    48   119  672    79   246  217    22
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:    44 1604   492   173  999    48   119  672    79   246  217     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   44 1604   492   173  999    48   119  672    79   246  217     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:   44 1604   492   173  999    48   119  672    79   246  217     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.86  0.14  1.00 2.00  1.00  2.00 2.00  1.00
Final Sat.:  1600 4800  1600  1600 4582   218  1600 3200  1600  2880 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.33  0.31  0.11 0.22  0.22  0.07 0.21  0.05  0.09 0.07  0.00
Crit Moves:       ****        ****                   ****        ****
********************************************************************************
```

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                          Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                AM Peak Hour
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #8 PCH / Loynes Drive
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.836
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        86                Level Of Service:                  D
********************************************************************************
Street Name:                  PCH                            Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0   1  0  3  0  1   1  0  1  1  0   1  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      52 1772    97    80  912    22    24  234   156   119  180    61
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   56 1914   105    86  985    24    26  253   168   129  194    66
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   56 1914   105    86  985    24    26  253   168   129  194    66
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    56 1914   105    86  985    24    26  253   168   129  194    66
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   56 1914   105    86  985    24    26  253   168   129  194    66
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   56 1914   105    86  985    24    26  253   168   129  194    66
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.84  0.16  1.00 3.00  1.00  1.00 1.20  0.80  1.00 2.00  1.00
Final Sat.:  1600 4551   249  1600 4800  1600  1600 1920  1280  1600 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.04 0.42  0.42  0.05 0.21  0.01  0.02 0.13  0.13  0.08 0.06  0.04
Crit Moves:       ****        ****                   ****        ****
********************************************************************************
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                           Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                 AM Peak Hour
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #9 PCH / 2nd Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):          1.085
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):       xxxxxx
Optimal Cycle:       180                Level Of Service:                   F
********************************************************************************
Street Name:                  PCH                            2nd Street
Approach:       North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include          Include          Include           Ovl
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        2  0  2  1  0   1  0  2  1  0   2  0  2  1  1   2  0  3  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     437 1350   734   147  778   139   215  688   317   267 1022   186
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  472 1458   793   159  840   150   232  743   342   288 1104   201
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  472 1458   793   159  840   150   232  743   342   288 1104   201
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   472 1458   793   159  840   150   232  743   342   288 1104   201
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  472 1458   793   159  840   150   232  743   342   288 1104   201
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  472 1458   793   159  840   150   232  743   342   288 1104   201
OvlAdjVol:                                                                  42
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  0.90 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00
Lanes:       2.00 2.00  1.00  1.00 2.55  0.45  2.00 2.74  1.26  2.00 3.00  1.00
Final Sat.:  2880 3200  1600  1600 4072   728  2880 4381  2019  2880 4800  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.16 0.46  0.50  0.10 0.21  0.21  0.08 0.17  0.17  0.10 0.23  0.13
OvlAdjV/S:                                                                0.03
Crit Moves:             ****  ****             ****                  ****
********************************************************************************
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                           Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #10 PCH / Studebaker Road
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):         0.855
Loss Time (sec):       18 (Y+R=4.0 sec)   Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         96                 Level Of Service:                  D
********************************************************************************
Street Name:                 PCH                            Studebaker Road
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected       Split Phase      Split Phase
Rights:           Include          Include          Ovl              Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  3  0  1    1  0  2  0  1    1  1  0  0  1    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      35 2393     5     0 1269    51    87    9   228     1    6     3
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   38 2584     5     0 1371    55    94   10   246     1    6     3
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   38 2584     5     0 1371    55    94   10   246     1    6     3
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    38 2584     5     0 1371    55    94   10   246     1    6     3
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   38 2584     5     0 1371    55    94   10   246     1    6     3
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   38 2584     5     0 1371    55    94   10   246     1    6     3
OvlAdjVol:                                                 208
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.00  1.00  1.81 0.19  1.00  0.10 0.60  0.30
Final Sat.:  1600 4800  1600  1600 3200  1600  2900  300  1600   160  960   480
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.02 0.54  0.00  0.00 0.43  0.03  0.03 0.03  0.15  0.01 0.01  0.01
OvlAdjV/S:                                                0.13
Crit Moves:       ****        ****                        ****       ****
********************************************************************************
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                           Haynes Power Station EIR
              Future No Project Construction Conditions (Year 2012)
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #11 Bixby Village Road / Loynes Drive
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.300
Loss Time (sec):      10 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        25                Level Of Service:                  A
********************************************************************************
Street Name:        Bixby Village Road                 Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted        Permitted        Permitted
Rights:          Include          Include          Include          Include
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        0  0  1! 0  0   0  1  0  0  1   1  0  2  0  1   1  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 2 Dec 2008 <<
Base Vol:      30    7    24    32    2    48    45  339    20    10  284    33
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   32    8    26    35    2    52    49  366    22    11  307    36
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   32    8    26    35    2    52    49  366    22    11  307    36
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    32    8    26    35    2    52    49  366    22    11  307    36
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   32    8    26    35    2    52    49  366    22    11  307    36
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   32    8    26    35    2    52    49  366    22    11  307    36
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.50 0.11  0.39  0.94 0.06  1.00  1.00 2.00  1.00  1.00 1.79  0.21
Final Sat.:   787  184   630  1506   94  1600  1600 3200  1600  1600 2867   333
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.02 0.04  0.04  0.02 0.02  0.03  0.03 0.11  0.01  0.01 0.11  0.11
Crit Moves:       ****        ****             ****                   ****
********************************************************************************
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                          Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                AM Peak Hour
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                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #12 Seal Beach Blvd. / Westminster Ave
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         0.696
Loss Time (sec):       5 (Y+R=4.0 sec)   Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        37                 Level Of Service:                  B
********************************************************************************
Street Name:         Seal Beach Blvd.                  Westminster Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Protected        Protected        Protected        Protected
Rights:          Include           Ovl             Ignore           Include
Min. Green:     0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        1  0  2  1  0    2  0  3  0  1    2  0  3  0  1    2  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      36  772   161   172  668   228   240  563    25   262  829   170
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   39  834   174   186  721   246   259  608    27   283  895   184
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   39  834   174   186  721   246   259  608    27   283  895   184
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Volume:    39  834   174   186  721   246   259  608     0   283  895   184
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   39  834   174   186  721   246   259  608     0   283  895   184
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
FinalVolume:   39  834   174   186  721   246   259  608     0   283  895   184
OvlAdjVol:                                117
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06
Lanes:       1.00 2.48  0.52  2.00 3.00  1.00  2.00 3.00  1.00  2.00 1.66  0.34
Final Sat.:  1700 4220   880  3400 5100  1700  3400 5100  1700  3400 2821   579
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.02 0.20  0.20  0.05 0.14  0.14  0.08 0.12  0.00  0.08 0.32  0.32
OvlAdjV/S:                                0.07
Crit Moves:       ****        ****              ****                   ****
********************************************************************************
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AM Peak No Project (Year 20Tue Jan 20, 2009 16:07:43              Page 15-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
             Future No Project Construction Conditions (Year 2012)
                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
      ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #13 2nd Street / Project Entrance
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         0.530
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        44                 Level Of Service:                  A
********************************************************************************
Street Name:                2nd Street                    Project Entrance
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected         Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        0  0  0  0  0    1  0  0  0  1    1  0  2  0  0    0  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0    0     0     1    0    15     6  758     0     0 1078     5
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0    0     0     1    0    16     6  819     0     0 1164     5
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0    0     0     1    0    16     6  819     0     0 1164     5
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0    0     0     1    0    16     6  819     0     0 1164     5
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0    0     0     1    0    16     6  819     0     0 1164     5
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0    0     0     1    0    16     6  819     0     0 1164     5
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  1.00 0.00  1.00  1.00 2.00  0.00  0.00 1.99  0.01
Final Sat.:     0    0     0  1600    0  1600  1600 3200     0     0 3185    15
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.00 0.00  0.01  0.00 0.26  0.00  0.00 0.37  0.37
Crit Moves:                              ****  ****                   ****
********************************************************************************
```

```
PM Peak No Project (Year 20Tue Jan 20, 2009 16:09:11              Page 3-1
--------------------------------------------------------------------------------
                            Haynes Power Station EIR
                    Future No Project Construction Conditions
                            PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                       Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Studebaker Road / SR-22 WB Ramps
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.949
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                Level Of Service:                  E
********************************************************************************
Street Name:         Studebaker Road                     SR-22 WB Ramps
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected         Protected        Protected
Rights:          Ignore           Include           Include          Ignore
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   1  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      0  873    34    39 1447     0     0    0     0   919    0   460
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   0  943    37    42 1563     0     0    0     0   993    0   497
Added Vol:     0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:   0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   0  943    37    42 1563     0     0    0     0   993    0   497
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:    0  943     0    42 1563     0     0    0     0   993    0     0
Reduct Vol:    0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   0  943     0    42 1563     0     0    0     0   993    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:   0  943     0    42 1563     0     0    0     0   993    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  0.00
Final Sat.:    0 3200  1600  1600 3200     0     0    0     0  3200    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.29  0.00  0.03 0.49  0.00  0.00 0.00  0.00  0.31 0.00  0.00
Crit Moves:                        ****                          ****
********************************************************************************
```

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--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                   Future No Project Construction Conditions
                           PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #2 Studebaker Road / SR-22 EB Ramps
********************************************************************************
Cycle (sec):         100               Critical Vol./Cap.(X):         0.854
Loss Time (sec):      15 (Y+R=4.0 sec) Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180               Level Of Service:                  D
********************************************************************************
Street Name:         Studebaker Road                     SR-22 EB Ramps
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected       Split Phase      Split Phase
Rights:          Ignore           Include          Include          Ignore
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   2  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0  870   857   296 2058     0     0    0     0    25    0    58
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0  940   926   320 2223     0     0    0     0    27    0    63
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0  940   926   320 2223     0     0    0     0    27    0    63
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  940     0   320 2223     0     0    0     0    27    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0  940     0   320 2223     0     0    0     0    27    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  940     0   320 2223     0     0    0     0    27    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  2880    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.29  0.00  0.20 0.69  0.00  0.00 0.00  0.00  0.01 0.00  0.00
Crit Moves:                        ****                          ****
********************************************************************************
```

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PM Peak No Project (Year 20Tue Jan 20, 2009 16:09:11              Page 5-1
--------------------------------------------------------------------------------
                          Haynes Power Station EIR
                  Future No Project Construction Conditions
                          PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #3 Studebaker Road / AES Plant Driveway
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         0.791
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        75                 Level Of Service:                  C
********************************************************************************
Street Name:          Studebaker Road                  AES Plant Driveway
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted      Split Phase      Split Phase
Rights:          Include          Include          Include          Include
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       0 1372    2    8 1868    0    0    0    0    7    0   15
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0 1482    2    9 2017    0    0    0    0    8    0   16
Added Vol:      0    0    0    0    0    0    0    0    0    0    0    0
PasserByVol:    0    0    0    0    0    0    0    0    0    0    0    0
Initial Fut:    0 1482    2    9 2017    0    0    0    0    8    0   16
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0 1482    2    9 2017    0    0    0    0    8    0   16
Reduct Vol:     0    0    0    0    0    0    0    0    0    0    0    0
Reduced Vol:    0 1482    2    9 2017    0    0    0    0    8    0   16
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0 1482    2    9 2017    0    0    0    0    8    0   16
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  1.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  1600    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.46  0.00  0.01 0.63  0.00  0.00 0.00  0.00  0.00 0.00  0.01
Crit Moves:  ****                    ****                                   ****
********************************************************************************
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--------------------------------------------------------------------------------
                         Haynes Power Station EIR
                  Future No Project Construction Conditions
                         PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Studebaker Road / Loynes Drive
********************************************************************************
Cycle (sec):          100                Critical Vol./Cap.(X):         0.764
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         70                Level Of Service:                  C
********************************************************************************
Street Name:          Studebaker Road                     Loynes Drive
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted      Split Phase      Split Phase
Rights:          Include          Include         Include          Include
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        1  0  2  0  0   0  0  2  0  1   2  0  0  0  2   0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      74 1178    0    0 1382  585  260    0   79    0    0    0
Growth Adj:  1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08
Initial Bse:   80 1272    0    0 1493  632  281    0   85    0    0    0
Added Vol:      0    0    0    0    0    0    0    0    0    0    0    0
PasserByVol:    0    0    0    0    0    0    0    0    0    0    0    0
Initial Fut:   80 1272    0    0 1493  632  281    0   85    0    0    0
User Adj:    1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
PHF Adj:     1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
PHF Volume:    80 1272    0    0 1493  632  281    0   85    0    0    0
Reduct Vol:     0    0    0    0    0    0    0    0    0    0    0    0
Reduced Vol:   80 1272    0    0 1493  632  281    0   85    0    0    0
PCE Adj:     1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
MLF Adj:     1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00
FinalVolume:   80 1272    0    0 1493  632  281    0   85    0    0    0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600 1600 1600 1600 1600 1600 1600 1600 1600 1600 1600
Adjustment:  1.00 1.00 1.00 1.00 1.00 1.00 0.90 1.00 1.00 1.00 1.00 1.00
Lanes:       1.00 2.00 0.00 0.00 2.00 1.00 2.00 0.00 2.00 0.00 0.00 0.00
Final Sat.:  1600 3200    0    0 3200 1600 2880    0 3200    0    0    0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.05 0.40 0.00 0.00 0.47 0.39 0.10 0.00 0.03 0.00 0.00 0.00
Crit Moves:  ****                ****      ****
********************************************************************************
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PM Peak No Project (Year 20Tue Jan 20, 2009 16:09:11             Page 7-1
--------------------------------------------------------------------------------
                          Haynes Power Station EIR
                  Future No Project Construction Conditions
                          PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #5 Studebaker Road / 2nd Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        1.141
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       180                Level Of Service:                 F
********************************************************************************
Street Name:         Studebaker Road                       2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected        Permitted
Rights:           Include           Ovl             Include           Ovl
Min. Green:    0     0     0    0     0     0    0     0     0    0     0     0
Lanes:        0  0  0  0  0   2  0  0  0  2   2  0  2  0  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      0     0     0  390     0  1178   820  704     0     0  848   498
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   0     0     0  421     0  1272   886  760     0     0  916   538
Added Vol:     0     0     0    0     0     0    0     0     0     0     0     0
PasserByVol:   0     0     0    0     0     0    0     0     0     0     0     0
Initial Fut:   0     0     0  421     0  1272   886  760     0     0  916   538
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    0     0     0  421     0  1272   886  760     0     0  916   538
Reduct Vol:    0     0     0    0     0     0    0     0     0     0     0     0
Reduced Vol:   0     0     0  421     0  1272   886  760     0     0  916   538
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   0     0     0  421     0  1272   886  760     0     0  916   538
OvlAdjVol:                                                                 304
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  2.00 0.00  2.00  2.00 2.00  0.00  0.00 2.00  1.00
Final Sat.:    0     0     0  2880     0  3200  2880 3200     0     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.15 0.00  0.40  0.31 0.24  0.00  0.00 0.29  0.34
OvlAdjV/S:                                                                0.19
Crit Moves:                              ****  ****                  ****
********************************************************************************
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PM Peak No Project (Year 20Tue Jan 20, 2009 16:09:11              Page 8-1
--------------------------------------------------------------------------------
                         Haynes Power Station EIR
                 Future No Project Construction Conditions
                         PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #6 PCH / 7th Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         1.178
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                Level Of Service:                  F
********************************************************************************
Street Name:                  PCH                            7th Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted        Permitted
Rights:           Include          Include           Include          Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0   2  0  2  1  0   0  0  2  1  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     189  655    11   692  917    15     0 2105   125     0 1834   517
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  204  707    12   747  990    16     0 2273   135     0 1981   558
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  204  707    12   747  990    16     0 2273   135     0 1981   558
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   204  707    12   747  990    16     0 2273   135     0 1981   558
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  204  707    12   747  990    16     0 2273   135     0 1981   558
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  204  707    12   747  990    16     0 2273   135     0 1981   558
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.95  0.05  2.00 2.95  0.05  0.00 2.83  0.17  0.00 2.00  1.00
Final Sat.:  1600 4721    79  2880 4723    77     0 4531   269     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.13 0.15  0.15  0.26 0.21  0.21  0.00 0.50  0.50  0.00 0.62  0.35
Crit Moves:       ****        ****             ****                   ****
********************************************************************************
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PM Peak No Project (Year 20Tue Jan 20, 2009 16:09:11              Page 9-1
--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                   Future No Project Construction Conditions
                           PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #7 PCH / Bellflower Boulevard
********************************************************************************
Cycle (sec):          100               Critical Vol./Cap.(X):         0.807
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         79               Level Of Service:                  D
********************************************************************************
Street Name:                  PCH                        Bellflower Boulevard
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted      Split Phase      Split Phase
Rights:          Include          Include         Include          Ignore
Min. Green:     0    0     0     0    0     0    0    0     0    0    0     0
Lanes:        1  0  3  0  1   1  0  2  1  0   1  0  2  0  1   1  1  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     108  866   382   112  907    68   45  372    55   527  351    14
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08 1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  117  935   413   121  980    73   49  402    59   569  379    15
Added Vol:      0    0     0     0    0     0    0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0    0    0     0     0    0     0
Initial Fut:  117  935   413   121  980    73   49  402    59   569  379    15
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:   117  935   413   121  980    73   49  402    59   569  379     0
Reduct Vol:     0    0     0     0    0     0    0    0     0     0    0     0
Reduced Vol:  117  935   413   121  980    73   49  402    59   569  379     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:  117  935   413   121  980    73   49  402    59   569  379     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600 1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00 1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.79  0.21 1.00 2.00  1.00  2.00 2.00  1.00
Final Sat.:  1600 4800  1600  1600 4465   335 1600 3200  1600  2880 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.07 0.19  0.26  0.08 0.22  0.22 0.03 0.13  0.04  0.20 0.12  0.00
Crit Moves:             ****  ****                ******         ****
********************************************************************************
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--------------------------------------------------------------------------------
                           Haynes Power Station EIR
                   Future No Project Construction Conditions
                           PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #8 PCH / Loynes Drive
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.890
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       104                Level Of Service:                  D
********************************************************************************
Street Name:                   PCH                           Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0     0     0    0     0     0    0     0     0    0     0     0
Lanes:        1  0  2  1  0   1  0  3  0  1   1  0  1  1  0   1  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     204 1179   129    69 1443    48    34  220   131   236  364    60
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  220 1273   139    75 1558    52    37  238   141   255  393    65
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  220 1273   139    75 1558    52    37  238   141   255  393    65
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   220 1273   139    75 1558    52    37  238   141   255  393    65
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  220 1273   139    75 1558    52    37  238   141   255  393    65
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  220 1273   139    75 1558    52    37  238   141   255  393    65
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.70  0.30  1.00 3.00  1.00  1.00 1.25  0.75  1.00 2.00  1.00
Final Sat.:  1600 4327   473  1600 4800  1600  1600 2006  1194  1600 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.14 0.29  0.29  0.05 0.32  0.03  0.02 0.12  0.12  0.16 0.12  0.04
Crit Moves:  ****                  ****              ****        ****
********************************************************************************
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--------------------------------------------------------------------------------
                         Haynes Power Station EIR
                  Future No Project Construction Conditions
                         PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #9 PCH / 2nd Street
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        1.081
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       180                Level Of Service:                 F
********************************************************************************
Street Name:                 PCH                              2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include          Include          Include           Ovl
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        2  0  2  1  0   1  0  2  1  0   2  0  2  1  1   2  0  3  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     322  918   403   261 1180   315   400  658   305   297 1236   312
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  348  991   435   282 1274   340   432  711   329   321 1335   337
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  348  991   435   282 1274   340   432  711   329   321 1335   337
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   348  991   435   282 1274   340   432  711   329   321 1335   337
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  348  991   435   282 1274   340   432  711   329   321 1335   337
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  348  991   435   282 1274   340   432  711   329   321 1335   337
OvlAdjVol:                                                                   55
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  0.90 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00
Lanes:       2.00 2.08  0.92  1.00 2.37  0.63  2.00 2.73  1.27  2.00 3.00  1.00
Final Sat.:  2880 3336  1464  1600 3789  1011  2880 4373  2027  2880 4800  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.12 0.30  0.30  0.18 0.34  0.34  0.15 0.16  0.16  0.11 0.28  0.21
OvlAdjV/S:                                                                 0.03
Crit Moves:       ****        ****              ****                 ****
********************************************************************************
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-------------------------------------------------------------------------------
                          Haynes Power Station EIR
                  Future No Project Construction Conditions
                          PM Peak Hour (Year 2012)
-------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
*******************************************************************************
Intersection #10 PCH / Studebaker Road
*******************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         1.121
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                Level Of Service:                  F
*******************************************************************************
Street Name:                PCH                         Studebaker Road
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected       Split Phase      Split Phase
Rights:           Include          Include           Ovl            Include
Min. Green:    0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        1  0  3  0  1    1  0  2  0  1    1  1  0  0  1    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:     155 1460    26    35 1785   119   184   27   336    77   51    38
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  167 1577    28    38 1928   129   199   29   363    83   55    41
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  167 1577    28    38 1928   129   199   29   363    83   55    41
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   167 1577    28    38 1928   129   199   29   363    83   55    41
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  167 1577    28    38 1928   129   199   29   363    83   55    41
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  167 1577    28    38 1928   129   199   29   363    83   55    41
OvlAdjVol:                                                   195
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.00  1.00  1.74 0.26  1.00  0.46 0.31  0.23
Final Sat.:  1600 4800  1600  1600 3200  1600  2791  409  1600   742  492   366
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.10 0.33  0.02  0.02 0.60  0.08  0.07 0.07  0.23  0.11 0.11  0.11
OvlAdjV/S:                                                  0.12
Crit Moves:  ****                    ****                   ****  ****
*******************************************************************************
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PM Peak No Project (Year 20Tue Jan 20, 2009 16:09:12            Page 13-1
--------------------------------------------------------------------------------
                          Haynes Power Station EIR
                  Future No Project Construction Conditions
                          PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #11 Bixby Village Road / Loynes Drive
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.391
Loss Time (sec):      10 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        28                Level Of Service:                 A
********************************************************************************
Street Name:        Bixby Village Road                  Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted        Permitted        Permitted
Rights:          Include          Include          Include          Include
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  1! 0  0   0  1  0  0  1   1  0  2  0  1   1  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 2 Dec 2008 <<
Base Vol:      19    5    19    22   16    58    33  334    28    23  587    56
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   21    5    21    24   17    63    36  361    30    25  634    60
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   21    5    21    24   17    63    36  361    30    25  634    60
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    21    5    21    24   17    63    36  361    30    25  634    60
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   21    5    21    24   17    63    36  361    30    25  634    60
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   21    5    21    24   17    63    36  361    30    25  634    60
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.44 0.12  0.44  0.58 0.42  1.00  1.00 2.00  1.00  1.00 1.83  0.17
Final Sat.:   707  186   707   926  674  1600  1600 3200  1600  1600 2921   279
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.01 0.03  0.03  0.01 0.03  0.04  0.02 0.11  0.02  0.02 0.22  0.22
Crit Moves:  ****                        ****  ****                   ****
********************************************************************************
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-------------------------------------------------------------------------------
                          Haynes Power Station EIR
                  Future No Project Construction Conditions
                          PM Peak Hour (Year 2012)
-------------------------------------------------------------------------------
                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
*******************************************************************************
Intersection #12 Seal Beach Blvd. / Westminster Ave
*******************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.771
Loss Time (sec):       5 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        47                Level Of Service:                  C
*******************************************************************************
Street Name:         Seal Beach Blvd.                 Westminster Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include           Ovl             Ignore           Include
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        1  0  2  1  0   2  0  3  0  1   2  0  3  0  1   2  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:      76  785   202   237  705   284   353  620    30   231  816   207
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   82  848   218   256  761   307   381  670    32   249  881   224
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   82  848   218   256  761   307   381  670    32   249  881   224
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Volume:    82  848   218   256  761   307   381  670     0   249  881   224
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   82  848   218   256  761   307   381  670     0   249  881   224
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
FinalVolume:   82  848   218   256  761   307   381  670     0   249  881   224
OvlAdjVol:                                116
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06
Lanes:       1.00 2.39  0.61  2.00 3.00  1.00  2.00 3.00  1.00  2.00 1.60  0.40
Final Sat.:  1700 4056  1044  3400 5100  1700  3400 5100  1700  3400 2712   688
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.05 0.21  0.21  0.08 0.15  0.18  0.11 0.13  0.00  0.07 0.32  0.32
OvlAdjV/S:                                0.07
Crit Moves:       ****        ****             ****                   ****
*******************************************************************************
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PM Peak No Project (Year 20Tue Jan 20, 2009 16:09:12            Page 15-1
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                           Haynes Power Station EIR
                   Future No Project Construction Conditions
                           PM Peak Hour (Year 2012)
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #13 2nd Street / Project Entrance
********************************************************************************
Cycle (sec):         100               Critical Vol./Cap.(X):        0.626
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:        52               Level Of Service:                 B
********************************************************************************
Street Name:             2nd Street                  Project Entrance
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        1  0  0  0  0   1  0  0  0  1   1  0  2  0  0   0  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module: >> Count Date: 4 Dec 2008 <<
Base Vol:       2    0    0     8    0    6    15 1080    0     0 1359    2
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    2    0    0     9    0    6    16 1166    0     0 1468    2
Added Vol:      0    0    0     0    0    0     0    0    0     0    0    0
PasserByVol:    0    0    0     0    0    0     0    0    0     0    0    0
Initial Fut:    2    0    0     9    0    6    16 1166    0     0 1468    2
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     2    0    0     9    0    6    16 1166    0     0 1468    2
Reduct Vol:     0    0    0     0    0    0     0    0    0     0    0    0
Reduced Vol:    2    0    0     9    0    6    16 1166    0     0 1468    2
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    2    0    0     9    0    6    16 1166    0     0 1468    2
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 0.00  0.00  1.00 0.00  1.00  1.00 2.00  0.00  0.00 1.99  0.01
Final Sat.:  1600    0     0  1600    0  1600  1600 3200     0     0 3195     5
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.01 0.00  0.00  0.01 0.36  0.00  0.00 0.46  0.46
Crit Moves:  ****             ****             ****                   ****
********************************************************************************
```

KOA CORPORATION
PLANNING & ENGINEERING

APPENDIX E
Intersection Level-of-Service Worksheets
Year 2012 "With Project Construction" Conditions

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AM Peak With Project      Wed Jul 22, 2009 10:52:38              Page 6-1
--------------------------------------------------------------------------------
                            Haynes Power Station EIR
                   Future With Project Construction Conditions
                                  AM Peak Hour
--------------------------------------------------------------------------------
                       Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Studebaker Road / SR-22 WB Ramps
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):        0.618
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        51                 Level Of Service:                 B
********************************************************************************
Street Name:         Studebaker Road                  SR-22 WB Ramps
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected        Protected        Protected
Rights:          Ignore           Include          Include           Ignore
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   1  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0  614    40    73  697     0    0    0     0  587    0   449
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0  663    43    79  753     0    0    0     0  634    0   485
Added Vol:      0    2     1     0   11     0    0    0     0   40    0     0
PasserByVol:    0    0     0     0    0     0    0    0     0    0    0     0
Initial Fut:    0  665    44    79  764     0    0    0     0  674    0   485
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  665     0    79  764     0    0    0     0  674    0     0
Reduct Vol:     0    0     0     0    0     0    0    0     0    0    0     0
Reduced Vol:    0  665     0    79  764     0    0    0     0  674    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  665     0    79  764     0    0    0     0  674    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  0.00
Final Sat.:     0 3200  1600  1600 3200     0    0    0     0 3200    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.21  0.00  0.05 0.24  0.00  0.00 0.00  0.00  0.21 0.00  0.00
Crit Moves:       ****        ****                              ****
********************************************************************************
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                        Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #2 Studebaker Road / SR-22 EB Ramps
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.532
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        63                Level Of Service:                  A
********************************************************************************
Street Name:         Studebaker Road                    SR-22 EB Ramps
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected       Split Phase      Split Phase
Rights:           Ignore          Include          Include          Ignore
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    2  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      0  550  1195   237 1069     0     0    0     0     7    0    75
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   0  594  1291   256 1155     0     0    0     0     8    0    81
Added Vol:     0    3     5     0   51     0     0    0     0     8    0     0
PasserByVol:   0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   0  597  1296   256 1206     0     0    0     0    16    0    81
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:    0  597     0   256 1206     0     0    0     0    16    0     0
Reduct Vol:    0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   0  597     0   256 1206     0     0    0     0    16    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:   0  597     0   256 1206     0     0    0     0    16    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  1.00
Final Sat.:    0 3200  1600  1600 3200     0     0    0     0  2880    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.19  0.00  0.16 0.38  0.00  0.00 0.00  0.00  0.01 0.00  0.00
Crit Moves:                        ****                          ****
********************************************************************************
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                            Haynes Power Station EIR
                   Future With Project Construction Conditions
                                  AM Peak Hour
-------------------------------------------------------------------------------
                       Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
*******************************************************************************
Intersection #3 Studebaker Road / AES Plant Driveway
*******************************************************************************
Cycle (sec):         100                  Critical Vol./Cap.(X):        0.687
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        58                  Level Of Service:                 B
*******************************************************************************
Street Name:         Studebaker Road                   AES Plant Driveway
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted       Protected       Split Phase      Split Phase
Rights:          Include          Include          Include          Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0 1495    15    25 1189     0     0    0     0     6    0    19
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0 1615    16    27 1284     0     0    0     0     6    0    21
Added Vol:      0    8     0     0   59     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0 1623    16    27 1343     0     0    0     0     6    0    21
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0 1623    16    27 1343     0     0    0     0     6    0    21
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0 1623    16    27 1343     0     0    0     0     6    0    21
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0 1623    16    27 1343     0     0    0     0     6    0    21
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  1.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  1600    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.51  0.01  0.02 0.42  0.00  0.00 0.00  0.00  0.00 0.00  0.01
Crit Moves:       ****        ****                                           ****
*******************************************************************************
```

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                           Haynes Power Station EIR
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                                 AM Peak Hour
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Studebaker Road / Loynes Drive
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):        0.709
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        61                 Level Of Service:                 C
********************************************************************************
Street Name:          Studebaker Road                     Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted       Split Phase      Split Phase
Rights:          Include          Include          Include          Include
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  2  0  0    0  0  2  0  1    2  0  0  0  2    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      44 1271     0     0  878   270   339    0    55     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   48 1373     0     0  948   292   366    0    59     0    0     0
Added Vol:      0    8     0     0   59     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   48 1381     0     0 1007   292   366    0    59     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    48 1381     0     0 1007   292   366    0    59     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   48 1381     0     0 1007   292   366    0    59     0    0     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   48 1381     0     0 1007   292   366    0    59     0    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.00  0.00  0.00 2.00  1.00  2.00 0.00  2.00  0.00 0.00  0.00
Final Sat.:  1600 3200     0     0 3200  1600  2880    0  3200     0    0     0
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.43  0.00  0.00 0.31  0.18  0.13 0.00  0.02  0.00 0.00  0.00
Crit Moves:       ****        ****              ****
********************************************************************************
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                           Haynes Power Station EIR
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #5 Studebaker Road / 2nd Street
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):        1.029
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                 Level Of Service:                  F
********************************************************************************
Street Name:           Studebaker Road                     2nd Street
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected         Permitted
Rights:           Include           Ovl             Include            Ovl
Min. Green:     0     0     0     0     0     0     0     0     0     0     0     0
Lanes:        0  0  0  0  0    2  0  0  0  2    2  0  2  0  0    0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0     0   287    0   769  1106  418     0     0  603   345
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0    0     0   310    0   831  1194  451     0     0  651   373
Added Vol:      0    0     0    59    0     0     0   25     0     0    3     8
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0    0     0   369    0   831  1194  476     0     0  654   381
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0    0     0   369    0   831  1194  476     0     0  654   381
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0    0     0   369    0   831  1194  476     0     0  654   381
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0    0     0   369    0   831  1194  476     0     0  654   381
OvlAdjVol:                                                                  176
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  2.00 0.00  2.00  2.00 2.00  0.00  0.00 2.00  1.00
Final Sat.:     0    0     0  2880    0  3200  2880 3200     0     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.13 0.00  0.26  0.41 0.15  0.00  0.00 0.20  0.24
OvlAdjV/S:                                                                  0.11
Crit Moves:                              ****  ****                   ****
********************************************************************************
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                           Haynes Power Station EIR
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #6 PCH / 7th Street
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):        1.210
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                 Level Of Service:                 F
********************************************************************************
Street Name:                 PCH                            7th Street
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Protected        Protected         Permitted        Permitted
Rights:          Include          Include          Include          Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0    2  0  2  1  0    0  0  2  1  0    0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:     189 1339     4   709  956     6     0 1828   129     0 1455   522
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  204 1446     4   766 1032     6     0 1974   139     0 1571   564
Added Vol:      0    0     0     3    3     0     0    3     3     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  204 1446     4   769 1035     6     0 1977   142     0 1571   564
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   204 1446     4   769 1035     6     0 1977   142     0 1571   564
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  204 1446     4   769 1035     6     0 1977   142     0 1571   564
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  204 1446     4   769 1035     6     0 1977   142     0 1571   564
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.99  0.01  2.00 2.98  0.02  0.00 2.80  0.20  0.00 2.00  1.00
Final Sat.:  1600 4786    14  2880 4770    30     0 4478   322     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.13 0.30  0.30  0.27 0.22  0.22  0.00 0.44  0.44  0.00 0.49  0.35
Crit Moves:       ****        ****              ****                  ****
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--------------------------------------------------------------------------------
                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #7 PCH / Bellflower Boulevard
********************************************************************************
Cycle (sec):        100                 Critical Vol./Cap.(X):         0.891
Loss Time (sec):     15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:      104                 Level Of Service:                  D
********************************************************************************
Street Name:                  PCH                        Bellflower Boulevard
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Permitted       Split Phase      Split Phase
Rights:          Include          Include          Include           Ignore
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  3  0  1   1  0  2  1  0   1  0  2  0  1   1  1  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      41 1485   456   160  925    44   110  622    73   228  201    20
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   44 1604   492   173  999    48   119  672    79   246  217    22
Added Vol:      0    0     0     3    0     0     0    6     0     0    1     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   44 1604   492   176  999    48   119  678    79   246  218    22
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:    44 1604   492   176  999    48   119  678    79   246  218     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   44 1604   492   176  999    48   119  678    79   246  218     0
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:   44 1604   492   176  999    48   119  678    79   246  218     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.86  0.14  1.00 2.00  1.00  2.00 2.00  1.00
Final Sat.:  1600 4800  1600  1600 4582   218  1600 3200  1600  2880 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.33  0.31  0.11 0.22  0.22  0.07 0.21  0.05  0.09 0.07  0.00
Crit Moves:       ****        ****                   ****        ****
********************************************************************************
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Haynes Power Station EIR
Future With Project Construction Conditions
AM Peak Hour

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

****

Intersection #8 PCH / Loynes Drive

****

Cycle (sec):	100	Critical Vol./Cap.(X):	0.837
Loss Time (sec):	15 (Y+R=4.0 sec)	Average Delay (sec/veh):	xxxxxx
Optimal Cycle:	86	Level Of Service:	D

****

Street Name:	PCH						Loynes Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2	1 0	1 0	3	0 1	1 0	1	1 0	1 0	2	0 1
Volume Module:												
Base Vol:	52	1772	97	80	912	22	24	234	156	119	180	61
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	56	1914	105	86	985	24	26	253	168	129	194	66
Added Vol:	0	1	0	0	8	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	56	1915	105	86	993	24	26	253	168	129	194	66
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	56	1915	105	86	993	24	26	253	168	129	194	66
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	56	1915	105	86	993	24	26	253	168	129	194	66
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	56	1915	105	86	993	24	26	253	168	129	194	66
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.84	0.16	1.00	3.00	1.00	1.00	1.20	0.80	1.00	2.00	1.00
Final Sat.:	1600	4551	249	1600	4800	1600	1600	1920	1280	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.04	0.42	0.42	0.05	0.21	0.01	0.02	0.13	0.13	0.08	0.06	0.04
Crit Moves:		****		****				****		****		

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                           Haynes Power Station EIR
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #9 PCH / 2nd Street
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         1.097
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                 Level Of Service:                  F
********************************************************************************
Street Name:                 PCH                             2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Protected        Protected        Protected        Protected
Rights:          Include          Include          Include            Ovl
Min. Green:    0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        2  0  2  1  0    1  0  2  1  0    2  0  2  1  1    2  0  3  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:     437 1350   734   147  778   139   215  688   317   267 1022   186
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  472 1458   793   159  840   150   232  743   342   288 1104   201
Added Vol:      0    0    11     8    0     0     0    6     0     2    1     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  472 1458   804   167  840   150   232  749   342   290 1105   202
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   472 1458   804   167  840   150   232  749   342   290 1105   202
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  472 1458   804   167  840   150   232  749   342   290 1105   202
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  472 1458   804   167  840   150   232  749   342   290 1105   202
OvlAdjVol:                                                                   35
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  0.90 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00
Lanes:       2.00 2.00  1.00  1.00 2.55  0.45  2.00 2.75  1.25  2.00 3.00  1.00
Final Sat.:  2880 3200  1600  1600 4072   728  2880 4392  2008  2880 4800  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.16 0.46  0.50  0.10 0.21  0.21  0.08 0.17  0.17  0.10 0.23  0.13
OvlAdjV/S:                                                                 0.02
Crit Moves:             ****  ****             ****                   ****
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                       Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #10 PCH / Studebaker Road
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        0.858
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       97                 Level Of Service:                 D
********************************************************************************
Street Name:                   PCH                        Studebaker Road
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Protected        Protected       Split Phase      Split Phase
Rights:          Include          Include           Ovl             Include
Min. Green:    0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        1  0  3  0  1    1  0  2  0  1    1  1  0  0  1    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      35 2393     5     0 1269    51    87    9   228     1    6     3
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   38 2584     5     0 1371    55    94   10   246     1    6     3
Added Vol:      0   11     0     0    2     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   38 2595     5     0 1373    55    94   10   246     1    6     3
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    38 2595     5     0 1373    55    94   10   246     1    6     3
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   38 2595     5     0 1373    55    94   10   246     1    6     3
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   38 2595     5     0 1373    55    94   10   246     1    6     3
OvlAdjVol:                                                   208
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.00  1.00  1.81 0.19  1.00  0.10 0.60  0.30
Final Sat.:  1600 4800  1600  1600 3200  1600  2900  300  1600   160  960   480
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.02 0.54  0.00  0.00 0.43  0.03  0.03 0.03  0.15  0.01 0.01  0.01
OvlAdjV/S:                                                  0.13
Crit Moves:       ****        ****                          ****       ****
********************************************************************************
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Haynes Power Station EIR
Future With Project Construction Conditions
AM Peak Hour

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #11 Bixby Village Road / Loynes Drive

Cycle (sec):	100	Critical Vol./Cap.(X):	0.300
Loss Time (sec):	10 (Y+R=4.0 sec)	Average Delay (sec/veh):	xxxxxx
Optimal Cycle:	25	Level Of Service:	A

Street Name:	Bixby Village Road						Loynes Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	1!	0 0	0 1	0	0 1	1 0	2	0 1	1 0	1	1 0
Volume Module:												
Base Vol:	30	7	24	32	2	48	45	339	20	10	284	33
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	32	8	26	35	2	52	49	366	22	11	307	36
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	32	8	26	35	2	52	49	366	22	11	307	36
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	32	8	26	35	2	52	49	366	22	11	307	36
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	32	8	26	35	2	52	49	366	22	11	307	36
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	32	8	26	35	2	52	49	366	22	11	307	36
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.50	0.11	0.39	0.94	0.06	1.00	1.00	2.00	1.00	1.00	1.79	0.21
Final Sat.:	787	184	630	1506	94	1600	1600	3200	1600	1600	2867	333
Capacity Analysis Module:												
Vol/Sat:	0.02	0.04	0.04	0.02	0.02	0.03	0.03	0.11	0.01	0.01	0.11	0.11
Crit Moves:		****		****			****				****	

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                           Haynes Power Station EIR
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #12 Seal Beach Blvd. / Westminster Ave
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.701
Loss Time (sec):       5 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        37                Level Of Service:                  C
********************************************************************************
Street Name:         Seal Beach Blvd.                  Westminster Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:           Include           Ovl             Ignore           Include
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0    2  0  3  0  1    2  0  3  0  1    2  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      36  772   161   172  668   228   240  563    25   262  829   170
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   39  834   174   186  721   246   259  608    27   283  895   184
Added Vol:      6    0     0     0    0     6     1    2     1     0   17     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   45  834   174   186  721   252   260  610    28   283  912   184
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Volume:    45  834   174   186  721   252   260  610     0   283  912   184
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   45  834   174   186  721   252   260  610     0   283  912   184
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
FinalVolume:   45  834   174   186  721   252   260  610     0   283  912   184
OvlAdjVol:                                122
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06
Lanes:       1.00 2.48  0.52  2.00 3.00  1.00  2.00 3.00  1.00  2.00 1.66  0.34
Final Sat.:  1700 4220   880  3400 5100  1700  3400 5100  1700  3400 2830   570
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.20  0.20  0.05 0.14  0.15  0.08 0.12  0.00  0.08 0.32  0.32
OvlAdjV/S:                                0.07
Crit Moves:       ****        ****              ****                   ****
********************************************************************************
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                          Haynes Power Station EIR
                 Future With Project Construction Conditions
                                AM Peak Hour
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                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #13 2nd Street / Project Entrance
********************************************************************************
Cycle (sec):          100                 Critical Vol./Cap.(X):         0.598
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         49                 Level Of Service:                  A
********************************************************************************
Street Name:               2nd Street                     Project Entrance
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected         Permitted
Rights:           Include          Include          Include           Include
Min. Green:    0     0     0    0     0     0    0     0     0    0     0     0
Lanes:        0  0  0  0  0   1  0  0  0  1   1  0  2  0  0   0  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      0     0     0     1     0    15     6   758     0     0 1078     5
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   0     0     0     1     0    16     6   819     0     0 1164     5
Added Vol:     0     0     0     4     0    11    85     0     0     0    0    28
PasserByVol:   0     0     0     0     0     0     0     0     0     0    0     0
Initial Fut:   0     0     0     5     0    27    91   819     0     0 1164    33
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    0     0     0     5     0    27    91   819     0     0 1164    33
Reduct Vol:    0     0     0     0     0     0     0     0     0     0    0     0
Reduced Vol:   0     0     0     5     0    27    91   819     0     0 1164    33
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   0     0     0     5     0    27    91   819     0     0 1164    33
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  1.00 0.00  1.00  1.00 2.00  0.00  0.00 1.94  0.06
Final Sat.:    0     0     0  1600     0  1600  1600 3200     0     0 3111    89
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.00 0.00  0.02  0.06 0.26  0.00  0.00 0.37  0.37
Crit Moves:                               ****  ****                   ****
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Studebaker Road / SR-22 WB Ramps
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):         0.955
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                Level Of Service:                  E
********************************************************************************
Street Name:         Studebaker Road                 SR-22 WB Ramps
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|----------------||----------------||----------------||----------------|
Control:        Permitted        Protected        Protected        Protected
Rights:           Ignore           Include          Include          Ignore
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    1  0  1! 0  0
------------|----------------||----------------||----------------||----------------|
Volume Module:
Base Vol:       0  873    34    39 1447     0     0    0     0   919    0   460
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0  943    37    42 1563     0     0    0     0   993    0   497
Added Vol:      0   23    17     0    5     0     0    0     0    16    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0  966    54    42 1568     0     0    0     0  1009    0   497
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:     0  966     0    42 1568     0     0    0     0  1009    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0  966     0    42 1568     0     0    0     0  1009    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:    0  966     0    42 1568     0     0    0     0  1009    0     0
------------|----------------||----------------||----------------||----------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  0.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  3200    0     0
------------|----------------||----------------||----------------||----------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.30  0.00  0.03 0.49  0.00  0.00 0.00  0.00  0.32 0.00  0.00
Crit Moves:                        ****                          ****
********************************************************************************
```

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--------------------------------------------------------------------------------
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       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #2 Studebaker Road / SR-22 EB Ramps
********************************************************************************
Cycle (sec):        100                 Critical Vol./Cap.(X):        0.862
Loss Time (sec):     15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:      180                 Level Of Service:                 D
********************************************************************************
Street Name:          Studebaker Road                     SR-22 EB Ramps
Approach:      North Bound      South Bound       East Bound        West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected        Split Phase       Split Phase
Rights:          Ignore            Include          Include            Ignore
Min. Green:    0    0     0    0    0     0     0    0     0     0    0     0
Lanes:        0  0  2  0  1    1  0  2  0  0    0  0  0  0  0    2  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      0  870   857   296 2058     0     0    0     0    25    0    58
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   0  940   926   320 2223     0     0    0     0    27    0    63
Added Vol:     0   39    79     0   21     0     0    0     0     3    0     0
PasserByVol:   0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   0  979  1005   320 2244     0     0    0     0    30    0    63
User Adj:    1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:    0  979     0   320 2244     0     0    0     0    30    0     0
Reduct Vol:    0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   0  979     0   320 2244     0     0    0     0    30    0     0
PCE Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
MLF Adj:     1.00 1.00  0.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
FinalVolume:   0  979     0   320 2244     0     0    0     0    30    0     0
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  2.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  2880    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.31  0.00  0.20 0.70  0.00  0.00 0.00  0.00  0.01 0.00  0.00
Crit Moves:                        ****                          ****
********************************************************************************
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       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #3 Studebaker Road / AES Plant Driveway
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         0.798
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180                 Level Of Service:                  C
********************************************************************************
Street Name:         Studebaker Road                  AES Plant Driveway
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Permitted        Protected       Split Phase      Split Phase
Rights:          Include          Include          Include          Include
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        0  0  2  0  1   1  0  2  0  0   0  0  0  0  0   1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0 1372    2    8 1868    0    0    0    0    7    0   15
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0 1482    2    9 2017    0    0    0    0    8    0   16
Added Vol:      0  118    0    0   24    0    0    0    0    0    0    0
PasserByVol:    0    0    0    0    0    0    0    0    0    0    0    0
Initial Fut:    0 1600    2    9 2041    0    0    0    0    8    0   16
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0 1600    2    9 2041    0    0    0    0    8    0   16
Reduct Vol:     0    0    0    0    0    0    0    0    0    0    0    0
Reduced Vol:    0 1600    2    9 2041    0    0    0    0    8    0   16
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:    0 1600    2    9 2041    0    0    0    0    8    0   16
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 2.00  1.00  1.00 2.00  0.00  0.00 0.00  0.00  1.00 0.00  1.00
Final Sat.:     0 3200  1600  1600 3200     0     0    0     0  1600    0  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.50  0.00  0.01 0.64  0.00  0.00 0.00  0.00  0.00 0.00  0.01
Crit Moves:                        ****                                     ****
********************************************************************************
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Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #4 Studebaker Road / Loynes Drive

Cycle (sec):	100	Critical Vol./Cap.(X):	0.771
Loss Time (sec):	15 (Y+R=4.0 sec)	Average Delay (sec/veh):	xxxxxx
Optimal Cycle:	71	Level Of Service:	C

Street Name:	Studebaker Road						Loynes Drive					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2 0 0			0 0 2 0 1			2 0 0 0 2			0 0 0 0 0		
Volume Module:												
Base Vol:	74	1178	0	0	1382	585	260	0	79	0	0	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	80	1272	0	0	1493	632	281	0	85	0	0	0
Added Vol:	0	118	0	0	24	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	80	1390	0	0	1517	632	281	0	85	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	80	1390	0	0	1517	632	281	0	85	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	80	1390	0	0	1517	632	281	0	85	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	80	1390	0	0	1517	632	281	0	85	0	0	0
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	0.00	0.00	2.00	1.00	2.00	0.00	2.00	0.00	0.00	0.00
Final Sat.:	1600	3200	0	0	3200	1600	2880	0	3200	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.05	0.43	0.00	0.00	0.47	0.39	0.10	0.00	0.03	0.00	0.00	0.00
Crit Moves:	****				****		****					

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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #5 Studebaker Road / 2nd Street
********************************************************************************
Cycle (sec):         100               Critical Vol./Cap.(X):         1.157
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       180               Level Of Service:                  F
********************************************************************************
Street Name:         Studebaker Road                      2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected         Permitted
Rights:           Include           Ovl            Include            Ovl
Min. Green:    0     0     0     0     0     0     0     0     0     0     0     0
Lanes:        0  0  0  0  0   2  0  0  0  2   2  0  2  0  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      0     0     0   390     0  1178   820   704     0     0   848   498
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   0     0     0   421     0  1272   886   760     0     0   916   538
Added Vol:     0     0     0    24     0     0     0    10     0     0    51   118
PasserByVol:   0     0     0     0     0     0     0     0     0     0     0     0
Initial Fut:   0     0     0   445     0  1272   886   770     0     0   967   656
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    0     0     0   445     0  1272   886   770     0     0   967   656
Reduct Vol:    0     0     0     0     0     0     0     0     0     0     0     0
Reduced Vol:   0     0     0   445     0  1272   886   770     0     0   967   656
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   0     0     0   445     0  1272   886   770     0     0   967   656
OvlAdjVol:                                                                   409
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 0.00  0.00  2.00 0.00  2.00  2.00 2.00  0.00  0.00 2.00  1.00
Final Sat.:    0     0     0  2880     0  3200  2880 3200     0     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.15 0.00  0.40  0.31 0.24  0.00  0.00 0.30  0.41
OvlAdjV/S:                                                                  0.26
Crit Moves:                                ****  ****                 ****
********************************************************************************
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       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
*******************************************************************************
Intersection #6 PCH / 7th Street
*******************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         1.182
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):       xxxxxx
Optimal Cycle:       180                 Level Of Service:                  F
*******************************************************************************
Street Name:                 PCH                            7th Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Permitted        Permitted
Rights:           Include          Include          Include          Include
Min. Green:     0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0   2  0  2  1  0   0  0  2  1  0   0  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:     189  655    11   692  917    15     0 2105   125     0 1834   517
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  204  707    12   747  990    16     0 2273   135     0 1981   558
Added Vol:      6    6     0     1    1     0     0    1     1     0    6     6
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  210  713    12   748  991    16     0 2274   136     0 1987   564
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   210  713    12   748  991    16     0 2274   136     0 1987   564
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  210  713    12   748  991    16     0 2274   136     0 1987   564
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  210  713    12   748  991    16     0 2274   136     0 1987   564
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  0.90 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.95  0.05  2.00 2.95  0.05  0.00 2.83  0.17  0.00 2.00  1.00
Final Sat.:  1600 4721    79  2880 4723    77     0 4529   271     0 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.13 0.15  0.15  0.26 0.21  0.21  0.00 0.50  0.50  0.00 0.62  0.35
Crit Moves:       ****        ****             ****                  ****
*******************************************************************************
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #7 PCH / Bellflower Boulevard
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):         0.808
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        79                 Level Of Service:                  D
********************************************************************************
Street Name:                  PCH                       Bellflower Boulevard
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|----------------||----------------||----------------||----------------|
Control:        Permitted         Permitted       Split Phase      Split Phase
Rights:          Include           Include          Include           Ignore
Min. Green:    0     0     0     0     0     0     0     0     0     0     0     0
Lanes:       1  0  3  0  1    1  0  2  1  0    1  0  2  0  1    1  1  2  0  1
------------|----------------||----------------||----------------||----------------|
Volume Module:
Base Vol:     108   866   382   112   907    68    45   372    55   527   351    14
Growth Adj:  1.08  1.08  1.08  1.08  1.08  1.08  1.08  1.08  1.08  1.08  1.08  1.08
Initial Bse:  117   935   413   121   980    73    49   402    59   569   379    15
Added Vol:      0     0     0     1     0     0     0     2     0     0    11     6
PasserByVol:    0     0     0     0     0     0     0     0     0     0     0     0
Initial Fut:  117   935   413   122   980    73    49   404    59   569   390    21
User Adj:    1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00
PHF Adj:     1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00
PHF Volume:   117   935   413   122   980    73    49   404    59   569   390     0
Reduct Vol:     0     0     0     0     0     0     0     0     0     0     0     0
Reduced Vol:  117   935   413   122   980    73    49   404    59   569   390     0
PCE Adj:     1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00
MLF Adj:     1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.00
FinalVolume:  117   935   413   122   980    73    49   404    59   569   390     0
------------|----------------||----------------||----------------||----------------|
Saturation Flow Module:
Sat/Lane:    1600  1600  1600  1600  1600  1600  1600  1600  1600  1600  1600  1600
Adjustment:  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  1.00  0.90  1.00  1.00
Lanes:       1.00  3.00  1.00  1.00  2.79  0.21  1.00  2.00  1.00  2.00  2.00  1.00
Final Sat.:  1600  4800  1600  1600  4465   335  1600  3200  1600  2880  3200  1600
------------|----------------||----------------||----------------||----------------|
Capacity Analysis Module:
Vol/Sat:     0.07  0.19  0.26  0.08  0.22  0.22  0.03  0.13  0.04  0.20  0.12  0.00
Crit Moves:              ****  ****                    ****        ****
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                  Future With Project Construction Conditions
                                 PM Peak Hour
--------------------------------------------------------------------------------
                        Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #8 PCH / Loynes Drive
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):        0.891
Loss Time (sec):      15 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       104                 Level Of Service:                 D
********************************************************************************
Street Name:                  PCH                           Loynes Drive
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Protected        Protected         Permitted         Permitted
Rights:          Include          Include           Include           Include
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0    1  0  3  0  1    1  0  1  1  0    1  0  2  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:     204 1179   129    69 1443    48    34  220   131   236  364    60
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  220 1273   139    75 1558    52    37  238   141   255  393    65
Added Vol:      0   17     0     0    3     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  220 1290   139    75 1561    52    37  238   141   255  393    65
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   220 1290   139    75 1561    52    37  238   141   255  393    65
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  220 1290   139    75 1561    52    37  238   141   255  393    65
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  220 1290   139    75 1561    52    37  238   141   255  393    65
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 2.71  0.29  1.00 3.00  1.00  1.00 1.25  0.75  1.00 2.00  1.00
Final Sat.:  1600 4332   468  1600 4800  1600  1600 2006  1194  1600 3200  1600
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.14 0.30  0.30  0.05 0.33  0.03  0.02 0.12  0.12  0.16 0.12  0.04
Crit Moves:  ****                  ****                  ****        ****
********************************************************************************
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--------------------------------------------------------------------------------
                           Haynes Power Station EIR
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                        Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #9 PCH / 2nd Street
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):        1.087
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       180                 Level Of Service:                 F
********************************************************************************
Street Name:                  PCH                           2nd Street
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|----------------||----------------||----------------||----------------|
Control:       Protected        Protected        Protected        Protected
Rights:          Include          Include          Include           Ovl
Min. Green:     0    0    0    0    0    0    0    0    0    0    0    0
Lanes:        2  0  2  1  0   1  0  2  1  0   2  0  2  1  1   2  0  3  0  1
------------|----------------||----------------||----------------||----------------|
Volume Module:
Base Vol:     322  918   403   261 1180   315   400  658   305   297 1236   312
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  348  991   435   282 1274   340   432  711   329   321 1335   337
Added Vol:      0    0     5     3    0     0     0    2     0    23   11    17
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  348  991   440   285 1274   340   432  713   329   344 1346   354
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   348  991   440   285 1274   340   432  713   329   344 1346   354
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  348  991   440   285 1274   340   432  713   329   344 1346   354
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  348  991   440   285 1274   340   432  713   329   344 1346   354
OvlAdjVol:                                                                   69
------------|----------------||----------------||----------------||----------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  0.90 1.00  1.00  1.00 1.00  1.00  0.90 1.00  1.00  0.90 1.00  1.00
Lanes:       2.00 2.08  0.92  1.00 2.37  0.63  2.00 2.74  1.26  2.00 3.00  1.00
Final Sat.:  2880 3324  1476  1600 3789  1011  2880 4377  2023  2880 4800  1600
------------|----------------||----------------||----------------||----------------|
Capacity Analysis Module:
Vol/Sat:     0.12 0.30  0.30  0.18 0.34  0.34  0.15 0.16  0.16  0.12 0.28  0.22
OvlAdjV/S:                                                                 0.04
Crit Moves:       ****        ****             ****                  ****
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                          Haynes Power Station EIR
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                                PM Peak Hour
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                     Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #10 PCH / Studebaker Road
********************************************************************************
Cycle (sec):         100                Critical Vol./Cap.(X):        1.128
Loss Time (sec):      18 (Y+R=4.0 sec)  Average Delay (sec/veh):     xxxxxx
Optimal Cycle:       180                Level Of Service:                 F
********************************************************************************
Street Name:                 PCH                          Studebaker Road
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Protected        Protected       Split Phase      Split Phase
Rights:          Include          Include           Ovl            Include
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  3  0  1   1  0  2  0  1   1  1  0  0  1   0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:     155 1460    26    35 1785   119   184   27   336    77   51    38
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:  167 1577    28    38 1928   129   199   29   363    83   55    41
Added Vol:      0    5     0     0   23     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  167 1582    28    38 1951   129   199   29   363    83   55    41
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:   167 1582    28    38 1951   129   199   29   363    83   55    41
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:  167 1582    28    38 1951   129   199   29   363    83   55    41
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:  167 1582    28    38 1951   129   199   29   363    83   55    41
OvlAdjVol:                                                   195
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 3.00  1.00  1.00 2.00  1.00  1.74 0.26  1.00  0.46 0.31  0.23
Final Sat.:  1600 4800  1600  1600 3200  1600  2791  409  1600   742  492   366
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.10 0.33  0.02  0.02 0.61  0.08  0.07 0.07  0.23  0.11 0.11  0.11
OvlAdjV/S:                                                  0.12
Crit Moves:  ****                   ****                    ****  ****
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                           Haynes Power Station EIR
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                       Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #11 Bixby Village Road / Loynes Drive
********************************************************************************
Cycle (sec):         100                 Critical Vol./Cap.(X):        0.391
Loss Time (sec):      10 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:        28                 Level Of Service:                 A
********************************************************************************
Street Name:        Bixby Village Road                  Loynes Drive
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|----------------||----------------||----------------||----------------|
Control:       Permitted        Permitted        Permitted        Permitted
Rights:         Include          Include          Include          Include
Min. Green:    0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        0  0  1! 0  0    0  1  0  0  1    1  0  2  0  1    1  0  1  1  0
------------|----------------||----------------||----------------||----------------|
Volume Module:
Base Vol:      19    5    19    22   16    58    33  334    28    23  587    56
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   21    5    21    24   17    63    36  361    30    25  634    60
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   21    5    21    24   17    63    36  361    30    25  634    60
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    21    5    21    24   17    63    36  361    30    25  634    60
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   21    5    21    24   17    63    36  361    30    25  634    60
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   21    5    21    24   17    63    36  361    30    25  634    60
------------|----------------||----------------||----------------||----------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.44 0.12  0.44  0.58 0.42  1.00  1.00 2.00  1.00  1.00 1.83  0.17
Final Sat.:   707  186   707   926  674  1600  1600 3200  1600  1600 2921   279
------------|----------------||----------------||----------------||----------------|
Capacity Analysis Module:
Vol/Sat:     0.01 0.03  0.03  0.01 0.03  0.04  0.02 0.11  0.02  0.02 0.22  0.22
Crit Moves:  ****                        ****  ****                    ****
********************************************************************************
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                           Haynes Power Station EIR
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #12 Seal Beach Blvd. / Westminster Ave
********************************************************************************
Cycle (sec):          100                Critical Vol./Cap.(X):         0.777
Loss Time (sec):        5 (Y+R=4.0 sec)  Average Delay (sec/veh):      xxxxxx
Optimal Cycle:         48                Level Of Service:                  C
********************************************************************************
Street Name:          Seal Beach Blvd.                  Westminster Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Protected        Protected        Protected        Protected
Rights:          Include           Ovl             Ignore           Include
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:        1  0  2  1  0   2  0  3  0  1   2  0  3  0  1   2  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      76  785   202   237  705   284   353  620    30   231  816   207
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   82  848   218   256  761   307   381  670    32   249  881   224
Added Vol:      2    0     0     0    0     2    11   34    11     0    7     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   84  848   218   256  761   309   392  704    43   249  888   224
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
PHF Volume:    84  848   218   256  761   309   392  704     0   249  888   224
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:   84  848   218   256  761   309   392  704     0   249  888   224
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00  1.00 1.00  1.00
FinalVolume:   84  848   218   256  761   309   392  704     0   249  888   224
OvlAdjVol:                                113
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06  1.06 1.06  1.06
Lanes:       1.00 2.39  0.61  2.00 3.00  1.00  2.00 3.00  1.00  2.00 1.60  0.40
Final Sat.:  1700 4056  1044  3400 5100  1700  3400 5100  1700  3400 2716   684
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.05 0.21  0.21  0.08 0.15  0.18  0.12 0.14  0.00  0.07 0.33  0.33
OvlAdjV/S:                                0.07
Crit Moves:       ****        ****              ****                   ****
********************************************************************************
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                           Haynes Power Station EIR
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                      Level Of Service Computation Report
       ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)
********************************************************************************
Intersection #13 2nd Street / Project Entrance
********************************************************************************
Cycle (sec):          100                  Critical Vol./Cap.(X):         0.756
Loss Time (sec):       15 (Y+R=4.0 sec)  Average Delay (sec/veh):       xxxxxx
Optimal Cycle:         69                  Level Of Service:                  C
********************************************************************************
Street Name:              2nd Street                     Project Entrance
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Split Phase      Split Phase       Protected         Permitted
Rights:           Include          Include          Include           Include
Min. Green:    0    0     0    0    0     0    0    0     0    0    0     0
Lanes:       1  0  0  0  0   1  0  0  0  1   1  0  2  0  0   0  0  1  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      2    0     0    8    0     6   15 1080     0    0 1359     2
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:   2    0     0    9    0     6   16 1166     0    0 1468     2
Added Vol:     0    0     0   56    0   169   35    0     0    0    0    12
PasserByVol:   0    0     0    0    0     0    0    0     0    0    0     0
Initial Fut:   2    0     0   65    0   175   51 1166     0    0 1468    14
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:    2    0     0   65    0   175   51 1166     0    0 1468    14
Reduct Vol:    0    0     0    0    0     0    0    0     0    0    0     0
Reduced Vol:   2    0     0   65    0   175   51 1166     0    0 1468    14
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
FinalVolume:   2    0     0   65    0   175   51 1166     0    0 1468    14
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1600 1600  1600  1600 1600  1600  1600 1600  1600  1600 1600  1600
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       1.00 0.00  0.00  1.00 0.00  1.00  1.00 2.00  0.00  0.00 1.98  0.02
Final Sat.:  1600    0     0  1600    0  1600  1600 3200     0     0 3169    31
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.00  0.00  0.04 0.00  0.11  0.03 0.36  0.00  0.00 0.46  0.46
Crit Moves:  ****                        ****  ****                    ****
********************************************************************************
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