HEALTH RISK ASSESSMENT REPORT
PACIFIC STEEL CASTING COMPANY
1333 SECOND STREET
BERKELEY, CALIFORNIA 94710

Prepared for:

Pacific Steel Casting Company

Berkeley, California

Prepared by:

ENVIRON International Corporation

Emeryville, California

September 24, 2007

Contract No. 03-16476B

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

(*italics indicates file(s) included electronically*)

ACRONYMS

µg/m^3	micrograms per cubic meter
AB2588	Air Toxics "Hot Spots" Information and Assessment Act of 1987
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ATC	Authority to Construct
BAAQMD	Bay Area Air Quality Management District
BPIP	Building Profile Input Program
Cal/EPA	California Environmental Protection Agency
CARB	California Air Resources Board
CBE	Communities for a Better Environment
COPC	Chemical of Potential Concern
CPF	Cancer Potency Factor
CSF	Cancer Slope Factor
DHS	Department of Health Services
EAF	Electric Arc Furnace
EIR	Emission Inventory Report
ENVIRON	ENVIRON International Corporation
ERM	Environmental Resources Management
FID	Flame Ionization Detector
HARP	Hot Spots Analysis & Reporting Program
HI	Hazard Index
HQ	Hazard Quotient
HRA	Health Risk Assessment
HRSA	Heath Risk Screening Analysis
ISCST3	Industrial Source Complex Short Term 3 Model
MEIR	Maximally Exposed Individual Resident
MEIW	Maximally Exposed Individual Worker
MSA	Metropolitan Statistical Area
NCP	National Contingency Plan
OEHHA	Office of Environmental Health Hazard Assessment
PAH	Polycyclic Aromatic Hydrocarbon
PCDDs	polychlorinated dibenzo-p-dioxins
PCDFs	polychlorinated dibenzofurans
PMI	Point of Maximum Impact
PRIME	Plume Rise Model Enhancements
PSC	Pacific Steel Casting Company
RAAC	Risk Assessment Advisory Committee

REL	Reference Exposure Level
TAC	Toxic Air Contaminant
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

As requested by the Bay Area Air Quality Management District (BAAQMD or the "District,"), this Air Toxics Health Risk Assessment (HRA) report is being submitted to the District pursuant to the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB2588) on behalf of Pacific Steel Casting Co. (PSC) of Berkeley, California. The objective of this HRA is to meet the programmatic requirements outlined by the District under AB2588. Under AB2588, PSC's Berkeley Facility ("the Facility") is required to quantify both the air emissions of listed substances (AB2588 substances commonly referred to as toxic air contaminants [TACs]) resulting from operations at the Facility and the potential health impacts of those emissions on nearby populations.

What is the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB2588)?

AB2588 is "designed to provide information to state and local agencies and to the general public on the extent of airborne emissions from stationary sources and the potential public health impacts of those emissions."[1] The primary goals of AB2588 are to require the collection of emission data, identify facilities having localized impacts, quantify health risks (i.e., health risk assessment), notify nearby exposed populations, and/or implement emission or risk reduction programs if the estimated health risks exceed certain threshold levels.

What is a health risk assessment?

The Office of Environmental Health Hazard Assessment (OEHHA) of the California Environmental Protection Agency (Cal/EPA) defines risk assessment as "the characterization (in the present context) of the probability of potentially adverse health effects to people from exposure to environmental chemical hazards."[2] The risk assessment process can be used for a variety of purposes including: permitting, public notification, and risk management decisions.

Risk assessments include the following four components, as defined by OEHHA:[3]

> *Hazard Identification:* identifying if a hazard exists, and if so, identification of chemical(s) of concern (if any) associated with a facility and whether a chemical is a potential human carcinogen and/or is associated with non-cancer adverse health effects.

[1] California Environmental Protection Agency. 2003. *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*. Office of Environmental Health Hazard Assessment. August.
[2] Ibid.
[3] Ibid.

Exposure Assessment: Estimation of the extent of public exposure to each chemical for which potential cancer risk or acute and chronic non-cancer health effects will be evaluated. This involves estimation of facility emissions, modeling of environmental transport, evaluation of environmental fate, identification of exposure routes, identification of exposed populations, and estimation of short-term and long-term exposure levels.

Dose-Response Assessment: The process of characterizing the relationship between exposure to a chemical and the incidence of an adverse health effect in exposed populations.

Risk Characterization: Information obtained from the exposure assessment and dose-response assessment steps are combined to estimate the probability of cancer and non-cancer health effects associated with an estimated exposure.

Risk assessment results are presented as calculated cancer risks and non-cancer hazards during the risk characterization step. Cancer risk estimates represent the probability of cancer (presented as a probability per million people) related to potential exposures to pollutants evaluated in the HRA. Non-cancer hazards are represented as the ratio between the estimated dose (i.e., intake of chemical) and chemical-specific reference exposure level developed and approved by Cal/EPA for a specific health endpoint (e.g., eye or lung irritation). The cancer risk or non-cancer hazard index estimate is then compared to a threshold level that is intended to be protective of public health. This comparison aids the District in issuing permits or prescribing appropriate action(s) to mitigate risks, if needed. If cancer risk estimates exceed a threshold level termed a Notification Level, the facility may also be required to notify impacted populations of potential chemical exposures.

To provide perspective for the results of a risk assessment, OEHHA indicates that the cancer risks estimated in a risk assessment can be "compared to the overall risk of cancer in the general U.S. population" or "to the risk posed by all harmful chemicals in a particular medium, such as air. The cancer risk from breathing current levels of pollutants in California's ambient air over a 70-year lifetime is estimated to be 760 in one million"[4]. Furthermore, the California Department of Health Services (DHS) reports that two in five Californians will be diagnosed with cancer during their lifetime, corresponding to a background cancer risk of 400,000 in one million.[5]

[4] Office of Environmental Health Hazard Assessment (OEHHA) 2001. *A Guide to Health Risk Assessment.* California Environmental Protection Agency.

[5] California Department of Health Services (DHS), California Cancer Registry. 2006. Available at http://www.dhs.ca.gov/cdic.

Risks quantified during the risk assessment process are based primarily on a series of conservative assumptions related to predicted environmental concentrations, exposure, and chemical toxicity. The use of conservative assumptions (i.e., health-protective assumptions) tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions made in risk assessment, the use of conservative assumptions is likely to result in substantial overestimates of exposure, and hence, risk. Specifically, the District states that "the methods used [to estimate risk] are conservative, meaning that the real risks from the source may be lower than the calculations, but it is unlikely that they will be higher."[6]

What is a "significant risk" or Notification Level?

The notification level represents a value that the District has deemed triggers a requirement on the part of the Facility to notify all affected persons, with either a letter to individuals, or with a newspaper notification. The District notification levels identified for AB2588 assessments are:

- **Cancer risk notification level[7,8]:** 10 in a million
- **Acute and chronic non-cancer notification level[9]:** >10
- **Risk reduction level[10]**: > 100 in a million

For additional reference, the U.S. Environmental Protection Agency (USEPA) National Contingency Plan (NCP) (40 CFR § 300) is commonly cited as the basis for target risk levels (or "significant risks") for risk assessments conducted in regulatory programs outside of the AB2588 framework. According to the NCP, an acceptable site-specific lifetime incremental cancer risk falls within the range of 1 in a million (1×10^{-6}) to 100 in a million (1×10^{-4}). Cancer risks below or within the range of 10^{-6} to 10^{-4} are generally considered protective of human health by the USEPA.

How was this health risk assessment conducted?

This HRA evaluates the potential impacts to human health in the vicinity of the PSC Facility under two scenarios:

---

[6] Bay Area Air Quality Management District (BAAQMD). 2007a. *Frequently Asked Questions – Toxic Air Contaminants*. Online: http://www.baaqmd.gov/pmt/air_toxics/faq.htm. Accessed: July.
[7] BAAQMD. 2004. *Toxic Air Contaminant Control Program, Annual Report.* June.
[8] California Air Resources Board. 2005. *District Prioritization Scores and Risk Threshold Values.* Updated August 25. Online: http://www.arb.ca.gov/ab2588/district_levels.htm. Accessed: July.
[9] Ibid.
[10] Ibid.

- **Existing Operational Conditions**: Under this scenario, ENVIRON International Corporation (ENVIRON) evaluated the potential impacts to human health resulting from exposure to facility emissions under current operational conditions and controls as outlined in the District-approved[11] AB2588 Emission Inventory Report (EIR) previously conducted by ENVIRON.[12]
- **Future Controlled Conditions:** Under this scenario, ENVIRON evaluated the potential impacts to human health resulting from exposure to Facility emissions with the additional controls and operational changes either already implemented or being implemented at the Plants (Plants 1 and 3) within the facility. These changes are being implemented, in part, as a result of two separate settlement agreements reached with the District and with Communities for a Better Environment (CBE).

The methodologies used to complete this HRA are based on the District-approved Revised Modeling Protocol for Pacific Steel Casting Health Risk Assessment[13] and the Protocol Addendum,[14] approved by the District on March 28, 2007.[15]

As prescribed in guidance and recommended by the District, CARB's *Hot Spots Analysis and Reporting Program* (HARP, version 1.3) was used to complete the health analysis portion of the HRA. HARP is a software program designed to assist in the implementation of the programmatic requirements of health risk assessment guidelines under AB2588.

What are the health risks estimated for the PSC facility under the AB2588 framework?

The results of this HRA indicate that cancer risks and non-cancer hazard indices estimated for individuals who may be exposed to Facility emissions under existing operational conditions and who reside or attend day care or school in areas surrounding the Facility that are designated as Residential or Mixed-Use Light Industrial zones **do not** exceed the Notification Levels established by the District.

[11] BAAQMD. 2007a. Letter from Brian Bateman, Director Engineering Division of BAAQMD to Joe Emmerichs, General Manager of Pacific Steel Casting Company regarding Final Emissions Inventory Report, February 23.
[12] Final Emission Inventory Report, submitted to the BAAQMD on February 15, 2007.
[13] Environmental Resources Management. 2005. Revised Modeling Protocol for Pacific Steel Casting Heath Risk Assessment. August.
[14] Addendum to Modeling Protocol for Pacific Steel Casting Health Risk Assessment, submitted to the BAAQMD on March 26, 2007.
[15] BAAQMD. 2007c. Letter from Brian Bateman, Director Engineering Division of BAAQMD to Joe Emmerichs, General Manager of Pacific Steel Casting Company regarding Addendum to Modeling Protocol, March 28.

Further, only those individuals who may work or live in the area designated as a Manufacturing zone may be located in areas where the estimated cancer risks exceed the District Notification Level (10 in a million) as shown in Figures ES.1 and ES.2.[16] The City of Berkeley zoning requirement generally prohibits individuals from residing in areas zoned Manufacturing.[17] However, the City of Berkeley appears to have granted a limited number of use permits for individuals to reside in certain live/work studios adjacent to the Facility despite their location in a Manufacturing zone.

For all populations considered in this HRA, the estimated cancer risks associated with potential exposure to facility emissions are below the District risk reduction level (100 in a million) and are within the range of risks (1 in a million to 100 in a million) considered by USEPA to be protective of human health.

Adverse non-cancer health effects are not expected due to exposure to Facility emissions because the estimated chronic and acute non-cancer hazard indices for all receptors are below the District non-cancer Notification Level. In addition, the estimated maximum 30-day average lead concentration is less than the lead threshold (0.12 micrograms per cubic meter [$\mu g/m^3$]) established by Cal/EPA[18] to be protective of children, the most sensitive population when considering lead exposures.

What is a cancer burden analysis?

At the request of the District, PSC also performed a cancer burden analysis. Although a cancer burden analysis is not required under AB2588, the District may request that a facility perform a cancer burden analysis in addition to the standard risk assessment described above. A cancer burden analysis is a form of population-level risk evaluation that is commonly used for risk communication purposes to provide perspective on the magnitude of the potential public health impacts posed by a facility. The cancer burden was estimated following methods recommended in OEHHA Hot Spot Guidance. The results of the cancer burden analysis provide an estimate of the number of excess cancer cases in the exposed population expected from lifetime (70-year) exposure to current estimated facility emissions. The methods used and findings of the cancer burden analysis performed for PSC are presented in Appendix F of this report. The results of the cancer burden analysis indicate that less than one case (0.015) of cancer would be expected within the zone of impact of the Facility under both existing operational and

[16] Figure ES.2 presents the off-site worker cancer risk isopleth for the 8-hour shift from 12 am to 8 am. This shift represents the largest isopleth for the three worker shifts modeled in this HRA.

[17] City of Berkeley, California. 1999b. *Berkeley Zoning Code, Chapter 23E.72 M Manufacturing District Provisions*, http://www.ci.berkeley.ca.us/bmc/berkeley%5Fzoning%5Fcode/Sub-Title_23E/72/index.html, accessed April 16, 2007.

[18] Cal/EPA. 2001. *Risk Management Guidelines for New, Modified, and Existing Sources of Lead.* California Air Resources Board. March.

future controlled conditions. Therefore, it is unlikely that a single case of cancer will occur as a result of exposure to Facility emissions.

What actions are being taken by PSC to reduce risks?

Since submission and approval of the EIR, PSC began the process of implementing several changes at the Facility to reduce emissions. These changes were incorporated and evaluated under the Future Controlled Conditions scenario presented in the HRA. PSC has entered into two separate settlement agreements, one with the District and the other with CBE. As a result of these settlement agreements, PSC is in the process of making or has made the following changes:

1. Installing an abatement system over the Plant 3 electric arc furnace which will result in decreased emissions from this source.

2. Installing a new, upgraded baghouse and additional ductwork for control of emissions from the electric arc furnace in Plant 1, which will decrease emissions from this source. This modification is completed and is currently operational.

3. PSC has completed its evaluation of a new, lower volatile organic compound (VOC) binder in the Plant 3 mold mixing operations under a 90-day temporary District permit and has applied to the District for a non-temporary permit. Use of the new binder will result in reduced VOC and TAC emissions.

For the first project, PSC has received the Authority to Construct (ATC) needed to install this additional equipment and is in the process of selecting contractors needed to build and install the abatement system. The second project has already been completed and the new control device is operational.

As a result of the implementation of the controls outlined above (i.e., Future Controlled Conditions), it is anticipated that the non-Facility areas within the contours shown on Figures ES.1 and ES.2 will be reduced by up to 57% from Current Operating Conditions to Future Controlled Conditions.

1.0 INTRODUCTION

1.1 Overview

As requested by the Bay Area Air Quality Management District (BAAQMD or the "District," 2005a), this Air Toxics Heath Risk Assessment (HRA) report is being submitted to the District pursuant to the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB2588) on behalf of Pacific Steel Casting Co. (PSC) of Berkeley, California. The objective of this HRA is to meet the programmatic requirements outlined by the District under AB2588. Under AB2588, PSC's Berkeley Facility ("the Facility") is required to quantify air emissions of listed substances (AB2588 substances commonly referred to as toxic air contaminants or TACs) resulting from operations at the Facility and the potential health impacts of those emissions on adjacent populations. To meet the statutory requirements under AB2588, PSC has retained ENVIRON International Corporation (ENVIRON) to quantify both the air emissions of AB2588 substances resulting from operations at the Facility and the potential health impacts of those emissions on adjacent populations. On February 23, 2007 the District approved the Facility's AB2588 Emission Inventory Report (EIR) previously submitted by ENVIRON. This report describes the AB2588 HRA that evaluates potential health impacts from the emissions characterized in the EIR.

Since submission and approval of the EIR, PSC is in the process of implementing several changes at the Facility that will reduce its emissions. These changes are being implemented, in part, as a result of two separate settlement agreements reached with the District and with Communities for a Better Environment (CBE). A first abatement project concerns the installation of an abatement system in Plant 1603 to capture fugitive emissions that result from pouring operations at the electric arc furnace (Source 1). The abatement system is similar to an existing system that has been operating in Plant 703 (Source 27). This project, which is required under the settlement agreement with the District, will result in increased capture efficiency at the Plant 1603 electric arc furnace. PSC has received the Authority to Construct (ATC) needed to install this additional equipment and is in the process of selecting contractors needed to build and install the abatement system.

PSC has also installed a new, state-of-the art baghouse along with the required ductwork to further capture emissions from the electric arc furnace (Source 1) in Plant 187. The new baghouse will result in a capture efficiency that is similar to or exceeds the capture efficiency of the electric arc furnace located at Plant 703.

Finally, PSC has completed its temporary evaluation of a new, lower volatile organic compound (VOC) TECHNISET binder that is used in the Plant 1603 mold mixing operations (Source 14). Because the TECHNISET binder met production specifications under this pilot trial, the facility has applied to the District for a non-temporary permit for the use of the TECHNISET binder which will result in reduced VOC and TAC emissions and is waiting for approval from the District to make this change.

The primary goals of AB2588 are to require the collection of emission data, identify facilities having localized impacts, quantify health risks, notify nearby exposed populations and/or implement emission or risk reduction programs if the estimated health risks exceed certain threshold levels. The threshold levels that are considered significant for notification or risk reduction purposes are not defined in AB2588 but are left to the discretion of the District.

On the subject of notification, AB2588 states:

> "Upon approval of the health risk assessment, the operator of the facility shall provide notice to all exposed persons regarding the results of the health risk assessment prepared pursuant to Section 44361 if, in the judgment of the district, the health risk assessment indicates there is a significant health risk associated with emissions from the facility. If notice is required under this subdivision, the notice shall include all information concerning significant health risks attributed to the specific facility for which notice is required. Any notice shall be made in accordance with procedures specified by the district (California Health and Safety Code, Section 44362 [b])."

According to a *Toxic Air Contaminant Control Program Annual Report* published by the District in 2004, the District has established specific public notification measures for various levels of risk identified under AB2588. Based on this report, the District requires facilities to engage in public notification if the health risks for the facility are Level 1 or greater (maximum cancer risk of ten in a million or greater). ENVIRON was not able to locate documentation from the District reporting the District-required notification level for the non-cancer endpoint and thus relied on levels reported by the California Air Resources Board (CARB) for the District. The Notification Level reported by CARB for the non-cancer endpoint is greater than (>) 10 for chronic and acute non-cancer hazard indices (HI) (CARB 2005). A facility located in the District must also submit a plan to reduce risks from emissions to their facility if the risks exceed 100 in a million (CARB 2005).

The methods developed by the State of California to meet the goals under AB2588 are used by state and local agencies to expedite review of HRAs, allow comparison between different facilities using consistent methodology, and to ensure implementation of the Office of Environmental Health Hazard Assessment (OEHHA) *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* ("OEHHA Hot Spots Guidance," California Environmental Protection Agency [Cal/EPA] 2003a). The District acknowledges that the methods used to quantify risks under AB2588 "are conservative, meaning that the real risks from a source may be lower than the calculations, but it is unlikely that they will be higher (BAAQMD 2007a)." Thus, risks calculated using the OEHHA Hot Spots Guidance (Cal/EPA 2003a) methods are reflective of upper-bound estimates of risk and are not likely representations of the actual risk incurred from exposures associated with the Facility. Rather, risk estimates predicted within the AB2588 framework are intended to provide a consistent point of comparison for significance or notification levels established by each District within the State.

An AB2588 HRA is comprised of three main components: (1) an inventory of TACs emitted from the Facility, (2) air dispersion modeling based on the emission inventory, and (3) a health risk analysis. The methods used to complete this HRA are briefly outlined below and are discussed in detail throughout this report.

1.2 Objectives/Methodology

Consistent with AB2588 requirements, the objective of this HRA is to estimate potential risks to exposed populations in the vicinity of the Facility due to current operational emissions. In addition, this HRA includes an evaluation of the potential change in health risk impacts as a result of additional control measures being implemented at the Facility. These additional control measures are being made, in part, pursuant to separate settlement agreements entered into between the Facility and the District and the Facility and CBE. Thus, this HRA evaluates the potential impacts to human health in the vicinity of the Facility under two scenarios:

- **Existing Operational Conditions:** Under this scenario, ENVIRON evaluated the potential impacts to human health resulting from exposure to facility emissions under current operational conditions and controls as outlined in the District approved AB2588 EIR prepared by ENVIRON.[19]

- **Future Controlled Conditions:** Under this scenario, ENVIRON evaluated the potential impacts to human health resulting from exposure to Facility emissions

[19] Final Emission Inventory Report, submitted to the BAAQMD on February 15, 2007.

with the additional controls that will be installed or used in Plants 187 and 1603. The additional controls include the abatement system in Plant 1603 to capture fugitive emissions that result from pouring operations at the electric arc furnace (Source 1) as well as the upgraded baghouse along with the required ductwork to further capture emissions from the electric arc furnace (Source 1) in Plant 187. This scenario also includes an analysis based on the substitution of the lower-VOC content binder (TECHNISET) for operations at Plant 1603.

The methodologies used to complete this HRA are based on the District-approved Revised Modeling Protocol for Pacific Steel Casting Health Risk Assessment (the "Protocol") (ERM 2005) and the Protocol Addendum ("Addendum") (Appendix C.1), approved by the District on March 28, 2007 (BAAQMD 2007c). The Addendum was developed based on the District's (BAAQMD 2007d) requested changes to the original Protocol, and to comply with the District's requirement to use the current U.S. Environmental Protection Agency (USEPA)-recommended air dispersion model for this HRA. That model is the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 07026 (USEPA 2005a).

In addition, the Addendum incorporated the District's recommendation[20,21,22] to use CARB's *Hot Spots Analysis and Reporting Program* (HARP, version 1.3) to complete the health analysis portion of the HRA. HARP is a software program designed to assist in the implementation of the programmatic requirements of health risk assessment guidelines under AB2588. The methodology implemented in HARP is consistent with the following BAAQMD, Cal/EPA and USEPA risk assessment guidance:

- *Air Toxics Hot Spots Program Risk Assessment Guidelines* ("OEHHA Hot Spots Guidance", CalEPA 2003a),
- *Air Resources Board Recommended Interim Risk Management Policy for Inhalation-based Residential Cancer Risk* (Cal/EPA 2003b),
- *BAAQMD Air Toxics NSR Program Heath Risk Screening Analysis (HRSA) Guidelines* ("BAAQMD HRSA Guidelines", BAAQMD 2005b)
- *Risk Assessment Guidance for Superfund. Volume I – Human Health Evaluation Manual (Part A)* (USEPA 1989),

[20] Personal communication, S. Lutz of the District in conversation with D. Daugherty of ENVIRON on September 21, 2006.
[21] Personal communication, D.Chong of the District by e-mail to M. Posson of ENVIRON on September 25, 2006.
[22] Personal communication, D.Chong of the District in conversation with M. Posson of ENVIRON on September 25, 2006.

In July 2007, PSC submitted the HRA Report to the District for review and comment. District comments on the July 2007 HRA Report were provided in a letter dated August 16, 2007 and are provided in Appendix E. District Comment 1 stated that "the HRA report should include the results of a cancer burden analysis for receptors within the zone of impact (greater than one in a million)." In response, ENVIRON performed a cancer burden analysis. A cancer burden analysis is a form of population-level risk evaluation that is commonly used for risk communication purposes to provide perspective on the magnitude of the potential public health impact posed by a facility. The cancer burden was estimated following methods recommended in OEHHA Hot Spot Guidance. Specifically, the cancer burden was calculated by multiplying the number of people exposed by the cancer risk at the population centroid of each census block. The results of the cancer burden analysis provide an estimate of the number of excess cancer cases in the exposed population expected from a 70-year exposure to current estimated facility emissions. The methods used and findings of the cancer burden analysis performed for PSC are presented in Appendix F of this report.

1.3 Report Organization

This HRA report is divided into seven sections as follows:

Section 1.0 – Introduction: describes the purpose and scope of the HRA and outlines the report organization.

Section 2.0 – Site Characterization: presents an overview of the Facility and surrounding area and discusses current land uses.

Section 3.0 – Quantification of Emissions: briefly summarizes results for the District-approved EIR and discusses modifications to the inventory from the final version submitted to the District on February 15, 2007.

Section 4.0 – Air Dispersion Modeling: describes the methodology for the estimation of ambient air concentrations. This section discusses the selection of the dispersion model, the data used in the dispersion model (terrain, meteorology, source characterization) and the identification of receptors evaluated in this HRA, as well as modeling to evaluate potential lead exposure.

Section 5.0 – Health Risk Analysis Methods: presents methods used to estimate potential cancer risks and chronic and acute non-cancer health effects related to chemical emissions from the Facility.

Section 6.0 – Risk Characterization Results: presents the cancer risk and non-cancer HIs estimated in this HRA. This section also describes the uncertainties

associated with the risk estimates and discusses how these uncertainties may affect the risk assessment conclusions.

Section 7.0 – Summary and Conclusions: summarizes the results and findings of the HRA.

Section 8.0 – References: includes all references cited in this report.

The appendices include supporting information. Appendix A provides key correspondence between the District , PSC and ENVIRON. Appendix B contains information on Facility emissions used to complete the air dispersion modeling. Appendix C provides the supporting information, model inputs and outputs for estimation and air dispersion modeling of operational emissions from BAAQMD-permitted sources at the Site. Appendix D describes how health risks were calculated from model output files and contains the databases used to complete those calculations. District comments on the July 2007 HRA Report and the Facility responses to those comments are provided in Appendix E. Appendix F describes the methods used to perform a cancer burden analysis for the Facility.

2.0 SITE CHARACTERIZATION

2.1 Facility Description

PSC's Berkeley facility produces steel castings that are used in various industries. The castings are produced by pouring molten metal into a mold or around a core that has the shape of the products. Molds and cores are made of sand that has been clay bonded (commonly called green sand) or chemically bonded. In general, the process operations at the Facility include fabrication of molds and cores, melting metal, pouring of the molten metal into the molds/cores, cooling of the casting, separation of the solid casting from the mold/core, post-processing the molds/cores after they are separated from the castings, including sand recycling, and cleaning/finishing the final product.

The Facility is located at 1333 Second Street in Berkeley, California. The general location of the Facility is depicted in Figure 2.1. The Facility is bounded by Gilman Street to the north, 3rd Street (a railroad) to the east, Page Street to the south and Eastshore/Interstate-80/580 to the west, as shown in Figure 2.2. PSC operates processes in three separate buildings or "Plants" located within 200 feet of each other. Plant #1 (BAAQMD Plant 187) uses green sand molds. The green sand consists of approximately 85 to 90 percent sand, 4 to 10 percent bentonite clay, 2 to 5 percent water, and 2 to 10 percent corn starch. Plant #2 (BAAQMD Plant 703), uses phenolic shell binders for the molds and cores. Plant #3 (BAAQMD Plant 1603), uses phenolic no-bake binders for the molds and cores.

All three Plants have allowable emissions under current BAAQMD permits to operate (BAAQMD 2006).

2.2 Surrounding Area

Figure 2.3 shows the zoning information for the area in the immediate vicinity of the Facility, collected from the City of Berkeley Department of Information Technology (City of Berkeley 1999a) and the City of Albany Community Development Department. To the west, the Facility is bordered by city streets and freeways. To the west, on the other side of the freeway, the area between the freeway and San Francisco Bay is an area zoned "specific plan." To the north, east and south, the Facility is immediately surrounded by areas zoned "manufacturing." To the east, beyond areas that are zoned for Manufacturing, are areas zoned Mixed Use-Light Industrial, followed by areas zoned Mixed Use-Residential and Residential moving further east.

Each zone is described as follows:

- **Manufacturing.** The Manufacturing zone is "dedicated unequivocally to manufacturing and industrial uses" and no residents are allowed in this zone. Child Care Centers and Schools are prohibited in manufacturing zones, as well (City of Berkeley 1999b).

- **Mixed Use-Light Industrial.** The traditional uses of the Mixed Use-Light Industrial zone are manufacturing, wholesale trade, and warehousing. Live/work units are available to artisans whose work falls under the designation of Arts/Crafts Studio as defined in Section 23F.04.010 of Berkeley's Zoning Code (City of Berkeley 1999c). Such occupants must be informed in writing of the fact they reside in a Mixed Use-Light Industrial zone whose primary characteristic is light industry. Child Care Centers and Schools are prohibited in Mixed Use-Light Industrial zones (City of Berkeley 1999d).

- **Mixed Use–Residential.** Mixed Use-Residential areas have provisions for light industry, warehouses, and wholesaling, with limits on their hours of operation. Mixed Use-Residential zones also allow typical residential use as long as residences are located at least 150 feet from a Manufacturing or mixed Manufacturing zone, and child care centers and schools are permitted (City of Berkeley 1999e).

- **Residential.** Residential areas have varying restrictions on type of housing but are primarily for non-commercial uses. Residential areas can include child care centers and schools (City of Berkeley 1999f).

- **Specific Plan.** Specific Plan zones require Use Permits for child care centers and schools but do not have generic guidance for land uses permitted (City of Berkeley 1999g).

ENVIRON used the zoning information presented above in an initial attempt to identify potential residential and worker populations surrounding the Facility. ENVIRON then conducted further investigations and file reviews to clarify some existing information that potentially conflicted with zoning information. For example, as only limited residential use is permitted in the areas zoned Mixed Use – Light Industrial, ENVIRON conducted some visual reconnaissance of these areas to determine potential live/work units that may contain residential populations.

In another example, it was initially assumed that no residential populations could occupy areas zoned Manufacturing since residential uses are prohibited in areas with this zoning.

However, PSC had previously identified two locations near the Facility with potential or apparent live/work units that may contain residents:

1. Several buildings in the Tannery Complex located at 1300 4th Street (directly across 3rd Street from PSC's warehouse facility) in an area with a Manufacturing zoning designation, and

2. A collection of artists' live/work studios in a building located at 1450 4th Street (approximately 100 meters southeast of PSC's Plant 1603) in an area with a Mixed Use – Light Industrial zoning designation.

To determine whether residents are allowed to live in the Tannery Complex, even though it is in an area zoned Manufacturing where residential uses are prohibited, ENVIRON obtained the City of Berkeley use permit for the Complex. In the use permit dated May 17, 1994, the City of Berkeley Zoning Adjustments Board appears to have allowed 17 live/work units in the Tannery Complex with the provision that the all future property owners or tenants be notified (in the deed or covenants, conditions and restrictions of the development) that the area is designated for industrial use in the manufacturing district of the West Berkeley Plan. ENVIRON did not independently verify which, if any, of these 17 live/work units are currently occupied with residents. ENVIRON obtained a copy of the Declaration of Covenants, Conditions and Restrictions of the Tannery, recorded September 27, 1996 (Series No. 96-249344, Alameda County Records); though was unable to identify this notification.

In further efforts to determine if there are any other residential properties in areas zoned manufacturing, ENVIRON contacted the City of Berkeley Planning and Development Department[23] to determine if there are additional residential properties with apparent exemptions similar to the Tannery Complex. The Planning and Development Department staff indicated that the City does not currently maintain a list of properties that have been granted exemptions for residents to live in areas zoned for manufacturing; however, were in the process of developing one.

In summary, both potential residential and worker populations were identified near the Facility. Based on the City of Berkeley zoning designations, a ground investigation of adjacent properties and an evaluation of the use permit for the Tannery Complex, ENVIRON identified the nearest suspected residential properties to the Facility. By virtue of the City of Berkeley exemption to its zoning designation, the nearest residential property identified based on available information is located in the Tannery Complex located at 1300 4th Street, which is in an area zoned as Manufacturing. The nearest

[23] Personal communication, A. Brooks of the City of Berkeley Planning and Development Department in telephone conversation with M. Keinath of ENVIRON on June 13, 2007.

residential property that is consistent with City of Berkeley zoning designations that allow for residential uses is a series of live/work units at 1450 4th Street in an area zoned Mixed Use – Light Industrial. As the area between PSC Plants and immediately surrounding the Facility is zoned for Manufacturing, worker populations were identified in all areas surrounding the Facility. It should be noted that regulatory defined "sensitive population" locations, such as hospitals, K-12 schools, preschools, child care facilities, and age-care facilities as defined by State and District guidance, were also identified near the Facility. Section 4.7.2 provides a more detailed description of the identification of these locations.

3.0 QUANTIFICATION OF EMISSIONS

This HRA is based on the AB2588 EIR submitted to the District on February 15, 2007 (attached as Appendix B.1) and approved for use in the HRA by the District in a letter dated February 23, 2007 (BAAQMD 2007b, Appendix A.1). The AB2588 program identifies substances that are required to be quantified in a facility's EIR if they are emitted into the air (CARB 1997). For purposes of this report, these substances will be referred to as chemicals of potential concern or COPCs. Emissions from both permitted sources and sources exempt from District permitting requirements ("exempt sources") were quantified for the EIR. Details about methodology used to estimate emissions and the type and efficiency of emissions control equipment present on each source can be found in the EIR (Appendix B.1).

3.1 Modifications to February 15, 2007, EIR

In response to comments from the District (BAAQMD 2007e) on a previous version of the EIR, ENVIRON has made several modifications to the February 15, 2007 EIR. The District provided PSC with three comments to address in preparing the emissions inventory used for this HRA: 1) to estimate emissions of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs) from the Plant 703 pour/cool area, 2) to determine mass emission rates and control efficiencies that are representative of current operations at the Plant 1603 carbon adsorption system, and 3) to incorporate abatement device control efficiencies for the Plant 1603 exempt finishing sources. The District subsequently requested two additional inclusions: 1) incorporation of results from a source test of Plant 1603 EAF fugitive emissions conducted by the District on March 7-8, 2007 and 2) incorporation of naphthalene emissions from the Plant 1603 Mold Mixing Area. The following sections address these outstanding comments and additional requests from the District.

3.1.1 District Mandated Estimation of PCDD/PCDF Emissions from Plant 703

PCDD/PCDF emissions have not been measured in detectible quantities in Plant 703. In May 2006, the District commissioned a source test for PCDDs/PCDFs in the Plant 703 Thermal Sand Recycler (the Avogadro Group, 2006a) in which no PCDDs/PCDFs were measured above detection limits. The District did not evaluate potential PCDD/PCDF formation in the pour area (Source S29) of Plant 703 as they did for the pour/cool area (S19) of Plant 1603. The District maintains that the level of dioxin formation at the pour areas of Plants 703 and 1603 is directly related to the aromatic content in binder used to make sand molds. PSC

does not agree with this assumption as no supporting scientific information was provided to support this assumption. However, assuming the District's assertion is valid, an analysis, attached in Appendix B.2, was conducted to determine the total aromatics in the binders used in Plants 703 and 1603. Calculations show that the maximum aromatic usage at Plant 703 is roughly 8% that of the average used at Plant 1603 (note this is conservative as the maximum at Plant 703 is compared to an average value from Plant 1603).

If PCDDs/PCDFs were present in the pouring/cooling area of Plant 703 and if aromatic content is a predictor of dioxin formation, then the concentrations of PCDDs/PCDFs in the pouring/cooling area of Plant 703 would theoretically, at a maximum, be approximately 8% of those measured at Plant 1603 pouring/cooling, which is well below the detection limits for PCDDs/PCDFs in source testing conducted by the District. However, as mandated by the District for this HRA, PCDD/PCDF emissions were assumed for Plant 703 Source S29/S31 as 8% of the emission factor used for Plant 1603 S4/S19.

3.1.2 Revision of Plant 1603 Pour/Cool Area (Sources S4/S19) Emissions

The District determined that the carbon adsorption system and associated Flame Ionization Detector (FID) monitoring system was operating under a shakeout period until early-January 2007. As more data on the mass emission rates were being collected, the District requested that PSC determine mass emission rates and control efficiencies that are representative of current operations at Plant 1603 carbon adsorption system. Using data from the FID monitoring system during the first three complete carbon change-out cycles after the shakeout period (a period from February 5, 2007 through May 22, 2007), PSC personnel determined that the average control efficiency of the carbon adsorption system over that period of operation was 90.5%. The data collected and accompanying analysis used to determine the control efficiency were provided to the District, which subsequently approved the 90.5% control efficiency.[24] As a result, the control efficiency for VOCs routed through a carbon adsorption system at all three Plants was assumed to be 90.5% instead of the 95% originally used in the EIR, with the exception of formaldehyde that was conservatively assumed to not be controlled by the carbon adsorption units. This change resulted in an increase in emissions estimates from the carbon adsorption units in the plants.

[24] Personal communication, S. Lutz of the District by e-mail to D. Daugherty of ENVIRON on June 13, 2007.

3.1.3 Incorporation of Abatement Devices Control for Plant 1603 Exempt Finishing Sources

Some of the exempt finishing sources in Plant 1603 are routed to baghouses; however, to be conservative in the EIR, it was assumed that none of these exempt sources are routed through abatement devices. However, as discussed in ENVIRON's response to the District's comments (see Appendix G of the February 15, 2007 Final Emission Inventory Report, incorporated at Appendix B.1 of this HRA) further information was collected from the Facility to refine emission estimates for these sources. Based on information provided by PSC personnel, the composite control efficiency for these exempt finishing sources is approximately 52%. A discussion of the analysis used to develop this control efficiency is presented in Appendix B.3. For this refined HRA analysis, as a conservative assumption a composite control efficiency of 50% was incorporated into the analysis.

3.1.4 Incorporation of District Source Test on Plant 1603 Source 1 (Electric Arc Furnace) Fugitive Emissions

On April 18, 2007 the District provided ENVIRON with results from their March 6-8, 2007 source test of the Plant 1603 electric arc furnace fugitive emissions (BAAQMD 2007e). In accordance with the District's discussion of the inclusion of additional source test data into the HRA (BAAQMD 2007d) and because of the importance of including this relevant data into PSC's HRA, ENVIRON has incorporated these new source test results into the health risk assessment analysis, superseding the emissions from the Plant 1603 EAF fugitives presented in the EIR.

3.1.5 Incorporation of Naphthalene Emissions from Plant 1603 Mold Mixing Area

As requested by the District, since naphthalene was not measured at the Mold Mixing Area, emissions were estimated based on measured phenol emissions in the Mold Mixing Area and the ratio of phenol to naphthalene emissions measured at S4/19 Pour Area. Naphthalene and phenol are both present in the binders that applied to sand molds in the Mold Mixing Area. Those molds are then moved to the S4/S19 Pour Area where the molten steel is poured, forcing volatilization and oxidation of a portion of the organics present in the binders. As the same potential source of naphthalene and phenol is present at both the Mold Mixing Area and S4/S19 Pour Area, it is appropriate to assume that the relative ratio of phenol to naphthalene is consistent between the two areas.

The source test of the S4/S19 Pour Area indicated phenol emissions of 0.304 lbs phenol per ton steel processed and 0.223 lbs naphthalene per ton steel proceed, for a naphthalene to phenol ratio of 0.74. At the Mold Mixing Area, the source test indicated 0.0024 lbs phenol per ton sand processed. Applying the 0.74 ratio of phenol naphthalene to phenol yields a naphthalene emission rate of 0.0018 lbs per ton sand at the Mold Mixing Area.

3.1.6 Correction to Plant 1603 Sources 4/19 Pour Area Fugitive Emissions of Volatile Organic Compounds

Due to a transcription error, the fugitive emissions of volatile organic compounds from Plant 1603 Sources 4/19 Pour Area were represented incorrectly (overestimated) in the February 15, 2007 EIR. This transcription error has been corrected and is reflected in the revised emissions.

3.2 Summary of Emissions Estimates used for HRA

As discussed in Section 1.2, this HRA addresses two operational scenarios:

1. Existing Operational Conditions, and
2. Future Controlled Conditions.

Emissions were estimated for each operating scenario. Details of the emissions estimates for each operating scenario are discussed below.

3.2.1 Existing Operational Conditions

For this scenario, ENVIRON evaluated the emissions under current operational conditions and controls as outlined in the District approved AB2588 Emission Inventory Report (EIR) conducted by ENVIRON (Appendix B.1) with the modifications described in the previous section (Section 3.1). Table 3.1 presents a summary of the total quantities of COPCs potentially emitted at each Plant for this emissions scenario. Revised versions of emissions in Tables 5-7 of the EIR (Appendix B.1), incorporating the changes discussed above, are presented in Appendix B.4.

3.2.2 Future Controlled Conditions

For this scenario, ENVIRON evaluated emissions with the additional controls and operational changes to be installed or used in Plants 187 and 1603 made, in part, pursuant to separate settlement agreements between the Facility and the District and CBE (as discussed in Section 1.1). This emission scenario is based on the

Existing Operating Conditions Scenario (Section 3.2.1), incorporating all the changes listed in Section 3.1, as well as several modifications currently under implementation at PSC. This Future Controlled Conditions Scenario includes the following modifications to the facility:

- Installation of an abatement system in Plant 1603 to capture fugitive emissions that result from pouring operations at the electric arc furnace (Source 1). The abatement system is similar to an existing system that has been operating in Plant 703 (Source 27) and will result in an increased capture efficiency,

- Installation of an upgraded baghouse and additional ductwork for control of emissions from the electric arc furnace (Source 1) in Plant 187, which will also result in a capture efficiency that meets or exceeds the capture efficiency of that of Plant 703, and

- A switch to a lower volatile organic compound (VOC) binder (TECHNISET) in mold mixing operations (Source 14) located at Plant 1603.

These combined changes result in the reduction of estimated TAC emissions from the Facility by approximately 1,000 pounds per year, in addition to further reductions in criteria pollutants such as VOCs and particulate matter. Table 3.2 presents a summary of the total quantities of COPCs potentially emitted at each Plant under the Future Controlled Conditions Emissions Scenario. Revised versions of emissions in Tables 5-7 of the EIR (Appendix B.1), incorporating the changes discussed above for this scenario, are presented in Appendix B.5.

4.0 AIR DISPERSION MODELING

ENVIRON used air dispersion modeling to estimate ambient COPC concentrations for the Facility emissions characterized in the EIR. The air dispersion analysis was performed in accordance with USEPA, CARB and District modeling guidelines (USEPA 2005a, Cal/EPA 2003a, BAAQMD 2005b). The results of the air dispersion analysis were used in conjunction with the chemical-specific emissions rates discussed in Section 3.2 and Appendices B.4 and B.5 to estimate ambient COPC concentrations.

As discussed in Section 1.0, the methodologies used to conducted the air dispersion modeling are based on the District-approved Revised Modeling Protocol for Pacific Steel Casting Health Risk Assessment (the "Protocol") (ERM 2005) and the Protocol Addendum ("Addendum") (Appendix C.1), approved by the District on March 28, 2007 (BAAQMD 2007c). The Addendum was developed based on the District's (BAAQMD 2007d) requested changes to the original Protocol, and to comply with the District's requirement to use the current USEPA-recommended air dispersion model, AERMOD, for this HRA,

The air dispersion analysis requires the following: 1) selection of the dispersion model, 2) identification of source parameters and operating schedules, 3) evaluation of building downwash effects, 4) preparation of meteorological data, 5) evaluation of potential terrain considerations, 6) selection of appropriate dispersion coefficients based on land use, 7) selection of receptor locations, and 8) selection of appropriate averaging time periods. The following sections describe each of these steps.

Appendices C.2 through C.7 provide electronic files related to the air dispersion modeling analysis.

4.1 Air Dispersion Model Selection

At the District's direction for this HRA (BAAQMD 2007d), ENVIRON used the AERMOD version 07026, the USEPA recommended air dispersion model (USEPA 2004). AERMOD was developed as a replacement for USEPA's ISCST3 air dispersion model to improve the accuracy of air dispersion model results for routine regulatory applications and to incorporate the progress in scientific knowledge of atmospheric turbulence and dispersion. This change was made in November 2005 (USEPA 2005a). After a one-year transition period for the change in model (i.e., as of November 9, 2006), ISCST3 was no longer considered a USEPA-approved model for certain regulatory applications.

AERMOD is appropriate for use in estimating ground-level short-term ambient air concentrations resulting from non-reactive buoyant emissions from sources located in simple and complex terrain. ENVIRON conducted the air dispersion analysis using AERMOD in the regulatory default mode, which includes the following modeling control options:

- adjusting stack heights for stack-tip downwash (except for building downwash cases),
- incorporating the effects of elevated terrain,
- employing the calms processing routine, and
- employing the missing data processing routine.

4.2 Source Parameters and Operating Schedules

Table 4.1 lists the emission points (e.g., point and volume sources) and associated release parameters for each emission point that were approved by the District for the air dispersion modeling (BAAQMD 2007c). Figures 4.1 through 4.3 identify the location of each emission source at Plants 189, 703 and 1603, respectively. Table 4.1 also indicates which sources (as identified by District source ID) are routed through each emission point. This table is consistent with the emissions tables (Tables 5 through 7) and process flow diagrams (Figures 3 through 6) presented in the EIR (Appendix B.1).

Emission sources operate on different schedules depending on the type of operation (e.g., finishing, pouring, and molding) and the Plant in which they are located. In accordance with (BAAQMD 2000) and Cal/EPA (Cal/EPA 2003a) guidance, to ensure that diurnal emission patterns match the diurnal dispersion characteristics of the ambient air, hourly emission scalars were used to reflect the operation schedules for each emission source. Table 4.1 also shows the operating hours and days of week that were assumed for each emissions source based on operations information provided by PSC personnel.

4.3 Building Downwash

Building downwash is the effect of structures on the dispersion of emissions from nearby point (stack) sources. As most point sources at PSC were identified as adjacent to or on top of buildings, building downwash was considered in this assessment. Building dimensions (i.e., location of building corners and heights of buildings) were either provided by PSC personnel (in the case of onsite buildings) or through the use of aerial photos and a site survey to measure adjacent building heights (for offsite buildings). This information was used along with USEPA's Building Profile Input Program (BPIP) to account for building-induced aerodynamic downwash effects using the Plume Rise

Model Enhancements (PRIME) algorithm. A table of building downwash parameters as well as the BPIP PRIME files input to the model are included as Appendix C.2.

4.4 Urban Heat Island Effect

As determined in the land use analysis discussed in the Addendum, these sources are located in an urban area and have been modeled with the urban boundary layer option selected in AERMOD. As the urban boundary layer is selected, published census data were used to determine the population contributing to the heat island effect, as recommended by USEPA (USEPA 2005a) for input into AERMOD. USEPA guidance (USEPA 2005b) recommends using published census data corresponding to the Metropolitan Statistical Area (MSA) for the model area, in this case the San Francisco-Oakland-Fremont MSA (population 4,123,470; USCB 2003). However, to be conservative for this analysis, estimated population data for Berkeley, Albany, and El Cerrito (total population of 139,606) has been used (USCB 2007).

4.5 Meteorological Data

At the District's direction in the letter to PSC dated January 29, 2007 (Appendix A.3), ENVIRON used meteorological data collected by the District (wind direction, wind speed, and temperature) at the UC Berkeley Richmond Field Station (UC Richmond) for air dispersion modeling as the District determined it to be the most representative meteorological data available for air dispersion modeling at PSC. Meteorological data for use in AERMOD were processed according to the methods in the Addendum to the modeling Protocol (Addendum) submitted to the District March 26, 2007 (Appendix C.1). A description of meteorological data processing can be found in the Addendum and processed meteorological data ready for use in AERMOD are available in Appendix C.3. Note that the version of AERMOD used in this analysis will not accept non-sequential years of meteorological data; therefore observations for 2005 were substituted for the missing 2002, since 2002 did not meet USEPA's completeness criteria. As a result the meteorological file appears to have observations for 2000 through 2004, inclusive; however, the actual observations modeled were for 2000, 2001, 2003, 2004 and 2005. Wind roses for the entire modeling period for the resident scenario and three worker shifts are shown in Figure(s) 4.4 to 4.7.

4.6 Terrain

An important consideration in an air dispersion modeling analysis is whether the terrain in the modeling area is simple or complex (i.e., terrain above the effective height of the emission point). Complex terrain can affect the results of a dispersion analysis involving point and volume sources, but does not affect the predicted results for area sources

(USEPA 2005b). Terrain elevations were obtained from United States Geological Survey (USGS) maps for the following 7.5 Minute Quadrangles: San Quentin, Richmond, Briones Valley, San Francisco North, Oakland West, and Oakland East. Electronic files containing these terrain elevations are included in Appendix C.4. The modeling area for this assessment contains both simple and complex terrain. Since some areas of the model domain contain complex terrain, complex terrain elevations were used in the air dispersion modeling for this HRA.

4.7 Receptor Locations

4.7.1 Grid Receptors

As described in the Protocol (ERM 2005), three resolutions of grid spacing were used at differing distances from the Facility. A fine grid with 20 meter spacing between receptors was used for areas around and up to 500 meters from the Facility. Per District (BAAQMD 2000) and Cal/EPA (Cal/EPA 2003a) guidance, only off-site receptors were evaluated. A coarse grid receptor spacing of 100 meters was used up to two kilometers from the Facility and extra-coarse grid spacing of 1,000 meters was used up to ten kilometers from the Facility. Figure 4.8 shows the grid receptor locations used in this analysis. The grid receptors were used to estimate exposures for residential and worker populations.

4.7.2 Sensitive Receptors

Guidance from the District (BAAQMD 2000) and the Cal/EPA (Cal/EPA 2003a) was used to identify sensitive receptors. Per this guidance, sensitive receptors were placed at sites such as hospitals, K-12 schools, preschools, child care facilities, and age-care facilities. Searches of on-line databases that contain publicly available information, such as those made available by the California Community Care Licensing Division, California Department of Education, Office of Statewide Health Planning and Development, and Yellow Pages were used in this task. Sensitive receptor locations were identified from searches of the following sources:

- California Community Care Licensing Division (http://www.ccld.ca.gov/docs/ccld_search/ccld_search.aspx)
- California Department of Education, California School Directory (http://www.cde.ca.gov/re/sd/)

- California Office of Statewide Health Planning and Development, Licensed Facility Information System (http://alirts.oshpd.ca.gov/LFIS/LFISHome.aspx)
- Yellow Pages (yp.yahoo.com)

These on-line databases were searched for the following zip codes in the cities of Albany and Berkeley encompassed in the modeling domain: 94702, 94703, 94704, 94705, 94706, 94707, 94708, 94709, 94710 and 94720.

These searches identified 152 child care centers, K-12 schools, hospitals, and retirement facilities. In addition to the resources searched, the District provided ENVIRON with several additional sensitive receptor locations for evaluation. These are also included in the analysis, with the exception of the Childtime Learning Center previously located at 711 Harrison St., Berkeley, California. Childtime Learning Center is no longer in operation and as such is not included as a sensitive receptor in this HRA. Table 4.2 lists all sensitive receptors evaluated in the HRA. Sensitive receptor locations are also shown in Figure 4.9.

4.8 Averaging Time

Calculation of chemical concentrations for use in exposure analysis requires the selection of appropriate concentration averaging times. Multiple dispersion averaging times are used in this analysis and are discussed below. The AERMOD model input and output files used to estimate long- and short-term dispersion factors are presented as an electronic attachment in Appendices C.5 and C.6, respectively. The use of these dispersion factors to estimate exposure point concentrations for the risk calculations is discussed in Appendix D.

4.8.1 Long Term

Average concentrations over the five-year span of the UC Richmond meteorological data were calculated for each COPC for use in estimating potential residential cancer risks and chronic non-cancer health effects. In order to evaluate potential cancer risks for offsite workers, average concentrations were also calculated for three periods corresponding to typical 8-hour worker shifts: 8:00 am to 4:00 pm, 4:00 pm to 12:00 am, and 12:00 am to 8:00 am, as per OEHHA Hot Spots Guidance (Cal/EPA 2003a).

OEHHA Hot Spots Guidance does not explicitly address the OEHHA-recommended approach for estimating a chronic hazard quotient (HQ) for a worker. Consequently, ENVIRON contacted OEHHA to seek clarification on the

method preferred by OEHHA. OEHHA stated that they require use of the 8-hour shift concentration rather than the annual average concentration when estimating a chronic HQ for a worker.[25] Based on this discussion, the 8-hour shift concentrations described above were also used to estimate chronic non-cancer health effects for workers. As noted earlier in Section 4.2, operating schedules for each emission source were incorporated into the modeling to match diurnal emission patterns with diurnal dispersion characteristics of ambient air. These operating schedules were also used in estimating the average air concentrations during each of the three assumed offsite worker shifts. As discussed in Section 5.4.2, use of the concentrations corresponding to an 8-hour shift to evaluate chronic non-cancer health effects for workers is conservative and likely overestimates the non- cancer effects associated with worker exposure to Facility emissions. To address the uncertainty associated with use of an 8-hour shift concentration in the worker non-cancer evaluation, the District and OEHHA have recommended use of a worker adjustment factor for manganese which is discussed in Section 5.4.2.[26]

4.8.2 Short Term

Maximum short-term concentrations (one-hour averages) of the five-year period modeled were calculated using maximum hourly emission rates to estimate acute non-health effects in the databases in Appendix C.6. One hour maximum source-specific concentrations were summed regardless of time of occurrence (i.e., hour of year), which can differ by source, thereby conservatively overestimating the true one hour maximum at any one time.

4.8.3 30-Day Rolling Average for Inorganic Lead Evaluation

A maximum 30-day rolling average lead concentration was also evaluated for the five years of UC Richmond meteorological data used as described in Cal/EPA guidance (Cal/EPA 2001). For the purpose of obtaining a rolling average, AERMOD was run for two sets of sequential years, one for 2000 and 2001 and the other for 2003 through 2005. In order to calculate a 30-day rolling average, ENVIRON used an add-on supplied with BREEZE AERMOD / ISC software package that takes an AERMOD output file (with a .pct extension) and calculates rolling averages based on a specified period, in this case 30 days (720 hours).

[25] Personal communication, R. Bliasdell of OEHHA in conversation with G. Caviness of ENVIRON in March 2007.

[26] Personal communication, S. Lutz of the District by e-mail to D. Daugherty of ENVIRON, September 10, 2007.

ENVIRON analyzed monthly steel production rates over a period from January 1, 2005 though December 31, 2006 to evaluate variations in production that could cause an individual 30-day average to be higher than that predicted using the annual average production rates. Over the period evaluated, the highest single production month was approximately 21% over the two-year average production rate. Therefore, the emission rates used for the inorganic lead analysis were conservatively assumed to be 25% above the annual emission rates so the maximum 30-day rolling average air concentration would be conservatively estimated for peak production periods.

The emission rates used are tabulated in Appendix C.7. Results from AERMOD and the RunAvg utility can also be found as an electronic attachment in Appendix C.7 and are discussed in Section 6.5.

5.0 HEALTH RISK ANALYSIS METHODS

The purpose of this section is to describe the methods ENVIRON used to evaluate the health impacts associated with potential exposure to Facility emissions under Existing Operational Conditions and Future Controlled Conditions. As indicated in the HRA Protocol (ERM 2005), the health risk calculations were conducted using the CARB's HARP (HARP, version 1.3, Cal/EPA 2006). HARP is a software program designed to assist in the implementation of the programmatic requirements of health risk assessment guidelines under AB2588. HARP joins air modeling and risk assessment techniques identified in the OEHHA Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments ("OEHHA Hot Spots Guidance," Cal/EPA 2003a) and the Air Resources Board Recommended Interim Risk Management Policy for Inhalation-based Residential Cancer Risk (Cal/EPA 2003b). The guidelines implemented by HARP are also consistent with those outlined by the District in the BAAQMD Air Toxics NSR Program HRSA Guidelines ("District HRSA Guidelines") for air permitting purposes under AB2588 (BAAQMD 2005b).

The stated purpose of HARP is to ensure state-wide consistency with AB2588 risk assessment procedures. The use of consistent risk assessment methods is preferred by state and local agencies to expedite review of HRAs, allow comparison of various facilities, and ensure implementation of the OEHHA Hot Spots Guidance (Cal/EPA 2003a). As previously discussed, AERMOD was used to estimate exposure point concentrations under the direction of the District (BAAQMD 2007d). Since AERMOD is incompatible with the current version of HARP, all air modeling was conducted independent of HARP. To accommodate this fact, the District recommended that HARP could be used to generate "HARP-Factors."[27,28,29] These factors represent the mathematical combination of the toxicity values and exposure parameters specific to this HRA as required under AB2588. The HARP-Factors are then combined with the air modeling results to estimate health risks. Risk results estimated using the HARP-Factor approach are mathematically equivalent to the results that would be obtained using HARP. The assumptions and methods used to derive and apply the HARP-Factors are described in this section.

[27] Personal communication, S. Lutz of the District in conversation with D. Daugherty of ENVIRON on September 21, 2006.
[28] Personal communication, D.Chong of the District by e-mail to M. Posson of ENVIRON on September 25, 2006.
[29] Personal communication, D.Chong of the District in conversation with M. Posson of ENVIRON on September 25, 2006.

Because the toxicity values and exposure factors within HARP represent health-protective upper-bound parameters and assumptions, risks estimated using HARP likely overestimate the true risks attributable to emissions from a given facility. Risk assessment results estimated using HARP do not represent site-specific conditions in the vicinity of a specific facility, nor are they likely representations of the actual risk incurred from exposures associated with the facility. As stated by the District (BAAQMD 2007a), "the methods used are conservative, meaning that the real risks from the source may be lower than the calculations, but it is unlikely they will be higher."

This section is organized to reflect the four elements of a risk assessment:

1. **Section 5.1 - Hazard Identification:** describes the methods used to select the chemicals that were quantitatively evaluated in the health risk analysis.

2. **Section 5.2 - Exposure Assessment:** provides estimates of the concentrations of the chemicals identified in Section 5.1 and develops estimates of human exposure or intake (dose) based on physiological assumptions (e.g. breathing rate) and activity patterns (e.g. number of years at the same residence).

3. **Section 5.3 – Dose-Response Assessment:** characterizes the relationship between dose and effect of chemicals and describes the sources of the toxicity values used in the HRA.

4. **Section 5.4 - Risk Characterization Methodology:** calculates the estimated incremental lifetime cancer risks, chronic non-cancer hazard index (HI) and acute non-cancer HI using information developed in the previous sections and characterizes the uncertainties associated with the risk estimates.

5.1 Hazard Identification

The EIR (Appendix B.1) and revised emissions tables (Appendices B.4 and B.5) presented a list of chemicals that are potentially released from emission sources at the Facility, as discussed in Section 3.0. These chemicals were identified in the EIR as COPCs and evaluated in the air dispersion analysis described in Section 4.0.

Those COPCs for which carcinogenic risks and non-cancer HIs are quantified in this HRA include only those chemicals that meet the following criteria: (1) The chemical was identified as a COPC in the EIR (Appendix B.1) and (2) the chemical must have a toxicity value listed in HARP.

Table 5.1 shows the complete list of chemicals evaluated in this HRA. The chemical classes evaluated include VOCs, polycyclic aromatic hydrocarbons (PAHs), dioxins, and metals.

5.2 Exposure Assessment

The USEPA (1989) defines exposure as "the contact with a chemical or physical agent" and defines the magnitude of exposure as "the amount of an agent available at human exchange boundaries (i.e., lungs, gut, skin) during a specified time." The components of the exposure assessment include the identification of potentially exposed populations, the estimation of exposure point concentrations, the identification of exposure pathways, and the selection of exposure assumptions and exposure analysis methods to quantify chemical intakes that may result from Facility emissions.

5.2.1 Identification of Potentially Exposed Populations

The potentially exposed populations considered include current residents, off-site workers, and sensitive receptors located within the grid area specified in the Protocol (ERM 2005) and described in Section 4.7.1. Locations of each potentially exposed population were identified based on land use designations and zoning information presented in Section 2.2. As discussed in Section 2.2, by virtue of the apparent exemption by the City of Berkeley to its Manufacturing zoning designation, the nearest residential property identified based on available information is located in the Tannery Complex at 1300 4th Street. This property is within an area zoned as Manufacturing. The nearest residential property that is consistent with City of Berkeley zoning designations that allow for residential uses is a series of live/work units at 1450 4th Street in an area zoned Mixed Use – Light Industrial. As the area between the PSC Plants as well as the land immediately surrounding the Facility is zoned for Manufacturing, worker populations were identified in all of these areas. Sensitive population locations, such as hospitals, K-12 schools, preschools, child care facilities, and age-care facilities as defined by State and District guidance, were also identified near the Facility. Section 4.7.2 provides a more detailed description of the process used to identify these sensitive receptor locations. Figure 2.3 shows the land use designations in the vicinity of the Facility.

Consistent with OEHHA Hot Spots Guidance (Cal/EPA 2003a), risks were estimated at the point of maximum impact (PMI), the location of the maximally exposed individual resident (MEIR), and the location of the maximally exposed individual worker (MEIW). The MEIR and MEIW are defined as the off-site receptor locations where individuals may reside or work with the highest cancer

risk, acute HI, or chronic non-cancer HI, (Cal/EPA 2003a). The PMI is defined as "a location, with or without people currently present, at which the total cancer risk, or total non-cancer risk, has the highest numerical value" (Cal/EPA 2003a). Consistent with OEHHA Hot Spots Guidance (Cal/EPA 2003a) and District HRSA Guidelines (BAAQMD 2005b), the risk at the PMI was calculated assuming individuals live near the Facility boundary; however, individuals do not currently reside at this location. Consequently, the risk results estimated at the PMI location do not reflect actual risks to a specific population. In this assessment, three MEIRs were identified based on identified residential locations within the Manufacturing Zone, Mixed-Use Light Industrial Zone, and Mixed-Use Residential Zone. The MIER identified in the Manufacturing Zone is termed the "MEIR-Manufacturing Zone." It should be noted that the MEIR-Manufacturing Zone was identified based on residential exceptions approved by the City of Berkeley within the manufacturing zone adjacent to the Facility, as described in Section 2.2. The second MEIR is identified as a receptor location within the Mixed-Use Light Industrial Zone located east of the Facility and is termed the "MEIR – Mixed Use - Light Industrial Zone." The MEIR located within the Mixed-Use Residential Zone is termed the "MEIR-Mixed Use Residential Zone." MEIWs were identified for three work-shifts, defined as 8 a.m. to 4 p.m., 4 p.m. to 12 a.m., and 12 a.m. to 8 a.m. While potential cancer risks and non-cancer hazard indices are reported for all three shifts in this HRA, a more focused discussion will be presented for the work-shift with the greatest estimated health impacts.

Potentially sensitive populations were also identified for evaluation. Methods used to identify potentially sensitive receptors in the vicinity of the Facility are described in Section 4.7.2. Risks and HIs were estimated for the maximally exposed sensitive receptor, identified as a child attending the day care facility (Duck's Nest) closest to the Facility. Of the sensitive receptors identified in Section 4.7.2, children attending the Duck's Nest daycare center are the closest to the Facility and incur the greatest exposure to chemicals emitted from the Facility. Hence, it may be assumed that if the risks estimated for this maximally exposed sensitive receptor are acceptable, then risks estimated for other sensitive receptors would also be lower than notification levels defined by the District.

5.2.2 Estimation of Exposure Point Concentrations

Exposure point concentrations are the concentrations of each chemical to which an individual may be exposed at a given receptor location. Chemical concentrations in air at each receptor location were estimated for the Existing Operational and Future Controlled Scenarios based on the air dispersion modeling

described in Section 4.0. The exposure point concentrations used to estimate carcinogenic risks and chronic non-cancer HIs for residential and sensitive receptors are the annual average concentrations of each chemical and are presented in a series of Microsoft Access 2003 databases as Appendix D.

To evaluate potential cancer risks and chronic non-cancer health effects of offsite workers, average concentrations were calculated for three periods corresponding to typical 8-hour worker shifts: 8:00 am to 4:00 pm, 4:00 pm to 12:00 am, and 12:00 am to 8:00 am. As discussed in Section 5.4.2, use of concentrations corresponding to an 8-hour shift to evaluate chronic non-cancer health effects for workers is conservative and likely overestimates the non- cancer effects associated with worker exposure to Facility emissions. To address the uncertainty associated with use of an 8-hour shift concentration in the worker non-cancer evaluation, the District and OEHHA have recommended use of a worker adjustment factor for manganese which is discussed in Section 5.4.2.[30]

OEHHA has recommended a deposition model for use in estimating the amount of a chemical emitted from a Facility that may deposit onto surfaces (e.g. surface soils and vegetation). The deposition modeling recommended in OEHHA Hot Spots Guidance (Cal/EPA 2003a) has been incorporated into HARP. HARP allows for selection of two default deposition rates to account for controlled or uncontrolled emission sources. As the Facility currently has emission sources that are both controlled and uncontrolled (e.g., fugitive), the default deposition rates in HARP of 0.02 and 0.05 meters per second (m/s) were selected for controlled and uncontrolled releases, respectively, and were incorporated into the HARP-Factors. As recommended in OEHHA Hot Spots Guidance, the annual average concentration is used in the deposition modeling for both residents and workers (Cal/EPA 2003a). This recommendation is based on the assumption that a chemical will be deposited and accumulate in the soil over the entire period that the facility operates regardless of whether or not a resident or worker is present at an off-site location.

5.2.3 Exposure Pathways

The exposure pathways evaluated in this HRA were selected in accordance with OEHHA Hot Spots Guidance (2003a) and in consultation with the District.[31,32]

[30] Personal communication, S. Lutz of the District by e-mail to D. Daugherty of ENVIRON, September 10, 2007.
[31] Personal communication, D.Chong of the District by e-mail to M. Posson of ENVIRON on September 25, 2006.
[32] Personal communication, D.Chong of the District in conversation with M. Posson of ENVIRON on September 25, 2006.

Within the AB2588 risk assessment framework, the inhalation pathway must be evaluated for all chemicals.

OEHHA Hot Spots Guidance also requires the evaluation of non-inhalation exposure pathways, referred to as a multipathway analysis, in risk assessments prepared to meet AB2588 regulations. Selection of the additional pathways for a multipathway analysis is specific to the chemical and land use designations in the area impacted by the Facility. The chemicals that must be evaluated in a multipathway analysis are shown in Table 5-1 of the OEHHA Hot Spots Guidance and are programmed into HARP.

The sections below discuss the exposure pathways considered for each potentially exposed population identified in the vicinity of the Facility.

Residents

Consistent with the recommendations of the OEHHA Hot Spots Guidance (Cal/EPA 2003a) for conducting a multipathway analysis, it was assumed that residents considered in this HRA may be exposed to Facility emissions via inhalation, dermal contact with soil, incidental ingestion of soil, ingestion of homegrown produce, and ingestion of mother's milk (PCDDs/PCDFs only).

Since the Facility is located in an urban area with no agricultural areas (e.g. cattle grazing areas) in the vicinity, this HRA does not include an evaluation of potential exposures via ingestion of meat, milk, or eggs. However, potential exposures to chemicals in homegrown produce were evaluated for a resident in this HRA because it is possible that residents in the area may have small vegetables gardens exclusively for personal use.

Ingestion of fish is not considered a complete exposure pathway for residents. A portion of the San Francisco Bay and Berkeley Aquatic Park lie in the immediate area of the Facility. Evaluation of potential impacts on fish that inhabit the San Francisco Bay is not recommended. Specifically, OEHHA states that "although regional air contaminants depositing into the ocean, bays and estuaries are a significant problem, the risks predicted from a single source are relatively insignificant due to tidal flows and dilution (Cal/EPA 2000)." While the Berkeley Aquatic Park is a land locked water body, the City of Berkeley's Department of Recreation and Waterfront prohibits recreational fishing in the lake (City of Berkeley 2007).

Off-Site Workers

Consistent with OEHHA Hot Spots Guidance (Cal/EPA 2003a), off-site workers are assumed to be potentially exposed to facility emissions via inhalation, dermal contact with soil, and incidental ingestion of soil.

Sensitive Receptors

Children at the Duck's Nest daycare facility are assumed to be the most sensitive receptors at potential sensitive receptor locations, where they may be exposed to facility emissions via inhalation, dermal contact with soil, and incidental ingestion of soil.

5.2.4 Exposure Assumptions

For all pathways, default exposure assumptions built into HARP were used in the risk calculations. The exposure assumptions in HARP are consistent with OEHHA Hot Spots Guidance (Cal/EPA 2003b) and District HRSA Guidelines (BAAQMD 2005b). However, the specific exposure assumptions applied to calculate risks are dependent on the exposure analysis method selected to calculate risks, as described below in Section 5.2.5.

5.2.5 HARP Exposure Analysis Methods

HARP allows a user to select from a series of exposure analysis methods. Each method in HARP utilizes exposure assumptions differently, depending on the requirements of a specific regulation (i.e., compliance with CARB's Air Toxics Hot Spots Program) or project need (i.e., provide point estimates for risk management decisions). That is, HARP will select the dominant pathway(s) and assign exposure assumptions depending on the exposure analysis method identified by the user. For this HRA, each exposure analysis method selected was based on recommendations from the District (Personal Communication with D. Chong of BAAQMD 2006a, 2006b), and are described below.

Resident

Consistent with HARP and OEHHA Hot Spots Guidance (Cal/EPA 2003a), cancer risks for residential populations were calculated using the Derived (Adjusted) Analysis Method. This method applies high-end exposure assumptions to the two dominant exposure pathways for each chemical. The remaining pathways are evaluated using average exposure assumptions. If inhalation is one of the two dominant exposure pathways, then it is evaluated using the 80^{th} percentile breathing rate (302 L/kg-day).

As required in OEHHA Hot Spots Guidance (Cal/EPA 2003a) and District HRSA Guidelines (BAAQMD 2005b) for preparing a Tier 1 risk assessment under AB2588, it was assumed that a resident may be exposed to Facility emissions for their entire lifetime (70-years). Cancer risks estimated assuming a residential exposure duration of 70-years are used by State and local agencies for risk management and public notification purposes. Specifically, OEHHA Hot Spots Guidance states that "Lifetime or 70-year exposure is the historical benchmark for comparing facility impacts on receptors for evaluating the effectiveness of air pollution control measures (Cal/EPA 2003a)." Use of the 70-year exposure duration in risk assessments is intended to produce a hypothetical estimate of risk that does not underestimate risks and that can be viewed as an upper-bound estimate. To illustrate the conservative nature of the assumption, it is worth noting that the USEPA has estimated that 50% of the U.S. population lives in the same residence for only nine years, while only 10% remain in the same house for 30 years (USEPA 1997). Adults, moreover, spend only 68-73% of their total daily time at home (USEPA 1997), rather than the 100% assumed in this HRA. Accordingly, the actual risks to residents in the vicinity of the Facility are likely to be significantly lower than those calculated in this HRA.

To address the significant uncertainty associated with assuming that an individual will reside in the same location for a 70-year lifetime, OEHHA has made provisions for using more realistic exposure durations in risk assessment. OEHHA Hot Spots Guidance indicates that "exposure durations of 9-years and 30-years may also be evaluated as supplemental information to show the range of cancer risk based on residency periods (Cal/EPA 2003a)." OEHHA selected these exposure assumptions to coincide with USEPA estimates of average (9-years) and high-end estimates (30-years) of residence time. Thus, estimated cancer risks assuming 30-year and 9-year exposure durations are also presented in this HRA to provide a more realistic range of cancer risks pertaining to actual residency periods. Consistent with OEHHA Hot Spots Guidance (Cal/EPA 2003a), the 9-year exposure scenario was calculated using assumptions for a child. It should be noted that alternative exposure durations were not evaluated in the estimation of non-cancer HIs.

As discussed previously, it was assumed that individuals residing in the vicinity of the Facility may ingest produce obtained from vegetable gardens grown at their homes. Ingestion of homegrown produce is estimated by applying a default parameter of 5.2 percent. This value reflects the percentage of total produce ingested by individuals in an urban setting that is homegrown, and is comprised of root and leafy vegetables.

The Derived (OEHHA) Analysis method was used to calculate chronic non-cancer HIs for the resident. This method, as previously noted, utilizes high-end exposure assumptions to the two dominant pathways for each chemical. The remaining pathways are evaluated using average exposure assumptions.

Off-Site Worker

Consistent with OEHHA Hot Spots Guidance, the Point Estimate Analysis method was used to calculate carcinogenic risks and chronic non-cancer HIs associated with off-site worker exposure to Facility emissions. This method utilizes the standard exposure assumptions for worker populations as defined in OEHHA Hot Spots Guidance (Cal/EPA 2003a) and District HRSA Guidelines (BAAQMD 2005b).

Sensitive Receptor

The Derived (OEHHA) Analysis method described previously was used to calculate risks for the maximally exposed sensitive receptor (i.e., children attending Duck's Nest). Potential exposures of the maximally exposed sensitive receptor were evaluated using a 9-year exposure duration recommended by in District HRSA Guidelines (BAAQMD 2005b). Consistent with District HRSA Guidelines, it was further assumed that children attend school 10 hours per day for 180 days per year (BAAQMD 2005b). Thus, factors of 0.4 (10 hours/24 hours) and 0.5 (180 days/350 days) were applied when estimating carcinogenic risks for the children at the maximally exposed sensitive receptor location. Pursuant to OEHHA Hot Spots Guidance, no adjustment factor was applied when estimating the non-cancer HIs for a child.

5.3 Dose-Response Assessment

The dose-response assessment (also referred to as the toxicity assessment) examines the potential for a chemical to cause adverse health effects in exposed individuals. Toxicity values that are used to estimate the likelihood of adverse effects occurring in humans are identified in this component of the risk assessment process. Toxicity factors in the HARP program were used in this HRA. The HARP program contains the most up to date listing of available inhalation and oral cancer potency factors (CPFs), chronic inhalation and oral reference exposure levels (RELs), and acute RELs developed and/or approved by Cal/EPA for use in AB2588 Air Toxics Hot Spots Program risk assessments. The methods used to evaluate non-cancer effects of lead are described in Section 5.4.4.

5.4 Risk Characterization Methodology

This section describes the methods used to estimate potential adverse effects associated with off-site exposures to chemicals emitted from the Facility. The results of the HRA are presented in Section 6.0. HARP was used to estimate carcinogenic risks and non-cancer HIs associated with potential exposures to emissions from the Facility. At the recommendation of the District,[33,34] the HARP program was used to generate HARP-Factors calculated for each potentially exposed population using the inputs discussed in Sections 5.2 through 5.3. The HARP Factors are included as part of the database used to calculate risks associated with Facility emissions in Appendix D.2. The risk and hazard indices calculated using this approach are mathematically equivalent to the results that would be obtained using HARP, but do not restrict the assessor to use of a single air dispersion model.

The methods used to estimate carcinogenic risk and chronic and acute non-cancer HIs are discussed in Sections 5.4.1, 5.4.2, and 5.4.3. Section 5.4.4. describes the approach used to evaluate potential non-cancer effects of lead. The cancer burden analysis requested by the District is summarized in Section 5.4.5. and discussed in detail in Appendix F.

5.4.1 Carcinogenic Risks

Carcinogenic risks were estimated as the incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to carcinogens potentially present in Facility emissions (USEPA 1989). The estimated risk is expressed as a unitless probability. The equation used to calculate the potential excess cancer risk for each carcinogenic chemical is:

$$Risk_i = C_i \times \text{HARP Factor}_c$$

Where:

$Risk_i$ = Lifetime excess cancer risk from exposure to $chemical_i$

C_i = Average air concentration of $chemical_i$ ($\mu g/m^3$)

HARP Factor_c = Carcinogenic HARP-factor for $chemical_i$ $(\mu g/m^3)^{-1}$

The total cancer risk $(Risk_T)$ is then estimated as follows:

[33] Personal communication, D.Chong of the District by e-mail to M. Posson of ENVIRON on September 25, 2006.

[34] Personal communication, D.Chong of the District in conversation with M. Posson of ENVIRON on September 25, 2006.

$$Risk_T = \sum_{i=1}^{n} Risk_i \ .$$

5.4.2 Chronic Non-cancer Hazards

When evaluating chronic non-cancer effects due to chemical exposures, a hazard quotient (HQ) is established for each constituent. The equations used to calculate a HQ is:

$$HQ_i = \frac{C_i}{HARPFactor_i}$$

Where:

HQ_i	=	Chronic hazard quotient for chemical$_i$
C_i	=	Average air concentration ($\mu g/m^3$)
HARP Factor$_{nc}$	=	Non-cancer HARP factor for chemical$_i$ ($\mu g/m^3$)

To evaluate the potential for adverse non-cancer health effects from simultaneous exposure to multiple chemicals, the HQs for all chemicals that affect the same target organ are summed yielding a HI. The HI is thus estimated as follows:

$$HI_{(eyes)} = \sum HQ_{substance\,1\,(eyes)} + HQ_{substance\,2\,(eyes)}$$

Estimation of an HI for each target organ (also referred to as a segregation of HI by target organ analysis) is recommended by OEHHA because the non-cancer effects of chemicals with different target organs are generally not additive. For this HRA, a segregation of hazard indices analysis was performed for all receptors.

As discussed in Section 4.8.1, OEHHA Hot Spots Guidance (Cal/EPA 2003a) does not explicitly address the OEHHA recommended approach for estimating a chronic HQ for a worker. Consequently, ENVIRON contacted OEHHA to seek clarification on the method preferred by OEHHA. OEHHA stated that they require use of the 8-hour shift concentration rather than the annual average concentration when estimating a chronic HQ for a worker.[35] Based on this

[35] Personal communication, R. Blaisdell, of OEHHA in conversation with G. Caviness of ENVIRON, March 2007.

discussion, the 8-hour shift concentrations described above were also used to estimate chronic non-cancer health effects . In addition, OEHHA Hot Spots Guidance (Cal/EPA 2003a) currently does not recommend adjustment of a chronic HQ to account for the difference between actual worker exposure (typically, 8 hours per day, 5 days per week) and the duration of exposure reflected in the REL (24 hours per day, 7 days per week, for a lifetime) (Cal/EPA 2003a). However, OEHHA has recently acknowledged that this approach likely over-estimates potential worker exposures and thus the chronic HI for workers and is in the process of developing draft guidelines to address the need for exposure adjustments when estimating a chronic HQ for workers.

In anticipation of these guidelines, the District and OEHHA have recommended a worker exposure adjustment factor of 0.357 (applied only for manganese) for use in this HRA.[36] This factor is applied to manganese in this HRA to estimate a chronic HI that reflects actual worker exposure during an 8-hour work day. The adjustment factor for this HRA was provided by the District and OEHHA and was derived using an equation from *Air Toxics Hot Spots Program Risk Assessment Guidelines, Part III, Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels* (Cal/EPA 2000):

$$C_{AVG} = C_{OBS} \times (10\ m^3/day \div 20\ m^3/day) \times (5\ days\ per\ 7\ days/week).$$

Where:

C_{AVG} = Equivalent Exposure-weighted Concentration for a worker assuming exposure to facility emissions occur only during their 8-hour shift for 5 days a week (and they are not exposed to facility emissions after they leave work)

C_{OBS} = 8-hour shift concentration for a worker

$10\ m^3/day$ = breathing rate of a worker, assuming an 8-hour work day

$20\ m^3/day$ = breathing rate of a resident over a 24-hour period

The draft guidelines that are being developed by OEHHA are not available for public review, and are not final and may be subject to change. Further, OEHHA has indicated that the worker exposure adjustment factor may not be applied to all chemicals considered in this risk assessment. This is because it may not be appropriate to apply the adjustment to those chemicals for which the toxicological

[36] Personal communication, S. Lutz of the District in e-mail to D. Daugherty of ENVIRON, September 13, 2007.

endpoint is concentration-dependent rather than dose-dependent. For this reason, OEHHA and the District have recommended use of the worker exposure adjustment factor to estimate the chronic HQ for worker exposure to manganese only (since manganese has been identified as having a dose-dependent toxicological endpoint). The results (see Section 6) are presented for both approaches; (1) chronic HI for a worker estimated using the adjustment factor for manganese recommended by the District and OEHHA and (2) chronic HI for a worker estimated without applying the adjustment factor recommended by the District and OEHHA.

5.4.3 Acute Non-cancer Hazards

The potential for acute effects was evaluated by comparing the annual one-hour maximum concentrations with the acute RELs within the HARP program. Acute HQs were estimated for those chemicals for which an REL was available. The equation used to calculate acute HQs is as follows:

$$HQ_i = \frac{C_i}{REL_i}$$

Where:

HQ_i = Acute hazard quotient for $chemical_i$

C_i = One-hour maximum air concentration for $chemical_i$ ($\mu g/m^3$)

REL_i = Acute non-cancer reference exposure level for $chemical_i$ ($\mu g/m^3$)

ENVIRON conservatively summed the HQs to obtain a target organ-specific HI as follows:

$$HI_{(eyes)} = \sum HQ_{substance1\ (eyes)} + HQ_{substance2\ (eyes)}$$

The acute HIs presented in this HRA conservatively overestimate the true one hour maximum at any one time because one hour maximum air concentrations were summed regardless of time of occurrence (i.e., hour of year) which can differ by source. The District conducted a screening analysis which superimposes impacts from multiple sources at a particular receptor for a particular hour of meteorological data, and determines the overall maximum 1-hour exposure and the particular hour of the year that this condition occurs. The District's analysis

indicated a HI approximately 30% lower than the reported acute HI at one MEIR, emphasizing the conservative nature of the analysis presented in this HRA.

5.4.4 Non-cancer Evaluation of Lead

OEHHA Hot Spots Guidance recommends the methods outlined in Cal/EPA's *Risk Management Guidelines for New, Modified, and Existing Sources of Lead* ("Cal/EPA Lead Guidance") for the evaluation of non-cancer effects of lead under AB2588 (Cal/EPA 2001). In this guidance, Cal/EPA identifies a risk management threshold lead concentration of 0.12 $\mu g/m^3$. This value represents the concentration of lead in air that yields a greater than 10% increase in blood-lead levels for children within a high exposure area. This threshold represents the most stringent threshold lead concentration proposed in the Cal/EPA Lead Guidance. Concentrations below this level are not expected to pose adverse health effects among the exposed population. To evaluate the non-cancer effects of lead in this HRA, the lead threshold concentration of 0.12 $\mu g/m^3$ was compared to the maximum 30-day average concentration of lead, as recommended in the Cal/EPA Lead Guidance.

5.4.5 Cancer Burden Analysis

At the request of the District, ENVIRON performed a cancer burden analysis. A cancer burden analysis is a form of population-level risk evaluation that is commonly used for risk communication purposes to provide perspective on the magnitude of the potential public health impact of a facility. The cancer burden was estimated following methods recommended in OEHHA Hot Spot Guidance. Generally, the cancer burden was calculated by multiplying the number of people exposed by the cancer risk at the population centroid of each census block. The results of the cancer burden analysis provide an estimate of the number of excess cancer cases in the exposed population expected from a 70-year exposure to current estimated facility emissions. The methods used and findings of the cancer burden analysis performed for PSC are presented in Appendix F of this report.

6.0 RISK CHARACTERIZATION RESULTS

The subsections below present the risk results for this HRA. Section 6.1 presents the estimated carcinogenic risk and HI for a resident and, specifically, the MEIR; Section 6.2 presents the risk assessment results for the off-site worker and corresponding MEIWs for the three modeled 8-hour shifts; Section 6.3 presents the results for the sensitive receptor; and Section 6.4 presents the results for the acute non-cancer HIs. Section 6.5 summarizes the findings of the cancer burden analysis. The results of an evaluation of the potential non-cancer effects of exposure to lead are provided in Section 6.6. The risk results and the results for the PMI locations are summarized in Table 6.1a-c. The uncertainties associated with the HRA are discussed in Section 6.6.

To focus the presentation and evaluation of the risk assessment results, the magnitude of the estimated carcinogenic risks and non-cancer HIs are discussed relative to Notification Levels reported by the District (BAAQMD 2004) and CARB. The Notification Level reported by CARB (2005) for the District is ten in one million for cancer effects ("cancer risk Notification Level") and greater than (>) 10 for chronic and acute non-cancer HIs ("non-cancer HI Notification Level). A facility located in the District must also submit a plan to reduce risks from emissions to their facility if the risks exceed 100 in one million.

ENVIRON also compared the risk assessment results to acceptable levels published in the National Contingency Plan (NCP) (40 CFR § 300), which is commonly cited as the basis for target risk levels for risk assessments conducted in regulatory programs outside of the AB2588 framework. According to the NCP, an acceptable site-specific lifetime incremental cancer risk falls within the range of 1 in a million (1×10^{-6}) to 100 in a million (1×10^{-4}). Cancer risks below or within the range of 10^{-6} to 10^{-4} are generally considered protective of human health by the USEPA.

6.1 Resident (MEIR)

The carcinogenic risk isopleths for resident receptors under Existing Operational Conditions and Future Controlled Conditions are shown on Figure 6.1. The isopleths show the area surrounding the Facility where residents have a potential estimated excess lifetime cancer risk of ten in one million if exposed to Facility emissions for a 70-year lifetime. Under Existing Operational Conditions, the ten in one million isopleth is contained within the Mixed-Use Light Industrial and Manufacturing zones and does not extend into the Mixed-Use Residential Zone. The area impacted by a residential lifetime cancer risk of ten in a million or greater is reduced approximated 57% under the Future Controlled Conditions when comparing the isopleths for Existing Operational Conditions

and Future Controlled Conditions. Thus, the Future Controlled Conditions isopleth is contained to the immediate vicinity of the Facility within the Manufacturing Zone and is further distanced from the Mixed-Use Residential zone, as shown on Figure 6.1.

As required in OEHHA Hot Spots Guidance (Cal/EPA 2003a) and District HRSA Guidelines (BAAQMD 2005b) for preparing a Tier 1 risk assessment under AB2588, cancer risks and isopleths were calculated assuming that a resident may be exposed to Facility emissions for their entire lifetime (i.e., 70-years). Cancer risks estimated assuming a residential exposure duration of 70-years are conservative upper-bound estimates used by State and local agencies for risk management and public notification purposes. Because census data indicate that individuals seldom reside at the same location for a lifetime, OEHHA Hot Spots Guidance allows for an evaluation of more representative exposure durations in risk assessments. These more representative exposure durations coincide with USEPA estimates of average (i.e., 9 years) and high-end (i.e., 30-years) of residence time. Thus, estimated cancer risks assuming 30-year and 9-year exposure durations are also presented in this HRA to provide a more realistic upper-bound range of cancer risks pertaining to actual residency periods.

This HRA includes estimated risks for residents at three MEIR locations within the Manufacturing, Mixed-Use Light Industrial and Mixed-Use Residential zones termed the "MEIR-Manufacturing Zone," "MEIR-Mixed-Use Light Industrial," and "MEIR-Mixed-Use Residential," respectively. The estimated risks associated with the three MEIRs are presented in the following sections.

6.1.1 MEIR-Manufacturing Zone

As discussed in Section 2.2, the Manufacturing zone is "dedicated unequivocally to manufacturing and industrial uses" and no residents are allowed in this zone. Child Care Centers and Schools are prohibited in Manufacturing zones, as well (City of Berkeley 1999b). However, the City of Berkeley has apparently approved a land use exemption to allow for live-work units within the Manufacturing zone near the Facility. As discussed in Section 2.2, PSC identified several buildings with live/work units within an area designated as a Manufacturing zoning designation. The location of these buildings, which are located in the Tannery Complex located at 1300 4th street (directly across 3rd Street from PSC's warehouse facility) is shown on Figure 6.2.

The total estimated cancer risk associated with residential exposure to Facility emissions at the MEIR-Manufacturing Zone under Existing Operational Conditions and Future Controlled Conditions are presented in Table 6.1. The estimated cancer risks associated with a lifetime (i.e., 70-years) of exposure under

Existing Operational Conditions is 19 in one million. This risk estimate exceeds the District cancer risk Notification Level of ten in one million. It should be noted though that the USEPA considers cancer risks within the range of one in one million (1×10^{-6}) to one hundred in one million (1×10^{-4}) to be protective of human health. The estimated cancer risk for a resident under Existing Operational Conditions assuming a 30-year exposure duration (8.2 in one million) and 9-year exposure duration (5.3 in one million) are below the District cancer risk Notification Level.

The chemical-specific cancer risks associated with the 70-year residential exposure scenario under Existing Operational Conditions at the MEIR-Manufacturing Zone are presented in Table 6.2. The risk estimate at the MEIR-Manufacturing Zone is primarily attributable to hexavalent chromium (35%), arsenic (21%), cadmium (12%), and nickel (9%). As shown in Table 6.3, 69% of the total cancer risk is attributed to inhalation exposures, followed by dermal (15%), soil ingestion (9%), and ingestion of homegrown produce (7%). The chemical-specific risks for hexavalent chromium (7 in one million), cadmium (2 in one million), and nickel (2 in one million), are attributable entirely to the inhalation exposure pathway. The risk associated with potential exposure to arsenic (4 in one million) is attributable primarily to the dermal contact pathway.

Risks estimated for the MEIR-Manufacturing Zone under Future Controlled Conditions indicate that the proposed emission controls would reduce the estimated cancer risk by approximately 33% to 13 in one million assuming 70 years of exposure. In addition, the controls would significantly reduce the risks associated with potential exposures to metals and naphthalene. As shown in Table 6.2, the chemical-specific risk for hexavalent chromium would be reduced approximately 52%. Risk reduction associated with exposures to Facility emissions of arsenic (36%), cadmium (15%), and nickel (26%), naphthalene (24%) and lead (38%) would also occur following implementation of the proposed controls under Future Controlled Conditions.

As discussed in Section 5.4.2., chronic non-cancer HIs were estimated by target organ per OEHHA Hot Spots Guidance. The maximum target organ-specific chronic non-cancer HIs for the MEIR-Manufacturing Zone under Existing Operational Conditions and Future Controlled Conditions are 0.48 and 0.28, respectively, and account for effects to the central nervous system (see Table 6.1b). All target organ-specific non-cancer HIs are provided in Appendix D.4 and are well below the District non-cancer HI Notification Level of ten. Thus, adverse chronic non-cancer health effects are not expected due to exposure to

Facility emissions. Figures 6.2 and 6.3 presents the location of the MEIR-Manufacturing Zone for the chronic HI.

6.1.2 MEIR – Mixed-Use Light Industrial Zone

As discussed in Section 2.2, the traditional uses of the Mixed Use-Light Industrial zone are manufacturing, wholesale trade, and warehousing. Live/work units are available to artisans whose work falls under the designation of Arts/Crafts Studio as defined in Section 23F.04.010 of Berkeley's Zoning Code (City of Berkeley 1999c). Such occupants must be informed in writing of the fact they reside in a Mixed Use-Light Industrial zone whose primary characteristic is light industry. Child Care Centers and Schools are prohibited in Mixed Use-Light Industrial zones (City of Berkeley 1999d).

All estimated cancer risks within the Mixed-Use Light Industrial zone are below the District cancer risk Notification Level. As shown in Table 6.1, the total estimated 70-year lifetime cancer risks at the MEIR-Mixed-Use Light Industrial Zone under Existing Operational Conditions is 9.6 in one million. Risks estimated assuming that controls are implemented in the future to reduce Facility emissions indicate that the proposed controls will result in a risk of 6.5 in one million. The cancer risks estimates under Existing Operating Conditions representing more realistic residency times of 30-years and 9-year (Child) are even further reduced and range from 1.8 to 4.1 in one million, as shown in Table 6.1a.

The estimated maximum target organ-specific chronic non-cancer HIs for the MEIR-Mixed-Use Light Industrial Zone under Existing Operational Conditions and Future Controlled Conditions are 0.24 and 0.14, respectively, and account for effects to the central nervous system (see Table 6.1b). All target organ-specific non-cancer HIs are provided in Appendix D.4 and are well below the District non-cancer HI Notification Level of ten. Thus, adverse chronic non-cancer health effects are not expected to occur due to exposure to Facility emissions. Figure 6.2 and 6.3 presents the location of the MEIR- Mixed-Use Light Industrial Zone for the chronic HI.

6.1.3 MEIR-Mixed-Use Residential Zone

As discussed in Section 2.2, Mixed Use-Residential areas have provisions for light industry, warehouses, and wholesaling, with limits on their hours of operation. Mixed Use-Residential zones also allow typical residential use as long as residences are located at least 150 feet from a Manufacturing or Mixed

Manufacturing zone, and child care centers and schools are permitted (City of Berkeley 1999e). All estimated cancer risks within the mixed-use residential and residential zones are below the District cancer risk Notification Level. As shown in Table 6.1, the total estimated 70-year lifetime cancer risks at the MEIR-Mixed-Use Residential Zone under Existing Operational Conditions is 7.9 in one million. Risks estimated assuming that controls are implemented in the future to reduce Facility emissions indicate that the proposed controls will result in a risk of 4.9 in one million. The cancer risks estimates under Existing Operating Conditions representing more realistic residency times of 30-years and 9-year (Child) are even further reduced and range from 1.3 to 3.4 in one million, as shown in Table 6.1a.

The maximum target organ-specific chronic non-cancer HIs for the MEIR-Mixed-Use Residential Zone under Existing Operational Conditions and Future Controlled Conditions are 0.21 and 0.11, respectively, and account for effects to the central nervous system (as shown in Table 6.1b). All target organ-specific non-cancer HIs are provided in Appendix D.4 and are well below the District non-cancer HI Notification Level of ten. Thus, adverse chronic non-cancer health effects are not expected due to exposure to Facility emissions. Figures 6.2 and 6.3 presents the location of the MEIR- Mixed-Use Residential Zone for the chronic HI.

6.2 Off-Site Worker (MEIW)

The carcinogenic risk isopleth for the three 8-hour shifts for off-site worker receptors under Existing Operational Conditions and Future Controlled Conditions are shown on Figures 6.4 through 6.6,and define the area surrounding the Facility where off-site workers have a potential estimated excess lifetime cancer risk of ten in one million or greater. A comparison of isopleths in each of the Figures 6.4 through 6.6 shows significant reductions in the isopleths between Existing Operational Conditions and Future Controlled Conditions for the three 8-hour shifts.

The MEIW receptor location(s) is representative of the point with the highest numerical cancer risk within a non-residential land use zone and may not reflect the actual location where individuals work. As discussed in Section 4.8, three work shifts were modeled to characterize the 8-hour period with the highest modeled off-site worker exposure. Based on the results of the modeling, facility emissions at the MEIW location are greatest during the shift that occurs from 12 a.m. to 8 p.m. However, this may not reflect the time period when most off-site workers are working**.** Cancer risks for the two additional work shifts from 8 a.m. to 4 p.m. and 4 p.m. to 12 a.m. are slightly lower than those for the

12 a.m. to 8 a.m. shift. The receptor locations of the MEIW for the three work shifts change due to differences in Facility operations during different times of the day. The remainder of this section focuses on the shift with the greatest estimated health impacts (i.e., 12 a.m. to 8 a.m.). However, the risk results for the other two shifts are also presented for comparative purposes.

To estimate cancer risks for off-site workers, workers were assumed to be exposed to Facility emissions for 245 days per year for 40 years, the default exposure values from OEHHA Hot Spots Guidance (Cal/EPA 2003a). The 40-year exposure duration assumed for the off-site worker will likely overestimate the time a worker is employed in a single location. The estimated risks at the MEIWs for the off-site worker under Existing Operational Conditions and Future Controlled Conditions are discussed in the sections below.

6.2.1 MEIW-Existing Operational Conditions

As shown on Figure 6.2, the MEIW under Existing Operational Conditions is adjacent to the northern property boundary of Plant 1 (Receptor ID R2984). The total estimated cancer risk at this location is 31 in one million, which exceeds the District cancer risk Notification Level. As shown in Table 6.4, the major chemical contributors to the total estimated cancer risk are hexavalent chromium (60%) and arsenic (27%). As shown in Table 6.5, 73% of the total cancer risk is attributed to inhalation exposures, followed by dermal (19%) and soil ingestion (9%) exposures.

Significant reductions in cancer risk at the MEIW for Existing Operational Conditions (receptor ID R2984) were noted for Future Controlled Conditions. Cancer risks are reduced by approximately 64% to 11 in one million when controls are implemented under Future Controlled Conditions. Significant reductions in cancer risks for hexavalent chromium (70%) and arsenic (62%) are projected. In addition, reductions in risks from lead (55%), nickel (48%), and naphthalene (22%) are also projected.

Cancer risks at the MEIW under Existing Operational Conditions for the two other shifts of 8 a.m. to 4 p.m. and 4 p.m. to 12 a.m. were estimated as 23 in one million, as shown in Table 6.1a.

6.2.2 MEIW – Future Controlled Conditions

Concentration estimates in close proximity to the facility (i.e., PMI, MEIW, MEIR), are highly dependent on air dispersion modeling assumptions and parameters. That is, changes in modeling parameters regarding the spatial and

temporal distributions of the emission sources can greatly influence the resulting concentration estimates in proximity to the emission sources, including the magnitude and location of the MEIW. Due to the sensitivity of near source receptor locations, concentration changes can be observed at receptor locations adjacent to emission sources (e.g., PMI, MEIW) when implementing emission controls. In this case, the MEIW location changed between Existing Operational Conditions and Future Controlled Conditions due to controls to key emission sources of metals. The location of the MEIW under Future Controlled Conditions is shown in Figure 6.3.

The cancer risk at the MEIW for Future Controlled Conditions (receptor ID R2476) is 23 in one million. As shown in Table 6.6, the major chemical contributors to the total estimated lifetime cancer risk are hexavalent chromium (44%) and arsenic (25%). As shown in Table 6.7, 66% of the total cancer risk is attributed to inhalation exposures, followed by dermal (24%) and soil ingestion (9%).

A more modest reduction in cancer risks (18%) was observed at the MEIW for the Future Controlled Conditions (receptor ID R2476) when compared to risks estimated under Existing Operational Conditions. As shown in Table 6.6, cancer risk reductions for hexavalent chromium (27%), nickel (19%), lead (16%), arsenic (15%), cadmium (12%), and naphthalene (8%) are projected at the MEIW for Future Controlled Conditions (receptor ID R2476).

Cancer risks for the two other shifts of 8 a.m. to 4 p.m. and 4 p.m. to 12 a.m. were estimated as 12 in one million and 19 in one million, respectively, as shown in Table 6.1a.

6.2.3 MEIW – Non-cancer Hazard Index

Under Existing Operational Conditions and Future Controlled Conditions, the maximum target organ-specific chronic non-cancer HIs for the MEIW (Shift 12 a.m. to 8 a.m.) are 1.8 and 1.6, respectively, and account for effects to the respiratory system (as shown in Table 6.1b). Approximately 70% of these estimated chronic HIs are attributable to nickel. These results, which reflect HIs estimated using the adjustment factor for manganese (Section 5.4.2) recommended by the District and OEHHA, [37] are summarized in Table 6.1b. Table 6.1b also presents the HIs estimated without applying the adjustment factor recommended by the District and OEHHA. As shown on Table 6.1b, all target organ-specific non-cancer HIs are well below the District non-cancer HI

[37] Personal communication, Scott Lutz of the District by e-mail to D. Daugherty of ENVIRON, September 10, 2007.

Notification Level of ten. The target organ-specific chronic HIs for the MEIW for Existing Operational Conditions and Future Controlled Conditions are presented in Appendix D.4.

The maximum target organ-specific chronic non-cancer HIs for the two other off-site worker shifts of 8 a.m. to 4 p.m. and 4 p.m. to 12 a.m. (ranging from 1.0 to 1.2) are also presented in Table 6.1b and are well below the District non-cancer HI Notification Level of ten.

6.3 Maximally Exposed Sensitive Receptor

The Duck's Nest child care facility lies in the Mixed-Use Light Industrial zone located directly west of the Facility, as shown on Figures 6.2 and 6.3. Based on the City of Berkeley Zoning Code (Section 23F.04.010), Child Care Centers and Schools are prohibited in Mixed Use-Light Industrial zones (City of Berkeley 1999d).

As shown in Table 6.1a, the total estimated cancer risks at the maximally exposed sensitive receptor (children at Duck's Nest child care facility) under Existing Operational Conditions and Future Controlled Conditions are 0.54 and 0.32 in one million, which are well below the District cancer risk Notification Level. Because the individuals at the maximally exposed sensitive receptor experience greater exposure than all other sensitive receptors identified in Section 4.7.2, it may be assumed that the risks for all other sensitive receptors are also well below the District cancer risk Notification Level.

As shown in Table 6.1b, the maximum target organ-specific chronic non-cancer HIs for the maximally exposed sensitive receptor under Existing Operational Conditions and Future Controlled Conditions are 0.24 and 0.13, respectively, which are well below the District non-cancer HI Notification Level. Thus, adverse non-cancer health effects are not expected to occur at any of the sensitive receptor locations identified in the vicinity of the Facility as a result of exposures to Facility emissions.

6.4 Estimated Acute Non-cancer Hazard Indices

As shown in Table 6.1c and Appendix D.4, the maximum target organ-specific acute HIs at all receptors under Existing Operational Conditions and Future Controlled Conditions do not exceed the District non-cancer HI Notification Level and are not expected to result in adverse non-cancer health effects. The acute HIs presented in this HRA conservatively overestimate the true one hour maximum at any one time because one hour maximum air concentrations were summed regardless of time of occurrence (i.e., hour of year) which can differ by source.

6.5 Cancer Burden Analysis

As presented in Appendix F, the results of the cancer burden analysis provide an estimate of the number of excess cancer cases in the exposed population expected from lifetime (70-year) exposure to current estimated facility emissions. The results of the cancer burden analysis indicate that less than one case (0.015) of cancer would be expected within the zone of impact of the Facility under both Existing Operational and Future Controlled Conditions. Therefore, it is unlikely that a single case of cancer will occur as a result of exposure to Facility emissions.

6.6 Lead Evaluation

As discussed in Section 5.4.4, the lead risk management threshold of 0.12 $\mu g/m^3$ recommended by Cal/EPA was compared to the maximum 30-day average lead concentration to evaluate non-cancer effects of lead in this HRA. The estimated maximum 30-day average lead concentration for Existing Operational Conditions (0.06 $\mu g/m^3$) does not exceed the Cal/EPA recommended risk management threshold for lead. Since Future Controlled Conditions reduce lead emissions by approximately 41%, the modeled 30-day average lead concentration is expected to be lower than the predicted concentration under the Existing Operational Conditions and below the risk management threshold. Thus, lead emissions under Existing Operational Conditions and Future Controlled Conditions from the Facility are not expected to pose any non-cancer adverse health effects.

6.7 Uncertainties

Understanding the degree of uncertainty associated with each component of a risk assessment is critical to interpreting the results of that assessment. As recommended by the National Research Council (NRC 1994), [a risk assessment should include] "a full and open discussion of uncertainties in the body of each EPA risk assessment, including prominent display of critical uncertainties in the risk characterization." The NRC (1994) further states that "when EPA reports estimates of risk to decision-makers and the public, it should present not only point estimates of risk, but also the sources and magnitude of uncertainty associated with these estimates." Similarly, recommendations to Cal/EPA on risk assessment practices and uncertainty analysis from the Risk Assessment Advisory Committee (RAAC) were adapted from NRC recommendations (RAAC 1996). Thus, to ensure an objective and balanced characterization of risk and to place the risk assessment results in the proper perspective, the results of a risk assessment should always be accompanied by a description of the uncertainties and critical assumptions that influence the key findings of the risk assessment.

In accordance with the recommendations described above, ENVIRON has evaluated the uncertainties associated with this HRA, including emissions estimation, air dispersion modeling, and risk estimation. The following sections summarize the critical uncertainties associated with these components of the risk assessment.

6.7.1 Estimation of Emissions

There are a number of uncertainties associated with the estimation of emissions from the Facility that may affect the subsequent estimation of exposure concentrations and risk characterization. This section briefly describes many of uncertainties that may affect emissions estimates.

Many of the emissions estimates were made using results from source tests. Source tests are generally the most appropriate method for determining site-specific emissions information; however, the source test is representative of emissions during the time of the testing. Emission factors were developed using source test results and operational data, such as throughput, so that emissions could be calculated independent of the actual operating conditions. Results from the source tests were assumed to be accurate and consistent for the 70-year duration of the HRA analysis. The conditions in the Facility observed during the source testing may not be representative for the entire 70-year time horizon.

As discussed in Section 3.1.1, the District mandated that emissions of PCDD/PCDF be estimated from Plant 703. This is a conservative assumption as there is no supporting scientific information for the District's assumption that PCDD/PCDF formation in the pour area is directly related to the aromatic content in the binder used to make the sand molds.

6.7.2 Estimation of Exposure Concentrations

There are a number of uncertainties associated with the estimation of exposure concentrations from air dispersion modeling of potential emissions from the facility. This section briefly describes some of the uncertainties that may influence the exposure concentrations used in the risk characterization.

As discussed in Section 4.1, the USEPA-recommended dispersion model AERMOD was used to estimate average off-site chemical exposure concentrations at the various offsite receptor locations. This model uses the Gaussian plume equation to calculate ambient air concentrations from emission sources. For this model, the magnitude of error for the maximum concentration is estimated to range from 10 to 40% (USEPA 2005a). Therefore, offsite exposure concentrations used in this assessment represent approximate offsite exposure concentrations.

OEHHA recommends that the concentration used to estimate a chronic HI for a worker correspond to the average concentration that may occur during the 8-hour work shift.[38] In addition, OEHHA Hot Spots Guidance currently does not recommend adjustment of a chronic HQ to account for the difference between actual worker exposure (typically, 8 hours per day, 5 days per week) and the duration of exposure reflected in the REL (24 hours per day, 7 days per week, for 70 years) (Cal/EPA 2003a). However, OEHHA has recently acknowledged that this approach likely over-estimates potential worker exposures and thus the chronic HI for workers and is in the process of developing draft guidelines to address the need for exposure adjustments when estimating a chronic HQ for workers.

In anticipation of these guideline, the District and OEHHA have recommended a worker exposure adjustment factor of 0.357 (only for manganese) for use in this HRA.[39] This factor is applied in this HRA to estimate a chronic HI that reflects actual worker exposure during an 8-hour work day.

It should be noted that the draft guidelines that are being developed by OEHHA are not available for public review, and are not final and may be subject to change. Further, OEHHA has indicated that the worker exposure adjustment factor may not be applied to all chemicals considered in this risk assessment. This is because it may not be appropriate to apply the adjustment to those chemicals for which the toxicological endpoint is concentration dependent rather than dose dependent. For this reason, OEHHA and the District have recommended use of the worker exposure adjustment factor to estimate the chronic HQ for worker exposure to manganese only (since manganese has been identified as having a dose-dependent toxicological endpoint). To address the uncertainty associated with the use of each approach, the results (see Section 6) are presented for both approaches; (1) chronic HI for a worker estimated using the adjustment factor for manganese recommended by District and OEHHA and (2) chronic HI for a worker estimated without using the adjustment factor recommended by the District and OEHHA.

[38] Personal communication, R. Blaisdell, of OEHHA in conversation with G. Caviness of ENVIRON, March 2007.

[39] Personal communication, Scott Lutz of the District by e-mail to D. Daugherty of ENVIRON, September 10, 2007.

6.7.3 Exposure Assessment

Consistent with OEHHA Hot Spots guidance (Cal/EPA 2003a) and District HRSA Guidelines (BAAQMD 2005b) for Tier 1 risk evaluations, health risks associated with Facility sources were calculated assuming that resident receptors are exposed to COPCs for 70 years. However, the USEPA has estimated that 50% of the population lives in the same residence for only nine years, while only 10% remain in the same house for 30 years (USEPA 1997). Adults, moreover, spend only 68-73% of their total daily time at home (USEPA 1997), rather than the 100% assumed in this risk assessment. Accordingly, the actual risks to residents are likely to be lower than those calculated in this evaluation.

OEHHA Hot Spots guidance (Cal/EPA 2003a) and District HRSA Guidelines (BAAQMD 2005b) state that all risk assessments conducted within the Hot Spots program include a Tier 1 evaluation based on a 70-year residential exposure duration. However, OEHHA Hot Spots guidance (Cal/EPA 2003a) indicates that "exposure durations of 9-years and 30-years may also be evaluated as supplemental information to show the range of cancer risk based on residency periods (Cal/EPA 2003a)." OEHHA selected these exposure assumptions to coincide with USEPA estimates of average (9 years) and high-end estimates (30-years) of residence time. Assuming a 30-year exposure duration instead of the 70-year exposure duration required for a Tier 1 evaluation would result in an approximate 57% reduction in the risks estimated for the Facility.

Off-site workers were assumed to be exposed to Facility emissions for 245 days per year for 40 years, the default exposure values from OEHHA Hot Spots guidance. The 40-year exposure duration assumed for the off-site worker will likely overestimate the time a worker typically spends in a single location.

6.7.4 Dose-Response Assessment

The primary uncertainties associated with the toxicity assessment are related to derivation of toxicity values for COPCs. Standard RELs and Cancer Slope Factors (CSFs) established by Cal/EPA and listed in HARP were used to estimate potential carcinogenic and non-cancer health effects from exposures to COPCs emitted from the Facility. These values are derived by applying conservative (i.e., health-protective) assumptions and are intended to protect the most sensitive individuals in the potentially exposed populations.

To derive the toxicity values, Cal/EPA makes several assumptions that tend to overestimate the actual hazard or risk to human health. Because data from human studies are generally unavailable, RELs are typically derived from animal studies.

Uncertainty factors and modifying factors are then applied to these data to ensure that the RELs are adequately protective of human health. For many compounds, it is anticipated that this approach overestimates the potential for non-cancer effects.

CSFs used to estimate carcinogenic risk are also typically derived based on data from animal studies. These data are based on studies in which high doses of a test chemical were administered to laboratory animals, and the reported response is extrapolated to the much lower doses typical of human exposure. Very little experimental data are available on the nature of the dose-response relationship at low doses (e.g., a threshold may exist or the dose-response curve may pass through the origin). Because of this uncertainty, a conservative model is used to estimate the low-dose relationship, and uses an upper bound estimate [the 95 upper confidence limit of the slope predicted by the extrapolation model) as the CSF. With this factor, an upper-bound estimate of potential cancer risks is obtained.

6.7.5 Risk Calculation

Most CSFs are an upper 95th percentile estimate of potency. Because upper 95th percentiles of probability distributions are not strictly additive, the total estimated incremental cancer risk may become artificially more conservative as risks from a number of different carcinogens are summed. Similarly, ENVIRON summed the HQs of chemicals not expected to induce the same type of effects or that do not act by the same mechanism. This tends to overestimate the total estimated HI.

The USEPA (1989b) notes that the conservative assumptions used in a risk assessment are intended to assure that the estimated risks do not underestimate the actual risks posed by a site and that the estimated risks do not necessarily represent actual risks experienced by populations at or near a site. By using standardized conservative assumptions in a risk assessment, USEPA (1989b) further states that:

> *"These values [risk estimates] are upperbound estimates of excess cancer risk potentially arising from lifetime exposure to the chemical in question. A number of assumptions have been made in the derivation of these values, many of which are likely to overestimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates and may be zero."*

The estimated risks in this risk assessment are based primarily on a series of conservative assumptions related to predicted environmental concentrations,

exposure, and chemical toxicity. The use of conservative assumptions tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions made in this risk assessment, the use of conservative assumptions is likely to result in substantial overestimates of exposure, and hence, risk. The District acknowledges this uncertainty by stating: "the methods used [to estimate risk] are conservative, meaning that the real risks from the source may be lower than the calculations, but it is unlikely that they will be higher" (BAAQMD 2007a).

7.0 SUMMARY AND CONCLUSIONS

The results of this HRA indicate that cancer risks and non-cancer hazard indices estimated for individuals who may be exposed to Facility emissions under Existing Operational conditions and who reside or attend day care or school in areas surrounding the Facility that are designated as Residential or Mixed-Use Light Industrial zones **do not** exceed the Notification Levels established by the District.

Further, only those individuals who may work or live in the area designated as a Manufacturing zone may be located in areas where the estimated cancer risks exceed the District Notification Level (10 in a million) as shown in Figures 6.1 and 6.4 through 6.6. The City of Berkeley zoning requirement generally prohibits individuals from residing in areas zoned Manufacturing (City of Berkeley 1999b). However, the City of Berkeley appears to have granted a limited number of use permits for individuals to reside in certain live/work studios adjacent to the Facility despite their location in a Manufacturing zone.

For all populations considered in this HRA, the estimated cancer risks associated with potential exposure to facility emissions are below the District risk reduction level (100 in a million) and are within the range of risks (1 in a million to 100 in a million) considered by USEPA to be protective of human health.

Adverse non-cancer health effects are not expected due to exposure to Facility emissions because the estimated target organ-specific chronic and acute non-cancer hazard indices for all receptors are below the District non-cancer Notification Level. In addition, the estimated maximum 30-day average lead concentration is less that the lead threshold (0.12 $\mu g/m^3$) established by Cal/EPA to be protective of children, the most sensitive receptor when considering lead exposures.

Potential health risks (i.e., cancer risk, non-cancer chronic and acute HIs) resulting from emissions from the PSC facility assuming current operational conditions and future controlled conditions were estimated at the locations of the MEIR, the locations of the MEIW, sensitive receptor locations surrounding the Facility, and the at the PMI. Consistent with OEHHA and District guidance, the PMI was calculated assuming individuals live near the Facility boundary; however, individuals do not currently reside at this location. Identification of these points is required under AB2588 risk assessment guidelines (Cal/EPA 2003a) for informational purposes and may not represent the exact location where an individual works or lives.

MEIR

Three MEIR locations were identified for evaluation in this HRA. The City of Berkeley zoning requirement generally prohibits individuals from residing within zone for manufacturing (i.e., Manufacturing Zone) (City of Berkeley 1999b); however, the City of Berkeley apparently granted a limited number of use permits for individuals to reside in certain live/work studios adjacent to the Facility despite being located in a Manufacturing Zone. The City of Berkeley also allows individuals to reside in live/work artist studios within the Mixed-Use Light Industrial zone, provided their work falls under the designation of Arts/Crafts Studio as defined in Berkeley's Zoning Code and such occupants are informed in writing that they are living in an area surrounded by light industrial activity (City of Berkeley 1999c, 1999d). Consequently, ENVIRON identified MEIRs located in the Manufacturing and Mixed-Use Light-Industrial zones in addition to identifying an MEIR in the Residential and Mixed-Use Residential zones.

As previously discussed, cancer risks estimated for individuals residing in the Residential, Mixed-Use Residential, and Mixed-Use Light Industrial zones are below the District Notification Level and within the range USEPA considers to be protective of human health.

The MEIR within the Manufacturing Zone (termed the MEIR-Manufacturing Zone) is in the immediate vicinity of the Facility at the Tannery Complex located at 1300 4th Street (directly across 3rd Street from PSC's warehouse facility). The cancer risk estimated under existing operational conditions and future controlled conditions at the MEIR-Manufacturing Zone exceed the District cancer Notification Level, but are within the range of risks (one in a million to 100 in a million) considered by USEPA to be protective of human health.

Further, it is anticipated that implementation of the controls outlined in the District and CBE Settlement Agreements (i.e., Future Controlled Conditions) will reduce the cancer risks for all three MEIR receptors considered in this HRA by approximately 30 percent.

Adverse non-cancer health effects are not expected due to exposure to Facility emissions because the estimated target organ-specific chronic and acute non-cancer hazard indices for residential receptors are below the District non-cancer Notification Level. In addition, the estimated maximum 30-day average lead concentration is less that the lead threshold (0.12 µg/m^3) established by Cal/EPA to be protective of children, the most sensitive receptor when considering lead exposures (Cal/EPA 2001).

MEIW

The MEIW is located within the manufacturing zone adjacent to the northern boundary of Plant 1. For the MEIW, the estimated cancer risk (31 in a million) exceeds the District Notification Level but is within the risk range USEPA considers to be protective of human health. This risk was estimated for individuals who may work at the MEIW location between the hours of 12 a.m. and 8 a.m. Cancer risks for the two other shifts of 8 a.m. to 4 p.m. and 4 p.m. to 12 a.m. were estimated as 23 in one million. Risk reductions (up to 64% depending on location) are anticipated for workers under Future Controlled Conditions but the MEIW (12 a.m. to 8 a.m.) under the Future Controlled Conditions scenario would also have a cancer risk (23 in a million), which is above the District Notification Level.

Adverse non-cancer health effects are not expected due to exposure to Facility emissions because the estimated target organ-specific chronic and acute non-cancer hazard indices for workers are below the District non-cancer Notification Level.

Sensitive Receptors

Children attending child care at the Duck's Nest were identified as the sensitive receptor likely to incur the greatest exposure to Facility emissions. Duck's Nest lies in the Mixed-Use Light Industrial zone located directly west of the Facility. Based on the City of Berkeley Zoning Code (Section 23F.04.010), Child Care Centers and Schools are apparently prohibited in Mixed Use-Light Industrial zones (City of Berkeley 1999d).

The estimated cancer risk associated with potential child exposures to Facility emissions at Duck's Nest under Existing Operational Conditions is well below the District cancer risk Notification Level. Because the individuals at the maximally exposed sensitive receptor experience greater exposure than all other sensitive receptors, it may be assumed that the risks for all other sensitive receptors are also well below the District cancer risk Notification Level.

Cancer Burden

As presented in Appendix F, the results of the cancer burden analysis provide an estimate of the number of excess cancer cases in the exposed population expected from lifetime (70-year) exposure to current estimated facility emissions. The results of the cancer burden analysis indicate that less than one case (0.015) of cancer would be expected within the zone of impact of the Facility under both Existing Operational and Future Controlled Conditions. Therefore, it is unlikely that a single case of cancer will occur as a result of exposure to Facility emissions.

Lead Exposures

Adverse non-cancer health effects are not expected due to exposure to Facility emissions because the estimated chronic and acute non-cancer hazard indices for all sensitive population locations are below the District non-cancer Notification Level. In addition, the estimated maximum 30-day average lead concentration is less that the lead threshold (0.12 µg/m3) established by Cal/EPA to be protective of children, the most sensitive receptor when considering lead exposures.

8.0 REFERENCES

The Avogadro Group. 2006. *Source Test Report, 2006 Dioxin/Furan Emissions Tests, Pacific Steel Casting Company, Berkeley, California.* Prepared for the Bay Area Air Quality Management District. July 14.

Bay Area Air Quality Management District (BAAQMD). 2000. Bay Area Air Quality Management Air Toxic Risk Evaluation Procedure (REP) and Risk Management Policy (RMP). February 3.

BAAQMD. 2004. *Toxic Air Contaminant Control Program, Annual Report.* June.

BAAQMD. 2005a. Letter from Brian Bateman, Director Engineering Division of BAAQMD to Joe Emmerichs, General Manager of Pacific Steel Casting Company regarding Emissions Reporting and Health Risk Assessment. April 11.

BAAQMD. 2005b. Air Toxics NSR Program Health Risk Screening Analysis (HRSA) Guidelines. June.

BAAQMD. 2006. Pacific Steel Casting Company's Permit to Operate for Plants 187, 703, and 1603.

BAAQMD. 2007a. *Frequently Asked Questions – Toxic Air Contaminants*. Online: http://www.baaqmd.gov/pmt/air_toxics/faq.htm. Accessed: July.

BAAQMD. 2007a. Letter from Brian Bateman, Director Engineering Division of BAAQMD to Joe Emmerichs, General Manager of Pacific Steel Casting Company regarding Final Emissions Inventory Report, February 23.

BAAQMD. 2007b. Letter from Brian Bateman, Director Engineering Division of BAAQMD to Joe Emmerichs, General Manager of Pacific Steel Casting Company regarding Addendum to Modeling Protocol, March 28.

BAAQMD. 2007c. Letter from Scott Lutz, Manager, Toxic Evaluation Section of Engineering Division of BAAQMD to Joe Emmerichs, General Manager of Pacific Steel Casting Company regarding Air Dispersion Modeling for Health Risk Assessment, January 29.

BAAQMD. 2007d. Letter from Brian Bateman, Director Engineering Division of BAAQMD to Joe Emmerichs, General Manager of Pacific Steel Casting Company regarding Emission Inventory Report, February 5.

BAAQMD. 2007e. Summary of Plant 3 EAF Fugitives Source Test conducted March 7-8, 2007 sent by Scott Lutz, Manager, Toxic Evaluation Section of Engineering Division of BAAQMD to ENVIRON, April 18.

California Air Resources Board (CARB). 1997. Emissions Inventory Criteria and Guidelines Report for the Air Toxics "Hot Spots" Program. May.

CARB. 2005. *District Prioritization Scores and Risk Threshold Values.* Updated August 25. Online: http://www.arb.ca.gov/ab2588/district_levels.htm. Accessed: July.

California Department of Health Services (DHS), California Cancer Registry. 2006. Available at http://www.dhs.ca.gov/cdic.

California Environmental Protection Agency (Cal/EPA). 2000. *Air Toxics Hot Spots Program Risk Assessment Guidelines: Part IV, Technical Support Document for Exposure Assessment and Stochastic Analysis*. Office of Environmental Health Hazard Assessment. September.

Cal/EPA. 2001. *Risk Management Guidelines for New, Modified, and Existing Sources of Lead.* California Air Resources Board. March.

Cal/EPA. 2003a. *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*. Office of Environmental Health Hazard Assessment. August.

Cal/EPA. 2003b. *Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk.* Air Resources Board. Letter dated October 9, 2003

Cal/EPA. 2006. *Hotspots Analysis and Reporting Program (HARP).* California Environmental Protection Agency. Reporting Year 2. Version 1.3 (Build 23.04.05). October.

City of Berkeley, California. 1999a. Official Zoning Map, http://www.ci.berkeley.ca.us/gis/maproom/Zoning/Zoning%20Map%20plates%20color%2020050215.pdf, accessed April 16, 2007.

City of Berkeley, California. 1999b. Berkeley Zoning Code, Chapter 23E.72 M Manufacturing District Provisions, http://www.ci.berkeley.ca.us/bmc/berkeley%5Fzoning%5Fcode/Sub-Title_23E/72/index.html, accessed April 16, 2007.

City of Berkeley, California. 1999c. Berkeley Zoning Code, Section 23F.04.010 Definitions, http://www.ci.berkeley.ca.us/bmc/berkeley%5Fzoning%5Fcode/Sub-Title_23F/04/010.html, accessed April 16, 2007.

City of Berkeley, California. 1999d. Berkeley Zoning Code, Chapter 23E.80 MU-LI Mixed Use-Light Industrial District Provisions, http://www.ci.berkeley.ca.us/bmc/berkeley%5Fzoning%5Fcode/Sub-Title_23E/80/index.html, accessed April 16, 2007.

City of Berkeley, California. 1999e. Berkeley Zoning Code, Chapter 23E.84 MU-R Mixed Use-Residential District Provisions, http://www.ci.berkeley.ca.us/bmc/berkeley%5Fzoning%5Fcode/sub%2Dtitle%5F23e/84/index.html, accessed April 16, 2007.

City of Berkeley, California. 1999f. Berkeley Zoning Code, Chapter 23D.20 R-1A Limited Two-Family Residential District Provisions, http://www.ci.berkeley.ca.us/bmc/berkeley%5Fzoning%5Fcode/sub%2Dtitle%5F23d/20/index.html, accessed April 16, 2007.

City of Berkeley, California. 1999g. Berkeley Zoning Code, Chapter 23E.88 SP Specific Plan District Provisions, http://www.ci.berkeley.ca.us/bmc/berkeley%5Fzoning%5Fcode/sub%2Dtitle%5F23e/88/index.html, accessed April 16, 2007.

City of Berkeley, California. 2007. *Aquatic Park Information Page*. Division of Parks Recreation and Waterfront. Online: http://www.ci.berkeley.ca.us/parks/parkspages/AquaticPark.html. Accessed: June.

Environmental Resources Management (ERM). 2005. Revised Modeling Protocol for Pacific Steel Casting Heath Risk Assessment. August.USEPA. 2000. *Meteorological Monitoring Guidance for Regulatory Modeling Applications*. Office of Air Quality Planning and Standards Research Triangle Park, North Carolina EPA-454/R-99-005. 6-32. February.

National Research Council. 1994. *Science and Judgment in Risk Assessment.* National Academy Press, Washington, D.C.

Office of Environmental Health Hazard Assessment (OEHHA) 2001. *A Guide to Health Risk Assessment.* California Environmental Protection Agency.

Risk Assessment Advisory Committee (RAAC). 1996. *A Review of the California Environmental Protection Agency's Risk Assessment Practices, Policies, and Guidelines.* October.

United States Census Bureau (USCB). 2003. Census 2000 PHC-T-29. Ranking Tables for Population of Metropolitan Statistical Areas, Micropolitan Statistical Areas, Combined Statistical Areas, New England City and Town Areas, and Combined New England City and Town Areas: 1990 and 2000 (Areas defined by the Office of Management and Budget as of June 6, 2003), http://www.census.gov/population/cen2000/phc-t29/tab01a.xls.

United States Census Bureau (USCB). 2007. 2005 Population Estimates for Berkeley, Albany and El Cerrito, California, http://factfinder.census.gov.

U.S. Environmental Protection Agency (USEPA). 1989a. *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A). Interim*

Final. Office of Emergency and Remedial Response. EPA-540/1-89/002. Washington, D.C. December.

U.S. Environmental Protection Agency (USEPA). 1989b. *Risk Assessment Guidance for Superfund Human Health Risk Assessment: U.S. EPA Region IX Recommendations (Interim Final).* San Francisco, CA. December 15.

U.S. Environmental Protection Agency (USEPA). 1997a. *Exposure Factors Handbook.* Office of Research and Development. Washington, D.C. August.

United States Environmental Protection Agency (USEPA). 2004. *User's Guide for the AMS/EPA Regulatory Model (AERMOD).* Office of Air Quality Planning and Standards. Emissions Monitoring and Analysis Division. Research Triangle Park, North Carolina. EPA-454/B-03-001. September.

United States Environmental Protection Agency (USEPA). 2005a. *Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule. 40 CFR Part 51, Appendix W.* 70 Federal Register 68218-61. November 9.

United States Environmental Protection Agency (USEPA). 2005b. *AERMOD Implementation Guide*. Research Triangle Park, North Carolina. September 27.

TABLES

Table 3.1. Summary of COPC Emissions by Plant under Existing Operational Conditions Scenario
Pacific Steel Casting Company
Berkeley, California

COPC	CAS Number	COPC Release (lb/yr)			
		Plant 187	Plant 703	Plant 1603	Total
2-Methylnaphthalene	91576		2.1	12	14
Acenaphthene	83329		0.072	0.047	0.12
Acenaphthylene	208968		1.7	0.032	1.7
Acetaldehyde	75070	38	18	0.72	57
Anthracene	120127		1.6	0.16	1.8
Arsenic	7440382	0.27	0.16	0.065	0.49
Benz(a)anthracene	56553		0.052	0.012	0.064
Benzene	71432	0.065	100	80	180
Benzo(a)pyrene	50328		0.026	0.018	0.044
Benzo(b)fluoranthene	205992		0.059	0.0031	0.063
Benzo(e)pyrene	192972		0.023		0.023
Benzo(g,h,i)perylene	191242		0.017		0.017
Benzo(k)fluoranthene	207089		0.014		0.014
Beryllium	7440417	0.005			0.005
Cadmium	7440439	0.38	0.38	1.3	2.1
Chromium(VI)	18540299	0.15	0.064	0.016	0.23
Chromium, Total	7440473	18	9.8	16	43
Chrysene	218019		0.038	0.025	0.063
Copper	7440508	6.6	6.3	15	28
Dibenzo(a,h)anthracene	53703		0.0042		0.0042
Ethyl Benzene	100414			1	1
Fluoranthene	206440		0.25	0.035	0.29
Fluorene	86737		2.6	0.19	2.8
Formaldehyde	50000	65	550	15	630
Indeno(1,2,3-cd)pyrene	193395		0.016		0.016
Isopropanol	67630		570	630	1200
Lead	7439921	6.7	7.2	18	32
m,p-Cresol	108394		18	2.8	21
m,p-Xylene	108383			11	11
Manganese	7439965	210	120	84	420
4,4'-Methylenediphenyl Diisocyanate (MDI)	101688			1.5	1.5
Mercury	7439976	0.23	0.34	0.11	0.67
Naphthalene	91203		13	250	260
Nickel	7440020	3.5	3.6	18	25
o-Cresol	95487		24	30	54
o-Xylene	95476			4.9	4.9
Perylene	198550		0.0042	0.0054	0.0096
Phenanthrene	85018		1.6	0.49	2
Phenol	108952		720	340	1100
Pyrene	129000		0.14	0.015	0.15
Selenium	7782492	0.26	0.44	1.6	2.3
Toluene	108883	0.11	0.084	24	24
Total PCDD/PCDF (TEF weighted equivalents)	1086		2.7E-08	1.00E-07	1.3E-07
Zinc	7440666	1100	460	76	1600
	Grand Total	1,400	2,600	1,700	5,700

Notes:
COPC = chemical of potential concern

Table 3.2. Summary of COPC Emissions by Plant under Future Controlled Conditions Scenario
Pacific Steel Casting Company
Berkeley, California

COPC	CAS Number	COPC Release (lb/yr)			
		Plant 187	Plant 703	Plant 1603	Total
2-Methylnaphthalene	91576		2.1	12	14
Acenaphthene	83329		0.072	0.047	0.12
Acenaphthylene	208968		1.7	0.032	1.7
Acetaldehyde	75070	38	18	0.72	57
Anthracene	120127		1.6	0.16	1.8
Arsenic	7440382	0.1	0.16	0.044	0.31
Benz(a)anthracene	56553		0.052	0.012	0.064
Benzene	71432	0.065	100	80	180
Benzo(a)pyrene	50328		0.026	0.018	0.044
Benzo(b)fluoranthene	205992		0.059	0.0031	0.063
Benzo(e)pyrene	192972		0.023		0.023
Benzo(g,h,i)perylene	191242		0.017		0.017
Benzo(k)fluoranthene	207089		0.014		0.014
Beryllium	7440417	0.005			0.005
Cadmium	7440439	0.23	0.38	1.1	1.7
Chromium(VI)	18540299	0.054	0.064	0.0049	0.12
Chromium, Total	7440473	6.5	9.8	15	31
Chrysene	218019		0.038	0.025	0.063
Copper	7440508	3.5	6.3	12	22
Dibenzo(a,h)anthracene	53703		0.0042		0.0042
Ethyl Benzene	100414			1	1
Fluoranthene	206440		0.25	0.035	0.29
Fluorene	86737		2.6	0.19	2.8
Formaldehyde	50000	65	550	15	630
Indeno(1,2,3-cd)pyrene	193395		0.016		0.016
Isopropanol	67630		570	630	1200
Lead	7439921	3	7.2	8.8	19
m,p-Cresol	108394		18	2.8	21
m,p-Xylene	108383			11	11
Manganese	7439965	70	120	47	240
4,4'-Methylenediphenyl Diisocyanate (MDI)	101688			1.5	1.5
Mercury	7439976	0.22	0.34	0.062	0.62
Naphthalene	91203		13	180	200
Nickel	7440020	1.8	3.6	12	17
o-Cresol	95487		24	30	54
o-Xylene	95476			4.9	4.9
Perylene	198550		0.0042	0.0054	0.0096
Phenanthrene	85018		1.6	0.49	2
Phenol	108952		720	340	1100
Pyrene	129000		0.14	0.015	0.15
Selenium	7782492	0.25	0.44	0.91	1.6
Toluene	108883	0.11	0.084	24	24
Total PCDD/PCDF (TEF weighted equivalents)	1086		2.7E-08	1.00E-07	1.3E-07
Zinc	7440666	330	460	69	860
	Grand Total	520	2,600	1,500	4,700

Notes:
COPC = chemical of potential concern

Table 4.1. Source Parameters for Air Dispersion Modeling Using AERMOD
Pacific Steel Casting Company
Berkeley, California

Point Sources

Plant	Stack Name	Abatement Device	Associated Source Number(s)	Operating Hours per Day	Operating Days per Week	Modeling Source ID (SRC*)			
						OP	W1	W2	W3
187	Plant 1 P1/P7	A8 Baghouse/A7 Carbon	S2	9 pm to 1 pm	5	2	62	122	182
			S3, S4	24	5	1	61	121	181
	Plant 1 P2	A2 Baghouse	S16, S17	24	6	3	63	123	183
	Plant 1 P3	A3 Baghouse	S15	24	6	4	64	124	184
	Plant 1 P4	A4 Baghouse	S12, S13	24	6	5	65	125	185
	Plant 1 P5	A5 Baghouse	S1	7 pm to 1 pm	5	6	66	126	186
	Plant 1 P6	A6 Baghouse	S14	24	6	7	67	127	187
	Plant 1 Finishing Roof A-D	None	S12 fug, S13 fug, S14 fug	24	6	8-11	68-71	128-131	188-191
	Plant 1 Main Roof A-B	None	S1 fug	7 pm to 1 pm	5	12,13	72,73	132,133	192,193
			S2 fug	9 pm to 1 pm	5	301,302	303,304	305,306	307,308
			S3 fug, S4 fug, S22, S32001	24	5	16,17	76,77	136,137	196,197
			S18	24	6	14,15	74,75	134,135	194,195
703	Plant 2 P1	A1/A2 Baghouses/A7 Carbon	S26, S29, S31	6 pm to 10 am	5	18	78	138	198
			S22, S23	9 pm to 2 pm	5	19	79	139	199
			S30	24	5	20	80	140	200
			S32	5 am to 11 pm	5	21	81	141	201
	Plant 2 P3	A3 Baghouse	S27	6 pm to 10 am	5	22	82	142	202
	Plant 2 P4	A4 Baghouse	S6, S7, S8, S9, S10, S11, S12	9 pm to 2 pm	5	23	83	143	203
	Plant 2 P5	A5 Baghouse	S33-S40	5 am to 11 pm	5	24	84	144	204
	Plant 2 P10	A10 Baghouse	S44-49	24	5	25	85	145	205
	Plant 2 Source 24 Stack	None	S24	9 pm to 2 pm	5	241	242	243	244
	Plant 2 Finishing Roof A-B	None	S33-S40 fug	5 am to 11 pm	5	26,27	86,87	146,147	206,207
	Plant 2 Molding Roof A-F	None	S13-S18, S20, S21, S22 fug, S23 fug	9 pm to 2 pm	5	28-33	88-93	148-153	208-213
		None	S27 fug, S29 fug, S30 fug, S31 fug	6 pm to 10 am	5	34-39	94-99	154-159	214-219
1603	Plant 3 P1	A1 Baghouse	S1	8 pm to 12 pm	5	46	106	166	226
	Plant 3 P2	A2/A6 Baghouses	S5, S6	24	6	47	107	167	227
	Plant 3 P3	A3/A7 Baghouses/A8 Carbon	S4, S19, Mold Mixing Area	8 pm to 1 pm	5	48	108	168	228
	Plant 3 Molding Roof A-B	None	S4 fug, S19 fug, Mold Mixing Area	8 pm to 1 pm	5	49,50	109,110	169,170	229,230
	Plant 3 Finishing Roof A-F	None	Heat Treat Furnace, Cleaning and Grinding, Arc Air Booth Welding	24	6	51-56	111-116	171-176	231-236
	Plant 3 Meltshop Roof A-C	None	S1 fug	8 pm to 12 pm	5	57-59	117-119	177-179	237-239

Volume Sources

Plant	Name	Abatement Device				OP	W1	W2	W3
703	Plant 2 TSR Door	NA	S47 fug, S48 fug, S49 fug	24	5	60	120	180	240

Notes:

"Fug" after a source number indicates fugitive emissions from that source.
NA = not applicable.

Table 4.2. Sensitive Receptors within Zip Codes 94702-94710 and 94720
Pacific Steel Casting Company
Berkeley, California

Receptor ID	Name	Street	City	State	Zip	UTMx	UTMy	Type
R1	A Brighter Today	2220 Cedar Avenue	Berkeley	CA	94709	564,486	4,192,600	Child Care Center
R2	Academy, The	2722 Benvenue Ave.	Berkeley	CA	94705-1202	565,495	4,190,703	School
R3	Ala Costa Ctr for the Developmentally Disabled	1300 Rose St	Berkeley	CA	94702	562,510	4,192,375	School Age Child Care Center
R7841	Albany Children's Center, University Village	1125 Jackson St	Albany	CA	94706	561,557	4,193,411	Child Care Center
R4	Albany High	603 Key Route Blvd.	Albany	CA	94706-1422	562,161	4,194,593	School
R5	Albany Middle	1259 Brighton Ave.	Albany	CA	94706	561,950	4,194,714	School
R6	Albany Preschool	850 Masonic Ave	Berkeley	CA	94706	562,068	4,194,037	Child Care Center
R7	Alta Bates Summit Med Ctr-Alta Bates Campus	2450 Ashby Street	Berkeley	CA	94705	565,263	4,190,151	General Acute Care Hospital
R8	Alta Bates Summit Med Ctr-Herrick Campus	2001 Dwight Way	Berkeley	CA	94704	564,188	4,190,958	General Acute Care Hospital
R9	Angeleon Care Home	2124 Ashby Avenue	Berkeley	CA	94705	564,563	4,190,024	Residential Care for the Elderly
R10	Aquatic Park School	830 Heinz Avenue	Berkeley	CA	94710	562,144	4,189,749	Child Care Center
R11	Arrowsmith Academy	2300 Bancroft Way	Berkeley	CA	94704-4704	564,721	4,191,434	School
R12	Bahia School Age Program	1718 8th St	Berkeley	CA	94710	561,809	4,191,876	School Age Child Care Center
R13	Bay Area Kinder Stube	842 Key Route Boulevard	Berkeley	CA	94706	562,140	4,194,075	Child Care Center
R14	Berkeley Alternative High	2701 Martin Luther King Jr. Way	Berkeley	CA	94703	564,036	4,190,510	School
R15	Berkeley Arts Magnet at Whittier	1645 Milvia St.	Berkeley	CA	94709-2073	564,053	4,192,406	School
R16	Berkeley Chinese School	720 Jackson St	Albany	CA	94706	561,288	4,194,263	School Age Child Care Center
R17	Berkeley High	1980 Allston Way	Berkeley	CA	94704	564,085	4,191,530	School
R18	Berkeley Hills Nursery School	1161 Sterling Ave	Berkeley	CA	94708	565,397	4,193,854	Child Care Center
R19	Berkeley Montessori School	2030 Francisco St	Berkeley	CA	94709	564,125	4,192,230	Child Care Center
R20	Berkeley YMCA Early Head Start	1450 Sixth St	Berkeley	CA	94710	561,504	4,192,296	Infant Center
R21	Berkeley YMCA EHS	2246 Martin Luther King Jr. Way	Berkeley	CA	94710	563,922	4,191,419	Infant Center
R22	Berkeley YMCA Head Start	1227 Bancroft Wat	Berkeley	CA	94702	562,648	4,191,089	Child Care Center
R23	Berkeley YMCA Head Start	1222 University Ave	Berkeley	CA	94702	562,553	4,191,557	Child Care Center
R24	Berkeley YMCA Head Start	1422 San Pablo Ave	Berkeley	CA	94702	561,954	4,192,501	Child Care Center
R25	Berkeley YMCA Head Start	3155 Sacramento St	Berkeley	CA	94703	563,474	4,189,459	Child Care Center
R26	Berkeley YMCA Head Start	2901 California St	Berkeley	CA	94703	563,549	4,190,009	Child Care Center
R27	Berkeley YMCA Head Start	2009 10th St	Berkeley	CA	94710	562,151	4,191,475	Child Care Center
R28	Berkeley YMCA Head Start	2009 Tenth St	Berkeley	CA	94710	562,151	4,191,475	Infant Center
R29	Berkeley Youth Alternatives Preschool C.D. Program	1255 Allston Way	Berkeley	CA	94702	562,703	4,191,292	Child Care Center
R7838	Berkeley-Albany YMCA Head Start	1454 Sixth St	Berkeley	CA	94710	561,506	4,192,289	Child Care Center
R30	Berkwood Hedge	1809 Bancroft Way	Berkeley	CA	94703-4703	563,793	4,191,298	School
R31	Beth El Nursery School	1301 Oxford St	Berkeley	CA	94709	564,375	4,193,268	Child Care Center
R32	Black Pine Circle School	2027 Seventh St.	Berkeley	CA	94710-2091	561,864	4,191,389	School
R33	Bright Star Montessori School	720 Jackson St	Berkeley	CA	94706	561,288	4,194,263	Child Care Center
R34	BUSD - Franklin State Preschool	1460 Eighth St	Berkeley	CA	94710	561,685	4,192,334	Child Care Center
R35	BUSD - Hopkins Street	1810 Hopkins Street	Berkeley	CA	94707	563,659	4,193,276	Child Care Center
R36	BUSD - King Children Center	1939 Ward St	Berkeley	CA	94703	564,107	4,190,443	Child Care Center
R37	BUSD - Rosa Parks Montessori Preschool	920 Allston Way	Berkeley	CA	94710	562,037	4,191,135	Child Care Center
R38	Castle Retirement Home	1731 6th St	Berkeley	CA	94710	561,661	4,191,813	Residential Care for the Elderly
R39	Cedar Creek Montessori School	1600 Sacramento St	Berkeley	CA	94702	563,050	4,192,364	Child Care Center
R40	Cedar Street Childcare Center	2138 Cedar St	Berkeley	CA	94709	564,346	4,192,575	Child Care Center
R41	Cedar Street Childcare Center	2138 Cedar St	Berkeley	CA	94709	564,346	4,192,575	Infant Center
R42	Center for the Education of the Infant Deaf	1035 Grayson St.	Berkeley	CA	94710	562,523	4,190,087	School
R43	Centro Vida Bilingual Childcare Center	1000 Camelia St	Berkeley	CA	94710	561,761	4,192,526	Child Care Center
R44	Child Education Center	1222 University Ave	Berkeley	CA	94702	562,553	4,191,557	Child Care Center

Table 4.2. Sensitive Receptors within Zip Codes 94702-94710 and 94720
Pacific Steel Casting Company
Berkeley, California

Receptor ID	Name	Street	City	State	Zip	UTMx	UTMy	Type
R45	Child Education Center	1222 University Ave	Berkeley	CA	94702	562,553	4,191,557	Infant Center
R46	Children's Community Center	1140 Walnut st	Berkeley	CA	94707	564,199	4,193,530	Child Care Center
R47	City of Albany "Friendship Club"	1331 Portland Avenue	Albany	CA	94706	562,319	4,194,393	School Age Child Care Center
R145	Claremont Day Nurseries Inc	2845 Woolsey Ave	Berkeley	CA	94705	565,928	4,189,910	Child Care Center
R48	Claremont Day Nurseries Inc	1550 Oakview Ave	Kensington	CA	94707	562,625	4,194,899	Child Care Center
R49	Color Me Children Preschool	1141 Bancroft Way	Berkeley	CA	94702	562,491	4,191,056	Child Care Center
R7842	Community Center, City of Albany	1249 Marin Ave	Albany	CA	94706	562,128	4,193,614	Child Care Center
R50	Congregation Beth Israel-Gan Shalom	2230 Jefferson St	Berkeley	CA	94703	563,426	4,191,364	Child Care Center
R51	Cornell Elementary	920 Talbot Ave.	Albany	CA	94706-2020	561,967	4,193,827	School
R52	Cornerstone Children's Center	2407 Dana St	Berkeley	CA	94704	564,969	4,191,253	Child Care Center
R53	Cornerstone Children's Center	2407 Dana St	Berkeley	CA	94704	564,969	4,191,253	Infant Center
R54	Cragmont Elementary	830 Regal Rd.	Berkeley	CA	94708	564,330	4,194,333	School
R55	Crowden, The	1475 Rose St.	Berkeley	CA	94702	562,938	4,192,589	School
R56	Dandelion Nursery School, Inc.	941 The Alameda	Berkeley	CA	94707	563,575	4,193,853	Child Care Center
R57	Duck's Nest	1411 4th St	Berkeley	CA	94710	561,327	4,192,375	Child Care Center
R58	East Bay School For Girls	2727 College Ave.	Berkeley	CA	94705-4705	565,627	4,190,670	School
R60	Ecole Bilingue De Berkeley	1009 Heinz Ave.	Berkeley	CA	94710-2718	562,491	4,189,877	School
R59	Ecole Bilingue de Berkeley	2830 Tenth St	Berkeley	CA	94710	562,509	4,190,004	Child Care Center
R61	Eden Community Care Home for Elderly	3028 Regent St	Berkeley	CA	94705	565,341	4,189,963	Residential Care for the Elderly
R62	Emerson Elementary	2800 Forest Ave.	Berkeley	CA	94705-1309	565,811	4,190,717	School
R63	Ephesian Children's Center	1907 Harmon Ave	Berkeley	CA	94703	564,157	4,189,428	Child Care Center
R64	Ephesian Children's Center	1907 Harmon Ave	Berkeley	CA	94703	564,157	4,189,428	School Age Child Care Center
R65	Garden Day Montessori School	1332 Parker St	Berkeley	CA	94702	562,930	4,190,514	Child Care Center
R66	Golden Oasis	2312 10th St	Berkeley	CA	94710	562,256	4,190,961	Residential Care for the Elderly
R67	Griffin Nursery School	2410 Prince St	Berkeley	CA	94705	565,092	4,189,855	Child Care Center
R68	Growing Light Montessori School of Kensington	52 Arlington Avenue	Kensington	CA	94707	563,108	4,196,536	Child Care Center
R69	Gussie's Senior Care Home	1533 Woolsey St	Berkeley	CA	94703	563,507	4,189,525	Residential Care for the Elderly
R70	Hearts Leap ICRI Preschool	2638 College Ave	Berkeley	CA	94704	565,585	4,190,795	Child Care Center
R71	Hopkins Street Childcare Center	1910 Hopkins St	Berkeley	CA	94707	563,751	4,193,383	Child Care Center
R72	Jefferson Elementary	1400 Ada St.	Berkeley	CA	94702-1217	562,848	4,192,618	School
R73	Jewish Community Ctr of the East Bay	1414 Walnut St	Berkeley	CA	94709	564,289	4,192,959	Child Care Center
R74	Jewish Community Ctr of the East Bay	1414 Walnut St	Berkeley	CA	94709	564,289	4,192,959	School Age Child Care Center
R75	John Muir Elementary	2955 Claremont Ave.	Berkeley	CA	94705-2449	566,326	4,190,236	School
R76	Kensington Elementary	90 Highland Blvd.	Kensington	CA	94708	563,390	4,196,381	School
R77	Kensington Home	23 Anson Way	Kensington	CA	94707	562,590	4,196,502	Residential Care for the Elderly
R78	Kensington Nursery School	52 Arlington Avenue	Kensington	CA	94707	563,108	4,196,536	Child Care Center
R79	Kids Club YMCA	1216 Solano Ave	Albany	CA	94706	561,952	4,193,886	School Age Child Care Center
R80	Kids Club YMCA	1001 Santa Fe Ave	Albany	CA	94706	562,557	4,193,706	School Age Child Care Center
R81	Kids in Motion	2955 Claremont Avenue	Berkeley	CA	94705	566,326	4,190,236	School Age Child Care Center
R82	Lawson Health Care Facility	1811 Berryman St	Berkeley	CA	94703	563,663	4,193,101	Residential Care for the Elderly
R83	Leconte Elementary	2241 Russell St.	Berkeley	CA	94705-1029	564,828	4,190,265	School
R84	Longfellow Arts and Technology Middle	1500 Derby St.	Berkeley	CA	94703-1817	563,300	4,190,369	School
R85	Loving Care	1628 Oregon St	Berkeley	CA	94703	563,583	4,190,119	Residential Care for the Elderly
R86	MacGregor High (Continuation)	1000 Jackson St.	Albany	CA	94706-1404	561,477	4,193,585	School
R87	Malcolm X Elementary	1731 Prince St.	Berkeley	CA	94703-2464	563,850	4,189,678	School
R88	Marin Elementary	1001 Santa Fe Ave	Albany	CA	94706-2341	562,557	4,193,706	School

Table 4.2. Sensitive Receptors within Zip Codes 94702-94710 and 94720

Pacific Steel Casting Company
Berkeley, California

Receptor ID	Name	Street	City	State	Zip	UTMx	UTMy	Type
R89	Martin Luther King Middle	1781 Rose St.	Berkeley	CA	94703-1048	563,540	4,192,864	School
R90	Maybeck High School, Inc.	2362 Bancroft Way	Berkeley	CA	94704-1604	564,846	4,191,457	School
R91	Model School Comprehensive Humanistic Learning C	2330 Prince St	Berkeley	CA	94705	564,990	4,189,843	Child Care Center
R92	Model School Comprehensive Humanistic Learning C	2330 Prince St	Berkeley	CA	94705	564,990	4,189,843	Infant Center
R93	Montessori Family	One Lawson Rd.	Kensington	CA	94707-1015	563,034	4,196,910	School
R95	Montessori Family School	1850 Scenic Ave.	Berkeley	CA	94709-4709	564,812	4,192,248	School
R94	Montessori Family School	1850 Scenic Avenue	Berkeley	CA	94709	564,812	4,192,248	Child Care Center
R96	Mustard Seed Preschool	1640 Hopkins St	Berkeley	CA	94707	563,336	4,193,057	Child Care Center
R97	Neighborhood Pre-School	59 Arlington Avenue	Kensington	CA	94707	563,154	4,196,477	Child Care Center
R98	Neighborhood School	90 Highland Boulevard	Kensington	CA	94708	563,390	4,196,381	Child Care Center
R99	Neighborhood School at Kensington	90 Highland Boulevard	Kensington	CA	94708	563,390	4,196,381	School Age Child Care Center
R100	New School of Berkeley-Schoolage	1924 Cedar St	Berkeley	CA	94709	563,936	4,192,505	School Age Child Care Center
R101	NIA House Learning Center	2234 9th St	Berkeley	CA	94710	562,124	4,191,097	Child Care Center
R102	Ocean View Elementary	1000 Jackson St.	Albany	CA	94706	561,477	4,193,585	School
R103	Oxford Elementary	1130 Oxford St.	Berkeley	CA	94707-2624	564,276	4,193,642	School
R104	Progressive Christian Day Care Center	1728 Alcatraz Ave	Berkeley	CA	94703	563,943	4,189,277	Child Care Center
R105	RN3 Loving Care Home	906 Cornell Avenue	Albany	CA	94706	561,892	4,193,862	Residential Care for the Elderly
R106	RN3 Loving Care Home III	1133 Garfield Ave	Albany	CA	94706	561,663	4,194,462	Residential Care for the Elderly
R107	Rosa Parks Environmental Science Magnet	800 Allston Way	Berkeley	CA	94710	561,730	4,191,057	School
R108	Saint Mary's College High	1294 Albina Ave.	Berkeley	CA	94706-2599	562,955	4,192,956	School
R109	School of the Madeleine	1225 Milvia St.	Berkeley	CA	94709-1932	563,970	4,193,299	School
R7844	Senior Center, City of Albany	846 Masonic Ave	Albany	CA	94706	562,065	4,194,046	Senior Center
R111	Shelton's Primary Education Center	3339 Martin Luther King Jr. Way	Berkeley	CA	94703-4703	564,058	4,189,161	School
R110	Shelton's Primary Education Center	3339 Martin Luther King Jr. Way	Berkeley	CA	94703	564,058	4,189,161	Child Care Center
R112	Skytown Parent Cooperative Preschool	1 Lawson Rd	Kensington	CA	94708	563,034	4,196,910	Child Care Center
R113	St. John's Center Child Care Program	2717 Garber St	Berkeley	CA	94705	565,649	4,190,651	Infant Center
R114	St. John's Child Care Center	2717 Garber St	Berkeley	CA	94705	565,649	4,190,651	Child Care Center
R115	St. Joseph the Worker	2125 Jefferson Ave.	Berkeley	CA	94703-4703	563,432	4,191,610	School
R116	Step One School	499 Spruce St	Berkeley	CA	94708	564,113	4,195,171	Child Care Center
R117	Sunshine Preschool	1035 Grayson St	Berkeley	CA	94710	562,523	4,190,087	Child Care Center
R7843	Teen Center, City of Albany	900 Buchanan St	Albany	CA	94706	561,335	4,193,573	Child Care Center
R118	The Arlington Preschool	52 Arlington Avenue	Kensington	CA	94707	563,108	4,196,536	Child Care Center
R119	The Berkshire	2235 Sacramento St	Berkeley	CA	94702	563,176	4,191,362	Residential Care for the Elderly
R120	The Gay Austin School	1611 Hopkins St	Berkeley	CA	94707	563,197	4,192,999	Child Care Center
R121	The Monteverde School	2727 College	Berkeley	CA	94705	565,627	4,190,670	Child Care Center
R122	The Mulberry School	207 Alvarado Road	Berkeley	CA	94705	567,125	4,190,144	Child Care Center
R123	The New School of Berkeley	1606 Bonita	Berkeley	CA	94709	563,923	4,192,501	Child Care Center
R124	The Snuggery	2008 McGee	Berkeley	CA	94704	563,492	4,191,726	Child Care Center
R125	Therapeutic Nursery School	3408 Martin Luther King Jr. Way	Berkeley	CA	94609	564,216	4,186,501	Child Care Center
R126	Thousand Oaks Elementary	840 Colusa Ave.	Berkeley	CA	94707	563,213	4,194,209	School
R144	UCB - After School Program	2601 Warring St	Berkeley	CA	94720	565,966	4,191,023	School Age Child Care Center
R127	UCB - Anna Head 1	2537 Haste St	Berkeley	CA	94720	565,232	4,191,250	Infant Center
R128	UCB - Anna Head Children's Center	2537 Haste St	Berkeley	CA	94720	565,232	4,191,250	Child Care Center
R129	UCB - Clark Kerr Campus Children's Center	2900 Dwight Way	Berkeley	CA	94720	566,019	4,191,201	Child Care Center
R130	UCB - Clark Kerr Infant Center	2900 Dwight Way	Berkeley	CA	94720	566,019	4,191,201	Child Care Center
R131	UCB - Clark Kerr Infant Center	2900 Dwight Way	Berkeley	CA	94720	566,019	4,191,201	Infant Center

Table 4.2. Sensitive Receptors within Zip Codes 94702-94710 and 94720

Pacific Steel Casting Company
Berkeley, California

Receptor ID	Name	Street	City	State	Zip	UTMx	UTMy	Type
R132	UCB - Girton Hall Child Care Center	UC Berkeley Central Campus	Berkeley	CA	94720	565,040	4,191,876	Child Care Center
R133	UCB - Harold E. Jones Child Study Ctr/Childcare	2425 Atherton St	Berkeley	CA	94704	564,677	4,191,209	Child Care Center
R134	UCB - Infant Toddler Center	2340 Durant Avenue	Berkeley	CA	94704	564,818	4,191,347	Infant Center
R135	Via Center	2126 Sixth St.	Berkeley	CA	94710	561,788	4,191,204	School
R136	Via Nova Children's School	3032 Martin Luther King Jr. Way	Berkeley	CA	94703	564,067	4,189,840	Child Care Center
R137	Walden Center and School	2446 McKinley Ave.	Berkeley	CA	94703-4703	563,869	4,190,993	School
R138	Washington Elementary	2300 Martin Luther King Jr. Way	Berkeley	CA	94704-1412	563,933	4,191,302	School
R7840	West Berkeley Senior Center	1900 Sixth St	Berkeley	CA	94710	561,701	4,191,542	Senior Center
R139	Wheezles and Sneezles	1108 F San Pablo Avenue	Albany	CA	94706	561,793	4,193,147	Child Care Center - Mildly Ill
R140	Willard Middle	2425 Stuart St.	Berkeley	CA	94705-1209	565,161	4,190,526	School
R141	Windsor House Residence	2741 Hillegass	Berkeley	CA	94705	565,414	4,190,657	Residential Care for the Elderly
R142	Woolly Mammoth Child Care and Pre School	2315 Bancroft Way	Berkeley	CA	94704	564,744	4,191,469	Child Care Center
R143	Woolly Mammoth Child Care and Pre School	2314 Bancroft Way	Berkeley	CA	94704	564,749	4,191,439	Infant Center

Table 5.1. Site Related COPCs with Health Effects
Pacific Steel Casting Company
Berkeley, California

COPC	Cancer	Chronic HI	Acute HI
2-Methylnaphthalene			
Acenaphthene	X		
Acenaphthylene			
Acetaldehyde	X	X	
Anthracene			
Arsenic	X	X	X
Benz(a)anthracene	X		
Benzene	X	X	X
Benzo(a)pyrene	X		
Benzo(b)fluoranthene	X		
Benzo(e)pyrene			
Benzo(g,h,i)perylene			
Benzo(k)fluoranthene	X		
Beryllium	X	X	
Cadmium	X	X	
Chromium(VI)	X	X	
Chromium, Total			
Chrysene	X		
Copper		X	X
Dibenzo(a,h)anthracene	X		
Ethyl Benzene		X	
Fluoranthene			
Fluorene			
Formaldehyde	X	X	X
Indeno(1,2,3-cd)pyrene	X		
Isopropanol (IPA)		X	X
Lead	X		
m,p-Cresol		X	
m,p-Xylene		X	X
Manganese		X	
Methyldiisocyanate (MDI)		X	
Mercury		X	X
Naphthalene	X	X	
Nickel	X	X	X
o-Cresol		X	
o-Xylene		X	X
Perylene			
Phenanthrene			
Phenol		X	X
Pyrene			
Selenium		X	
Toluene		X	X
Total PCDD/PCDF	X	X	
Zinc		X	

Notes:

COPC = chemical of potential concern

PCDD/PCDF = polychlorinated dibenzo-*p* -dioxins/polychlorinated biobenzofurans equivalents

Table 6.1a. Cancer Risk Summary
Pacific Steel Casting Company
Berkeley, California

Receptor	Cancer Risk (number in one million)		
	Exposure Duration	**Existing Operational Conditions**	**Future Controlled Conditions**
MEIR - Manufacturing Zone[a]	70-Years	**19**	**13**
	30-Years	8.2	5.5
	9-Years (Child)	5.3	3.5
MEIR - Mixed-use Light Industrial Zone[b]	70-Years	9.6	6.5
	30-Years	4.1	2.8
	9-Years (Child)	2.6	1.8
MEIR - Mixed-use Residential Zone[c]	70-Years	7.9	4.9
	30-Years	3.4	2.1
	9-Years (Child)	2.2	1.3
MEIW - 12 a.m. to 8 a.m.	40-years	**31**[d]	**23**[e]
MEIW - 8 a.m. to 4 p.m.		**23**[d]	**11**[f]
MEIW - 4 p.m. to 12 a.m.		**23**[d]	**19**[e]
Maximum Sensitive Receptor[g]	9-Years (Daycare Child)	0.54	0.32
PMI[h]	70-Years	88[d]	64[e]
District Notification Level[i]		**10**	

Notes:

Bold values above District notification levels

[a] Risks reported for receptor R2987 (UTMx - 561200, UTMy - 4192520).

[b] Risks reported for receptor R1983 (UTMx - 561280, UTMy - 4192200).

[c] Risks reported for receptor R2692 (UTMx - 561360, UTMy - 4192420).

[d] Risks reported for receptor R2984 (UTMx - 561040, UTMy - 4192520).

[e] Risks reported for receptor R2476 (UTMx - 561080, UTMy - 4192360).

[f] Risks reported for receptor R2545 (UTMx - 561180, UTMy - 4192380).

[g] Risks reported for receptor R57 (UTMx - 561327, UTMy - 4192375). Since sensitive receptor location is at Duck's Nest Daycare Center, children assumed to be exposed via inhalation, ingestion of soil, and dermal contact. Ingestion of homegrown produce is not a complete pathway at a daycare center.

[h] Risks at the PMI calculated using residential exposure assumptions as required for reporting under AB2588. The PMI is "a location, with or without people currently present, at which the total cancer risk, or the total noncancer risk, has the highest numerical value" (Cal/EPA 2003).

[i] Cancer risk notification level identified by the District (Bay Area Air Quality Management District [BAAQMD] 2004) and California Air Resources Board (CARB 2005).

Acronyms:

MEIR = Maximum exposed individual resident
MEIW = Maximum exposed individual worker
PMI = Point of maximum impact

Sources:

Bay Area Air Quality Management District (BAAQMD). 2004. *Toxic Air Contaminant Control Program, Annual Report.* June.

California Air Resources Board (CARB). 2005. *District Prioritization Scores and Risk Threshold Values. Updated August 25. Online: http://www.arb.ca.gov/ab2588/district_levels.htm. Accessed: July.*

California Environmental Protection Agency (Cal/EPA). 2003. *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. Office of Environmental Health Hazard Assessment (OEHHA). August.*

Table 6.1b. Target Organ-Specific Chronic Non-cancer Hazard Index Summary
Pacific Steel Casting Company
Berkeley, California

Receptor	Target Organ-Specific Chronic HI			
	Existing Operational Conditions		Future Controlled Conditions	
	HI	Target Organ	HI	Target Organ
MEIR - Manufacturing Zone[a]	0.48	Central Nervous System	0.28	Central Nervous System
MEIR - Mixed-use Light Industrial Zone[b]	0.24	Central Nervous System	0.14	Central Nervous System
MEIR - Mixed-use Residential Zone[c]	0.21	Central Nervous System	0.11	Central Nervous System
MEIW[d] - 12 a.m. to 8 a.m.	1.8[e,f]	Respiratory	1.6[e,g]	Respiratory
MEIW[d] - 8 a.m. to 4 p.m.	1.2[e,h]	Respiratory	1.2[e,i]	Respiratory
MEIW[d]- 4 p.m. to 12 a.m.	1.2[j,k]	Central Nervous System	1.0[j,l]	Central Nervous System
Maximum Sensitive Receptor[m]	0.24	Central Nervous System	0.13	Central Nervous System
PMI[n]	2.7[e]	Central Nervous System	1.7[j]	Central Nervous System
District Notification Level[o]	**10**			

Notes:

Bold values above District notification levels

HI values reflect the maximum target organ-specific HI. The chronic HIs for all target organs are provided in Appendix D.4.

[a] HIs reported for receptor R2987 (UTMx - 561200, UTMy - 4192520).

[b] HIs reported for receptor R1983 (UTMx - 561280, UTMy - 4192200).

[c] HIs reported for receptor R2692 (UTMx - 561360, UTMy - 4192420).

[d] Per BAAQMD direction, the chronic HI reported for the MEIWs reflects the worker adjusted manganese evaluation (discussed in Section 5.4)

[e] HIs reported for receptor R2545 (UTMx - 561180, UTMy - 4192380).

[f] The HI without the worker adjustment recommended by the District and OEHHA is 4.9 (Central Nervous System) and occurs at receptor R2984 (UTMx - 561040, UTMy - 4192520).

[g] The HI without the worker adjustment recommended by the District and OEHHA is 3.6 (Central Nervous System) and occurs at receptor R2476 (UTMx - 561080, UTMy - 4192360).

[h] The HI without the worker adjustment recommended by the District and OEHHA is 3.2 (Central Nervous System) and occurs at receptor R2984 (UTMx - 561040, UTMy - 4192520).

[i] This is also the HI without the worker adjustment recommended by the District and OEHHA.

[j] HIs reported for receptor R2476 (UTMx - 561080, UTMy - 4192360).

[k] The HI without the worker adjustment recommended by the District and OEHHA is 3.3 (Central Nervous System) and occurs at receptor R2476 (UTMx - 561080, UTMy - 4192360).

[l] The HI without the worker adjustment recommended by the District and OEHHA is 2.8 (Central Nervous System) and occurs at receptor R2476 (UTMx - 561080, UTMy - 4192360).

[m] HIs reported for receptor R57 (UTMx - 561327, UTMy - 4192375). Since sensitive receptor location is at Duck's Nest Daycare Center, children assumed to be exposed via inhalation, ingestion of soil, and dermal contact. Ingestion of homegrown produce is not a complete pathway at a daycare center.

[n] HIs at the PMI calculated using residential exposure assumptions as required for reporting under AB2588. The PMI is "a location, with or without people currently present, at which the total cancer risk, or the total noncancer risk, has the highest numerical value" (Cal/EPA 2003).

[o] Chronic HI notification level identified by CARB (2005).

Acronyms:

HI = Hazard index
MEIR = Maximum exposed individual resident
MEIW = Maximum exposed individual worker
PMI = Point of maximum impact

Sources:

California Air Resources Board (CARB). 2005. *District Prioritization Scores and Risk Threshold Values. Updated August 25. Online: http://www.arb.ca.gov/ab2588/district_levels.htm. Accessed: July.*

California Environmental Protection Agency (Cal/EPA). 2003. *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. Office of Environmental Health Hazard Assessment (OEHHA). August.*

Table 6.1c. Target Organ-Specific Acute Non-Cancer Hazard Index Summary
Pacific Steel Casting Company
Berkeley, California

Receptor	Target Organ-Specific Acute HI			
	Existing Operational Conditions		Future Controlled Conditions	
	HI	Target Organ	HI	Target Organ
MEIR - Manufacturing Zone[a]	0.26	Respiratory	0.24	Respiratory
MEIR - Mixed-use Light Industrial Zone[b]	0.28	Respiratory	0.25	Respiratory
MEIR - Mixed-use Residential Zone[c]	0.25	Respiratory	0.23	Respiratory
MEIW - 12 a.m. to 8 a.m.	0.85[d]	Respiratory	0.81[d]	Respiratory
MEIW - 8 a.m. to 4 p.m.	0.62[d]	Respiratory	0.60[e]	Respiratory
MEIW- 4 p.m. to 12 a.m.	0.83[d]	Respiratory	0.80[d]	Respiratory
Maximum Sensitive Receptor[f]	0.27	Respiratory	0.25	Respiratory
PMI[g]	0.85[d]	Respiratory	0.82[d]	Respiratory
District Notification Level[h]	**10**			

Notes:

Bold values above District notification levels

HI values reflect the maximum target organ-specific HI. The acute HIs for all target organs are provided in Appendix D.4.

[a] HIs reported for receptor R2987 (UTMx - 561200, UTMy - 4192520).

[b] HIs reported for receptor R1983 (UTMx - 561280, UTMy - 4192200).

[c] Risks reported for receptor R2422 (UTMx - 561380, UTMy - 4192340).

[d] Risks reported for receptor R2110 (UTMx - 561140, UTMy - 4192240).

[e] Risks reported for receptor R2414 (UTMx - 561220, UTMy - 4192340).

[f] HIs reported for receptor R57 (UTMx - 561327, UTMy - 4192375). Since sensitive receptor location is at Duck's Nest Daycare Center, children assumed to be exposed via inhalation, ingestion of soil, and dermal contact. Ingestion of homegrown produce is not a complete pathway at a daycare center.

[g] HIs at the PMI calculated using residential exposure assumptions as required for reporting under AB2588. The PMI is "a location, with or without people currently present, at which the total cancer risk, or the total noncancer risk, has the highest numerical value" (Cal/EPA 2003).

[h] Acute HI notification level identified by CARB (2005).

Acronyms:

HI = Hazard index
MEIR = Maximum exposed individual resident
MEIW = Maximum exposed individual worker
PMI = Point of maximum impact

Sources:

California Air Resources Board (CARB). 2005. *District Prioritization Scores and Risk Threshold Values. Updated August 25. Online: http://www.arb.ca.gov/ab2588/district_levels.htm. Accessed: July.*

California Environmental Protection Agency (Cal/EPA). 2003. *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. Office of Environmental Health Hazard Assessment (OEHHA). August.*

Table 6.2. Chemical-Specific Risk Summary, MEIR - Manufacturing Zone
Pacific Steel Casting Company
Berkeley, California

Chemical	Cancer Risk		Effective Percent Risk Reduction
	Existing Operational Conditions	Future Controlled Conditions	
Receptor ID:	**R2987**		
2-Methylnaphthalene	--	--	--
Acenaphthene	--	--	--
Acenaphthylene	--	--	--
Acetaldehyde	2.4E-08	2.4E-08	0%
Anthracene	--	--	--
Arsenic	4.0E-06	2.5E-06	36%
Benz(a)anthracene	1.5E-07	1.5E-07	0%
Benzene	7.0E-07	7.0E-07	0%
Benzo(a)pyrene	1.1E-06	1.1E-06	0%
Benzo(b)fluoranthene	1.4E-07	1.4E-07	0%
Benzo(e)pyrene	--	--	--
Benzo(g,h,i)perylene	--	--	--
Benzo(k)fluoranthene	3.4E-08	3.4E-08	0%
Beryllium	2.4E-09	2.4E-09	0%
Cadmium	2.3E-06	2.0E-06	15%
Chromium(VI)	6.7E-06	3.3E-06	52%
Chromium, Total	--	--	--
Chrysene	1.5E-08	1.5E-08	0%
Copper	--	--	--
Dibenzo(a,h)anthracene	3.6E-08	3.6E-08	0%
Ethyl Benzene	--	--	--
Fluoranthene	--	--	--
Fluorene	--	--	--
Formaldehyde	4.8E-07	4.8E-07	0%
Indeno(1,2,3-cd)pyrene	3.9E-08	3.9E-08	0%
Isopropanol	--	--	--
Lead	8.4E-07	5.2E-07	38%
m,p-Cresol	--	--	--
m,p-Xylene	--	--	--
Manganese	--	--	--
MDI	--	--	--
Mercury	--	--	--
Naphthalene	8.1E-07	6.2E-07	24%
Nickel	1.7E-06	1.2E-06	26%
o-Cresol	--	--	--
o-Xylene	--	--	--
Perylene	--	--	--
Phenanthrene	--	--	--
Phenol	--	--	--
Pyrene	--	--	--
Selenium	--	--	--
Toluene	--	--	--
Total PCDD/PCDF	8.1E-09	8.1E-09	0%
Zinc	--	--	--
Total	**1.9E-05**	**1.3E-05**	**33%**

Notes:
-- = Not evaluated
% = Percent
ID = Identification
MDI = Methylene diphenyl diisocyanate
MEIR = Maximum exposes individual resident
PCDD/PCDF = Polychlorodibenzodioxins/Polychlorodibenzofuranes
Risk breakdowns presented for 70-year Exposure Scenario

Table 6.3. Existing Operational Conditions: Pathway-Specific Cancer Risk Summary, MEIR - Manufacturing Zone
Pacific Steel Casting Company
Berkeley, California

Chemical	Inhalation		Dermal Contact		Ingestion of Soil		Ingestion of Mother's Milk		Ingestion Of Homegrown Produce	
	Risk	% Total Risk	Risk	% Total Risk	Risk	% Total Risk	Risk	% Total Risk	Risk	% Total Risk
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--	--
Acetaldehyde	2.4E-08	0%	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--
Arsenic	3.5E-07	2%	2.3E-06	12%	1.1E-06	6%	--	--	2.0E-07	1%
Benz(a)anthracene	1.9E-09	<0.1%	6.1E-08	0.3%	9.2E-09	<0.1%	--	--	7.8E-08	0%
Benzene	7.0E-07	4%	--	--	--	--	--	--	--	--
Benzo(a)pyrene	1.3E-08	<0.1%	4.5E-07	2%	6.7E-08	0%	--	--	5.6E-07	3%
Benzo(b)fluoranthene	1.7E-09	<0.1%	5.7E-08	0.3%	8.5E-09	<0.1%	--	--	7.2E-08	0.4%
Benzo(e)pyrene	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	4.2E-10	<0.1%	1.4E-08	<0.1%	2.1E-09	<0.1%	--	--	1.8E-08	<0.1%
Beryllium	2.4E-09	<0.1%	--	--	--	--	--	--	--	--
Cadmium	2.3E-06	12%	--	--	--	--	--	--	--	--
Chromium(VI)	6.7E-06	35%	--	--	--	--	--	--	--	--
Chromium, Total	--	--	--	--	--	--	--	--	--	--
Chrysene	1.8E-10	<0.1%	6.0E-09	<0.1%	9.0E-10	<0.1%	--	--	7.6E-09	<0.1%
Copper	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	1.3E-09	<0.1%	1.4E-08	<0.1%	2.1E-09	<0.1%	--	--	1.8E-08	<0.1%
Ethyl Benzene	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--	--
Formaldehyde	4.8E-07	3%	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	4.8E-10	<0.1%	1.6E-08	<0.1%	2.4E-09	<0.1%	--	--	2.0E-08	0.1%
Isopropanol	--	--	--	--	--	--	--	--	--	--
Lead	8.5E-08	0%	1.3E-08	<0.1%	4.4E-07	2%	--	--	3.1E-07	2%
m,p-Cresol	--	--	--	--	--	--	--	--	--	--
m,p-Xylene	--	--	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--	--	--
MDI	--	--	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--	--	--
Naphthalene	8.1E-07	4%	--	--	--	--	--	--	--	--
Nickel	1.7E-06	9%	--	--	--	--	--	--	--	--
o-Cresol	--	--	--	--	--	--	--	--	--	--
o-Xylene	--	--	--	--	--	--	--	--	--	--
Perylene	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	--	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	--	--	--	--	--
Total PCDD/PCDF	4.1E-10	<0.1%	3.4E-09	<0.1%	1.4E-09	<0.1%	2.6E-09	<0.1%	2.3E-10	<0.1%
Zinc	--	--	--	--	--	--	--	--	--	--
Pathway Specific Totals	**1.3E-05**	**69%**	**2.9E-06**	**15%**	**1.6E-06**	**9%**	**2.6E-09**	**0.01%**	**1.3E-06**	**7%**

Total Cancer Risk = 1.9E-05

Notes:
-- = Not evaluated
% = Percent
MDI = Methylene diphenyl diisocyanate
MEIR = Maximum exposes individual resident
PCDD/PCDF = Polychlorodibenzodioxins/Polychlorodibenzofuranes
Risk breakdowns presented for 70-year Exposure Scenario

Table 6.4. Chemical-Specific Risk Summary: Existing Operational Conditions - MEIW - 12 a.m. to 8 a.m. Shift (R2984)
Pacific Steel Casting Company
Berkeley, California

Chemical	Cancer Risk		Effective Percent Risk Reduction
	Existing Operational Conditions	Future Controlled Conditions	
Receptor ID:	**R2984**		
2-Methylnaphthalene	--	--	--
Acenaphthene	--	--	--
Acenaphthylene	--	--	--
Acetaldehyde	6.2E-08	6.2E-08	0%
Anthracene	--	--	--
Arsenic	8.4E-06	3.2E-06	62%
Benz(a)anthracene	2.2E-08	2.2E-08	0%
Benzene	1.5E-07	1.5E-07	0%
Benzo(a)pyrene	1.3E-07	1.3E-07	0%
Benzo(b)fluoranthene	2.2E-08	2.2E-08	0%
Benzo(e)pyrene	--	--	--
Benzo(g,h,i)perylene	--	--	--
Benzo(k)fluoranthene	5.5E-09	5.5E-09	0%
Beryllium	7.7E-09	7.7E-09	0%
Cadmium	1.6E-06	9.5E-07	40%
Chromium(VI)	1.8E-05	5.4E-06	70%
Chromium, Total	--	--	--
Chrysene	1.8E-09	1.8E-09	0%
Copper	--	--	--
Dibenzo(a,h)anthracene	6.0E-09	6.0E-09	0%
Ethyl Benzene	--	--	--
Fluoranthene	--	--	--
Fluorene	--	--	--
Formaldehyde	1.4E-07	1.4E-07	0%
Indeno(1,2,3-cd)pyrene	6.3E-09	6.3E-09	0%
Isopropanol	--	--	--
Lead	6.8E-07	3.1E-07	55%
m,p-Cresol	--	--	--
m,p-Xylene	--	--	--
Manganese	--	--	--
MDI	--	--	--
Mercury	--	--	--
Naphthalene	1.4E-07	1.1E-07	22%
Nickel	1.0E-06	5.3E-07	48%
o-Cresol	--	--	--
o-Xylene	--	--	--
Perylene	--	--	--
Phenanthrene	--	--	--
Phenol	--	--	--
Pyrene	--	--	--
Selenium	--	--	--
Toluene	--	--	--
Total PCDD/PCDF	1.1E-09	1.1E-09	0%
Zinc	--	--	--
Total	**3.1E-05**	**1.1E-05**	**64%**

Notes:
-- = Not evaluated
% = Percent
ID = Identification
MDI = Methylene diphenyl diisocyanate
MEIW = Maximum exposes individual worker
PCDD/PCDF = Polychlorodibenzodioxins/Polychlorodibenzofuranes

Table 6.5. Pathway-Specific Cancer Risk Summary: Existing Operational Conditions - MEIW 12 a.m. to 8 a.m. Shift (R2984)
Pacific Steel Casting Company
Berkeley, California

Chemical	Inhalation		Dermal Contact		Ingestion of Soil	
	Risk	% Total Risk	Risk	% Total Risk	Risk	% Total Risk
2-Methylnaphthalene	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--
Acetaldehyde	6.2E-08	0.2%	--	--	--	--
Anthracene	--	--	--	--	--	--
Arsenic	8.3E-07	3%	5.3E-06	17%	2.2E-06	7%
Benz(a)anthracene	7.2E-10	<0.1%	1.9E-08	<0.1%	2.4E-09	<0.1%
Benzene	1.5E-07	0.5%	--	--	--	--
Benzo(a)pyrene	4.4E-09	<0.1%	1.1E-07	0%	1.4E-08	<0.1%
Benzo(b)fluoranthene	7.2E-10	<0.1%	1.9E-08	<0.1%	2.4E-09	<0.1%
Benzo(e)pyrene	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--
Benzo(k)fluoranthene	1.8E-10	<0.1%	4.7E-09	<0.1%	6.1E-10	<0.1%
Beryllium	7.7E-09	<0.1%	--	--	--	--
Cadmium	1.6E-06	5%	--	--	--	--
Chromium(VI)	1.8E-05	60%	--	--	--	--
Chromium, Total	--	--	--	--	--	--
Chrysene	6.1E-11	<0.1%	1.6E-09	<0.1%	2.0E-10	<0.1%
Copper	--	--	--	--	--	--
Dibenzo(a,h)anthracene	5.6E-10	<0.1%	4.8E-09	<0.1%	6.2E-10	<0.1%
Ethyl Benzene	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--
Formaldehyde	1.4E-07	0.4%	--	--	--	--
Indeno(1,2,3-cd)pyrene	2.0E-10	<0.1%	5.4E-09	<0.1%	7.0E-10	<0.1%
Isopropanol	--	--	--	--	--	--
Lead	8.6E-08	0.3%	2.2E-07	1%	3.7E-07	1%
m,p-Cresol	--	--	--	--	--	--
m,p-Xylene	--	--	--	--	--	--
Manganese	--	--	--	--	--	--
MDI	--	--	--	--	--	--
Mercury	--	--	--	--	--	--
Naphthalene	1.4E-07	0.4%	--	--	--	--
Nickel	1.0E-06	3%	--	--	--	--
o-Cresol	--	--	--	--	--	--
o-Xylene	--	--	--	--	--	--
Perylene	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--
Phenol	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--
Selenium	--	--	--	--	--	--
Toluene	--	--	--	--	--	--
Total PCDD/PCDF	1.1E-10	<0.1%	7.6E-10	<0.1%	2.7E-10	<0.1%
Zinc	--	--	--	--	--	--
Pathway Specific Totals	**2.2E-05**	**73%**	**5.7E-06**	**19%**	**2.6E-06**	**9%**

Total Cancer Risk = 3.1E-05

Notes:
-- = Not evaluated
% = Percent
MDI = Methylene diphenyl diisocyanate
MEIW = Maximum exposes individual worker
PCDD/PCDF = Polychlorodibenzodioxins/Polychlorodibenzofuranes

Table 6.6. Chemical-Specific Risk Summary: Future Controlled Conditions - MEIW 12 a.m. to 8 a.m. Shift (R2476)
Pacific Steel Casting Company
Berkeley, California

Chemical	Cancer Risk		Effective Percent Risk Reduction
	Existing Operational Conditions	Future Controlled Conditions	
Receptor ID:	**R2476**		
2-Methylnaphthalene	--	--	--
Acenaphthene	--	--	--
Acenaphthylene	--	--	--
Acetaldehyde	4.8E-08	4.8E-08	0%
Anthracene	--	--	--
Arsenic	6.8E-06	5.8E-06	15%
Benz(a)anthracene	2.4E-07	2.4E-07	0%
Benzene	1.0E-06	1.0E-06	0%
Benzo(a)pyrene	1.2E-06	1.2E-06	0%
Benzo(b)fluoranthene	2.5E-07	2.5E-07	0%
Benzo(e)pyrene	--	--	--
Benzo(g,h,i)perylene	--	--	--
Benzo(k)fluoranthene	6.4E-08	6.4E-08	0%
Beryllium	1.9E-09	1.9E-09	0%
Cadmium	2.1E-06	1.8E-06	12%
Chromium(VI)	1.2E-05	8.9E-06	27%
Chromium, Total	--	--	--
Chrysene	1.7E-08	1.7E-08	0%
Copper	--	--	--
Dibenzo(a,h)anthracene	7.0E-08	7.0E-08	0%
Ethyl Benzene	--	--	--
Fluoranthene	--	--	--
Fluorene	--	--	--
Formaldehyde	9.0E-07	9.0E-07	0%
Indeno(1,2,3-cd)pyrene	7.3E-08	7.3E-08	0%
Isopropanol	--	--	--
Lead	8.7E-07	7.2E-07	16%
m,p-Cresol	--	--	--
m,p-Xylene	--	--	--
Manganese	--	--	--
MDI	--	--	--
Mercury	--	--	--
Naphthalene	3.1E-07	2.8E-07	8%
Nickel	1.5E-06	1.2E-06	19%
o-Cresol	--	--	--
o-Xylene	--	--	--
Perylene	--	--	--
Phenanthrene	--	--	--
Phenol	--	--	--
Pyrene	--	--	--
Selenium	--	--	--
Toluene	--	--	--
Total PCDD/PCDF	9.5E-09	9.5E-09	0%
Zinc	--	--	--
Total	**2.8E-05**	**2.3E-05**	**18%**

Notes:
-- = Not evaluated
% = Percent
ID = Identification
MDI = Methylene diphenyl diisocyanate
MEIW = Maximum exposes individual worker
PCDD/PCDF = Polychlorodibenzodioxins/Polychlorodibenzofuranes

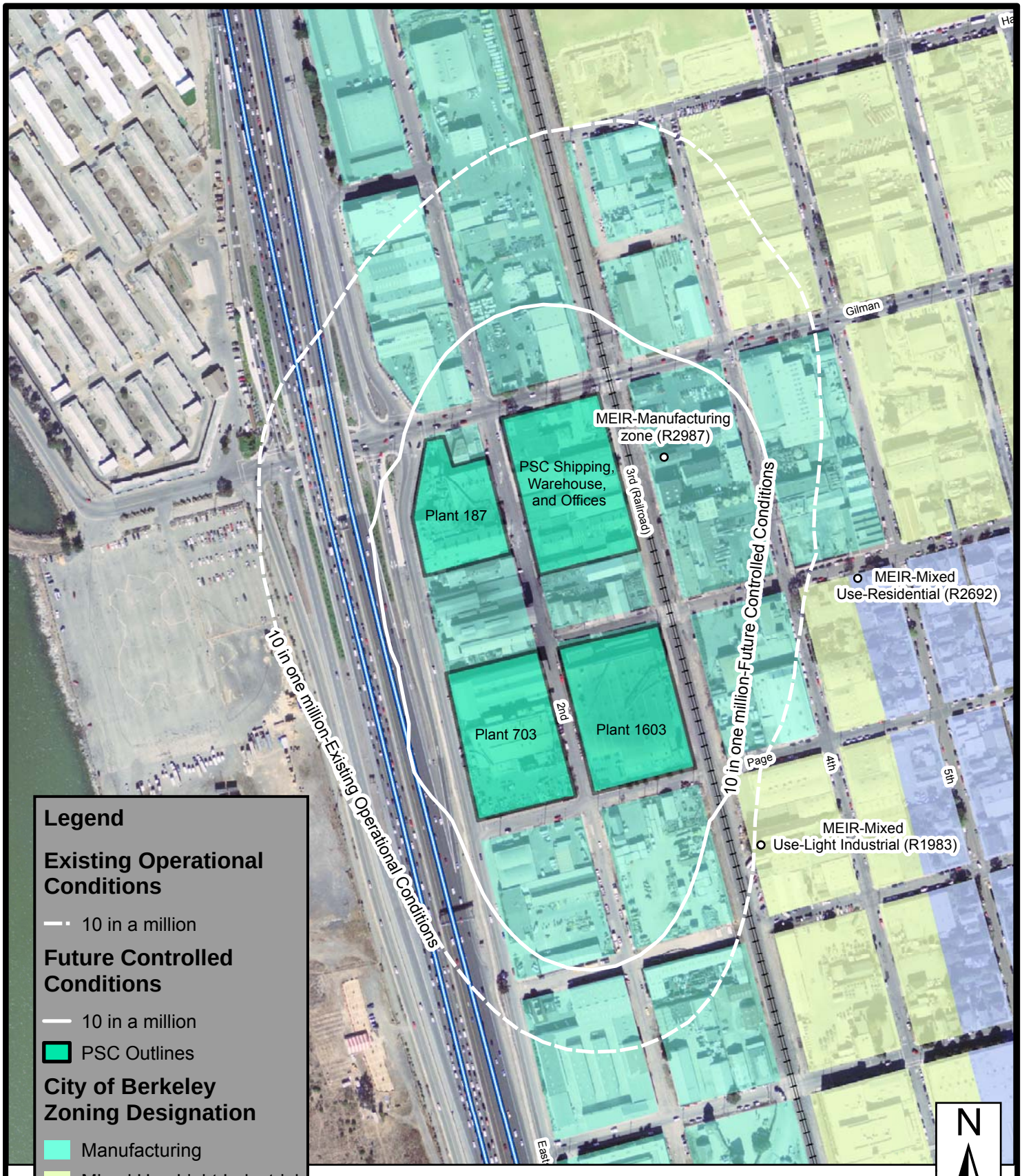
Table 6.7. Pathway-Specific Cancer Risk Summary: Future Controlled Conditions - MEIW 12 a.m. to 8 a.m. Shift (R2476)
Pacific Steel Casting Company
Berkeley, California

Chemical	Inhalation		Dermal Contact		Ingestion of Soil	
	Risk	% Total Risk	Risk	% Total Risk	Risk	% Total Risk
2-Methylnaphthalene	--	--	--	--	--	--
Acenaphthene	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--
Acetaldehyde	4.8E-08	0.2%	--	--	--	--
Anthracene	--	--	--	--	--	--
Arsenic	6.4E-07	3%	3.6E-06	16%	1.5E-06	7%
Benz(a)anthracene	7.3E-09	<0.1%	2.0E-07	0.9%	2.6E-08	0%
Benzene	1.0E-06	4.6%	--	--	--	--
Benzo(a)pyrene	3.7E-08	0%	1.0E-06	5%	1.3E-07	1%
Benzo(b)fluoranthene	7.8E-09	<0.1%	2.2E-07	1.0%	2.8E-08	0%
Benzo(e)pyrene	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--
Benzo(k)fluoranthene	2.0E-09	<0.1%	5.5E-08	0%	7.2E-09	<0.1%
Beryllium	1.9E-09	<0.1%	--	--	--	--
Cadmium	1.8E-06	8%	--	--	--	--
Chromium(VI)	8.9E-06	39%	--	--	--	--
Chromium, Total	--	--	--	--	--	--
Chrysene	5.4E-10	<0.1%	1.5E-08	<0.1%	1.9E-09	<0.1%
Copper	--	--	--	--	--	--
Dibenzo(a,h)anthracene	6.2E-09	<0.1%	5.6E-08	0%	7.3E-09	<0.1%
Ethyl Benzene	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--
Formaldehyde	9.0E-07	4.0%	--	--	--	--
Indeno(1,2,3-cd)pyrene	2.2E-09	<0.1%	6.3E-08	0%	8.2E-09	<0.1%
Isopropanol	--	--	--	--	--	--
Lead	9.7E-08	0.4%	2.3E-07	1%	3.9E-07	2%
m,p-Cresol	--	--	--	--	--	--
m,p-Xylene	--	--	--	--	--	--
Manganese	--	--	--	--	--	--
MDI	--	--	--	--	--	--
Mercury	--	--	--	--	--	--
Naphthalene	2.8E-07	1.3%	--	--	--	--
Nickel	1.2E-06	5%	--	--	--	--
o-Cresol	--	--	--	--	--	--
o-Xylene	--	--	--	--	--	--
Perylene	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--
Phenol	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--
Selenium	--	--	--	--	--	--
Toluene	--	--	--	--	--	--
Total PCDD/PCDF	7.3E-10	<0.1%	6.4E-09	<0.1%	2.3E-09	<0.1%
Zinc	--	--	--	--	--	--
Pathway Specific Totals	**1.5E-05**	**66%**	**5.5E-06**	**24%**	**2.1E-06**	**9%**

Total Cancer Risk = 2.3E-05

Notes:
-- = Not evaluated
% = Percent
MDI = Methylene diphenyl diisocyanate
MEIW = Maximum exposes individual worker
PCDD/PCDF = Polychlorodibenzodioxins/Polychlorodibenzofuranes

FIGURES

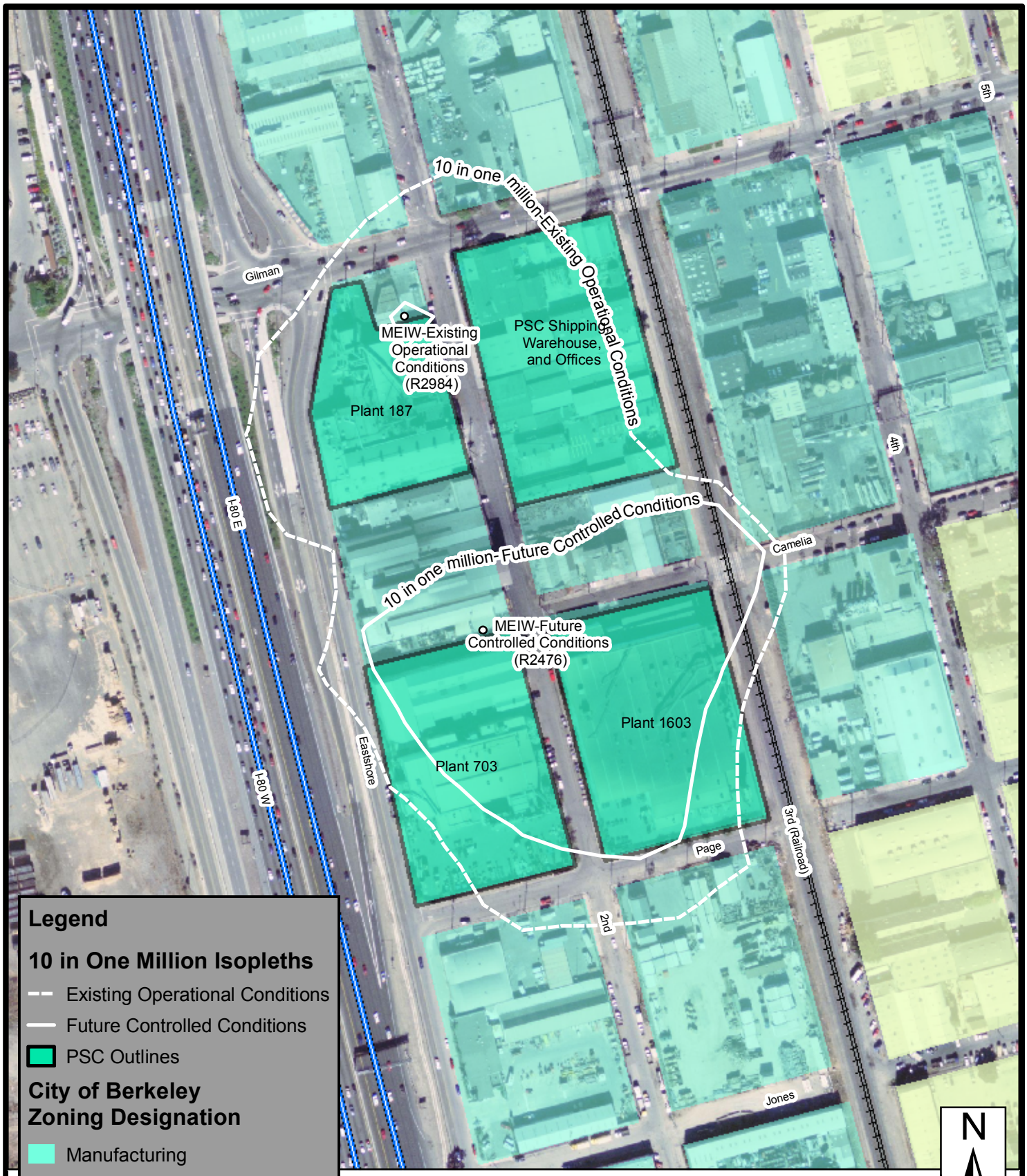


ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Existing Operational and Future Controlled Conditions
Lifetime (70-yr) Residential Cancer Risk Isopleth
Pacific Steel Casting Company, Berkeley, CA

Figure
ES.1

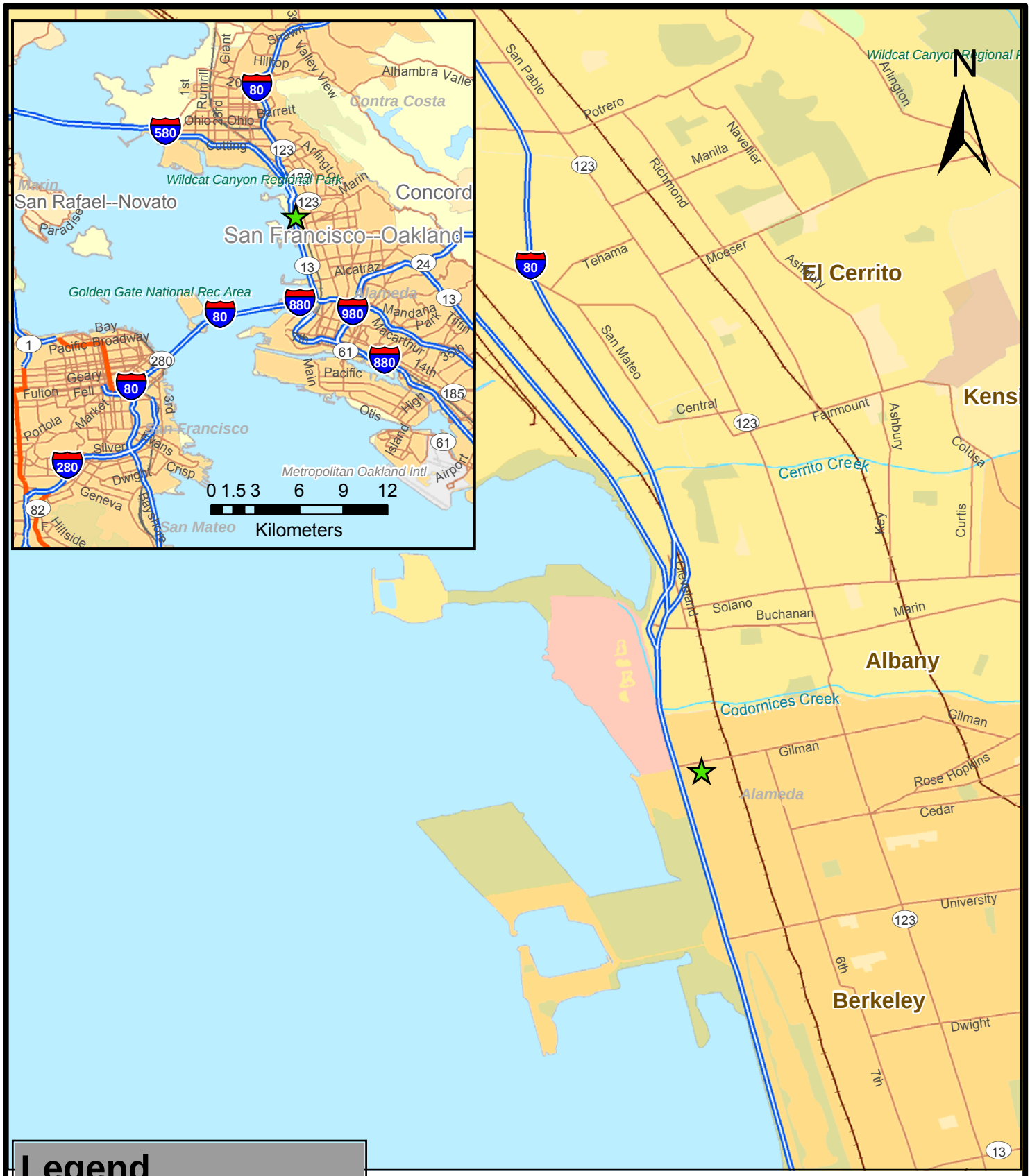


ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Existing Operational and Future Controlled Conditions
Off-Site Worker Cancer Risk Isopleth (12 am to 8 am)
Pacific Steel Casting Company, Berkeley, CA

Figure
ES.2



ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Location of Facility
Pacific Steel Casting Company
Berkeley, California

Figure
2.1

ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Location of Plants
Pacific Steel Casting Company
Berkeley, California

Figure

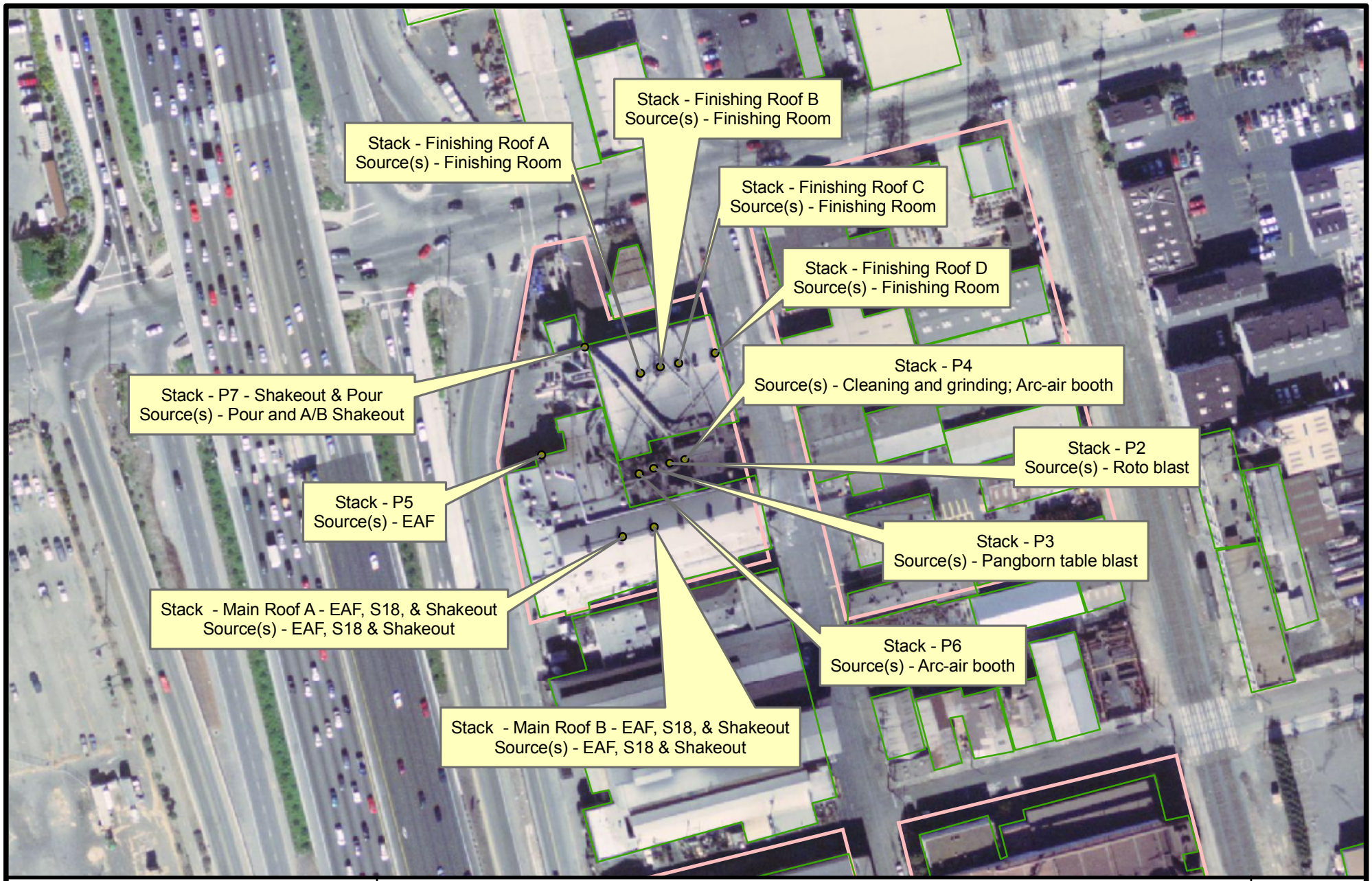
2.2

ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Surrounding Land Use
Pacific Steel Casting Company
Berkeley, CA

Figure
2.3

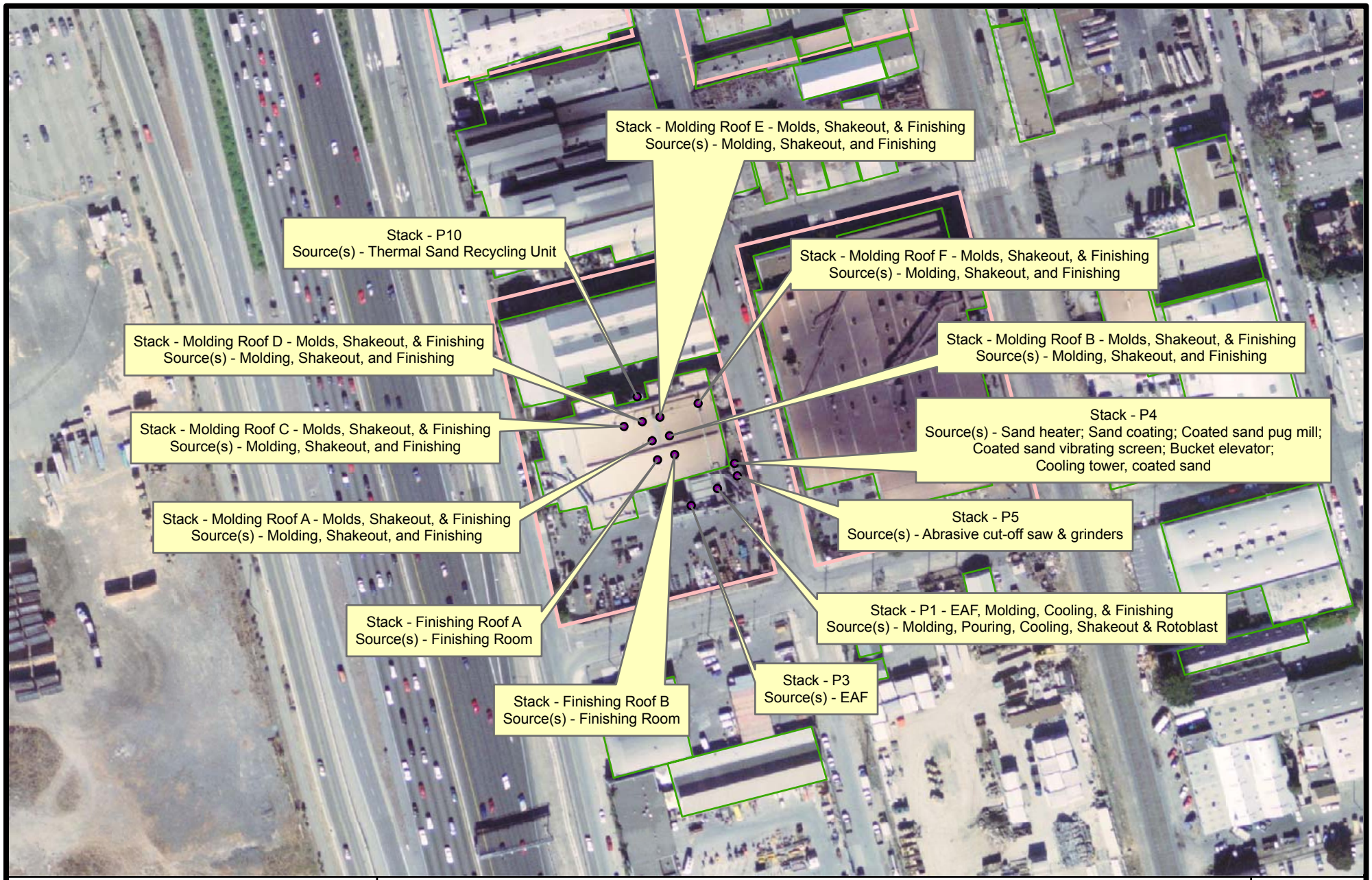


ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Emission Point Locations, Plant 187
Pacific Steel Casting Company
Berkeley, California

Figure
4.1



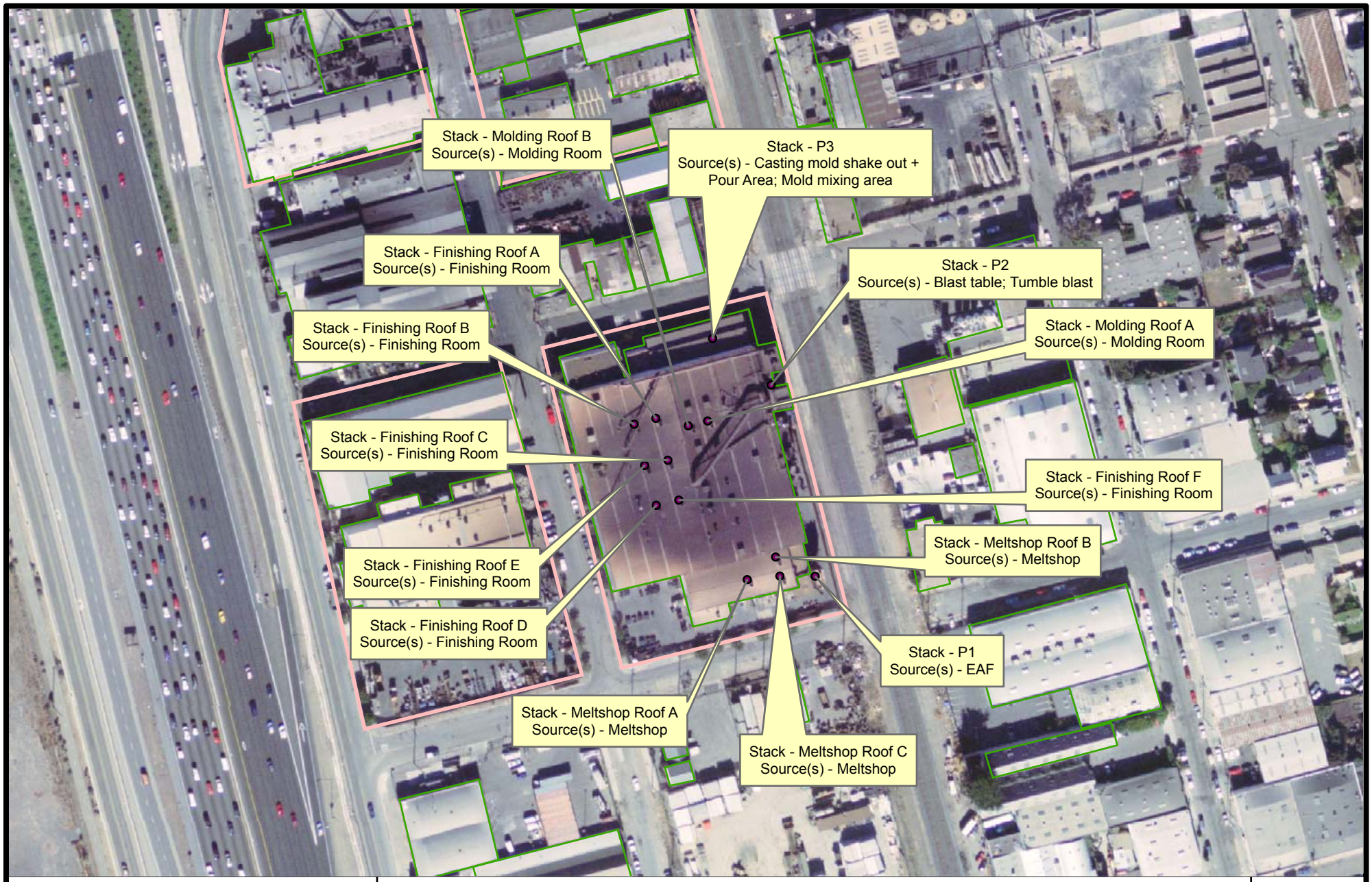
ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Source Locations, Plant 703
Pacific Steel Casting Company
Berkeley, California

Figure

4.2



ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Source Locations, Plant 1603
Pacific Steel Casting Company
Berkeley, California

Figure

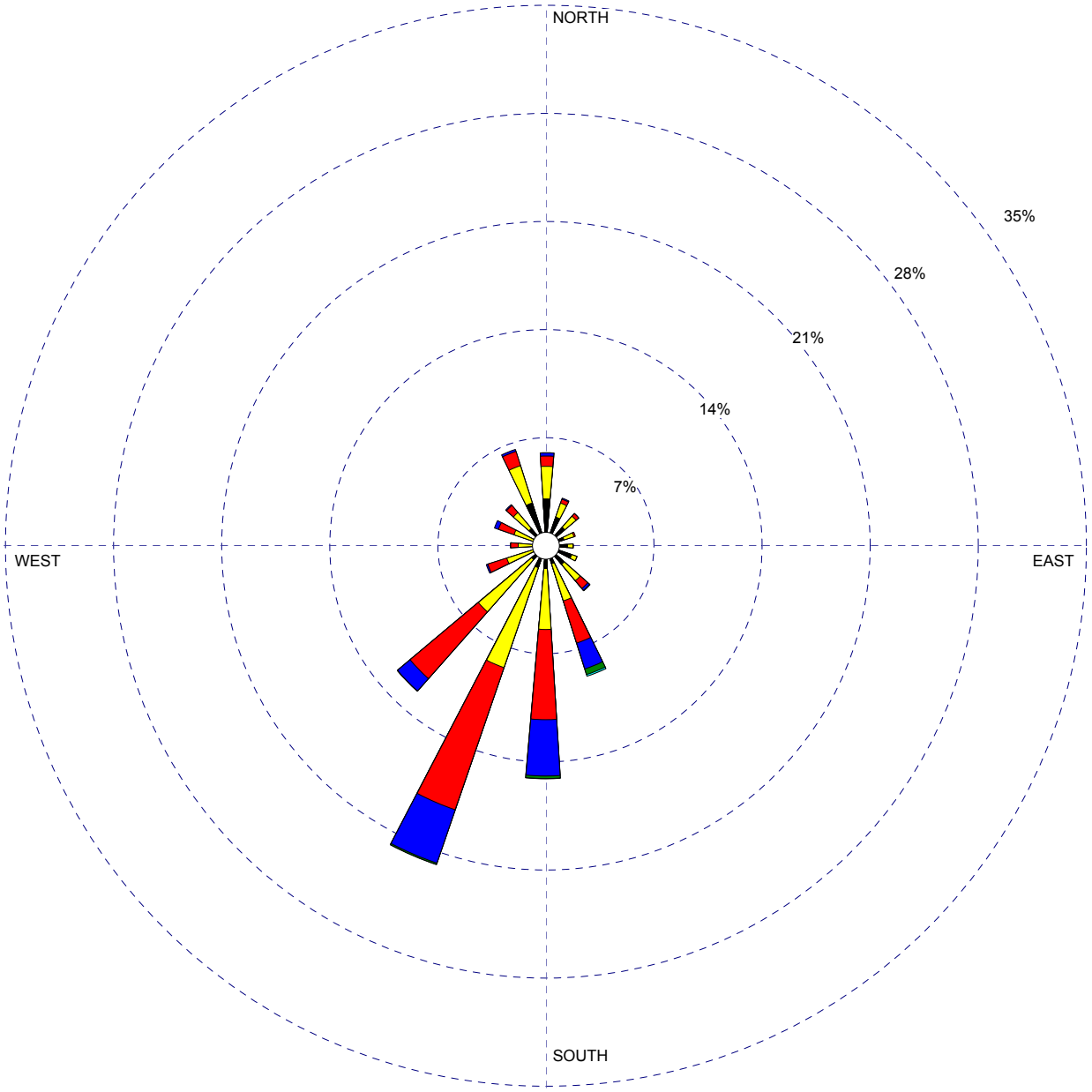
4.3

WIND ROSE PLOT:

UC Richmond Meteorological Station
Wind Rose - 2000, 2001, 2003, 2004, and 2005

DISPLAY:

Wind Speed
Direction (blowing from)



Wind Speed
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

DATA PERIOD:

2000
Jan 1 - Dec 31
00:00 - 23:00

COMPANY NAME:

COMMENTS:

TOTAL COUNT:

43841 hours

MODELER:

CALM WINDS:

0.10%

DATE:

04/05/2007

AVG. WIND SPEED:

3.23 m/s

PROJECT NO.:

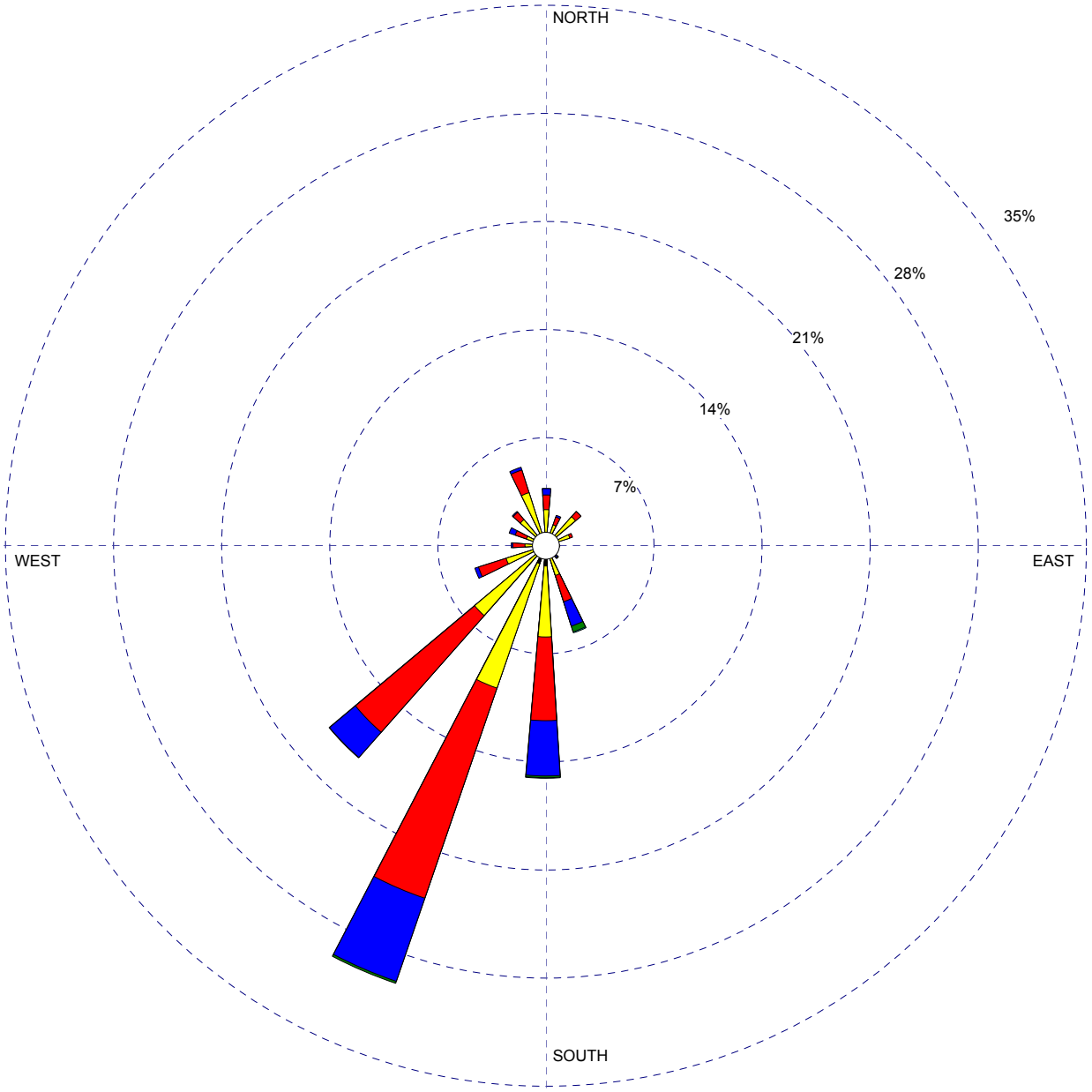
03-16476B

WIND ROSE PLOT:

UC Richmond Meteorological Station
Wind Rose - 8 a.m. to 4 p.m. - 2000, 2001, 2003, 2004, and 2005

DISPLAY:

Wind Speed
Direction (blowing from)



Wind Speed
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

DATA PERIOD:

2000
Jan 1 - Dec 31
08:00 - 15:00

COMPANY NAME:

COMMENTS:

TOTAL COUNT:

14616 hours

MODELER:

CALM WINDS:

0.03%

DATE:

04/05/2007

AVG. WIND SPEED:

3.75 m/s

PROJECT NO.:

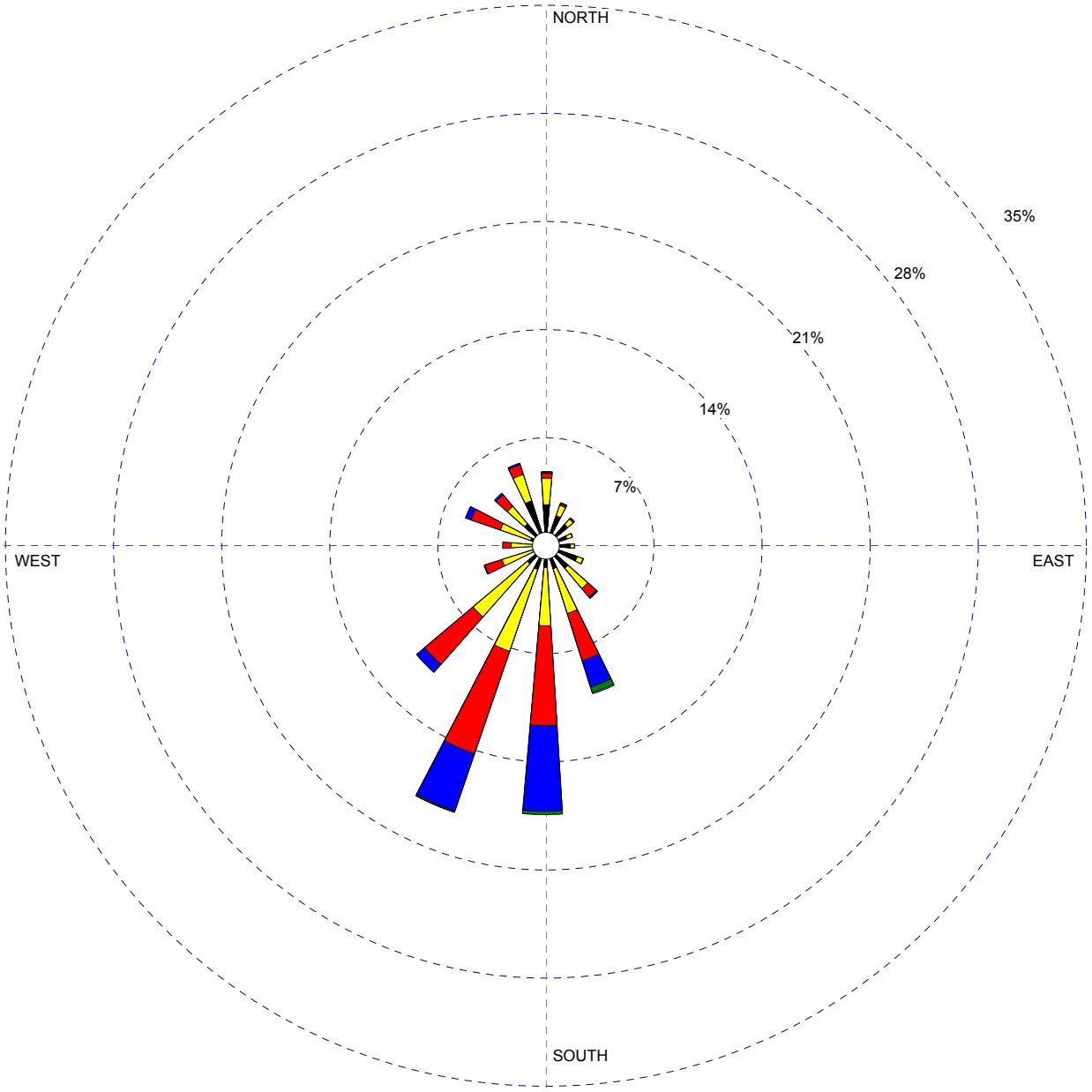
03-16476B

WIND ROSE PLOT:

UC Richmond Meteorological Station
Wind Rose - 4 p.m. to Midnight - 2000, 2001, 2003, 2004, and 2005

DISPLAY:

Wind Speed
Direction (blowing from)



Wind Speed
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

DATA PERIOD:

2000
Jan 1 - Dec 31
16:00 - 23:00

COMPANY NAME:

COMMENTS:

TOTAL COUNT:

14609 hours

MODELER:

CALM WINDS:

0.07%

DATE:

04/05/2007

AVG. WIND SPEED:

3.20 m/s

PROJECT NO.:

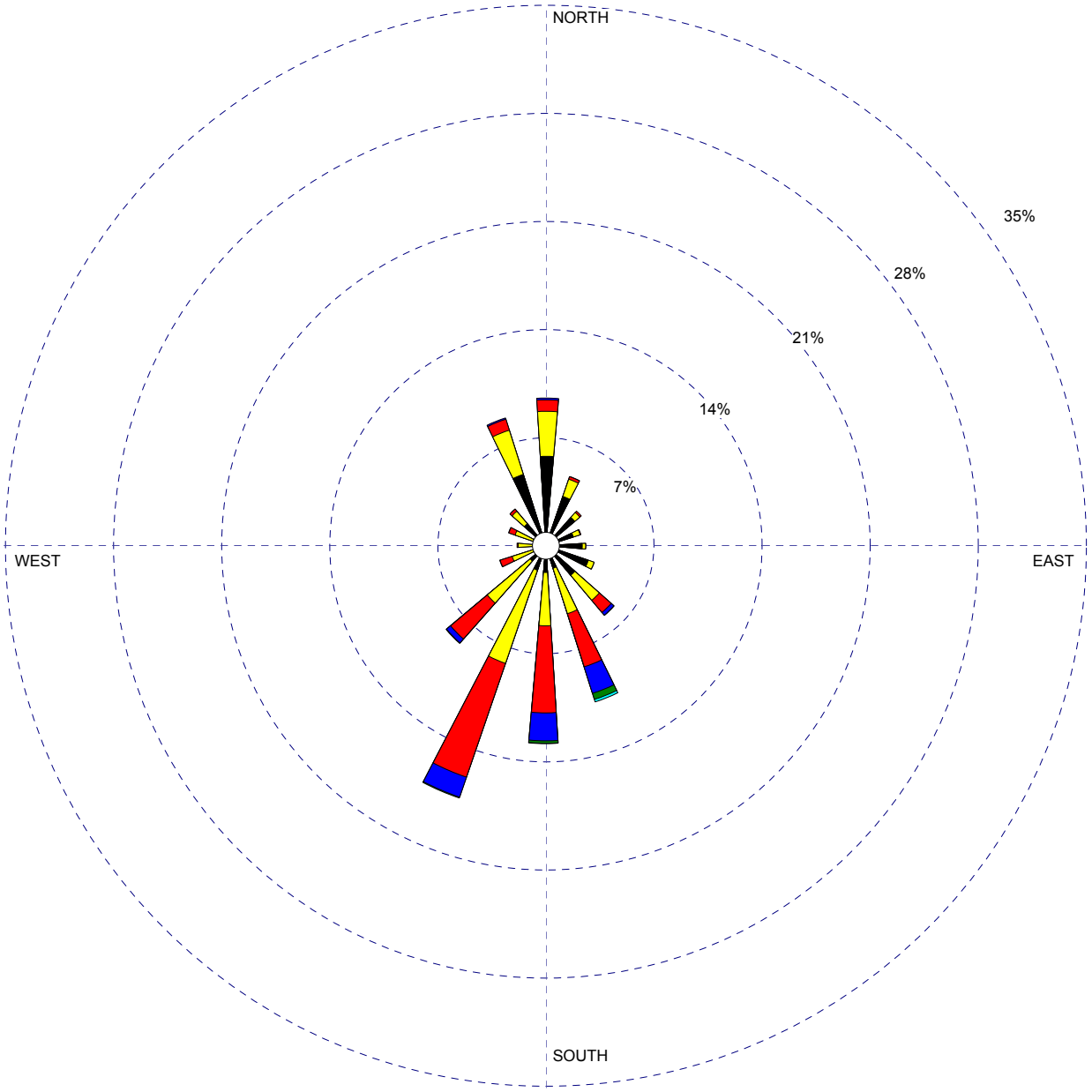
03-16476B

WIND ROSE PLOT:

UC Richmond Meteorological Station
Wind Rose - Midnight to 8 a.m. - 2000, 2001, 2003, 2004, and 2005

DISPLAY:

Wind Speed
Direction (blowing from)



Wind Speed
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

DATA PERIOD:

2000
Jan 1 - Dec 31
00:00 - 07:00

COMPANY NAME:

COMMENTS:

TOTAL COUNT:

14616 hours

MODELER:

CALM WINDS:

0.21%

DATE:

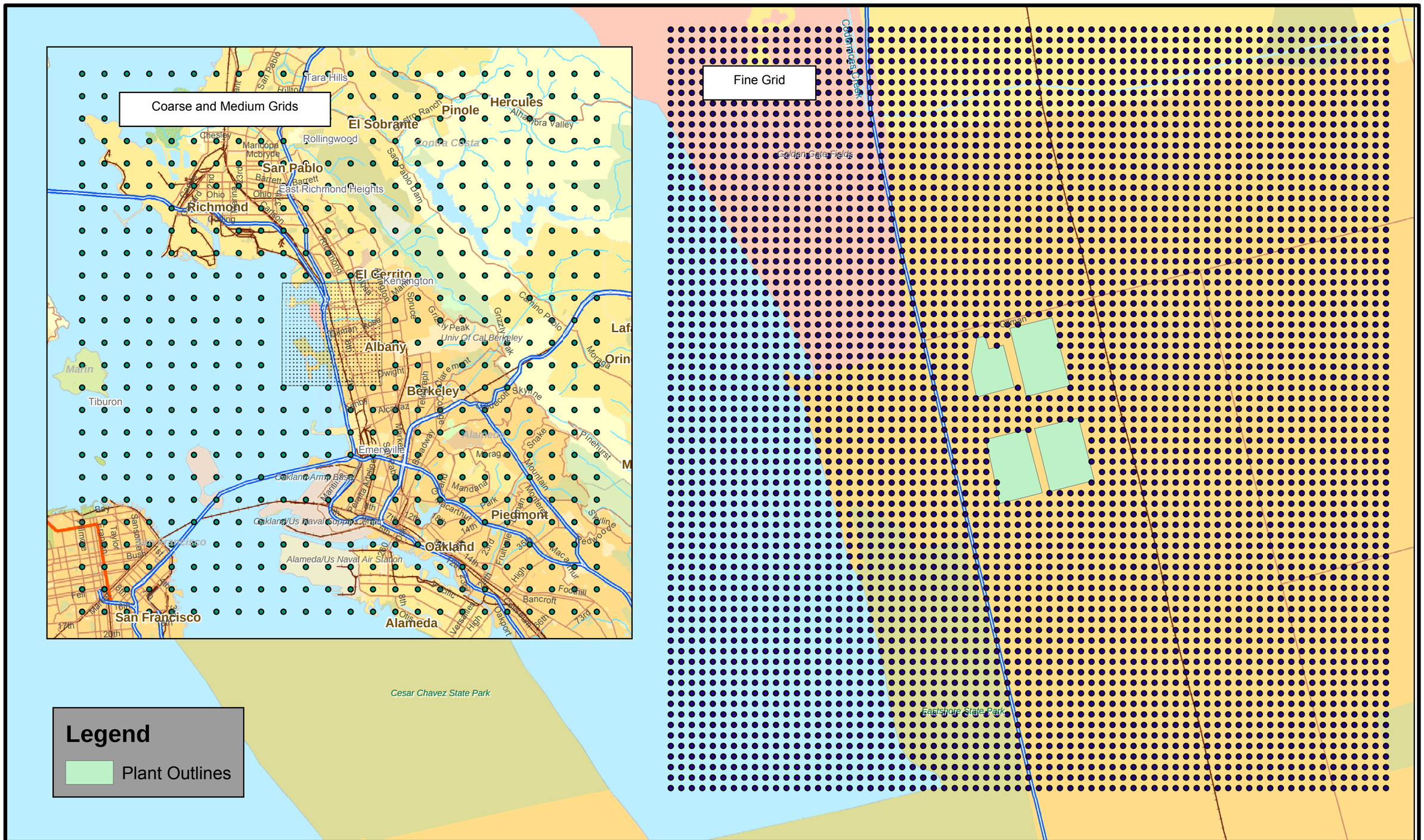
04/05/2007

AVG. WIND SPEED:

2.73 m/s

PROJECT NO.:

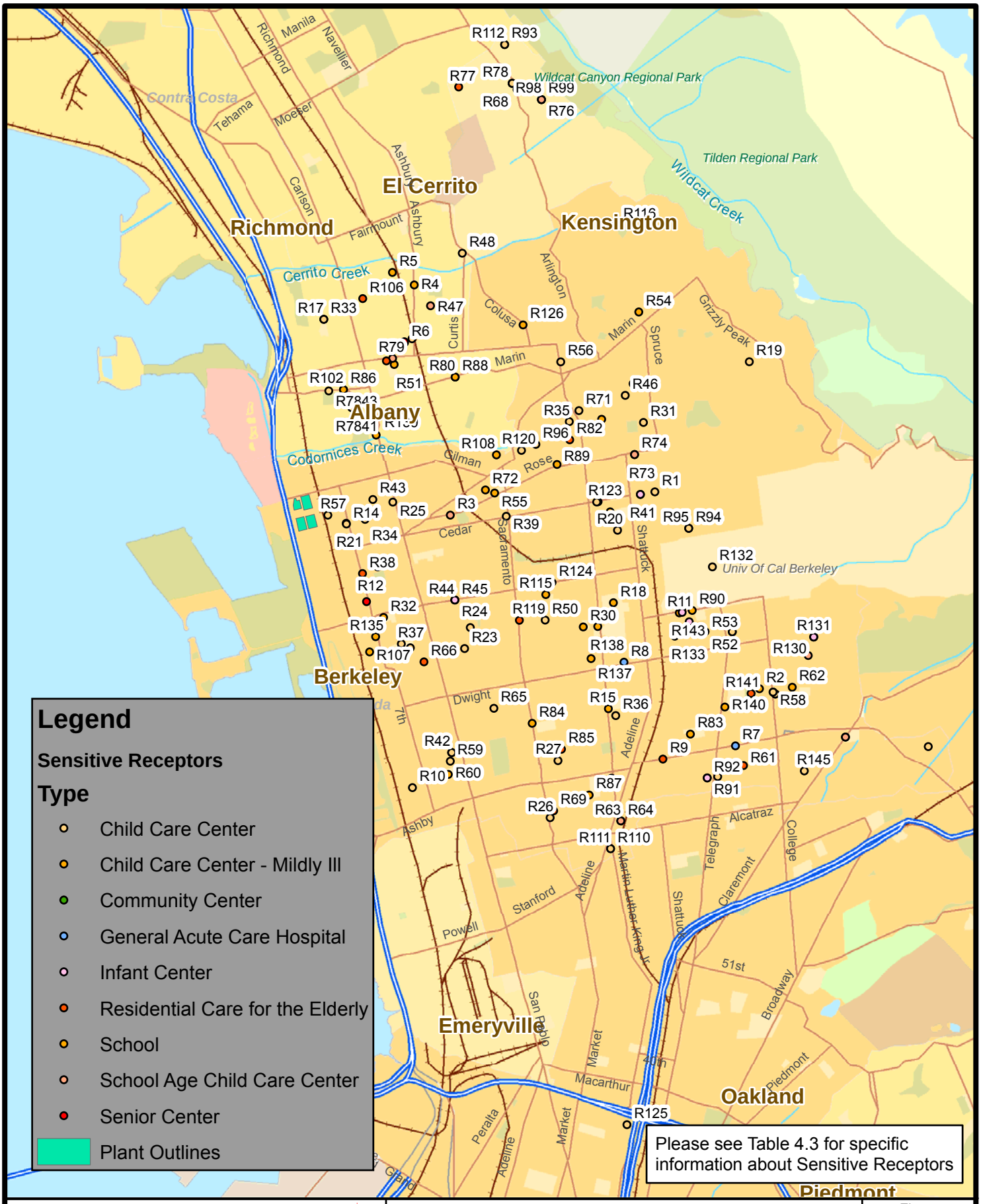
03-16476B



ENVIRON
6001 Shellmound St., Suite 700, Emeryville, CA 94608

Receptor Locations
Pacific Steel Casting Company
Berkeley, California

Figure
4.8

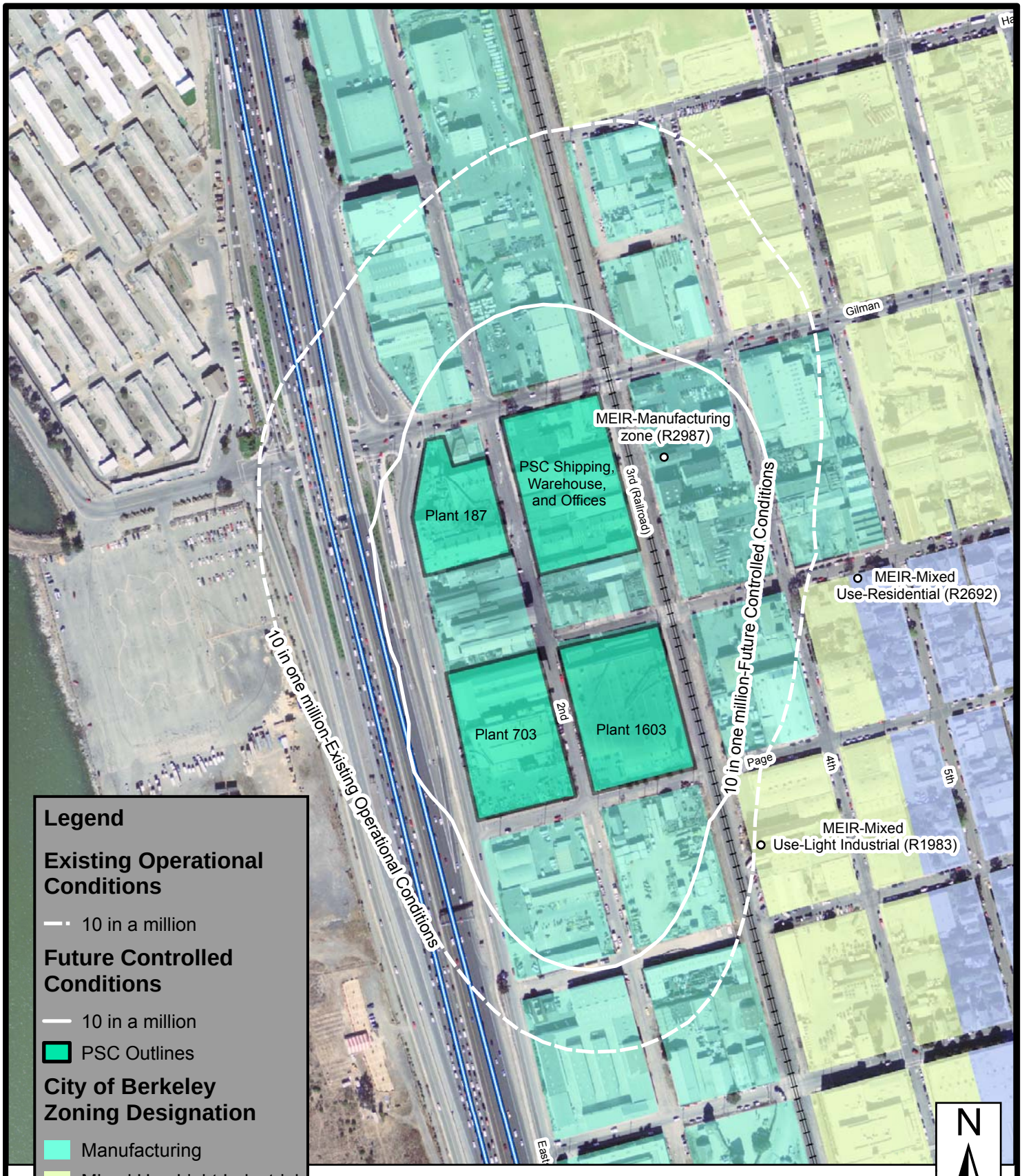


ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Sensitive Receptor Locations
Pacific Steel Casting Company
Berkeley, California

Figure
4.9

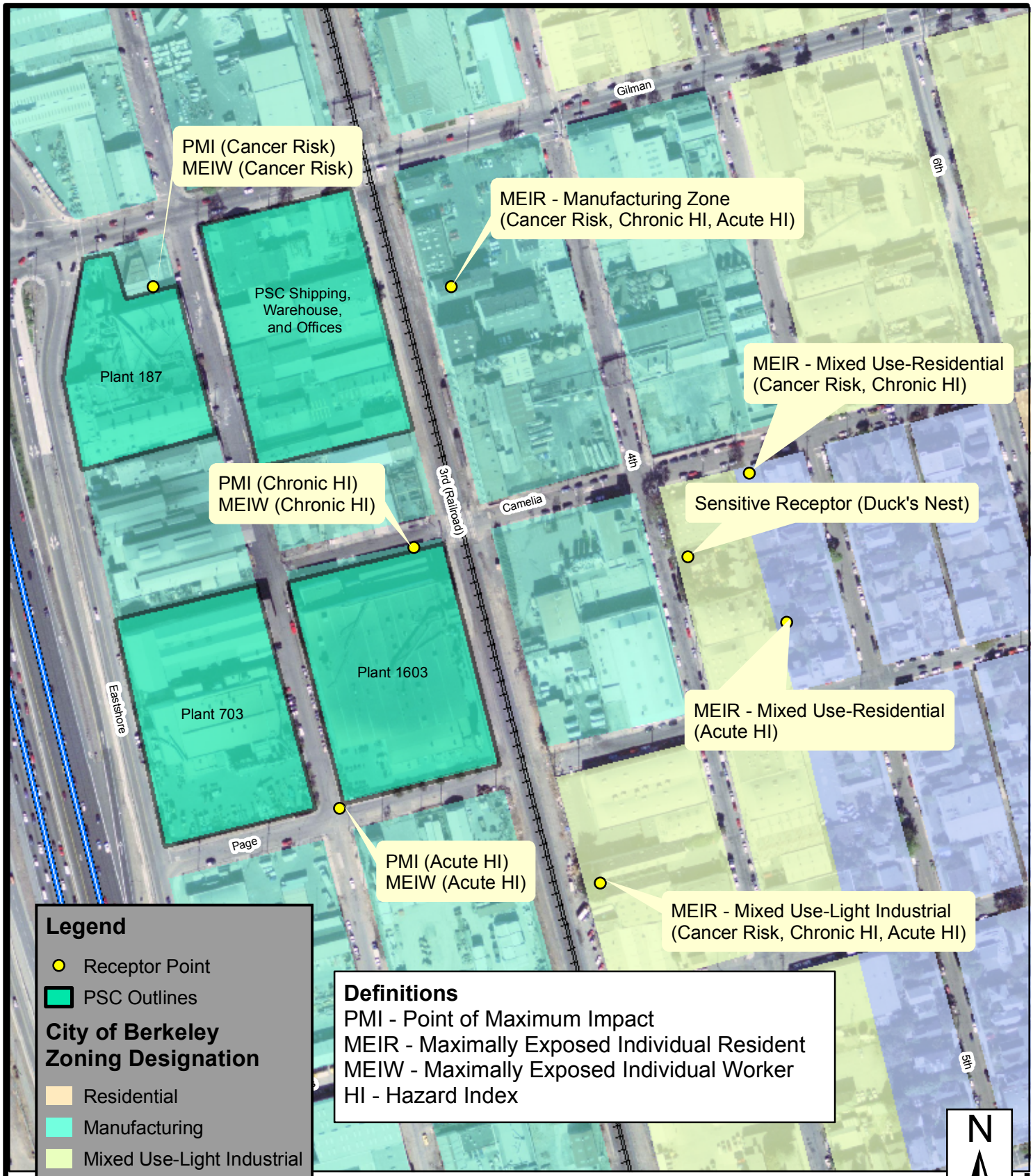


ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Existing Operational and Future Controlled Conditions
Lifetime (70-yr) Residential Cancer Risk Isopleth
Pacific Steel Casting Company, Berkeley, CA

Figure
6.1



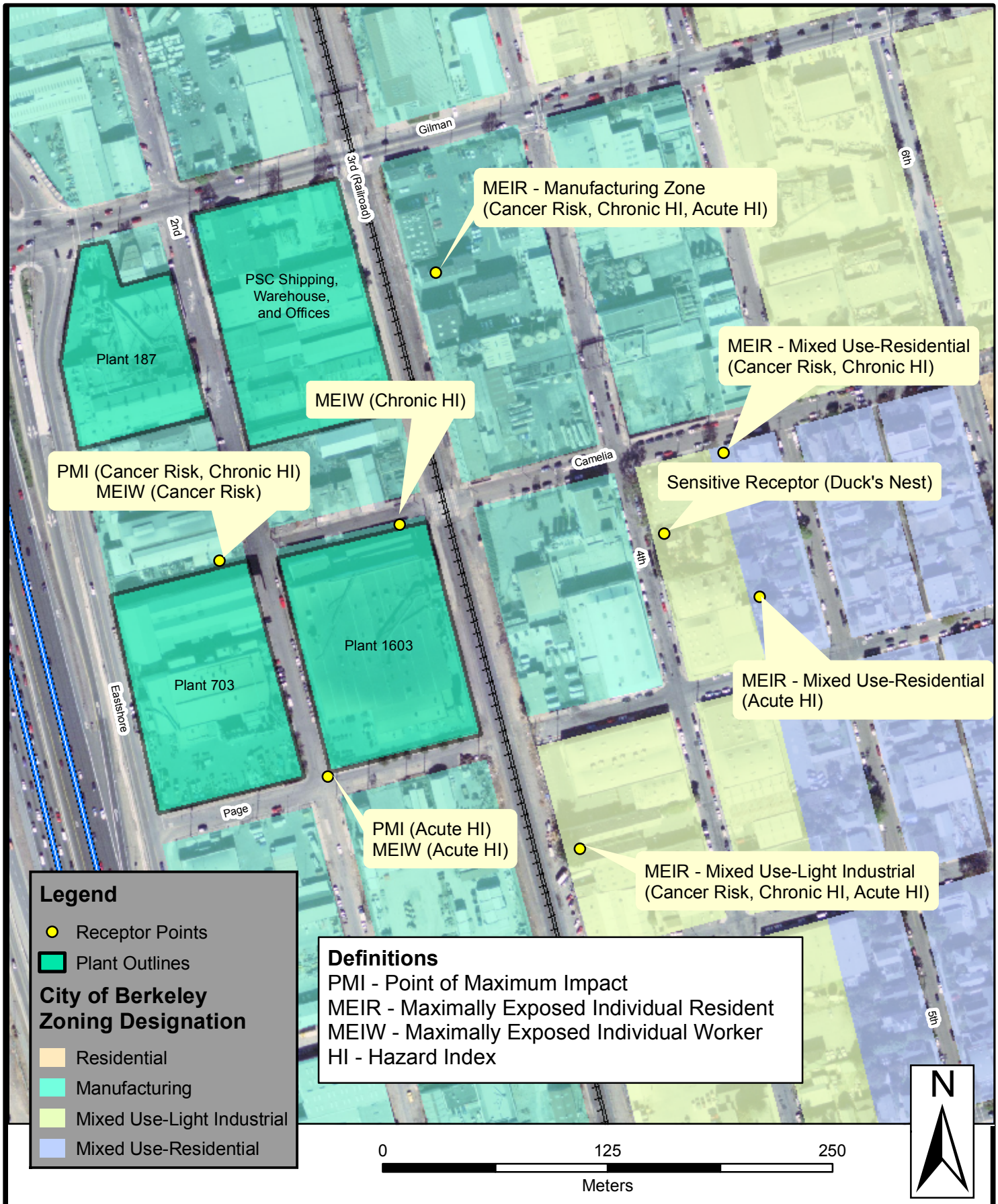
ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Existing Operational Conditions,
Maximum Impact Receptor Point Locations
Pacific Steel Casting Company, Berkeley, CA

Figure

6.2



ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Future Controlled Conditions,
Maximum Impact Receptor Point Locations
Pacific Steel Casting Company, Berkeley, CA

Figure

6.3

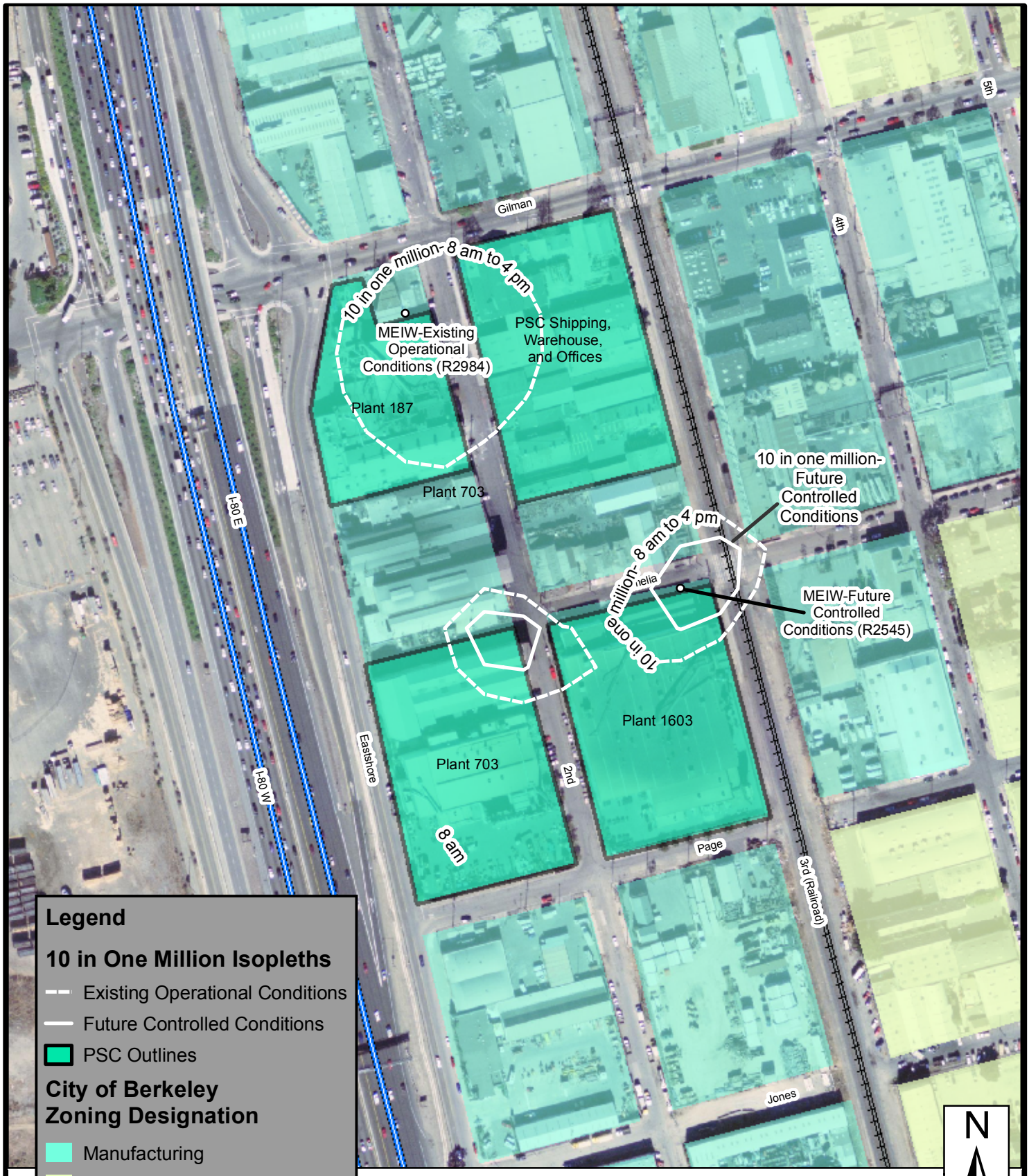
ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Off-Site Worker Cancer Risk Isopleths
Worker Shift 12 am to 8 am
Pacific Steel Casting Company, Berkeley, CA

Figure

6.4



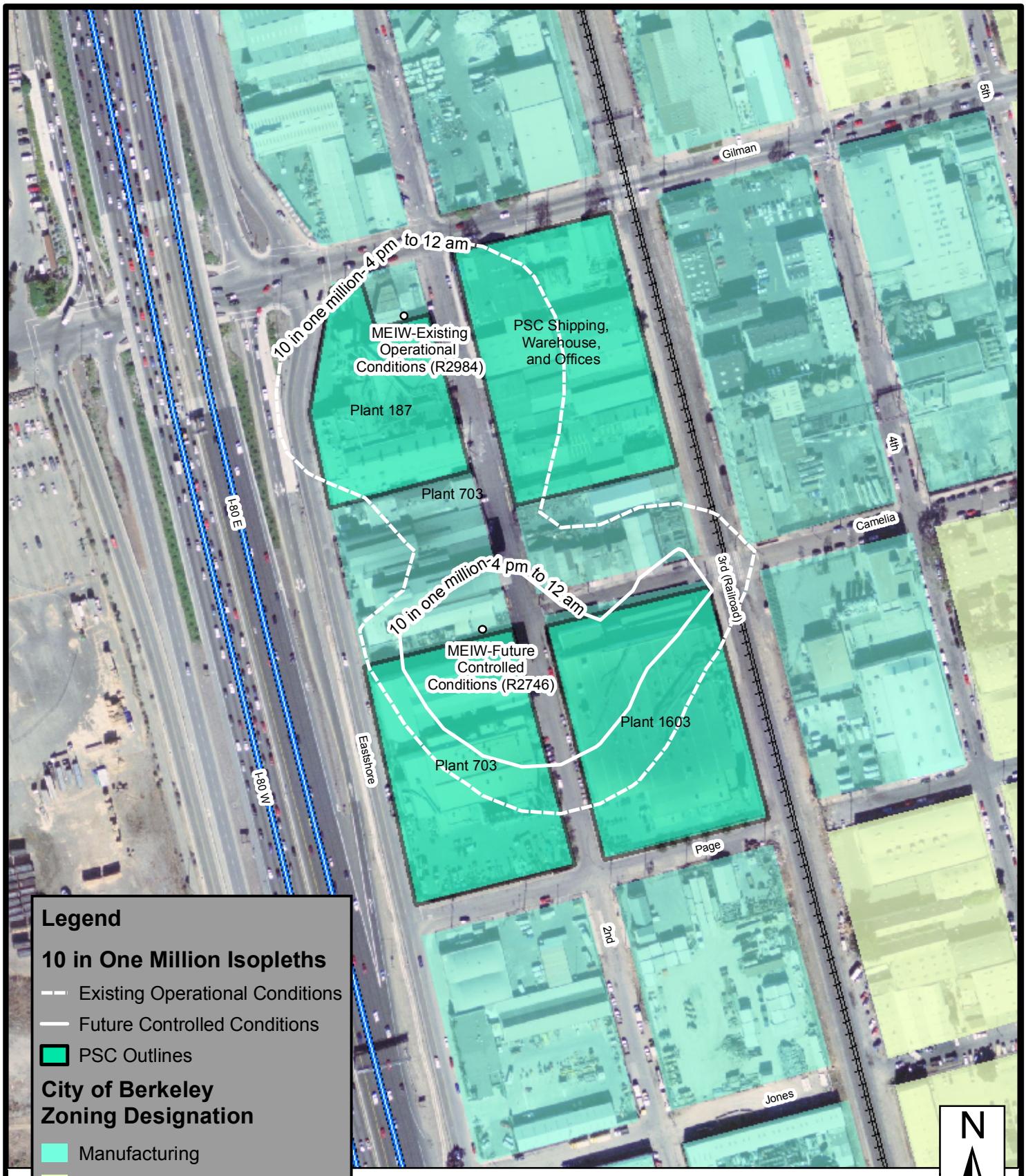
ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Off-Site Worker Cancer Risk Isopleths
Worker Shift 8 am to 4 pm
Pacific Steel Casting Company, Berkeley, CA

Figure

6.5



ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Off-Site Worker Cancer Risk Isopleths
Worker Shift 4 pm to 12 am
Pacific Steel Casting Company, Berkeley, CA

Figure

6.6