An Assessment of the Health and Safety Implications of Coal Transport through Oakland

Public Health Advisory Panel on Coal in Oakland
Oakland, California
June 14, 2016

Panelists

Charles M. Crane, MD, MPH, former Medical Director, TB Program, Contra Costa Health Services

Paul English, PhD, MPH, Public Health Institute, public health epidemiologist

Jonathan Heller, PhD, Co-Director and Co-Founder, Human Impact Partners

Janice Kirsch, MD, MPH, Medical oncologist and hematologist

Heather Kuiper, DrPH, MPH, public health consultant

Amy D Kyle, PhD, MPH, School of Public Health, University of California Berkeley (institution for identification only)

Bart Ostro, PhD, former Chief of Air Pollution Epidemiology Section, California EPA, currently Research Faculty, Air Quality Research Center, UC Davis

Linda Rudolph, MD, MPH, Center for Climate Change and Health, Public Health Institute, former Health Officer and Director of Public Health, City of Berkeley

Seth Shonkoff, PhD, MPH, Executive Director of the Energy Science and Policy Institute, PSE Healthy Energy; Visiting Scholar, Department of Environmental Science, Policy and Management, UC Berkeley; and Affiliate, Lawrence Berkeley National Laboratory

Acknowledgements

We, in particular Human Impact Partners, would like to thank The California Endowment for their generous support.

And, for their outstanding contributions as technical reviewers on this project, we also would like to thank:

- Brendan DeCenso, MPH, Public Health Analyst and medical student, University of Pittsburgh School of Medicine
- Elizabeth J Fuller, DrPH, Health Policy Consultant

Endorsements

More endorsements will come in. A final list will be made available prior to the June 27, 2016 meeting.

John Balmes MD	Professor of Medicine, Division of Occupational and Environmental Medicine, University of California, San Francisco
Wendel Brunner MD, PhD, MPH	former Director of Public Health, Contra Costa Health Services
Arthur M. Chen MD	former Public Health Officer, Alameda County; President of Alameda-Contra Costa Medical Association
Larry Cohen	Executive Director, Prevention Institute
Robert M. Gould MD	Associate Adjunct Professor, Program on Reproductive Health and the Environment Department of Obstetrics, Gynecology and Reproductive Sciences, UCSF School of Medicine (for identification purposes only); President, San Francisco Bay Area Chapter Physicians for Social Responsibility; Immediate Past-President Physicians for Social Responsibility (National)
Anthony Iton MD, MPH, JD	Former Director, Alameda County Public Health Department
Richard J Jackson MD, MPH	Professor, UCLA, Former Director, CDC National Center for Environmental Health
Rick Kreutzer MD	MD, Environmental and Occupational Health physician
Michael Lipsett MD	Former Chief, Environmental Health Investigations Branch California Department of Public Health (retired)
Barbara Sattler RN, DrPH	Professor at University of San Francisco and Alliance of Nurses for Healthy Environments

UCSF Benioff Children's Hospital - Oakland

James Feusner MD	Medical Director of Oncology, Children's Hospital & Research Center Oakland; Professor of Pediatrics, UCSF
Celeste Allen MD	Attending physician
Lisa Arcilla MD	Pediatric Cardiology
Rachna Wadia MD	Pediatric Pulmonology
Noemi Alice Spinazzi MD	Chief Resident, Oakland Fellow of the American Academy of Pediatrics

Executive Summary:

An Assessment of the Health and Safety Implications of Coal Transport through Oakland

Public Health Panel on Coal in Oakland, California
June 13, 2016

A panel of public health experts considered the health and safety implications related to the potential transport, storage and handling of coal at the Oakland Bulk and Oversized Terminal (OBOT) proposed to be constructed on the former Oakland Army Base.
The panel reviewed evidence submitted to the Oakland City Council in conjunction with a public hearing held on September 21, 2015 and identified and considered additional sources including scientific articles in peer-reviewed journals, professional reports, press reports, and government data. The panel also conducted original calculations.
This review was conducted in the context of the Oakland City Council's upcoming decision concerning the proposed transport, storage, and handling of coal, which will be informed by public health and safety considerations for current and future Oakland workers and residents.
Based on its review, the panel offers the following summary of its findings.

Transporting coal by rail through the City of Oakland and transferring it through the OBOT facility will increase exposures to air pollutants with known adverse health effects including deaths

- Coal trains significantly increase concentrations of fine particulate matter (PM2.5) in the local community due to emissions of both coal dust and diesel exhaust.
- PM2.5, at levels currently experienced in Oakland, is definitively associated with premature death and increases in lung cancer, hospitalization for heart and lung disease, emergency room visits, asthma attacks, adverse birth outcomes, school and work loss and respiratory symptoms. Introduction of a new PM2.5 source will increase the risks of these poor health outcomes. Even brief spikes from the passing trains may increase health risks.
- Increased emissions of coal and diesel pollutants will likely push current outdoor air concentrations above state, federal, and international air quality standards. However, the U.S. EPA and the World Health Organization (WHO) have determined there is no clear safe level of PM2.5 exposure and effects have been clearly documented below the standards.
- Coal dust typically contains toxics such as mercury, lead, arsenic, cadmium, and crystalline silica. These substances are of high health concern if inhaled or ingested and are known to cause cancer, fetal defects and neurological damage, even at very low doses. There are no known safe levels of exposure to these toxics.

  Atmospheric transport of pollutants generated from coal combustion in Asia back to the Bay Area has increased levels of PM2.5 and air toxics in Oakland.

There are no proven methods to eliminate or reduce the emission of these pollutants to a safe level

- Use of covers for coal cars has been asserted to prevent emissions of coal dust, but this approach is largely experimental and has not been demonstrated in the field to be safe, reliable or effective. Since the panel could find no evidence that covers for coal train cars are currently in use in the U.S., it is impossible to vouch for their safety regarding the possibility of combustion due to the confinement of coal.
- Use of surface sprays to coal for transport has been asserted to achieve partial emission control but such chemicals degrade over time. Through travel from Utah, the surfactants will degrade and will not significantly reduce coal dust emissions locally.

There are inherent hazards in transporting and handling coal, including the risk of catastrophic explosion

- Since coal is inherently combustible, each step in its handling creates hazards for workers and nearby communities.
- Project proponents assert that all inherent hazards can be managed by use of a closed facility that will enable transfers and storage to be completed in a confined space. We have not identified evidence of safety of these designs in comparable urban settings. Transporting and managing coal in confined spaces creates potential for suspension of coal dust in the air, which can be explosive. Coal dust also poses a hazard for workers if inhaled. Further, we are concerned that the Basis of Design documents do not actually indicate a truly closed system, meaning issues of fugitive dust typical to coal terminal facilities would apply In Oakland.
- If the design plans were to be implemented, the City of Oakland would need to assure vigilance in monitoring, operation, oversight, and prompt remediation to ensure protection of workers, residents, and the environment. This would require active engagement throughout the duration of the facility's operations. The level of oversight required, given the myriad opportunities for violation of safety and environmental protection, would be very difficult to enforce and is unlikely a reliable strategy for protecting health and safety.

The combustion of coal exported from OBOT will contribute to global climate change, resulting in additional adverse health risks to Oakland residents

- If climate change continues to progress, it will cause significant impacts on the health of Oakland residents. These impacts include increased heat and ground level ozone-related mortality and morbidity, displacement and economic insecurity due to storm surges, and sea level rise, and flooding, especially in West Oakland, increased respiratory and cardiovascular illnesses caused by air pollution from more frequent wildfires, food insecurity resulting in worsened nutrition, and migration of disease vectors into the Oakland area as environmental conditions change.

- West Oakland residents are particularly vulnerable to the health impacts of climate change, including increased respiratory and cardiovascular disease, heat-induced illness and death, and food and water insecurity.
- There is a narrow window during which actions around the world can be taken to prevent catastrophic climate change by limiting the overall average temperature on Earth to no more than 1.5°C. On a cumulative basis, combustion of OBOT coal produces a significant fraction of the total amount of CO_2 remaining for the whole world to burn over the next millennium while staying within this limit.
- Exporting coal through OBOT will undermine the local, regional, state and international climate initiatives that will protect public health everywhere—including here in Oakland. In contrast, this investigation finds that coal slated for OBOT is likely to stay in the ground absent availability of this facility, making prohibition of coal a reasonable and effective method for Oakland to contribute to the effort to protect public health globally and in Oakland.

Impacts of coal transport and handling will be greatest in West Oakland, a neighborhood already burdened by significant and inequitable environmental hazards

- Those who live, work and play near the rail lines and terminal will experience more significant exposures than those farther away are less likely to experience.
- High prevalence of poverty, coexisting chronic diseases, and reduced access to health care or coping resources, will make those experiencing these exposures less resilient to disease and disability.
- The transportation and handling of coal in Oakland introduces unique risks and challenges for West Oakland residents, and the implications of exposures are more complex. For example, coal trains in Oakland will add to noise exposures, which would reach levels that increase risk for disrupted sleep and reduced work and academic performance for residents living and working nearby. For vulnerable children, subsequent behavioral problems and reduced educational attainment can have far-reaching consequences.

Together, these findings span hundreds of sources that point in the same direction: If coal is transported, stored, and handled in Oakland, we can reasonably conclude that Oakland residents, in West Oakland in particular, will face increased exposure to several known hazards. It is highly likely that there will be increases in adverse health outcomes along with possible adverse safety outcomes.

TABLE OF CONTENTS

Chapter 1: Resiliency, Vulnerability, and West Oakland

Key Points

We start this assessment of the health and safety implications of coal export with a focus on West Oakland,[1] not only because it is the neighborhood closest to the Oakland Bulk and Oversized Terminal (OBOT) site and likely rail route, but also because this health assessment is ultimately about people and where they live. We also frame this assessment with the definition of health, established in 1948 by the World Health Organization and unchanged since then:

> Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. (World Health Organization, 1948)

From that perspective, there are many ways that West Oakland is a healthy community. Many of its residents are engaged agents of their lives, embedded in strong social networks and active in transforming the environmental injustices impacting them. This strength and vibrancy is seen in myriad community-based projects that pursue justice and health, such as West Oakland Environmental Indicators Project's 100 x 100 citizen air monitoring project, their near-roadway monitoring project, and their upcoming social cohesion study. The faith community is active in West Oakland, along with many community-based organizations that foster positive cultural identity and service. West Oakland is a powerful community, with numerous organizations and individuals who are engaged for social, economic, environmental and health equity.

This dynamism and resiliency is necessary but insufficient for achieving the full state of health defined by the WHO. Underlying vulnerabilities must also be resolved to do so. In West Oakland, high levels of the following factors make residents exceptionally susceptible to the adverse health effects of harmful environmental exposures:

- chronic disease
- disadvantaged demographics
- low income, low educational attainment, and poverty
- insufficient health-supporting infrastructure

For example, compared to other parts of Oakland such as North Oakland and the hills, residents of West Oakland have disproportionately high exposure to:

- Air pollution
- Noise
- Flooding

This brief focuses on how some populations and communities in Oakland – primarily West Oakland – will be more exposed and susceptible to the health risks of OBOT's coal export.[2]

---

[1] This chapter focuses on West Oakland for its proximity to the terminal and because the most likely route for coal

[2] This write-up about West Oakland was neither co-created with its members nor authentically vetted by them. These are shortcomings. At a minimum though, the findings are likely to be familiar – unfortunately – to any West

In the remainder of this assessment document, each chapter will speak to the particular vulnerabilities associated with its topic. This chapter here, with a focus on vulnerability, is overarching.

Summary of Submitted Evidence

There were several submissions to the City Council that provided evidence that the proposed coal export would disproportionately burden West Oakland. The contributors included Communities for a Better Environment, Earth Justice, Forests Forever, Paul English of the California Department of Public Health, Deborah Niemeier, Professor of Civil and Environmental Engineering at UC Davis, and the report from Multnomah Health Department (Oregon) on the impact of passing coal trains. These sources largely relied upon published journal articles and government data from the state, Alameda County, and BAAQMD.

Three main points were made in the submitted evidence (The Multnomah County report supports these points at the thematic level, with similar findings for its own population):

1. Residents in West Oakland face levels of exposure to environmental health hazards that are already high – and higher than many other residents of the city.
2. Many in West Oakland are more susceptible to a greater number and severity of adverse health outcomes due to poor existing environmental conditions and greater sensitivity to the exposures per baseline health and socio-demographic standing.
3. Many residents of West Oakland have limited financial resources and live in low resource settings, limiting their capacity to adapt to adverse environmental conditions.

The submissions converged on the following conclusion:

Given West Oakland residents have 1) high likelihood of exposure to coal trains and coal operations at the terminal, 2) high sensitivity to environmental hazards, and 3) low adaptive capacity due to economic and structural inequity, **any increase in exposure to environmental hazards related to the coal exports will likely have an adverse health impact on the West Oakland population, possibly with greater severity than for others in Oakland were they to face a similar exposure.**

Findings

Assessment of vulnerability to coal transport and handling in Oakland

Vulnerability, per Crimmins et al. (2016) and Turner et al. (2003), can be defined as follows: "whether or not a person is exposed to a health threat or suffers… adverse health outcomes from that exposure depends on a complex set of vulnerability factors," including

---

Oakland resident, and the spirit with which it is submitted – in the pursuit of health equity – is likely to be supported.

exposure, sensitivity or susceptibility to harm, and the capacity to adapt or to cope. (See Figure 1) Working definitions of these terms are listed below.

- ***Exposure*** is contact between a person and one or more biological, psychosocial, chemical, or physical stressors. Contact may occur in a single instance or repeatedly, in one location or over a wider geographic area.
- ***Sensitivity* or susceptibility** is the degree to which people or communities are affected, either adversely or beneficially, by the exposure.
- ***Adaptive capacity*** is the ability of communities, institutions, or people to adjust to potential hazards. A related term, *resilience*, is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

  (US GCRP, 2016, Ch. 9 as adapted from Intergovernmental Panel on Climate Change, 2014 and National Research Council, 2012)

Figure 1 Determinants of Vulnerability

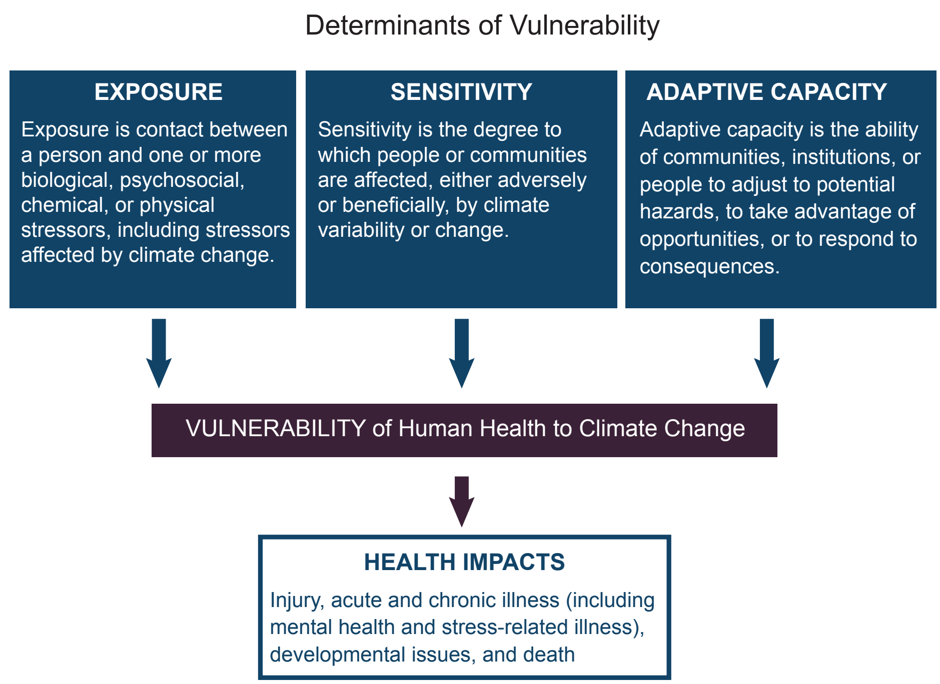


Figure 1: Defining the determinants of vulnerability to health impacts associated with climate change, including exposure, sensitivity, and adaptive capacity. (Figure source: adapted from Turner et al. 2003)[4]

Source, US GCRP, 2016 Chapter 9, referencing Turner, 2003

Exposure

1. **West Oakland residents are in closest proximity to the rails and the OBOT site. Based upon this proximity, West Oakland residents have higher levels of exposures to**

environmental health hazards, including higher exposure (more days of exposure and at higher levels) to:[3]

1.1. air pollution (especially particulate matter and ozone) from trains, ship, coal handling operations, and coal dust

1.1.1. The Oakland Army Base (OAB) EIR finds the project as a whole will have significant and unavoidable air quality impacts (LSA Associates 2012). It states that the project would substantially increase diesel emissions, increasing nearby residents' exposure to toxic air contaminants. The impacts would be concentrated in West Oakland. Emissions would come from ship and rail operations, passenger and transport trucks, and space and water heating (Cambridge Systematics, Inc. 2015).

1.1.2. In a health assessment of the Oakland Army Base conversion to export facilities, the Alameda County Public Health Department calculated the degree to which residents in Alameda county, by census tract, were "freight-impacted."[4] They found that those areas most freight-impacted included West and East Oakland which are adjacent to the tracks, and that, compared to those who were least freight impacted, they were exposed to 2.6 times more diesel particulate matter per day (41.26 kg/day versus 15.83 kg /day; see Figure 2) (Garzón-Galvis et al. 2016).

1.2. noise from the passing trains and terminal operations

1.2.1. (See Chapter 9)

1.3. storm surges and flooding related to climate change

1.3.1. (See Chapter 8)

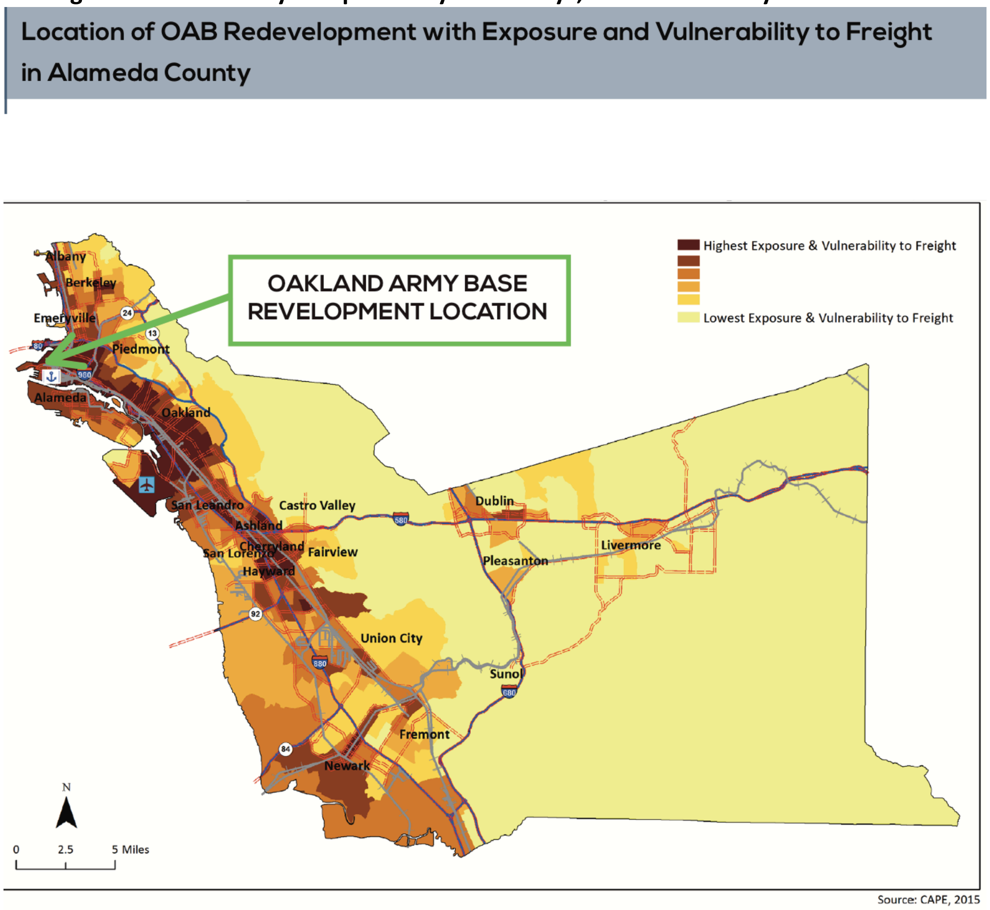
2. Exposure Inequities: The potential burdens of coal export would fall on the same populations who are already exposed to the highest levels of air pollution, industrial noise, and the worst baseline health conditions. (Multnomah County Health Department 2013)

2.1. Rail yards disproportionately impact communities of color. People of color make up a larger proportion of the population near the rail lines and terminal and as a result, people of color may be disproportionately exposed to the effects of coal transportation (Communities for a Better Environment 2010). Data from the

[3] (See other sections of this document for topical exposure details)

[4] Degree of impact from freight combines 1) Proximity to truck routes, rail lines, the Port of Oakland, and Oakland airport, 2) freight-related environmental exposures, such as diesel PM, and concentration of vulnerable populations (those in poverty, young children, seniors, people of color, freight workers)

Figure 2 Vulnerability and proximity to railways, Alameda County



2.2. Alameda County Public Health Department (Table 1) shows that the Oakland population living within one mile of rail lines is markedly different demographically than that living outside, with a higher percentage of nonwhites, children and adolescents, as well as a higher percentage living in poverty (ACPHD 2016). These geographic differences have the potential to differentially impact health – for instance, according to a Health Impact Assessment of rail transport in Alameda County: "In 17 out of 18 rail yards in California, a significantly higher proportion of people of color reside within high-risk cancer zones near rail yards than within other areas of the county. In Oakland, 64% of residents within the highest risk cancer zone surrounding the Union Pacific rail yard are African American, compared with 14% of residents in Alameda County as a whole" (Garzón-Galvis et al., 2016).

2.3. One study found that transporting freight by rail may expose a greater number of people living in "environmental justice communities"[5] (Communities for a Better Environment 2010). See Figure 3.

[5] Environmental justice communities, in this analysis, are census block groups that meet one or more of three criteria: more than 25% of residents are people of color (non-white); median household income is less than 65% of

Table 1 Demographic characteristics in relation to rail line proximity

	Between rail lines & 500 ft	Between 500 ft and 0.5 miles	Between 0.5 & 1.0 miles	Other Oakland
Population	9455	73632	102751	219231
% in Poverty	23.4%	30.0%	28.5%	13.7%
% Hisp/Lat	47.9%	43.3%	34.5%	16.2%
% White	12.4%	8.4%	11.4%	37.4%
% AA/Black	24.7%	22.2%	28.4%	24.7%
% AmerInd	0.3%	0.3%	0.3%	0.3%
% Asian	11.2%	22.7%	21.0%	15.7%
% PacIsl	0.7%	0.5%	0.9%	0.4%
% Multirace	2.6%	2.4%	3.2%	4.9%
% Other	0.2%	0.2%	0.3%	0.4%
% <18 Years	25.8%	24.4%	22.8%	19.4%
% 65+ Years	7.1%	9.9%	11.1%	14.9%
% Male	50.9%	51.3%	49.5%	47.3%
% Female	49.1%	48.7%	50.5%	52.7%

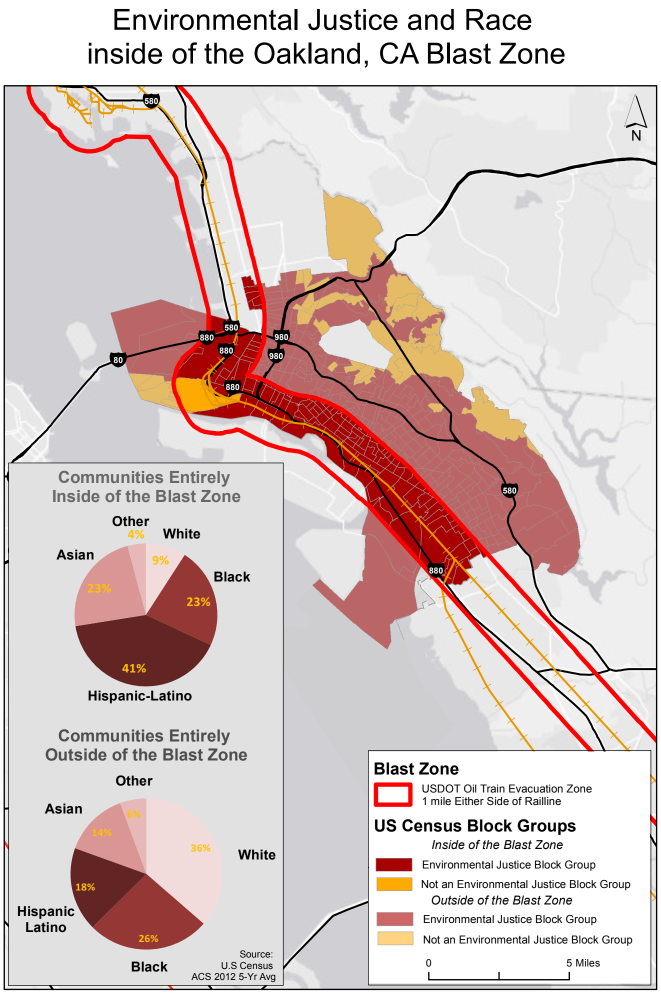
Source: ACPHD 2016

2.4. The Alameda County Goods Movement Plan noted that West Oakland is currently exposed to diesel particulate matter (DPM) ambient concentrations about three times as high as average concentrations within the Bay Area. (Cambridge Systematics, Inc. 2015)

2.5. The California Environmental Protection Agency rated parts of West Oakland as some of the highest census tracts in the State burdened by pollution. For example, some tracts are as high as the 78th percentile for overall pollution burden and in the top percentile for clean-up sites compared to all other CA census tracts (English, 2015).

statewide median household income; more than 25% of households are linguistically isolated (no English speaker older than 14).

Figure 3 Environmental Justice and Race inside the Oakland blast zone



Source: Crude injustice on the rails, Communities for a Better Environment

Susceptibility

3. **Living near rails and terminal operations is associated with heightened susceptibility to adverse morbidity and mortality outcomes.**

    3.1. The Alameda County Public Health Department states that "Any additional sources of air pollution will have a significantly greater impact in an area already disproportionately burdened by multiple sources of air pollution and with high rates of emergency room visits and hospitalization for asthma and cancer risk from existing pollution." (ACPHD, 2015)

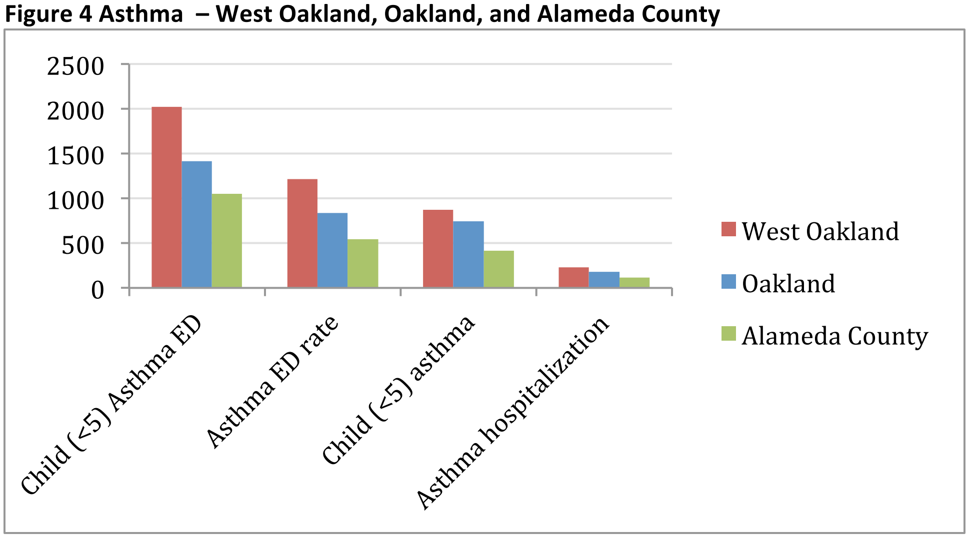
    3.2. Areas of West Oakland had some of the highest rates of emergency room visits for asthma for children in Alameda County (Garzón-Galvis et al., 2016). Data provided by the Alameda County Public Health Department indicate that West Oakland, relative to Alameda county as a whole, experiences roughly twice the rate of asthma Emergency Department (ED) visits, under-5 asthma ED visits, asthma hospitalization, and under-5 asthma hospitalizations (see Table 2 and Figure 4) (ACPHD 2016). These disparities are all the more profound considering that Alameda County historically ranks among the California counties with the highest asthma hospitalization rates (Roberts et al. 2006).

Table 2 Rates for asthma-related ED visits and hospitalizations in Alameda county (2012-2014)

	West Oakland (zip 94607) Age-adjusted rate (95% LCL-UCL)	**Oakland Age-adjusted rate (95% LCL-UCL)**	**Alameda county Age-adjusted rate (95% LCL-UCL)**
Asthma ED rate	1218.4 (1138.3-1298.5)	838.8 (822.6-855.1)	545.8 (539-552.6)
Child (<5) Asthma ED rate	2026.2 (1635.4-2482.2)	1416.4 (1334.2-1498.6)	1053.3 (1016-1090.5)
Asthma hospitalization rate	229.3 (193.2-265.3)	178.9 (171.2-186.5)	112.2 (109.1-115.4)
Child (<5) asthma hospitalization rate	871.5 (622.6-1186.7)	747.3 (687.6-807)	415.4 (392-438.8)

Source: ACPHD 2016

Figure 4 Asthma – West Oakland, Oakland, and Alameda County



Source: ACPHD 2016

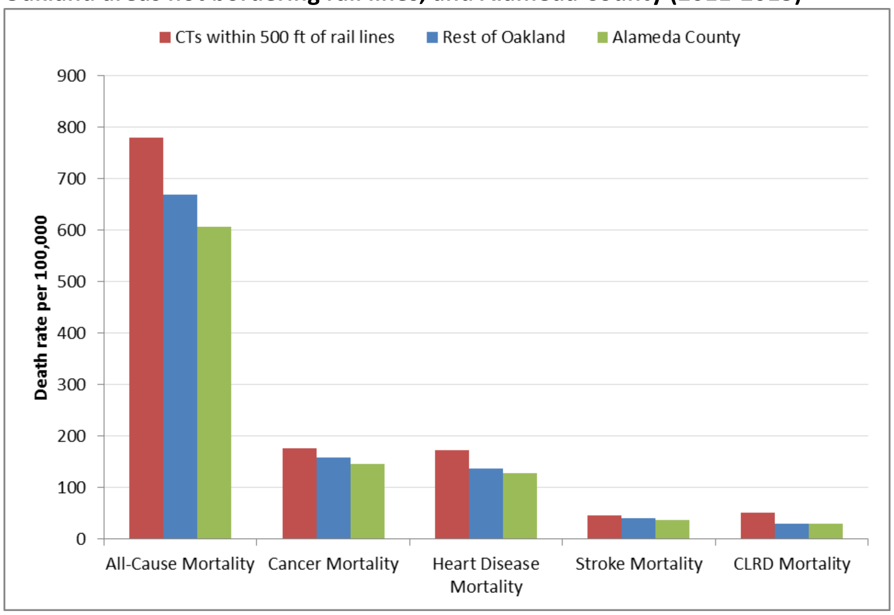
3.3. Oakland furthermore suffers from higher mortality rates than Alameda County as a whole, particularly in areas near rail lines. As displayed in Table 3 and Figure 5, Oakland census tracts within 500 feet of rail lines – compared to Alameda County – have statistically significant higher rates of mortality from all causes, cancer, heart disease, stroke, and chronic lower respiratory disease. (ACPHD, 2016). These higher mortality rates translate to life expectancies 14 years and 12 years shorter for African Americans in East Oakland and West Oakland, respectively, relative to Whites in Oakland Hills (ACPHD, 2015).

Table 3 Mortality by distance from rail system

	CTs within 500 ft of rail lines	Rest of Oakland	Rate Ratio (*=significantly higher)	Alameda County	Rate Ratio (*=significantly higher)
All-Cause Mortality	780.7	668.3	* 1.2	607.5	* 1.3
Cancer Mortality	176.1	157.7	1.1	145.6	* 1.2
Heart Disease Mortality	172.5	136.6	* 1.3	128.2	* 1.3
Stroke Mortality	46.4	40.8	1.1	37.5	* 1.2
CLRD Mortality	50.6	29.0	* 1.7	29.1	* 1.7

Source: ACPHD 2016

Figure 5 Mortality rates for Oakland census tracts bordering rail lines, Oakland areas not bordering rail lines, and Alameda County (2011-2013)



Source: ACPHD 2016

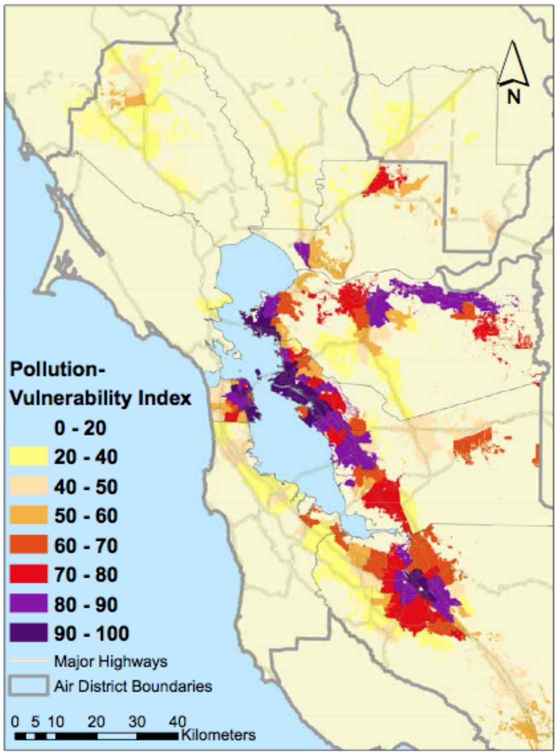
3.4. BAAQMD's Community Air Risk Evaluation (CARE) Program considers East and West Oakland to suffer most from poor health outcomes due to air pollution, relative to other Bay Area communities (ACPHD, 2015). BAAQMD found that West Oakland's Pollution Vulnerability Index (PVI, a score based upon level of health risk from air pollution) was among the highest quintile of PVI (80 – 100 percentile). Those with the highest PVI score live three fewer years. See Figure 6 (Garzón-Galvis et al. 2016).

3.5. The 2012 OAB EIR quantified the increase in cancer risk associated with the projected increase in diesel emissions and toxic air contaminants in proximity to the OAB redevelopment, finding maximum cancer risk from the project at 96 cases per million. (Garzón-Galvis et al. 2016)

3.6. Other health hazards disproportionately faced by residents of Oakland redevelopment areas include diabetes and premature or low birth weight infants (Gutierrez 2015a, Communities for a Better Environment 2010). African Americans in West Oakland are 1.5 times more likely to be born premature or of low birth weight, and 5 times more likely to be hospitalized for diabetes, compared to Whites in Oakland Hills (Alameda County Public Health Department 2008).

3.7. Rates of pedestrian injuries and deaths are seven times higher in the county's most freight-impacted areas (See footnote [4] for definition). (Garzón-Galvis et al. 2016)

Figure 6 the pollution-vulnerability index by zip code



Source: BAAQMD 2014b

"The figure displays the accentuated vulnerability of West Oakland and East Oakland, using the BAAQMD's Pollution Vulnerability Index (PVI), whereby low and high values of the PVI correspond to low and high health impacts, respectively. Vulnerability is constructed to combine existing rates of mortality and illnesses together with exposure to PM and ozone when determining health impacts related to air quality. "Thus the highest PVI values occur where TAC and PM concentrations are high and where health records indicate higher rates of illness associated with air pollutants." (BAAQMD, 2014b)

4. Lower socio-economic standing can increase susceptibility to adverse health impacts of the coal export.

4.1. The BAAQMD analysis found that, on average, compared to areas with the lowest PVI scores, those with the highest PVI score (Garzón-Galvis et al. 2016):

4.1.1. have average annual household income that is more than $40,000 lower

4.1.2. average a year and a half less education

4.1.3. have a five times higher percentage of Black residents

5. **Underlying health conditions increase susceptibility to adverse health impacts of the coal export.**

   5.1. The disproportionately high number of children suffering from asthma in West Oakland would likely experience a further loss of lung function from inhaling even low levels of coal dust (especially those particles of coal dust < 10 microns). (English, 2015)

   5.2. Adults are also subject to increased harm from air pollution due to underlying conditions, such as diabetes, cardiovascular disease, and obesity. (Morello-Frosch et al., 2011; Niemeier, 2015)

6. **Being a person of color, especially being Black is associated with susceptibility to adverse health impacts of coal export.**

   6.1. For instance, in West Oakland from 2011-14, Black children had roughly twice the rate of child (5 – 19yr) emergency department visits for asthma (206.4 per 10,000, 95% CI 176.1-239.7) as did Whites (115.1 per 10,000, 95% CI 62.9-188.0) or Hispanics (92.5 per 10,000, 95% CI 60.9-132.5). See Table 4 (California Department of Public Health 2016)

Table 4 Emergency Department Visits due to Heart Attacks, 2011-2014

		West Oakland (94607)			Alameda County		
		Age Adjusted Rate per 10,000	Lower CI 95%	Upper CI 95%	**Age Adjusted Rate per 10,000**	Lower CI 95%	Upper CI 95%
Overall (All Races/All Ages)		**29.68**	25.43	34.35	**22.01**	21.51	22.53
Adults 35yrs+	**Black**	**36.33**	27.56	46.66	**28.86**	27.24	30.55
	Hispanic	**N/A**	N/A	N/A	**14.39**	13.41	15.42
	White	**107.82**	75.38	147.16	**24.64**	23.8	25.51
	Asian/PI	**13.54**	9.68	18.37	**16.44**	15.63	17.29

N/A= Data not available for counts under 12.
California Environmental Health Tracking Program, Asthma and Heart Attack emergency room visit age-adjusted rates by race/ethnicity, 2011-2014.

7. **In neighborhoods where disadvantaged socio-demographic characteristics interact with environmental exposures, susceptibility from health disparities emerges.** [6]

   7.1. Black children in West Oakland, from 2011-14, had 5 times the rate of hospital admissions as did White children from the rest of Alameda County. (ACPHD, 2015)

   7.2. West Oakland zip code 94607 will likely experience an increase in cancer risk from the OBOT project, even though it already has the highest cancer risk from air pollution in the County, at 689.2 cases per million. West Oakland's diesel cancer risk is three times that of the Bay Area. (Garzón-Galvis et al., 2016)

[6] HHS defines a racial or ethnic health disparity as ''a particular type of health difference that is closely linked with social, economic, and/or environmental disadvantage. Health disparities adversely affect groups of people who have systematically experienced greater obstacles to health based on their racial or ethnic group.'' (U.S. Department of Health and Human Services 2008)

7.3. West Oakland is exposed to multiple sources of diesel pollution, leading to cumulative adverse health impacts of rail yards.

Adaptive capacity

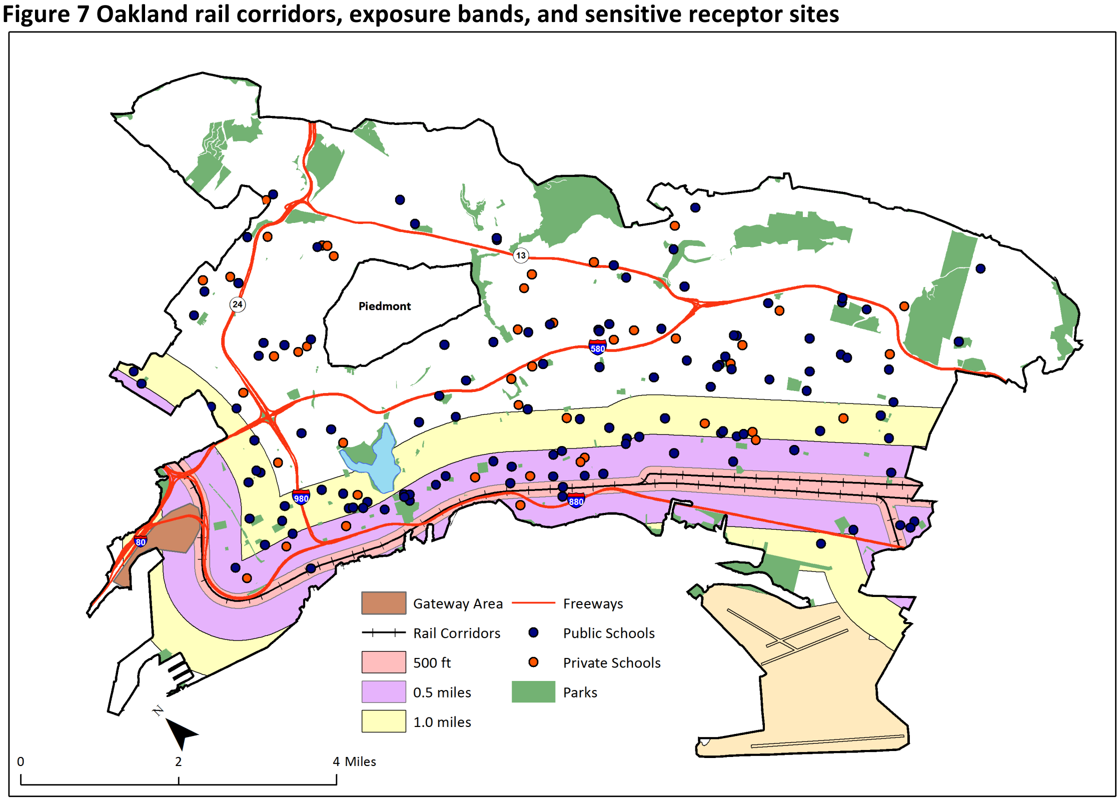
8. Not only do West Oakland residents face higher levels of harmful exposure and adverse outcomes, but due to financial constraints they also have less ability to adapt to and recover from those obstacles relative to residents of surrounding communities.

8.1. West Oakland has an average household income roughly half that of Alameda County as a whole (Rubenstein 2014). An African-American child born in West Oakland is seven times as likely to be born into poverty than a White child born in Oakland Hills (Alameda County Public Health Department 2008).

8.2. Even within Oakland, areas with higher levels of exposure have higher poverty rates – the population living within one mile of rail lines is more than twice as likely to be living in poverty (as shown in Table 1). (ACPHD 2016)

8.3. As illustrated in Figure 7, many important community resources and sensitive sites (schools, parks, community services) are located near the rails and terminal, thereby structurally locking in higher exposures for more vulnerable populations.

Figure 7 Oakland rail corridors, exposure bands, and sensitive receptor sites



Source: CAPE, with rail data from CalTrans, parks data from CPAD 2015b, Gateway area from Oakland Redevelopment Agency, schools from CDE.

Chapter 2: Coal and Diesel-Related Particulate Matter

Key Points

Particulate Matter from diesel engines and coal dust is one of the most important air-pollution-related causes of death and disease. After extensive review of submitted and supplemental literature we found that **transporting coal by rail through the City of Oakland and transferring it through the OBOT facility will increase exposures to air pollutants with known adverse health effects including deaths.**

1. There is documented evidence that coal trains will increase exposure to both diesel particles and coal dust. Both are emitted as fine particles (PM2.5) that will be inhaled into the deep lung. Coal dust also contains larger particles where are known to impact asthmatics.
2. Exposure to these pollutants have been linked in hundreds of peer-reviewed studies, including several conducted in California, with severe health outcomes. These outcomes include premature death, hospitalization for cardiovascular and respiratory disease, emergency room visits, asthma, adverse birth outcomes and school absenteeism. Diesel particles also have a documented effect on lung cancer.
3. These adverse health outcomes are associated with both short-term exposures (from one-hour to one-day) and with exposures over a longer term period (one-month to several years).
4. Increased emissions of coal and diesel pollutants will likely push current outdoor air concentrations above state, federal, and international air quality standards. However, the U.S. EPA and the World Health Organization (WHO) have determined there is no clear safe level of PM2.5 exposure and effects have been clearly documented below the standards.
5. Introduction of a new PM2.5 source will increase the risks of these poor health outcomes. Even brief spikes from the passing trains may increase health risks.

Findings on level of exposure

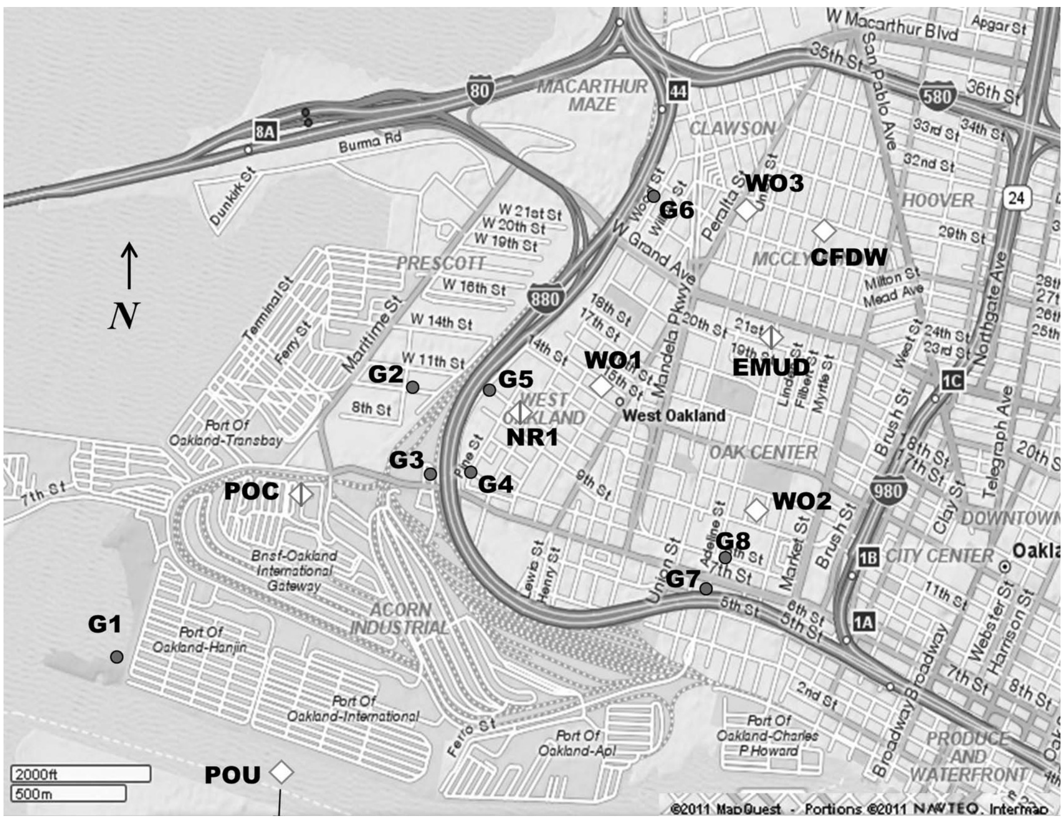
With the risks of PM2.5 clearly established, the question to answer is: What sort of exposure will Oakland residents have to this pollutant as a result of coal transport through the city? Because Oakland is a major urban center with extensive goods movement activity, it is relevant to first establish baseline exposure. If baseline concentrations of particulate matter are high, then any contribution from coal dust and coal train engines is likely to cause health effects.

What is the current level of particulate air pollution (PM2.5) in West Oakland?

In 2008, the Bay Area Air Quality Management District (BAAQMD) conducted a special study in West Oakland and several air pollution monitors were placed throughout the area (see Figure 1, below for location of monitors). Among the aims of the study were to measure particulate concentrations near the Port of Oakland. As a result, concentrations of fine particle (PM2.5) were measured for one-month periods in the summer and winter. In addition, there were two existing monitors already in place as part of separate studies (labeled as EBMUD and CFDW in Figure 1). One was located further downwind from the Port and another at an upwind site in Alameda (POU).

Study results were published in a peer-reviewed journal (Fujita et al. 2013). For the winter month, the average concentration of PM2.5 across all of the monitors was 14.5 micrograms per cubic meter ($\mu g/m^3$, which is the standard way to describe PM2.5 concentrations in the air) and 7.4 $\mu g/m^3$ in the summer month. However, if we isolate the three monitors downwind and closest to the proposed Oakland Air Base (OAB) project (monitors labeled NR1, WO1, WO3, all of which are on or west of Peralta St.; see Figure 1 below) we can obtain a clearer picture of the pollution levels in the potentially impacted community.

Figure 1 Location of PM monitors in West Oakland



There is a clear gradient as you move further downwind and away from the port (Fujita et al. 2013). **The winter and summer month averages for these three monitors are 15.2 and 7.75 $\mu g/m^3$, respectively, with a combined average of 11.5 $\mu g/m^3$.** This average of the two months provide a reasonable approximation of the annual average. **To put this average of 11.5 $\mu g/m^3$ in perspective, the State of California and Federal annual air pollution standards for PM2.5 are both 12 $\mu g/m^3$, and the World Health Organization (WHO) standard is 10 $\mu g/m^3$**. The agencies responsible for promulgating these standards -- the California EPA, the U.S. EPA and the WHO -- all clearly stated that the standards **do not represent thresholds** or an absolutely safe level of exposure and that PM2.5-associated death and disease effects definitely occur below these levels. Regardless, the concentrations from 2008 clearly indicate that the citizens of West Oakland who live within approximately 1500 feet of the proposed OAB project already experience levels of PM2.5 that are close to the existing state and federal standards and above the WHO health-based standard. Additional PM2.5 from diesel combustion and coal dust emissions would likely push air quality in the area over the state and federal standards (see the next section for calculations). West Oakland demographic data indicate there are about 83,000 people residing within 2500 feet of the rail line with a poverty rate of 27%. This renders this population more susceptible to pollution effects due to risk factors associated with poverty including lack of regular medical care and less access to healthy food.

The 2008 BAAQMD study is supported by more recent data collected from a monitor located at 21st and Chestnut, roughly 4000 feet from the proposed OAB site (and therefore much further downwind from the OAB proposed location). At this monitoring site, the three-year annual average ending in 2015 for PM2.5 is 10.8 μg/m^3. In other words, though this monitor was located more than three-quarters of a mile downwind of the OAB site, the air quality at this monitor still violated the WHO annual PM2.5 standard.

What is the expected increment to particulate air pollution in West Oakland?

Trains that carry coal in uncovered rail cars emit both diesel particles from fuel combustion and blowing coal. Both pollutants can add significantly to the ambient levels of PM2.5. The proposed project as described is expected to bring in up to 10 million tons of coal per year by train to the Port of Oakland. Each train would be more than a mile long with more than 100 uncovered cars. Based on BNSF railway's own statements, each car could lose up to 600 pounds of coal dust between the Utah mines and West Oakland. Specifically, they stated the following: "The amount of coal dust that escapes from PRB [Powder River Basin] is surprisingly large. While the amount of coal dust that escapes from a particular coal car depends on a number of factors, including the weather, BNSF has done studies indicating that from 500 lbs. to a ton of coal can escape from a single loaded coal car. Other reports have indicated that as much as 3% of the coal loaded into a coal car can be lost in transit. In many areas, a thick layer of black coal dust can be observed along the railroad right of way and in between the tracks." If 3% of the projected 10 million tons of year end up being emitted from the coal trains, this amounts to about 620 tons per year that would be emitted into West Oakland (see below for assumptions and calculations).[7] **Thus based on BNSF's own statements and using simple assumptions, approximately 620 tons of coal dust could be blown into West Oakland every year**. Even with a potential reduction of 85% through the use of surfactants, there still would be a significant emission of coal of 90 tons per year. However, an 85% effectiveness is unlikely given the length of the trip and the known degradation of the surfactants over time and space. This is why the Powder River coal shipments necessitated a re-application of the surfactants about halfway through the trip to the coast. In addition, the 85% effectiveness required specific coal load profiles for each car. In their assessment of the literature regarding the impact of coal trains, the Multnomah County Health Department (2013) determined that coal

[7] Calculations for expected increase in coal dust in West Oakland. Assumptions: 1) The distance from Utah mines to Oakland = 800 miles; 2) North-south distance along the track in West Oakland is 1.65 miles; 3) An equal rate of dust leakage per mile during the trip. 4) Proposed 10 million tons per year and 3% lost during the trip. Thus, we 10 million x 0.03 x (1.65/800) = 618.8 tons/year of coal dust emitted on the local community.

dust may travel approximately 500 m to 2 km (1/3 to 1 ¼ miles) from the train tracks, depending on weather conditions and train speed.

It would be useful to translate this increase in coal emissions into a subsequent increase in air pollution concentrations but due to data limitations, it is difficult to estimate the exact increment in PM2.5 expected at the site. We do know, however, that PM2.5 levels will increase from coal dust blowing from the trains and from the increases in diesel fuel combustion needed to haul coal trains which are likely to be heavier than a non-coal bearing freight trains. Moreover, PM2.5 emissions from coal rail cars have been investigated in Washington State. In recent studies of 367 trains in the Columbia River Gorge and other routes in the Seattle area Jaffe et al. (2014; 2015) reported the average peak in PM2.5 concentrations near coal trains was twice that of trains carrying other freight -- specifically 21 versus 11 μg/m^3, respectively over the background PM2.5 concentrations. In addition, in several cases the enhancement to PM2.5 from coal trains was **over 75 μg/m^3 with concentrations observed as high as 230 μg/m3**. The BNSF railway requires that a surfactant be applied over the top of coal being transported by rail; therefore, **these high PM2.5 peaks occurred despite existing dust mitigation measures. These extreme short term peaks are of concern given the extensive scientific evidence (as discussed below) of significant adverse health effects, including the possibility of heart attacks, after exposures to PM2.5 as short as one hour.**

We can provide only a general estimate of the additional contribution to PM2.5 from the coal cars versus non-coal freight. Data from Jaffe et al. (2015) indicates the PM2.5 enhancement at different effective wind speeds (train speed plus wind speed at 180 degrees to the train movement). In developing the estimates below, we are assuming a 30 MPH train speed through Oakland based on the CCIG report. Wind analysis from the Bay Area Air Quality Management District shows that 100% of the winds in the summer, when people spend the greatest amount of time outdoors, are from the west. This means that dust from rail operations, including train fuel combustion, will blow directly into Oakland's residential areas, particularly West Oakland. In the winter the wind is from the West about 70% of the time. In addition, on many days wind speeds exceed 10 mph. (Eric Fujita and Campbell, West Oakland Monitoring Report, DRI, 2010). Therefore the effective wind speed under these conditions would exceed 40 MPH or 64 kilometers per hour. With an effective wind speed of this intensity, data from Jaffe et al. (2015, Fig. 4) show short-term PM2.5 enhancements of approximately 20 μg/m^3 over background with some enhancements of 45 μg/m^3. Three trains per day passing for 6 minutes every day for a year, would ultimately add 0.25 μg/m^3 to the annual average concentration of PM2.5. A short-term enhancement of 45 μg/m^3 would add 0.625 μg/m^3 to the annual average for the local population. Thus, under these reasonable assumptions, the annual average of PM2.5 would be near to or exceed the federal and state standards for PM2.5 and would clearly exceed the WHO guidelines of 10 μg/m^3.

The effects from coal-loaded trains on nearby residents bears some resemblance to the effects of road traffic on populations within 100 to 500 feet (and sometimes further) from major roadways. The range reflects local conditions including meteorology, season and background concentrations. Traffic will generate both fine and smaller sized particles and nitrogen dioxide (all emitted from diesel fuel combustion) as well as other pollutants. In their the review of the scientific literature on traffic, the Health Effects Institute (HEI 2010) (an independent non-profit jointly funded by the motor vehicle industry and U.S. EPA and specializing in research on the health effects of air pollution) concluded that there was a causal relationship between exposure to traffic and exacerbation of asthma with additional evidence of effects on respiratory symptoms, impaired lung function and cardiovascular mortality and morbidity.

It is particularly concerning that these increases in concentrations of PM2.5 will occur in the vicinity of Raimondi Park, where, annually, over 27,000 person-visits are made by mostly youth but also adult athletes and their coaches to engage in soccer and football. These intensive exercises increase respiration rates and the total amount of pollution dose.

These increment to the annual averages calculated above do not include several other sources of PM2.5 from the hauling of coal which could add to the problem including re-entrained coal dust (dust sitting on and around the tracks that will ultimately be stirred up by other trains and wind) and blowing coal stored at the railroad spur or as a result of loading the coal onto the ships for export. In addition, as demonstrated by Jaffe et al. (2014, Figures 6 and 7), measurements from Washington indicate that coal trains produce a substantial amount of coal dust in the form of larger particles between 2.5 and 10 microns in diameter, called "coarse particles". As documented below, coarse particles have strong associations with both mortality and exacerbation of asthma.

To reiterate, these air quality standards and guidelines do not represent a bright line below which exposed individuals face no health risks. Studies from around the world and published in **the scientific literature have clearly documented significant adverse health effects, including both premature death and hospitalization for heart and lung disease, at levels below these standards** (U.S. EPA, 2009). Thus, the data suggest that every increment in PM2.5 is related to negative health outcomes. Specifically, according to both the U.S. EPA and the WHO, a one $\mu g/m^3$ increase in PM2.5 is associated with a 1.6% increase in death from cardiovascular disease. There are similar impacts on hospitalization and emergency room visits and even larger impacts per $\mu g/m^3$ on asthma attacks, work and school loss and adverse birth outcomes including low birth weight and premature births (Fleischer et al. 2014). When you multiply these percent increases times the large number of people exposed, it results in very large impacts. For example, the WHO and others have estimated over 3 million deaths per year worldwide from exposure to PM2.5, making it the largest environmental hazard in the world (Lim et al. 2014; Anenberg et al. (2010).

Findings of health effects associated with PM2.5 exposure

- Fine particles, also called PM2.5 or particles below 2.5 microns (compared to the width of a human hair which is around 70 microns) are a well-documented health hazard. PM2.5 is inhaled into the deep lung and causes systemic inflammation, a known cause of subsequent heart and lung diseases. Air pollution standards for PM2.5 were established over 15 years ago by the World Health Organization, the U.S. EPA and the CalEPA.
- Studies from around the world and from California demonstrate important associations between daily exposure to PM2.5 and a wide range of health impacts including respiratory symptoms, school and work loss, asthma exacerbation, emergency room visits, non-fatal heart attacks, adverse birth outcomes (including low birth weight and premature births),

hospital admissions, and death from cardiovascular disease. (A complete review of the evidence can be found in U.S. EPA 2009; Brook et al. 2009 (Official statement from the American Heart Association); Pope et al. 2009).

- Recent estimates by WHO and others indicate that PM2.5 is responsible for over three million deaths per year worldwide (Lim et al. 2012, Annenberg et al. 2010).
- Current state and federal standards exist based on either a 24-hour or annual average. However, studies show that exposures as short as one- or two-hours are associated with significant cardiovascular health outcomes including heart attacks (e.g. Peters et al. 2001; Mar 2005; Urch et al. 2005; Ljungman 2008; Link et al. 2013).
- The populations at greatest risk (though other groups are also susceptible) include infants and children, asthmatics and older individuals with pre-existing cardiovascular or respiratory disease and the elderly (EPA 2009). In addition Bell et al. (2013) found evidence that those with lower education, income, or employment status have higher risk of death from PM2.5 exposure.
- Studies specifically in California demonstrate that daily exposure to PM2.5 and larger particles can lead to early death, increases in hospitalization and emergency room visits for heart and lung disease, asthma and adverse birth outcomes (Ostro et al. 2006, 2009; Malig and Ostro 2009; Malig et al. 2013; Basu et al. 2004; McConnell 1999).
- While specific ambient standards have been established for PM2.5, institutions including California EPA and WHO, have specified there is no clear-cut safe level for these effects. This indicates that every exposure adds to the likelihood of an adverse health outcome (EPA 2009; WHO 2005; CalEPA 2002).
- Diesel engines emit a complex mixture of air pollutants, including both gaseous and solid material. The solid material in diesel exhaust is known as diesel particulate matter (DPM). More than 90% of DPM is less than 1 micron in diameter (about 1/70th the diameter of a human hair), and thus is a subset of particulate matter less than PM2.5. DPM is typically composed of carbon particles ("soot", also called black carbon, or BC) and numerous organic compounds, including over 40 known cancer-causing organic substances including polycyclic aromatic hydrocarbons, benzene and formaldehyde. Diesel exhaust also contains gaseous pollutants, including volatile organic compounds and nitrogen dioxide (NO2). NO2 is important for two reasons: (1) after chemical reactions in the atmosphere, emissions will lead to formation of PM2.5 and ozone and (2) there are documented health effects from NO2 including premature mortality and respiratory disease (Adapted from ARB website, Overview: Diesel Exhaust and Health)
- In 1998, the California Air Resources Board (ARB) identified DPM as a toxic air contaminant based on the published evidence of a relationship between diesel exhaust exposure and lung cancer and other adverse health effects. In 2012, additional studies on the cancer-causing potential of diesel exhaust published since ARB's determination led the International Agency for Research on Cancer (IARC, a division of the World Health Organization) to list diesel engine exhaust as "carcinogenic to humans".

- Because it is part of PM2.5, DPM also contributes to the same non-cancer health effects as PM2.5 exposure. These effects include premature death, hospitalizations and emergency department visits for exacerbated chronic heart and lung disease, including asthma, increased respiratory symptoms, and decreased lung function in children. Several studies suggest that exposure to DPM may also facilitate development of new allergies. Those most vulnerable to non-cancer health effects are children whose lungs are still developing and the elderly who often have chronic health problems.
- Coal dust is also emitted as "coarse" particles which are between 2.5 and 10 microns in diameter. In studies in California, coarse particles have been associated with premature death and various diseases including asthma (Malig and Ostro 2009; Malig et al. 2013

Further support for our assessment of the likelihood of adverse health effects from coal dust and diesel exhaust is provided by the attached letter from Dr. John Balmes and Dr. Michael Lipsett. Together these physician-researchers have over 50 years of experience investigating the clinical effects of PM2.5 on health.

They state the following:

> *In other words, since diesel particles and a significant portion of coal dust fall within the PM2.5 and PM10 size ranges, the health effects consistently linked with ambient PM are also likely to result from exposure to these two coal train-associated pollutants. Hundreds of peer-reviewed scientific articles link PM10 and PM2.5 exposure with premature mortality and with the occurrence of many serious health outcomes, including heart attacks and strokes, lung cancer, as well as hospital admissions and emergency room visits for a variety of cardiovascular and respiratory conditions (including asthma, chronic obstructive lung disease, and respiratory infections).*

Summary of Submitted Evidence

In conjunction with its 9/21/2015 hearing on the Army Base Gateway Redevelopment Project, the city received evidentiary submissions extensively detailing the harmful levels of air pollution and negative health effects that would result from shipping coal through Oakland. The documents included peer-reviewed literature, expert opinions, reviews of literature from environmental health organizations, as well as a government report from another community in which coal shipping had been debated and subsequently prohibited. Submitted documents are listed below:

- Letter 9/2/15 - Irene Gutierrez for Earthjustice ("EJ")
- Letter 7/30/15 - Adrienne Alvord for Union of Concerned Scientists ("Alv")
- Environmental, Health and Safety Impacts of the Proposed Oakland Bulk and Oversized Terminal by Phyllis Fox, PhD for Sierra Club ("Fox")

- Technical Memorandum Air Quality, Climate Change, and Environmental Justice Issues from Oakland Trade and Global Logistics Center by Sustainable Systems Research, LLC for Earthjustice ("SSR")
- Testimony to City Council 9/21/15 - Dr. Jasmin Ansar, Economics Professor at Mills College ("Ans")
- Manuscript - Dr. Daniel Jaffe et al., "Diesel Particulate Matter and Coal Dust from Trains in the Columbia River Gorge" ("Jaf")
- Letter 9/21/15 - Dr. Bart Ostro ("Ost")
- Critique of Health & Safety Assessment by Bart Ostro and Lora Jo Foo (draft) ("OC")
- The Human Health Effects of Rail Transport of Coal Through Multnomah County, Oregon ("Mul")
- Letter 9/18/15 - No Coal in Oakland ("NCIO")
- News Article - Ashley Ahearn, "What Coal-Train Dust Means for Human Health" ("Ahe")

Because the body of evidence surrounding particulate matter is so vast, the above documents had to summarize large number of primary sources that each focus on individual health effects arising from exposure. In our subsequent analysis, we identified roughly 80 unique primary sources that directly speak to the dangers faced by West Oakland with respect to coal dust and increased diesel emissions due to coal shipping -- over one-half of the references came from the peer-reviewed literature, and one-fifth from government reports or the WHO. We also reviewed those submissions to the City Council that support coal shipments and touched on coal dust and diesel emissions ("SB", "JH", "Bur", "HDR"). Table 1 (see chapter appendix) summarizes key findings from our review, the submission(s) contributing to each finding, and source material used to substantiate each finding. It is important to note that the topical brief forming the basis of our air quality assessment draws upon both the submitted evidence and findings from additional review. Table 1 illustrates only the scope of evidence currently in the record (submitted for the 9/21/2015 hearing), and does not necessarily represent the scope of existing evidence, nor does it place a limit on the panel's conclusions concerning these issues.

Chapter 3: Assessment of Mitigations for Fugitive Coal Dust

Key Points

As follows are mitigation measures proposed by the developer to prevent coal dust exposure, and comments on the potential for those measures to reduce the risk of endangerment to public health and safety.

In this instance we drew significantly from original investigation as well as submitted evidence. In particular some panelists called rail car cover companies directly, and the panel also reviewed a memo produced by Lora Jo Foo and submitted to the City on June 2, 2016.

Based upon what we have learned to-date, we find that no proposed mitigations for coal dust can be considered reliable, safe, or effective:

- Use of rail car covers for the purpose of preventing exposure to dust is largely experimental and has not been demonstrated in the field to be safe, reliable or effective. And, since could find no evidence that covers for coal train cars are currently in use in the U.S., making it impossible to vouch for their safety regarding the possibility of combustion due to the confinement of coal.
- Further, use of surface sprays to coal for transport has been asserted to achieve partial emission control but such chemicals degrade over time. Through travel from Utah, the surfactants will degrade and will not significantly reduce coal dust emissions locally.

Findings

From direct interviews with companies that have designed covers for coal train cars we found they have never field tested them to determine if they are effective in preventing the escape of fugitive coal dust during the transport of coal. While a number of these cover designs may be commercially available today, none have made it to market.
The Federal Railroad Administration (FRA) does not issue approvals for rail car covers and is not involved with testing for coal dust emissions. Neither FRA nor any federal agency has established standards for field testing the effectiveness of coal covers' containment of coal dust.

Mitigation measure #1: Coal train car covers will be used to prevent fugitive dust emissions.

Comments:

Multiple submissions for the 9/21/2015 hearing on the Army Base Gateway Redevelopment Project reported on the lack of commercial availability of coal car covers (Fox, 2015; Ostro, 2015; Sustainable Systems Research, LLC, 2015). Since that time, interviews by Lora Jo Foo of No Coal In Oakland with potential coal car cover producers revealed that of five companies which at one point had planned to provide coal car covers, three companies have progressed to the point of having prototype ready for production, though none have begun commercial manufacturing (Foo, 2016).

As far as we know, no coal car cover has been sold commercially in the U.S., a fact that alone shows the degree to which the technology is untested and therefore experimental. However beyond this issue, coal car covers present an issue of enforceability for the city of Oakland, as federal regulation preempts state and local regulation with regards to railroad operations (Trimming, 2013). Importantly, in her interviews with potential coal car cover producers, Ms. Foo found that one company shelved development due to lack of demand arising from the federal government choosing not to pursue a mandate of coal car covers (Foo, 2016) -- that is, the only entity with authority to enforce coal car covers has chosen not to do so. It is possible that a state include coal dust regulation, such as coal car covers, as part of its State Implementation Plan (SIP) submitted to the EPA, and that the courts harmonize the SIP with federal preemption (Trimming, 2013). However this is no guarantee, as the state regulation must not overly interfere with railroad operations or interstate commerce (Trimming, 2013), an outcome that seems quite likely given the exorbitant cost of coal rail car covers (see below). Moreover, the city of Oakland has no guarantee that the state would bring forth such a regulation. Indeed, in its 9/8/15 submission, the developer's legal counsel argued that federal preemption would hinder any city action (Smith, 2015). The city does, however, have the legal authority to ban coal as a bulk commodity due to its substantial endangerment of health and safety. These findings suggest that rail car covers do not appear to be a feasible option.

Coal car covers present a daunting capital expense. In her interview with one potential producer, Ms. Foo found that a cover for a single rail car would cost roughly $13,000-$15,000, over 20% the cost of rail cars themselves. Moreover, interviews revealed that likely the shippers, not TLS, would be responsible for purchasing or leasing the covers. Given these high costs, the tumbling profit margins of coal operations (Fulton et al., 2014), and probable lack of enforcement, it seems unlikely that shippers would heed the plans laid out by TLS for covered coal cars.

A number of other factors point to the unreliability of coal car covers in preventing dangers to human health, and therefore their farfetchedness as a mitigation measure that will be implemented by shippers:

- Covers are not 100% effective at reducing fugitive dust, as roughly 7 percent of dust leaks out of the bottom of bottom-unloading cars in transit (California Capital Investment Group, 2015). The Basis of Design (BOD) for the proposed terminal calls for bottom-unloading cars (California Capital Investment Group, 2015).
- Covers do not prevent the increased diesel emissions along the rail lines that will result from shipping coal rather than some other good. Coal trains weigh anywhere from 50-200% more than normal freight trains, requiring vastly more diesel fuel (Fox, 2015), with each gallon of diesel fuel emitting incrementally more harmful air pollutants -- including black carbon -- into the surrounding community (Galvis et al., 2013). Even if the same tonnage of a different commodity were to be transported into the terminal, that commodity would spread out emissions over a larger number of trains, and reduce the sharp increases in particulate matter that lead to acute health conditions.

- The enclosed space created by covers leaves coal prone to spontaneous combustion in the rail car (Trimming 2013), which occurs with some frequency:

  "Spontaneous combustion of coal is a well-known phenomenon, especially with PRB coal. This high-moisture, highly volatile sub-bituminous coal will not only smolder and catch fire while in storage piles at power plants and coal terminals, but has been known to be delivered to a power plant with the rail car or barge partially on fire." (Hossfeld and Hatt, 2005)

  PRB coal combusts easier than Utah coal, with PRB BTU/lb anywhere from 8000-9400 (Hossfeld and Hatt, 2005), compared 11400 for the Utah site (Bowie Resource Partners website). However Utah coal still has a much lower BTU/lb than Appalachian coals, and has a history of spontaneously combusting (U.S. Department of Energy National Energy Technology Laboratory, 2002).

Overall, the use of coal car covers is a highly speculative mitigation measure for the city to undertake. Beyond be expensive and likely unenforceable, coal car covers are untested and -- even if 100% effective -- would still not prevent harmful exposures to fugitive dust from coal car bottoms or combustion fires.

Mitigation measure #2: In packing cars, coal dust will be controlled through load profiling and treatment with topping agents to minimize emissions.

Response:

As stated above for rail car covers, the use of topping agents is wholly unenforceable by the city of Oakland. Beyond this issue, perhaps the best demonstration of the impracticality of topping agents is the dispute that has occurred between BNSF and shippers of PRB coal, which ended up before the U.S. Surface Transportation Board (U.S. Department of Transportation Surface Transportation Board, 2011)). The dispute began as a result of derailments that were caused by fugitive coal dust, which has been shown to destabilize rail bed ballast and deposit on tracks (Vorhees, 2010). In order to avoid future derailments, BNSF required that topping agents be applied to coal shipments originating in Wyoming and Montana, and that proper load profiling be used to produce an 85% reduction in fugitive dust. The dispute centered around which party (shippers or BNSF) should pay for the reduction, which would cost upwards of $100 million per year (Vorhees, 2010).

The PRB dispute showed that, beyond being costly, topping agents have lower real-world effectiveness than has been cited by HDR and the developer. Shippers argued before the Surface Transportation Board that no amount of surfactants and proper load profiling could meet BNSF's 85% standard (US Dept of Trans 2011), while BNSF argued that auditing indicated shippers do not regularly adhere to best practices for load profiling in order for topping agents to have the maximum 85% effectiveness (BNSF, 2010). Either way, the 85% threshold would not likely be met. Moreover, those along BNSF railroads have made similar statements about the lack of real-world effectiveness: *"while the railroad requires shippers to spray coal cars with surfactant to keep down the dust, it only is estimated that 30 percent of shippers comply with* *the rule"* (Online Public Meeting for the Draft EIS for the Proposed Tongue River Railroad, 2015).

Lastly, topping agents may have negative aquatic and environmental effects, as encapsulated below:

> *"In a concerning aside, the authors noted, based on earlier research, that "surfactants," the chemical adhesives commonly used to reduce coal dust on trains, can boost the ability of coal pollutants to enter the environment, and the Washington State Department of Natural Resources raises similar concerns about surfactants."* (de Place and Kershner, 2013))

> *"Potential environmental impacts include: surface and groundwater quality deterioration; soil contamination; toxicity to soil and water biota; toxicity to humans during and after application; air pollution from volatile dust suppressant components; accumulation in soils; changes in hydrologic characteristics of the soils; and impacts on native flora and fauna populations." "The potential impact of dust suppressants on soils and plants includes changes in surface permeability, uptake by plant roots that could affect growth, and biotransformation of the dust suppressants in the soil into benign or toxic compounds depending on the environmental conditions and associated microbiota. Vegetation adjacent to the area where dust suppressants are applied could be impacted by airborne dust suppressants. This includes browning of trees along roadways and stunted growth. These effects will vary since different plants have different tolerances. The potential impact of dust suppressants to water quality and aquatic ecosystems include contaminated ground and surface waters, and changes in fish health. Dust suppressants that are water-soluble can be transported into surface waters and materials that are water-soluble but do not bind tenaciously to soil can enter the groundwater. Fish may be affected by direct ingestion of toxic constituents and also by changes in water quality (e.g., BOD, DO, salinity)."* (Piechota et al., 2002)

<u>Mitigation measure #3</u>: Fully enclosed facilities will prevent fugitive dust emissions. Proper coal storage and handling of coal will prevent hazardous coal dust explosions and spontaneous combustions.

The developer proposes to ship up to 10 million metric tons of coal through OBOT each year, with 2-3 trains arriving at the facility each day (Tagami and Bridges, 2015). Mitigation plans to reduce fugitive dust at the terminal -- including planned use of enclosed storage and water spraying -- will only partly address the issue, and moreover may cause health hazards in and of themselves.

First, full coal cars will sit exposed on the tracks for hours at a time waiting to be unloaded. Sustainable Systems Research, LLC (2015) estimated that up to 650 tons of coal per year could be lost from idling full coal cars due to wind erosion. These emissions will be constant sources of exposure to particulate matter for both terminal workers and residents of areas surrounding the terminal.

While covered storage facilities would prevent further fugitive dust emissions from stockpiles, the enclosed spaces in those facilities promote (1) coal dust explosions due to high concentrations of ambient combustible material (Hossfeld and Hatt, 2005), and (2) fires due to spontaneous combustion of coal at high temperatures and pressures while sitting in stockpiles (de Place, 2012; U.S. Department of Energy, 1993). Even with proper handling and layering of coal stores, it may be difficult to control combustion in an enclosed environment -- for instance, the U.S. Department of Energy in its Piñon Pine project determined that the only feasible way to store coal in order to prevent it from combusting was to store it outside (U.S. Department of Energy National Energy Technology Laboratory, 2002).

To reduce risks of explosions, the developer proposes continual water spraying in the facility (Liebsch and Musso, 2015). Spraying down coal stockpiles in such close proximity to a waterway could lead to harmful leachates that negatively impact marine life (Ahrens and Morrisey, 2005; Campbell and Devlin, 1997; Johnson and Bustin, 2006).

In summary, the terminal facilities proposed by the developer only partially mitigate exposure to particulate matter, and produce a host of other occupational and public health issues. Like the other mitigation measures, a "state-of-the-art" terminal is by no means a perfect solution.

Chapter 4: Hazardous Toxics Accompanying Coal Dust

Key Points

- Many highly toxic chemicals accompany coal dust. There are no known doses that are risk-free, especially for the very young and for those in communities exposed to multiple toxins.
- Cadmium poses danger as a kidney toxin and cause of osteoporosis. Cadmium exposure is linked to kidney, bladder and lung cancer.
- Mercury toxicity derives from consuming or inhaling this element or its organic form. There is substantial evidence that it reduces mental function especially in the very young and exposure is also linked to heart disease, diabetes and adverse birth outcomes.
- Lead is an infamous toxin, strongly associated with brain and nerve damage, especially in children. It is linked to increased risk for lung, stomach and bladder cancer.
- Arsenic is a known cause of skin, bladder and lung cancer.
- Crystalline silica is a causative agent for lung cancer. Monitoring of silica levels near a coal export facility revealed air levels that exceeded regulatory guidelines.

Summary of Submitted Evidence

Several submissions note that a range of toxics accompany coal dust, furthering the point that there is no clean coal. Phyllis Fox, in her technical report for the Sierra Club (a), provides provides an in-depth discussion of toxics of critical concern:

She discusses that coal contains many kinds of polycyclic aromatic compounds (PAHs), including both naphthalene and benzo[b]fluoranthene (Zhao et al., 2000), two compounds listed by the State of California's Proposition 65 list (California EPA OEHHA, 2016). PAHs are toxic constituents of PM2.5 that have been shown to have mutagenic, carcinogenic, and asthma-inducing effects (WHO, 2003). She also finds that coal dust additionally contains a host of metals and metalloids, including silica, which have been shown to have a negative effect on human health. Although coal is not classified as hazardous, Fox explains that its constituents are, for example, the minimum and maximum levels for arsenic in Utah coal are 1-8ppm, which are approximately 14-114 times the residential risk-based screening level suggested by CEPA (.07ppm). These arsenic levels are also higher than the CEPA industrial risk-based screening level of 0.24ppm (Fox, 2015).

This chapter reviews some of the high profile toxic constituents of coal.

Findings

CADMIUM

This element has multiple well-known toxicities including renal toxicity (1,2,3) and such kidney damage may occur at very low levels of exposure, with even house dust being a contributing factor (4). Cadmium exposure also increases the risk of osteoporosis, associated fractures and decreased quality of life, even at very low exposure levels (5,6,7). This toxin is also classified as an IARC Group I carcinogen (8). Epidemiologic studies have linked cadmium exposure to lung cancer (9,10), kidney cancer (11) and bladder cancer (12). Cadmium exposure is associated with an increase in blood sugar and risk for diabetes (13). An association with overall mortality and environmental cadmium exposure has been found, which risk is independent of kidney damage (14). Furthermore, there appears to be no threshold for this effect (4).

Populations at increased risk for cadmium toxicities include diabetics (5), postmenopausal women and those of reproductive age, (15).

Cadmium serves no laudable effect in human biology, only a deleterious one. Due to a number of industrial processes, including the extraction and combustion of coal, current U.S. and European standards for tolerable weekly intake have already been exceeded in many cities (16,4). There is no known safe dose of exposure for the outcome of increased overall mortality (4,13,14). Given these data, any additional cadmium exposure is highly likely to lead to an increase in disease and death.

MERCURY

Coal carries mercury as a contaminant. This is why coal-fired power plants comprise the largest source of mercury pollution in the United States (17). Airborne mercury in its inorganic form is eventually transported to water and earth, where food sources become contaminated (18). Bioaccumulation of low levels of mercury in aquatic species can lead to high levels of organic mercury levels in people consuming such fish. In fact, the FDA currently advises that young children, pregnant women and nursing mothers limit their amount and type of fish consumption (19) as higher fish consumption in these groups is associated with cognitive problems in young children (20). All forms of mercury are toxic to many organ systems. Airborne and food sources of mercury have both been associated with lower IQs in young children (21). Such cognitive impairment in children is likely to be permanent (22,23). Memory, mood and anger problems have also been associated with mercury toxicity (24,25,26). High levels of mercury are associated with an increased risk of diabetes mellitus, coronary heart disease, and cardio-vascular mortality, but even chronic, low-dose exposure can lead to cardiovascular disease and chronic renal disease (27,28)). Mercury has also been associated with adverse reproductive outcomes including an increased risk of spontaneous abortions (29) and impaired fertility and newborn development (30).

Infants and children, people with iron deficiency and those consuming large quantities of fish are among most vulnerable of populations.

LEAD

Lead, also a component of coal, causes multiple morbidities, some of which occur at very low levels of exposure. Indeed, the Centers for Disease Control and Prevention have steadily lowered the threshold of acceptable blood levels considered dangerous for in children by 88% (from 60 micrograms/dl to 10 micrograms/dl) over the last 40 years (31). The nervous system is the organ complex most vulnerable to lead-induced toxicity (32). Both the peripheral and central nervous systems are susceptible to lead toxicity (33). Children are particularly prone to suffer irreversible central nervous system damage, even at the lowest levels of exposure (34,35,36,37). In fact, there is no known safe dose of lead for developing brains (38). Pre-natal transmission of lead from mother to fetus can also harm cognitive function in infants and children (39). Syndromes consistent with attention deficit and hyperactivity disorder (ADHD) have also be linked to low-level lead exposure (40). In adults, lead exposure increases the risk of hypertension, heart disease and stroke (41). Even very low levels of exposure can lead to increases in blood pressure (42). Lead causes anemia by blocking synthesis of heme, even when blood levels are 10 micrograms/dl or lower (43). IARC deems inorganic lead a probable human carcinogen, likely increasing the risk of lung, stomach and bladder cancer (44).

No safe exposure has been identified for many of lead's severe toxicities. The most severely affected population are the very young. Blood levels of lead are higher among minority children, those in low income households and children living in older homes (34).

ARSENIC

Arsenic, also a component of coal, affects many organ systems. Exposure can occur through contaminated water or by inhalation (45). Some of these toxic effects occur with chronic, low levels of exposure. For this reason, government agencies in several countries have progressively decreased the maximum allowable dose of arsenic in drinking water (46,47,48,49). There are few promising treatment methods (45). IARC has listed arsenic as a human carcinogen since 1980 (50). Arsenic is unique in that it is the only known chemical carcinogen for which there is strong evidence of cancer risk by both inhalation and ingestion (51). Arsenic exposure is associated with a number of tumor types including skin cancer (52), bladder cancer (53), lung cancer (54). Arsenic also has deleterious effects on the nervous system. Long-term exposure may result in neurobehavioral effects in adolescents. The problem may be more severe if lead exposure is also present (55). Arsenic peripheral neuropathy, including sensory loss, pain and muscle weakness, is well-described (56,57). Children's intellectual function can be decreased by arsenic exposure (58). Arsenic is a reproductive toxin, exposures leading to fetal loss and premature delivery (59). Studies have documented a relationship between arsenic exposure and diabetes (60,61). A U.S. study concluded that even low levels of inorganic arsenic may play an important role in increasing the incidence of type 2 diabetes (62). Long-term exposure to arsenic may also increase carotid atherosclerosis (63). Long-term exposure to arsenic also results in an increasing incidence of respiratory disease, including chronic bronchitis (63,64).

Many of arsenic's toxic effects occur at relatively low levels of exposure. The most vulnerable populations include the very young, pregnant women, those who are also exposed to lead and those who have risk factors for or a family history of Type 2 diabetes mellitus.

CRYSTALLINE SILICA

Silica has been known for centuries to cause silicosis and, in the last few decades, has been shown to be a cause of lung cancer. Crystalline silica is a Group 1 IARC carcinogen (65). The silica content of coal dust has made this substance a well-documented occupational hazard (66) a cause of chronic lung disease including fibrotic pneumoconiosis (silicosis), interstitial inflammation, emphysema, fibrotic granulomata and sclerotic nodules (67,68,69). In addition, silicosis increases the incidence of tuberculosis in affected individuals (70). Respirators may be useful in short-term, high-dose exposures, but are generally not useful as the primary means of exposure control due to workplace discomfort, difficulties in communicating with other workers, lack of compliance, and difficulties with obtaining and maintaining a good mask fit (71). Chronic levels of silica dust, that do not cause disabling silicosis, may cause the development of chronic bronchitis, emphysema and/or airflow obstruction, even in the absence of radiological evidence of silicosis (72). On the basis of epidemiological studies, the OEHHA derived an inhalation chronic reference exposure level (REL) for silica – a level below which no adverse effects due to prolonged exposure would be expected in the general public – of only 3 micrograms/cubic meter (73). It is noteworthy that air quality monitoring near a coal export facility in Seward, Alaska revealed crystalline silica levels that exceeded this REL on at least 2 occasions (73).

Chapter 5: Local impacts of international combustion of coal: trans-pacific travel of air pollution

Key Points

As documented extensively in this report, shipping coal through OBOT will negatively impact the health of Oaklanders by releasing coal dust and diesel pollutants during transport. A less tangible, but incredibly important consequence of shipping coal to Asia will be pollution introduced to the Western United States including the Bay Area as the result of the coal being burned in Asia. A wealth of scientific literature has shown that a large fraction of air pollution on the West Coast can be attributed to products of coal burning in Asia that subsequently blow across the Pacific Ocean. By this token, the city of Oakland would in effect be shipping coal to be burned and blown back over itself.

Findings & Summary of Submitted Evidence

Repercussions from Asian consumption of OBOT coal include:

1. **Increased hazardous air pollutants** -- Levels of dangerous air pollutants in the Bay Area -- including $PM_{2.5}$, PAHs, ozone, sulfates, and mercury -- are linearly related with coal consumption on Asia.
2. **Increased mortality in the Oakland area** -- Overseas combustion of coal has a direct, measurable impact on local mortality rates.
3. **An inability to meet air quality standards** -- Pollution resulting from Asian consumption would add to Oakland's already high background air pollution levels, making it unlikely that the city will meet air quality standards. In particular, increased ground level ozone (which also acts as a greenhouse gas) would likely exceed standards.

Evidence submitted prior to the 9/21/2015 hearing on the Army Base Gateway Redevelopment Project spoke to the direct air quality impacts that combustion of coal shipped from OBOT will have on Oakland, the Bay Area, and the world. Below are summarized findings from submitted evidence (also cited are references used in developing those findings), as well as findings from analysis subsequent to the 9/21/2015 hearing:

- Air pollution exposure: As noted elsewhere, burning the nine million metric tons of coal that the developer proposes shipping through OBOT each year will add 22 million metric tons of CO_2 annually to the atmosphere, or 1.5 billion tons of CO_2 over the length of the developer's lease (Gutierrez, 2015a; No Coal In Oakland, 2015; Union of Concerned Scientists; Wisland, 2015). Burning coal in Asia will similarly increase air pollutants, which disproportionately impact the Bay Area. Prevailing westerly winds blow coal burning products across the Pacific Ocean from Asia directly to the western U.S. (Zhang et al., 2008, 2009). Numerous studies have captured the degree to which Asian emissions are accountable for West Coast pollution, the findings of which include (but are not limited to):

- A 2010 study conducted in Oakland indicated that roughly 30% of the region's particulate matter ($PM_{2.5}$) air pollution originated in Asia (Ewing et al., 2010).
- Pacific Northwest air samples detected polycyclic aromatic hydrocarbons (PAHs) from the incomplete combustion of coal in Asia (Lafontaine et al., 2015).
- 14% and 18% of mercury deposits at two sites in Oregon were found to come from Asian air pollution (de Place, 2012b).
- Roughly 20% of ground-level ozone (O_3) in California originates from Asian sources (Lin et al., 2012)
- Production of Chinese export goods adds 12-24% of sulfate pollution over the Western U.S. (Lin et al., 2014).

The adverse health outcomes resulting from exposure to the above mentioned pollutants have been documented elsewhere in this report, however it is important to note that high enough exposure to methylmercury (a byproduct of mercury pollution) causes severe developmental disorders in children (Sustainable Systems Research, LLC, 2015).

- Health impacts and implications: Intercontinental air pollutants have direct effects on human health and the ability of California cities to meet air quality standards, as demonstrated in the studies below:

  - 3-7% of deaths from $PM_{2.5}$ exposure can be attributed to intercontinental air pollutant transport (Anenberg et al., 2014).
  - Asian pollution threatens the ability of the Western U.S. to meet the ozone standards proposed by the EPA of 65-70ppbv, as trans-Pacific contributions to ozone levels currently equal up to 5±5.5ppbv and are increasing at a rate of 0.8±0.3ppbv (Christensen et al., 2015). Other studies similarly found increases in ozone levels (Zhang et al., 2008, 2009)
  - Asian air pollution is associated with increased severity of Pacific storms (Zhang et al., 2007). Natural disasters inequitably impact socioeconomically vulnerable groups, populations which are highly represented in Oakland (Pacific Institute, 2012; Wisland, 2015).

- As with any other commodity, reducing the supply of coal will increase its price and reduce consumption (de Place, 2012b). Therefore it is likely that if the City of Oakland bans coal exports, it will directly reduce fossil fuel consumption and global warming.

For years, California and Oakland have been at the forefront of environmental activism, and through proactive legislation have dramatically reduced both greenhouse gases and the fraction of energy coming from coal (California Energy Commission, 2015; City of Oakland, 2012; Office of Governor Brown, 2015; Wisland, 2015). In allowing coal shipments through OBOT, Oakland and California would sharply contradict these stated goals.

Chapter 6: Responses to Developer Comments Concerning Coal Dust

Key Points

During the course of receiving comments and testimony in September and October, 2015, several comments were made by the developers with regards to risks and exposures to pollution that might emanate from the project, with coal dust being a point of focus. Often there was a rebuttal or alternate view, and these have been gathered from the submitted record to present a cogent flow of information, below. In many instances the Panel provided supplemental review and response.

This section is important to a health assessment because the degree to which the comments are true – or not – will have bearing upon our exposure estimates.

Comments and Responses

<u>Comment by coal proponent:</u>

Little to no fugitive dust will be emitted by the time trains arrive in West Oakland. If proper load profiling, packing, and topping practices are applied, coal dust will only be emitted during initial acceleration away from the loading point. In its Publication AP-42, the USEPA states that wind erosion of coal piles is limited by the amount of erodible material, such that no wind erosion will take place once erodible material is removed. (Liebsch and Musso, 2015)

<u>Response:</u>

The claim that the vast majority of coal dust emissions "*will occur during the initial acceleration phase after the train cars are freshly loaded"* (Liebsch and Musso, 2015) is based on a USEPA report which is not relevant to moving freight. The focus of the USEPA report is on dust emissions produced "by wind erosion of open aggregate storage piles and exposed areas within an industrial facility" (USEPA Office of Air Quality Planning and Standards, 1995). The report states that dust emissions are limited by the availability of erodible coal stored at the facility, however as noted by Dr. Phyllis Fox, rail transport constantly produces erodible material: "movement of cars during transit creates vibrations that break larger pieces of coal into smaller particles, creating a continuous source of dust as the trains travel to their destination." (Fox, 2015). Peer-review studies have confirmed that coal dust particulate matter is produced and emitted throughout the entirety of transit, including at the destination. (Jaffe et al., 2014; Jaffe et al., 2015)

<u>Argument by coal proponent:</u>

The Jaffe et al. (2014) study used measurement devices calibrated for diesel particulate matter detection rather than coal dust detection, and therefore cannot state that the PM captured was coal dust, nor that it was $PM_{2.5}$. Furthermore, the study was conducted in an area of Seattle with already high diesel particulate matter levels. (Tagami and Bridges, 2015)

Response:

The author of the article responds: "The comments about the DustTrak are not really relevant to our findings. The DRX is not a regulatory instrument, but has been used in many scientific studies for PM2.5, as documented in our paper. While it is true that we did not "calibrate for coal dust", nonetheless, the relative response for coal trains and diesel trains that we observed can not be explained by a calibration difference. Doing the calibration they suggested would be a complex and costly experiment. To my knowledge, no one has ever done this." (Personal communication, Dan Jaffe, 2016)

Comment by coal proponent:

Coal dust is not defined as a hazardous material by USEPA, as it is not included on the State of California's Proposition 65 list of chemicals known to cause cancer or reproductive toxicity. (Liebsch and Musso, 2015)

Response:

As stated in Fox (2015), "coal dust" is "an umbrella term that includes the full range of particle classifications based on size, from granules to very small particles." To give an example, raw coal contains many kinds of polycyclic aromatic compounds (PAHs), including both naphthalene and benzo[b]fluoranthene (Zhao et al., 2000), two compounds listed by the State of California's Proposition 65 list (California EPA OEHHA, 2016). PAHs are toxic constituents of PM2.5 that have been shown to have mutagenic, carcinogenic, and asthma-inducing effects (WHO, 2003). Coal dust additionally contains a host of metals and metalloids, including silica, which have been shown to have a negative effect on human health (Colinet, 2010; Epstein et al., 2011; USEPA (U.S. Environmental Protection Agency), 2009a).

More generally, a good portion of blowing coal is documented to be in the fine particle range (i.e., PM2.5). As documented in Chapter 2, the WHO considers $PM_{2.5}$ to be a causal determinant of poor health, including premature mortality:

> *"The 2009 PM ISA synthesized the epidemiologic literature characterizing the association between long-term exposure to PM2.5 and increased risk of mortality and concluded that 'a causal relationship exists between long-term exposure to PM2.5 and mortality' (See Section 7.6 of the 2009 PM ISA). Long-term mean PM2.5 concentrations ranged from 13.2 to 32.0 µg/m^3 during the study periods in the areas in which these studies, comprising the entire body of evidence reviewed in the 2009 ISA, were conducted. When evaluating cause-specific mortality, the strongest evidence contributing to this causal determination was observed for associations between PM2.5 and cardiovascular mortality. Positive associations were also reported betweenPM2.5 and lung cancer mortality."*

"The epidemiologic evidence evaluated in the ISA contributed to the determination that there is sufficient evidence to conclude that 'a causal relationship exists' between short-term PM2.5 exposure and cardiovascular effects and mortality, and a 'likely to be causal relationship exists' between short-term PM2.5 exposure and respiratory effects (Chapter 2, 2009 PM ISA)." (U.S. EPA (U.S. Environmental Protection Agency), 2012)

Comment by coal proponent:

A series of studies conducted in the UK found no association between respiratory diseases and proximity to opencast coal mining sites, suggesting a lack of causality between exposure to coal dust and health effects in children. (Burns, 2015)

Response:

As detailed in the Appendix Chapter 2, findings from the cited studies of communities surrounding opencast mining operations in the UK run counter to an overwhelming preponderance of evidence suggesting a link between particulate matter and a host of respiratory conditions. Recent evidence of the respiratory response to particulate matter ($PM_{2.5}$) includes, but is not limited to: incident asthma in both children and adults (Brauer et al., 2007; Künzli et al., 2009; Leon Hsu et al., 2015; Young et al., 2014), emergency department visits for respiratory conditions (Alhanti et al., 2016; Malig et al., 2013; Strickland et al., 2015), as well as reduced lung function and bronchitic symptoms in children with asthma (Berhane K et al., 2016; McConnell et al., 2003; Neophytou et al., 2016).

The studies in the UK contain a number of troubling methodological issues with respect to defining the control and exposure groups. The two groups were defined solely using distance from mining operations, excluding important determinants of PM_{10} exposure such as topography and wind conditions. Indeed, PM10 levels were higher in one of the control groups relative to the exposed, demonstrating the difficulty of measuring exposure by distance alone. The authors further failed to control for potential confounders of the studied relationship, such as medication. It could be the case that children living near coal mining operations were more likely to be prescribed asthma medications, which would obscure the health impacts of exposure (the study did find that children living close to mining sites visited their general practitioners more often, which could have led to increased prescriptions). Taking into account these shortcomings in the UK studies, along with the vast literature contradicting them, one can conclude that exposure to particulate matter resulting from shipping coal through Oakland would have negative respiratory on those in the surrounding community.

Comment by coal proponent:

Coal mine occupational exposure studies are not applicable to fugitive dust. (Smith, 2015)

Response:

As stated elsewhere in this report, no threshold concentrations have been found for ambient particulate matter below which negative health effects do not occur, such that it is reasonable that health effects similar to those faced by coal miners will be experienced by workers handling coal at the terminal. The potentially hazardous conditions faced by workers should not be discounted as a harm of the proposed terminal. Occupational dangers include:

- Inhalation of coal dust
- Exposure to diesel emissions, particularly black carbon (Galvis et al., 2013)
- Train derailments (U.S. Department of Transportation Surface Transportation Board, 2011; Vorhees, 2010)
- Coal dust explosions and coal fires (Hossfeld and Hatt, 2005; de Place, 2012; U.S. Department of Energy, 1993)

Comment by coal proponent:

The metal content of coal is minimal compared to background soil levels and risk-based screening levels as defined by the USEPA. (Liebsch and Musso, 2015)

Response:

This argument ignores several residential and industrial risk-based screening levels exceeded by the metal content of raw coal, and moreover does not make mention of CEPA risk-based screening levels (California Environmental Protection Agency, 2004). For instance, the minimum and maximum levels for arsenic in Utah coal are 1-8ppm, which are approximately 14-114 times the residential risk-based screening level suggested by CEPA (.07ppm). These arsenic levels are also higher than the CEPA industrial risk-based screening level of 0.24ppm (Fox, 2015). Table 1 below displays EPA risk-based screening levels and California background soil levels adapted from Liebsch and Musso (2015), as well as CEPA risk-based screening levels.

Table 1 - EPA & CEPA residential and industrial risk-based screening levels

	Uinta Basin Coal							
	Average	Max		CA Soil Backgd	EPA RSL - Res.	EPA RSL - Ind. Soil	CEPA RSL - Res.	CEPA RSL - Ind. Soil
Element	ppm (or mg/kg)	ppm		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sb	0.2	0.9		0.15 - 1.95	39	580	30	380
As	1	8		0.6 - 11	0.68	3	0.07	0.24
Cd	0.1	0.2		0.05 - 1.7	71	980	1.7	7.5
Cr	7	30		23 - 1579	120000	1800000	100000	100000
Co	1.2	3		2.7 - 46.9	23	350	660	3200
Pb	3.6	7.7		12.4 - 97.1	400	800	150	3500
Hg	0.05	0.38		0.1 - 0.90	23	350	18	180
Ni	2.8	10		9 - 509	1500	22000	1600	16000
Se	1.8	3.4		0.015 - 0.43	390	5800	380	4800
Th	3.4	7.9		5.3 - 36.2	0.78	12	--	--
U	0.9	3.1		1.2 - 21.3	230	3500	--	--

Sources: (California Environmental Protection Agency, 2004) (Liebsch and Musso, 2015)

Comment by coal proponent:

Coal trains currently run through Oakland without any noticeable impact on the surrounding community. (Smith, 2015)

Response

Coal is not currently shipped from the Port of Oakland, nor do coal trains move through Oakland with any semblance of regularity. Coal trains often move between Utah and the private Levin-Richmond terminal north of Oakland. The southern route to the Levin-Richmond terminal, which goes through Oakland, is longer and more expensive than the northern route, such that trains passing through Oakland would be incredibly rare (Gutierrez, 2015b). Notably, residents along the northern route to the Levin-Richmond terminal have commented at length about the disruption to their daily living caused by coal trains (Small, 2015). In a 10/2/2015 letter in response to Question #8 from Assistant City Administrator Claudia Cappio's 9/28/2015 memo, Lora Jo Foo of No Coal In Oakland detailed an extensive investigation into coal trains passing through Oakland over the prior year. In her investigation, Ms. Foo spoke to Port of Oakland and Union Pacific officials, all of whom confirmed that coal trains very rarely pass through Oakland. In fact, likely only two trains had passed through Oakland during the prior year, one of which had been mistakenly routed to the Port of Oakland and was immediately removed upon discovery of the misrouting. Ms. Cappio herself stated that evidence of coal trains in Oakland was limited to two sightings (Foo, 2015).

Comment by coal proponent:

The project will create economic benefits including 2400 jobs, half of which will be given to Oaklanders. (Burns, 2015)

Response:

Relative to other alternatives, coal shipping creates few jobs per dollar invested (Kammen, 2013). Moreover, as detailed by Tom Sanzillo and Margaret Rossoff in their submissions for the 9/21/2015 hearing on the Army Base Gateway Redevelopment Project, coal is not an economically viable export, nor will it produce nearly the number of jobs estimated by the developer. From their findings, it can be concluded that better job alternatives to coal exist. Findings were as follows:

- While the entirety of Oakland Global is projected to create roughly 2400 permanent jobs and 2700 construction jobs, the bulk terminal used to ship coal will provide just 5% of total full-time permanent on-site jobs and 6% of construction jobs, a total of 278 jobs that would just as likely be created using the terminal for a different commodity (Rossoff, 2015).

- The developer estimate of 212 indirect jobs created by the bulk terminal is overstated -- amongst other estimation errors, the developer did not account for jobs loss, such as trucking positions that will no longer exist with increased rail transport. Moreover, the indirect jobs created by the terminal would by no means be located in Oakland, the area that would be most negatively impacted by coal.(Rossoff, 2015).

- The coal industry has been dramatically declining for years, meaning that jobs created at the terminal would be constantly in danger. It would be financially reckless for the city to allow devoted resources in the OAB to such an economically weak commodity. Evidence pointing to the weakness of the coal industry includes:
    - Coal producers have seen dozens of firms enter bankruptcy since 2012 (Sanzillo, 2015), including in recent months the largest U.S. producer of coal (Brickley, 2016). Over the past two decades, the percent of U.S. electricity coming from coal has dropped from over 50% to just 34%. Asian demand for coal -- once seen as a life preserver for the industry -- is similarly on the decline, with China's coal imports dropping by roughly 40% from 2013 to 2015. The largest U.S. investments firms almost uniformly conveyed a pessimistic long-term outlook for coal exports (Sanzillo, 2015).

    - Global prices for coal sunk by as much as 75% from 2011 to 2015, dropping far below prices considered to be sustainable by producers (Sanzillo, 2015).

Bowie Resources, the coal producer linked with OBOT, has experienced a declining market share for years, and been hurt by the retirement of many of the coal plants with which it transacts. The fact that the state of Utah is putting up additional capital for the project -- not Bowie Resources parent company Trafigura -- speaks to the total lack of confidence in Bowie Resources to deliver for the full length of their contract. Furthermore, in its own recently filed IPO, Bowie Resources itself indicated that it did not anticipate nearly the level of demand needed to meet throughput targets with its partner ports (Sanzillo, 2015).

Comment by coal proponent:

The coal shipped through OBOT will be "Compliance Coal", which has a low sulfur content and is amongst the cleanest burning coals -- it will replace dirtier coals and biomass burning, actually leading to a net reduction in pollution and climate change. (Bridges, 2015)

Response

As noted by Laura Wisland of the Union of Concerned Scientists in her submission for the 9/21/2015 hearing on the Army Base Gateway Redevelopment Project, while coal with a lower sulfur content is considered to be cleaner, the contribution of coal shipped from OBOT will in no uncertain terms contribute to global warming emissions, for the reasons listed below:

- "Compliant coal" is still harmful for the environment. The ten million metric tons of coal shipped through OBOT each year will result in annual CO_2 emissions of 26 million tons into the atmosphere, requiring 10 billion gallons of water (Wisland, 2015). CO_2 emissions will exceed 1.5 billion tons over the course of the developer's 66-year lease (No Coal In Oakland, 2015).

- Sub-bituminous coal has a lower BTU content than other coals, meaning more must be burnt relative to other coals to obtain the same amount of energy. This lower energy potential of coal could offset any net gains from its low sulfur content (Wisland, 2015).

A further economic case can be made that shipment of coal from OBOT will lead to higher greenhouse gas emissions, as classic supply and demand theory predicts that the arrival of large amounts of coal on foreign markets will lower its price and increase consumption through "induced demand." Additionally, coal supporters have argued that the presence of a more efficient coal on the market would lead to less demand for dirtier biofuels. This rationalization underestimates the ability of developing countries to replace biofuels with renewable energy sources, which are increasingly available (Wisland, 2015).

Overall, Bridges (2015) is correct in making the assumption that coal is a dirty fuel which must be transitioned away from on the world market, however doing so by simply adding more coal would be counterproductive and harmful to the environment.

Chapter 7: Health and Safety Hazards at the Port

Key Points

1. Coal is inherently challenging to handle and transport. This is because it is (a) combustible in solid form, (b) highly explosive when suspended as particles in confined spaces, (c) toxic to humans especially when inhaled as dust, and (d) noxious to those who encounter its dust.
2. Export of coal through Oakland requires that coal be transferred from the mine site to rail cars, transported by rail over many hundreds of miles to the port facility, transferred from rail cars into the port facility, transferred into storage heaps pending shipment, transferred out of the storage heaps to the wharves, loaded into ships, and then shipped out to the destination. Each step creates opportunities for release of dust and for hazards to adjacent workers, residents, businesses, and communities.
3. Environmental impacts include air pollution, water pollution, solid waste, noise, and safety and traffic hazards. Not all of these issues appear to be addressed in the Basis for Design or related documents.
4. The project area has seismic vulnerabilities that could create hazards in the likely event of an earthquake, as the soils are in highest category for liquefaction.

Findings

1. **Coal is inherently challenging to handle and transport. This is because it is (a) combustible in solid form, (b) highly explosive when suspended as particles in confined spaces, (c) toxic to humans especially when inhaled as dust, and (d) noxious to those who encounter its dust.**

   The adverse traits of coal are acknowledged by the project proponents as noted in the Basis of Design submitted for the Oakland Bulk and Oversize Terminal (OBOT). The document notes that the commodity (described as "A") will be "extremely abrasive, very dusty, exhibit spontaneous combustion behavior, and potentially explosive" (1).

   a. **Spontaneous combustion**

      Coal is combustible and considered to be "notoriously liable" to spontaneously ignite [8] when transported over long distances or stored (2). The conditions under which this can occur are complex. Because the port area is small, ignition would create health and safety concerns for workers at the port, other businesses, nearby residents, first responders, and critical transportation links such as freeways.

[8] Spontaneous combustion is also referred to as "autogenous heating." This is not the same thing as the explosions that can occur with an accumulation of dust.

In one reported case of spontaneous combustion, two firefighters were killed trying to put out a fire at a coal storage silo in South Dakota. Contributing causes of the explosion and fire according to the report published by the National Institute for Occupational Safety and Health (NIOSH) in the Centers for Disease Control and Prevention (CDC) included the design of the silo, the unique explosive characteristics of bituminous coal, and fire fighting tactics (3).

In its report the National Institute for Occupational Safety and Health wrote:

> *One of the primary concerns for the bulk storage of coal is its ability to produce its own heat. The storage of bulk coal, whether inside a silo or stockpiled on the ground, releases heat slowly through oxidation. It is possible for enough heat to be released over a period of time to raise the coal temperature to self-ignition or spontaneous combustion. Such fires can be very stubborn to extinguish because of the amount of coal involved (often hundreds of tons) and the difficulty of getting to the seat of the fire. Moreover, bituminous coal in either the smoldering or flaming stage may produce copious amounts of methane and carbon monoxide gases. Methane is not a concern with sub-bituminous (PBR) coals.*
>
> *In addition to their toxicity, these gases are highly explosive in certain concentrations, and can further complicate efforts to fight this type of coal fire. Even the most universal firefighting substance, water, cannot always be used because of the possibility of a steam explosion. Water contributes to the exothermic reaction of coal increasing the fire problem.*

b. Explosion

Coal dust can be highly explosive in confined spaces such as mines or closed terminals (4-7). The potential for coal dust explosion is a concern whenever dust may accumulate in enclosed spaces, is not limited to mines (8), and includes shipment and transfer of bulk coal (9). At underground mines, ignition of coal dust is a cause of mine explosions that have killed many hundreds of miners, so rock dust is distributed to reduce the potential explosiveness of coal dust (10) This is not practical at a port.

The size of dust particles matters, as finer particles are more likely to create combustible conditions. There is some suggestion that cleaning and processing of coal tends to create smaller particles (11). While transportation facilities are not likely to experience as high concentrations of coal dust in confined space, they are still noted as a major concern for explosion. The Port of Los Angeles experienced fires during ship loading in 2001 and 2002 attributed to ignition of coal dust (12). A fire was reported on June 6 at a coal-fired power plant in Springield, Missouri in a dust control system and attributed to highly combustible coal (13).

c. **Toxicity**

Coal dust is a toxic substance that poses health risks when inhaled. Coal dust is well documented to cause extensive health effects and mortality in miners, though at greater concentrations than likely at a port (14-19). One component of coal dust is PM 2.5 (discussed elsewhere) but it can include toxic metals (also discussed elsewhere) and poly aromatic hydrocarbons (20, 21).

d. **Noxious and abrasive nuisance**

Coal dust is black and tends to be sticky and accumulate on people and property, creating a significant nuisance near coal terminals (22). Residents of areas impacted by coal dust often complain of the nuisance and filth of the particles. Residents of Richmond complain of dust from coal trains and the coal terminal (23). This terminal ships only about 1 million metric tons of coal a year (but accumulates coal in a heap outdoors).

Recent complaints by people living in Mobile about dust from coal terminals led to an investigative report by a local television station that also conducted sampling at various locations and reported significant fractions of coal dust at all places sampled (24, 25).

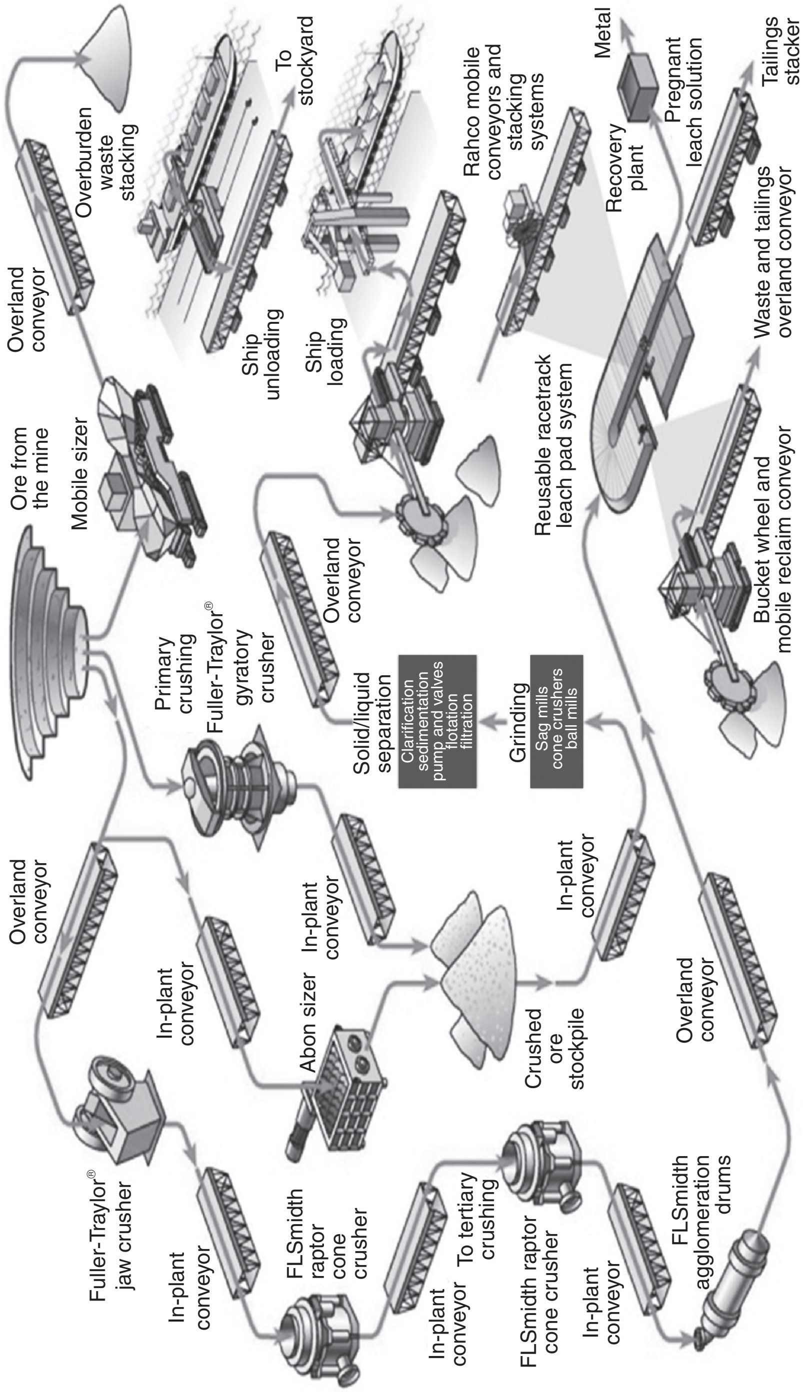
Coal dust is also abrasive and may damage equipment and increase cleaning and maintenance costs. The Surface Transportation Board has determined that coal dust "poses a serious problem for railroad safety and operations" because it accumulates along the rail right of way and damages the infrastructure. The Board recognized that controls on dust are important to protect the interests of the companies that operate railroads and public safety (26, 27).

2. **Export of coal through Oakland requires that coal be transferred from the mine site to rail cars, transported by rail over many hundreds of miles to the port facility, transferred from rail cars into the port facility, transferred into storage heaps pending shipment, transferred out of the storage heaps to the wharves, loaded into ships, and then shipped out to the destination. Each step creates opportunities for release of dust and for hazards to adjacent workers, residents, businesses, and communities.**

A. **Can a coal terminal be fully enclosed?**

The project proponents assert that the inherent hazards associated with coal transportation will be managed because the terminal will be constructed and operated as a wholly enclosed facility that will provide for all transfers and storage to be completed in a confined space. Handling of coal through dumping out of the bottom of train cars, loading into storage piles or areas, or conveyance to ships can contribute to generation and distribution of coal dust (28).

Flow chart of coal processing



20.1 Generic flow chart coal handling. (Source: FLSmidth standard flow sheets.)

© Woodhead Publishing Limited, 2013

The proposal to wholly encapsulate the terminal seems to represent a departure from practice at any other coal terminal that we can identify and so seems to be an unproven technology. Coal terminals typically employ various degrees of covering and dust control but are not entirely contained. We did not identify any coal terminals that operated in contained spaces that prevent release of dust to the ambient environment, nor has the project proponent identified any as far as we have been able to determine.

There appear to be discrepancies between the assertion that the entire terminal will be enclosed and the Basis for Design document offered as substantiation for the project. The Basis for Design provides for movement of coal unloaded from rail cars through conveyers, spreading of coal into horizontal heaps for storage, and overhead loading of coal into ships. None of these things seems to be encapsulated within the enclosed design.

B. Managing coal and coal dust creates hazards

The handling of coal dust is an on-going and significant concern as long as coal is transferred through the port, regardless of whether the facilities are contained or not. There may be tradeoffs in terms of infrastructure between allowing more ventilation of coal and of coal dust, which will tend to increase the distribution of dust into the environment but reduce the potential for explosion compared to the containment of coal. If coal and dust is contained in confined spaces, there is potential for suspension of coal dust in the air, which can be explosive and ignited by spark, static electricity, or heat. Coal dust explosions are of course extremely dangerous for workers, emergency responders, and the nearby community.

Either way, introduction of the noxious materials into a highly used area in the immediate vicinity of West Oakland neighborhoods, recreational facilities, and highways, very close to the downtown of a major city and cultural center, will require effective management.

Design of facilities to ensure a level of dust reduction necessary to meet environmental standards and address public health concerns is identified as a major challenge for development of coal ports (2, 29). Primary prevention strategy would be to prevent the generation or accumulation of the dust. Secondary mitigation strategies try to control the dust through ventilation or dust removal (30) as proposed for this project.

C. Dust control through air filters creates potential for fire and requires active management

The documents provided by the project sponsor acknowledge the importance of ensuring that conditions amenable to combustion do not occur. They say that extensive spraying of coal will be conducted to control dust and reduce the likelihood of explosion. The project proponents assert that they will eliminate dust hazards through use of air filtering technologies. However, these actions are not without alternate persistent hazards. Air filtering technologies can contribute to explosive ignition of coal dust if not actively and competently managed on a daily basis.

Though there are some preliminary indications of types of equipment that may be used and mention of the use of both dust filters and wetting as strategies for dust control from the project proponents, as far as we can determine, no safety analysis has been conducted for the potential transfer of bulk coal through OBOT.

The design of conveyances to achieve performance and other goals including environmental goals needs to consider the specific factors at each installation and the materials being used and so cannot be guaranteed without site specific design and subsequent performance verification and testing (29). This means that assurance of performance capacity of any system cannot be guaranteed at an early design stage and health and safety review and verification is needed up to the point of operation. They may not be suitable for urban areas such as Oakland.

The Basis of Design submitted by the project proponent states that railcar dumpers will be used at the facility with a bottom dump. The rail cars would be North American Covered Hopper Cars. These are denoted as removable, fiberglass covers (1). However, in searching for such a car used for coal, no examples were found. North American Covered Hopper Cars are described by GATX, a major purveyor, as being of three types and used for several types of materials but not for coal (31). Additional discussion of this issue appears elsewhere in this submittal.

Conveyors tend to release dust and so have health and safety concerns, especially in an area prone to wind. While the Basis of Design document discusses the use of Pipe Conveyers, which are less prone to emit dust, for transfer from the railcar dumper to storage, other types of belt conveyers are to be used at other phases of the transfer including moving the coal to storage.

We did not identify many coal terminals in such close proximity to dense urban environments as downtown Oakland or critical infrastructure as the Bay Bridge. The Long Beach coal terminal is located at the far southern end of the Port of Long Beach away from freeways and critical infrastructure and areas of dense housing. The prevailing winds would tend to push dust out over the water rather than into downtown Long Beach. Moreover, this facility was grandfathered in and has never received an environmental review. Nearby residents complain of dust. Some areas have rejected construction or expansion of coal terminals in recent years including most recently the rejection by the US Army Corps of Engineers of the Gateway Project near Bellingham Washington (32).

3. **Environmental impacts include air pollution, water pollution, solid waste, noise, and safety and traffic hazards. Not all of these issues appear to be addressed in the Basis for Design or related documents.**

The environmental impacts of coal transportation include air pollution, water pollution, solid wastes, noise levels, and safety and traffic hazards (36). The OBOT response to the City on September 28, 2015 states that no environmental review is required because the project will comply with numerous air and water quality regulations**.** However it does not appear that all issues will be addressed through existing regulations and reviews.

a. **Use of Water and Generation of Contaminated Process Water and Wastewater**
   Demands for water appear to be significant and may conflict with the demands for water from the community of Oakland, creating health impacts.
   The documents provided by the project sponsor say that extensive spraying of coal will be conducted to control dust and reduce the likelihood of explosion. Application of water to the coal will generate significant wastewater contaminated with coal dust containing toxic fractions that then have to be managed. Any release of water contaminated with constituents of coal dust or the disposal of sludge associated with the treatment of such wastewater can introduce toxic elements into aquatic food chains that support human consumption of fish and wildlife and contribute to health effects.

   The plans for disposal of process water are not specified. There would be an onsite treatment facility for circulation or discharge. Such a discharge would presumably require an NPDES wastewater treatment permit and trigger CEQA review.

   Raw coal dust emission sources to marine ecosystems include preparation and washing of coal, loading operations, runoff from storage areas, transport and cargo washing, and accidental releases (37). Coal terminals have been found to contribute to accumulation of coal dust particles in the surrounding marine waters, and these particles can disperse over a significant area, creating risks to aquatic species and ecosystem (38). Raw un-combusted coal contains PAHs, some of which can be toxic. High volatility, bituminous coal (such as that from Utah) has been reported to have relatively higher concentrations of the PAHs that are considered Priority Pollutants by the US EPA (39). The types of PAHs found in coal varies by type, "rank," and basin of origin (40). One study reported that PAHs are much more concentrated in raw coal than in coal ash (after combustion) (20). Raw coal contains PAHs that may be harmful to marine organisms (37). There is emerging evidence of the effects of coal particles and dusts on wildlife and biota (41, 42). A study on mice using exposure to sand contaminated with coal dust reported effects on several types of assays and diminished lung function (43). A study of a Colombian coal terminal found accumulation of certain PAHs and metals along the shoreline, and assays suggested possible effects on exposed species (44).

   Any plans needed for removal and treatment of ballast water from the incoming ships are not included here.

b. Full Site Assessment and Response

The Basis of Design document states that the project proponents will not do any site assessment for hazardous materials nor be responsible for any materials present. It would be important for some entity to be responsible for this. There are references to assessments conducted by the Department of Toxic Substances Control, but it appears that the City assumed the responsibility and liability for areas and contaminants not to be addressed in those plans. Some clarification of what approach would be taken would be important.

c. Noise

Noise is a significant issue for conveyance equipment when located near an urban environment or adjacent to a neighborhood (45). Noise remains a concern and is not addressed in the Basis for Design.

c. Air Pollution Control

The OBOT response to the City on September 28, 2015 notes that one action will be taken to reduce exposure to particulate matter for indoor spaces. Several possible actions are discussed, and it is impossible to determine whether this would benefit adjacent workers or residents.

The OBOT response to the City on September 28, 2015 states that common exterior spaces will be shielded from air pollution, but given the small size of the available land parcel this does not appear to be meaningful. In any case, buildings do not stop air pollution. Additional mitigation measures are discussed with regard to offsetting PM 10 emissions. Project proponents do not seem to be aware of health concerns with PM 2.5 particulate matter emissions, as the smaller particles that can penetrate deeper into the lungs and that may cross over into the blood stream. This issue is discussed elsewhere.

In their September 2015 report, the consultants to the project proponents assert that no air quality impacts will occur and the permitting process of the Bay Area Air Quality Management District (BAAQMD) will address any dust or air pollution concerns and ensure compliance with requirements for Best Available Control Technology (BACT). With regard to defining BACT for coal dust emissions, we have not been able to identify any applicable rules for BAAQMD. From the Richmond case, it appears there are no rules applicable to coal terminals (23).[9, 10]

It is also important to understand that there is no guarantee that sufficient technology exists to eliminate or significantly reduce the health impacts or risks.

---

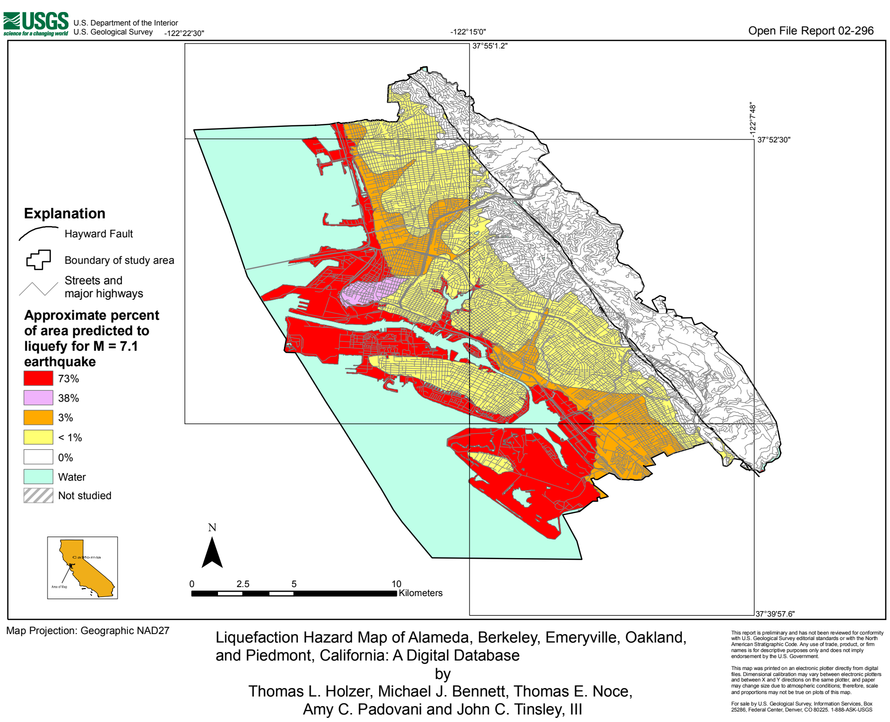
[9] By contrast, the South Coast Air Quality Management District, which has jurisdiction over Los Angeles, does.

[10] At the European Commission, a document defining BAT for storage of solid commodities has been defined and includes these elements that do not seem to be addressed in the documents submitted by and for the OBOT group include consideration of the layout and placement of facilities, control of wind exposures, and attention to maintenance of good practices over time (46).

Few if any terminals are located adjacent to a densely populated city as Oakland so where would such technologies have been perfected? It can be possible to apply BACT and yet still have emissions that are detrimental to health in cases when sufficient technological controls have not been developed. This can particularly be true when a community is already heavily impacted by air pollution and where the many dust-generated activities with be conducted immediately adjacent to recreational activities and facilities, other businesses, and residences.

4. The project area has seismic vulnerabilities that could create hazards in the likely event of an earthquake, as the soils are in highest category for liquefaction.
   One additional safety concern is the seismic instability of the area where the facility is to be built. As noted in the Basis of Design document (1), existing soils in the project area are prone to seismic-induced liquefaction and lateral spreading. This area has been designated as being of the highest category of risk for failure due to earthquakes in the greater Bay Area (46). Often systems failures occur when multiple unfortunate events occur at the same time, and earthquakes can be a precipitating event. The proposed remedy seems to be to replace soils adjacent to the wharf areas but not other areas. This may warrant additional scrutiny.

Liquefaction Map Including Oakland



Chapter 8: Climate Change and Health and Oakland

Key Points

Climate change implications of coal shipments through Oakland are important to consider for these reasons:

- The overseas combustion of coal from Oakland will contribute to cumulative global greenhouse gas concentrations and climate change.
- The export of coal from Oakland thus increases the risk of serious health and safety harms from climate change for the residents of Oakland, and constitutes a substantial health hazard.
    - Climate change is the greatest health challenge of this century, and is a significant threat to the health and safety of Oakland residents.
    - Extreme heat and increased ozone resulting from climate change and increased exposure to particulate matter from the smoke of more frequent and severe wildfires in California will increase death and illness in Oakland.
    - Sea level rise, higher storm surges, and more extreme precipitation events will increase risk of flooding that can cause displacement, loss of essential infrastructure, and trauma-related death, injury and mental health problems. An estimated 3,100 to 5,200 Oakland residents will be at greatest risk.
    - Increases in the frequency, duration, and magnitude of drought will threaten water quality and potentially lead to severe water shortages, increasing spread of infectious and vector-borne diseases, poor hygiene, and impairment of the water infrastructure essential to support Oakland's growing population.
- Low-income communities and communities of color are at highest risks of adverse health impacts associated with climate change.
- Not shipping coal from Oakland is a reasonable and effective method of preventing associated greenhouse gas emissions and health impacts.

Findings

For the sake of clarity, details and citations to primary sources are included in an immediately following addendum, indexed in the present text for easy reference.

1. **Climate change is the greatest public health challenge of the 21st century. If climate change continues to progress, it will cause significant adverse impacts on the health of people in Oakland, including:**
    a. Higher overall temperatures, more extreme heat days, and more heat waves will increase heat-related mortality and morbidity. *(Addendum 1.3.1, 1.3.4, 25, 35.2)*
    b. Increased ground level ozone and smog formation will lead to increased respiratory and cardiovascular mortality and morbidity, especially in areas already experiencing high levels of pollution. *(Addendum 1.3.5, 26, 35.3)*
    c. Sea level rise and storm surges will produce flooding, especially in areas of Oakland that are low-lying or have dilapidated infrastructure, resulting in various adverse health and safety impacts, as well as displacement and job loss. *(Addendum 21, 27)*
    d. Decreased quality and availability of food will increase risk for food insecurity and malnutrition, especially among the poor. *(Addendum 24, 27.2, 30)*
    e. Increased air pollution from wildfires will increase respiratory and cardiovascular illnesses. *(Addendum 20, 31)*
    f. Increased pollen production, and the length of the pollen season will increase asthma. *(Addendum 1.3.4, 15.1, 26.2, 33)*
    g. Changes in temperature and precipitation patterns may lead to an increase of vector-borne and water-borne infectious diseases in the Bay Area. *(Addendum 22, 28, 30.2, 34*)
    h. West Oakland residents are particularly vulnerable to the health impacts of climate change, rising sea levels, and other phenomena associated with greenhouse gas emissions. *(Addendum 1.3.4, 1.3.6, 1.3.7, 19.2, 21.4, 21.5, 25.2, 27.1, 35)*
2. **At this point in history, there is a narrow window during which actions can be taken to limit climate change and prevent these damaging effects on health.**
    a. Holding temperature rise at or below 1.5°C is critical for averting the worst of the projected exposure risks and impacts of climate change. *(Addendum 2.2)*
    b. Because greenhouse gas emissions accumulate, human activities (mostly by the richer countries) have already emitted most of the greenhouse gases that can be released for the next several thousand years without exceeding the 1.5°C threshold. *(Addendum 5)*
    c. After 2015, there remains for the entire world a "carbon budget" of only 240 billion metric tons of CO_2 emissions for a 66% chance of limiting global

temperature rise to 1.5°C.[11] If this budget is exceeded, there is significant danger that global temperature will rise above 1.5°C*. (Addendum 5.)*

3. **Shipping large quantities of coal from a bulk commodities terminal in Oakland will contribute to the progression of climate change, and the local health consequences of that progression in part would be fairly attributed to Oakland's actions.**
   a. The prevention of severe health harms requires alignment of every level of government with the greenhouse gas reductions needed to meet the global carbon budget and consideration of the climate change consequences at every decision point. *(Addendum 6, 9, 10, 13)*
   b. Rapidly and dramatically reducing greenhouse gas emissions is required to stay under the 1.5°C threshold and prevent severe climate change heath impacts for the people of Oakland. *(Addendum 3.3, 5.4)*
   c. However, the tonnage that could be shipped through Oakland over the 66-year term of lease with OBOT would consume a significant fraction – 0.6% – of the entire world's remaining "carbon budget." *(Addendum 5.1-5.3, 9.1-9.4)*
   d. Further, the CO_2 that will be generated by burning coal shipped through Oakland will also be substantial in relation to California's climate goals. California has set goals to reduce statewide annual carbon emissions to 431 million metric tons of CO_2 equivalent (MMTCO_2e) by 2020 and 259 MMTCO_2e by 2030. *(Addendum 9.4.3)* But each year, the coal passing through Oakland could produce 22 million metric tons of CO2 emissions, fully 5.2% of the state's entire annual budget for greenhouse gas emissions in 2020 and 8.5% of its budget for 2030. *(Addendum 9.4.3)* California does not count overseas emissions in its carbon budget, but, when it comes to climate change, the health and environmental exposure consequences are the same whether coal is burned in California or shipped overseas to be burned. *(Addendum 10.1)*
4. **In contrast, prohibition of the transport, storage and handling of coal in Oakland is a reasonable and effective way to prevent the proposed coal from ever being burned, and will thereby contribute to limiting future global greenhouse gas emissions, climate change, and local adverse health effects. *(Addendum 13)* There is strong evidence that much of the coal that would arrive in Oakland would not be shipped and combusted at all, absent the availability of OBOT. *(Addendum 13.3)***

[11] The IPCC calculated the total remaining amount of carbon dioxide that can be emitted in the future for various probabilities of staying within the 1.5°C limit (33%, 50%, 66%). (See Table 1) Given the potential gravity of the consequences of passing 1.5°C, the carbon budget referred to in this chapter is based on the IPCC calculation of the limit on total emissions with a 66% chance of success, rather than 50%, which would reflect the same odds as a coin toss. At the current rate of 40 million metric tons per year, the 400 million metric tons for a 66% chance of success *after 2011* has already been reduced to 240 million metric tons *after 2015*. *(Addendum 5)*

Addendum

Cumulative Emissions and Carbon Commitments

1. Climate change is the greatest threat to health facing the world.

1.1. The World Health Organization (WHO) calls climate change the greatest threat to global health in the 21st century. (WHO, 2016) The U.S. Global Change Research Program (USGCRP), mandated by Congress in the Global Change Research Act of 1990, states that "[c]limate change is a significant threat to the health of the American people." (USGCRP, 2016.)

1.2. California's legislature identified climate change as a serious health and safety issue when it enacted the landmark Global Warming Solutions Act of 2006 (AB 32) which became part of the State's Health and Safety Code. (Health & Safety Code § 38500.)

1.3. GHG emissions are cumulative over time and across sources – every source contributes to global temperature change and local exposure and impact (Allen, 2009a, b). As detailed later in the Addendum, Oakland may experience climate-change-induced health impacts including:

1.3.1. The number of extreme heat[12] days in Oakland will increase: assuming a "high GHG scenario," 2017 is projected to have 28 extreme heat days, up from 4 anticipated in 2016. (City of Oakland, 2016a) Statewide, heat waves will increase 2-4 fold, resulting in a 2-6 fold increase in heat-related deaths (California Climate Change Center, 2012)

1.3.2. Mortality in Alameda County may increase 9.8% for every 10^{o} F change in mean daily temperature, with an excess mortality risk of 5.1% for people > 65. (Ostro, 2011)

1.3.3. Respiratory and cardiovascular hospital admissions in Alameda County may increase 2.6% and 1.4% per 10^{o}F increase in mean daily temperature. (Ostro, 2011)

1.3.4. Oakland, considered the city most vulnerable to extreme heat in the Bay Area, (California Energy Commission, 2012) will likely also see an increase in asthma and acute respiratory distress, hospital visits, lost school days, pre-term births, heat stress, and allergy duration and intensity due to rising temperature. (USGCRP, 2016)

---

[12] The State of California defines an extreme heat day as a day during the months of April through October, where the maximum temperature exceeds (in Oakland) 81 degrees Fahrenheit, and defines a heat wave as five or more consecutive extreme heat days. The projections for Oakland are based on the 98th historical percentile of max temperatures based on daily temperature maximum data between 1961-1990. See Cal-Adapt website http://cal-adapt.org/temperature/heat/#. Extreme heat conditions can result in heat stroke, heat exhaustion and cardiovascular stress and there are greater risks for the elderly and children. (City of Oakland, 2016a)

1.3.5. Rising temperatures due to greenhouse gases can cause excess mortality associated with ozone and particulate matter exposure. Excess annual air pollution deaths due solely to GHG-related temperature rise may reach roughly 600 PM2.5-attributable and 400 ozone-attributable deaths in the U.S. per 1°C increase. (Jacobsen, 2008)

1.3.6. An estimated 3,100-5,200 Oakland residents[13] are at risk of flooding in coming decades due to higher storm surges, extreme precipitation events, and sea-level rise. (Pacific Institute, 2014) Likely effects of these scenarios include traumatic injury and death, mental health disturbances (anxiety, stress-related trauma), increased infection and communicable disease, displacement, and disrupted access to safe food, water and essential services. (City of Oakland, 2016a; Pacific Institute, 2014)

1.3.7. While the health impacts of climate change affect all Oakland residents, those of West Oakland, especially in neighborhoods adjacent to the former Oakland Army Base, and those in the flatlands of East Oakland are at increased risk for harmful effects and for more severe consequences due to preexisting health conditions, higher exposure to environmental hazards, social, economic and demographic factors, and limited adaptive capacity. (CA Energy Commission, 2012)

1.4. "Climate change is a medical emergency," according to the Lancet Commission on Health and Climate Change. "It thus demands an emergency response…." (Lancet Commission on Health and Climate, 2015)

2. Global temperature rise will drive health effects of climate change

2.1. Planetary and health effects of climate change at a 2°C rise are severe. For over a decade, the 2.0°C mark has been criticized for inappropriately accounting for climate dynamics – "with disastrous consequences." (Hansen, 2005; 2013) Its validity as a safety threshold has been widely challenged. (Tschakert, 2015)

2.2. Holding temperature rise at or below 1.5°C is critical for averting the worst of the projected exposure risks and impacts of climate change. (UNFCCC, 2015) Significantly, in a 1.5°C scenario, after the year 2100 many climate impacts begin to reverse, while at 2.0°C, they increase or accelerate. (Schleussner, 2016)

2.3. The 2015 Paris Agreement partially responded to the 1.5°C imperative: "Recognizing that climate change represents an urgent and potentially irreversible threat to human societies and the planet," the 2015 Paris Agreement aims to hold the increase in the

---

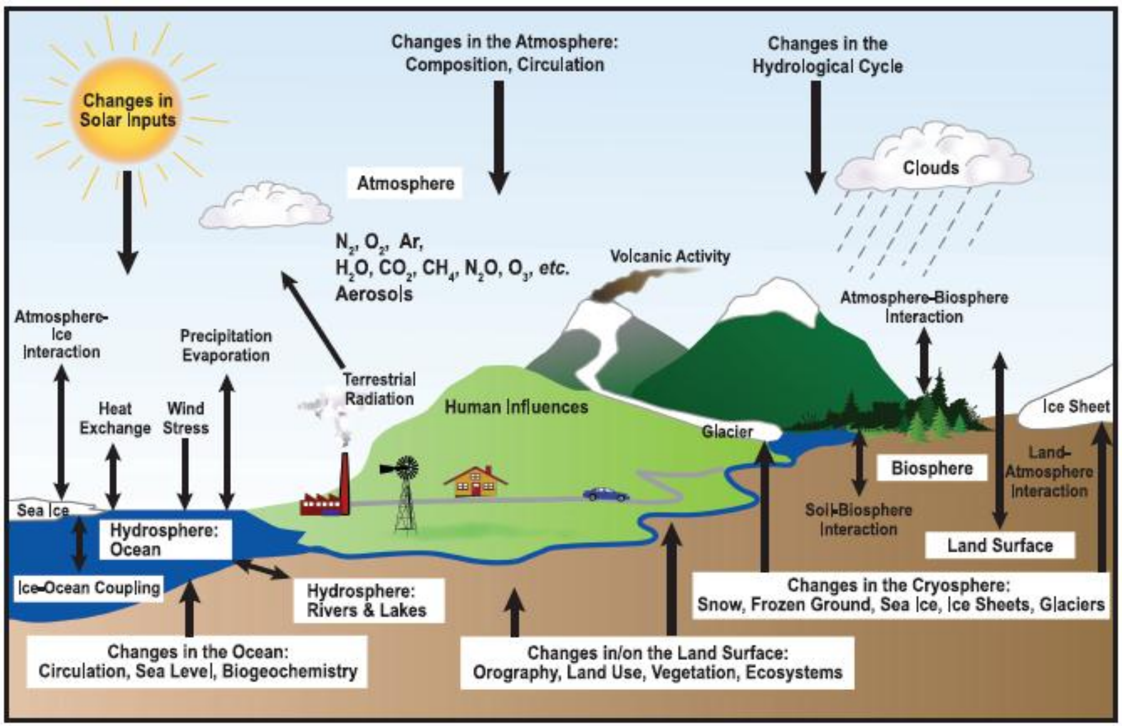
[13] Oakland residents living in West Oakland, China- town, San Antonio, Fruitvale, Central East Oakland, and Elmhurst districts will experience the most exposure to flooding in the future. (Pacific Institute, 2014)

global average temperature “to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C.” (UNFCCC, 2015)

3. Effective prevention of any level of temperature rise requires targeting its root cause: the increase in concentration of greenhouse gases in the earth’s atmosphere.

3.1. The number one cause of climate change is the burning of fossil fuels—coal, oil, and natural gas. (EPA, 2016e) Their combustion releases greenhouse gases (GHGs) that warm the Earth by trapping heat in the earth’s atmosphere (Figure 1).[14]

Figure 1 Components of the climate system



Source: Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007: The Physical Science Basis”, Cambridge University Press, 2007, page 104.

3.2. Carbon dioxide (CO_2) is the primary GHG driving climate change, accounting for 81% of GHGs. (EPA, 2016b) Long-term temperature change remains primarily associated with total cumulative CO_2 emissions. (Mathews, 2012)

3.3. According to the IPCC Fifth Assessment Report, mitigation, in the context of climate change, means human intervention to reduce the sources or enhance the sinks of GHGs. (IPCC, 2014)

[14] The principal greenhouse gases—carbon dioxide, methane, and nitrous oxide—have increased to levels unprecedented in the last 800,000 years. (IPCC, 2013c; USEPA, 2016f) Atmospheric carbon dioxide concentrations have increased over 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. (IPCC, 2013b, c; USEPA, 2016f)

4. **However, individual sources and annual levels of emissions cannot be seen in isolation; the cumulative effect of GHG emissions drive climate change (and its health impacts).**

4.1. Once emitted, much of the CO_2 remains in the atmosphere for many thousands of years before natural processes reduce its concentration.[15] (Archer, 2009) There is no known safe and effective way to remove greenhouse gases from the atmosphere on a global scale. (Royal Society, 2009)

4.2. Therefore the magnitude of warming that we experience is not determined by "emissions in any one year, but by cumulative CO_2 emissions produced over time." (Davis and Socolow, 2014)

4.3. Further, the magnitude of climate change is largely driven by the amount of greenhouse gases emitted globally (EPA, 2016b; Allen, 2009a,b); each new source of emissions must be considered in the global context of *all* current and future emissions and their cumulative, or aggregated, impacts. "[C]hoices made now and in the next few decades will determine the amount of additional future warming." (USGCRP, 2014) Regardless of where combustion occurs, the resultant emissions contribute to global changes in temperature and other climate impacts.

5. **Based upon the cumulative dynamics of CO_2 emissions, the Intergovernmental Panel on Climate Change has clarified that all emissions draw from a singular global "climate budget." which is the amount remaining for humanity to emit before reaching a CO_2 concentration that corresponds with a global temperature rise (e.g., 1.5°C). Exceeding this budget and thereby surpassing 1.5°C is irreconcilable with the continuation of the world's current natural systems and human societies.**

5.1. The Intergovernmental Panel on Climate Change (IPCC) has estimated that, in order to have a 66% chance of keeping global temperature rise at or below 1.5°C, humanity's total cumulative CO_2 emissions after 2011 for the next several millennia must not exceed 400 billion metric tons (Table 1). (IPCC, 2013b; Allen, 2009b)

[15] The ocean equilibrates to capacity with atmospheric CO_2 (Archer, 2009) and has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification. (IPCC, 2013) The 20-40% of CO_2 remaining in the atmosphere takes much longer to process or equilibrate, meaning the "climate effects of CO_2 releases to the atmosphere will persist for tens, if not hundreds, of thousands of years into the future." (Archer, 2009)

Table 1 Cumulative carbon dioxide emissions consistent with limiting warming to less than the stated temperature at different levels of probability, as calculated by the IPCC.

Cumulative CO_2 emissions from 1870 in $GtCO_2$									
Net anthropogenic warming [a]	<1.5°C			<2°C			<3°C		
Fraction of simulations meeting goal [b]	66%	50%	33%	66%	50%	33%	66%	50%	33%
Complex models, RCP scenarios only [c]	2250	2250	2550	2900	3000	3300	4200	4500	4850
Simple model, WGIII scenarios [d]	No data	2300 to 2350	2400 to 2950	2550 to 3150	2900 to 3200	2950 to 3800	n.a. [e]	4150 to 5750	5250 to 6000
Cumulative CO_2 emissions from 2011 in $GtCO_2$									
Complex models, RCP scenarios only [c]	400	550	850	1000	1300	1500	2400	2800	3250
Simple model, WGIII scenarios [d]	No data	550 to 600	600 to 1150	750 to 1400	1150 to 1400	1150 to 2050	n.a. [e]	2350 to 4000	3500 to 4250
Total fossil carbon available in 2011 [f]: 3670 to 7100 $GtCO_2$ (reserves) and 31300 to 50050 $GtCO_2$ (resources)									

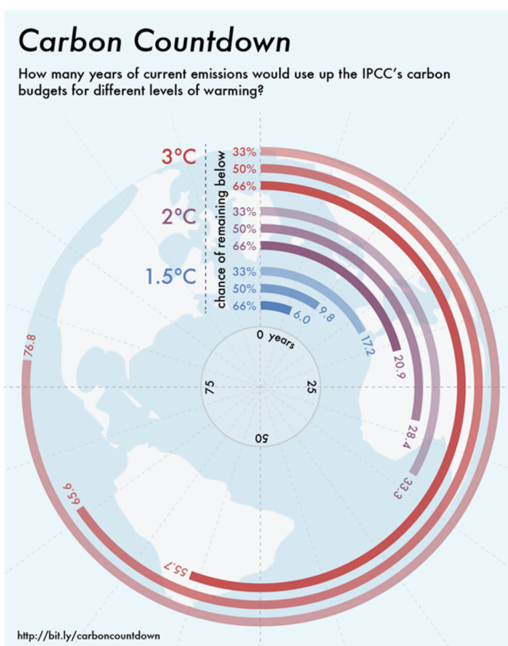
Source: Table 2.2 of IPCC, 2013b

5.2. Since 2011, global emissions have averaged approximately 40 billion metric tons per year (Rogelj et al., 2016), consuming about 10% of the budget each year.

5.3. At this rate, only 240 billion metric tons of the budget remains after 2015 and the entire post-2011 400 billion metric ton budget will be used up in less than six years. (Figure 2) (Carbon Brief, 2015)

5.4. Stringent early reductions in greenhouse gas emissions will slow cumulative impacts and are "key to retain a possibility for limiting warming to below 1.5°C by 2100," and "the window for achieving this goal is small and rapidly closing." (Rogelj et al., 2015)

Figure 2 Illustration of the remaining global carbon budget by temperature scenarios, starting at 2105



Source: Carbon Brief, 2015. Infographic at http://www.carbonbrief.org/six-years-worth-of-current-emissions-would-blow-the-carbon-budget-for-1-5-degrees); data at http://bit.ly/carboncountdown (accessed June 11, 2016).

6. **Action at the local, regional, and state level therefore must be directed toward staying within global limits on cumulative CO_2 emissions if we are to avert the most negative health and safety consequences of climate change. Frameworks for doing so already exist.**

   6.1. To align with a global carbon budget, local decisions must be made within the context of global cumulative and aggregate emissions.

   6.2. California law already provides a framework for decision-making on a cumulative basis. When interpreting CEQA, the California Supreme Court recognized that, "because of the global scale of climate change, any one project's contribution is unlikely to be significant by itself. The challenge for [environmental] purposes is to determine whether the impact of the project's emissions of greenhouse gases is *cumulatively* considerable, in the sense that 'the incremental effects of [the] individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.'" (California Supreme Court, 2015).

   6.3. Internalizing the cumulative direct and indirect impacts of a decision or action is an established element of several economic and environmental frameworks, including true cost accounting (environmental full cost accounting) (Steffan and Burritt, 2000), GHG Protocol Product LifeCycle Accounting and Reporting Standard (The Product Standard) (Greenhouse Gas Protocol, 2011), Consumption-based Accounting (Davies and Caldeira, 2010) and Commitment Accounting, a method to inform public policy by quantifying future emissions implied by current investments. (Davies and Socolow, 2014; NCIO 2015).

      6.3.1. "Commitment accounting of CO_2 emissions provides critical information about future emissions related to infrastructure that currently exists or might be built. Reducing CO_2 emissions will ultimately mean retiring CO2-emitting infrastructure more quickly than it is built… By revealing the emissions that are anticipated decades into the future, commitment accounting of CO2 emissions may help to integrate analyses of capital investment, cumulative emissions, and damages from climate warming." (Davis and Socolow, 2014)

7. **Oakland's existing policy and contractual obligations already support accounting for the total cumulative emissions associated with its decisions.**

   7.1. Oakland's Energy and Climate Action Plan of 2012 already supports accounting for total emissions in its stated purpose, which is to "identify and prioritize actions the city can take to reduce energy consumption and greenhouse gas emissions associated with Oakland." (City of Oakland, 2012) This formulation does not limit its scope to emissions occurring within the city line.

7.2. The Development Agreement between the City of Oakland and the Developer regarding the "Gateway Development / Oakland Global" states in section 3.4.2 that the City's police powers extend to not only current but also future users and neighbors of the project. (City of Oakland, 2013) By including this express provision in the Development Agreement, the City has acknowledged accountability for the impacts its decisions today will have on the circumstances faced by future residents and workers.

8. **Globally, one of the most important carbon commitments to address on a cumulative basis is the combustion of coal. Coal-fired power plants are a leading source of CO_2 emissions; coal combustion causes more than 40% of the world's carbon emissions. (Center for Climate and Energy Solutions)**

    8.1. "Current frontline stockpiles of hydrocarbons – of oil, coal, and gas – are multiples of what could possibly be consumed this century if the climate is to be kept under control… All but the firmest responses leave the door wide open to catastrophic risks and threats to the planet's ability to support life." (DARA, 2012)

    8.2. China, India, Indonesia and Vietnam account for three-quarters of new coal-fired power plants scheduled to be launched in the next five years. (Global Coal Plant Tracker, 2016)

    8.3. In an address to government and corporate leaders in Washington DC this May, World Bank President Jim Yong Kim declared that, "…if the entire region implements the coal-based plans right now, I think we are finished. That would spell disaster for us and our planet." (Goldenberg, 2016)

9. **Oakland faces the prospect of making a massive commitment to coal-related GHG emissions, on a scale that blows past any emissions target previously conceived. If Oakland permits this coal to be shipped, the emissions associated with this decision will be measurable on a global scale, substantial in impact, subversive of the collective initiative to limit GHG impacts to tolerable levels, and associated with climate-related health impacts in Oakland.**

    9.1. Building an export terminal designed to send up to 9 million metric tons per year[16] of coal to Asian export markets for the next 66 years (the length of OBOT's lease) is a massive carbon commitment that would add as much as 1.46 billion metric tons of CO_2 to Earth's atmosphere. [17]

---

[16] The July 16, 2015 Basis of Design submitted by the developer in September 2015 reported 9 million metric tons (9.9 million short tons per year) as the design capacity of the terminal. The developer claims a vested right to use the terminal to ship any lawful commodities—including coal—in any proportion. Accordingly, the calculations in this chapter, like those in the report submitted in September 2015 by Dr. Phyllis Fox, assume shipments of 9 million metric tons per year of coal.

[17] Burning a short ton (2000 pounds) of bituminous coal produces 4,931.30 pounds of CO_2. (United States Energy Information Agency (EIA). 2016) Thus, each unit of mass of coal produces 4,931 ÷ 2,000 = 2.466 units of mass of

9.2. 1.46 billion metric tons is a substantial amount of CO_2 – representing 0.6% of humanity's entire remaining budget of fossil fuel emissions for a (66%) chance of keeping global warming to less than 1.5°C.

9.3. All over the planet, people and their governments are making decisions on the use of coal. If only a small portion of the decisions lead to similar amounts of consumption, then humanity would exceed the limit that is the best chance of protecting the health and safety of Oaklanders and people throughout the world.

9.4. In annual terms, burning 9 million metric tons of OBOT coal each year will result in annual emissions of about 22 million metric tons of CO_2 equivalent ($MMTCO_2e$). This amount alone is equivalent to:

9.4.1. 20,000 times BAAQMD's proposed 1,100-ton threshold of significance under CEQA; (Bay Area Air Quality Management District, 2011)

9.4.2. more than 140% of the total GHG emissions (15.5 MMT) of the Bay Area's five oil refineries. (Bay Area Air Quality Management District, 2015);

9.4.3. a substantial portion – 5.2% – of the *statewide* 2020 annual emissions target of 431 $MMTCO_2e$ and 8.5% of the 2030 emission target of 259 $MMTCO_2e$. (CARB, 2015b; CARB, 2015c)

9.5. If California were required to count the 22 $MMTCO_2e$ that would be generated by burning 9 MMT of coal overseas each year, it would add substantially to the difficulty of meeting its 2020 and 2030 goals.

10. 1.5 billion metric tons of CO_2 will have a discernable effect on global climate, which will be associated with adverse health impacts in Oakland.

10.1. From the standpoint of public health and safety, the climate change exposures and consequential public health impacts of burning fossil fuels in California or overseas are identical. Greenhouse gases affect climate change equally regardless of where they are emitted, and thus they are truly global pollutants.[18] (USEPA, 2016g)

11. Failing to curtail cumulative GHG emissions through "stringent and early reductions" will endanger health and safety in Oakland.

CO_2. Each metric ton of coal produces 2.466 metric tons of CO_2. Burning 9 million metric tons of coal each year will, therefore, produce 22.19 million metric tons of CO_2 per year. Over the 66 year period of the OBOT lease, the cumulative emissions attributable to coal passing through Oakland would be 22.19 million x 66 = 1.46 billion metric tons of CO_2.

[18] As air moves around the world, greenhouse gases become globally mixed, which means the concentration of a greenhouse gas like carbon dioxide is roughly the same no matter where you measure it.

11.1. The Lancet Commission on Health and Climate Change, in its most recent release, cautions that, in the absence of any major cut in emissions, projections of mortality and illness and other effects, like famine, worsen. (Lancet Commission, 2015)

11.2. If global temperature rise does not stay below 1.5°, Oakland may confront extreme, cumulative environmental exposures that challenge its capacity to avert adverse health and safety impacts (Rogelj et al., 2015). See further details below.

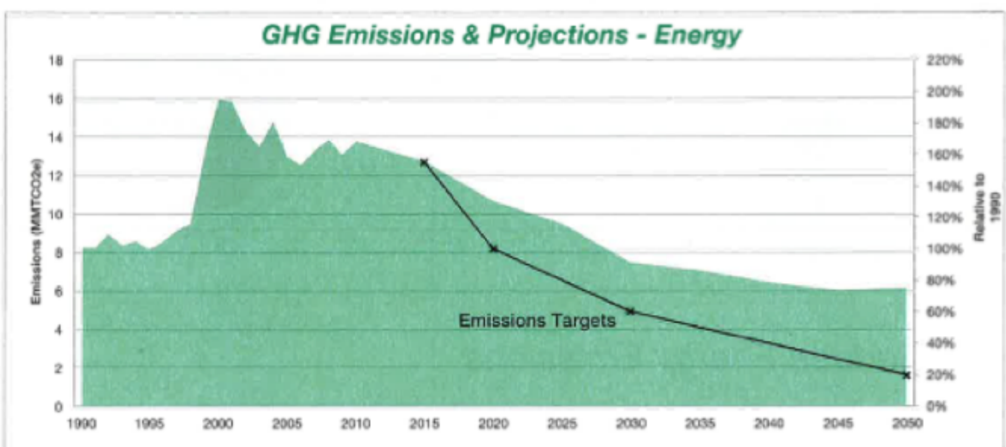
12. Alarmingly, the world, California, the Bay Area, and Oakland are not on track to meet the targets needed to slow and stop global warming.

12.1. An inventory of emissions in the global power sector finds that, despite international efforts to reduce CO_2 emissions, total remaining commitments in the global power sector "have not declined in a single year since 1950 and are in fact growing rapidly (by an average of 4% per year 2000–2012)." (Davis and Sokolow, 2014)

12.2. The 2015 report by the Lancet Commission on Health and Climate Change notes that global carbon emission rates have exceeded the worst-case scenarios used in 2009. (Lancet Commission, 2015)

12.3. By 2013, California still generated 459.3 MMT, while the state's population and economic output are expected to grow substantially by 2020. (CARB, 2015a.) This level of emissions exceeds California's 431 MMT target. (CARB, 2015b.)

Figure 3 Illustration of the gap between projected emissions decreases and reductions necessary to meet climate targets



The graph shows projected trends in Bay Area GHG emissions by sector through year 2050. The projected emissions take into account anticipated emission reductions from policies that have already been adopted at the State or regional level, as well as future policies that are likely to be adopted as an extension of current efforts. The chart also shows the emissions reduction trajectory needed in order to achieve interim (2020 and 2030) and long-range (2050) GHG reduction targets adopted by the State and the Air District.

12.4. Unofficial findings from the Bay Area Air Quality Management District's forthcoming Clean Air Plan / Climate Strategies Report (to be released July or August, 2016) indicate that the Bay Area will similarly fall short. The report's projections indicate that the GHG reduction trajectory of each sector in the Bay Area will not meet the intermediate (2020, 2030) and long-term (2050) GHG reduction targets adopted by the State and the Air District. This failure may be even greater than reported, as the projected reductions already consider not only estimated effects of current State and regional policies but also future policies *that have not yet been adopted*. (See Figure 3 for example)

13. A different approach is imperative if health is to be protected from climate change. In this instance, a decision to prohibit coal's transport and processing through Oakland is an effective, reasonable and necessary means for contributing to the prevention of climate change-related health and safety impacts in Oakland.

13.1. Other than prohibition of this coal's transport through and storage and handling in Oakland, the submitted evidence and other existing literature does not present a mitigation or adaptation strategy that would effectively prevent the climate-related exposures and health consequences attributable to combustion of this coal.

13.2. In response to the City's question 7, CCIG/OBOT/TLS submitted to the record that, should the coal be prohibited from exporting through OBOT, "the product will continue to be shipped as it is today, through Stockton, CA; Levin Terminal in Richmond, CA; Pier G in Long Beach, CA; and may be shipped through the Ridley Terminal in Canada or the proposed Guaymas Terminal in Mexico in order to supply the market demands." (Tagami and Bridges, 2015).

13.3. However, review of the submitted record and additional investigation finds that the above assertion is not substantiated. Instead, as detailed in Table 2, prohibition of coal transport, storage and processing for shipment in Oakland is likely to stop this coal from being combusted altogether. In which case, this prohibition is health protective and not doing so could present a danger to public health and safety.

Table 2 Summary of information indicating coal would not be shipped if prohibited in Oakland

Oakland is the most viable option	
Project Spokesmen	The project's own spokespeople make the case that Oakland is by far the most feasible option: At a Utah Community Impact Board hearing, one of the representatives for the developer (strategic infrastructure advisor for the project Jeff Holt, or Master developer for the Oakland Army Base Mark McClure) stated: "There just aren't very many deep-water bulk terminals on the West Coast. Most of them are covered with containers. So the Oakland facility is a rare and serendipitous find/opportunity." (Utah Community Impact Board (CIB), 2015)
Report on Bowie Resources	"Records also show that Bowie Resources' plan to mine coal from Sufco appears to depend on the Oakland deal going through and that the company might not otherwise find a market for the fossil fuel. As such, shipping coal through Oakland likely will lead to a massive expansion of coal mining in Utah that might not otherwise occur." (Bondgraham, 2015)
Other Ports are not options	
Stockton	Stockton does not have the water depth to handle the ship size necessary for the large and heavy coal cargo, and requires an extra-expensive 3 days of travel to and from the sea. The Port of Stockton's website confirms that its high-tide depth is 40 feet; whereas the ships anticipated for this coal require 52 ft.[19]
Richmond / Levin	Levin Terminal currently does not have the capacity for the anticipated volume of coal, is already facing community opposition to the impacts of the relatively smaller amount of coal it does ship, and may not renew the contract to ship coal at all at its upcoming contract renewal.
Long Beach	Pier G of Long Beach is unlikely to have capacity for this added coal volume, since recently the Long Beach council voted against a new EIR as part of lease renewal on the basis that there would be no change of use or capacity of the storage "shed." Says Art Wong, Port spokesperson, "The environmental part is whether this (lease renewal) is going to increase the usage or change the capacity, and on that narrow environment issue, that's a no — there will be no increase in capacity." (Siegal, 2014).
Los Angeles	The Port of Los Angeles' contentious closure and expensive public cleanup of its coal terminal precludes it as an option (McGreevy, 2003)
Ridley and Gayama	Both the Ridley and Guayamas Terminals represent longer hauls (of roughly 1,500 and 1,00 miles, respectively, compared to a haul to Oakland of roughly 700 miles). Longer hauls, especially of a low bulk-to-value commodity such as coal raises questions of financial viability, especially because alternatives to coal power, including renewable energy, energy conservation and energy efficiency are increasingly available and cost competitive with coal (COP21, 2015). An investor report for Cloud Peak confirms that long hauls are cost prohibitive. In its 2011 investor report it states, "As previously disclosed, exports through the Ridley terminal incur significantly higher rail costs than through Westshore due to the longer multi railroad haul."[20]
Coal terminals are not opening	
Shortage of options	A 2011 investor report for Cloud Peak reveals an industry-wide challenge to find shipping locations, stating there were not enough terminals: ".... next year's exports will again be limited by available terminal capacity…."[Error! Bookmark not defined.]
No coal from Public Ports	The public ports of Portland, Seattle, Kalama, Tacoma, and Port of Oakland all declined various coal terminal proposals.[21]
Options in Washington fold	The Gateway Terminal at Cherry Point in Washington State was denied a permit to ship coal (Washington State Department of Ecology). Coal shipping through the Millennium Bulk Terminal is currently the subject of contentious debate (Quintana, 2016)
Oregon	Plans were dropped for coal export terminals at 1) Port Westward (Wilson and Swan, 2013); 2) Morrow Pacific and Coo's Bay due to local and state government resistance (Bernard, 2016; Elber, 2013).
Economic theory does not support coal shipment from elsewhere	
Dr. Thomas Power, professor of economics at The University of Montana and chairman of the economics department for thirty years, refuted coal industry arguments that "… decrease of exported coal would not change the amount of coal burned: only the source would change." He explains that, because of the effect of increased supply on prices and of prices on investment decisions, these theories are "incorrect, and inconsistent with both the basic principles of economics as well as the abundant literature regarding energy use and consumption patterns in Asia." (Power, 2011)	

[19] http://www.portofstockton.com/deepwater-channel-info
[20] http://www.sightline.org/2011/11/09/coal-company-destroys-key-argument-for-coal-terminal/
[21] http://www.sourcewatch.org/index.php/Millennium_Bulk_Terminals

14. Preventing the transport and processing of coal for shipment in Oakland is the most reliable approach to preventing climate change health impacts attributable to this coal.

15. Given the likelihood this proposed coal would <u>not</u> be combusted if snot shipped from Oakland, Oakland has a causal link and accountability to the carbon commitments of this coal.

Climate Change Exposure Assessment: Environmental Impacts

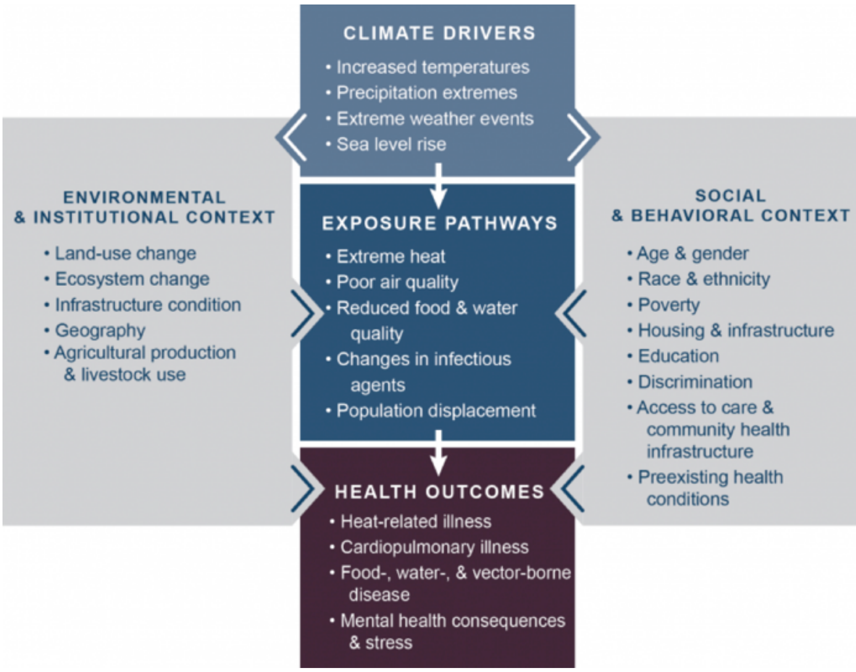
Climate change is the greatest health challenge of the 21st century, according to multiple recent reports and statements by many of the world's leading health experts. The impacts of climate change on health derive from the impacts of climate change on local and global environments. The magnitude of climate change and its health consequences depends on cumulative emissions of greenhouse gases into the earth's atmosphere, regardless of where those gases are emitted. The greater the cumulative emissions of GHG, the more severe the impact on human health, and the higher the risk of catastrophic climate changes that threaten human survival. Thus, the best way to prevent the health impacts of climate change — locally and globally — is to reduce the emissions of greenhouse gas emissions.

16. Health impacts of climate result from exposure to changes in environmental conditions.

16.1. According to the U.S. Global Change Research Program (2016), climate change — including increased temperature, rising sea levels, ocean acidification, and extreme weather — leads to environmental exposures that create adverse health outcomes (See Figure 4). Climate-related health impacts are direct (e.g., exposure to heat), or indirect (e.g. water and food insecurity related to declining snow pack or reduced crop yields, or disease due to increases in air pollution) (Watts et al., 2015).

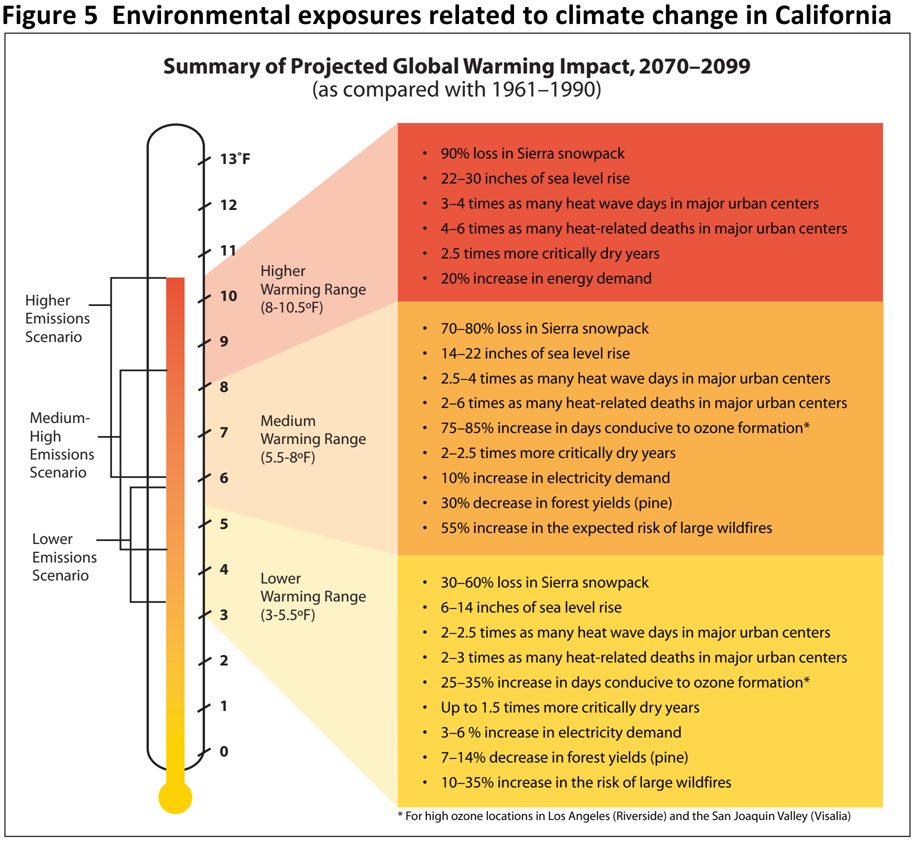
17. Many impacts of climate change felt in Oakland will mirror or interact with those experienced in the Bay Area and the state. Figure 5 shows 2012 projections for climate impacts in California, and Table 2 presents climate change exposures germane to Oakland, as detailed in the following text.

Figure 4 Framework for climate impact on health



Source: USGCRP. 2016. The Impacts of Climate Change on Human Health in the United States: a Scientific Assessment.

Figure 5 Environmental exposures related to climate change in California

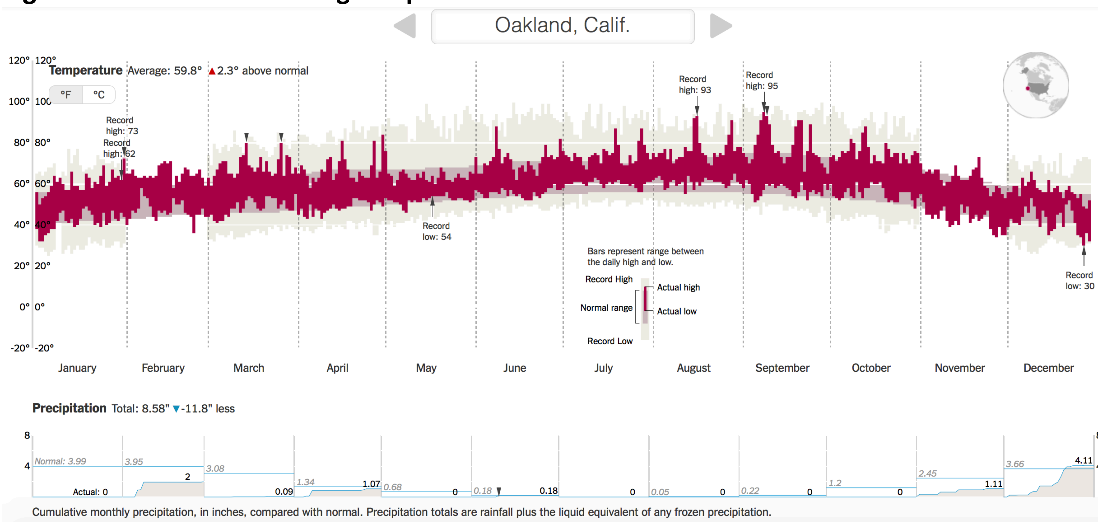


Source: California Climate Change Center report: Our Changing Climate. 2012.

18. Average temperature in Oakland, the number of extreme heat days, and the frequency and duration of heat waves will rise:

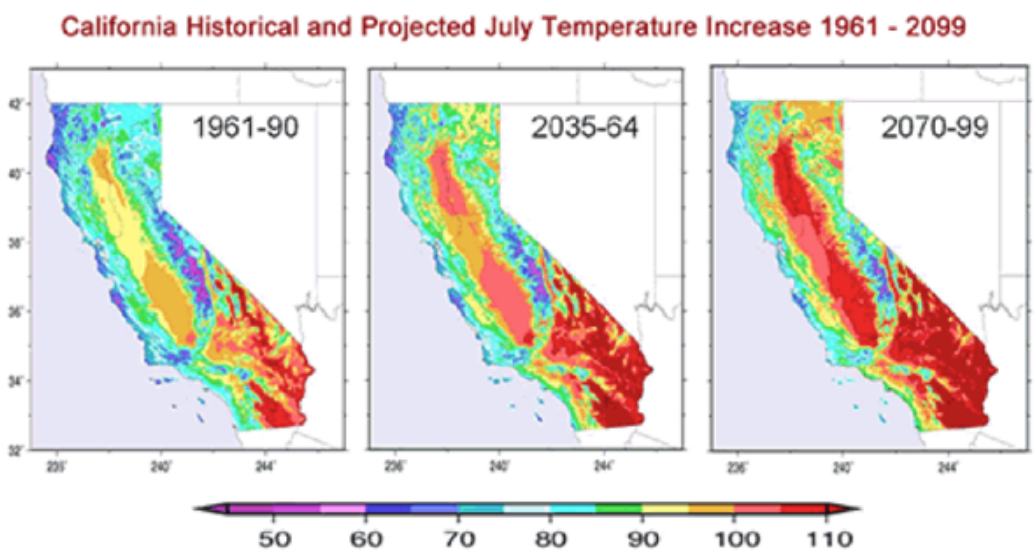
18.1. Oakland's average temperature in 2015 was 2.3°F above normal (59.8°F) – see Figure 6. (Lai, 2016) The average temperature in Alameda County is projected to increase by 3.3 – 5.6°F by 2065, (City of Oakland, 2016a; California Energy Commission 2010, 2012) along with annual average temperature rises throughout the state (Figure 7). (California Department of Public Health, 2014)

Figure 6 Oakland's trending temperature and rainfall



Source, New York Times, Science, February 19, 2016
Temperature and precipitation data are provided by AccuWeather.
The normal range of temperature is calculated by normalizing the weather from 1981 to 2010.

Figure 7 Historical and projected temperature changes in California as a result of climate change



Source: California Natural Resources Agency, 2009 California Climate Adaptation Strategy. Available at http://resources.ca.gov/docs/climate/Statewide_Adaptation_Strategy.pdf (accessed June 11, 2016).

18.2. By 2100, in the Bay Area between six and 10 more heat waves can be expected per year. (California Department of Public Health, 2014) Heat waves statewide will increase 2-4 fold, resulting in a 2-6 fold increase in heat-related deaths (California Climate Change Center, 2012)

18.3. The area will see an increase in extreme heat days, with a predicted 28 extreme heat days in 2017, compared with a current statewide baseline of 4 days. (City of Oakland, 2016a).

19. Warm temperatures will lead to increased ozone pollution in Oakland

19.1. Warmer temperatures from climate change will increase ozone production in Oakland and the frequency of days with unhealthy levels of ground-level ozone, a harmful air pollutant, and a component in the formation of smog. (EPA, 2016a; USGCRP, 2016)

19.2. The American Lung Association ranked Oakland 16th for high ozone days out of 228 metropolitan areas in the country (ALA, 2016 as of December 2015). Alameda County does not currently meet state air quality standards for ozone, with subsequent increases in harmful effects (BAAQMD, 2016). According to BAAQMD, rising temperatures threaten to undermine years of progress in improving air quality in the San Francisco Bay Area. The Bay Area Air Quality Monitoring District (BAAQMD) modeled that an anticipated 2^{o} C (~4^{o}F) increase in average temperatures would set back progress in reducing ozone by a decade. (BAAQMD, 2010).

19.3. A UC Berkeley study found that Bay Area ozone levels may be the most augmented by higher temperatures; parts of the Bay Area could experience an increase in ozone concentrations of nearly 10%. (Steiner et al., 2006; BAAQMD 2010).

20. Wildfires will increase air pollution in Oakland

20.1. Large wildfires in California and the West markedly increased in the mid-1980s, likely from increased spring and summer temperatures, earlier spring snowmelt, and drying trees. (Westerling, 2006; BAAQMD, 2010; EBMUD, 2014)

20.2. The risk of large wildfires in California could increase by as much as 55 percent in the next several decades. (CCCC, 2012) By 2085, increases in the number of large fires statewide would increase 58 percent to 128 percent above historical levels and the burned area will increase 57 to 169 percent. (EBMUD, 2014)

20.3. Wildfires generate huge quantities of particulate matter and release large amounts of CO_2 back into the atmosphere, thus contributing directly to the increase of GHG emissions in the atmosphere. (BAAQMD, 2010)

20.4. Some wild fires will impair Oakland's air quality as smoke plumes carry PM2.5 long distances. California's wildfires of June 2008 caused unprecedented concentrations of ozone and PM2.5, with 5 or 10-fold increases compared to normal. (BAAQMD, 2010)

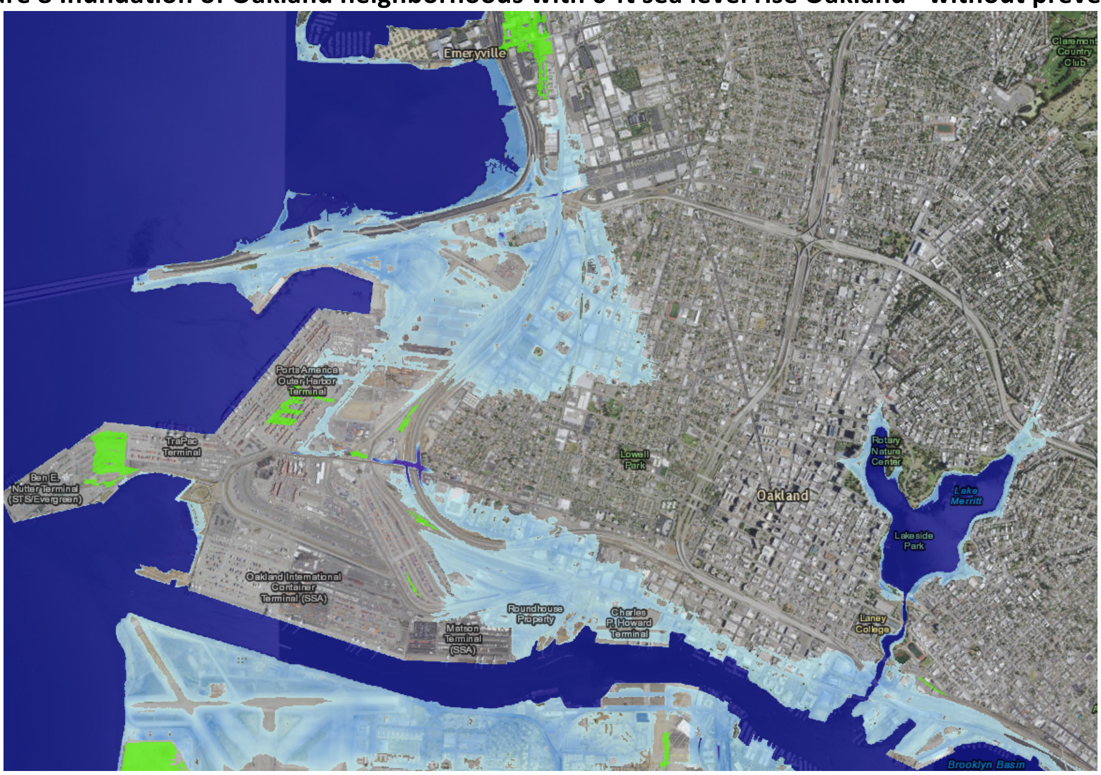
Table 3 Climate change exposure summary

CO_2 emissions last for thousands of years and have global repercussions including rising temperatures, extreme heat, worsening air pollution, rising seas and extreme weather.	(Archer, 2009; Davis and Socolow, 2014; EPA, 2016a; EPA, 2016b; IPCC, 2013b)
Rising temperatures and extreme heat • OBOT coal will increase the probability of Earth exceeding a 1.5°C global temperature rise, largely considered the upper limit of tolerable anthropogenic warming. Oakland's average temperature in 2015 was 2.3°F above normal and Alameda County is projected to see a 3.3-5.6°F increase in temperature by 2065. • Frequency of extreme heat days and heat waves will increase greatly. Oakland is projected to have roughly 28 extreme heat days in 2017 (relative to 4 in 2016), and by 2100, the Bay Area may have 6 – 10 more heat waves per year over current conditions. • Rising temperatures can increase exposure to new pathogens.	(California Department of Public Health, 2014; California Energy Commission 2010, 2012; Lai, 2016; CCCC, 2012; City of Oakland, 2016a; IPCC, 2013b)
Worsening air pollution • Increased heat will increase production of and exposure to ozone, a dangerous air pollutant. Ozone levels in California could increase by as much as 10% due to increased temperatures alone, negating air quality progress that the state has made over the past decade. The American Lung Association ranked Oakland 16th for high ozone days out of 228 metropolitan areas in the country in 2015. • Wildfires already occur more often in California, and with continued rising temperatures will increase by 55% or more over the next few decades; by 2085 the State's burned area could increase 57% – 169%. Wildfires are a high priority in Oakland's hazard mitigation plan. Even if they occur elsewhere, winds can carry hazardous fire pollutants to Oakland, causing steep increases in exposure; California wildfires in June 2008 caused unprecedented concentrations of ozone and PM2.5, with 5 and 10-fold increases compared to normal.	(BAAQMD, 2010; CCCC, 2012; EBMUD, 2014; Jacobsen, 2008; Steiner et al., 2006; Westerling, 2006)
Rising sea levels and extreme weather events • Flooding will be more frequent and more intense due to rising sea levels, storm surges, and extreme precipitation events. California's sea levels are expected to rise 5-24 inches by 2050 and up to 66 inches by 2100, where a one-foot rise increases the probability of extreme storm surge floods by roughly a factor of ten, with Alameda County experiencing a 44% increase in land vulnerable to this event. Amplified climate feedback may actually raise sea level for California over 6 feet, inundating most of the flatlands. Flooding, storm runoff, and overwhelmed infrastructure can contaminate water with sewage or toxic chemicals. Housing, 2 (25%) fire stations, 5 health care facilities, 2 homeless shelters, 1 food bank, 6 childcare centers and 3 schools are at great risk. Exposure to waterborne pathogens will increase. • While extreme precipitation events will increase, overall, critically dry years will increase 1.5-2.5 fold in California. For the Bay Area, mean annual rainfall will decrease 4-5 inches. In 2015, Oakland's total precipitation was 11.8" less than average. The current drought is 15 – 20% worse due to climate change, and the odds of future severe droughts have roughly doubled over the century. With a 7.2°F (4°C) rise in temperature, Oakland's (Mokelumne) watershed spring snowpack could decrease by up to half; drought and heat may render the watershed inadequate to support Oakland's needs. EBMUD anticipates severe water shortages and rationing, decreased water quality, and impaired flood control and electricity infrastructure. • Droughts, heat, and overdrawn groundwater threaten California agriculture. 2015's drought led to a 72% increase in groundwater extraction, 45% increase in fallow land, 21,000 lost jobs, and $2.6 billion in losses. Increased heat will worsen quantity and quality of crop yield and raise food prices, reducing the availability of affordable produce, especially for the poor.	(CCCC, 2012; Committee on Sea Level Rise in California, Oregon and Washington, 2012; CDPH, 2014; EPA, 2016a; USGCRP, 2016; Lai, 2016; Williams, 2015; Hansen 2016; NASA images; Berdalet, 2015; Semenza, 2012; EBMUD, 2014; Howitt, 2015; CCC, 2012)

21. For a significant portion of Oakland, risk of exposure to flooding will increase, due to sea level rise, storm surges, and high precipitation storms

21.1. California is projected to experience, relative to 2000, a likely sea level rise of 2–12 inches by 2030, 5–24 inches by 2050, and 17–66 inches by 2100. (Committee on Sea Level Rise in California, Oregon and Washington, 2012). New research suggests the higher end of that range is more likely, with leading climate scientist James Hansen and his colleagues reporting that amplified climate feedbacks may create several meters (over 6 feet) of sea level rise by 2100. (Hansen, 2016.) Maps prepared by the National Oceanic and Atmospheric Administration show that 6 feet of sea rise will inundate a large part of West Oakland, including the site of the OBOT near the Bay Bridge toll plaza. (See Figure 8)

Figure 8 Inundation of Oakland neighborhoods with 6-ft sea level rise Oakland - without prevention



Source: United States Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, https://coast.noaa.gov/slr/

21.2. As the average sea level rises, the number and duration of extreme storm surges and high waves are expected to escalate, and this increases the risk of flooding, coastal erosion, and wetland loss. (Committee on Sea Level Rise in California, Oregon and Washington, 2012; City of Oakland, 2016a)

21.3. Extreme storms with extreme precipitation are likely to occur more frequently. (EPA, 2016a; USGCRP, 2016) A 1 foot rise in sea level changes a "1 in 100" storm surge flood event into a "1 in 10" storm surge flood event. (CCCC, 2012) Extreme weather events and storm surges can damage or exceed the water infrastructure (such as drinking water or wastewater treatment plants). Extreme rainfall increases flooding, storm runoff, and overwhelmed infrastructure which can contaminate water with sewage or toxic chemicals. (EPA, 2016a)

21.4. The number of acres vulnerable to flooding is expected to increase 20 to 30 percent in most parts of the Bay Area, with some areas projected for increases over 40 percent. Coastal areas are estimated to experience an increase of approximately 15 percent in the acreage vulnerable to flooding. Alameda County is expected to experience a 44% increase in area of land vulnerable to a 100-year flood event. (CDPH, 2014)

21.4.1. A large portion of Oakland's infrastructure and most vulnerable housing are close to sea level. Oakland's infrastructure may be overwhelmed since much of it is located in flood zones (airport, wastewater, roads, rail, power, telecommunications utilities) (See Table 3). (City of Oakland, 2016a; Pacific Institute, 2014; Cal-Adapt; San Francisco Bay Conservation and Development Commission, 2011)

21.4.2. During the winters of 1982–1983 and 1997–1998, abnormally high seas and storm surges caused millions of dollars' worth of damage in the San Francisco Bay area. "Highways were flooded as six-foot waves crashed over waterfront bulkheads, and valuable coastal real estate was destroyed." (CCCC, 2012)

21.5. The areas of Oakland experiencing the greatest social vulnerability, such as West Oakland, are also areas that will be highly impacted by excess water, be it sea level rise, storm surges, or flooding.

21.5.1. At-risk infrastructure in Oakland includes 2 (25%) fire stations, 5 health care facilities, 2 homeless shelters, 1 food bank, 6 childcare centers and 3 schools. (City of Oakland, 2016b) Flooding of this infrastructure would be highly disruptive (Table 4).

21.5.2. Flooding of homes could lead to displacement and homelessness.

Table 4 Critical infrastructure needed for health and safety or serving vulnerable populations that will be impacted by sea-level rise without climate change prevention

City Facilities	Total Number	Number at Risk from Sea Level Rise	
		16 inches by 2050	55 inches by 2100
Emergency Response Facilities			
Fire Stations	8	2	2
Facilities serving at-risk populations			
Health Care facilities	87	5	13
Homeless shelters	12	2	4
Food Banks	14	1	5
Facilities serving vulnerable, less mobile populations			
Senior housing facility	45	0	3
Childcare center	146	6	16
Schools	81	3	13

Source: City of Oakland Preliminary Resilience Assessment, 2016b

22. Exposure to water-borne pathogens and contaminants will increase.

22.1. Increasing temperature, more frequent heavy rains and runoff, and the effects of storms, can increase exposure to waterborne pathogens (bacteria, viruses, and parasites); toxins produced by harmful algal and cyanobacterial blooms in the water; and chemicals. (USGCRP, 2016; EPA, 2016a) Increased microbial contamination and harmful algal blooms increase the risk of water-borne illnesses, reduce access to recreational waters, and preclude the harvesting of shellfish and other marine food sources. (Berdalet, 2015; Semenza, 2012)

23. Oakland's water supply will be imperiled, with possibly severe water shortage:

23.1. The Bay Area is projected to experience a moderate decline in annual rainfall, 1 to 3 inches by 2050 and 4 to 5 inches by 2090 is projected throughout the region (CDPH, 2014). The number of critically dry years in California projected for a 1.5-2.5 fold increase (CCCC, 2012)

23.2. California suffers from periodic droughts, and the odds of a severe drought in California have roughly doubled over the past century. The severity of California's current drought has intensified 15 - 20 percent due to climate change. (Williams, 2015) During years of extreme drought, Oakland can expect severe water shortages and rationing. (Department of Water Resources, 1979; EBMUD, 2014)

23.3. California is reliant on runoff from spring snow-melt. Over the century, the Sierra Nevada spring snowpack is projected to reduce by as much as 30 to 90 percent. (CCCC, 2012)

23.4. The Mokelumne River watershed, which supplies 90% of Oakland's water, is relatively small, and 40% is developed or unprotected, making it more vulnerable to degradation (See Figures 9 and 10). (The Nature Conservancy of California, 2012)

23.4.1. With growing population, drought and more heat may render the watershed inadequate to support Oakland's needs. In 2015, Oakland's total precipitation was 11.8" less than average (Lai, 2016). Under a scenario of a 7.2^{o}F (4^{o}C) rise in temperature, the Mokelumne watershed spring snowpack could decrease by up to half. (East Bay Municipal Utilities District, 2014)

23.5. The states emerging groundwater crisis, if not resolved, will threaten some watersheds and increase pressure on others. (The Nature Conservancy of California, 2012)

23.6. The East Bay Regional Municipal Utilities District, (EBMUD), which supplies Oakland's water, forecasts that with increases in water demand and climate change, there will be increases in severe water shortages, leading to increased severity of water rationing, decreased water quality, and the district will face challenges managing infrastructure that controls flooding and electricity. (EBMUD, 2014)

24. Climate impacts will impair agricultural production in California, in particular In the Central Valley.

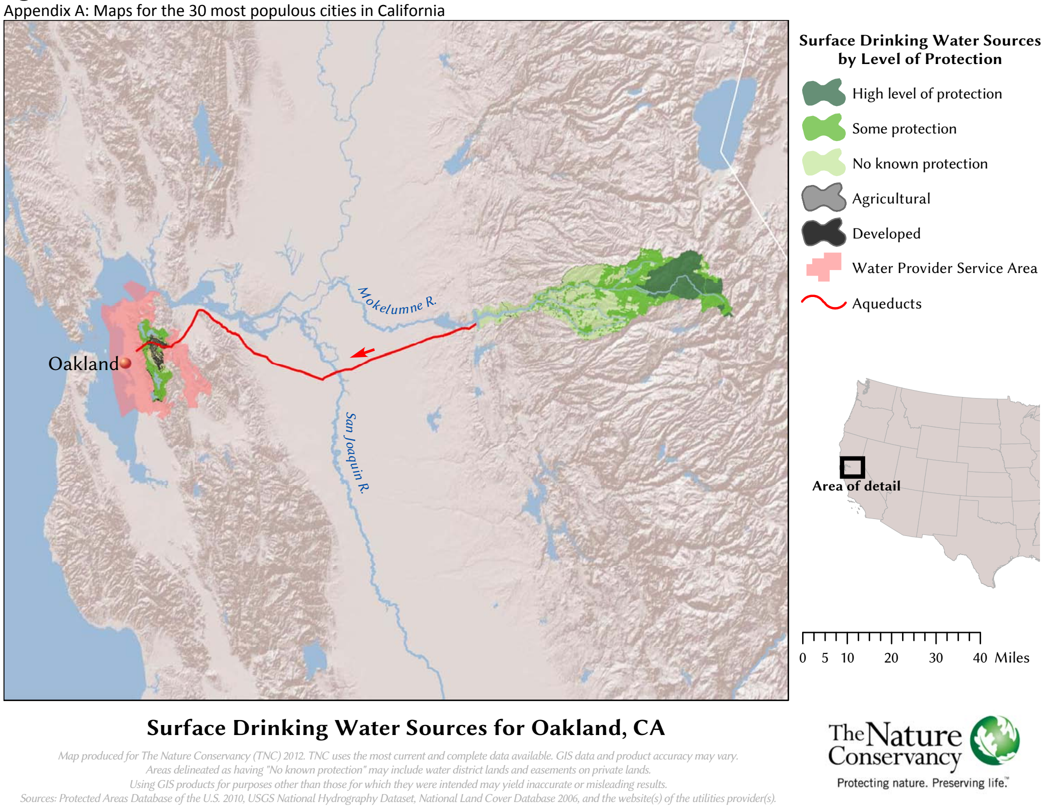
24.1. The current drought is responsible for the greatest surface water shortfall ever experienced by California agriculture. (Howitt, 2015)

24.2. California farmers could lose as much as 25 percent of the water they currently need. During this drought, groundwater extraction increased 72 percent, there was a 45 percent increase in land left fallow, and 21,000 jobs were lost, with a total economic impact of $2.7 billion. (Howitt, 2015) These consequences impact the general wealth of the state and increase food insecurity, especially for the poor.

24.3. Increased temperatures are likely to worsen the quantity and quality of crop yield. Climate-related rises in temperature and ozone pollution will make plants and trees more susceptible to disease and pests and interfere with plant growth. Reduced crop yields are associated with higher food prices, and could reduce the availability of affordable fresh produce. (CCCC, 2012).

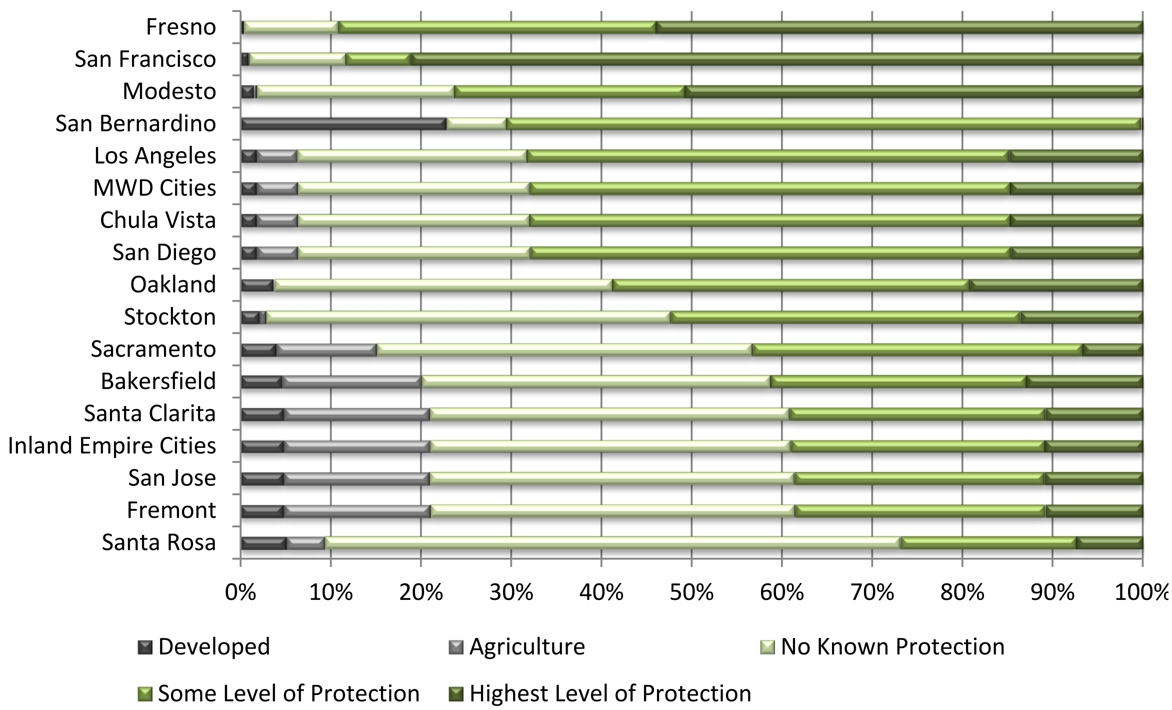
Figure 9 Oakland's watershed

Appendix A: Maps for the 30 most populous cities in California



Source The Nature Conservancy

Figure 10 Land Use and Protection of Watersheds Supplying Drinking Water by City



Source: The Nature Conservancy

Impacts of Climate Change on Health, focus on Oakland

The health impacts of climate change are occurring now and will worsen in coming years as the cumulative effects of climate change mount. Recent surveys of physicians across the U.S. show that a majority are seeing the effects of climate change in their patients now (Sarfaty et al. 2014). Table 5 details climate-related health impacts relevant to Oakland.

25. Heat illness and deaths may increase in Oakland.

25.1. Extreme heat increases the risks of heat stroke/exhaustion, heart attack, stroke, respiratory disease, and death from dehydration (US EPA, 2016a). Heat waves are more likely to cause excess deaths when the temperature rises above that to which the local population is accustomed and acclimated, especially in the absence of effective heat death prevention plans.

25.2. In the Bay Area, Oakland is considered the area most vulnerable to extreme heat, according to a 2012 risk assessment. (California Energy Commission's California Climate Change Center, 2012) This heightened vulnerability is due in part to Oakland residents being less accustomed to high temperatures and to greater socio-economic vulnerability and fewer resources to respond to heat.

25.3. Extreme heat events result in more fatalities than any other weather-related phenomenon (Centers for Disease Control and Prevention 2012). By mid-century, mortality caused by heat may increase 2-3 fold in California urban centers during an extreme heat event (CCCC, 2012; Basu and Ostro, 2008a, 2008b). Annual premature mortality due to extreme heat in California is projected to range from 2,100 to 4,300 in 2025 and from 6,700 to 11,300 for 2050. (Ostro 2009, 2011; BAAQMD, 2010).

25.3.1. In the California heat wave of 2006, there were an estimated 655 excess deaths (an average 6% increase), 16,166 excess ED visits, and 1,182 excess hospitalizations statewide. (Knowlton, 2009)

25.3.2. Mortality in Alameda County may increase 9.8% for every 10^{o} F change in mean daily temperature, with an excess mortality risk of 5.1% for people > 65. (Ostro, 2011)

25.3.3. Respiratory and cardiovascular hospital admissions in Alameda County may increase 2.6% and 1.4% per 10^{o}F increase in mean daily temperature. (Ostro,2011)

Table 5 Climate change impact summary

Health effects of heat exposure	
• Extreme heat events – especially those above temperatures a population is accustomed to – result in more fatalities than any other weather-related phenomenon, due to heat stroke/exhaustion, heart attack, stroke, respiratory disease, and dehydration. Oakland is considered the most vulnerable to heat in the Bay Area. • By 2050, mortality caused by an extreme heat event may increase 2-3 fold in California urban centers (CCCC, 2012; Basu and Ostro, 2008a, 2008b). Annual premature mortality due to extreme heat in California is projected to range from 2,100 - 4,300 in 2025 and from 6,700 - 11,300 in 2050. Mortality in Alameda County may increase 9.8% for every 10^{o}F change in mean daily temperature, with an excess mortality risk of 5.1% for people > 65. Respiratory and cardiovascular hospital admissions in Alameda County may increase 2.6% and 1.4% per 10^{o}F increase in mean daily temperature.	(CDC, 2012; Basu and Ostro, 2008a, 2008b; California Energy Commission, 2012; CCCC, 2012; CDC 2012; Ostro, 2009, 2011; Reeves et al., 1994; USGCRP, 2016; US EPA, 2016a)
Impacts from rising sea levels and extreme weather	
• 3,100-5,200 Oakland residents are at risk of flooding in coming decades due to higher storm surges, extreme precipitation events, and sea-level rise. Resulting effects include traumatic injury and death, mental health disturbances (anxiety, stress-related trauma), increased infection, communicable disease and other illness per contact with contaminated and toxic run-off, displacement, and disrupted access to safe food, water and essential services. • Consequences of climate effects on water quantity and distribution due to extreme precipitation, flooding and droughts may include increases in vector and water-borne disease incidence and prevalence. Drought, snow melt, and ground water depletion independently and together can affect the availability of clean and safe water for drinking and basic hygiene, increasing risk of infection and spread of disease. • The agricultural effects of drought will lead to higher food prices and food insecurity, along with the diet-related conditions that follow (hypertension, diabetes, etc.). Drought furthermore increases the likelihood of communicable illness spread.	(Cal-Adapt; CCCC, 2012; CDC, 2010; City of Oakland, 2016b; City of Oakland, 2016a; Howitt, 2015; Pacific Institute 2014; San Francisco Bay Conservation and Development Commission, 2011; USGCRP, 2016; EPA, 2016a)
Health outcomes of temperature interaction with ozone and particulate matter pollution	
• Temperature rises accelerate ozone production more in already polluted areas, and air pollution has more severe effects on those with underlying illness. West and East Oakland's high existing air pollution and prevalence of chronic disease makes them especially vulnerable to climate-related increased air pollution. Increased ozone exposure due to rising temperatures will increase the 8,800 deaths that already occur each year in California due to ozone and particulate matter exposure. Ozone pollution also induces respiratory irritation, impaired lung function, aggravation of asthma, allergies, and other lung diseases, heart attacks, and stroke. • Rising temperatures due to greenhouse gases can independently cause excess mortality from ozone and particulate matter exposure: Excess annual air pollution deaths due solely to GHG-related temperature rise may reach roughly 400 ozone-attributable and 600 PM2.5-attributable deaths in the U.S. per 1^{o}C increase. • Temperature rise increases wildfires and resulting air pollution, especially PM2.5, leads to respiratory illness, cardiovascular illness, and premature mortality.	(CCCC, 2012; EPA, 2013; EPA, 2016a; Jacobsen, 2008)

26. Ozone-related mortality and morbidity will increase

26.1. The health impacts of ozone include respiratory irritation, impaired lung function, increased susceptibility to respiratory infections, aggravation of asthma, allergies, and other lung diseases, cardiovascular disease including heart attacks and stroke, and premature death. (EPA, 2013)

26.2. Rising temperatures due to climate change can cause excess mortality associated with interactions between ozone and particulate matter exposure. Excess annual air pollution deaths due solely to GHG-related temperature rise may reach roughly 600 PM2.5-attributable and 400 ozone-attributable deaths in the U.S. per $1^{o}C$ increase. (Jacobsen, 2008) In one study, it was projected that by the 2020s, climate change could cause a 7.3% increase in regional summer ozone-related asthma emergency department visits for children aged 0–17 years (across the New York metropolitan region). (Sheffield, 2011)

26.3. Those most vulnerable to ozone's effects are children and teens, elderly over 65; people who work or exercise outdoors; people with existing lung diseases, such as asthma and chronic obstructive pulmonary disease; and people with cardiovascular disease. However, even healthy individuals can experience chest pain, coughing, nausea, and pulmonary congestion when exposed to ground-level ozone. (ALA, 2016; EPA, 2014)

27. Oakland residents face an increasing risk to their health and safety from flooding linked to sea level rise, storm surges, and extreme precipitation.

27.1. An estimated 3,100-5,200 Oakland residents[22] are at risk of flooding in coming decades due to higher storm surges, extreme precipitation events, and sea-level rise. (Pacific Institute, 2014) Likely effects of these scenarios include traumatic injury and death, mental health disturbances (anxiety, stress-related trauma), increased infection and communicable disease, displacement, job loss, and disrupted access to safe food, water and essential services. (City of Oakland, 2016a; Pacific Institute, 2014)

27.2. The availability of safe food and drinking water may be limited, and hospitals, emergency services and communications infrastructure may be disabled or hampered. Disruption may be at a city-wide level. (City of Oakland 2016a)

27.3. Previous floods in Oakland have led to extensive exposure to water contaminated with toxic waste and / or pathogens. These exposures can increase risk for cancer or

[22] Oakland residents living in West Oakland, Chinatown, San Antonio, Fruitvale, Central East Oakland, and Elmhurst districts will experience the most exposure to flooding in the future. (Pacific Institute)

other diseases, or promote spread of infectious disease. In particular following power outages, there can be increases in stomach and intestinal illness. (EPA, 2016a)

27.4. Emergency evacuations pose health risks to older adults and others who may be unable to access evacuation routes or have difficulty in understanding or receiving warnings of impending danger. (EPA, 2016a)

28. Changes in water quantity and distribution through extreme precipitation and flooding (compounded by interaction with droughts) may increase water-borne disease incidence and prevalence.

28.1. People become ill if they come into contact with contaminated drinking or recreational water. Health impacts may include gastrointestinal illness like diarrhea, effects on the body's nervous and respiratory systems, or liver and kidney damage (USGCRP, 2016; EPA, 2016a)

28.2. Climate effects on the distribution and quality of surface water can impede personal hygiene and impair local sewage systems. (USGCRP, 2016; EPA, 2016a) Natural events (e.g., floods, storms, heavy rainfall, and snowmelt) often can wash fecal matter into potable water. (USGCRP, 2016; EPA, 2016a).

29. Health effects of drought, snow melt, and ground water depletion on Oakland

29.1. Drought, snow melt, and ground water depletion independently and together can affect the availability of clean and safe water for drinking and basic hygiene, increasing risk of infection and spread of disease. (CDC, 2010)

30. Rising CO_2 and climate change will affect the quality and distribution of food, with subsequent effects on food safety and nutrition. (USGCRP, 2016)

30.1. Drought and extreme weather events can reduce crop yield. Drought and heat also affect the health of livestock and levels of livestock milk production. Related increases in food prices lead to increases in food insecurity, which in turn is associated with increased risks of chronic diseases such as diabetes, obesity, and hypertension. Food insecurity disproportionately impacts poor people. (USGCRP, 2016; EPA, 2016a)

30.2. Higher air and water temperatures foster more rapid growth of microbial organisms such as Salmonella or Vibrio that cause food and water-borne illnesses. (Tirado, 2010; USEPA, 2016a) Higher sea surface temperatures will lead to higher mercury concentrations in seafood, and flooding can introduce contaminants into the food chain through stormwater runoff. (USEPA, 2016a)

30.3. Higher atmospheric concentrations of carbon dioxide are associated with lower levels of protein and essential minerals in crops such as wheat, rice, and potatoes. (USEPA, 2016a)

31. Wildfires and their associated air pollution can cause deaths, injuries, and eye, respiratory, and cardiovascular illnesses– in Oakland.

31.1. Community smoke exposure from wildfires – even when the fire occurs remotely – has been associated with increased emergency department visits and hospital admissions for chronic obstructive pulmonary disease (COPD), bronchitis, asthma, and chest pain. (Ginsberg, 2008) Through a meta-review, a study found very strong evidence linking fire smoke with increased risk of respiratory and cardiovascular diseases and found that children, the elderly and those with underlying chronic diseases appear to be highly susceptible. (Liu, 2015) Exposure to wildfire smoke can increase mortality: an Australian study found a 5% increase in non-accidental mortality and a 10% increase in cardiovascular mortality following exposure to wildfire (bushfire) smoke. (Johnston, 2008)

31.2. After the 2003 Californian wildfires, average increases of 70 microg/m(3) PM(2.5) were associated with 34% increases in asthma admissions. For every 10 microg/m(3) wildfire-related PM(2.5) exposure, there were increases in hospital admissions of: 9.% for acute bronchitis; 6.9% for chronic obstructive pulmonary disease (COPD) among 20-64 year olds; 6.4% for pneumonia in 5-18 year olds. There was a 6.1% increased rate of admission for cardiovascular complaints, including an 11.3% increased rate of admission due to cardiac failure. (Delfino, 2003) Effects can be immediate or present after several weeks. (Moore, 2006)

32. Climate change impacts mental health.

32.1. Experiencing an extreme weather event can cause acute stress, post-traumatic stress disorder, anxiety, depression, and other mental health consequences, particularly when a person loses livelihoods, loved ones, homes, and communities. Even the perceived threat of climate change (for example from reading or watching news reports about climate change) can influence stress responses and mental health. (USGCRP, 2016)

32.2. Some groups of people are at higher risk for mental health impacts, such as children and older adults, pregnant and post-partum women, people with pre-existing mental illness (see above), people with low incomes, and emergency workers. (USGCRP, 2016)

33. Global warming may affect seasonality (increase duration or altered timing) of certain allergic respiratory disorders, triggering asthma and hay fever (IPCC, 1997).

33.1. Allergic illnesses, (e.g., hay fever), affect about one-third of the U.S. population; more than 34 million Americans have been diagnosed with asthma (EPA, 2016a).

34. Changing climate conditions may lead to changes in the distribution of disease-carrying vectors such as ticks and mosquitos, with subsequent changes in the occurrence of vector-borne diseases such as dengue fever, west nile virus, or zika.

34.1. In California, the dengue and zika mosquito is now present in multiple counties.

35. Some populations in Oakland will be disproportionately vulnerable to these adverse health outcomes.

35.1. While the health impacts of climate change affect all Oakland residents, residents of West Oakland, especially in neighborhoods adjacent to the former Oakland Army Base, are at increased risk due to preexisting health conditions, higher exposure to environmental hazards (such as heat islands and housing in rising sea-level and flood zones), social, economic and demographic factors, and more limited adaptive capacity (California Energy Commission, 2012). West Oakland – and East Oakland – will disproportionately bear environmental exposures and morbidity/mortality burdens due to climate change.

35.2. ***Vulnerability to heat:*** Outdoor workers, homeless, the elderly, low-income people who lack access to air conditioning (or cannot afford to turn it on), young children, pregnant women, people with pre-existing chronic illness, and those who take certain medications are all more vulnerable to adverse health consequences of heat. (USGCRP, 2016)

35.2.1. Heat aggravates existing medical problems in vulnerable populations (Canadian Global Change Program, 1995). For example, mortality during oppressively hot weather is associated predominantly with preexisting cardiovascular, cerebrovascular, and respiratory disorders, as well as accidents. (Haines, 1993; IPCC 1997)

35.2.2. Lower income populations have less access to resources that can offset heat and its related illnesses, including the ability to afford air conditioning and associated electric costs. Modeling of heat-associated mortality finds a significant protective benefit to air conditioner ownership, where a 10% increase in air conditioning prevalence reduced the temperature mortality co-efficient by 1.4% (Ostro 2011). Additionally, lower income populations often lack the medical coverage needed to receive prompt treat ment for a heat-related medical condition. (Pacific Institute, 2012) West Oakland has some of the highest levels of poverty in the Bay Area.

35.2.3. People that live in urban heat islands - areas with dense building, high concentrations of impervious surfaces, low tree canopy, and little green space - are at particular risk of heat illness. (USEPA, 2016h) Oakland has several areas in the flatlands with these characteristics.

35.2.4. In temperate coastal regions such as Oakland, excessive heat is infrequent and populations accordingly are less acclimated and less likely to have air conditioning or be familiar with how to protect themselves during a heat wave. (WHO, 2003)

35.3. ***Vulnerability to poor air quality:*** People most at risk for adverse health consequences of increased ozone exposure include people with asthma and other respiratory diseases (e.g. COPD, emphysema), people with cardiovascular disease, children, older adults, and people who are active outdoors, especially outdoor workers. (EPA, 2013)

35.4. ***Vulnerability due to living in already polluted settings:*** Those living in neighborhoods with higher levels of air pollution - such as West Oakland - are more at risk, in part because of their higher prevalence of pollution-related chronic illness. (Jacobsen, 2008)

Description of submitted evidence

Five submissions were made to the city that provided documentation of the relationship between the export and combustion of coal, the association with climate change, and the impact on health and safety. The evidence provided in these submissions is included in our briefs, along with findings from supplemental review.

Substantiated points made	**EJ**	**SC**	**NCOI**	**Fox**	**UCS**
Coal export will lead to coal combustion and increased greenhouse gas emissions, with direct local and global climate change consequences	x	x		x	x
Coal export is inconsistent with state, regional, and local climate and air quality policies	x		x	x	x
Climate change and related health impacts in Oakland are and will be significant	x	x	x		x
Health impacts will relate to sea level rise, water shortages, temperature rise, air pollution, their interaction, and more		x	x		x
The cumulative greenhouse gas emissions of the project will be significant on a global scale		x	x		x
This issue is urgent and international commitment involves the whole world community – from global to local	x	x	x		x
Prohibiting transport, storage and handling of the Utah coal as proposed is an effective way to partially protect Oakland from climate change impacts		x			x
There is no established or meaningful mitigation of the climate impacts this coal will have (e.g., no clean coal, no supplanting dirtier fuel, etc.)	x				x

EJ = Irene Gutierrez, Earth Justice on behalf of Sierra Club, West Oakland Environmental Indicators Project, Communities for a Better Environment, San Francisco Baykeeper (Letter dated 9/2/15)

SC = Deborah Niemeier of Sustainable Systems Research, LLC for Sierra Club (Report submitted 9/21/15)

NCIO = No Coal In Oakland (Letter dated 9/18/15)

Fox = Phyllis Fox for Sierra Club (Report submitted 9/21/15)

UCS = Laura Wisland, Union of Concerned Scientists (Letter dated 9/18/15)

Chapter 9: Noise Effects of Coal Transport and Handling in Oakland

Key Points and Summary of Submitted Evidence

Two documents submitted to the Council for its 9/21/2015 hearing on the Army Base Gateway Redevelopment Project addressed noise levels that would be generated through the export of coal through Oakland:

- The Human Health Effects of Rail Transport of Coal Through Multnomah County, Oregon (Multnomah County Health Department 2013)
- Environmental, Health and Safety Impacts of the Proposed Oakland Bulk and Oversized Terminal by Phyllis Fox, PhD for Sierra Club (Fox 2015)

Conclusions were generally grounded in scientific literature, especially when documenting a range of health effects due to noise exposure.

The main points made in the submissions included:

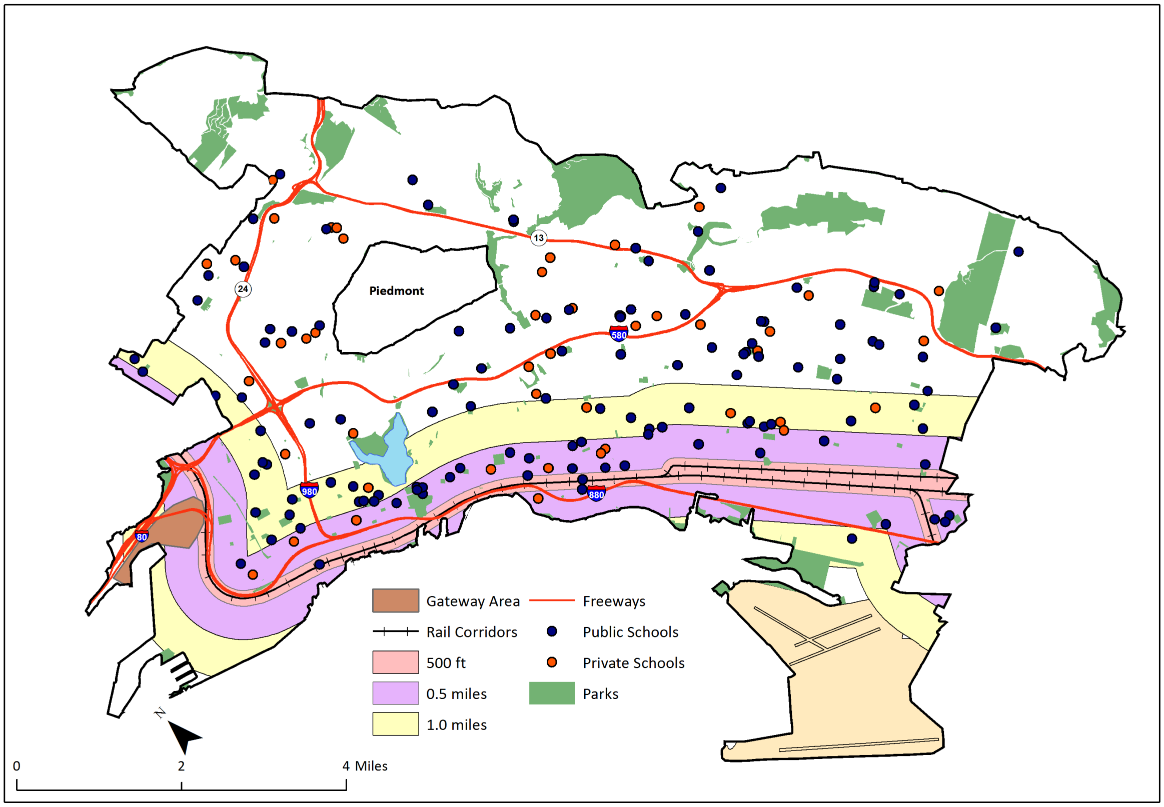
- Coal transport will likely generate pronounced noise
- Noise is implicated in a wide range of adverse health effects
- Cumulative health effects are likely

Additionally, from further analysis, we find that:

- Baseline noise exposure in much of West Oakland already exceeds levels considered compatible with residential usage, and current noise levels are already sufficient to interfere with activity and learning, as well as impair sleep.
- West Oakland will experience increased noise exposure pursuant to OBOT's addition of coal train activity.
- An increased proportion of people, in a larger geographic area, may experience higher risk for a greater number and / or severity of adverse health effects, including:
    - serious annoyance, sleep disturbance, speech disturbance, activity interference, myocardial infarction risk, learning and functioning disturbance (depending upon quality of indoor / classroom acoustics), and possibly hearing deficits
- Several sensitive areas are within the boundaries of anticipated exposure (Figure 1).
    - Raimondi Park is very close to the tracks and is heavily utilized, mostly by children. Roughly 27,375 people visit Raimondi per year, with 54,750 person hours of potential exposure each year.

Details and citations supporting these statements are included in the review below, combining both those that were submitted along with additional information and citations identified by the panel through supplemental review.

Figure 1 Coal corridors in terms of distance from rails, Oakland



Source: CAPE, with rail data from CalTrans, parks data from CPAD 2015b, Gateway area from Oakland Redevelopment Agency, schools from CDE.

Findings

1. **Noise is an environmental stressor that activates physiological responses which in turn can adversely impact health (Ising and Braun 2000). Noise can also directly impact hearing.**
2. **Characteristics of noise, the exposure setting, and the person experiencing the noise influence its impact.**

   2.1. Impact on health can vary (1) by *noise characteristics* including sound level, objective noise volume, intensity, duration, continuity, and contrast to ambient / background noise; (2) by *the exposure setting* including time of day that noise is experienced, the distance from source, and wind gradient; (3) by the *functional context*, such as if heard in a hospital or school; and (4) by *subjective perception* of the noise based upon an individual's characteristics. (Münzel et al. 2014) See Table 1 for definitions of acoustical terms.

Table 1: Definition of Acoustical Terms

Term	Definitions
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, Leq	The average A-weighted noise level during the measurement period. The hourly Leq used for this report is denoted as dBA Leq(h).
Lmax, Lmin	The maximum and minimum A-weighted noise level during the measurement period.
L01, L10, L50, L90	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, Ldn or DNL	The equivalent noise level for a continuous 24-hour period with a 10-decibel penalty imposed during nighttime and morning hours. (10:00 pm to 7:00 am).
Community Noise Equivalent Level, CNEL	CNEL is the equivalent noise level for a continuous 24-hour period with a 5-decibel penalty imposed in the evening (7:00 pm to 10:00 pm) and a 10-decibel penalty imposed during nighttime and morning hours (10:00 pm to 7:00 am).
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Harris, Handbook of Acoustical Measurements and Noise Control, 1998.

3. **Noise is implicated in a wide range of adverse health effects.**

3.1. Chronic exposure to moderate levels of noise, below levels that cause hearing loss, can lead to a diverse set of health and physiological impacts in the general population. (Passchier-Vermeer and Passchier 2000)

3.2. Transportation-related noise causes loss of 1 million healthy years of life annually in Europe — a disease burden second only to air pollution. (Hänninen et al. 2014)

3.3. Cumulative environmental noise exposure is responsible for 61,000 disability-adjusted life years (DALYs) due to ischemic heart disease, 45,000 DALYs due to cognitive impairment in children, and 22,000 due to tinnitus. (WHO 2011)

3.4. Noise works through various mechanisms to cause adverse health effects, including:

3.4.1. *Auditory effects,* such as temporary or permanent hearing loss.

3.4.2. *Biological effects*, whereby noise, including environmental noise, induces the release of stress hormones that create responses such as inflammation and changes in heart rate, and are associated with cardiovascular disease, hypertension, arrhythmia, and myocardial infarction (Babisch et al. 1993, Babisch 2000, 2005, 2006, van Kempen et al. 2002, Stansfeld and Matheson 2003, de Kluizenaar et al. 2009, Selander et al. 2009)

3.4.3. *Extra-auditory effects*, including annoyance and extreme annoyance, sleep disturbance and resultant fatigue, accidents, injuries, cognitive impairment and cardiovascular disease, cognitive impairment in children, exacerbation of mental health disorders (e.g. depression, stress, anxiety, psychosis), and activity interference (moderate levels of noise interfere with routine activities, including having a conversation, concentrating or working). (Passchier-Vermeer and Passchier 2000, Miedema and Oudshoorn 2001, de Kluizenaar et al. 2009, World Health Organization 2009, Basner et al. 2014, Hays et al. 2016). Definitions for selected non-auditory effects amongst those listed above are as follows:

3.4.3.1. *Annoyance*: Noise annoyance is defined as "a feeling of resentment, displeasure, discomfort, dissatisfaction, or offense when noise interferes with someone's thoughts, feelings, or actual activities" (Passchier-Vermeer and Passchier 2000). Annoyance is a very common response to environmental noise, producing feelings of anger, displeasure, anxiety, helplessness, distraction, and / or exhaustion (World Health Organization 2011). "Annoyance affects both the wellbeing and quality of life among populations exposed to environmental noise." (Hays et al. 2016)

3.4.3.2. *Sleep Disruption*: A common response to environmental noise that produces some of the most severe extra-auditory effects. (Muzet 2007, World Health Organization 2011, Hume et al. 2012)

3.4.3.3. *Cognitive Impairment in Children:* Children exposed to chronic transportation noise have deficits in reading and memory, suffering the resulting losses in school performance (Evans et al. 1998, Shield and

Dockrell 2003, Evans and Hygge 2007). For instance, in a study of rail and road noise, children exposed to noise levels of 62 dBA[23] (Ldn[23]) had deficits in memory compared to those exposed to 46 dBA (Ldn) (Lercher et al. 2003).

3.4.3.4. *Cardiovascular effects:* A meta-analysis of the relationship between noise exposure and heart disease found road traffic noise to be associated with higher risk for myocardial infarction and ischemic heart disease (van Kempen et al. 2002).

4. Levels of noise that can be generated by train operations correspond to documented levels of effect, for example:

4.1. *Annoyance:* Transportation noise has been ranked among the most significant causes of community dissatisfaction. On the aggregate, the level of high annoyance in a community averages 0 percent at 45 Ldn, approximately 10 percent at 60 Ldn, and escalates to 70 percent at 85 Ldn. (Federal Railroad Administration, accessed May 27, 2016)[24]

4.2. *Sleep Disruption*: Sleep disruption effects at various noise levels have been reported by the WHO as follows (World Health Organization 2009):

- Below 30 dBA: No sleep disruption effects are observed
- 30-40dBA: Modest sleep disruption occurs
- 40-55dBA: Many adverse health effects and coping behaviors occur (e.g., sleep disturbance, insomnia, and increased use of drugs)
- Above 55dBA: Disruption is of major concern and adverse health effects are frequent, accompanied by high annoyance and sleep-disturbed/deprived, along with risk of cardiovascular disease

4.2.1. An average nighttime noise level of 65 dB will result in self-reported disturbance of sleep in about 15% percent of the population, while a single noise event at 80 dB will result in awakenings in about a third of the population (World Health Organization 2009).

4.3. *Speech Interference*: The indoor threshold for speech interference is 45dBA for steady noise, and 55dBA for fluctuating noise; the outdoor threshold ranges from 60dBA – 70dBA. (Bhatia and Puccetti, 2015; US EPA, 1979)

4.3.1. Outdoor noise levels of greater than 72 dBA will prevent normal voice level communication at unprotected exterior locations, with .5 meters of distance between the speakers. (US EPA, 1979)

4.4. *Cardiovascular effects*: Moderate levels of traffic noise (>65 dBA) have been linked to both hypertension and ischemic heart disease. (Babisch 2008)

[23] For definition see **Table 1: Definition of Acoustical Terms**
[24] https://www.fra.dot.gov/Page/P0599

4.4.1. Community noise, including traffic noise above 50–60 dBA increases the risk of myocardial infarction and cardiovascular risk was found to increase with increasing daytime noise levels above 60 dBA. (Babisch 2005, 2006, 2008, Selander et al. 2009)

4.5. *Activity interference*: Activity is disrupted indoors at a level of 45dBA Ldn and outdoor at a level of 60 dBA Ldn. (Bhatia, 2015)

4.6. *Hearing loss*: Chronic or repeated exposure to sounds at or above 85 dB can cause hearing loss (National Institute of Deafness and Other Communication Disorders 2015). Decibels between 80-105 are labeled extremely loud, whereas those above 105 dBA are dangerous. (Coaltrain Facts, 2016)

5. United States local and state standards are not completely health protective according to World Health Organization guidelines (Human Impact Partners, 2011). WHO noise exposure thresholds are much lower, for example for levels inside (30 dBA) outside (50–55 dBA) homes, as well as for classrooms (35 dBA) (Human Impact Partners, 2011).

6. Certain populations may be more vulnerable to the effects of noise exposure.

6.1. *Children* are likely more vulnerable to negative cognitive effects (van Kamp and Davies 2013). Noise can be detrimental to comprehension, memory, and attention/perception (Haines et al. 2001a, 2001b). Children who are chronically exposed to noise may have impaired cognitive development and subsequent effects on educational attainment (World Health Organization 2011, Stansfeld and Clark 2015).

6.1.1. As an example of cognitive effects of noise, a California study found that at schools within 300 meters (984 feet) of the I-710 corridor, fewer students scored as proficient or advanced for reading (13% fewer) and math (11%) on the California Standardized Test for the 2008–2009 school year. (Human Impact Partners 2011)

6.2. *People with impaired capacity or cognition* may experience greater deficits (e.g. the elderly, mentally ill, depressed, students with learning difficulties, young children, and populations with low economic standing). (van Kamp and Davies 2013)

6.3. *People with pre-existing conditions* such as cardiovascular disease and tinnitus are more at risk for health effects of noise exposure. (van Kamp and Davies 2013)

7. Coal transport is likely to generate pronounced noise.

7.1. *Trains produce particularly disruptive noise* because human reaction to noise is influenced in part by the time between noises and the "difference in loudness between a noise event and background" (Berglund et al. 1999), and most train noise is in high contrast to typical ambient conditions (Multnomah County Health Department 2013)

7.2. *Unit coal trains are substantially longer and heavier, with several more engines than freight trains,* increasing the duration of disruption and possibly the loudness. (Fox, 2015)

7.3. *Terminal activity may produce a significant amount of noise* including moving rail cars into unloading stations and unloading them. (Multnomah County Health Department 2013, Fox 2015) (Fox & Multnomah submissions – further substantiate)

7.4. *Ship transit* for coal may involve larger ships and may also be a source of noise, however this factor has not been studied and requires further review.

Description of background (ambient) noise in West Oakland

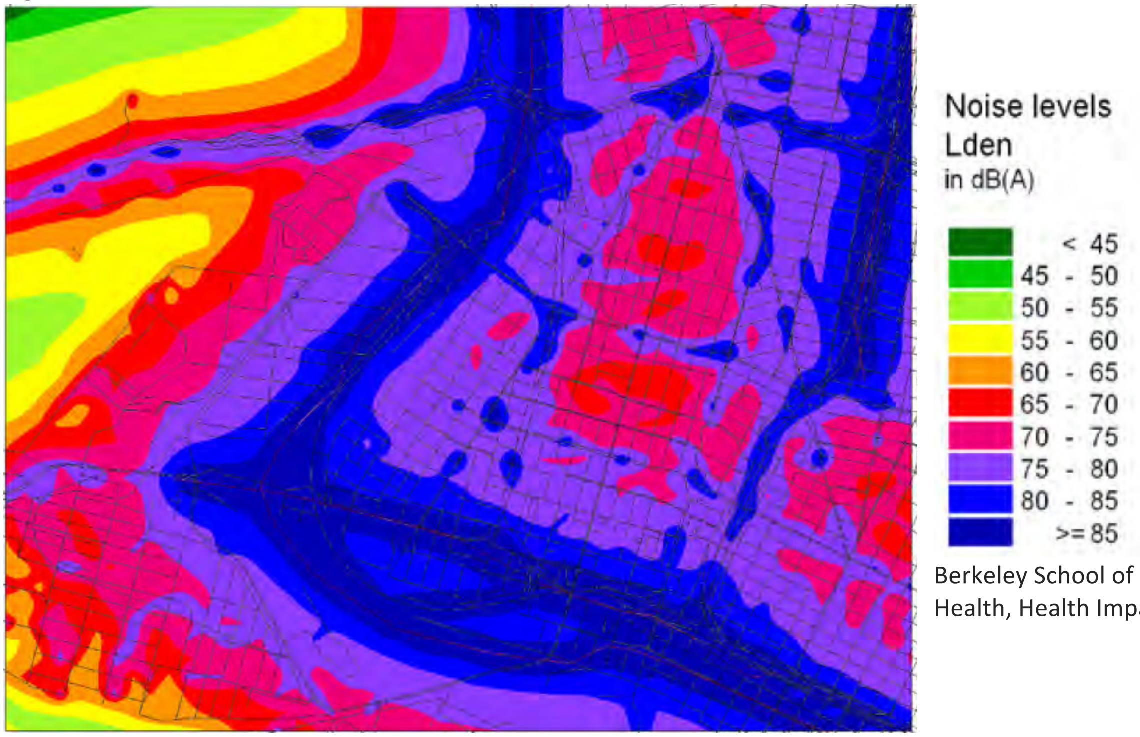
8. Baseline (ambient) noise conditions in West Oakland are high.

8.1. Transportation sources such as automobiles, trucks, and trains are the principal sources of noise in West Oakland. In addition to being subject to freeway traffic and BART noise, West Oakland is bordered on its south and west by the Union Pacific Railroad, BNSF Railroad, associated railyards, and Port of Oakland intermodal facilities, all significant noise sources affecting surrounding areas. (Lamphier-Gregory et al. 2014)

8.2. The West Oakland Specific Plan Draft EIR looked across several previous noise assessment studies in West Oakland or analogous settings (e.g., Jack London Square) to establish ambient noise levels. On the aggregate, these noise studies indicate that noise levels near unprotected major transportation sources range from CNEL 68 – 72 dBA and areas away from these sources are generally less than 65 dBA. (Lamphier-Gregory et al. 2014)

8.3. A 2010 Health Impact Assessment (HIA) for the Port of Oakland conducted by the UC Berkeley Health Impact Group estimated that the majority of West Oakland residents are exposed to ambient noise levels of 75 dB Ldn or higher based on existing conditions (See Figure 2 and Table 2). (UC Berkeley Health Impact Group (UCBHIG) 2010)

Figure 2 West Oakland Noise Contours, Port of Oakland HIA 2010



Source: UC Berkeley School of Public Health, Health Impact Group

Table 2 West Oakland Population Exposure to Various Noise Levels

dB	Population Exposed	Percent of Total Population
60	247	1%
65	2,110	9%
70	6,169	25%
75	9,696	40%
80	4,707	19%
85+	1,520	6%
Total	24449	

Source: UC Berkeley Health Impact Group (UCBHIG), *Health Impact Assessment of the Port of Oakland*, University of California, Berkeley, CA, March 2010.

9. Baseline noise conditions in West Oakland are already associated with adverse health and social effects, and in some areas are already incompatible with residential development (See Table 3 for Oakland Land Use Noise Compatibility Guidelines)

9.1. The West Oakland Specific Plan Draft EIR found several areas near existing transit corridors to be “generally incompatible with residential and other noise-sensitive uses,” and that of the remaining noise environments, most are considered only conditionally acceptable for residential uses (Lamphier-Gregory et al. 2014). Similarly, the Port of Oakland HIA indicates that 90% of West Oakland inhabitants live in an ambient environment of Ldn 65 dBA or higher (see Figure x and Table 7, adapted from UC Berkeley Health Impact Group (UCBHIG) 2010).

9.2. The Port of Oakland HIA (UC Berkeley Health Impact Group (UCBHIG) 2010) estimated that at baseline, in West Oakland:

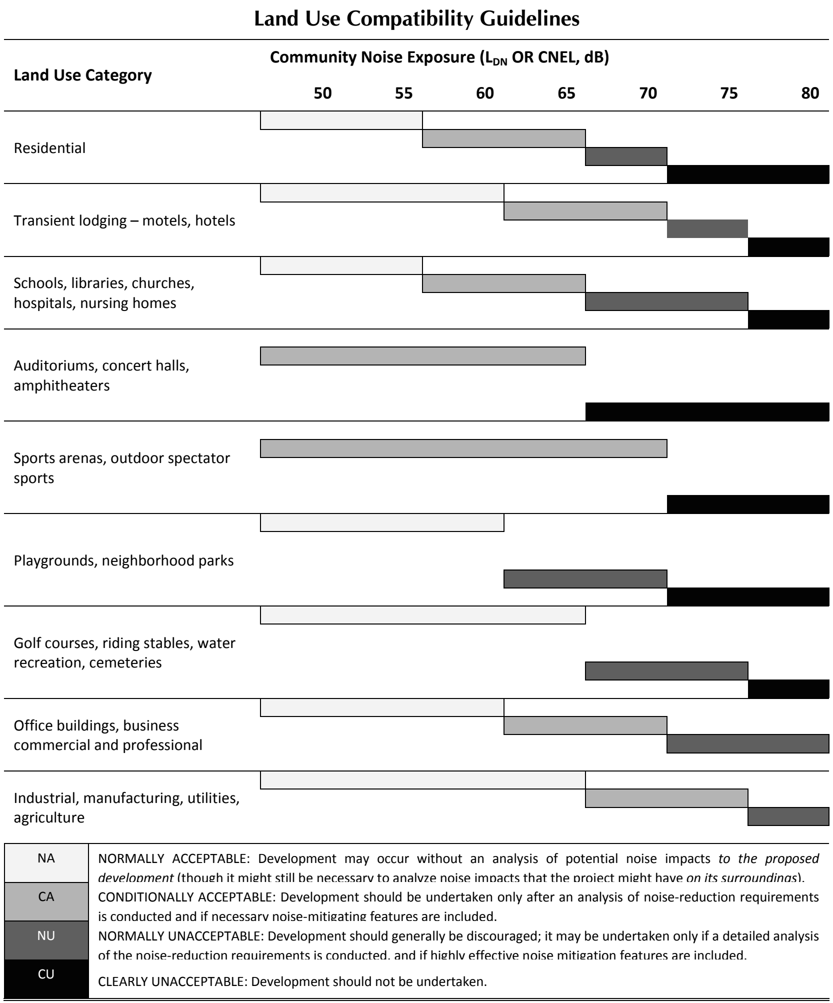
9.2.1. Greater than one in three residents are likely to be highly annoyed by noise.

9.2.2. 8 myocardial infarction deaths (15 percent of all myocardial infarction deaths) per year may be associated with noise exposure.

9.2.3. Approximately one third of residents may be at risk of sleep disturbance.

9.2.4. With an average noise exposure of 74 dB, West Oakland residents face risk of a 29 percent impairment in recall and reading, and a 4 percent impairment in recognition and attention relative to a typical 60 dB residential environment.

Table 3 Oakland General Plan Noise Guidelines for Land Use



Source City of Oakland General Plan

10. There are likely to be cumulative health impacts associated with the proposed coal export, which could involve up to 4 round trips per day of mile-long trains

10.1. Cumulative health impacts occur in part because biological / non-auditory effects (e.g., increased blood pressure, increased heart rate, vasoconstriction, changes in respiration, and arrhythmia) continue to have deleterious effects on human health even after a person "gets used to" the noise (Human Impact Partners 2011). Bhatia states that there is "no evidence that humans develop a physiologic tolerance to noise." (Bhatia and Puccetti, 2015)

10.2. Transportation-related noise in western Europe accounted for the cumulative loss of 903,000 DALYs due to sleep disturbance and 587,000 DALYs due to interference with normal function and activities. (World Health Organization, 2011)

10.3. Long term exposure to noise from road, rail, and air traffic results in physiological and psychological stress including elevated blood pressure, hypertension, ischemic heart disease, and stroke. (Münzel et al. 2014, Halonen et al. 2015, Vienneau et al. 2015)

10.4. Impact of this transient noise will be most significant when experienced during sleeping hours and for sensitive receptors, for example children in school or elderly.

Noise Exposure Assessment

11. Populations near the rails will be subject to two cumulative exposure scenarios:

11.1. The accumulation of noise exposure to trains passing through the neighborhood - annually and over the course of the 66-year lease - will create conditions of chronic noise exposure.

11.2. Noise from round-trip coal trains blasting 110 dB horns at each of 55 at-grade crossings (as per federal law[25]), will accumulate to 2 hours per day[26] of very loud noise throughout the region according to Fox's report. (Fox, 2015)

12. Extrapolating from a prototype sound study of coal trains in Washington State (Bhatia and Puccetti, 2015) (see chapter appendix), we can estimate that noise exposures will reach levels of observed effect and/or exceed established noise standards in both exposure scenarios: near or not near an at-grade crossing (horn blast). See Table 4 for noise estimated noise exposures.

---

[25] Federal regulation requires locomotive horns be sounded for 15-20 seconds before entering all public grade crossings, but not more than one-quarter mile in advance.
https://www.up.com/real_estate/roadxing/industry/horn_quiet/index.htm
Field measurements show an average Reference SEL of 107 dBA at 100 feet from the track increasing to 110 dBA at 110 feet from the at-grade roadway crossing.

[26] Daily duration of train noise: 20-seconds/sounding x 55 at-grade crossings x 6 (one-way x 3 round-trip train trips/day = 6,600 seconds= 1.83 hours of noise per day that is in contrast to background (meaning greater detrimental impact). By extrapolation, the regional loud episodic sound exposure would be 670 hours per year, and roughly 4400 hours over the course of the lease.

12.1. This assessment assumes 4 new coal trains (this parameter is the maximum for the project, but allows us to extrapolate from the Washington study). For sensitivity analysis, upper and lower limits are as follows:

12.1.1. *Lower limit:* Bellingham exposures, since ambient Ldn is lower than West Oakland's, but more closely approximates Oakland in terms of total train activity.

12.1.2. *Upper limit:* Cheney exposures, since Cheney's ambient Ldn is closer to West Oakland's, but the total train activity is higher.

Table 5 Extrapolated estimates of cumulative noise exposure pursuant to adding OBOT coal trains, associated health effects, and sensitive receptors – <u>distal / proximate to horn blast (per at-grade crossing)</u>

	100 ft	**250 ft**	**500 ft**	**1,000 ft**	**2-4,000 ft**
Bellingham Ambient Ldn	75 / 79	65 / 71	60 / 67	56 / 62	55
Cheney: Ambient Ldn	80 / 83	74 / 77	65 / 71	60 / 67	56/61
Health effects	Serious annoyance, sleep disturbance, speech disturbance, activity interference, MI risk, possible learning and functioning disturbance, depending upon quality of indoor / classroom acoustics				
	significant speech disturbance (>65), (hearing loss at >70-75)				
Sensitive Receptors West Oakland		Residential (East Oakland)	Residential	Raimondi Park, Willow Park	Prescott Elementary, St. Patrick, St. Martin de Porres, DeFremery Park, (McClymond High)*

*Note that McClymond High is about 4,200 feet and the West Oakland Senior Center is about 5,200 feet from the tracks. At the same time, the WHO set an indoor threshold of 30 dBA above which speech intelligibility and learning disruption can occur, and so it's possible that with an outdoor level of 50 dBA that some portion of the campus experiences levels of nose that can disrupt learning.

13. Those who must be in proximity to the coal export activities will experience the greatest exposure to noise (while also being exposed to the greatest amount of air pollution – these two exposures may interact, although the science is still emerging).

13.1. In particular, residents in proximity to the tracks and terminal (especially in poor quality housing), children who must attend school, people in nearby care facilities, and people seeking accessible recreational space close to the railway and terminal have greater exposure.

13.2. Workers at the site and on the rails also have greater exposure.

13.3. <u>*Athletes, especially the many youth athletes, who share Raimondi Park will have very high levels of combined noise and air pollution given their very close proximity to the tracks, with a high number of sensitive receptors (i.e. children and athletes).*</u>

13.3.1. Raimondi Park is heavily used, year round. Outside of summer months, a combination of teams uses the fields 4-10P on weekdays and 8A – 10P on weekends. During summer months, the hours of use begin at 9A. Assuming roughly 75 people per day use the fields 365 days / year = 27,375 visits per year at Raimondi. At usually 2 hours per visit (though some staff are there much longer), that's 54,750 person hours of potential exposure per year.

13.3.2. East Bay United (EBU) Soccer Club is one of the heavy users of Raimondi Park, cataloguing almost 23,000 person hours of exposure per year. Calculations are as follows:

13.3.2.1. January 1 – June 15: 75 people/day, 2 hrs per practice/day, 5 days / week, 375 people/week, 750 person hours / week, 22 weeks, approximately 16,500 person hours / year

13.3.2.2. Sept. 1 – Dec. 15: 75 people/day, 2 hrs per practice/day, 2 day/week, 150 people / week, 300 person hours / week, 14 weeks approximately 4,200 person hours / year

13.3.2.3. Summer camps – 7 hours/day x 75 people / day x 4 weeks = 2,100 person hours / year

13.3.3. Other groups that also use the field include: East Bay Warriors Football Teams, BASAC Charter School, EBSSL Adult Soccer League, and Oakland Youth Rugby.

Noise Impact Assessment

14. The prototype study (Bhatia and Puccetti, 2015) applied exposure estimates and the following exposure response functions to estimate the percent of the population that would be affected by activity interference (per annoyance) and sleep disturbance.

14.1. Percent of exposed who are highly annoyed by the increase in train noise with a threshold of 42 Ldn (Miedema and Oudshoorn 2001):

$$(7.158 \times 10^{-4} (Ldn - 42)^3 - 7.774 \times 10^{-3} (Ldn - 42)^2 + 0.163 (Ldn - 42))$$

14.2. Percent of exposed who experience highly disturbed sleep per the increase in train noise with threshold 42 L_{night} (Miedema and Vos 2007):

$$(11.3 - 0.55 (L_{night}) + 0.00759 (L_{night})^2)$$

15. An increased proportion, in a larger geographic area, would experience health effects related to the OBOT train activity (Table 6).

15.1. West Oakland's current noise exposure is already sufficient to interfere with activity and learning, as well as impair sleep. Exposure levels and health effects would worsen with incremental increases in rail freight transport of coal.

Table 5 Extrapolated estimates of possible cumulative impacts of noise pursuant to adding OBOT coal trains, associated health effects, and sensitive receptors – distal / proximate to horn blast (per at-grade crossing)

Impact	100 ft	250 ft		500 ft	1,000 ft	2-4,000 ft
	Bellingham –" lower limit"					
% Experiencing disturbed sleep	9.0 / 11.0	5.0 / 7.5		3.4 / 5.7	2.3 / 4.2	~2 / ~2.5-3
% Experiencing activity interference	22.7 / 30.7	7.9 / 15.9		4.5 / 10.0	2.9 / 6.2	2.5 / ~3 - 4
	Cheney – "upper limit"					
% Experiencing disturbed sleep	12.2 / 14.0	9.0 / 10.6		5.3 / 7.7	3.2 / 5.6	~2.2 / 3.7-2.8
% Experiencing activity interference	34.3 / 44.1	20.8 / 27.8		8.7 / 16.3	4.5 / 10.1	2.8-3.6 / 2.7-5.2

16. Noise mitigation options are available, but generally prove expensive.

16.1. To mitigate train noise, some cities have established quiet zones, in which safety modifications are made to public crossings to exempt trains from horn-blowing. However, these measures are expensive and shift liability from the railroad to the city. (Coal Train Facts 2012)

16.2. Prohibition of train movement outside of working hours would provide some noise relief and decrease sleep disturbance.

16.3. Maximum allowable noise levels should be adjusted down when sensitive receptors, such as schools and hospitals are present.

16.4. Physical improvements to the environment, such as sound walls, and use of sound-absorbing materials can decrease levels of noise exposure.

16.5. Title 24 of the California Code of Regulations provides for noise insulation standards for residential buildings, and can be applied when new housing is developed near the rails and terminal. Residences must be designed to limit interior noise to no more than a Ldn of 45 dB (UC Berkeley Health Impact Group (UCBHIG) 2010). This obligation would lead to an additional cost for housing developers in the future.

APPENDICES

Appendix Chapter 1: Resiliency, Vulnerability and West Oakland

References

Alameda County Public Health Department. 2008. Life and Death from Unnatural Causes: Health and Social Inequity in Alameda County.

California Department of Public Health. 2016. California Environmental Health Tracking Program Data, Asthma and Heart Attack emergency room visit age-adjusted rates by race/ethnicity, 2011-2014.

Cambridge Systematics, Inc. 2015. Alameda County Goods Movement Plan, Task 4B: Strategies Evaluation.

Committee on Increasing National Resilience to Hazards and Disasters. 2012. Disaster Resilience: A National Imperative. Washington, D.C.: National Academies Press.

Communities for a Better Environment. 2010. East Oakland Diesel Truck Survey Report.

Crimmins A, Balbus J, Gamble JL, Beard CB, Bell JE, Dodgen D, Eisen RJ, Fann N, Hawkins MD, Herring SC, Jantarasami L, Mills DM, Saha S, Sarofim MC, Trtanj J, Ziska L. 2016. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment, Chapter 9: Populations of Concern.

English PB. 2015. Public Health Impacts of Coal Exports at the Former Oakland Army Base.

Garzón-Galvis C, Harris L, Levitt Z, Ratner J. 2016. Making a good move for health: A health impact assessment of select strategies of the Alameda County goods movement plan.

Gutierrez I. 2015a. Re: Proposed Oakland Coal Export Terminal.

IPCC, Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B, Kissel ES, Levy AN, MacCraken S, Mastrandrea PR, White LL. 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

LSA Associates. 2012. 2012 Oakland Army Base Project Initial Study / Addendum.

Morello-Frosch R, Zuk M, Jerrett M, Shamasunder B, Kyle AD. 2011. Understanding The Cumulative Impacts Of Inequalities In Environmental Health: Implications For Policy. Health Affairs 30: 879–887.

Multnomah County Health Department. 2013. The Human Health Effects of Rail Transport of Coal Through Multnomah County, Oregon.

Niemeier D. 2015. Technical Memorandum: Air Quality, Climate Change, and Environmental Justice Issues from Oakland Trade and Global Logistics Center.

Roberts EM, English PB, Wong M, Wolff C, Valdez S, Van den Eeden SK, Ray GT. 2006. Progress in Pediatric Asthma Surveillance II: Geospatial Patterns of Asthma in Alameda County, CA. Preventing Chronic Disease.

Rubenstein G. 2014. Air Pollution Controversy Swirls Around Oakland Army Base Development. Available from: http://ww2.kqed.org/news/air-pollution-dispute-west-oakland-army-base/

Turner BL, Kasperson RE, Matson PA, McCarthy JJ, Corell RW, Christensen L, Eckley N, Kasperson JX, Luers A, Martello ML, Polsky C, Pulsipher A, Schiller A. 2003. A framework for vulnerability analysis in sustainability science. Proceedings of the National Academy of Sciences 100: 8074–8079.

U.S. Department of Health and Human Services. 2008. The Secretary's Advisory Committee on National Health Promotion and Disease Prevention Objectives for 2020. Phase I report: Recommendations for the framework and format of Healthy People 2020.

World Health Organization. 1948. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference.

Levels of use at Raimondi Field

Emailed communication

Raimondi is a very heavily used field essentially year round. EBU is one of the heavy users where essentially we have teams out there on Mondays and Wednesdays starting September 1 through December 15 from 4 – 9 PM. Number of players/coaches/parents that are out there for this time period is 75 per day or 150 for both days. We then have the field on M-F's from January 1 – June 15, again at 75 people/day or 375 people/week.

Other groups that also use the field include:

1. East Bay Warriors Football Teams
2. BASAC Charter School
3. EBSSL Adult Soccer League
4. Oakland Youth Rugby

These organizations plus our essentially use Raimondi from 4-10 PM weekdays and 8 AM – 10 PM on weekends. All of these groups have large numbers of participants in their permitted time slots. From my experience if you assume 75 people-day essentially 365 days/year = 27,375 people/year.

Nino Borsoni, PMP
Director, Field Operations
East Bay United Soccer Club
510.220.0559 Mobile

Appendix Chapter 2: Air Quality Particulate Matter

References

References for exposure assessment

Anenberg et al. (2010) Environmental Health Perspectives 118:1189-1195.

Fujita and Campbell (2010) West Oakland Monitoring Report, DRI.

Fujita et al. (2013) Journal of the Air & Waste Management Association, 63:1399-1411.

Fleischer et al. (2014) Environmental Health Perspectives 122:425–430.

Jaffe et al. (2014) Atmospheric Pollution Research 5:344-351.

Jaffe et al. (2015) Atmospheric Pollution Research 6: 946–952.

HEI Panel on the Health Effects of Traffic-Related Air Pollution (2010) Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. HEI Special Report 17. Health Effects Institute, Boston, MA.

Lim et al. (2012) Lancet 15(380):2224-60.

Multnomah County Health Department (2013) The Human Health Effects of Rail Transport of Coal Through Multnomah County, Oregon A Health Analysis and Recommendations for Further Action.

U.S. EPA (U.S. Environmental Protection Agency). 2009. Integrated Science Assessment for Particulate Matter (Final Report) EPA/600/R-08/139F.

References for health assessment

ARB (2002) California Air Resources Board. Staff Report.

Anenberg et al. (2010) **Environmental Health Perspectives** 118:1189-1195.

Basu et al. (2004) Journal of Exposure Analysis and Environmental Epidemiology 14:391–396.

Bell et al. (2013) American Journal of Epidemiology 178:865-876

Brook, R. D., et al. (2010) Circulation 121:2331–2378.

Hammer et al. (2014) Environmental Health Perspectives 122:115–119.

Jaffe et al. (2014) Atmospheric Pollution Research 5:344-351.

Lim et al. (2012) Lancet 15(380):2224-60

Link et al. (2013) Journal of the American College of Cardiology. 62:816-25.

Ljungman et al. (2008) European Heart Journal 29:2894-901.

Malig and Ostro (2009) Occupational and Environmental Medicine **66**:832-839.

Malig et al. (2013) American Journal of Epidemiology 178:58-69.

Mar et al. (2005) Environ Health Perspectives 113:1791-4.

McConnell et al. (1999) Environmental Health Perspective 107:757-760.

Ostro et al. (2006) Environmental Health Perspectives 114: 29–33.

Ostro et al. (2009) Environmental Health Perspectives 117:475-480.

Peters et al. (2001) Circulation *103*:2810–2815.

Pope et al., (2009) New England Journal of Medicine 360:376-386

Urch et al. (2005) Environmental Health Perspectives 113:1052-5.

U.S. EPA (U.S. Environmental Protection Agency). 2009. Integrated Science Assessment for Particulate Matter (Final Report) EPA/600/R-08/139F.

World Health Organization (WHO) (2005) Air quality guidelines - global update 2005

References linked to submissions to City Council

Ahrens, M.J., and Morrisey, R.J.A. (2005). Biological Effects of Unburnt Coal in the Marine Environment. In Oceanography and Marine Biology: An Annual Review, (CRC Press), pp. 69–122.

Ames, D.J. (2012). Position Statement on Coal Exports from Concerned Oregon Physicians to Governor Kitzhaber.

AMI Environmental (2012). AERMOD Modeling of Air Quality Impacts of the Proposed Morrow Pacific Project.

Atkinson, W. (2009). Combustible Coal Dust: An Explosion Waiting to Happen.

Bounds, W.J., and Johannesson, K.H. (2007). Arsenic Addition to Soils from Airborne Coal Dust Originating at a Major Coal Shipping Terminal. Water. Air. Soil Pollut. 185, 195–207.

Brabin, B., Smith, M., Milligan, P., Benjamin, C., Dunne, E., and Pearson, M. (1994). Respiratory morbidity in Merseyside schoolchildren exposed to coal dust and air pollution. Arch. Dis. Child. 70, 305–312.

Brook, R.D., Rajagopalan, S., Pope, C.A., Brook, J.R., Bhatnagar, A., Diez-Roux, A.V., Holguin, F., Hong, Y., Luepker, R.V., Mittleman, M.A., et al. (2010). Particulate Matter Air Pollution and Cardiovascular Disease An Update to the Scientific Statement From the American Heart Association. Circulation 121, 2331–2378.

California Air Resources Board (2007). Health Risk Assessment for the Union Pacific Railroad Stockton Railyard.

California Air Resources Board (2008). Diesel Particulate Matter Health Risk Assessment for the West Oakland Community.

California Department of Public Health (2012). Asthma Hospitalization and Emergency Room Visits Query Results.

Campbell, P.M., and Devlin, R.H. (1997). Increased CYP1A1 and ribosomal protein L5 gene expression in a teleost: The response of juvenile chinook salmon to coal dust exposure. Aquat. Toxicol. 38, 1–15.

Colinet, J. (2010). Health Effects of Overexposure to Respirable Silica Dust.

Communities for a Better Environment (2010). East Oakland Diesel Truck Survey Report.

Dockery, D.W., Speizer, F.E., Stram, D.O., Ware, J.H., Spengler, J.D., and Ferris, B.G. (1989). Effects of inhalable particles on respiratory health of children. Am. Rev. Respir. Dis. 139, 587–594.

Dockery, D.W., Pope, C.A., Xu, X., Spengler, J.D., Ware, J.H., Fay, M.E., Ferris, B.G.J., and Speizer, F.E. (1993). An Association between Air Pollution and Mortality in Six U.S. Cities. N. Engl. J. Med. 329, 1753–1759.

Epstein, P.R., Buonocore, J.J., Eckerle, K., Hendryx, M., Stout III, B.M., Heinberg, R., Clapp, R.W., May, B., Reinhart, N.L., Ahern, M.M., et al. (2011). Full cost accounting for the life cycle of coal. Ann. N. Y. Acad. Sci. 1219, 73–98.

Fujita, E.M., and Campbell, D.E. (2010). West Oakland Monitoring Study.

Gauderman, W.J., Avol, E., Gilliland, F., Vora, H., Thomas, D., Berhane, K., McConnell, R., Kuenzli, N., Lurmann, F., Rappaport, E., et al. (2004). The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age. N. Engl. J. Med. 351, 1057–1067.

Health Effects Institute (2010). Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects.

Hendryx, M. (2009). Mortality from heart, respiratory, and kidney disease in coal mining areas of Appalachia. Int. Arch. Occup. Environ. Health 82, 243–249.

Hendryx, M., and Ahern, M.M. (2008). Relations between health indicators and residential proximity to coal mining in West Virginia. Am. J. Public Health 98, 669–671.

Hendryx, M., Ahern, M.M., and Nurkiewicz, T.R. (2007). Hospitalization patterns associated with Appalachian coal mining. J. Toxicol. Environ. Health A 70, 2064–2070.

Hendryx, M., Fedorko, E., and Anesetti-Rothermel, A. (2010). A geographical information system-based analysis of cancer mortality and population exposure to coal mining activities in West Virginia, United States of America. Geospatial Health 4, 243–256.

Hossfeld, R.J., and Hatt, R. (2005). PRB Coal Degradation - Causes and Cures.

Jaffe, D., Putz, J., Hof, G., Hof, G., Hee, J., Lommers-Johnson, D.A., Gabela, F., Fry, J.L., Ayres, B., Kelp, M., et al. (2015). Diesel particulate matter and coal dust from trains in the Columbia River Gorge, Washington State, USA. Atmospheric Pollut. Res. 6, 946–952.

Jaffe, D.A., Hof, G., Malashanka, S., Putz, J., Thayer, J., Fry, J.L., Ayres, B., and Pierce, J.R. (2014). Diesel particulate matter emission factors and air quality implications from in–service rail in Washington State, USA. Atmospheric Pollut. Res. 5, 344–351.

Janssen, N.A.H., Hoek, G., Simic-Lawson, M., Fischer, P., van Bree, L., ten Brink, H., Keuken, M., Atkinson, R.W., Anderson, H.R., Brunekreef, B., et al. (2011). Black Carbon as an Additional Indicator of the Adverse Health Effects of Airborne Particles Compared with PM10 and PM2.5. Environ. Health Perspect. 119, 1691–1699.

Johnson, R., and Bustin, R.M. (2006). Coal dust dispersal around a marine coal terminal (1977–1999), British Columbia: The fate of coal dust in the marine environment. Int. J. Coal Geol. 68, 57–69.

Kan, H., Jia, J., and Chen, B. (2003). Acute stroke mortality and air pollution: new evidence from Shanghai, China. J. Occup. Health 45, 321–323.

Malig, B.J., and Ostro, B.D. (2009). Coarse particles and mortality: evidence from a multi-city study in California. Occup. Environ. Med. 66, 832–839.

Malig, B.J., Green, S., Basu, R., and Broadwin, R. (2013). Coarse particles and respiratory emergency department visits in California. Am. J. Epidemiol. 178, 58–69.

Moffatt, S., and Pless-Mulloli, T. (2003). “It wasn’t the plague we expected.” Parents’ perceptions of the health and environmental impact of opencast coal mining. Soc. Sci. Med. 57, 437–451.

Morello-Frosch, R., Zuk, M., Jerrett, M., Shamasunder, B., and Kyle, A.D. (2011). Understanding The Cumulative Impacts Of Inequalities In Environmental Health: Implications For Policy. Health Aff. (Millwood) 30, 879–887.

Newcastle Coal Infrastructure Group Operations Spontaneous Combustion Management Plan.

OEHHA data (2014). Cal EnviroScreen Results for Census Tract 6001401700.

Ostro, B., Broadwin, R., Green, S., Feng, W.-Y., and Lipsett, M. (2006). Fine Particulate Air Pollution and Mortality in Nine California Counties: Results from CALFINE. Environ. Health Perspect. 114, 29–33.

Ostro, B., Roth, L., Malig, B., and Marty, M. (2009). The effects of fine particle components on respiratory hospital admissions in children. Environ. Health Perspect. 117, 475–480.

Ostro, B., Tobias, A., Karanasiou, A., Samoli, E., Querol, X., Rodopoulou, S., Basagaña, X., Eleftheriadis, K., Diapouli, E., Vratolis, S., et al. (2014). The risks of acute exposure to black carbon in Southern Europe: results from the MED-PARTICLES project. Occup. Environ. Med. oemed-2014-102184.

Pacific Institute (2003). Reducing Diesel Pollution in West Oakland.

Pandya, R.J., Solomon, G., Kinner, A., and Balmes, J.R. (2002). Diesel exhaust and asthma: hypotheses and molecular mechanisms of action. Environ. Health Perspect. 110 Suppl 1, 103–112.

Peters, A., Dockery, D.W., Muller, J.E., and Mittleman, M.A. (2001). Increased Particulate Air Pollution and the Triggering of Myocardial Infarction. Circulation 103, 2810–2815.

Piechota, T., van Ee, J., Batista, J., Stave, K., and James, D. (2002). Potential Environmental Impacts of Dust Suppressants: "Avoiding Another Times Beach."

de Place, E. (2012). Coal's Spontaneous Combustion Problem.

Pless-Mulloli, T., Howel, D., King, A., Stone, I., Merefield, J., Bessell, J., and Darnell, R. (2000). Living near opencast coal mining sites and children's respiratory health. Occup. Environ. Med. 57, 145–151.

Pless-Mulloli, T., Howel, D., and Prince, H. (2001). Prevalence of asthma and other respiratory symptoms in children living near and away from opencast coal mining sites. Int. J. Epidemiol. 30, 556–563.

Pope, C.A., and Dockery, D.W. (1992). Acute health effects of PM10 pollution on symptomatic and asymptomatic children. Am. Rev. Respir. Dis. 145, 1123–1128.

Pope III C, Burnett RT, Thun MJ, and et al (2002). Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. JAMA 287, 1132–1141.

Rubenstein, G. (2014). Air Pollution Controversy Swirls Around Oakland Army Base Development | News Fix.

Sierra Research, Inc. (2007). Toxic Air Contaminant Emissions Inventory and Dispersion Modeling Report for the Dolores and ICTF Rail Yards, Long Beach, California.

Spencer, S. (2001). Effects of coal dust on species composition of mosses and lichens in an arid environment. J. Arid Environ. 49, 843–853.

U.S. Department of Energy (1993). EH-93-4 The Fire Below: Spontaneous Combustion in Coal.

U.S. Department of Energy National Energy Technology Laboratory (2002). Pinon Pine IGCC Power Project: A DOE Assessment.

U.S. Department of Transportation Surface Transportation Board (2011). 03/03/2011 - Decision - 40436.

U.S. Department of Transportation Surface Transportation Board (2015). Tongue River Railroad Environmental Impact Statement | Draft Environmental Impact Statement.

USEPA (U.S. Environmental Protection Agency) (2009a). Steam Electric Power Generating Point Source Category: Final Detailed Study Report.

USEPA National Center for Environmental Assessment, R.T.P.N., and Sacks, J (2009b). 2009 Final Report: Integrated Science Assessment for Particulate Matter.

USEPA website. Health | Particulate Matter. Available at: https://www3.epa.gov/pm/health.html.

Wade, W.A., Petsonk, E.L., Young, B., and Mogri, I. (2011). Severe occupational pneumoconiosis among west virginian coal miners: One hundred thirty-eight cases of progressive massive fibrosis compensated between 2000 and 2009. Chest 139, 1458–1462.

WHO (2003). Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide.

WHO website. Ambient air pollution. Available at: http://www.who.int/gho/phe/outdoor_air_pollution/en/.

Figures and Additional Submissions

Letter from Doctors John Balmes and Michael Lipsett on particulate matter

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO | SANTA BARBARA • SANTA CRUZ

John R. Balmes, M.D.
Professor of Medicine
Division of Occupational and Environmental Medicine
San Francisco General Hospital
1001 Potrero St., 5K1
San Francisco, CA 94110

Tel: 415/206-8314
Fax: 415/695-1551

E-mail: john.balmes@ucsf.edu

June 3, 2016

Oakland City Council
1 Frank Ogawa Plaza, Suite 226
Oakland, CA 94612

RE: Proposed coal project at the Port of Oakland

Dear Members of the City Council:

We are two California physicians with many decades of experience in the evaluation of the human health impacts of exposure to ambient air pollution. We are submitting these comments to provide information about some potential health impacts that may result from the proposed coal train project. Below we present a brief summary of some relevant published literature (with references at the end), followed by a short description of our backgrounds and qualifications.

Principal Health Impacts of Particulate Matter Air Pollution

Particulate matter (PM) is a heterogeneous airborne mixture of solid and liquid particles, varying widely across time and space. PM levels are generally described and regulated according to the concentration of different inhalable size fractions: specifically, PM10 (particles with a median diameter less than 10 microns [or μm]) and fine particles or PM2.5 (diameter less than 2.5 μm). The principal types of PM expected from the proposed coal rail transport project -- diesel exhaust and coal dust – are only two among many sources, but from a public health standpoint, they should not be treated differently from any other type of PM. **In other words, since diesel particles and a significant portion of coal dust fall within the PM2.5 and PM10 size ranges, the health effects consistently linked with ambient PM are also likely to result from exposure to these two coal train-associated pollutants.**

Hundreds of peer-reviewed scientific articles link PM10 and PM2.5 exposure with premature mortality and with the occurrence of many serious health outcomes, including heart attacks and strokes, lung cancer, as well as hospital admissions and emergency room visits for a variety of cardiovascular and respiratory conditions (including asthma, chronic obstructive lung disease, and respiratory infections). Other well-documented effects include increased respiratory symptoms (especially among asthmatics), decreased lung function (both short- and long-term), missed days at school and work, pre-term births and other adverse reproductive outcomes. This literature has been exhaustively reviewed by the U.S. Environmental Protection Agency (2009); many articles corroborating and extending these findings have been published since then (e.g., Brook et al. 2010; Guarnieri and Balmes 2014; Hart et al. 2015; Lipsett et al. 2011; Tétreault et al. 2016).

The adverse physiological effects of PM on the cardiovascular system have been likened to those of cigarette smoke, and include low-grade inflammation and narrowing of arteries, increased tendency to form blood clots (which can cause strokes and heart attacks), and increased blood pressure. The American Heart Association considers PM2.5 as a cause of both acute events (heart attacks and strokes – sometimes within hours of exposure) and as a contributor to the long-term development of cardiovascular disease (Brook et al. 2010).

Many studies have linked PM exposure with worsening of asthma, as measured by increased symptoms and medication use, emergency room visits and hospitalizations, school absences, and decreased lung function (US EPA 2009; Guarnieri and Balmes 2014). PM 2.5 exposure causes increased oxidative stress and inflammation in the lung, which are hallmarks of asthma. Local and systemic inflammation underlie the development of many chronic diseases, not just asthma. There is some evidence that PM exposure can also cause new cases of asthma, but this is not as firmly established as that for asthma exacerbations in people who already have the disease (Guarnieri and Balmes 2014).

Diesel particles' effects on asthma and allergy have been extensively studied: they can increase allergic responses and make it easier for people who already have allergies to develop new ones. Diesel exposure also increases airway inflammation, though some people with mild, well-controlled asthma may experience less immediate inflammation from diesel exposure than others (Balmes 2011). Diesel particles are also known to contain a variety of chemicals known to cause airway inflammation and damage, including polycyclic aromatic hydrocarbons (PAHs), metals, and chemically reactive chemicals known as free radicals (IARC 2014). The International Agency for Research on Cancer (IARC - a part of the World Health Organization) has also authoritatively designated diesel exhaust as a known human carcinogen (i.e., cause of cancer – IARC 2014).

While coal mining has long been associated with devastating occupational lung disease, there are only a few studies of environmental exposure to coal dust. There is some evidence that environmental exposure may be linked with increased respiratory symptoms in children. Brabin et al. (1994) reported increased wheezing, excess cough, breathlessness, and school absenteeism among children attending primary schools located between 0.5 and 2 kilometers (km) from a dock area in England where coal and petroleum coke were unloaded and stored when compared with children attending schools 3 to 8 km away. Pless-Mulloli et al. (2000) reported increased doctor visits for respiratory conditions (but no increases in some other measures of lung disease) among children living in communities "near" opencast coal mining sites in northern England versus those living further away. A few studies examining coal mining communities in the U.S. suggest that residential proximity to coal mines may be linked to cancer incidence and to increased rates of heart, lung, and kidney disease (Mueller et al. 2015; Hendryx and Ahern 2008). However, it is difficult to conduct such environmental health studies: none of these was designed or carried out in such a way as to be able to accurately assess specific effects of ambient coal dust on human health.

However, there is a large body of evidence that coal dust is toxic. It contains some of the same harmful constituents as diesel particles -- PAHs, metals, and free radicals (Dalal et al. 1995). Laboratory studies indicate that coal dust can damage lung cells and cause inflammation in a several ways (Schins et al. 1999). In occupational settings, coal dust exposure causes severe and often fatal chronic lung diseases. **Therefore, as with diesel exhaust, coal dust particles within the size range of regulated PM (that is PM10 and PM2.5) should not be treated differently from any other kind of PM when it comes to assessing human health risks and protecting public health.**

Our backgrounds

John Balmes, M.D., is a physician-scientist who is a Professor of Medicine at UCSF and a Professor of Environmental Health Sciences in the School of Public Health at UC Berkeley. He is an Attending Physician in the UCSF Division of Occupational and Environmental Medicine and the Division of Pulmonary and Critical Care Medicine at San Francisco General Hospital. At UC Berkeley, he is the Director of the Northern California Center for Occupational and Environmental Health and the UC Berkeley-UCSF Joint Medical Program. He is also one of the Principal Investigators of the Berkeley-Stanford Children's Environmental Health Center. Dr. Balmes has been studying the effects of occupational and environmental agents on respiratory and cardiovascular health for 35 years.

Michael Lipsett, M.D., is a physician-epidemiologist who worked on environmental health issues in California state government for nearly three decades before retiring in December 2013. He also served as an Associate Clinical Professor at the University of California, San Francisco School of Medicine. For much of his career, while at the California Office of Environmental Health Hazard Assessment, he developed the medical and public health basis for California's ambient air quality standards and conducted environmental epidemiological research, particularly in air pollution. Most recently he served as the Chief of the Environmental Health Investigations Branch in the California Department of Public Health. For many years, he was a member of the Advisory Council of the Bay Area Air Quality Management District and chaired its Public Health Committee, and served as well on the Board of the American Lung Association (Alameda, Contra Costa, Solano County affiliate). He has received several awards from government and non-governmental agencies for his work on air pollution.

We appreciate your consideration of these comments during your review of the coal rail project in the Port of Oakland.

Sincerely,

John R Balmes

John Balmes, M.D.
Professor of Medicine, UCSF
Professor of Environmental Health Sciences, School of Public Health, UC Berkeley

Michael Lipsett

Michael Lipsett, M.D. (retired)
Former Chief, Environmental Health Investigations Branch
California Department of Public Health

Response to Comments from Washington Burns M.D. Executive Director Prescott-Joseph Center

Given on Oct 14, 2015.

First, we would like to acknowledge the important contributions that Dr. Burns has made to the West Oakland community. His time and effort has provided many benefits to its citizens. Nevertheless, it is important for us to address his comments. Below we have paraphrased his main comments and provided a response to each.

Comment one: This issue is too much for Oakland to take on and coal use will continue anyway.

Response: California, in general, and the cities in the Bay Area, in particular, have been an example for the rest of the world with their progressive policies to reduce fossil fuel use. Banning coal from the Oakland Army Base is consistent with this policy and provides an example for communities around the world. In addition, this comment strikes us as the "tragedy of the commons" where individual users acting independently and according to their own perceived self-interest behave contrary to the common good of all users by depleting a shared resource (in this case the ability of the earth to bear the impacts of fossil fuel combustion).

Comment two: The publication of Pless-Mulloli, et al. (2000) regarding an open cast mining operation in England is used as evidence to state there will be no impacts on asthmatics in West Oakland.

Response: Regarding the experimental design of Pless-Mulloli, et al. (2000): This study, cherry picked from among dozens of available studies, is not relevant to the situation in West Oakland since it involves exposures from large open cast mines. In this case, two different groups were compared: those living close versus far from the mines. As pointed out by the authors, the actual individual exposures for each group are very difficult to measure given the varying distances, wind conditions and topography. In at least one comparison, the cleaner "control" group had higher PM10 (particles less than 10 microns; PM2.5, less than 2.5 microns, was not measured) concentrations than the "exposed" group. Thus, unlike the case in West Oakland where there is a very direct spatial relation between the railyard and the exposed population, the actual exposure experience will be very difficult to measure in the case of open cast mines in the central region of Britain. PM10 is much more variable over space than is PM2.5 and therefore is more difficult for a single monitor to measure accurately. It is well known in the biostatistical literature that if there is important mis-measurement of exposures, it will make it much more difficult to find an effect from the exposure, if one exists. Thus, between the larger particle size, wind and topography issues, pollution measurement in this study is quite challenging. Nevertheless, the authors report that a significant association was found between daily levels of PM10 and respiratory symptoms among asthmatics. While an interesting study, there are several other shortcomings. For example, there is no apparent control for use of medicine. It could be that the "exposed" group of asthmatics use more medicines including inhalers and corticosteroids. The latter may prevent some asthma attacks from occurring so that the "exposed" group may have the same (or even less) asthma attacks than the "control" group. In fact, there is also evidence from the study that the "exposed" group goes to the doctor more often. This could mean that there is both more disease from the coal exposure and a greater need and use of medicine for this subgroup.

In fact, it is surprising that a director of a mobile asthma clinic ignores the vast literature on the impacts of particulate air pollution on asthma, particularly in children. There are several dozen quality studies examining these effects in the peer review literature. Without going into a full literature review, we can highlight some of the more important and well-conceived recent studies. Several of these studies were conducted in California and involve the examination of tens of thousands of subjects. Specifically, recent studies have found that PM2.5 has the following effects on asthma:

1. Prenatal or early childhood exposure was associated with asthma development by age 6 (Hsu et al. 2015; Brauer et al. 2007).
2. Increased pediatric emergency department visits for asthma, wheeze and upper respiratory infections (Strickland et al. 2016; Alhanti et al. 2016).
3. Reduced lung function in minority youth with asthma (Neophytou et al. 2016) {note that decreased lung function substantially increases the risk of various diseases at adulthood}.
4. Increased bronchitic symptoms in children with asthma (Berhane et al. 2016, McConnell et al. 2003).
5. Early or late exposure increases the risk of developing asthma in adults (Young et al. 2014; Kunzli et al. 2009).
6. Emergency room visits for children and adults (Malig et al. 2013).

Comment Three: Trust TLS to do the right thing and never let coal see the light of day.
Response: There's no reason to believe that the coal companies will do the "right" thing when they have CEOs and stockholders and others who only purpose is to maximize profit. They will aim to do whatever they can do as cheaply as possible. If it is cheaper to run coal cars without covers, which it is, this is what they would prefer. In fact, according to the BNSF website, the coal companies fought the BNSF rule requiring surfactants on all coal cars. Further, even if they use covered cars, there's no guarantee that there will be zero emissions of coal dust or that they will keep using these covers for the life of the project. Further, there is likely to be an increase in diesel emissions from fuel combustion to carry the heavier coal load. Both the coal dust and diesel will impact asthmatics.

Summary: The proposed hauling of coal through West Oakland and its unloading will increase coal dust, diesel particles and noise pollution. All of these factors have known and substantial health impacts, particularly on children with asthma. In addition, the subsequent burning of up to 10 million tons of coal per year that would be exported to other countries with minimal pollution abatement would result in additional impacts on the global climate. These impacts would be experienced locally in terms of more frequent and intense heat waves and higher levels of ozone pollution. Both of these also have known important health impacts.

References

Alhanti et al. (2016) Journal of Exposure Science and Environ Epidemiology 26:180-188
Berhane et al. (2016) Journal of the American Medical Association 1315:491-501.
Brauer et al. (2007) European Respiratory Journal 29:879-888
Kunzli et al. (2009) Thorax 64:664-670.
Hsu et al. (2015) American Journal of Respiratory and Critical Care Medicine 192:1052-9.
Malig et al. (2013) American Journal of Epidemiology 178(1):58-69.
Mcconnell et al. (2003) American Journal of Respiratory and Critical Care Medicine 168:790-797.
Neophytou AM. American Journal of Respiratory and Critical Care Medicine 2016 (in press)
Pless-Mulloli, et al. (2000) Occupational and Environmental Medicine 57:145–151.
Strickland et al. (2016) Environmental Health Perspectives 124:690-696.
Young et al. (2014) American Journal of Respiratory and Critical Care Medicine 190:914-21.

Table 1 - Air quality findings from submitted evidence

	Submissions contributing to finding (✓ = cited primary source, ○ = no citation) (coal support submissions are shaded)															
	Coal opposition											**Coal support**				
Finding	EJ	Alv	Fox	SSR	Ans	Jaf	Ost	OC	Mul	NCIO	Ahe	SB	JH	Bur	HDR	**Primary source**
Exposure																
Relative to neighboring communities, West Oakland already suffers from high levels of existing air pollution, as evidenced by the following: • In 2010, annual averages for $PM_{2.5}$ concentration in West Oakland were in excess of 11 μg/m^3, relative to state and federal standards 12 μg/m^3. • West Oakland's level of diesel particulate matter is 3 times higher than the rest of the air basin, 5 times higher than the rest of Oakland, and 7 times higher than the rest of Alameda county. • West Oakland experiences higher incident rates of conditions related to air pollution (asthma, low birth weight, diabetes, heart disease, stroke, cancer, and premature mortality).	✓			✓	○			✓		✓						CARB, 2008; CBE, 2010; OEHHA data, 2014; Rubenstein, 2014; Pacific Institute, 2003; Fujita and Campbell, 2010; Cal Dep of Pub Hlth, 2012
Coal trains emit one pound of coal dust or more per car per mile, or tens of thousands of pounds of dust lost over a single trip from Utah to the proposed terminal.	✓		✓	✓	✓	✓		✓	✓	✓	✓					U.S. Dept of Trans, 2011; Minutes: Rail Energy Trans Adv Comm, 2009; de Place, 2011; Simp Weath Assoc, 1993
Trains subject to BNSF surfactant regulations produce PM2.5 concentrations roughly twice that of normal freight via coal dust and diesel exhaust along the entire length of the trip, leading to intense spikes of acute exposure to particulate matter in surrounding areas.			✓	✓		✓	✓	✓			✓					Jaffe et al., 2015; Jaffe et al., 2014
Shipping coal out of the proposed terminal will increase airborne pollutants through (1) diesel emissions from unloading/loading and train switching activities, and (2) fugitive coal dust from wind erosion while coal is stored in trains or stockpiles.	✓			✓												AMI Environmental, 2012; Sierra Research, 2007
Coal dust contains a number of toxic metalloids and metals, including silica, arsenic, cadmium, chromium, lead, mercury, manganese, beryllium, copper, iron, aluminum, and nickel.	✓		✓		○		○			✓						Colinet, 2010; Epstein et al., 2011; USEPA, 2009a

	Submissions contributing to finding (✓ = cited primary source, ○ = no citation) (coal support submissions are shaded)															
	Coal opposition											Coal support				
Finding	EJ	Alv	Fox	SSR	Ans	Jaf	Ost	OC	Mul	NCIO	Ahe	SB	JH	Bur	HDR	**Primary source**
With proper packing, load profiling, and topping, the "vast majority" of coal dust is emitted from coal trains while they accelerate from the loading point.															○	no citation†
A study for the Tongue River Rail Project in Montana found that pollutant concentrations near coal train shipping lanes (cars were uncovered, with proper load profiling and topping agents) were below state and federal standards.															✓	US Dept of Trans, 2015
Health Impacts																
According to the WHO, EPA, and numerous epidemiological studies, adverse health effects occur at all ambient particulate matter concentrations studied to-date. That is, the relationship between particulate matter and poor health is observed even at levels below federal, state, and WHO standards.							○	○	✓	○						WHO, 2003
Acute health effects																
The preponderance of pollution-related asthma literature finds a strong link between exposure to particulate matter and all of the following in children: incident asthma, respiratory episodes due to asthma, missed school due to respiratory illness, and asthma emergency department visits.	✓		✓	✓	○		✓	✓	✓	✓	○					Ames, 2012; Brabin et al., 1994; Dockery et al., 1989; Malig et al., 2013 Ostro et al., 2009; Brook et al., 2010; Health Effects Inst, 2010; Pandya et al., 2002; USEPA, 2009b
Acute exposure to particulate matter has been shown to be related to cardiovascular disease including non-fatal heart attack and stroke.	✓		✓	✓	○		✓	✓		✓						Ames, 2012; USEPA website; Kan et al., 2003; Peters et al., 2001; Malig and Ostro, 2009; Ostro et al., 2006; Brook et al., 2010; USEPA, 2009b

	Submissions contributing to finding (✓ = cited primary source, ○ = no citation) (coal support submissions are shaded)															
	Coal opposition											Coal support				
Finding	EJ	Alv	Fox	SSR	Ans	Jaf	Ost	OC	Mul	NCIO	Ahe	SB	JH	Bur	HDR	**Primary source**
Acute exposure to particulate matter has been shown to be related to all-cause premature mortality.			✓				✓	✓		✓						USEPA website; Malig and Ostro, 2009; Ostro et al., 2006; USEPA, 2009b
Coal stored in enclosed spaces such as domed structures or covered rail cars has a documented history of spontaneously combusting. Moreover, coal dust is liable to explode when a high enough concentration is exposed to an ignition source. Both these possibilities pose significant occupational hazards to those working with coal shipments.	✓	✓			✓				✓	✓						US Dep of Energy, 1993; de Place, 2012; Hossfeld and Hatt, 2005; Atkinson, 2009; Newcastle Coal Infra Grp; US Dept of Energy, 2002
Chronic health effects																
Chronic exposure to particulate matter is associated with a number of cardiopulmonary conditions, including hypertension, COPD, chronic bronchitis, IHD, and stroke.	✓	○	✓	✓	○	✓		✓	✓	✓	○					Ames, 2012; Hendryx and Ahern, 2008; Dockery et al., 1993; Janssen et al., 2011; Brook et al., 2010; WHO website; Pope III C et al., 2002; USEPA, 2009
Multiple studies show pregnant women exposed to diesel emissions are more likely to experience complications, including spontaneous abortion and low birth weight.	✓						✓	✓								CBE, 2010; Green et al., 2009
Pollutants commonly found in diesel ($PM_{2.5}$, NO_x, and ozone) are associated with reduced lung development and reduced lung function in adolescents, with chronic exposure throughout childhood leading to permanent lung underdevelopment.	✓	○		✓	○				✓							Ames, 2012; Gauderman et al., 2004; Thaller et al., 2008; Pope and Dockery, 1992
The literature demonstrates a strong link between particulate matter exposure and cancer. Cancer risk is not just occupational, but applies to those living within proximity of port, railyard, or mining activities.		○	✓		○				✓		○					CARB, 2007; Pope III et al., 2002
Occupational exposure to coal dust over a prolonged period of time causes a number of serious respiratory illnesses: pneumoconiosis,	✓		✓	○	○				✓	✓						Colinet, 2010; Ames, 2012; Wade et al., 2011;

	Submissions contributing to finding (✓ = cited primary source, ○ = no citation) (coal support submissions are shaded)															
	Coal opposition											**Coal support**				
Finding	EJ	Alv	Fox	SSR	Ans	Jaf	Ost	OC	Mul	NCIO	Ahe	SB	JH	Bur	HDR	**Primary source**
chronic bronchitis, emphysema, pulmonary tuberculosis, lung cancer, and silicosis. Moreover, studies of residential areas surrounding coal mining facilities have indicated that the health effects from exposure to such operations spill over into the community at-large, with higher-than-expected rates of COPD, hypertension, heart disease, kidney disease, and cancer.																Hendryx, 2009; Hendryx and Ahern, 2008; Hendryx et al, 2007, 2010
Particulate matter exposure disproportionately harms vulnerable populations, including children, the elderly, asthmatics, individuals with low incomes, and individuals with pre-existing cardiovascular or respiratory conditions.	✓		✓	✓			✓	✓	○	✓	○					USEPA website; Malig and Ostro, 2009; Malig et al., 2013; Ostro et al., 2006, '09, '14; Morello-Frosch et al 2011; Brabin et al., 1994; Ames, 2012
Exposure to opencast mining operations in the UK did not increase respiratory episodes amongst children, and further qualitative assessment showed parents in close proximity had a more favorable opinions of the mining operations after they had been in place for an extended period of time.									✓					✓		Moffatt and Pless-Mulloli, 2003; Pless-Mulloli et al., 2000; Pless-Mulloli et al.2001
Ecosystem impacts																
Coal dust and coal leachates can have a number of detrimental effects on the aquatic ecosystems of waterways bordering rail lines and the terminal, including but not limited to: • Damage to plants/animals living close to the surface of the water. • Reduced development of aquatic life due to suppressed photosynthetic potential, clogged respiratory/digestive organs, and settling of coal onto the floor of the waterway. • Increased acidity (due to coal's sulphur content) and trace metal concentration.	✓		✓				○			✓						Ahrens and Morrisey, 2005; Campbell and Devlin, 1997; Johnson and Bustin, 2006
Coal dust and coal leachates negatively impact soil by increasing its heavy metal concentration and altering its hydrology, interrupting the life cycles of everything from nitrogen-fixing lichens to animals that rely on plant growth for nourishment.			✓							✓						Bounds and Johannesson, 2007; Spencer, 2001; Piechota et al., 2002

Appendix Chapter 3: Assessment of Mitigations for Fugitive Coal Dust

References

Ahrens, M.J., and Morrisey, R.J.A. (2005). Biological Effects of Unburnt Coal in the Marine Environment. In Oceanography and Marine Biology: An Annual Review, (CRC Press), pp. 69–122.

BNSF (2010). Summary of BNSF/UP Super Trial 2010.

Bowie Resource Partners website Skyline | Bowie Resource Partners, LLC.

California Capital Investment Group (2015). Basis of Design: Oakland Bulk and Oversized Terminal.

Campbell, P.M., and Devlin, R.H. (1997). Increased CYP1A1 and ribosomal protein L5 gene expression in a teleost: The response of juvenile chinook salmon to coal dust exposure. Aquat. Toxicol. 38, 1–15.

Foo, L.J. (2016). Covers for rail transport of coal.

Fox, P. (2015). Environmental, health and safety impacts of the proposed Oakland Bulk and Oversized Terminal.

Fulton, M., Capalino, R., and Grant, A. (2014). “King Coal” disappoints investors: recent financial trends in global coal mining.

Galvis, B., Bergin, M., and Russell, A. (2013). Fuel-based fine particulate and black carbon emission factors from a railyard area in Atlanta. J. Air Waste Manag. Assoc. 1995 63, 648–658.

Hossfeld, R.J., and Hatt, R. (2005). PRB Coal Degradation - Causes and Cures.

Johnson, R., and Bustin, R.M. (2006). Coal dust dispersal around a marine coal terminal (1977–1999), British Columbia: The fate of coal dust in the marine environment. Int. J. Coal Geol. 68, 57–69.

Liebsch, E.J., and Musso, M. (2015). Oakland Bulk and Oversized Terminal Air Quality & Human Health and Safety Assessment of Potential Coal Dust Emissions.

Ostro, B. (2015). RE: Comments on: Oakland Bulk and Oversized Terminal Air Quality & Human Health and Safety Assessment of Potential Coal Dust Emissions, prepared for: California Capital and Investment Group, HDR Engineering, September 2015.

Piechota, T., van Ee, J., Batista, J., Stave, K., and James, D. (2002). Potential Environmental Impacts of Dust Suppressants: “Avoiding Another Times Beach.”

de Place, E. (2012). Coal’s Spontaneous Combustion Problem.

de Place, E., and Kershner, D. (2013). How Coal Affects Water Quality: State of the Science.

Smith, D.C. (2015). September 21, 2015, Oakland City Council Public Hearing.

Sustainable Systems Research, LLC (2015). Technical Memorandum: Air Quality, Climate Change, and Environmental Justice Issues from Oakland Trade and Global Logistics Center.

Tagami, P., and Bridges, J. (2015). Responses and Information for City Follow-Up Questions to September 21 Informational Hearing.

Trimming, T. (2013). Derailing Powder River Basin Coal Exports: Legal Mechanisms to Regulate Fugitive Coal Dust From Rail Transportation. Gold. Gate Univ. Environ. Law J. 6, 321.

U.S. Department of Energy (1993). EH-93-4 The Fire Below: Spontaneous Combustion in Coal.

U.S. Department of Energy National Energy Technology Laboratory (2002). Pinon Pine IGCC Power Project: A DOE Assessment.

U.S. Department of Transportation Surface Transportation Board (2011). 03/03/2011 - Decision - 40436.

Vorhees, J. (2010). Railroads, Utilities Clash Over Dust From Coal Trains. N. Y. Times. (2015). Online Public Meeting for the Draft EIS for the Proposed Tongue River Railroad.

Other materials

Memo from LoraJo Foo to City of Oakland regarding rail car covers for coal

To: Claudia Cappio, Assistant City Administrator
Honorable Mayor Libby Schaaf
Oakland City Council
City Attorney Barbara Parker

From: Lora Jo Foo
No Coal in Oakland

Date: June 2, 2016

Subject: Covers for rail transport of coal

I. ECOFAB COVER FOR RAIL TRANSPORT OF COAL HAS NEVER BEEN FIELD TESTED FOR COAL DUST EMISSIONS NOR HAS IT RECEIVED FRA APPROVAL

In responses to concerns raised by the public that the transport of coal by rail through Oakland will endanger the health and safety of Oakland residents, Terminal Logistics Solutions (TLS) has repeatedly stated, most recently in its May 22, 2016 press advisory, that:

> Any coal that may be shipped through Oakland Global will not emit coal dust – in fact, coal will never see the light of day. Rail cars will be covered from their point of origin using proven technology, an elaborate underground transloading system, enclosed dome storage, and a completely encapsulated operation.[27]

The proven technology that TLS was referring to for rail car covers is a design by EcoFab. At a press conference on May 23, 2016, when asked whether TLS was doing testing to be sure no coal dust escaped the rail cars, Jerry Bridges, CEO of TLS, responded:

> "FRA last year approved these particular covers, Ecofab is the name of the company, they approved these rail car covers for the transportation of coal."

Bridges also told the East Bay Times that EcoFab tested the covers.[28]

Contrary to Bridge's assertions, in fact, EcoFab has never tested the covers to determine their effectiveness in preventing leakages of fugitive coal dust. Nor has the Federal Rail Administration (FRA) approved EcoFab covers.

In the week of May 23, I interviewed Doug Bock, EcoFab's Vice President of Marketing and Sales, and also communicated with him by email regarding covers for rail transport of coal.

Bock stated in an email dated May 27, 2016 regarding Bridges' press conference statement that:

---

[27] http://www.businesswire.com/news/home/20160522005047/en/MEDIA-ADVISORY-Oakland-Community-Civic-Leaders-Voice

[28] See Erin Baldassari, Supporters of shipping coal through Oakland say it will bring jobs, East Bay Times (05/24/2016) http://www.eastbaytimes.com/breaking-news/ci_29929850/supporters-shipping-coal-through-oakland-say-it-will

> If Jerry has said that the FRA has approved our cover for coal, he is mistaken. Ecofab has at no time sought or received FRA approval for the cover we have presented to TLS.[29]

In our phone conversation on May 24, 2016, Bock stated that EcoFab has never done specific testing of its covers for coal transport.

I also interviewed and communicated by email with Dr. Harold Blankenship, Mechanical Engineer in the Office of Railroad Safety of the FRA about the approval process for coal car covers. He made clear that the FRA does not issue approvals for rail car covers and is not involved with testing for coal dust emissions. In an email dated May 26, 2016,[30] Dr. Blankenship responded to my questions as follows:

> Q: Does the federal rail authority have to "approve" these covers before they are made commercially available?
>
> Ans: Yes and No. The FRA and our Canadian Regulatory partner—Transport Canada work to enforce safety on all north American railroads. We do not "approve" coal car covers, HOWEVER, if for instance a company designs a "cover" and wants a safety review, the FRA will do this as a courtesy, with the intent to see that such a cover does not interfere with employee safety, block access to side ladders, end ladders, sill steps, handbrakes, or introduce an unacceptable risk to railroad employees.
>
> Q: Is testing for leakage of fugitive coal dust required in the approval process?
>
> Ans: No, FRA does not get involved with any fugitive coal dust emission tests as far as I know.
>
> Q: Are there any other companies who have received approval or whose approval is pending?
>
> Ans: FRA does NOT approve covers EXCEPT when requested to provide guidance for a particular design as it relates to the safety appliance arrangement contained in the proposal. Once reviewed, the FRA may issue a letter that the proposed design may or may not comply with current safety appliance regulations contained in AAR S-2044 and Title 49 Code of Federal Regulations (CFR) Part 231.

In summary, the proven technology that Bridges claims exists for rail car covers for coal is a mirage. EcoFab never tested its cover to determine if it is effective in preventing coal dust leakage. And the FRA performs safety reviews of rail car covers but does not review whether the covers prevent leakage of coal dust. Thus, neither FRA nor any federal agency has established standards for field testing the effectiveness of coal covers' containment of coal dust.

II. OF THE COVERS FOR COAL TRAINS NOW COMMERCIALLY AVAILABLE, NONE HAVE BEEN FIELD TESTED AND NONE HAVE MADE IT TO MARKET.

To determine whether covers for coal train cars are used anywhere in the U.S., whether any are commercially available, and whether they have been tested for their effectiveness in controlling fugitive coal dust, I interviewed the companies that have reportedly designed rail car covers for coal.

Dave Gambrel, a coal transportation consultant and former director of transportation for Peabody Energy, in a 2013 article in Coal Age listed the five companies that have worked on "different rail car cover designs to prevent

---

29 The full text of Doug Bock's email response is attached below.
30 The full text of Dr. Harold Blankenship's email is attached below.

coal dust from flying out the tops of rail cars."[31] I reached these companies by phone and posed these questions to them:

1) Why did you decide to go into this product line?
2) Did you go beyond the design stage? Did you produce a prototype? Is this design now commercially available?
3) Did you do testing to determine if the covers prevented leakage of coal dust? If yes, what were the results?

In summary, while three of the five companies state they have commercially available covers, none have manufactured any to date. While two companies performed functionality tests, that is, to determine if the covers opened and closed as designed, none of these covers has been field tested to determine their efficiency in keeping coal dust from escaping during transport. Below is a summary of the responses from the five companies to the questions I posed to them.

1. Strategic Rail System (Rush-Co) (http://www.rush-co.com/srs-rail/)

On May 23, 2016, I interviewed Evan Jones, President of Strategic Rail System (SRS). SRS was approached by Union Pacific (UP) to design covers for coal cars. Around four years ago, SRS built seven prototypes and tested them on UP lines. SRS designed covers that would automatically open and close for quicker loading and unloading, using a rotary system, not bottom dump. Anticipating that the federal government would soon adopt a regulation requiring covers of coal train cars, SRS bought a plant to gear up for production. Its covers were commercially available. But no regulation was adopted so there was no demand for the covers. SRS mothballed the project. The field testing that was done on UP lines was for functionality, that is, to determine if the covers opened and closed as they were designed to do. The covers worked as designed. However, one issue remained and that was how long the solar-powered batteries that are mounted on each car/cover to open and close the covers would last. SRS did not perform any field tests to determine the effectiveness of the covers in preventing leakage of coal dust.

2. CoalCap (Global One Transport) **(**http://www.coalcap.com/)

On May 23, 2016, I interviewed Jason Dial and Darrell Dial of Global One Transport (GOT). BNSF asked GOT to design covers to test and use for the export market. Five years ago, they built a cover and tested it from the Powder River Basin to Ohio. They had one test car behind the locomotive. They made several trips logging approximately 40,000 miles. They tested for functionality and it was a success – the cover stayed on the car and rotated fine. FRA has asked for certain modifications on their design, including placing handholds on the side of the cars. While Darrell Dial claims that dust is 100% contained, he did not perform field testing for coal dust emissions. He did videotape from time to time and saw no coal dust escaping and saw no dust on top of the covers or anywhere on the covers. When asked whether he might not have seen coal dust because it may have blown away during transport, he admitted that was possible. GOT's product is "commercially available" but they won't go into production until they receive an order.

3. CleaRRails, LCC

On May 23, 2016, I interviewed Mark Pettibone of CleaRRails. In 2015, his design (Coal Guard) received approval for safety from the FRA. He doesn't have a prototype yet. He hasn't done modeling for whether or not coal dust will be 100% contained. While other companies' covers have two doors that come off on the side of the car, his is

[31] http://www.coalage.com/departments/transportation-tips/2736-coal-dust-control-in-the-pacific-northwest.html#.VzuPOGZrXhO

a front-to-back design. A canister sits on either the front or back of car with a rolled up aluminum cover, like a garage door.

4. EcoFab (http://www.ecofab.com)

On May 24, 2016, I interviewed Doug Bock of EcoFab. A Utah coal mining company approached EcoFab about covers for coal cars. EcoFab adapted an existing cover, the Roto Cover, for transporting coal. The existing cover has been used for 40 years in the transport of lead, copper, zinc and low level radioactive material. Because TLS plans for bottom dump and not rotary cars, EcoFab adapted the Roto Cover for coal. The existing cover lifts off. The cover for coal is the same cover but is hinged and opens automatically. It is fixed permanently on the train car and removed only for preventative maintenance. EcoFab has never done specific testing for covers for coal. For that matter, it has never tested the existing covers used for transport of lead, copper and zinc to determine if dust or particles from these commodities have escaped during transport. As stated above, in an email dated May 27, 2016, Bock stated that EcoFab has at no time sought or received FRA approval for the cover it presented to TLS.

5. Structural Composite of Indiana (United Rail Covers) (http://www.railcarcovers.com)

URC designed three types of covers. But a year ago, the new owner of the company decided to drop the product line. I was not able to reach anyone at the company who was involved in designing the covers.

III. CONCLUSION

Coal dust can break down to as small as PM2.5. According to the California EPA and World Health Organization, there is no safe level of exposure to PM2.5. Therefore, rigorous testing is needed to determine if the covers that are now commercially available can prevent the escape of particles this small. However, as my interviews with four of the five companies that have designs and/or prototypes for coal covers reveal, none of them has done field testing to determine their effectiveness in preventing coal dust from escaping during transport.

For around four decades, railroads have been using covers for the transport of grain, fertilizer, copper, zinc, lead and other commodities. Tests for fugitive dust for the above commodities may or may not have been done at some point. We do not know if these covers are effective in preventing the escape of dust of these commodities. Even if they are, we don't know if the covers would work as effectively for coal dust. EcoFab's Roto Cover has been adapted to transport coal. TLS has stated that it plans to use this cover. While this cover may have been used to transport other commodities for decades, will the adapted version for coal do what it was designed to do, that is keep coal dust from escaping? Moreover, with covered coal cars, is there a potential for explosive concentrations of coal dust to form inside the containment? Might a blast occur from a static electricity discharge or other accidental source of ignition? Without field testing over a long period, we do not know.

Numerous questions remain unanswered because no such field testing has been done. Do these other commodities break down to as small as PM2.5? Can the seals on covers keep PM2.5 from leaking out? With particles this small, can the naked eye even see them escaping from the cars? How long do the seals last when coal rather than grain is the commodity? Without field testing over a period of time, we don't know how the covers will perform over time and in differing weather. Will they freeze up or malfunction when there is snow or ice or rain? Will they deform or twist or turn in the wind? Will they be as effective on the current fleet of train cars as on the latest generation of cars? Without field testing over a period of time, we do not know the answers to these questions.

EMAIL CORRESPONDENCE ON COVERS FOR COAL TRAINS

From: "Doug Bock" <DBock@ecofab.com>
Date: May 27, 2016 1:03 PM
Subject: Ecofab Covers
To: "lora jo foo" <ljfoo70@gmail.com>

If Jerry has said that the FRA has approved our cover for coal, he is mistaken. Ecofab has at no time sought or received FRA approval for the cover we have presented to TLS. Having said that Ecofab did receive approval for covering and containing low level radioactive material with the very same cover. In 1994 the US Department of Transportation (DOT) determined that the Ecofab Cover System met the criteria for a closed transport vehicle as specified in "Title 49 CFR 173.403 (c)." The approval of our cover system was sought and achieved by our customer at the time.

From: **lora jo foo** <ljfoo70@gmail.com>
Date: Fri, May 27, 2016 at 11:09 AM
Subject: Re: Covered coal cars
To: Doug Bock <DBock@ecofab.com>

Thanks for quick response. At a press conference earlier this week, when asked about whether TLS was doing testing to be sure no coal dust escaped the rail cars, Jerry Bridges responded:

> "FRA last year approved these particular covers, Ecofab is the name of the company, they approved these rail car covers for the transportation of coal."

I reviewed my notes and thought you said EcoFab did not seek FRA approval. Is that correct? Did Bridges misunderstand?
lora jo

From: **Doug Bock** <DBock@ecofab.com>
Date: Fri, May 27, 2016 at 10:53 AM
Subject: RE: Covered coal cars
To: lora jo foo <ljfoo70@gmail.com>

Yes we have spoken to and given a presentation to Terminal Logistics Solutions. Yes it was a Utah based mining company.

From: **lora jo foo** <ljfoo70@gmail.com>
Date: Fri, May 27, 2016 at 10:37 AM
Subject: Covered coal cars
To: Doug Bock <DBock@ecofab.com>

Dear Doug,

We spoke earlier this week about covers for coal train cars. I have two follow up questions I hope you can answer. You said that it was a mining company that approached EcoFab about your covers. Has anyone from Terminal Logistics Solutions, TLS, the company that will build and operate the Oakland export terminal contacted you or anyone else in your company to inquire about the covers? The principles of TLs are Jerry Bridges and Omar Benjamin. And can you tell me which mining company contacted you about the covers? Was it a Utah company? Any assistance would be greatly appreciated.

Lora Jo

From: **Blankenship, Harold (FRA)** <harold.blankenship@dot.gov>
Date: Thu, May 26, 2016 at 4:53 AM
Subject: RE: Covers for coal train cars
To: lora jo foo <ljfoo70@gmail.com>

Lora Jo,

Before we begin, I think I should give you some background as to my expertise, resume, etc.

I am a registered professional engineer with an electrical engineering degree, a mechanical engineering degree, an MBA and doctorate in operations management.

2. I spent 30 years with Norfolk Southern Railroad in a variety of management positions in the operating (mechanical and transportation) departments.

3. At present I have been with the FRA here in Washington, DC for 16 years, so basically I have 46 years of "hands on" railroad experience.

4. All my work is centered around "Railroad Safety" and regulation enforcement.

I am attaching a copy of my current position description and primary responsibilities here at the U.S. Department of Transportation Federal Railroad Administration (FRA).

<u>Answers/Responses to Lora Jo's questions</u>:

1. What was the impetus for the proposed rule? Ans. There are many federal agencies that may have at some point explored whether a "rule" was needed to govern the transport of coal, (EPA? DOT? Commerce?) so, without seeing a "hard copy" of a proposed rule, it would be hard to make any assumption here. Again, why was the "rule" not pursued? Without "seeing" what was proposed we cannot accurately give an opinion as it would be conjecture only.

2. Does the federal rail authority have to "approve" these covers before they are made commercially available? Ans. Yes and No. The FRA and our Canadian Regulatory partner—Transport Canada work to enforce safety on all north American railroads. We do not "approve" coal car covers, HOWEVER, if for instance a company designs a "cover" and wants a safety review, the FRA will do this as a courtesy, with the intent to see that such a cover does not interfere with employee safety, block access to side ladders, end ladders, sill steps, handbrakes, or introduce an unacceptable risk to railroad employees.

3. Is testing for leakage of fugitive coal dust required in the approval process? Ans. No, FRA does not get involved with any fugitive coal dust emission tests as far as I know.

4. Are there any other companies who have received approval or whose approval is pending? Ans. FRA does NOT approve covers EXCEPT when requested to provide guidance for a particular design as it relates to the safety appliance arrangement contained in the proposal. Once reviewed, the FRA may issue a letter that the proposed design may or may not comply with current safety appliance regulations contained in AAR S-2044 and Title 49 Code of Federal Regulations (CFR) Part 231.

5. Has EcoFab applied for approval of its covers? Ans. Without a file number or correspondence control number, I cannot tell whether the EcoFab cover has received an FRA safety appliance review.

From: **lora jo foo** <ljfoo70@gmail.com>
Date: Wed, May 25, 2016 at 11:54 AM
Subject: Covers for coal train cars
To: harold.blankenship@dot.gov

Dear Dr. Blankenship,
I left a voice message and thought I'd email you my questions for you to consider. I am assisting Dr. Heather Kuiper who coordinates an independent Public Health Experts Panel assessing evidence to determine the health impacts of the transport of coal from Utah to Oakland, CA. Their conclusions will be submitted to the Oakland City Council who is considering an ordinance to ban or regulate coal. One of the issues the council will look at is whether there are measures that would prevent leakage of fugitive coal dust during the rail transport of coal. Here's my questions:

1) A few years back a federal agency was considering adopting a rule requiring all coal trains be covered. In the end, no rule was issued. What was the impetus for the proposed rule? And why was the rule not pursued?
2) I have interviewed four companies who have designed covers for coal train cars. Does the Federal Rail Authority have to approve these covers before they are made commercially available? Is testing for leakage of fugitive coal dust required in the approval process? One of the companies stated that they did not need FRA approval for their covers since they've been used for decades for other commodities such as zinc, lead, and copper. I understand that Mark Pettibone's ClearRrails covers were FRA approved and that CoalCap's (Global One Tranport) approval is pending. Are there any other companies who have received approval or whose approval is pending? In particular, has EcoFab applied for FRA approval of its covers?

I can be reached at 510-842-0647 or 510-282-9454. Looking forward to speaking with you. Lora Jo

Appendix Chapter 4: Hazardous Toxics Accompanying Coal Dust

References

a) Fox, P. (2015). Environmental, health and safety impacts of proposed Oakland Bulk &Oversized Terminal.

1) Navas-Acien A, Silbergeld EK, Sharrett R, Calderon-Aranda E, Selvin E, Guallar, E (2005) Metals in urine and peripheral arterial disease. Environ Health Perspect 113: 164-169

2) Hellstrom L, Elinder CG, Dahlberg B, Lundberg M, Jarup L, Peterson B., Axelson O, (2001). Cadmium exposure and end-stage renal disease. Am J Kidney Dis. 38, 1001-1008

3) Jarup L, Persson B, Elinder CG (1997) Blood cadmium as an indicator of dose in a long-term follow-up of workers previously exposed to cadmium. Scandinavian Journal of Work and Environmental Health 24,31-36

4) Nawrot TS, Staessen, Roels HA, Munters E, Cuypers A, Richart T, Ruttens A, Smeets K, Clijsters H, Vangrunsveld J (2010) Cadmium exposure in the population: from health risks to strategies of prevention. Biometals 23:769-782

5) Akesson A, Lundh T, Vahter M, Bjellerup, Lidfeldt J, Nerbrand C, Samsloe G, Stromberg U, Skerfving S (2005) Tubular and glomerular kidney effects in Swedish women with low environmental cadmium exposure. Environ Health Perspect 113: 1627-1631

6) Schutte R, Nawrot TS, Richart T, Thija L, Vanderschueren D, Kuznet T, Van HE, Roels HA, Staessen JA, (2008b) Bone resorption and environmental exposure to cadmium in women: a population study. Environ Health Perspect 116: 777-783

7) Jin T, Nordberg G, Ye T, Bo M, Wang H, Zhu G, Kong Q, Bernard A (2004) Osteoporosis and renal dysfunction in a general population exposed to cadmium in China. Environ Res 96: 353-359

8) IARC (INTERNATIONAL AGENCY FOR RESEARCH ON CANCER) (1993) Beryllium, cadmium, mercury and exposures in the glass manufacturing industry IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans vol 58. 444: http://monographs.iarc.fr/ENG/Monographs/vol58/volume58.pdf

9) Nawrot T, Plusquuin M, Horgervorst J, Roels HA, Celis H, Thijs L, Vangronsveld J, Van Hecke E, Staessen JA, (2006) Environmental exposure to cadmium and risk of cancer: a prospective population-based study. Lancet Oncol. 7: 119-126

10) Ariscawa K, Uemura H, Hiyoshi M, Dakashita S, Kitayama A, Saito H, Soda M (2007) Cause-specific

mortality and cancer incidence rates in relation to urinary beta2-microglobulin: 23 year follow-up study in a cadmium-exposed area. Toxicol Lett. 173:168-174

11) Hyasova D, Elindrer CG (2005) Cadmium and renal cancer. Toxicol Appl Pharmacol. 207:!79-186

12) Kellen E, Zeegers MP, Hond ED, Buntinx F (2007) Blood cadmium may be associated with bladder carcinogenesis: the Belgian case-control study on bladder cancer. Cancer Detect. Prevent. 31:72-82

13) Schwartz CG, Il'yasova A (2003) Urinary cadmium, impaired fasting glucose, and diabetes in the NHANES III. Dabetes Care 26:458-470

14) Nawrot TS, Van HE, Thijs L, Richart T, Kutznesova T, Jin Y, Vansgronsveld J, Roels HA, Staessen JA (2008) Cadmium-related mortality and long-term secular trends in the cadmium body burden of an environmentally exposed population. Environ Health Perspect 116:1620=1628

15) Grondin MA, Ruivard M, Perreve A,Derumeaux-Burel H, Perthus I, Roblin J, Thiollieres F, Gerbaud L, (2008) Prevalence of iron deficiency and health-related quality of life among female students. J Am Coll Nutr 27: 337-343

16) CONTAM (2009) Scientific opinion of the panel on contaminants in the food chain on a request from the European commission on cadmium in food. EFSA J 980:1-139

17) "Mercury Emissions from Coal-Fired Power Plants: The Case for Regulatory Action"(http://.nescaum.org/documents/rpt031104mercury.pdf/) Northeast States for Coordinated Air Use Management, October 2003

18) Pironne N, Cinnirella S, Feng X, Finkelmann RB, Friedli HR, Leaner J, Mason R. Mukherjee AB, Stracher GB, Streets DC, Telmer K. Global mercury emissions to the atomosphere from anthropogenic and natural sources. Atmos.Chem.Phys. 1010:5051-5964

19) Food and Drug Administration. What you need to know about mercury in fish and shellfish (2004). http://www.fda.gov/food/foodsafety/product-specificinformation/seafood/food-bornhttp://www.fda.gov/foodsafety/product-specificinformation/foodbornepathogenscontaminants/methylmercury/ucm115552.htm.

20) Oken E, Radesky JS, Wright RO, Bellinger DC, Amarasiriwadena CJ, Kleinman KP, Hu H, Gillman MW. Maternal fish intake during pregnancy, blood mercury levels, and child cognition at age 3 years in a US cohort. (2008) American Journal of Epidemiology. 167:1171-1181

21) Trasande L, Schechter CB, Haynes KA, Landrigan PJ. Mental retardation and pre-natal methylmercury toxicity. (2006) American Journal of Industrial Medicine. 49(3):153-158

22) Grandjean P. Methylmercury toxicity and functional programming. (2007) Reprod Toxicol. 23:414-420

23) Murata K, Weihe P, Budtz-Jorgensen PJ, Granjean P. Delayed brainstem auditory evoked potential .

24) Clarkson TW, Magos L, Myers GJ. The toxicology of mercury-current exposures and clinical manifestations. (2003) N Engl J Med. 349:1731-1737

25) Nabi S. Toxic Effects of Mercury, Springer India (2014) http://dx.doi.org/10.1007/978-81-377-1922

26) Peplow D, Augustine S. Neurological abnormalities in a mercury-exposed population among indigenous Wayana in Southeast Surimane (2014). Environ Sci Processes Impacts. 16:2415-2422

27) Eom SY, Choi SH, Ahn SJ, Kim DK, Lim JA, Choi BS, Shin HJ, Yun SW, Sohn SJ, Kim H, Park KS, Pyo HS, Kim H, Lee SA, Ha M, Kwon HJ, Park JD. (2014) Reference levels of blood mercury and association with metabolic syndrome in Korean adults, Int Arch Occup Environ Health. 87:501-513

28) Guanghong J, Annaya RA, Martinez-Lemus LA, Sowers JR. (2015) Mitochondrial functional impairment in response to environmental toxins in the cardiorenal metabolic syndrome. Arch Toxicol. 89(2):147-153

29) Schuurs AHB. (1999) Reproductive toxicity of occupational mercury: a review of the literature. J Dent. 27(4):249-256

30) Neeri K, Prakash T. Effects of heavy metal poisoning during pregnancy (2013) Int Res J Environ Sci.2(1):88-92

31) Centers for Disease Control and Prevention. Laboratory standardization. (2006) Atlanta,GA

32) Cory-Stechta DA. Legacy of lead exposure: consequences for the central nervous system. (1996) Otolaryngol Head Neck Surg. 114:224-226

33) Hwan-Cheol, Kim, Tan-Won Jang, Hong-Jae Chae, Won-Jun Choi, Mi-Na Ha, Bysong-Jin Ye, Man-Joon Joong, Se-Yeong Kim, Youg-Seoub Hong. Evaluation and Management of Lead Exposure. Ann Occup Environ Med. 2015;27:30

34) Bellinger DC. Very low lead exposures and children's neurodevelopment. (2008) Current Opinion in Pediatrics. 20: 172-177

35) Jusko TA, Henderson CR, Lanphear BP, Cory-Slechta DA, Parsons PJ, Canfield RL. (2008) Blood lead concentrations < 10 micrograms/dL and child intelligence at 6 years of age. Environmental Health Perspectives. 116: 243-248

36) Lamphear BP, Hornung R, Khoury J, Yolton K, Baghurst P, Bellinger DC, Canfield RL, Dietrich KN, Bornschein R, Greene T, Rothenberg SJ, Needleman HL, Schaas L, Wasserman G, Graziano J, Roberts R. Low-level environmental lead exposure and children's intellectual function: and international pooled analysis. Environmental Health Perspectives. 2005;113(7):894-899

37) Liu J, Li L, Wang Y, Yan C, Liu X. Impact of low blood lead concentration on IQ and school performance in Chinese children. PLOS Onc. 2013;8(5):1-8

38) Jianghong L, Lewis G. Environmental toxicity & poor cognitive outcomes in children and adults. J Environ Health. 2014; 76(6):130-138

39) Jedrychowski, W, Perera FP, Jankowski J, Mrozek-Budzyn D, Mroz E, Flak E, Edwards S, Skaupa A, Lisowska-Miszczyk I. Very low pre-natal exposure to lead and mental development of children in infancy and early childhood: Krakow prospective cohort study. Neuroepidemiology. 2009; 32(4):270-278

40) Winneke G, Developmental aspects of environmental neurotoxicology: lessons from lead and polychlorinated biphenyls. J Neurol Sci; 2011; 308: 9-15

41) Navas -Acien A, Guallar E,Sibergeld EK, Rothenberg SJ. Lead exposure and cardiovascular disease – a systematic review. Environ Health Perspect. 2007; 115-:472-82

42) Sirivarasai J, Kaojarern S, Chanprasertyothin, S, Panpunuan P, Petchpoung K, Tatsaneeyapapant A, et Environmental lead exposure, catalase gene, and markers of antioxidant oxidative stress relation to hypertension: an analysis: an analysis based on the EGAT study. Biomed Res Int. 2015;856319

43) Ahamed M, Verma S, Kumar A, Siddiqui MK. Environmental exposure to lead and its correlation with biochemical indices in children. Sci Total Environ. 2005; 326:48-55

44) IARC monographs on the evaluation of carcinogenic risks to humans volume 87: Inorganic and organic lead compounds. International Agency for Research on Cancer, 2004. http://monographs.iarc.fr/ENG/Monographs/vol87/mono87.pdf.

45) Kapai S, Peterson H, Liber K, Bhattarcharya P. Human health effects from chronic arsenic poisoning—a review. J Environ Sci Health A Tox Hazard Subst Environ Eng. 2006;41(10): 2399-2428

46) USEPA. 2002 National primary drinking water regulations. Current drinking water regulations. US Environmental Protection Agency. Office of Water. www.epa.gov/safewater/mcl.html

47) NRC. 2001. Arsenic in Drinking Water. National Research Council. Washington, DC. http://www.nap.edu/openbook/0309076293/html/24html/

48) Health Canada. 2001. Arsenic in Drinking Water. It's your health. http://www.gc.ca/english/iyh/environment/arsenic.html

49) WHO Guidelines for Drinking Water Quality, Third edition. World Health Organization, Geneva, Switzerland. 2003. http://www.sho.int/water.sanitation.health/dwg/en/gdwq3.12.pdf

50) International Agency for Research on Cancer. Arsenic and arsenic compounds. 1980. Vol. 23. 39p. T

51) Centeno JA, Tchounwou PB, Patlolla AK, Mullick FG, Murakata L, Meza E. Gibb H, Longfellow D, Yedjou CG. Environmental Pathology and Health Effects of Arsenic Poisoning: A Critical Review. In Managing Arsenic in the Environment: From Soil to Human Health: Naidu R, Smith R, Owens E, Bhattacharya P; Nadelbaum, Eds; CSIRO Publishing. Melbourne, Australia, 2006; 311-327

52) Luster MI, Smeonova PP. Arsenic and urinary bladder cell proliferation. Toxicol Appl Pharmacol. 2004;198:

53) Rossman TG, Uddin AN, Burns FJ. Evidence that arsenite acts as a cocarcinogen in skin cancer. Toxicol. Appl Pharmacol. 2004: 198: 394-404

54) Ferreccio C, Gonzalez C, Milosavjlevic V, Marshall G, Sancha AM, Smith AH. Lung cancer and arsenic concentrations in drinking water in Chile. Epidemiology. 2000;11(6): 673-679

55) Tsai SY, Chou HY, HW, Chen CM, Chen CJ. The effects of chronic arsenic exposure from drinking water on the neurobehavioral development in adolescence. Neurotoxicology. 2003; 24: 747-753

56) Mukherjee SC, Rahman MM, Chowdhury UK, Sengupta MK, Lodh D, Chanda CR, Saha KC, Chakrahorti D. Neuropathy in arsenic toxicity from ground water arsenic contamination in West Bengal, India. J Environ Sci Health. 2003; A38:165-183

57) Guha Mazunder DN. Chronic arsenic toxicity: clinical features, epidemiology, and treatment: exposure: experience in West Bengal. J Environ Health. 2003; A38: 141-163

58) Wasserman GA, Liu X, Parvez F, Ahsan H, Factor-Litvak P, van Geen A, Slavkovich V, LoLacono NJ, Cheng Z, Hussain I, Momotaj H, Graziano JH. Water arsenic exposure and children's intellectual function in Araihazar, Bangladesh. Environ Health Perspect. 2004; 112(13): 1329-1333

59) Chakrahorti D, Mukherjee SC, Pati S, Sengupta MK, Rahman MM, Chowdhury UK, Lodh D, Chanda CR, Chakrahorti AK, Basu GK. Arsenic groundwater contamination in Middle Ganga Plain, Bihar, India. A future danger? Environ Health Perspect. 2003; 111: 1194-2201

60) Tseng CH, Tai TY, Chong CK, Tseng C, Lai MS, Lin BJ, Chiou HY, Hsueh YM, Hsu KH, Chen CJ. Long-term arsenic exposure and incidence of non-insulin dependent diabetes mellitus: a cohort study in arseniasis-hyperendemic villages in Taiwan. Environ Health Perspect. 2000; 108: 847-851

61) Tseng CH, Tseng C, Chiou HY, Hsueh YM, Chong CK, Chen CJ. Epidemiologic evidence of diabetogenic effect of arsenic. Toxiclol Lett. 2002; 133: 69-76

62) Spalding A, Kernan J, Lockette W. The metabolic syndrome: a modern plague spread by modern technology. J Clin Hypertens (Greenwich) 2009; 11(2): 755-760

63) Wang CH, Jeng JS, Yip K, Chen CL, Hau LI, Hsueh YM, Chiou HY, Wu MM, Chen CJ. Biological gradient between long-term arsenic exposure and carotid atherosclerosis. Circulation 2002;105: 1804-1809

64) Milton AH, Hasan Z, Rahman A, Rahman M. Respiratory effects and arsenic contaminated well water in Bangladesh. Int J Environ Health Res. 2003; 12: 175-179

65) IARC. Occupational and Environmental Health. Recognizing and Preventing Disease and Injury. Oxford, UK. Oxford University Press; 2011: 398-427

66) US Occupational Health and Safety Administration. Proposed rule: occupational exposure to respirable crystalline silica. Fed Regist. 2013; 78: 56273-56504.

67) Castranova V, Vallyathan V. (2000) Silicosis and coal workers' pneumoconiosis. Eviron Health Perspect.108:675-684

68) Chong S, Lee KS, Chung MJ, et al. Pneumoconiosis: comparison of imaging and pathologic findings. Radiographica. 26: 59-77

69) Ding M, Chen F, Shi X, et al. (2002) Diseases caused by silica: mechanism of injury and disease development. Int Immunopharmacol. 2:173-182

70) Ahasic AM, Christiani DC. Respiratory Disorders. In: Levy BS, Wegman DH, Baron ST, Sokas RK, eds Occupational and Environmental Health: Recognizing and Preventing Injury. Oxford, UK. Oxford University Press. 2011:398-426

71) Steenland K, Ward E. Silica: A Lung Carcinogen. CA Cancer J Clin.2104;64:52-69

72) IARC: Working groupon the Evaluation of Carcinogenic Risks to Humans: Silica, Some Silicates, Coal Dust, and Para-Aramid Fibrils. Lyon, 15-22. October1996. IARC Monogr Eval Carcinog Risks Hum.1997;68:1-475

73) Zimmer MS, Chernaik M, Larson D, Maddox R, Miller P. Coal Dust is Alaska: Hazards to Public Health. July 2014. Community Air Quality Monitoring in Seward AK

Appendix Chapter 5: Local Impacts of International Combustion of Coal

References

Anenberg, S.C., West, J.J., Yu, H., Chin, M., Schulz, M., Bergmann, D., Bey, I., Bian, H., Diehl, T., Fiore, A., et al. (2014). Impacts of intercontinental transport of anthropogenic fine particulate matter on human mortality. Air Qual. Atmosphere Health 7, 369–379.

California Energy Commission (2015). Electricity Forecasts.

Christensen, J.N., Weiss-Penzias, P., Fine, R., McDade, C.E., Trzepla, K., Brown, S.T., and Gustin, M.S. (2015). Unraveling the sources of ground level ozone in the Intermountain Western United States using Pb isotopes. Sci. Total Environ. 530–531, 519–525.

City of Oakland (2012). City of Oakland Energy and Climate Action Plan.

Ewing, S.A., Christensen, J.N., Brown, S.T., Vancuren, R.A., Cliff, S.S., and Depaolo, D.J. (2010). Pb isotopes as an indicator of the Asian contribution to particulate air pollution in urban California. Environ. Sci. Technol. 44, 8911–8916.

Gutierrez, I. (2015a). Re: Proposed Oakland Coal Export Terminal.

Lafontaine, S., Schrlau, J., Butler, J., Jia, Y., Harper, B., Harris, S., Bramer, L.M., Waters, K.M., Harding, A., and Simonich, S.L.M. (2015). Relative Influence of Trans-Pacific and Regional Atmospheric Transport of PAHs in the Pacific Northwest, U.S. Environ. Sci. Technol. 49, 13807–13816.

Lin, J., Pan, D., Davis, S.J., Zhang, Q., He, K., Wang, C., Streets, D.G., Wuebbles, D.J., and Guan, D. (2014). China's international trade and air pollution in the United States. Proc. Natl. Acad. Sci. 111, 1736–1741.

Lin, M., Fiore, A.M., Horowitz, L.W., Cooper, O.R., Naik, V., Holloway, J., Johnson, B.J., Middlebrook, A.M., Oltmans, S.J., Pollack, I.B., et al. (2012). Transport of Asian ozone pollution into surface air over the western United States in spring. J. Geophys. Res. Atmospheres 117, D00V07.

No Coal In Oakland (2015). Letter to Hon. Mayor Libby Schaaf and Councilmembers.

Office of Governor Brown (2015). Governor Brown Establishes Most Ambitious Greenhouse Gas Reduction Target in North America.

Pacific Institute (2012). Social Vulnerability to Climate Change in California.

de Place, E. (2012b). Coal Export FAQ.

Sustainable Systems Research, LLC (2015). Technical Memorandum: Air Quality, Climate Change, and Environmental Justice Issues from Oakland Trade and Global Logistics Center.

Union of Concerned Scientists How Coal Works.

Wisland, L. (2015). Letter 4/23/15 - from Dr. Laura Wiseland for Union of Concerned Scientists.

Zhang, L., Jacob, D.J., Boersma, K.F., Jaffe, D.A., Olson, J.R., Bowman, K.W., Worden, J.R., Thompson, A.M., Avery, M.A., Cohen, R.C., et al. (2008). Transpacific transport of ozone pollution and the effect of recent Asian emission increases on air quality in North America: an integrated analysis using satellite, aircraft, ozonesonde, and surface observations. Atmospheric Chem. Phys. Discuss. 8, 8143–8191.

Zhang, L., Jacob, D.J., Kopacz, M., Henze, D.K., Singh, K., and Jaffe, D.A. (2009). Intercontinental source attribution of ozone pollution at western U.S. sites using an adjoint method. Geophys. Res. Lett. 36, L11810.

Zhang, R., Li, G., Fan, J., Wu, D.L., and Molina, M.J. (2007). Intensification of Pacific storm track linked to Asian pollution. Proc. Natl. Acad. Sci. 104, 5295–5299.

Appendix Chapter 6: Responses to Developer Comments on Coal Dust

References

Alhanti, B.A., Chang, H.H., Winquist, A., Mulholland, J.A., Darrow, L.A., and Sarnat, S.E. (2016). Ambient air pollution and emergency department visits for asthma: a multi-city assessment of effect modification by age. J. Expo. Sci. Environ. Epidemiol. 26, 180–188.

Berhane K, Chang C, McConnell R, and et al (2016). ASsociation of changes in air quality with bronchitic symptoms in children in california, 1993-2012. JAMA 315, 1491–1501.

Brauer, M., Hoek, G., Smit, H.A., de Jongste, J.C., Gerritsen, J., Postma, D.S., Kerkhof, M., and Brunekreef, B. (2007). Air pollution and development of asthma, allergy and infections in a birth cohort. Eur. Respir. J. 29, 879–888.

Brickley, P. (2016). Peabody Energy Gets Go-Ahead for $800 Million Bankruptcy Financing. Wall Str. J.

Bridges, J. (2015). Letter to Ms. Sabrina Landreth, City Administrator.

Burns, W. (2015). Letter to Oakland City Council.

California Environmental Protection Agency (2004). Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil.

Colinet, J. (2010). Health Effects of Overexposure to Respirable Silica Dust.

Epstein, P.R., Buonocore, J.J., Eckerle, K., Hendryx, M., Stout III, B.M., Heinberg, R., Clapp, R.W., May, B., Reinhart, N.L., Ahern, M.M., et al. (2011). Full cost accounting for the life cycle of coal. Ann. N. Y. Acad. Sci. 1219, 73–98.

Foo, L.J. (2015). Response to Question #8.

Fox, P. (2015). Environmental, health and safety impacts of the proposed Oakland Bulk and Oversized Terminal.

Galvis, B., Bergin, M., and Russell, A. (2013). Fuel-based fine particulate and black carbon emission factors from a railyard area in Atlanta. J. Air Waste Manag. Assoc. 1995 63, 648–658.

Gutierrez, I. (2015b). Re: Proposed Oakland Coal Export Terminal.

Hossfeld, R.J., and Hatt, R. (2005). PRB Coal Degradation - Causes and Cures.

Jaffe, D., Putz, J., Hof, G., Hof, G., Hee, J., Lommers-Johnson, D.A., Gabela, F., Fry, J.L., Ayres, B., Kelp, M., et al. (2015). Diesel particulate matter and coal dust from trains in the Columbia River Gorge, Washington State, USA. Atmospheric Pollut. Res. 6, 946–952.

Jaffe, D.A., Hof, G., Malashanka, S., Putz, J., Thayer, J., Fry, J.L., Ayres, B., and Pierce, J.R. (2014). Diesel particulate matter emission factors and air quality implications from in–service rail in Washington State, USA. Atmospheric Pollut. Res. 5, 344–351.

Kammen, D. (2013). For Greater Job Growth, Invest in Clean Energy, Not U.S. Coal Exports.

Künzli, N., Bridevaux, P.-O., Liu, S., Garcia-Esteban, R., Schindler, C., Gerbase, M., Sunyer, J., Keidel, D., and Rochat, T. (2009). Traffic-Related Air Pollution Correlates with Adult-Onset Asthma among Never-Smokers. Thorax.

Leon Hsu, H.-H., Mathilda Chiu, Y.-H., Coull, B.A., Kloog, I., Schwartz, J., Lee, A., Wright, R.O., and Wright, R.J. (2015). Prenatal Particulate Air Pollution and Asthma Onset in Urban Children. Identifying Sensitive Windows and Sex Differences. Am. J. Respir. Crit. Care Med. 192, 1052–1059.

Liebsch, E.J., and Musso, M. (2015). Oakland Bulk and Oversized Terminal Air Quality & Human Health and Safety Assessment of Potential Coal Dust Emissions.

Malig, B.J., Green, S., Basu, R., and Broadwin, R. (2013). Coarse particles and respiratory emergency department visits in California. Am. J. Epidemiol. 178, 58–69.

McConnell, R., Berhane, K., Gilliland, F., Molitor, J., Thomas, D., Lurmann, F., Avol, E., Gauderman, W.J., and Peters, J.M. (2003). Prospective Study of Air Pollution and Bronchitic Symptoms in Children with Asthma. Am. J. Respir. Crit. Care Med. 168, 790–797.

Neophytou, A.M., White, M.J., Oh, S.S., Thakur, N., Galanter, J.M., Nishimura, K.K., Pino-Yanes, M., Torgerson, D.G., Gignoux, C.R., Eng, C., et al. (2016). Air Pollution and Lung Function in Minority Youth with Asthma in the GALA II (Genes–Environments and Admixture in Latino Americans) and SAGE II (Study of African Americans, Asthma, Genes, and Environments) Studies. Am. J. Respir. Crit. Care Med. 193, 1271–1280.

No Coal In Oakland (2015). Letter to Hon. Mayor Libby Schaaf and Councilmembers.

Ostro, B. (2016). Personal communication between Dr. Bart Ostro and Dr. Daniel Jaffe.

de Place, E. (2012). Coal's Spontaneous Combustion Problem.

Rossoff, M. (2015). Email received for 9/21/15 hearing on Army Base Gateway Redevelopment Project.

Sanzillo, T. (2015). Oakland Testimony: Tom Sanzillo.

Small, J. (2015). Coal Train Dust Worries Richmond Residents.

Smith, D.C. (2015). September 21, 2015, Oakland City Council Public Hearing.

Strickland, M.J., Hao, H., Hu, X., Chang, H.H., Darrow, L.A., and Liu, Y. (2015). Pediatric Emergency Visits and Short-Term Changes in PM2.5 Concentrations in the U.S. State of Georgia. Environ. Health Perspect. 124.

Tagami, P., and Bridges, J. (2015). Responses and Information for City Follow-Up Questions to September 21 Informational Hearing.

U.S. Department of Energy (1993). EH-93-4 The Fire Below: Spontaneous Combustion in Coal.

U.S. Department of Transportation Surface Transportation Board (2011). 03/03/2011 - Decision - 40436.

U.S. EPA (U.S. Environmental Protection Agency) (2012). Provisional Assessment of Recent Studies on Health Effects of Particulate Matter Exposure.

USEPA Office of Air Quality Planning and Standards (1995). Emissions Factors & AP 42.

USEPA (U.S. Environmental Protection Agency) (2009a). Steam Electric Power Generating Point Source Category: Final Detailed Study Report.

Vorhees, J. (2010). Railroads, Utilities Clash Over Dust From Coal Trains. N. Y. Times.

WHO (2003). Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide.

Wisland, L. (2015). Letter 4/23/15 - from Dr. Laura Wiseland for Union of Concerned Scientists.

Young, M.T., Sandler, D.P., DeRoo, L.A., Vedal, S., Kaufman, J.D., and London, S.J. (2014). Ambient Air Pollution Exposure and Incident Adult Asthma in a Nationwide Cohort of U.S. Women. Am. J. Respir. Crit. Care Med. 190, 914–921.

Zhao, Z.-B., Liu, K., Xie, W., Pan, W.-P., and Riley, J.T. (2000). Soluble polycyclic aromatic hydrocarbons in raw coals. J. Hazard. Mater. 73, 77–85.

Appendix Chapter 7: Occupational and Environmental Hazards of Coal Transport and Handling

References

1. Terminal Logistics Solutions, *Oakland Bulk and Oversize Terminal Draft Basis of Design Volume 1*, 2015: Oakland. p. 18.
2. Berkowitz, N., *An Introduction to Coal Technology, Second Edition.* 1994, San Diego: Academic Press.
3. Amyotte, P., *Chapter 4 - Myth No. 3 (Fuel): A Lot of Dust Is Needed to Have an Explosion*, in *An Introduction to Dust Explosions.* 2013, Butterworth-Heinemann: Boston. p. 31-38.
4. Amyotte, P., *Chapter 2 - Myth No. 1 (Fuel): Dust Does Not Explode*, in *An Introduction to Dust Explosions.* 2013, Butterworth-Heinemann: Boston. p. 9-16.
5. Amyotte, P., *Chapter 5 - Myth No. 4 (Fuel): Gas Explosions Are Much Worse Than Dust Explosions*, in *An Introduction to Dust Explosions.* 2013, Butterworth-Heinemann: Boston. p. 39- 50.
6. Amyotte, P., *Chapter 1 - Introduction: Dust Explosions—Myth or Reality?*, in *An Introduction to Dust Explosions* 2013, Butterworth-Heinemann: Boston. p. 1-7.
7. Harris, M.L., et al., *Particle size and surface area effects on explosibility using a 20-L chamber.* Journal of Loss Prevention in the Process Industries, 2015. **37**: p. 33-38.
8. Cashdollar, K.L., *Coal dust explosibility.* Journal of Loss Prevention in the Process Industries, 1996. **9**(1): p. 65-76.
9. Yuan, Z., et al., *Dust explosions: A threat to the process industries.* Process Safety and Environmental Protection, 2015. **98**: p. 57-71.
10. Sapko, M.J., K.L. Cashdollar, and G.M. Green, *Coal dust particle size survey of US mines.* Journal of Loss Prevention in the Process Industries, 2007. **20**(4–6): p. 616-620.
11. Exponent, *Coke and Coal Shiploading Fire: Los Angeles Port*, 2008.
12. Lazo, J.K. and K.T. McClain, *Community perceptions, environmental impacts, and energy policy - Rail shipment of coal.* Energy Policy, 1996. **24**(6): p. 531-540.
13. CDC, *Two Volunteer Fire Fighters Die After an Explosion While Attempting to Extinguish a Fire in a Coal Storage Silo – South Dakota.* Fatality Reports, 2012. **F2011-22 Date Released: September 14, 2012**
14. Blackley, D.J., C.N. Halldin, and A.S. Laney, *Resurgence of a debilitating and entirely preventable respiratory disease among working coal miners.* American journal of respiratory and critical care medicine, 2014. **190**(6): p. 708-9.
15. DOL, U.S Department of Labor. *Respirable Dust Rule: A Historic Step Forward in the Effort to End Black Lung Disease*. 2016 May 17, 2016]; Available from: https://www.msha.gov/news- media/special-initiatives/2016/09/28/respirable-dust-rule-historic-step-forward-effort-end.
16. NIOSH. DEPARTMENT OF HEALTH AND HUMAN SERVICES, *Coal Mine Dust Exposures and Associated Health Outcomes A Review of Information Published Since 1995*, 2011.
17. Halldin, C.N., B.C. Doney, and E. Hnizdo, *Changes in prevalence of chronic obstructive pulmonary disease and asthma in the US population and associated risk factors.* Chronic respiratory disease, 2015. **12**(1): p. 47-60.
18. Halldin, C.N., et al., *Debilitating lung disease among surface coal miners with no underground mining tenure.* Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine, 2015. **57**(1): p. 62-7.
19. Laney, A.S. and D.N. Weissman, *The classic pneumoconioses: new epidemiological and laboratory observations.* Clin Chest Med, 2012. **33**(4): p. 745-58.
20. Laney, A.S. and D.N. Weissman, *Respiratory diseases caused by coal mine dust.* J Occup Environ Med, 2014. **56 Suppl 10**: p. S18-22.
21. Verma, S.K., et al., *Investigations on PAHs and trace elements in coal and its combustion residues from a power plant.* Fuel, 2015. **162**: p. 138-147.
22. Zhao, Z.B., et al., *Soluble polycyclic aromatic hydrocarbons in raw coals.* Journal of hazardous materials, 2000. **73**(1): p. 77-85.
23. Australia, Department of Environmental Protection, Queensland, *Coal Dust Management*.
24. Small, J., *Coal train dust worries Richmond residents*, 2015, KQED.

25. Zonailo, G.W., *21 - Transportation by rail and sea in the coal industry A2 - Osborne, Dave*, in *The Coal Handbook: Towards Cleaner Production.* 2013, Woodhead Publishing. p. 705-730.

26. Bach, E., *20 - Coal handling along the supply chain*, in *The Coal Handbook: Towards Cleaner Production.* 2013, Woodhead Publishing. p. 654-704.

27. Eckhoff, R.K., *Current status and expected future trends in dust explosion research.* Journal of Loss Prevention in the Process Industries, 2005. **18**(4–6): p. 225-237.

28. US Surface Transportation Board, *Release: SURFACE TRANSPORTATION BOARD ISSUES DECISION ON COAL DUST*, 2011.

29. US Surface Transportation Board, *SURFACE TRANSPORTATION BOARD DECISION Docket No. FD 35305 . ARKANSAS ELECTRIC COOPERATIV E CORPORATION—PETITION FOR DECLARATORY ORDER .* 2011.

30. GATX, *Gravity Discharge Hopper Rail Cars*.

31. Walker, M., *Memorandum for Record on SUBJECT: Gateway Pacific Terminal Project and Lummi Nation's Usual and Accustomed Treaty Fishing Rights at Cherry Point, Whatcom County*, US Army Corps of Engineers, 2016.

32. Pastorino, R., et al., *Area risk analysis in an urban port: Personnel and major accident risk issues*, in *Chemical Engineering Transactions.* 2014. p. 343-348.

33. Christou, M.D., *Analysis and control of major accidents from the intermediate temporary storage of dangerous substances in marshalling yards and port areas.* Journal of Loss Prevention in the Process Industries, 1999. **12**(1): p. 109-119.

34. Amyotte, P.R., M.J. Pegg, and F.I. Khan, *Application of inherent safety principles to dust explosion prevention and mitigation.* Process Safety and Environmental Protection, 2009. **87**(1): p. 35-39.

35. Thomas F. Edgar, *Coal Processing and Pollutioin Control.* 1983, Houston: Gulf Publishing Company.

36. Achten, C. and T. Hofmann, *Native polycyclic aromatic hydrocarbons (PAH) in coals – A hardly recognized source of environmental contamination.* Science of the Total Environment, 2009. **407**(8): p. 2461-2473.

37. Johnson, R. and R.M. Bustin, *Coal dust dispersal around a marine coal terminal (1977–1999), British Columbia: The fate of coal dust in the marine environment.* International Journal of Coal Geology, 2006. **68**(1–2): p. 57-69.

38. Laumann, S., et al., *Variations in concentrations and compositions of polycyclic aromatic hydrocarbons (PAHs) in coals related to the coal rank and origin.* Environmental Pollution, 2011. **159**(10): p. 2690-2697.

39. Stout, S.A. and S.D. Emsbo-Mattingly, *Concentration and character of PAHs and other hydrocarbons in coals of varying rank – Implications for environmental studies of soils and sediments containing particulate coal.* Organic Geochemistry, 2008. **39**(7): p. 801-819.

40. de Souza, M.R., et al., *Evaluation of the genotoxic potential of soil contaminated with mineral coal tailings on snail Helix aspersa.* Chemosphere, 2015. **139**: p. 512-517.

41. Wei, M., Z.S. Yu, and H.X. Zhang, *Molecular characterization of microbial communities in bioaerosols of a coal mine by 454 pyrosequencing and real-time PCR.* Journal of Environmental Sciences, 2015. **30**: p. 241-251.

42. Caballero-Gallardo, K. and J. Olivero-Verbel, *Mice housed on coal dust-contaminated sand: A model to evaluate the impacts of coal mining on health.* Toxicology and Applied Pharmacology, 2016. **294**: p. 11-20.

43. Caballero-Gallardo, K., et al., *Chemical and toxicological characterization of sediments along a Colombian shoreline impacted by coal export terminals.* Chemosphere, 2015. **138**: p. 837-846.

44. James, G.L., *Chapter 19 - Coal conveying*, in *The Coal Handbook: Towards Cleaner Production.* 2013, Woodhead Publishing. p. 628-653.

45. European Commission, *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques on Emissions from Storage.* 2006.

46. Holzer, T.L., et al., *Liquefaction Hazard and Shaking Amplification Maps of Alameda, Berkeley, Emeryville, Oakland, and Piedmont, California: A Digital Database Version 1.2*, 2010, U.S. Geological Survey.

Appendix Chapter 8: Climate Change and Health in Oakland

References

Alexander K. 2013. Yosemite fire threatening SF's water supply. SFGate. Available from: http://www.sfgate.com/news/article/Yosemite-fire-threatening-SF-s-water-supply-4766176.php

Allen M, Frame D, Frieler K, Hare W, Huntingford C, Jones C, Knutti R, Lowe J, Meinshausen M, Meinshausen N, Raper S. 2009. The exit strategy. Nature Reports Climate Change 56–58.

Allen MR, Frame DJ, Huntingford C, Jones CD, Lowe JA, Meinshausen M, Meinshausen N. 2009. Warming caused by cumulative carbon emissions towards the trillionth tonne. Nature 458: 1163–1166.

American Lung Association (ALA). 2016. Ozone Pollution. Available from: http://www.stateoftheair.org/2015/key-findings/ozone-pollution.html

Archer D, Eby M, Brovkin V, Ridgwell A, Cao L, Mikolajewicz U, Caldeira K, Matsumoto K, Munhoven G, Montenegro A, Tokos K. 2009. Atmospheric Lifetime of Fossil Fuel Carbon Dioxide. Annual Review of Earth and Planetary Sciences 37: 117–134.

Basu R, Ostro B. 2008a. Characterizing Temperature and Mortality in Nine California counties, 1999–2003. Sacramento:California Energy Commission, PIER Energy-Related Environmental Research.

Basu R, Ostro BD. 2008b. A multicounty analysis identifying the populations vulnerable to mortality associated with high ambient temperature in California. Am J Epidemiol 168(6):632–637.

Bates BC, Kundzewicz ZW, Wu S, Palutikof JP, editors. 2008. Climate change and water. Geneva: International Panel on Climate Change Secretariat.

Bay Area Air Quality Management District (BAAQMD). 2011. California Environmental Quality Act Air Quality Guidelines. Available from
http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/BAAQMD%20CEQA%20Guidelines%20May%202011.ashx?la=en

Bay Area Air Quality Management District (BAAQMD). 2014a. Bay Area Emissions Inventory Summary Report: Criteria Air Pollutants Base Year 2011. Available from:
http://baaqmd.gov/~/media/Files/Planning%20and%20Research/Emission%20Inventory/BY2011_GHGSummary.ashx?la=en)

Bay Area Air Quality Management District (BAAQMD). 2014b. Improving Air Quality and Health In Bay Area Communities: Community Air Risk Evaluation Program Retrospective & Path Forward (2004 - 2013)

Bay Area Air Quality Management District (BAAQMD). 2015. Bay Area Emissions Inventory Summary Report – Base Year 2011 (Updated: January 2015). Available at
http://baaqmd.gov/~/media/Files/Planning%20and%20Research/Emission%20Inventory/BY2011_GHGSummary.ashx?la=en

Bay Area Air Quality Management District (BAAQMD). 2016. Air Quality Standards and Attainment Status. Available from: http://www.baaqmd.gov/research-and-data/air-quality-standards-and-attainment-status

Bernard S. 2016. King Coal's Final Fight in Washington. Seattle Weekly. Available from: http://www.seattleweekly.com/news/the-last-remaining-coal-terminals-last-chance-for-public-comment-2559319/

Berdalet E, Fleming L, Gowen R, Davidson K, Hess, P, Backer LC, Moore SK, Hoagland P, Enevoldsen H. 2015. Marine harmful algal blooms, human health and wellbeing: challenges and opportunities in the 21st century. J Mar Biol Assoc U.K. December. 10.1017/S0025315415001733. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4676275/

Finlay SE, Moffat A, Gazzrard R, Baker D, Murray V. 2012. Health Impacts of Wildfires Version 1. PLoS Curr. 2012 November 2; 4: e4f959951cce2c.

Bobb JF, Peng RD, Bell ML, Dominici F. 2014. Heat-related mortality and adaptation to heat in the United States. *Environmental Health Perspectives* 122: 811–816.

BondGraham D. 2015. Banking on Coal in Oakland. East Bay Express. Available from: http://www.eastbayexpress.com/oakland/banking-on-coal-in-oakland/Content?oid=4463888

Brahic, Catherine. 2009. Humanity's Carbon Budget Set at One Trillion Tons, New Scientist; access at http://www.newscientist.com/article/dn17051-humanitys-carbon-budget-set-at-one-trillion-tonnes.html

California Air Resources Board. 2015a. California Greenhouse Gas Emission Inventory—2015 Edition. Available from: http://www.arb.ca.gov/cc/inventory/data/data.htm.

California Air Resources Board. 2015b. California 1990 Greenhouse Emissions Level and 2020 Limit. Available from: http://www.arb.ca.gov/cc/inventory/1990level/1990level.htm (accessed June 11, 2016).

California Air Resources Board. 2015c. Frequently Asked Questions About Executive Order B-30-15: 2030 Carbon Target and Adaptation. Available from: http://www.arb.ca.gov/newsrel/2030_carbon_target_adaptation_faq.pdf (accessed June 11, 2016).

California Climate Change Center. July 2012. Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area: A Synthesis of PIER Program Reports and Other Relevant Research, A White Paper from the California Energy Commission's California Climate Change Center. *Available from* http://www.energy.ca.gov/2012publications/CEC-500-2012-071/CEC-500-2012-071.pdf.

California Department of Public Health, 2012. Climate health vulnerability assessment for Contra Costa County. Available from: https://www.cdph.ca.gov/programs/Documents/DRAFT%20Climate%20Change%20and%20Health%20Profile%20Report,%20Contra%20Costa-Example.pdf

California Department of Public Health. 2014. Climate and Health Profile Report, Contra Costa County (Example). Available from: https://www.cdph.ca.gov/programs/Documents/DRAFT%20Climate%20Change%20and%20Health%20Profile%20Report,%20Contra%20Costa-Example.pdf

California Department of Public Health. 2012. Climate Action for Health: Integrating Public Health into Climate Action Planning, 2012. Available from: http://www.cdph.ca.gov/programs/CCDPHP/Documents/CAPS_and_Health_Published3-22-12.pdf

California Energy Commission. 2010. Second California Climate Change Assessment. Estimating the mortality effect of the July 2006 California Heat wave. Available from: http://www.energy.ca/gov/2009publications/CEC-500-2009-036/CEC-500-2009-036.F.PDF

California Energy Commission's California Climate Change Center. 2012. Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area: A Synthesis of PIER Program Reports and Other Relevant Research, A White Paper. Available at: http://www.energy.ca.gov/2012publications/CEC-500-2012-071/CEC-500-2012- City of Oakland. 2016. Preliminary Resilience Assessment, February.071.pdf.

California Energy Commission, 2016. Cal-Adapt. Available from: http://cal-adapt.org/tools/factsheet/)

California Environmental Protection Agency Air Resources Board (CARB). 2015. California Greenhouse Gas Emission Inventory - 2015 Edition: 2000-2013 inventory by economic sector - Full Detail.

California Natural Resources Agency. 2009. 2009 California Climate Adaptation Strategy. Available at http://resources.ca.gov/docs/climate/Statewide_Adaptation_Strategy.pdf (accessed June 11, 2016).

California Supreme Court. 2015. *Center for Biological Diversity v. Calif. Dept. of Fish and Wildlife* (2015) 62 Cal.4th 204.

Canadian Global Change Program. 1995. Implications of Global Change for Human Health. Final Report of the Health Issues Panel, The Royal Society of Canada, Ottawa, ON, Canada.

Carbon Brief. 2015. Carbon Brief, *Six Years of Current Emissions Would Blow the Carbon Budget for 1.5 Degrees*. Available at http://www.carbonbrief.org/six-years-worth-of-current-emissions-would-blow-the-carbon-budget-for-1-5-degrees (accessed June 11, 2016).

Center for Climate and Energy Solutions. Coal. 2016. Available from: http://www.c2es.org/energy/source/coal (accessed June 11, 2016).

Centers for Disease Control and Prevention, United States Environmental Protection Agency, National Oceanic and Atmospheric Agency and Water Works Association, 2010. When every drop counts: protecting public health during drought conditions—a guide for public health professionals. Atlanta, GA. United States Department of Health and Human Services. Available from: https://www.cdc.gov/nceh/ehs/docs/when_every_drop_counts.pdf

Centers for Disease Control and Prevention, National Center for Environmental Health. 2012. Climate Change and Extreme Heat Events. Atlanta, GA. United States Department of Health and Human Services. Available from: https://www.cdc.gov/climateandhealth/pubs/ClimateChangeandExtremeHeatEvents.pdf

City of Oakland. 2012. City of Oakland Energy and Climate Action Plan. Available from: http://www2.oaklandnet.com/Government/o/PWA/s/SO/OAK025294

City of Oakland. 2013. Development Agreement by and between City of Oakland and Prologis CCIG Oakland Global, LLC Regarding the Property and Project Known as "Gateway Development/Oakland Global."

City of Oakland. 2016a. 2016-2021 Local Hazard Mitigation Plan.

City of Oakland. 2016b. Preliminary Resilience Assessment.

Clean Air Task Force. 2010. Available from: http://www.catf.us/fossil/problems/power_plants/

Committee on Sea Level Rise in California, Oregon, and Washington, Board on Earth Sciences and Resources, Ocean Studies Board, Division on Earth and Life Studies, National Research Council. 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Washington, D.C.: National Academies Press.

COP21 United Nations Climate Change Conference (COP21). 2015. Climate Change 2015-2016. Available from: http://www.climateactionprogramme.org/bookstore/book_2015

Department of Water Resources, State of California The Resources Agency. 1979. The 1976-1977 Drought in California: A Review. http://www.water.ca.gov/watertransfers/docs/9_drought-1976-77.pdf

DARA and the Climate Vulnerability Monitor, 2nd Edition. 2012. A Guide to the Cold Calculus of a Hot Planet. Available from: http://daraint.org/wpcontent/uploads/2012/09/CVM2ndEdFrontMatter.pdf

Davis SJ, Caldeira K. 2010. Consumption-based accounting of CO2 emissions. Proceedings of the National Academy of Sciences 107: 5687–5692.

Davis SJ, Socolow RH. 2014. Commitment accounting of CO 2 emissions. Environmental Research Letters 9: 84018.

Delfino RJ, Brummel S, Wu J, Stern H, Ostro B, Lipsett M, et al. 2009. The relationship of respiratory and cardiovascular hospital admissions to the southern California wildfires of 2003. *Occupational & Environmental Medicine* Mar;66(3):189-97. http://www.ncbi.nlm.nih.gov/pubmed/19017694

de Place, Eric. 2011. Northwest Coal Exports: Some Common Questions about economics, health, and pollution. Available from: www.sightline.org/wp-content/uploads/downloads/2012/11/coal-FAQ-November-12.pdf

Deschênes O, Greenstone M. 2011. Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the US. American Economic Journal: Applied Economics 3: 152–185.

East Bay Municipal Utility District (EBMUD). 2014 Climate Change Monitoring and Response Plan 2014.

The Economist. April, 2013. "Wood: the Fuel of the Future". Access at: http://www.economist.com/news/business/21575771-environmental-lunacy-europe-fuel-future

Elber G. 2013. Port's coal project grinds to a halt. The World. Available from: http://theworldlink.com/news/local/port-s-coal-project-grinds-to-a-halt/article_e1bbf2ee-9b3d-11e2-b55a-0019bb2963f4.html

Foster, John Bellamy. 2011. Occupy Denialism: Toward Ecological and Social Revolution, MRZine; Available from http://mrzine.monthlyreview.org/2011/foster111111.html.

Fox P. 2015. Environmental, health and safety impacts of the proposed Oakland Bulk and Oversized Terminal.

Freedman, Andrew. U.S. Airports Face Increasing Threat From Rising Seas, Climate Central, June 18, 2013; Available from http://www.climatecentral.org/news/coastal-us-airports-face-increasing-threat-from-sea-level-rise-16126.

Freeman, G., Sidhu, N. D., & Poghosyan, M. 2008. The AB 32 Challenge: Reducing California's Greenhouse Gas Emissions. Prepared for the Southern California Leadership Council.

Ginsberg M. et. al. 2008. Monitoring Health Effects of Wildfires Using the BioSense System --- San Diego County, California, October 2007. *MMWR* July 11/ 57(27);741-747. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5727a2.htm

Global Coal Plant Tracker. 2016. Proposed Coal Plants by Country: Generating Units December 2015. Available from: http://endcoal.org/wp-content/uploads/2016/01/Global-Coal-Plant-TrackerDecember-2015-Countries-Units.pdf

Goldenberg, Janet. 2016. Plans for coal-fired power in Asia are 'disaster for planet' warns World Bank. The Guardian (May 5, 2016) Available on the internet at: http://www.theguardian.com/environment/2016/may/05/climate-change-coal-power-asia-world-bank-disaster (accessed May 23, 2016).

Grady, Barbara. Sea Level Rise Threatens Oakland's Sewer System, Climate Central. June 2014. Available from http://www.climatecentral.org/news/sea-level-rise-oakland-sewer-17567.

Grady, Barbara. When the sea levels rise in the Bay, where will it hurt in Oakland? Oakland Local. June 2014. Available from http://oaklandlocal.com/2014/06/when-the-sea-levels-rise-in-the-bay-where-it-will-hurt-in-oakland/.

Greenhouse Gas Protocol. 2011. Product Life Cycle Accounting and Reporting Standard. .

Gutierrez I. 2015. Re: Proposed Oakland Coal Export Terminal.

Haines A, Parry M. 1993. Climate change and human health. Journal of the Royal Society of Medicine 86: 707–711.

Hansen JE. 2005. A slippery slope: How much global warming constitutes "dangerous anthropogenic interference"?: An Editorial Essay. Climatic Change 68: 269–279.

Hansen J, Sato M. 2016. Regional climate change and national responsibilities. Environmental Research Letters 11:3 4009.

Hansen J, Sato M, Hearty P, Ruedy R, Kelley M, Masson-Delmotte V, Russell G, Tselioudis G, Cao J, Rignot E, Velicogna I, Tormey B, Donovan B, Kandiano E, von Schuckmann K, Kharecha P, Legrande AN, Bauer M, Lo K-W. 2016. Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2 °C global warming could be dangerous. Atmos. Chem. Phys. 16: 3761–3812.

Health and Environment Alliance (HEAL). 2013. The Unpaid Health Bill: How coal power plants make us sick. Available from: http://www.envhealth.org/news/latestnews/article/theunpaidhealthbillhowcoal

Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC, 312 . Available from: http://dx.doi.org/10.7930/J0R49NQX

Höhne N, Day T, Hänsel G, Fekete H. 2015. Assessing the missed benefits of countries' national contributions: Quantifying potential cobenefits. New Climate. Available from: https://newclimate.org/2015/03/27/indccobenefits/

Hong & E.R. Slatik,1994. Energy Information Administration, Quarterly Coal Report, January-April 1994, DOE/EIA-0121(94/Q1), Available from: http://www.eia.gov/coal/production/quarterly/co2_article/co2.html.

Höhne N, Day T, Hänsel G, Fekete H. 2015. Assessing the missed benefits of countries' national contributions: Quantifying potential cobenefits. New Climate. Available from: https://newclimate.org/2015/03/27/indccobenefits/

Hoshiko S, English P, Smith D, Trent R. 2010. A simple method for estimating excess mortality due to heat waves, as applied to the 2006 California heat wave. International Journal of Public Health 55: 133–137.

Howitt RE, MacEwan D, Medellín-Azuara J, Lund JR, Sumner DA. 2015. Economic Analysis of the 2015 Drought for California Agriculture. Center for Watershed Sciences, University of California – Davis, Davis, CA. Available from: http://www.ipcc.ch/ipccreports/sres/regional/index.php?idp=238

Intergovernmental Panel on Climate Change (IPCC). 1997. The Regional Impacts of Climate Change: An Assessment of Vulnerability. Watson RT, Zinyowera MC, Moss RH (Eds) Cambridge University Press, UK. pp 517. http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: The Physical Science Basis—Summary for Policymakers. Geneva

Intergovernmental Panel on Climate Change (IPCC). 2013a. Climate Change 2013: the Physical Science Basis-Summary for Policymakers. Stockholm. Available from http://www.climatechange2013.org/

Intergovernmental Panel on Climate Change (IPCC). 2013b. IPCC, Climate Change 2014: Synthesis Report. Available from: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_All_Topics.pdf

Intergovernmental Panel on Climate Change (IPCC). 2013c. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Intergovernmental Panel on Climate Change (IPCC). 2014. Climate Change 2014: Mitigation of Climate Change. Stockholm. Available from: https://www.ipcc.ch/report/ar5/wg3/

Jacobson MZ. 2008. On the Causal Link Between Carbon Dioxide and Air Pollution Mortality, Geophysical Research Letters, 35. Available from: https://web.stanford.edu/group/efmh/jacobson/Articles/V/2007GL031101.pdf

Jaffe D, Prestbo E, Swartzendruber P, Weiss-Penzias P, Kato S, Takami A, Hatakeyama S, Kajii Y. 2005. Export of atmospheric mercury from Asia. Atmospheric Environment 39: 3029–3038.

Johnston F, Hanighan I, Henderson S, Morgan G, Bowman D. 2011. Extreme air pollution events from bushfires and dust storms and their association with mortality in Sydney, Australia 1994–2007. *Environmental Health* May 6. http://www.sciencedirect.com/science/article/pii/S0013935111001241

Knowlton K, Rotkin-Ellman M, King G, Margolis HG, Smith D, Solomon G, Trent R, English P. 2009. The 2006 California Heat Wave: Impacts on Hospitalizations and Emergency Department Visits. *Environ Health Perspect*,Vol 117(1). DOI:10.1289/ehp.11594. http://ehp.niehs.nih.gov/11594/

Lai KK R. 2016. How Much Warmer Was Your City in 2015? New York Times, Science Feb. 19. Available from: http://www.nytimes.com/interactive/2016/02/19/us/2015-year-in-weather-temperature-precipitation.html#berkeley_ca

Lancet Commission on Health and Climate. 2015. The Lancet: Climate change threatens to undermine the last half century of health gains. Available from: https://climatehealthcommission.files.wordpress.com/2015/04/press-release-health-and-climate-commission.pdf

Liberman, D. Climate Change: Global Risks, Challenges, and Decisions (Cambridge: Cambridge University Press, 2011), 212.

Jia C. Liu, Gavin Pereira, Sarah A. Uhl, Mercedes A. Bravo, Michelle L. Bell

Environ Res. Author manuscript; available in PMC 2016 January 1.

Liu JC, Pereira G, Uhl SA, Bravo MA, Bell BM. 2015. A systematic review of the physical health impacts from non-occupational exposure to wildfire smoke. *Environ Res.* January; 120–132. doi: 10.1016/j.envres.2014.10.015 ß http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4262561/

LoPresti A, Charland A, Woodard D, Randerson J, Diffenbaugh NS, Davis SJ. 2015. Rate and velocity of climate change caused by cumulative carbon emissions. Environmental Research Letters 10: 95001.

Maffly, B. The Salt Lake City Tribune, April 2015. Utah coal: California, here it comes — and not everyone is happy. Available from: http://www.sltrib.com/home/2425141-155/utah-coal-california-here-it-comes.

Matthews HD, Solomon S, Pierrehumbert R. 2012. Cumulative carbon as a policy framework for achieving climate stabilization. Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences 370: 4365–4379.

McGreevy P. 2003. L.A. Weighs Costly Exit From Coal Terminal. Los Angeles Times.

McKibben,Bill. July,2012. Global Warming's Terrifying New Math, Rolling Stone. Available from: http://www.rollingstone.com/politics/news/global-warmings-terrifying-new-math-20120719.

Meinshausen M, Meinshausen N, Hare W, Raper SCB, Frieler K, Knutti R, Frame DJ, Allen MR. 2009. Greenhouse-gas emission targets for limiting global warming to 2 °C. Nature 458: 1158–1162.

Mills D, Schwartz J, Lee M, Sarofim M, Jones R, Lawson M, Duckworth M, Deck L. 2014. Climate change impacts on extreme temperature mortality in select metropolitan areas in the United States. Climatic Change 131: 83–95.

Moore D, Copes R, Fisk R, Joy R, Chan K, Brauer M. 2006. Population health effects of air quality changes due to forest fires in British Columbia in 2003 : Estimates from physician-visit billing data. *Canadian Journal of Public Health* 97, 105-108. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3492003/

National Academy of Sciences, 2010. Advancing the Science of Climate Change, National Academies Press, Available from: http://www.nap.edu/catalog/12782/advancing-the-science-of-climate-change

The Nature Conservancy of California. 2012. Where Does California's Water Come From? Land conservation and the watersheds that supply California's drinking water. version 1.1. http://www.nature.org/media/california/california_drinking-water- sources-2012.pdf

Niemeier D. 2015. Technical Memorandum: Air Quality, Climate Change, and Environmental Justice Issues from Oakland Trade and Global Logistics Center.

No Coal In Oakland. 2015. Letter to Hon. Mayor Libby Schaaf and Councilmembers.

NOAA Press Release, March, 2012. Asian Emissions Can Increase Ground Level Ozone Pollution in the U.S. West. Available from: http://researchmatters.noaa.gov/news/Pages/ozonestudy.aspx.

Ostro B, Rauch S, Green S. 2011. Quantifying the health impacts of future changes in temperature in California. Environmental Research 111: 1258–1264.

Ostro BD, Roth LA, Green RS, Basu R. 2009. Estimating the mortality effect of the July 2006 California heat wave. Environmental Research 109: 614–619.

Pacific Institute. 2012. Social Vulnerability to Climate Change in California. Available from: http://pacinst.org/app/uploads/2014/04/social-vulnerability-climate-change-ca.pdf

Pacific Institute. 2014. The Impacts of Sea-Level Rise on the California Coast. Available from: http://pacinst.org/app/uploads/2014/04/sea-level-rise.pdf

Power. 2011. The Greenhouse Gas Impact of Exporting Coal from the West Coast. Sightline Institute. Available from: http://www.sightline.org/research_item/greenhouse-gas-impact-of-exporting-coal/

Quintana A. 2016. TRAC hosts last Millennium Bulk Terminal proposal open house. KVEW TV. Available from: http://www.kvewtv.com/article/2016/jun/02/trac-hosts-last-millennium-bulk-terminal-proposal-/

Reeves WC, Hardy JL, Reisen WK, Milby MM. 1994. Potential effect of global warming on mosquito-borne arboviruses. Journal of Medical Entomology 31: 323–332.

Richardson K, Steffen W, Liverman D. 2011. Climate Change: Global Risks, Challenges, and Decisions. Cambridge: Cambridge University Press.

Rodrique, JP. 2013. "Containerization of Commodities" in The Geography of Transport Systems. New York: Routledge. Available from: https://people.hofstra.edu/geotrans/eng/ch3en/appl3en/ch3a2en.html

Rogelj J, Luderer G, Pietzcker RC, Kriegler E, Schaeffer M, Krey V, Riahi K. 2015. Energy system transformations for limiting end-of-century warming to below 1.5 °C. Nature Climate Change 5: 519–527.

Rogelj J, Schaeffer M, Friedlingstein P, Gillett NP, van Vuuren DP, Riahi K, Allen M, Knutti R. 2016. Differences between carbon budget estimates unravelled. Nature Climate Change 6: 245–252.

San Francisco Bay Conservation and Development Commission, October, 2011. Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline at 2. Available from: http://www.bcdc.gov/BPA/LivingWithRisingBay.pdf.

Sarfaty M, Mitchell M, Bloodhart B, Maibach EW. 2014. A Survey of African American Physicians on the Health Effects of Climate Change. International Journal of Environmental Research and Public Health 11: 12473–12485.

Schleussner C-F, Lissner TK, Fischer EM, Wohland J, Perrette M, Golly A, Rogelj J, Childers K, Schewe J, Frieler K, Mengel M, Hare W, Schaeffer M. 2016. Differential climate impacts for policy-relevant limits to global warming: the case of 1.5 °C and 2 °C. Earth Syst. Dynam. 7: 327–351.

Schwartz JD, Lee M, Kinney PL, Yang S, Mills D, Sarofim MC, Jones R, Streeter R, Juliana AS, Peers J, Horton RM. 2015. Projections of temperature-attributable premature deaths in 209 U.S. cities using a cluster-based Poisson approach. Environmental Health 14: 85.

Seelye, K. 2002. Western Cities Join Suit to Fight Global Warming, New York Times. Available from http://www.nytimes.com/2002/12/24/politics/24ENVI.html/

Semenza JC, Caplan JS, Buescher G, Das T, Brink MV, Gershunov A. 2012. Climate Change and Microbiological Water Quality at California Beaches. EcoHealth DOI: 10.1007/s10393-012-0779-1. http://meteora.ucsd.edu/cap/pdffiles/ecohealth_jul2012_agershunov.pdf

Sheffield PE, Knowlton K, Carr JL, Kinney PL. 2011. Modeling of Regional Climate Change Effects on Ground-Level Ozone and Childhood Asthma. American Journal of Preventive Medicine 41: 251–257.

Siegal D. 2014. Enviros Can't Block Oxbow Coal Export In Long Beach. Law360.

Steffan S, Burritt R. 2000. Contemporary environmental accounting: issues, concepts and practice. Green-leaf Publishing.

Steiner AL, Tonse S, Cohen RC, Goldstein AH, Harley RA. 2006. Influence of future climate and emissions on regional air quality in California. Journal of Geophysical Research: Atmospheres 111: D18303.

Tagami P, Bridges J. 2015. Responses and Information for City Follow-Up Questions to September 21 Informational Hearing.

Temple, J. January, 2013. Projecting warming's impact on Bay Area, SFGate. Available from: http://www.sfgate.com/science/article/Projecting-warming-s-impact-on-Bay-Area-4170481.php.

Tirado MC, Clarke R, Jaykus LA, McQuatters-Gollop A, Frank JM. 2010. Climate change and food safety: A review. Food Research International 43 (2010) 1745–1765. doi:10.1016/j.foodres.2010.07.003. http://ucanr.edu/datastorefiles/608-149.pdf

Tschakert P. 2015. 1.5°C or 2°C: a conduit's view from the science-policy interface at COP20 in Lima, Peru. Climate Change Responses 2: 3.

UNFCCC. Conference of the Parties (COP). 2015. Adoption of the Paris Agreement. Proposal by the President.

United State Energy Information Agency (EIA). 2016. Carbon Dioxide Emissions Coefficients. Available from http://www.eia.gov/environment/emissions/co2_vol_mass.cfm.

United States Environmental Protection Agency (EPA). 2013. Integrated Science Assessment for Ozone and Related Photochemical Oxidants.

United States Environmental Protection Agency (EPA). 2014. Air Quality Trends.

United States Environmental Protection Agency (EPA). 2016a. Climate Change and Human Health. Accessed from the internet at: https://www3.epa.gov/climatechange/impacts/health.html#impactsheat and at https://www3.epa.gov/climatechange/impacts-adaptation-renamed/health.html

United States Environmental Protection Agency (EPA). 2016b. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014. Available at https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Main-Text.pdf (accessed June 11, 2016).

United States Environmental Protection Agency (EPA). 2016c. Future Climate Change. Available from http://www3.epa.gov/climatechange/science/future.html (accessed June 11, 2016).

United States Environmental Protection Agency (EPA). 2016d. Overview of Greenhouse Gases. Available from: https://www3.epa.gov/climatechange/ghgemissions/gases.html (accessed June 11, 2016).

United States Environmental Protection Agency (EPA). 2016e. Sources of Greenhouse Gas Emissions. Available from: https://www3.epa.gov/climatechange/ghgemissions/sources.html (accessed June 11, 2016).

United States Environmental Protection Agency (EPA). 2016f. Causes of Climate Change. Available from: https://www3.epa.gov/climatechange/science/causes.html (accessed June 3, 2016).

United States Environmental Protection Agency (EPA). 2016g. A Student's Guide to Climate Change: Greenhouse Gases. Available from: https://www3.epa.gov/climatechange/kids/basics/today/greenhouse-gases.html (accessed June 3, 2016).

United States Environmental Protection Agency (EPA). 2016h. Heat Island Effects. https://www.epa.gov/heat-islands/heat-island-impacts

USGCRP. 2014. National Climate Assessment. Available at http://nca2014.globalchange.gov/ (accessed June 11, 2016).

USGCRP. 2016: *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C.

Utah Community Impact Board (CIB). 2015. April 2, 2015 meeting audio (audio from 3:03 - 4:09). Available from: https://jobs.utah.gov/housing/cib/cib.html

Washington State Department of Ecology. Gateway Pacific Terminal proposal at Cherry Point. Available from: http://www.ecy.wa.gov/geographic/gatewaypacific/

Watts N, Adger WN, Agnolucci P, Blackstock J, Byass P, Cai W, Chaytor S, Colbourn T, Collins M, Cooper A, Cox PM, Depledge J, Drummond P, Ekins P, Galaz V, Grace D, Graham H, Grubb M, Haines A, Hamilton I, Hunter A, Jiang X, Li M, Kelman I, Liang L, Lott M, Lowe R, Luo Y, Mace G, Maslin M, Nilsson M, Oreszczyn T, Pye S, Quinn T, Svensdotter M, Venevsky S, Warner K, Xu B, Yang J, Yin Y, Yu C, Zhang Q, Gong P, Montgomery H, Costello A. 2015. Health and climate change: policy responses to protect public health. The Lancet 386: 1861–1914.

Westerling AL, Hidalgo HG, Cayan DR, Swetnam TW. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. Science 313: 940–943.

Williams AP, Seager R, Abatzoglou JT, Cook BI, Smerdon JE, Cook ER. 2015. Contribution of anthropogenic warming to California drought during 2012–2014. Geophysical Research Letters 42: 2015GL064924.

Wilson K, Swan D. 2013. Kinder Morgan pulls coal project out of Port Westward. Portland Tribune .

Wisland L. 2015. Letter 4/23/15 - from Dr. Laura Wiseland for Union of Concerned Scientists.

World Health Organization (WHO). 2003. Climate Change and Human Health: Risks and Responses.

World Health Organization (WHO). 2014. Ambient (outdoor) air quality and health. Fact sheet N°313 Updated March 2014. Available from: http://www.who.int/mediacentre/factsheets/fs313/en/

World Health Organization (WHO). 2014a. Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Available from: http://apps.who.int/iris/bitstream/10665/134014/1/9789241507691_eng.pdf?ua=1

World Health Organization (WHO). 2016. WHO Director General Keynote address at the Human Rights Council panel discussion on climate change and the right to health. Available from: http://www.who.int /dg/speeches/2016/humanrightscouncil/en

Zhang L, Jacob DJ, Kopacz M, Henze DK, Singh K, Jaffe DA. 2009. Intercontinental source attribution of ozone pollution at western U.S. sites using an adjoint method. Geophysical Research Letters 36: L11810.

Zhang L, Jacob DJ, Boersma KF, Jaffe DA, Olson JR, Bowman KW, Worden JR, Thompson AM, Avery MA, Cohen RC, Dibb JE, Flocke FM, Fuelberg HE, Huey LG, Mcmillan WW, Singh HB, Weinheimer AJ. 2008. Transpacific transport of ozone pollution and the effect of recent Asian emission increases on air quality in North America: an integrated analysis using satellite, aircraft, ozonesonde, and surface observations. Atmospheric Chemistry and Physics Discussions 8: 8143–8191.

Appendix Chapter 9: Noise Effects of Coal Transport and Handling in Oakland

References

Babisch W. 2000. Traffic noise and cardiovascular disease : Epidemiological review and synthesis. Noise and Health 2: 9.

Babisch W. 2005. Guest Editorial: Noise and Health. Environmental Health Perspectives 113: A14–A15.

Babisch W. 2006. Transportation noise and cardiovascular risk: Updated Review and synthesis of epidemiological studies indicate that the evidence has increased. Noise and Health 8: 1.

Babisch W. 2008. Road traffic noise and cardiovascular risk. Noise and Health 10: 27.

Babisch W, Ising H, Elwood PC, Sharp DS, Bainton D. 1993. Traffic Noise and Cardiovascular Risk: The Caerphilly and Speedwell Studies, Second Phase. Risk Estimation, Prevalence, and Incidence of Ischemic Heart Disease. Archives of Environmental Health: An International Journal 48: 406–413.

Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, Stansfeld S. 2014. Auditory and non-auditory effects of noise on health. The Lancet 383: 1325–1332.

Berglund B, Lindvall T, Schwela DH. 1999. WHO Document on Guidelines for Community Noise. 39–94.

Bhatia R, Puccetti K. 2015. Prototype Noise-Attributable Health Impacts Analysis On Coal Rail Transport In Washington State. .

Coal Train Facts. 2016. Key Facts: Noise. Coal Train Facts. Accessed from the internet on June 13, 2016 at http://www.coaltrainfacts.org/key-facts

County of Alameda, Eden Area General Plan. 2007. Noise Element.

de Kluizenaar Y, Janssen SA, Lenthe FJ van, Miedema HME, Mackenbach JP. 2009. Long-term road traffic noise exposure is associated with an increase in morning tiredness. The Journal of the Acoustical Society of America 126: 626–633.

Evans G, Hygge S. 2007. Noise and cognitive performance in children and adults. Noise and its effects Wiley.

Evans GW, Bullinger M, Hygge S. 1998. Chronic Noise Exposure and Physiological Response: A Prospective Study of Children Living Under Environmental Stress. Psychological Science 9: 75–77.

Federal Railroad Administration. [Internet]. Available from: https://www.fra.dot.gov/Page/P0599

Fox P. 2015. Environmental, health and safety impacts of the proposed Oakland Bulk and Oversized Terminal.

Haines MM, Stansfeld SA, Brentnall S, Head J, Berry B, Jiggins M, Hygge S. 2001b. The West London Schools Study: the effects of chronic aircraft noise exposure on child health. Psychological Medicine 31: 1385–1396.

Haines MM, Stansfeld SA, Job RFS, Berglund B, Head J. 2001a. Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children. Psychological Medicine 31: 265–277.

Halonen JI, Hansell AL, Gulliver J, Morley D, Blangiardo M, Fecht D, Toledano MB, Beevers SD, Anderson HR, Kelly FJ, Tonne C. 2015. Road traffic noise is associated with increased cardiovascular morbidity and mortality and all-cause mortality in London. European Heart Journal ehv216.

Hänninen O, Knol AB, Jantunen M, Lim T-A, Conrad A, Rappolder M, Carrer P, Fanetti A-C, Kim R, Buekers J, Torfs R, Iavarone I, Classen T, Hornberg C, Mekel OC, EBoDE Working Group. 2014. Environmental Burden of Disease in Europe: Assessing Nine Risk Factors in Six Countries. Environmental Health Perspectives 122: 439–446.

Hays J, McCawley M, Shonkoff SBC. 2016. Public health implications of environmental noise associated with unconventional oil and gas development. Manuscript submitted for publication.

Human Impact Partners. 2011. I-710 Corridor Project Health Impact Assessment. .

Hume K, Brink M, Basner M. 2012. Effects of environmental noise on sleep. Noise and Health 14: 297.

Illingworth and Rodkin, Incorporated. 2008. An acoustical engineering firm with experience since 1987 at http://iandrinc.com/.

Ising H, Braun C. 2000. Acute and chronic endocrine effects of noise : Review of the research conducted at the Institute for water, soil and air hygiene. Noise and Health 2: 7.

Lamphier-Gregory, JRDV Urban International, Kittleson & Associates, Hausrath Economics Group, Redwood Consulting. 2014. West Oakland Specific Plan Draft EIR, Chapter 4.7 Noise. .

Lercher P, Evans GW, Meis M. 2003. Ambient Noise and Cognitive Processes among Primary Schoolchildren. Environment and Behavior 35: 725–735.

Miedema HM, Oudshoorn CG. 2001. Annoyance from transportation noise: relationships with exposure metrics DNL and DENL and their confidence intervals. Environmental Health Perspectives 109: 409–416.

Miedema HME, Vos H. 2007. Associations Between Self-Reported Sleep Disturbance and Environmental Noise Based on Reanalyses of Pooled Data From 24 Studies. Behavioral Sleep Medicine 5: 1–20.

Multnomah County Health Department. 2013. The Human Health Effects of Rail Transport of Coal Through Multnomah County, Oregon.

Münzel T, Gori T, Babisch W, Basner M. 2014. Cardiovascular effects of environmental noise exposure. European Heart Journal 35: 829–836.

Muzet A. 2007. Environmental noise, sleep and health. Sleep Medicine Reviews 11: 135–142.

National Institute of Deafness and Other Communication Disorders. 2015. [Internet]. Available from: https://www.nidcd.nih.gov/health/noise-induced-hearing-loss

Passchier-Vermeer W, Passchier WF. 2000. Noise exposure and public health. Environmental Health Perspectives 108: 123–131.

Selander J, Nilsson ME, Bluhm G, Rosenlund M, Lindqvist M, Nise G, Pershagen G. 2009. Long-Term Exposure to Road Traffic Noise and Myocardial Infarction: Epidemiology 20: 272–279.

Shield B, Dockrell J. 2003. The Effects of Noise on Children at School: A Review. Building Acoustics 10: 97–116.

Stansfeld SA, Matheson MP. 2003. Noise pollution: non-auditory effects on health. British Medical Bulletin 68: 243–257.

Stansfeld S, Clark C. 2015. Health Effects of Noise Exposure in Children. Current Environmental Health Reports 2: 171–178.

U.S. Environmental Protection Agency. 1979. Noise Effects Handbook: A Desk Reference to Health and Welfare Effects of Noise. 1979

University of California, Berkeley Health Impact Group (UCBHIG). 2010. Health Impact Assessment of the Port of Oakland.

van Kamp I, Davies H. 2013. Noise and health in vulnerable groups: a review. Noise & Health 15: 153–159.

van Kempen EEMM, Kruize H, Boshuizen HC, Ameling CB, Staatsen BAM, de Hollander AEM. 2002. The association between noise exposure and blood pressure and ischemic heart disease: a meta-analysis. Environmental Health Perspectives 110: 307–317.

Vienneau D, Schindler C, Perez L, Probst-Hensch N, Röösli M. 2015. The relationship between transportation noise exposure and ischemic heart disease: A meta-analysis. Environmental Research 138: 372–380.

World Health Organization. 2009. Night Noise Guidelines for Europe.

World Health Organization. 2011. Burden of disease from environmental noise - Quantification of healthy life years lost in Europe.

Figures and Tables

Table 4 Parameters For Noise Model Everett-Bellingham Rail Line at Bellingham

	Bellingham			Cheney		
Train Type	Coal	Freight	Passenger	Coal	Freight	Passenger
Locomotives per train	5	5	2	5	5	2
Length of Rail Cars (feet)	7300	8000	850	7300	8000	1020
Average Speed	30	30	45	30	30	45
Wheel flats (%)	10%	10%	10%	10%	10%	10%
Rail type	Jointed	Jointed	Jointed	Jointed	Jointed	Jointed
Elevated Tracks	No	No	No	No	No	No
Sound Walls	No	No	No	No	No	No
Building Rows	One Row / 250 ft	One Row / 250 ft	One Row / 250 ft	One Row / 250 ft	One Row / 250 ft	One Row / 250 ft