

CSU SACRAMENTO

Hard to Breathe: An Analysis of How Community Planning Principles Can Reduce Elevated Asthma Rates in Low-Income and Minority Neighborhoods in the Sacramento Region

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Abbreviations in this Document

ALA – American Lung Association

AADT – Average Annual Daily Traffic

CDC – Centers for Disease Control

CNG – Compressed Natural Gas

CO₂ – Carbon Dioxide

EJI- Environmental Justice Initiative

EPA – Environmental Protection Agency

FBCP – Florin-Broadway Community Plan

NAAQS – National Ambient Air Quality Standards

NESHAP – National Emissions Standards for Hazardous Air Pollutants

NO₂ – Nitrogen Dioxide

O₃ – Ozone

OEJ – Office of Environmental Justice

PM – Particulate Matter

SACOG – Sacramento Area Council of Governments

SO₂ – Sulfur Dioxide

TOD – Transit-Oriented Development

TRP – Traffic-Related Pollutants

VMT – Vehicle Miles Traveled

VPD – Vehicles Per Day

Introduction

Asthma is a respiratory illness that affects nearly twenty million people in the United States (CDC 2013). Disadvantaged populations, which include children, elderly individuals, low-income individuals, and minorities, have higher rates of asthma than other demographic groups (CDC 2013; ALA 2010). Air pollution is a major factor in asthma rates, and many of the harmful substances that create polluted air come from vehicle emissions (Gordian et. al. 2006). Low-income and minority neighborhoods are sited near high-traffic roadways more often than higher-income and white neighborhoods and bear the related impacts (Bell and Ebisu 2012), which means that asthma prevalence in low-income and minority communities can be described as an instance of environmental injustice (Bell and Ebisu 2012). Local governments have a responsibility to correct environmental injustice, and through planning policies and principles that aim to reduce vehicle emissions and prolonged exposure to emissions in low-income and minority neighborhoods, environmental injustice can be remedied.

Sacramento, California is a large city that consistently experiences poor air quality, and also has a large minority and low-income population (US Census 2010). Asthma rates are also higher in Sacramento than the state and national averages (Sacramento Department of Health and Human Services 2013). The local planning departments in Sacramento at the city and county level therefore have a responsibility to enact policies and principles that reduce vehicle emissions and exposure to emissions. The numerous policies that can be implemented will be discussed in this paper, and this paper will also look at whether or not Sacramento's planning departments are implementing these policies. The goal of this paper is to examine how planning principles can be used to reduce asthma rates, and thus work as an instrument to address environmental injustice.

Background

Sacramento is located in the Central Valley approximately 85 miles east of San Francisco and approximately 120 miles west of the Nevada-California border. The Central Valley is bound on the east by the Sierra Nevada mountain range and on the west by the California Coastal Ranges. The elevation of Sacramento is about 30 feet above sea level. The population within the city limits as of the 2010 Census is 475,516 people, and the population of the entire County of Sacramento is 1,418,788 people (US Census 2010).

Over 200,000 people, equal to about 1 in 8 adults, in Sacramento County have asthma (California Breathing 2014). Asthma rates in Sacramento County are higher than the national and state averages for asthma prevalence: 14.9% of people of all ages in Sacramento have asthma, compared with the state average of 14.1% for all ages, and for ages 18-64, the difference is more apparent: 17% of people 18-64 have asthma in Sacramento County, compared to the state average of 14% for 18-64 year olds (California Breathing 2014). Low-income individuals and minorities are especially affected by asthma due to limited access to health care, neighborhood proximity to pollution sources, and poor community design, which means that asthma in disadvantaged populations is actually a result of environmental injustice. Hospitalization and emergency room visits are four times higher for low-income individuals, and asthma prevalence is 40% higher for African Americans than whites (California Department of Public Health 2013). Hospitalization is also higher among Hispanics, especially Hispanic children, than white children (California Department of Public Health 2013). Minority and low-income populations in Sacramento are larger than the state averages: 10.9% of people in Sacramento are black, compared to the state average of 6.6%, and 16.5% of people in Sacramento County are below the poverty line, compared to 15.3% of people in the state (US Census 2010).

The impacts of asthma are not only health-related: asthma costs the state of California \$11.3

billion annually from direct health care costs, productivity loss, and missed school and work days (California Department of Public Health 2013). Therefore, curbing asthma rates is not only important to the health of people, but to the health of the economy as well.

Issue Description

Asthma is a respiratory illness that constricts airways. Asthmatic episodes, called “asthma attacks,” can be moderate to severe; severe asthma attacks can result in emergency department visits, and in extreme cases, death. Approximately 18.7 million people, equal to about 1 in 12 adults, have asthma in the US (Center for Disease Control 2013). Race, income, gender, age, education level, and exposure to risk factors (e.g. secondhand smoke; obesity) are all factors that make an individual more likely to develop asthma (Center for Disease Control 2013). Asthma can be triggered by a number of irritants, including allergies from pollen, animals, mold and dust; cold weather, air pollution, second-hand smoke, and smoke from wildfires can all exacerbate asthma. Symptoms of asthma include wheezing, shortness of breath, coughing, and chest tightness (Center for Disease Control 2013).

Though the exact causes of asthma are not known (Center for Disease Control 2013), air pollution is thought to be a significant contributing factor to asthma rates (Tao and Lin 2014). In 2014, Sacramento was ranked among the top ten cities with the highest ozone pollution (American Lung Association 2014). Ozone pollution at lower atmospheric levels, called “tropospheric ozone,” presents a health risk; ozone at high atmospheric levels is regarded as safe. Air pollution may be the cause of the elevated asthma rates in the Sacramento region.

Air pollution comes from stationary (factories, dry cleaning facilities and manufacturing facilities) and mobile (cars and trucks) sources. The specific causes of asthma are unknown, but studies have shown air pollution from car and truck exhaust and from stationary sources can increase asthma rates and trigger asthmatic symptoms (Brugge, et. al. 2007; Gordian et. al. 2006; Kim et. al. 2008;

Mann et. al 2010; McConnell et. al. 2006). Eleven per cent of all American households are sited within 100 meters of 4-lane roads (Brugge et. al. 2007), and living near high-traffic roadways has been shown to increase asthma risk, especially in children (McConnell et. al. 2006). Schools sited near high-traffic roadways have also been shown to elevate asthma risk in children (Kim et al 2006), and 1 in 8 children in the US attend schools near high-traffic roadways (Green et al 2003).

Multiple sources generate air pollution in Sacramento. Emissions are the largest cause of air pollution in Sacramento (ALA 2014; U.E. EPA 2014). Four freeways, including two interstates, run directly through Sacramento, and are traveled by millions of cars and trucks each day (California Department of Transportation 2012). These freeways serve as major shipping routes, especially Interstates 5 and 80. Though mobile sources are the leading source of air pollution in the Sacramento region, stationary sources also contribute pollution.

Several industrial parks are located in Sacramento, including the Florin-Perkins Industrial Area, which represents the largest concentration of industrial land use in the city (City of Sacramento General Plan 2030 2013). Land uses in this particular area include a landfill and waste transfer station, manufacturing and warehousing, distribution, and business parks (City of Sacramento General Plan 2030 2013). Emissions from manufacturing and distribution contribute significantly to ambient air pollution, and though any one industrial area may not directly cause health risks, the cumulative impacts from both stationary industrial sources and mobile sources have been shown to not only increase asthma rates (Brugge et. al. 2007), but cancer rates as well (Jia and Foran 2013). Emissions from mobile and stationary sources can become trapped in the Central Valley when inversion layers, which occur when cold air sinks into the valley from the surrounding foothills and mountains, and becomes trapped under the warm air that is displaced. Emissions also become trapped under the warm layer of air, and can linger in the atmosphere for long periods of time before the inversion layer disappears. These risks highlight the need for planning agencies to site residential uses away from

industrial areas and high-traffic roadways. However, as the population of the region increases, mitigating the impacts from air pollution exposure will be a challenge.

In the early 2000s, the Sacramento metropolitan area was one of the fastest-growing areas in the state, and grew by 18% (Center for Strategic Economic Research 2012), which means that the number of vehicles on roadways also increased. Though growth has slowed, the population is still expanding. The population of Sacramento County is projected to grow to 3,232,589 people by 2035 and to 3,952,098 people by 2050 (Sacramento Area Council of Governments 2005). As the population continues to grow, vehicle usage and asthma rates are likely to increase as well. To address a growing population, and the adverse health effects associated with it, Sacramento planning agencies at both the city and county levels must implement policies and land use principles that reduce vehicle emissions and ensure “smart growth” initiatives are applied to all future development.

Because of their authority and influence over land use policies, the built environment, and zoning measures, planning departments in particular can have an enormous effect on emission-generating sources. Addressing how planning principles can be used to reduce vehicle emissions to mitigate asthma impacts is important because it is a powerful tool that local governments can use to ensure vulnerable populations are not unduly burdened by environmental impacts. Land use decisions are made at the local level, and the built environment has an enormous effect on human and environmental health (Stone 2008). Multiple studies have shown how living in proximity to high-traffic roadways not only exacerbates asthma (Lindgren et. al. 2013; Kim et. al. 2008; Mann et. al. 2010; Ostro et. al. 2001) but actually can cause early-onset asthma in children (Brugge et. al. 2007; Gordian, et. al. 2006; Tao and Lin 2014; McConnell et. al., 2006). Reducing exposure to air pollution, then, must be a key goal of regional planning agencies to mitigate asthma rates.

Air Pollution

Air pollution comes from both mobile and stationary sources. Stationary, or “point” sources include factories and manufacturing plants, power plants, and dry cleaning facilities. Mobile sources are vehicles, trucks, trains, plows and tractors, and shipping barges. Air pollution has serious health affects and in particular can create respiratory health problems, affect lung development in children, and exacerbate and even cause asthma (Tao and Lin 2014). Air pollution from vehicle emissions, or traffic-related pollutants (TRPs), include harmful gases and particulate matter and are regulated under the Clean Air Act by the Environmental Protection Agency (EPA) and regional air quality boards. The EPA currently identifies and regulates 187 toxic air pollutants under National Emissions Standards for Hazardous Air Pollutants (NESHAPs). The EPA has also set National Ambient Air Quality Standards (NAAQS) for six common pollutants, also referred to by the EPA as “criteria pollutants” (US EPA 2012):

- Ozone (O₃)
- Carbon Dioxide (CO₂)
- Sulfur Dioxide (SO₂)
- Nitrogen Dioxide (NO₂; sometimes also referred to as NOX)
- Particulate Matter (PM₁₀ and PM_{2.5})
- Lead

Exposure to these pollutants occurs when contaminated air is inhaled. Ozone is a basic component of the Earth's atmosphere and actually protects the Earth from the harmful effects of sun rays. When ozone is in the lower atmosphere, however, it becomes harmful when inhaled and is a main component of smog. Studies show that exposure to ground-level ozone increases coughing and wheeze in children (Ostro et al 2001). NO₂ is a by-product of vehicle emissions, and a relationship between long-term exposure and asthma prevalence has been shown (Studnicka et. al. 1997). PM₁₀ and PM_{2.5} (particulate

matter at 10 and 2.5 micrometers), are small particles of water, dust, soil, acids, metals, and organic matter. Breathing in particulate matter is harmful to one's airways, and it has been shown to increase hospitalization from asthma attacks from prolonged exposure in children (Lin et al 2002). The impacts of air pollution are significant, and can be affected by regional air conditions in addition to emissions generators.

Variables that can affect local air conditions include topography, wind patterns and weather events, and ambient air temperature. Wind patterns can move pollution long distances, including pollution from as far away as China, adding to the state's poor air quality (Lin et al 2014). Pollution from goods manufacturing and export adds additional pollutants to the Western US and in 2006 alone, pollution from these processes in China accounted for 36% of sulfur dioxide, 27% of nitrogen oxides, 22% of carbon monoxide, and 17% of black carbon (a harmful component of particulate matter) in ambient air in the Western US (Lin et al 2014). Pollution from China's rapid economic and industrial growth (He et. al. 2002), topography, wind patterns, weather events, and ambient air temperature are not variables that can be controlled through local planning efforts. Efforts must be made to reduce emissions from mobile sources, which account for most of the air pollution in Sacramento and can be impacted through local planning measures.

Mobile sources are the single largest generator of air pollution in Sacramento (U.S. EPA 2014). The leading source for 4 out of the 6 NAAQS in Sacramento are from mobile sources (Table 1). Mobile sources generate on average 87,502

NAAQS	Source	Total Annual Emissions (in tons)
CO ₂	Mobile	87,502
NOX	Mobile	17,305
SO ₂	Mobile	149
Lead	Mobile	1
PM ₁₀	Dust	5,132
PM _{2.5}	Fuel Combustion	1,867

Table 1: Annual emissions and their sources in Sacramento (U.S. EPA 2014).

tons of carbon monoxide, 1 ton of lead, 17,305 tons of nitrogen oxides, and 149 tons of sulfur dioxide (U.S. EPA 2014). 9,670 tons of volatile organic compounds, or VOCs, are emitted in Sacramento, however VOCs are not NAAQS (U.S. EPA 2014) but do impact air quality because VOCs are carbon-based compounds from a multitude of sources, including fuel combustion, and can aid in the formation of O₃ (U.S. EPA 2009). Mobile sources also generate 1,154 tons of PM₁₀, and 682 tons of PM_{2.5}, but their top sources in Sacramento are not mobile; dust is the top source of PM₁₀ in Sacramento at 5,132 tons generated annually, and fuel combustion (fuel combustion in this context is from stationary sources that burn coal, wood, oil, natural gas, and biomass for electricity and heating purposes) is the top source of PM_{2.5} at 1,867 annual tons (U.S. EPA 2014). Of the other emissions sources, including dust, smoke from wildfires, and industrial practices, none come close to the amount of pollution generated from mobile sources (U.S. EPA 2014). It is extremely important that local planning efforts be aimed at reducing asthma-exacerbating and asthma-causing mobile emissions.

Planning Policies

Planning agencies can develop and implement policies and planning principles to reduce emissions and emissions exposure. These measures can be divided into two categories: Local planning short-term planning principles, and long-term planning principles.

Short-term planning principles are policies that can be implemented at any time and have immediate impacts. Short-term planning principles that can reduce asthma rates include conducting emission inventories to target high-emission areas, creating buffer zones, and incentivizing public transit to reduce the amount of vehicles on roadways and to reduce vehicle miles traveled (VMTs). Short-term planning principles should begin with an emission inventory to determine where the greatest emissions are generated.

Emission inventories are already a common practice in planning, because it is the first step in

creating a Climate Action Plan. Climate Action Plans are strategies for cities and counties to adapt to climate change. These inventories can be used to aid in the decision-making process, because these inventories show where the highest concentrations of emissions are generated, and what the emissions are caused by. They allow planning agencies to create policies to reduce emissions in an effective manner. Creating green buffer zones and increasing the amount of trees is another short-term planning measure that can be implemented.

Green buffer zones are areas of vegetation, primarily trees, which separate a roadway from residential and commercial areas. Sacramento is often called the “City of Trees,” but there are areas in Sacramento that could benefit from more “urban forestry.” The area adjacent to Highway 50 in the communities within the policy jurisdiction of the Florin Broadway Community Plan (FBCP), for example, has few trees, especially when compared to the extensive green buffer zone separating the FBCP and Highway 99. Nowak, et. al. (2006) showed that urban vegetation (trees and shrubs) can remove significant amounts of air pollutions, especially sulfur dioxide, ozone, and nitrogen dioxide. Their study found that urban trees in the US removed 711,300 tons of ozone, PM₁₀, nitrogen dioxide, sulfur dioxide, and carbon monoxide from the air in 2006, and recommend increasing the total amount of urban canopy cover as a way to meet national air standards (Nowak et. al. 2006). In conjunction with increasing the amount of urban vegetation, reducing the number of vehicles traveled by encouraging public transit use can reduce emissions and emissions exposure.

Millions of cars and trucks travel through Sacramento on a daily basis (California Department of Transportation 2012). Encouraging and expanding public transportation is therefore an important issue for local planning agencies to address. Though public transportation currently exists in Sacramento by the Sacramento Regional Transit (SRT) in the form of light rail and bus transit, these services are lacking in terms of their service areas. The bus and van shuttle system is utilized by approximately 49,000 passengers daily (Sacramento Regional Transit District 2014). This number

could be improved by providing more busses, vans, and bus stops, but these transit forms all rely on compressed natural gas (CNG), a methane-based fossil fuel that is claimed to be a “cleaner burning alternative” (US Department of Energy 2013) but still has emissions issues from methane leakage (Alvarez et. al. 2012). SRT should therefore expand the current light-rail lines in Sacramento. Another measure that can be taken to encourage public transit use is offering tax incentives to businesses that have large numbers of their workforce utilizing public transit. Expanding existing light rail lines will also reduce the amount of vehicles driven, but this is a long-term planning goal.

Long-term planning principles are policies that reduce impacts to future development, and the benefits are not immediate. Expanding existing light rail lines, increasing building setback requirements from roadways in residential areas, and encouraging in-fill development and transit-oriented development (TOD) for future development are long-term planning principles that can reduce emissions and exposure to emissions. Light rail expansion is a long-term process that can take years of planning.

Three light rail lines, the Gold Line along Auburn-Folsom Boulevard, the Green Line in downtown Sacramento, and the Blue Line along Highway 80 serve Sacramento, and a fourth line extending south to Cosumnes River College is being planned (Sacramento Regional Transit District 2014). While this is commendable, it is not enough. More lines should be built, and local planning agencies should mandate that future developments are sited near rail lines. Light rail is powered by electricity instead of CNG, which means light rail is a relatively cleaner form of transportation as opposed to buses and shuttles, and light rail expansion should be a priority of both the Sacramento Regional Transportation District and regional planning agencies. Regional planning agencies, in addition to mandating future developments be sited near light rail stations, can also mandate setbacks from roadways, which would limit future exposure to emissions.

Ensuring that neighborhoods and schools are sited away from high-traffic roadways and

stationary pollution sources is a highly effective measure planning departments can implement to reduce asthma rates. If a residential area must be sited near a roadway, then larger setbacks should be implemented and green buffer zones should be created. However, it should be mandated that residential areas are never sited near high-traffic roadways, and special care must be taken to ensure schools are not sited along high-traffic roadways to ensure children are not further exposed to mobile emissions. These zoning measures would ensure that schools and residential areas are sited away from high-traffic roads, and ultimately reduce exposure to harmful mobile emissions.

Encouraging in-fill development reduces sprawl, and is another long-term planning policy that can have an impact on reducing mobile emissions. By developing in existing vacant lots instead of expanding development outside of the city, neighborhoods are revitalized (Ubuntu Green 2013) and vehicle dependency is reduced (Stone 2008). When developing in vacated lots, planning agencies should take the opportunity to implement transit-oriented development (TOD), which means developing near public transportation access points and encouraging mixed-use development of retail and residential uses to enable walkable neighborhoods to reduce vehicle dependency (Center for Transit Oriented Development 2010). A study published by the Center for Transit Oriented Development showed that neighborhoods within a half mile of public transit access experienced lower emissions from mobile sources (Center for Transit Oriented Development 2010). To address environmental justice issues, these measures must be implemented in low-income and minority neighborhoods.

Environmental Justice: Federal and State

Environmental justice is the solution to environmental *injustice*: environmental injustice is a term used to describe when disadvantaged populations (i.e. low-income, minority, elderly) are disproportionately impacted by their surrounding environment. Environmental justice seeks to remedy

these impacts.

Environmental injustice can take many forms and impacts those who often are the politically-weakest. For example, race and income are the most significant determining factors of where waste disposal sites are located (Cutter 1995). Minority populations are often economically disadvantaged, and therefore have less time to be active in their community and become engaged with their local government. Since the Clinton Administration, government agencies have undertaken solutions to environmental injustice.

In 1992, the US EPA created the Office of Environmental Equity (changed to the Office of Environmental Justice, or OEJ in 1994) in response to concerns by the Congressional Black Caucus that the EPA was not taking into consideration the disproportionate environmental effects that minority population's experience. The OEJ seeks to incorporate environmental justice in all of the EPA's actions and policies (US EPA 2012). In February 1992, President Bill Clinton signed Executive Order 12898, "Federal Actions to Address to Address Environmental Justice in Minority Populations and Low-Income Populations" (Federal Register 1994). This order:

- Mandates that every Federal agency must make achieving environmental justice as part of their mission
- Mandates that every Federal agency must create strategies to achieve their mission
- Creates an inter-agency working group to conduct research and provide guidance and assistance to Federal agencies on achieving environmental justice goals
- Mandates that Federal agencies collect data and conduct analysis on their impacts to human health and environmental justice (Federal Register 1994)

The state of California has also enacted several laws pertaining to environmental justice. California was the first state in the nation to implement laws for ensuring environmental justice. Government code section 65040.12 defines environmental justice as "the fair treatment of people of all races, cultures,

and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies” (Office of Environmental Health Hazard Assessment 2001). This code also designated the Office of Planning and Research as the coordinating environmental justice agency, and mandates that city and county general plans include guidelines for addressing environmental justice. More importantly, this section of code established guidelines for industrial zone and school siting, and specifically mandates that schools are sited away from the impacts of industrial uses (Office of Environmental Health Hazard Assessment 2001). Additionally, the state EPA, known as Cal EPA, has established the Environmental Justice Program in 2004, which implements the Intra-Agency Environmental Justice Strategy. This program seeks to ensure environmental justice is being practiced by state agencies. To this end, it created CalEnviroScreen, an interactive environmental justice database for California.

CalEnviroScreen is a database that evaluates California regions that are exposed to multiple pollution sources and identifies regions at the highest risk of exposure to adverse environmental impacts, and can be a useful tool for planning and development. This database is organized by zip code and three areas are ranked in the top 5% and top 10% of areas in Sacramento that are disproportionately burdened by environmental impacts (Figure 1). These areas include Del Paso Heights, Land Park, South Oak Park, and

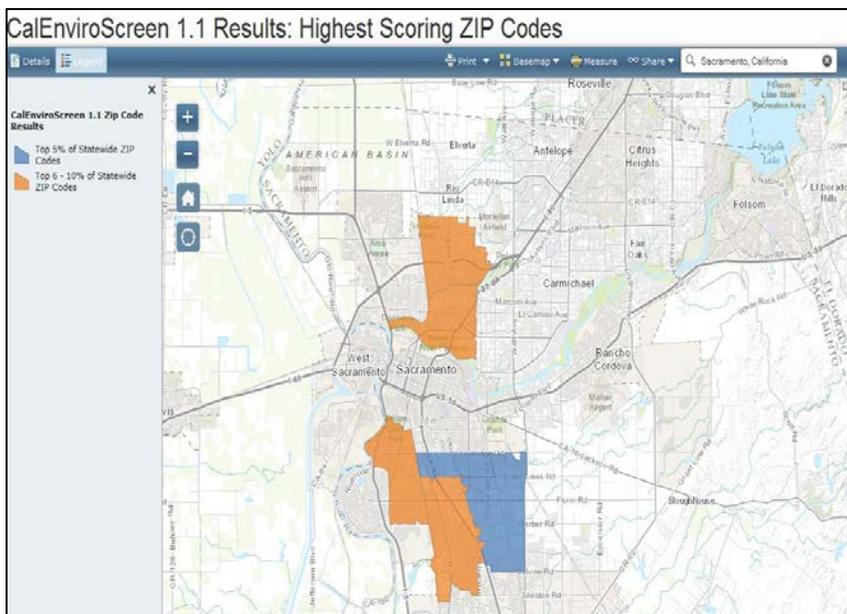


Figure 1: Sacramento areas by zip codes that are burdened by adverse environmental impacts (Office of Environmental Health Hazard Assessment 2014).

Tahoe Park which are low-income and minority neighborhoods in Sacramento. The area in blue is part

of the Fruitridge Broadway Community Plan (FBCP), which will be discussed at length as a case study to show how planning principles can reduce asthma rates. In addition to Cal EPA environmental justice programs and state government code section 65040.12, the state legislature has enacted several laws that aid in ensuring environmental justice for all California residents, including Assembly Bill (AB) 1360, AB 1390, AB 1553, AB 2312, Senate Bill (SB) 89, SB 115, SB 535, SB 828, SB 965, and SB 1542. In conjunction with federal and state environmental justice laws, local measures are also being taken to address environmental justice issues in Sacramento.

Environmental Justice: Sacramento

Many of Sacramento's low-income and minority populations are situated adjacent to the several freeways that run through the city. These freeways, including Interstates 80 and 5, are heavily used as shipping routes, and diesel trucks are the primary transportation mode for shipping goods cross-country. These freeways were built in the mid-twentieth century, severing communities like Oak Park, which had previously enjoyed a strong, vibrant neighborhood and is one of Sacramento's oldest (Ubuntu Green 2013). The freeways were built without concern to the people whose neighborhoods would be affected by them. Sacramento residents and organizations have begun to engage local planners to ensure the concerns of low-income and minority residents are considered in land use decisions to prevent the mistakes of past planning decisions. The Environmental Justice Initiative is working with community members and policy makers to remedy environmental injustice in Sacramento.

The Sacramento Environmental Justice Initiative (EJI) seeks to remedy adverse environmental impacts in low-income and minority neighborhoods; in particular, Oak Park, South Sacramento, Glen Elder, and Del Paso Heights. EJI is a partnership between two local non-profit organizations: the Sacramento Housing Alliance and Ubuntu Green. The EJI was created to conduct research and provide information to local communities about local environmental justice issues, assist with grassroots

organization building, and impact local and regional land use policies and decisions (Sacramento Housing Alliance 2014). The first year the EJI was established it worked with community members and succeeded in preventing a natural gas storage facility from being built in South Sacramento, a traditionally African-American neighborhood. Ubuntu Green worked with community members, and the Housing Alliance worked with the Legal Services of California to ensure that concerns were addressed by the Public Utilities Commission (Sacramento Housing Alliance 2014). Now in its second year, the EJI is advocating for in-fill development in neighborhoods that have been blighted and impacted by vacant lots and brownfields (Ubuntu Green 2013). The measures described in the EJI can be implemented in low-income neighborhoods to ensure that these areas are not adversely affected by environmental impacts. Oak Park and Glen Elder, two of the neighborhoods that the EJI focuses on, are part of the Fruitridge Broadway area, and building and development policies in this area are guided by the Fruitridge Broadway Community Plan (FBCP). The FBCP serves as a case study for this paper, and the policies in the FBCP are analyzed for their effectiveness in reducing emissions exposure.

Case Study: Fruitridge Broadway Community Plan

As a result of prior land use decisions, low-income and minority populations in Sacramento carry the heaviest burden of land use impacts. Additionally, asthma rates are higher on average in Sacramento compared to the rest of the state and the nation. Low-income and minority populations experience high asthma rates because of lack access

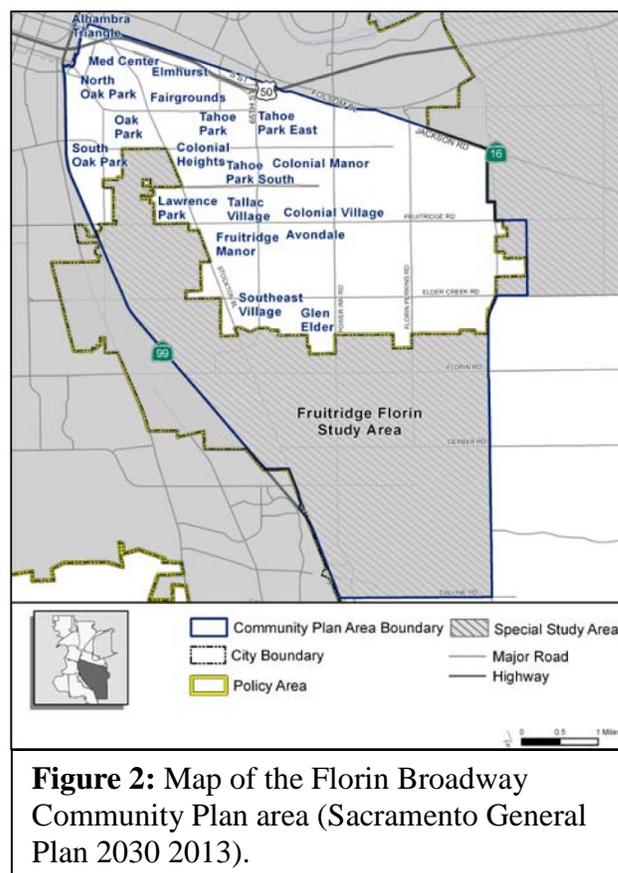


Figure 2: Map of the Florin Broadway Community Plan area (Sacramento General Plan 2030 2013).

to services (in this case, health services and government services) and high pollution burdens. Therefore, it is important that local planning departments in Sacramento solve this environmental injustice by

Neighborhood	Neighborhood Median Income	Sacramento Median Income	State Median Income
North Oak Park	\$36,009.00	\$47,908.00	\$61,400.00
Glen Elder	\$34,940.00	\$47,908.00	\$61,400.00

Table 2: Average incomes of North Park and Glen Elder compared to regional and state median incomes (US Census 2010).

implementing planning measures that can reduce vehicle emissions and exposure to emissions in low-income and minority communities, and thus, asthma rates. The Fruitridge Broadway Community Plan (Figure 2) will serve as a case study for this paper to examine how Sacramento planning efforts are mitigating for multiple pollution sources in an area that includes many low-income and minority neighborhoods. North Oak Park, a neighborhood that is largely African-American, and Glen Elder, a largely Asian neighborhood, are also low-income (Table 2).

North Oak Park is particularly impacted by high-traffic roadways, as the Highway 50 and Highway 99 junction is the northwestern boundary, and both highways are adjacent to this neighborhood. Glen Elder is impacted by Florin Road, another high-traffic roadway. Both neighborhoods are in the policy jurisdiction of the City of Sacramento, within the Fruitridge Broadway Community Plan.

The Fruitridge Broadway Community Plan (FBCP) is a specific policy document that is part of the City of Sacramento General Plan 2030 and contains land use policies and guides future development in the neighborhoods south of Highway 50, east of Highway 99, west of South Watt Avenue, and north of Florin Road. This area encompasses 13 neighborhoods, including Oak Park and Glen Elder, which are low-income and mainly minority neighborhoods. The Union Pacific Railroad runs north to south through the FBCP, and is used for freight shipping. The FBCP also includes the

Florin-Perkins Enterprise Zone, which is the largest industrial area in Sacramento. The Florin-Perkins Enterprise Zone is comprised of the Florin-Perkins Industrial Area (25,000 acres), Depot Business Park (400 acres), and Granite Regional Office Park (250 acres) (City of Sacramento General Plan 2030 2013). Warehousing, shipping, distributing, and office space are the main activities occurring in this industrial area. The freeways, the railroad, and the industrial area all impact the air quality in the neighborhoods in the FBCP, and also impact the regional air quality basin.

FBCP Traffic Volumes

Many high-volume roadways intersect the FBCP. The junction of Highway 50 and Highway 99 is located at the northwestern corner of the FBCP, and North Oak Park is adjacent to this junction. Florin-Perkins Road, Stockton Boulevard Fruitridge Boulevard, and 65th Street are heavily traveled by vehicles and trucks. The Traffic Data Branch of the California Department of Transportation, or Cal Trans, compiles annual average daily traffic (AADT) in vehicles per day (VPD) data for every highway in the state, and according to their information, the roadways listed above experience a combined

Roadway	Vehicle Back	Vehicle Ahead	Truck Back	Truck Ahead	Truck % of Total Traffic
Highway 50 Junction	142,000	178,000	13,632	N/A	9.6%
Highway 99 Junction	107,000	74,000	12,359	8,399	11.5%
Florin Road	101,000	114,000	1,035	N/A	9%
Stockton Boulevard	205,000	206,000	9,823	10,030	6.42%
Fruitridge Road	172,000	191,000	11,599	10,085	5.28%
65 th Street	192,000	197,000	7,968	7,979	4.05%
Total	916,000	960,000	56,416	36,493	5.0%
Average	152,666	160,000	9,402	9,123	-----
Total Cars, Back and Ahead	1,876,000				
Total Trucks, Back and Ahead	92,909				

Table 3: Average annual daily traffic volumes for cars and trucks on select roads in the FBCP (California Department of Transportation 2012).

average of 152,666 cars traveling back (defined as south from the sample point), 160,000 cars traveling ahead (defined as north of the sampling point), 9,402 trucks traveling back, and 9,123 trucks traveling ahead (California Department of Transportation 2012). Cal Trans defines trucks by the number of axles, and does not include vans or pickup trucks. AADT is measured as the total traffic volume of the year divided by 365 days. The most current data available are from 2012. The data show (Table 3) that on nearly 2 million cars and 93,000 trucks travel through the FBCP on a daily basis (California Department of Transportation 2012). These numbers suggest that mobile emissions sources are a large problem for regional air quality, and show the need for policies that will address this issue. Specific policies that will have an impact on improving local air quality have been created by the City of Sacramento Community Development Agency for the neighborhoods under the policy jurisdiction of the FBCP, and will help reduce emissions exposure in Sacramento.

FBCP Policies

In the FBCP, the City of Sacramento has implemented several policies aimed at discouraging industrial uses in residential and commercial zones, ensuring that new homes are sited further away from high-traffic roadways, thus reducing exposure to emissions. These policies are focused on land use, economic development, clean technology, and housing.

The first policy described in the FBCP is designed to encourage industrial areas to relocate to industrial zones, and prohibit new or future industrial uses from being sited in residential and commercial areas. Though this specific policy does not address reducing mobile emissions, reducing exposure to emissions from stationary sources in residential areas may alleviate potential health risks. This policy, Land Use (LU) 1.1, focuses on industrial uses on Stockton Boulevard, and mandates that industrial uses are reduced over time, and attempt to relocate industrial uses away from residential and commercial areas and into the Florin-Perkins Enterprise Zone. LU 1.1 is supported by Economic

Development (ED) Policy 1.1, which mandates that future industrial developments are located within the Florin-Perkins Enterprise Zone (City of Sacramento General Plan 2030 2013). These policies reveal the City's commitment to mitigating exposure to industrial emissions and the City's attention to resolve conflicting land uses, and also show that planners in the City acknowledge how industrial uses can impact residential areas. This policy additionally serves as an example of a long-term planning principle that will reduce exposure to emissions in residential areas, thus potentially reducing asthma rates.

The Florin-Perkins Enterprise Zone, according to the FBCP, will be designated by the state as a Clean Technology Zone. Within this zone, an emphasis on clean technology is encouraged, and the City is providing incentives for businesses that recycle manufacturing byproducts and participate in the Clean Technology Zone Program. The Clean Technology Zone Program incentives include tax credits, low-interest loans, and expedited permits (City of Sacramento General Plan 2030 2013). The Clean Technology Zone Program is a great way for the City to encourage industrial businesses to reduce their emissions output from manufacturing processes.

Another important policy within the FBCP is Housing Policy 1.1: Residential Design Criteria. This policy specifically addresses setbacks, which mandates how far from a property line a house or building must be. A "front" setback generally refers to the "front" or street-facing property line. Housing Policy 1.1 requires residential units with a front on "major streets" have a 35-45 foot setback. This setback requirement is 10-15 feet more than for houses without a front on a major street. Having a larger setback requirement for street fronts on residential lots is important, because it reduces exposure to vehicle emissions. One study found that asthma rates were lower among children who lived in homes 150 to 250 meters (490-660 feet) away from high-traffic roadways (McConnell et. al. 2006), suggesting that zoning setbacks may be an effective measure in reducing exposure to mobile emissions. Presently, the FBCP does allow for residential siting near roadways. The setback requirements in

Housing Policy 1.1 are a great first step, but the FBCP should mandate that no future development be sited near roadways to further reduce exposure to mobile emissions.

These FBCP policies will help to reduce pollution and exposure to emissions in the FBCP. However, there are several additional policies that the City of Sacramento Planning Division can implement to reduce pollution and exposure to emissions in the FBCP, which will ultimately aid in reducing asthma rates in these neighborhoods. These policies are: creating more green buffer zones, increasing access to public transportation, reducing sprawl in future developments and encouraging in-fill and transit-oriented development.

FBCP Opportunity Area: Expand Light Rail Tracks

The FBCP is serviced by Sacramento Regional Transit (SRT) by the city bus system and the light rail system. The bus system in the FBCP is well-established, and serves over 1,000 persons per day in the FBCP (City of Sacramento General Plan 2030 2013). SRT buses are low-emission emitters due to the fact that they are powered by compressed natural gas (CNG), a diesel alternative; but are still reliant on fossil-fuels. Therefore, light rail expansion should be a key goal of local planning efforts. Ensuring that future development is sited near existing light rail stations should be mandated for all future development in Sacramento to reduce vehicle dependency and vehicle miles traveled (VMTs).

There are currently 37.4 miles of light rail tracks in Sacramento in a service area that is 418 square miles (Sacramento Regional Transit 2014). The light rail Gold Line along Auburn-Folsom Road is the northern boundary of the FBCP and there is a station at 65th Street and Auburn-Folsom that services 1,750 passengers daily (Sacramento Regional Transit 2014). The light rail line is an excellent source of public transportation because it is powered by electricity via traction power supplied to 34 substations (Sacramento Regional Transit 2008 and 2011). Expanding the light rail track system south into the FBCP would increase access to the light rail station, reduce fossil fuel dependency, reduce

VMTs, and ultimately reduce emissions and air pollution that exacerbate asthma. SRT has plans in place to expand the light rail south from Meadowview to Cosumnes River College, west of Highway 99, but there are no future plans to extend lines south from 65th Street and into the FBCP (Sacramento Regional Transit 2014). To reduce vehicle usage and mobile emissions in the FBCP, SRT should expand light rail tracks south into the FBCP. Another planning principle that can be implemented for future development within the FBCP is to encourage in-fill development of existing empty lots.

FBCP Opportunity Area: Reduce Sprawl and Encourage In-Fill Development

Urban sprawl is a major issue in planning. Urban sprawl is associated with a number of environmental concerns including reducing permeable surface area, impacting air quality, reducing the amount of prime agricultural land (especially in California's Central Valley), decentralizing people and communities, and increasing vehicle dependency, as people live further away from amenities and employment centers (Stone 2008). Planning agencies can help reduce sprawl by mandating high-density, multi-family housing, and mixed-use, transit-oriented development, so housing is concentrated and people can live in walking distance to amenities instead of relying on their vehicles. Planning agencies can also reduce sprawl by mandating that in-fill areas be developed first, instead of creating large swaths of residential areas that are miles from employment centers and other services.

In-fill development means developing vacant lots in existing neighborhoods. Vacant lots blight communities, and can sometimes become high-crime areas and areas where people dump trash illegally. (Ubuntu Green 2013). Ubuntu Green is encouraging in-fill development in neighborhoods that are within the FBCP as part of their Environmental Justice Initiative in partnership with the Sacramento Housing Alliance and the Coalition on Regional Equity. In November 2013, they released their report on vacant lots in Sacramento, "From Wasted Spaces to Healthy Places: Transforming Brownfields and Vacant Spaces in Sacramento" as part of their Brownfields and Vacant Spaces Campaign. In their report,

they note that vacant lots are often a result of a lack of investment in development opportunities in low-income and minority neighborhoods and identify key areas of improvement (Ubuntu Green 2013). Many of the vacant lots in these neighborhoods are brownfields, or sites where operations like metal plating and dry cleaning facilities were once sited (Ubuntu Green 2013). These sites impose health risks by exposing residents to harmful toxins, in addition to the crime issues noted above. Decontaminating these areas and developing them with affordable, multi-family housing can improve the health of these communities and reduce urban sprawl, and thus reduce dependency on vehicle usage and exposure to mobile emissions.

Conclusion

Vehicles and trucks are the leading source of air pollution in Sacramento. Mobile emissions have been shown in numerous studies to cause and exacerbate asthma, especially in children and minorities. Sacramento experiences poor air quality on a regular basis, and asthma rates in Sacramento are among the highest in the country. Some of Sacramento's poorest neighborhoods, including Oak Park and Glen Elder, are situated near high-traffic roadways and therefore experience a larger burden of environmental impacts than white, affluent communities. City planning efforts and land use policies have a considerable impact on environmental and human health, and therefore city planners have a responsibility to ensure that all communities bear impacts evenly in an effort to remedy past environmental injustices. Increasing the amount of green buffer zones, reducing urban sprawl, and developing existing vacant lots are important planning policies that can be implemented to reduce mobile emissions and exposure to emissions, and thereby impact asthma rates.

Low-income and minority neighborhoods within the Fruitridge Broadway Community Plan can serve as a case-study of how well planning efforts are reducing impacts from air pollution. The City of Sacramento Planning Department has taken the initiative to create policies that reduce air pollution and

enhance community health. Land use policies that separate the conflicting land uses of residential areas and industrial areas, economic policies that encourage clean technology in industrial areas, and housing policies that increase setback requirements from roadways are all planning policies within the FBCP that will ultimately reduce air pollution and thus have an impact on asthma rates in low-income and minority neighborhoods in the FBCP. Future planning efforts must be focused on expanding public transportation services, creating green buffer zones, and reducing urban sprawl and encouraging in-fill development to further reduce air pollution and the associated impacts. As the population continues to grow, the importance of these issues will grow as well.

By implementing the policies herein and ensuring these policies are implemented in low-income and minority neighborhoods that truly need them, local planning departments can reduce air pollution and ensure environmental equity.

This paper offers several policy recommendations for local planning agencies to implement to ensure that low-income and minority populations are not disproportionately affected by emissions, and to reduce mobile emissions:

- Create emissions inventories to identify areas with high emissions concentrations
- Create additional green buffer zones near high-traffic roadways
- Encourage public transit use by providing incentives for businesses and residential developments that are near public transit stations and stops
- Expand existing light rail lines into areas of the city that do not have light rail access
- Mandate that all future residential and school development be sited away from high-traffic roadways
- In cases where no option for siting future development away from roadways exists, mandate large setbacks for residential land uses from roadways and create green buffer zones between developments and roadways

- Reduce urban sprawl by encouraging high-density, multi-family, transit-oriented, mixed use development to ensure that people can walk to local amenities to avoid vehicle dependence
- Give priority to in-fill development projects to reduce urban sprawl

As single policies, these measures cannot reduce mobile emissions on their own. However, cumulatively, they can. Reducing mobile emissions can result in lowering asthma rates, and when implemented in low-income and minority neighborhoods, can serve to remedy environmental injustice.

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