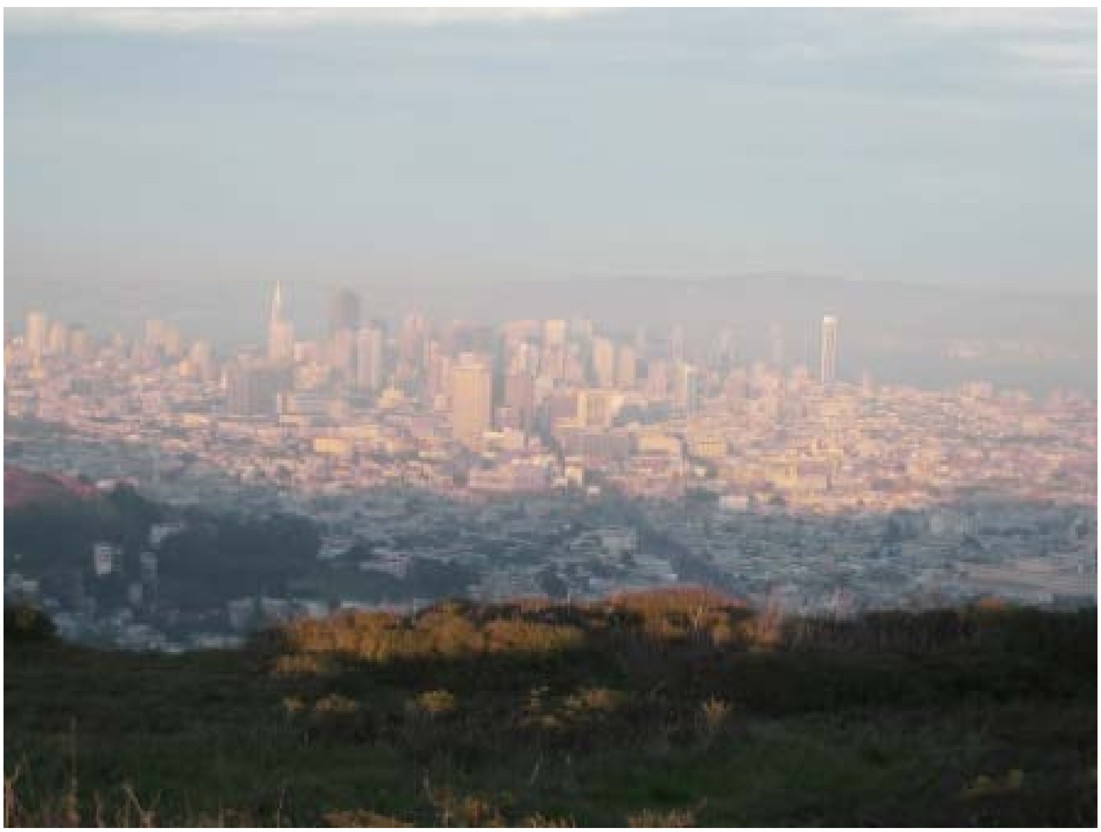
BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

STAFF REPORT – PARTICULATE MATTER

Proposed New Regulation 6: Common Definitions and Test Methods



Guy A. Gimlen
Principal Air Quality Engineer
June 2018

ACKNOWLEDGEMENTS

District staff members who contributed significantly to the development of this report and proposal:

Alexander Crockett, Esq., Assistant Counsel, Legal
Wayne Kino, Deputy Air Pollution Control Officer
Don VanBuren, Senior Air Quality Engineer, Compliance & Enforcement
Ed Giacometti, Air Program Supervisor, Compliance & Enforcement
Jeff Gove, Director, Compliance & Enforcement
Paul Hibser, Air Program Supervisor, Compliance & Enforcement
Ron Carey, Senior Inspector, Compliance & Enforcement
Greg Solomon, Supervisor, Engineering
Brian Lusher, Senior Air Quality Engineer, Engineering
Jerry Bovee, Manager, Meteorology and Measurement
Chuck McClure, Air Program Supervisor, Meteorology and Measurement
Tim Underwood, Principal Air Quality Engineer, Meteorology and Measurement
Brad Kino, Senior Air Quality Engineer, Meteorology and Measurement
Luz Gomez, Manager, Communications
David Ralston, Manager, Communications
Azibuike Abaka, Public Information Officer II, Community Engagement
Kristen Law, Staff Specialist I, Communications
Rosene Salmo, Staff Specialist I, Communications
Aneesh Rana, Air Quality Technician II, Communications

STAFF REPORT

Regulation 6: Common Definitions and Source Test Methods

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

The Bay Area Air Quality Management District (Air District) is proposing a new over-arching regulation for Particulate Matter, Regulation 6: Common Definitions and Test Methods (Reg 6) to accompany proposed amendments to Regulation 6, Rule 1: General Requirements, the Air District's general particulate matter emissions limitation rule. The new Regulation 6 is proposed to provide common definitions and test methods that apply to existing Regulation 6 rules and any other source-specific rules as they are developed in the future. This Staff Report provides background information on new Regulation 6 and a summary of the rationale for updating Regulation 6, Rule 1 (Rule 6-1). Background research on Bay Area particulate matter emissions is provided in Attachment 1. A separate Staff Report has been developed to provide the specific information supporting the proposed amendments to Rule 6-1. The two proposed rules and two staff reports are intended to provide the public with information on both the new Regulation 6 and draft amendments to Rule 6-1 in advance of Public Hearing the Air District will hold in Spring 2018.

The proposed amendments to Rule 6-1 address a commitment by the Air District's Board of Directors to review Regulation 6, Rule 1: General Requirements, identified as control measure SS31 in the Air District's 2017 Clean Air Plan. Prior to the 2017 Clean Air Plan, Air District staff developed a focused study to address the Bay Area's particulate matter challenges in a November 2012 report entitled *Understanding Particulate Matter: Protecting Public Health in the San Francisco Bay Area*. These proposed amendments to Regulation 6, Rule 1 are the first of many steps needed to reduce particulate matter emissions and improve public health.

Background research and analysis were done during the development of proposed amendments to Rule 6-1, and are intended to provide the foundation for the Air District's efforts to reduce public exposure to unhealthy levels of particulate matter. Particulate matter, also called PM or soot, are extremely small particles that cause or contribute to a wide variety of serious health problems, including asthma, bronchitis, cardio-vascular diseases, and cancer. The Air District has committed to reduce particulate matter levels to achieve significant health benefits. Staff expects that additional, source-specific rulemaking will build upon this foundation.

Staff is proposing a new Regulation 6: Common Definitions and Test Methods to provide definitions and test methods that apply to all Regulation 6, Particulate Matter rules. Proposed new Reg 6 includes the following:

- An expectation that all operators of facilities subject to Regulation 6 Rules will monitor their operations sufficiently to enable them to prevent violations, and take corrective actions as needed to ensure compliance.
- Common definitions that apply to all particulate matter rules. This approach standardizes the definitions and provides a single reference location for these definitions. Definitions can be compromised when located in several source specific rules, where version control is difficult.
- Source test methods that apply to all or most individual particulate matter rules. Similarly, this approach standardizes test methods and provides a single reference location for these test methods.

Staff proposes proposed amendments to Rule 6-1 because its particulate standards have not been updated in decades; other air districts in California have more stringent standards, and amendments are needed to ensure the Bay Area standards are equally health-protective. Control technology is available that facilities can use to comply at a reasonable cost; and the revised standards may lead to $PM_{2.5}$ reductions that will help the Air District achieve its health-based $PM_{2.5}$ goals.

Staff identified three additional opportunities to reduce particulate emissions:

- Bulk material storage and handling is subject to wind erosion, and can create particulate emissions from handling solids and from vehicle traffic in and around bulk material sites.
- Trackout of mud and dirt onto paved roadways, where the dirt gets pulverized into silt, and entrained in the air by passing vehicles.
- Asphalt operations, where hot asphalt vapors create odors and smoke. The smoke is vaporized asphalt that condenses to form particles in the air.

Requirements for bulk material storage and handling facilities have been included in amendments to Rule 6-1. A new Regulation 6, Rule 6: Prohibition of Trackout (Rule 6-6) is being proposed to prohibit trackout of dirt and other solids onto adjacent public roadways. The third opportunity – a draft new Regulation 6, Rule 7: Roofing Asphalt, was developed to control roofing asphalt fumes that are both odorous and condense to form tiny particles in the air. Costs determined during the workshop phase of the rule development process were found to be prohibitive, and further development of this draft rule has been halted until additional options can be identified.

A separate Staff Report has been developed for draft new Rule 6-6 to provide supporting information. The proposed rule and staff report are intended to provide the public with information in advance of a Public Hearing the Air District will hold in early 2018. Proposed new Rule 6-6 will be considered with proposed new Regulation 6, and amendments to Rule 6-1 at the same Public Hearing.

Staff recommends the Board of Directors adopt proposed new Regulation 6, proposed amendments to Regulation 6, Rule 1, and approve the associated CEQA Analysis Negative Declaration at the Public Hearing scheduled for Spring 2018.

The Air District invites all interested members of the public to review the proposed new Regulation 6, proposed amendments to Rule 6-1 and this Staff Report, to provide comments on this proposal, and to participate in the Public Hearing. Air District staff will accept written comments, will respond to all comments received and will present final proposals to the Air District's Board of Directors for their consideration. For further information in advance of the Public Hearing, please contact Guy Gimlen, Principal Air Quality Engineer, (415) 749-4734, ggimlen@baaqmd.gov.

II. BACKGROUND

A. Characterization of Particulate Matter

This section provides background information regarding airborne particulate matter (PM) and associated concerns with public health. The following discussion summarizes and applies information provided in four Air District source documents:

- Health Impact Analysis of Fine Particulate Matter in the San Francisco Bay Area, published in September 2011,
- Understanding Particulate Matter: Protecting Public Health in the San Francisco Bay Area, published in November 2012, and
- Sources of Bay Area Fine Particles: 2010 Update and Trends, published in December 2012.
- Bay Area 2017 Clean Air Plan, published in April 2017 (see Chapter 2).

1. Introduction to Particulate Matter

PM encompasses a diverse assortment of tiny airborne particles of different sizes, physical states, chemical compositions, and toxicity. Individual particles can vary in terms of their behavior in the atmosphere and the length of time they remain suspended in the air. PM can originate from a variety of anthropogenic stationary and mobile sources, as well as from natural sources. Typically, PM consists of a mixture of microscopic solid particles and minute liquid droplets known as aerosols that condense at atmospheric temperatures. PM can be emitted directly to the atmosphere (referred to as direct PM or primary PM), or formed in the atmosphere through reactions between other pollutants (referred to as indirect or secondary PM). Primary PM includes soot and liquid aerosols from a wide variety of sources, including cars, trucks, buses, industrial facilities, power plants, cooking, and burning wood. Primary PM also includes dust from construction sites, tilled fields, paved and unpaved roads, landfills, and rock quarries. Secondary PM may be formed when various pollutants from burning fuels such as sulfur oxides (SOx) and nitrogen oxides (NOx) react with volatile organic compounds (VOC) and ammonia in the presence of sunlight and water vapor. PM includes carbon and various metallic elements; compounds such as nitrates, organics, and sulfates; and complex mixtures such as diesel exhaust, wood smoke, and soil. Dust from roads, quarries and construction sites are generally larger, coarser particles, whereas combustion soot and secondary PM tend to be very fine particles. Unlike the other criteria pollutants, which are individual chemical compounds, particulate matter consists of all particles suspended in the air.

PM is often characterized based on particle size using the following terminology:

- **Total Suspended Particulate (TSP)**: Includes all sizes of airborne particles.
- **PM_{10}**: Is the fraction of the total particles in the atmosphere that are 10 microns or smaller in diameter (one micron or micrometer equals one-millionth [10^{-6}] of a meter). This includes $PM_{2.5}$ (described next).
- **$PM_{2.5}$**: Is the fraction of total particles that are 2.5 microns or smaller in diameter, and is sometimes referred to as "fine" PM. This includes ultrafine PM (described next).
- **Ultrafine PM**: Consists of particles smaller than 0.1 micron in diameter.

Larger particles weigh the most, so large particles represent the largest fraction in terms of weight, whereas the smaller particles are more numerous and have more surface area in aggregate but usually contribute less toward the total mass of PM_{10}. Ultrafine PM is estimated to account for roughly 90 percent of the total number of particles but usually represent much lower percentage of the mass.

When the 1970 federal Clean Air Act was adopted, regulatory efforts to address PM focused primarily on Total Suspended Particulate (TSP), the generic name for all airborne particles of any size. Regulation 6, Particulate Matter; Rule 1: General Requirements was developed at that time. Subsequently, scientific evidence pointed to smaller particles as posing the most serious health consequences. Therefore, in 1987, EPA replaced its TSP clean air standard with a PM_{10} clean air standard – one that regulated particles less than 10 microns in diameter. In 1997, EPA augmented its PM_{10} standard with a $PM_{2.5}$ clean air standard focused on particles less than 2.5 microns in diameter.

2. Bay Area PM Emissions and PM Formation

PM chemistry and formation are complex and variable. PM concentrations vary considerably both in composition and spatial distribution, and on a day-to-day basis as well as from season to season.

Primary PM Emissions

Direct $PM_{2.5}$ emissions in the Bay Area are produced by a wide variety of sources, both human and natural, but dominated by a few. About half of Bay Area $PM_{2.5}$ is directly emitted from combustion, i.e., burning fossil fuels, wood and other vegetative matter; or cooking. This directly emitted $PM_{2.5}$ is mostly composed of organic carbon compounds and soot containing pure carbon, as well as gases that form liquid aerosols as they cool, known as condensable PM.

Combustion of fossil fuels in all types of engines produces direct emissions of PM. In addition, motor vehicles also: i) cause re-entrainment of dust on and along the side of roads as they drive, ii) create particles known as road dust by abrading road materials such as concrete and asphalt pavement, and iii) create tiny particles from tire and brake pad wear. Combustion of fossil fuels also creates NO_x and SO_x which can react with other air pollutants to form secondary PM.

Diesel engines emit a complex mixture of air pollutants, with a major fraction consisting of $PM_{2.5}$. Diesel emissions account for roughly one-sixth of total emissions of carbonaceous $PM_{2.5}$ in the Bay Area. Because exposure to diesel PM is linked to a wide range of negative health effects, as described below, reducing emissions of diesel PM from heavy-duty engines is a priority for the California Air Resources Board (CARB) and the Air District. Diesel PM emissions from heavy-duty vehicles have already declined substantially over the past decade, and they are expected to continue decreasing significantly over the next decade in response to recent CARB Diesel Risk Reduction Program regulations and Air District regulations and other efforts.

Geological dust, which includes construction dust and windblown dust, accounts for a relatively modest fraction of $PM_{2.5}$ (five to ten percent), but a very large portion of PM_{10} (50 - 60 percent). Sea salt from the ocean contributes another ten percent on an annual basis.

Condensable PM Emissions

Condensable particulates are a subset of directly emitted, primary particulate matter. Condensable PM leaves the hot engine exhaust or industrial stack in gaseous form, and then condenses to form liquid aerosols or solid particles after mixing with cooler ambient air. The amount of condensable PM is an unknown for many industrial sources because methods to accurately quantify condensable PM have only recently been finalized.

Secondary PM Emissions

In addition to directly emitted PM, emissions of PM precursors such as sulfur dioxide (SO_2), NO_X, ammonia, and volatile hydrocarbons contribute to atmospheric chemical reactions that form secondary PM. Ammonia reacts with SO_2 to form ammonium sulfate. Combustion of fossil fuels produces NO_X, which combines with ammonia in the atmosphere to form ammonium nitrate. Volatile organic compounds can also form particles through a number of complex chemical mechanisms in the atmosphere. These secondary PM compounds constitute approximately one-third of the Bay Area $PM_{2.5}$ on an annual basis, and approximately 40 – 45 percent of Bay Area $PM_{2.5}$ during winter peak periods. Secondary PM formation of ammonium sulfate is relatively low (averaging 1-2 µg/m^3), but it does account for approximately 10 percent of total $PM_{2.5}$ on an annual average basis.

Even though primary (direct) PM and secondary PM are defined in terms of the processes and sources that produce PM, most individual particles in the atmosphere are in fact a combination of both primary and secondary PM. An individual particle typically begins as a core or nucleus of carbonaceous material, often containing trace metals. These primary (directly emitted) particles are geologic dust or originate from incomplete combustion of fossil fuels or biomass. Layers of organic and inorganic compounds then condense or deposit onto the particle, causing it to grow in size. These layers are largely comprised of secondary material that is not emitted directly. As a particle grows larger, gravity eventually causes it to fall out and be deposited onto a surface.

Aligning Emissions with Ambient Air Monitoring Results

Determining the relative contributions of various sources of direct emissions and $PM_{2.5}$ precursors to the total is very complex. An estimate of the relative contribution from various sources is based on emissions inventory data combined with results of chemical mass balance (CMB) analysis[1] of the material gathered by the ambient air monitors. In analyzing PM sources, there may be discrepancies between the estimated PM emissions inventory and ambient PM concentrations estimated from CMB analysis. For example, the emissions inventory lists road dust, construction dust, and windblown dust as significant sources, whereas chemical mass balance analysis shows such dust to be a very small portion of $PM_{2.5}$, particularly during winter when $PM_{2.5}$ levels are at their highest. A likely explanation is that humidity is generally higher during the winter rainy season, so geologic dust is less likely to become airborne during winter. An additional influence is that fugitive dust does not necessarily stay airborne over extended distances. Larger $PM_{2.5}$ particles – i.e. those nearly 2.5 microns in diameter tend to settle out relatively quickly, whereas smaller particles – those less than one micron in diameter including combustion related $PM_{2.5}$ – can stay airborne much longer.

Seasonal Impacts

The Air District has found that $PM_{2.5}$ levels that occur on a given day are strongly influenced by the prevailing weather. Cool weather is especially conducive to the formation of ammonium nitrate. Ammonium nitrate is a significant source of secondary $PM_{2.5}$ in winter months, contributing approximately 10 – 20 percent of total $PM_{2.5}$ near the coast, and 40 – 50 percent of total $PM_{2.5}$ inland. This semi-volatile $PM_{2.5}$ component is stable in solid form only during the cool winter months.

The relationship between the weather and $PM_{2.5}$ levels has been analyzed using a statistical technique known as cluster analysis to find groups of days exhibiting similar conditions. Cluster analysis was applied to ten years of measurements to determine winter weather patterns associated with elevated Bay Area $PM_{2.5}$ levels. Cluster analysis found that a single weather pattern accounted for most elevated 24-hour $PM_{2.5}$ episodes in the Bay Area. $PM_{2.5}$ exceedances in the Bay Area usually occurred after two to four consecutive days of $PM_{2.5}$ buildup under a high-pressure system. High $PM_{2.5}$ episodes are typically regional in scale, affecting multiple Bay Area locations, but can also be highly localized depending on proximity of a source, meteorology and other factors. These conditions occur when a high-pressure system moves over Central California in winter months, resulting in sunny days and clear, cold nights with little wind. The lower levels

[1] Chemical mass balance (CMB) analysis is a methodology in which a computer model is used to apportion ambient $PM_{2.5}$ collected on filters over 24-hour periods at monitoring sites around the Bay Area to a set of source categories. Each filter was analyzed for a range of chemical species. The same species were measured in special studies of emissions from various sources, such as motor vehicles and wood burning. The CMB model finds the mix of these source measurements that best matches the ambient sample, chemical species by chemical species.

of sunlight in the winter lead to strong temperature inversions (phenomenon where the atmospheric temperature increases with altitude). These inversions are conducive to the buildup of PM in ambient air near ground level, especially $PM_{2.5}$ and ultrafine particles, which can remain airborne for many days.

Winter is also when the most residential wood burning occurs. The CMB analysis shows that both fossil fuels and biomass (primarily wood) combustion sources are large $PM_{2.5}$ contributors in all seasons. The biomass combustion's contribution to peak 24-hour $PM_{2.5}$ levels is about three to four times higher in winter than the other seasons, as confirmed by isotopic carbon (^{14}C) analysis, reflecting increased levels of wood burning during the winter season. In the Bay Area, wood smoke is the largest source of airborne $PM_{2.5}$ during winter elevated 24-hour PM episodes.

During winter months, the Bay Area may also be impacted by PM from the Central Valley. High-pressure systems over Central California are highly conducive to the build-up of $PM_{2.5}$ in the Central Valley. As dense cold air converges on the Central Valley floor, which increases air pressure, air flows westward through the Carquinez Strait and into the Bay Area, thereby transporting $PM_{2.5}$ from the Central Valley to the Bay Area. When $PM_{2.5}$ from the Central Valley combines with $PM_{2.5}$ emitted or formed within the Bay Area, elevated PM levels in the Bay Area can occur, especially in the eastern parts of the region closest to the Central Valley.

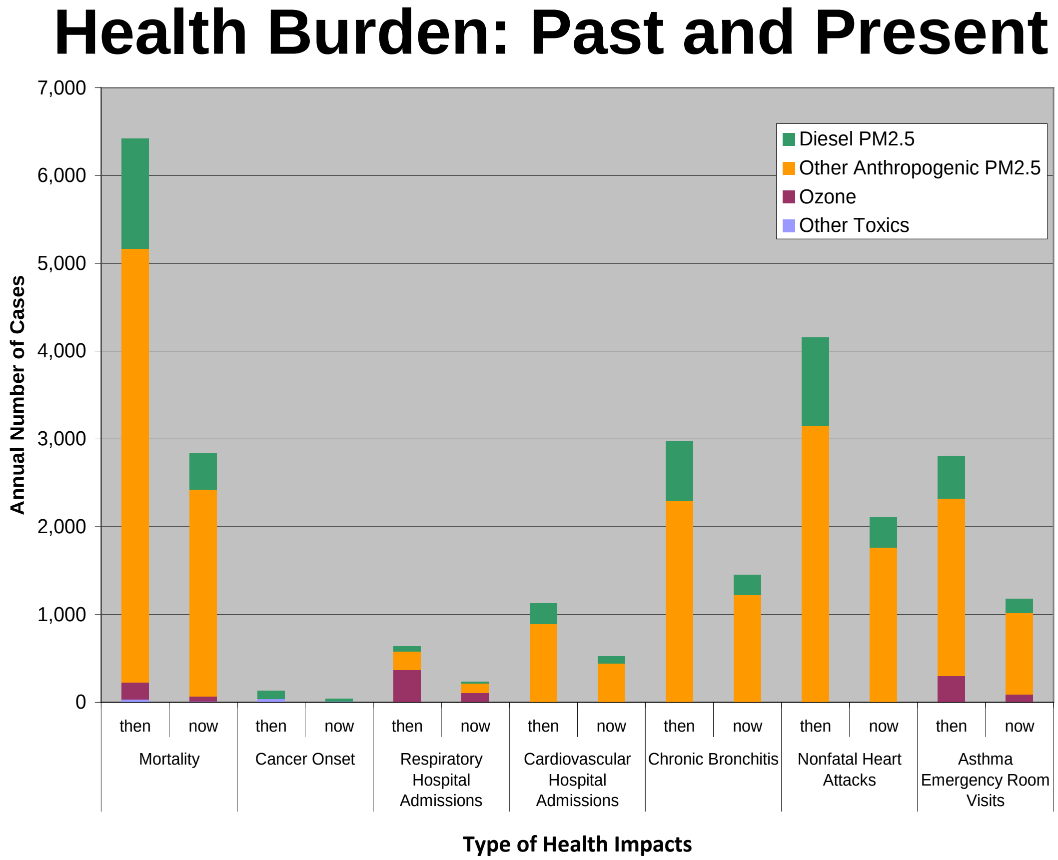
3. PM Health Effects

Since exposure to ambient PM has long been understood as a health hazard,[2] PM was designated as one of the criteria pollutants in the original 1970 federal Clean Air Act. Concerns about PM were initially based on its respiratory health effects, such as aggravating asthma, bronchitis, and emphysema. However, in recent years, many epidemiological studies have linked PM exposure to a much wider range of negative health effects, including cardiovascular effects such as atherosclerosis (hardening of the arteries), ischemic strokes (caused by obstruction of the blood supply to the brain), and heart attacks. Studies also indicate that exposure to PM may be related to other health effects, including reduction in cognitive function, autism, and increased risk of diabetes. Infants and children, the elderly, and persons with heart and lung disease are most sensitive to the effects of PM.

Analysis by Air District staff found that $PM_{2.5}$ is the most significant air pollution health hazard in the Bay Area, particularly in terms of premature mortality.[3] Studies have concluded that reducing PM emissions can reduce mortality and increase average life span.[4] Figure II-1 shows the assessment of air pollution impacts on key health indicators in the Bay Area related to exposure to emissions of PM, ozone and toxics. The graph presents information for "now" (based on 2008 data) compared to several decades ago (1970's for ozone, late 1980's for toxics and PM).

[2] The London fogs of the early 1950s that killed thousands of people were primarily caused by PM from coal, which led to the banning of coal burning within the city.
[3] See Appendix A in the Bay Area 2010 Clean Air Plan.
[4] For example, a recent study of nationwide scope found that reducing fine PM results in significant and measurable improvements in human health and life expectancy. Pope, C. Arden III et al. "Fine Particulate Air Pollution and Life Expectancy in the United States." New England Journal of Medicine, January 22, 2009. Volume 360:376-386. No. 4.

Figure II-1: Assessment of Bay Area Health Burden from PM & Other Air Pollutants



Although the epidemiological evidence that shows strong correlation between elevated PM levels and public health effects is very well documented, scientists are still working to understand the precise biological mechanisms through which PM damages our health. A recent study by researchers at the University of Michigan suggests that PM may harm our bodies by a combination of 1) increasing blood pressure and 2) triggering a response causing inflammation that can stiffen and damage blood vessels.[5]

The smaller the particle, the more easily it can evade the body's filtration system, penetrate deep into the lungs and enter the bloodstream. Research in recent years suggests that both $PM_{2.5}$ and "ultrafine" particles (those less than 0.1 microns) may pose the most serious threat to public health.[6] Because of their small size, $PM_{2.5}$ and ultrafine particles account for a relatively small fraction of total PM mass; however, they comprise the vast majority of particles by number. In addition, small particles have a much higher surface area per mass than larger particles; therefore, they can act as carriers for other agents such as trace metals and organic compounds that collect on their surface. Again, internal combustion engines, whether powered by gasoline, diesel, or natural gas, are a major source of $PM_{2.5}$ and ultrafine PM. Studies in Southern California have found elevated counts of ultrafine particles near freeways. Numerous studies[7] have shown increased incidence of respiratory and cardiovascular disease near heavily traveled roadways.

---

[5] See Robert Brook et al. "Insights into the Mechanism and Mediators of the Effects of Air Pollution Exposure on Blood Pressure and Vascular Function in Healthy Humans" Hypertension: Journal of the American Heart Association, July 29, 2009.

[6] See Chapter 11 (Ultrafine Particles) in the 2007 South Coast Air Quality Management Plan.

[7] Health Effects Institute Panel on the Health Effects of Traffic-Related Air Pollution, Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. Health Effects Institute: Boston, 2010. Available at www.healtheffects.org.

Public health officials and regulatory agencies, including the CARB, have expressed concern about public exposure to PM from diesel engines. Diesel PM endangers public health not only as a component of $PM_{2.5}$, but also as a carcinogenic TAC. Analysis of TACs in the Bay Area for the Air District's Community Air Risk Evaluation (CARE) program identified diesel PM as the TAC responsible for the majority of cancer risk from air pollution in the Bay Area. It should be noted, however, that the mortality risk from diesel PM primarily relates to its role as a component of $PM_{2.5}$, rather than as a carcinogenic TAC.

Significant progress has been made to enhance our technical understanding of PM, including improved monitoring and enhanced modeling capabilities. However, because the shift in focus toward PM is relatively recent, efforts to analyze and control PM still lag pollutants such as ozone, ozone precursors, and carbon monoxide. Research on the health impacts of $PM_{2.5}$ and ultrafine particles is still evolving, and no ambient air quality standards for ultrafine PM have yet been established. Existing state and national ambient PM standards are based on mass (weight) concentrations in the air, rather than the number of airborne particles.

A study of particle suspension in the air has shown that larger particles (larger than PM_{10}) fall back to the earth quickly (typically within 100 - 200 feet), and smaller particles ($PM_{2.5}$) tend to dissipate in the surrounding air. Measurements of diesel and other ultrafine PM from vehicles on the freeways indicate that particulates tend to reach background concentrations about 250 meters away from the freeway.[8, 9]

The chemical and physical properties of PM vary greatly with time, region, meteorology, and source, thus complicating the assessment of health and welfare effects. One of the challenges in devising strategies to reduce PM is that scientists are still working to determine the relative health risk associated with the many types, sources and sizes of particles that comprise PM. Better information in this regard will help prioritize our efforts to achieve the greatest benefit in reducing health risks associated with PM. Nevertheless, our best knowledge to date suggests that fine particles themselves are harmful, irrespective of composition, and reduction of $PM_{2.5}$ concentrations result in significant health benefits.

Other Impacts of PM

PM emissions also have impacts on the climate. PM aerosols can help to reduce the full effect of global warming by scattering sunlight. Conversely, black carbon or soot, a component of PM emitted by diesel engines and by wood or biomass combustion, absorbs sunlight and thus contributes to global warming. Because airborne particles can have both cooling and heating effects, it is difficult to determine the net impact of $PM_{2.5}$ on climate. However, there is consensus that we need to decrease emissions of black carbon to protect the climate.[10]

Particulate matter, especially larger particles (TSP and PM_{10}) can constitute significant nuisances and are a source of public complaints, particularly about dust. Dust can also exacerbate a wide variety of respiratory issues. PM is a prime cause of regional haze, which is a more general quality of life issue.

[8] Improving Air Quality and Health in Bay Area Communities, Community Air Risk Evaluation Program Retrospective and Path Forward (2004 – 2014), April 2014, page 76.
[9] Zhu, Y.F., W.C. Hinds, S. Kim, S Shen, C. Sioutas, 2002. Study of ultrafine particles near a major highway with heavy-duty diesel traffic. Atmospheric Environment, 36, 4323-4335. doi:10.1016/S1352-2310(02)00354-0.
[10] US EPA Report to Congress on Black Carbon, March 2012

4. Bay Area's Attainment Status of PM Air Quality Standards

The U.S. Environmental Protection Agency (EPA) and CARB have adopted health-based air quality standards for PM_{10} and $PM_{2.5}$. The federal standards are referred to as the National Ambient Air Quality Standards (NAAQS), and the California standards are referred to as the California Ambient Air Quality Standards (CAAQS) and are designed to protect public health. Both sets of standards are set as concentrations of particles (either 10 microns or smaller, or 2.5 microns or smaller) in the ambient air, using units of micrograms per cubic meter (µg/m^3).

Both the national and California standards are reviewed periodically to evaluate whether developments in public health and medical research suggest that the standards should be made even more stringent. To date, researchers have not been able to identify a clear threshold below which there are no adverse health effects from exposure to $PM_{2.5}$. This suggests that $PM_{2.5}$ standards may be further reduced in the future.

The EPA and CARB designate each region in the state as to whether it is "attaining" each NAAQS and CAAQS. A summary of the Bay Area's attainment status with respect to each national standard is as shown in the following table.

Table II-1: National Ambient Air Quality Standards for $PM_{2.5}$ and PM_{10}

National Air Quality Standards	Limit (µg/m^3 [a])	2015-2017 Design Value[b] (µg/m^3)	2015-2017 Design Value excluding fire-affected data[c] (µg/m^3)	Attainment Status
National 24-hour $PM_{2.5}$ standard (Three-year average of 98th percentiles)	35[d]	35	25	Non-attainment[e]
National Annual $PM_{2.5}$ standard (Three-year average)	12.0	11.0	10.3	Unclassifiable/Attainment
National 24-hour PM_{10} standard	150[f]	92	58	Unclassifiable/Attainment

[a] micrograms per cubic meter (µg/m^3)

[b] The Design Value for the 24-hour $PM_{2.5}$ standard is the highest three-year average of 98th percentile concentrations at any site. The Design Value for the 24-hour $PM_{2.5}$ standard is the highest three-year average of the annual means at any site. The PM_{10} Design Concentration is the highest maximum 24-hour concentration measured during the three-year period at any site.

[c] Data from days affected by wildfires (September 1-4 and October 9-19, 2017) are removed from these Design Value determinations.

[d] US EPA tightened the national 24-hour $PM_{2.5}$ standard from 65 to 35 µg/m^3 in 2006. The designation of the Bay Area as non-attainment for the 2006 24-hr national $PM_{2.5}$ standard became effective on December 14, 2009.

[e] On January 9, 2013, U.S. EPA issued a Clean Data Finding for the 2006 24-hour $PM_{2.5}$ National Ambient Air Quality Standard based on air monitoring data, published in the Federal Register, Vol. 78, Page 1760 (78 FR 1760). However, the Bay Area AQMD has not yet submitted a redesignation request to EPA. The

Bay Area will continue to be designated as non-attainment until the District submits a redesignation request and maintenance plan to EPA, and EPA approves the request.

[f] The national 24-hour PM_{10} standard is met if every site has no more than one expected exceedance per year averaged over three years. However, with a one-in-six day sampling frequency, a monitoring site with one exceedance during the three year period would violate the standard.

As explained in the table's note b, the U.S. EPA finalized a Clean Data Finding for the 2006 24-hour $PM_{2.5}$ standard based on air monitoring data. The air monitoring data indicator for attainment of national standards is known as the "Design Value." The Design Value for 2015 through 2017 is 35 µg/m^3. If data affected by wildfires is removed, the 2015-2017 Design Value is 25 µg/m^3. The Bay Area is designated Unclassifiable/Attainment for both the national annual $PM_{2.5}$ standardand the national 24-hour PM_{10} standard.

Table II-2 provides a summary of the Bay Area's attainment status with respect to each California standard.

Table II-2: California Ambient Air Quality Standards for $PM_{2.5}$ and PM_{10}

California Air Quality Standards	**Limit** (µg/m^3)	**2015-2017 Designation Value** [a] (µg/m^3)	**2015-2017 Designation Value excluding fire-affected data**[b] (µg/m^3)	**Current Attainment Status**
California Annual $PM_{2.5}$ standard (maximum of most recent 3 years)	12	14	12	Non-attainment
California 24-hour PM_{10} standard	50	95	58	Non-attainment
California Annual PM_{10} standard	20	22	21	Non-attainment

[a] The "Designation Value" is the highest yearly maximum or average between 2015 through 2017.

[b] Data from days affected by wildfires (September 1-4 and October 9-19, 2017) are removed from these Designation Value determinations.

The Air District is not in attainment with the California annual $PM_{2.5}$ standard of 12 µg/m^3. The air monitoring data indicator for attainment of the California standards is known as the "Designation Value" and is the maximum concentration measured at any site in the area during a three year period. For 2015 – 2017, the Designation Value for the Bay Area is 14 µg/m^3, measured at the Napa site in 2017. If data affected by major wildfires is removed, the Designation Value is 12 µg/m^3, measured at the Oakland-West site in 2017.

The Air District is not in attainment with the California 24-hour PM_{10} standard of 50 µg/m^3. The air monitoring data for the State 24-hour PM_{10} standard are:

1. The number of days that are estimated to exceed the standard,
2. The high of the 24-hour average, and
3. The 24-hour Expected Peak Day Concentration (EPDC).

Compliance with the 24-hour PM_{10} standard is determined as follows:

1. An Expected Peak Day Concentration (EPDC) is computed based on the available 24-hour data from each monitoring site,

2. The EPDC is an estimate of the 24-hour PM_{10} concentration that would be exceeded once per year on average,
3. Each site's Designation Value is the highest measured PM_{10} concentration below the EPDC, and
4. If the Designation Value exceeds 50 µg/m3 the site does not meet the standard.

During 2015-2017, the Bay Area does not meet the 50 µg/m^3 standard at the San Pablo monitoring site which had a Designation Value in 2017 of 95 µg/m^3. The 2017 Designation Value at San Pablo, excluding data affected by wildfires is 53 µg/m^3.

The Air District is not in attainment with the California Annual PM_{10} standard of 20 µg/m^3. The air monitoring data for the annual PM_{10} standard are:

1. The annual average at each monitoring site, and
2. The highest annual average during most recent three years.

Compliance requires the annual PM_{10} average at each monitoring location be at or below 20 µg/m^3 for each of the most recent three years. In 2015, the only site with an annual average above 20 µg/m^3 was San Jose, with a value of 21 µg/m^3. In 2017, San Francisco was the highest annual average at 22 µ/m^3, followed by San Jose at 22 µg/m^3 and San Pablo at 20 µg/m^3. There were no values exceeding 20 µg/m^3 during 2016. The 2015 value of 21 µg/m^3 is the highest for 2015 – 2017, when data in 2017 affected by wildfires are removed.

The Bay Area is not yet in compliance with California PM_{10} clean air standards.

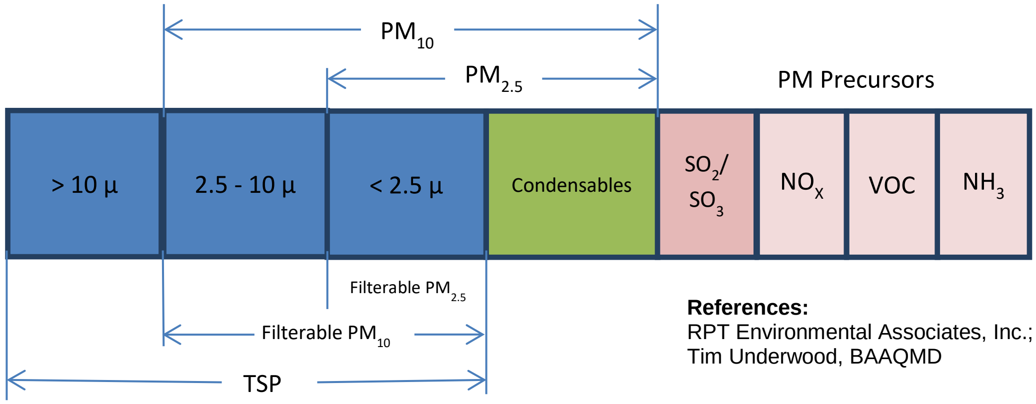
5. Particulate Matter Test Methods

Test methods used to characterize and quantify PM emissions have evolved over time. PM regulatory efforts initially focused on TSP, and EPA's original test method, EPA Test Method 5, was designed to measure TSP. EPA Test Method 5 measures the solid particles in a sample stream with a filter that is designed to collect 99.5 percent of all particles larger than 0.3 microns. The solid particles captured in the sample probe and on the filter are known as "filterable" PM. The Air District has its own testing procedures, which are set forth in the Air District's Manual of Procedures (MOP). The MOP Source Test Method ST-15 has been used to quantify PM emissions from permitted stationary sources in the Air District, and was in use prior to development of EPA Test Method 5. MOP Source Test Method ST-15 is similar to EPA Method 5. It collects solid matter on an in-stack filter that is designed to capture 99.5 percent of particles 0.3 micron and larger, i.e. all the filterable particles known as Total Suspended Particles. The MOP Source Test Method ST-15 reports emissions results for Total Suspended Particles (TSP) in units of +/- 0.002 grains/standard dry cubic feet, and in pounds per hour.

When the PM_{10} clean air standard replaced the TSP standard in 1987, EPA developed a revised test method to measure PM_{10}. The revision incorporated the addition of a cyclone that separated large particles from the PM_{10}. The revised test methodology is called EPA Test Method 201/201A.

When $PM_{2.5}$ requirements were added in 1997, Test Method 201/201A was further refined to differentiate PM_{10} from $PM_{2.5}$ by using an additional cyclone to segregate the particles larger than 2.5 microns from those smaller. After filtration, both test methods cool the sample stream to capture any liquid aerosols and solid particles that condense. The liquids and solids captured after cooling are known as "condensable" PM and were sometimes referred to as "back half" PM emissions. Condensable PM is measured by EPA Test Method 202. All condensable PM is considered $PM_{2.5}$, since it is formed after passing through a 0.3-micron filter. The condensable particles can also be separated into organic and inorganic condensable particulates. There is no standardized test method yet for ultrafine PM.

The following diagram shows the many forms of PM, and test methods needed to differentiate each. Regulation 6 defines these terms and test methods. Proposed amendments to Rule 6-1 will cite the specific test methods required for compliance.



Total Suspended Particles (TSP): PM that can be filtered out of a gas stream as measured using EPA Test Method 5.
PM_{10}: PM with an aerodynamic diameter equal to 10 microns or less, including both filterable and condensable particles.
$PM_{2.5}$: PM with an aerodynamic diameter equal to 2.5 microns or less, including both filterable and condensable particles.
Filterable PM_{10}: PM with an aerodynamic diameter equal to 10 microns or less that can be filtered out of a gas stream at its normal operating temperature. These liquid and / or solid particles are identified using EPA Test Method 201A.
Filterable $PM_{2.5}$: PM with an aerodynamic diameter equal to 2.5 microns or less that can be filtered out of a gas stream at its normal operating temperature. These liquid and / or solid particles are identified using EPA Test Method 201A.
Condensable PM: Liquid droplets that coalesce, or gaseous emissions that condense to form liquid or solid particles. These liquid and/or solid particles are identified as condensable organic or condensable inorganic PM using EPA Test Method 202.
PM Precursors: Air pollutants that can react with each other to form solid or liquid particles.

A significant amount of source testing has taken place on the Bay Area's largest stationary sources. Mid-sized stationary sources in the Bay Area have source tests done based on a recurring test schedule, and smaller stationary sources have source tests done upon request. As test methods changed over the years, the historical source test results have been a mix of TSP, PM_{10} and $PM_{2.5}$ information, sometimes clearly identified as "filterable" and "condensable" PM, and sometimes not clearly identified. Quality and comparability of the Air District PM data will improve with use of consistent source test methods.

Measuring Visible Emissions Opacity

Opacity is a measurement of the degree to which particulates in an exhaust stream or dust plume obscure the ability of an observer to see through the exhaust stream or dust plume. Opacity can also be measured with instrumentation by a beam of light's ability to pass through the exhaust stream without being reflected by any particles in the exhaust stream. As such, opacity is a surrogate for the much more complicated and time intensive source testing (mass-based measurements) of PM emissions. Regulation 6, Rule 1: General Requirements, Regulation 6, Rule 3: Wood-burning Devices, and Regulation 12, Rule 4: Sandblasting all refer to the opacity test method cited in the MOP, based on EPA Test Method 9. This opacity test method requires a person to be trained and certified to view and "read" the degree to which the emissions obscure the observer's view. If the emission is dark-colored, results are most often reported using the Ringelmann scale from zero to five, representing 20 percent increments of reduced opacity. If the emission is light-colored, results are most often reported using increments of five percent opacity. EPA Method 9 defines the observer's positioning requirements in relation to the emission (with the sun at the observer's back), and requires the observer to view, read and record the opacity once every 15 seconds for a six-minute observation period. Opacity limits are typically defined as "no more than 20 percent opacity (or Ringelmann 1) for no more than a cumulative six minutes (which would be 24 readings at 15 second intervals) in any one-hour observation period."

EPA provides three other source test methods for assessing opacity that supplement EPA Method 9. EPA Method 203A uses the same qualifications and methods as EPA Method 9, yet provides for "time-averaged" opacity readings every 15 seconds for observation periods other than 6 minutes long. EPA Method 203B provides a "time-exception" method where a facility may be allowed to exceed an opacity threshold for a certain period (example being three minutes in an hour) but not longer. EPA Method 203C provides for instantaneous opacity readings (every 5 seconds) where 12 consecutive readings can be averaged to provide a one-minute average opacity.

EPA has recently certified an alternate method, based on an American Society for Testing and Materials (ASTM) procedure, to measure opacity by using a digital camera and calculating the opacity based on the digital picture of the emissions compared to the background. The Air District is working with this technology to determine what role it may play in the future.

Observing Visible Dust Plumes

Fugitive dust can also be regulated by defining requirements that limit "visible emissions," in terms of whether dust or a dust plume is visible or not. The only requirement for observing emissions is to have the sun (or other source of light) positioned behind the observer, as described in EPA Method 9. EPA Test Method 22 uses the same requirements for observer positioning as EPA Method 9, and assesses whether the emission is visible (or not) once every 15 seconds for the duration of an observation period.

6. Bay Area PM Emissions Sources

This Section provides a summary of the technical review that Air District staff has undertaken to review and identify the initial opportunities to reduce PM emissions. Air District staff first reviewed the PM emissions inventory to identify source categories with the potential for significant PM emissions reductions, and where the Air District has regulatory authority to address these sources. Staff then evaluated control technologies that could be applied to reduce emissions in the various significant emissions categories. A complete review of the research done to develop the draft amendments to Rule 6-1, and two proposed new rules is shown in Attachment 1.

Air District PM Emissions Inventory

A summary of the 2011 Emissions Inventory is shown below in Table II-3. Complete details of the 2011 Emissions Inventory for PM are shown in Attachment 1-1.

Table II-3: 2011 Particulate Emissions Inventory - tons per day (tpd)

Source Categories	TSP	PM_{10}	$PM_{2.5}$
Petroleum Refining	**0.38**	**0.27**	**0.16**
Other Industrial / Commercial Processes			
Chemical Manufacturing	0.43	0.39	0.38
Cooking	2.81	2.81	1.80
Other Food and Agricultural Processes	0.63	0.44	0.26
Metallurgical Foundries & Forging	0.98	0.61	0.46
Metal Recycling and Shredding	0.14	0.10	0.07
Wood Products Manufacturing	0.15	0.10	0.06
Cement Manufacturing	0.12	0.11	0.08
Asphalt Concrete Plants	0.55	0.22	0.18
Concrete Batching	1.21	1.11	0.75
Glass & Related Products	0.71	0.69	0.68
Stone, Sand & Gravel	0.86	0.43	0.06
Sand Blasting	0.35	0.17	0.01
Landfills	6.35	1.56	0.22
Waste Management - other	0.35	0.34	0.32
Other Industrial / Commercial	1.07	0.75	0.45
Subtotal	**16.71**	**9.83**	**5.78**
Combustion – Stationary Sources			
Domestic Combustion - space heating	0.70	0.70	0.70
Domestic Combustion - water heating	0.47	0.47	0.47
Wood Stoves	2.59	2.42	2.33
Fireplaces	8.88	8.31	8.00
Gas Turbines	0.89	0.88	0.88
Petroleum Refinery Combustion	2.51	2.51	2.45
Landfill Flares	0.11	0.11	0.11
Other Natural Gas Combustion	1.41	1.41	1.41
Planned Fires (prunings, crops, weeds, etc.)	0.32	0.29	0.27
Subtotal	**17.88**	**17.10**	**16.62**
Off-Road Mobile Sources	**5.83**	**5.76**	**5.66**
On-Road Motor Vehicles	**12.70**	**12.51**	**6.69**
Construction	**23.44**	**11.47**	**1.14**
Farming	**3.48**	**1.58**	**0.23**
Accidental Fires	**1.39**	**1.25**	**1.20**
Entrained Road Dust	**59.42**	**28.05**	**4.00**
Animal Waste	**19.05**	**9.17**	**1.05**
Wind Blown Dust	**10.40**	**5.25**	**1.03**
Tobacco Smoke & Miscellaneous	**3.52**	**3.39**	**2.75**
Total	**174.20**	**105.63**	**46.31**

A complete analysis of the emission inventory is available in Attachment 1-2.

Review of Bay Area Stationary Sources for Potential PM Reductions

PM from Combustion

Combustion of various fuels and materials from stationary sources is the single largest category of PM emissions. Rule 6-3 is very effectively addressing PM from fireplaces and woodstoves. However, the remaining sources are much more difficult to control.

The primary control technology used for natural gas combustion sources to minimize direct emissions of PM is "good combustion practice," which means ensuring that combustion is as complete as possible. Normally good combustion practice is indicated by low carbon monoxide (CO) concentration in the outlet stream, since low CO concentrations are an indication of complete combustion. Natural gas is by far the cleanest burning fuel because it usually has a very consistent heating content, and is relatively easy to mix the fuel and air as needed for clean combustion. PM from combustion for space heating and hot water is dependent on the design of the furnace, boiler or water heater. In general, this equipment is very efficient, and burns cleanly. The reason the PM emissions are high from this equipment is that a large volume of natural gas is burned in these devices for heating across the entire Bay Area.

PM emissions from gas turbines, and electrical power generating stations are significant because they are large combustion sources, and most burn natural gas. Gas turbines generally have CO emissions limits in their operating permit to ensure complete combustion. Rule 9-11 limits NOx from electrical power boilers, and includes a CO emission limit to ensure complete combustion.

PM emissions from refinery combustion are significant, because refineries are large combustion sources, and they burn refinery process gas. Refinery process gas does not burn as cleanly as natural gas because it is a variable mixture of fuels from various refining processes. Rule 9-10 limits NOx from refinery combustion, and includes a CO emission limit for all refinery process heaters to ensure complete combustion.

Liquid fuels like jet fuel, diesel and fuel oil produce much higher PM emissions. Solid fuels like petroleum coke (and coal, although no coal is burned the Bay Area) create the highest PM emissions. Most industrial sources in the Bay Area burn natural gas, and refineries burn refinery fuel gas.

Although it is less common, several types of sources such as foundries and calciners use incinerators or thermal oxidizers for particulate control. Incinerator efficiencies can range from 25 to 99 percent, depending on the source and design of the incinerator.

As mentioned above, diesel truck exhaust is a significant source of $PM_{2.5}$ in the Bay Area. CARB is phasing in clean burning diesel fuel requirements, which also apply to non-emergency stationary diesel engines. Clean burning diesel fuel coupled with diesel particulate filters can reduce diesel $PM_{2.5}$ by 85 percent.

PM from Wide Variety of Stationary Sources

Table II-4 shows the Source Categories that are considered significant sources of PM, and are stationary sources (either point sources or area sources) where the Air District has jurisdiction to regulate the emissions. There are two broad areas where emission reductions may be achieved: i) industrial emissions from materials processing, and ii) fugitive dust from a variety of sources such as construction sites, disturbed surfaces and road dust.

Table II-4: Stationary Source Categories Considered for Rule 6-1 Amendments

Source Category	TSP tpd	PM_{10} tpd	$PM_{2.5}$ tpd
Petroleum Refinery Processing[a]	0.38	0.27	0.16
Chemical Manufacturing	0.43	0.39	0.38
Other Food and Agricultural Processes	0.63	0.44	0.26
Wood Products Manufacturing	0.15	0.10	0.06
Asphaltic Concrete Plants	0.55	0.22	0.18
Concrete Batching	1.21	1.11	0.75
Glass & Related Products	0.71	0.69	0.68
Stone, Sand & Gravel	0.86	0.43	0.06
Landfills	6.35	1.56	0.22
Waste Management – other	0.35	0.34	0.32
Other Industrial / Commercial	1.07	0.75	0.45
Construction – 5 source categories	23.44	11.47	1.14
Entrained Road Dust – 6 source categories	59.42	28.05	4.00
Total:	95.55	45.82	8.66

[a] Excludes combustion at refineries

Twenty-two stationary source categories were identified, consisting of 2,455 permitted stationary sources with particulate matter emissions. These sources were screened to focus on the largest of these facilities, 55 of which emit more than 90 lb/day of particulates. These 55 large sources represent slightly more than 2.2 percent of the permitted sources and approximately 85 percent of the total emissions.

Staff visited each of these 55 facilities to assess the current conditions, and understand what the potential impact would be if PM control requirements were placed on these operations. Some of these 55 facilities have PM emissions from industrial stacks and vents and could be affected by the more stringent TSP concentration and mass emissions limits proposed in the draft amendments to Rule 6-1. Some of these source categories are sources of fugitive dust so more stringent visible emissions limits may have an impact. Background information and the potential for reduced PM emissions are summarized for each of these sources below. These assessments provide the basis for estimated PM emissions reductions and estimated costs for these facilities to comply with potential PM controls. A complete analysis of the potential for PM controls and associated emission reductions are shown in Attachment 1-3.

7. Opportunities for PM Emissions Reductions

Industrial Stacks and Vents

Most industrial stacks and vents have permit limits based on Best Available Control Technology (BACT) at the time the facilities were installed or modified, but a few do not. New general requirements from the proposed amendments to Rule 6-1 will affect the facilities that do not have stringent permit conditions. Amendments to Rule 6-1 are proposed separately along with its own staff report.

Fugitive Dust from Bulk Materials, Construction Sites, and Disturbed Surface Areas

Bulk material stockpiles, construction projects and disturbed surfaces are susceptible to wind erosion, and can be significant sources of fugitive dust. While fugitive dust is a significant source of PM emissions, the particle size of the dust depends on the specific material. Dust from gypsum is almost 90 percent PM_{10}, and approximately 50 percent $PM_{2.5}$. About half (50 percent) of most typical geologic dust is larger than 10 microns, and only about 5 percent is smaller than 2.5 microns. Most grains used for flour and animal feed are only 30 percent PM_{10}, and about one percent $PM_{2.5}$. Fugitive dust, which can cause haze and quality of life issues, is a moderate contributor to the $PM_{2.5}$ concerns about health impacts. Analysis of data collected by Air District particulate matter monitors indicates that geological material comprises a small part (less than 10 percent) of the PM_{10} and $PM_{2.5}$ in the atmosphere. This is likely since these kinds of particles tend to settle out of the air rather quickly. In addition, sources of fugitive dust are many, varied, and spread widely across the Bay Area.

While preventing and controlling fugitive dust is helpful in reducing area haze and PM_{10} levels, it is less effective at reducing $PM_{2.5}$–the particles with greatest health impact. Most of the practical fugitive dust control strategies use water to wet dusty areas. Given the severe drought situation in California, staff believes the concerns about the lack of water currently outweigh the need for general fugitive dust controls at this time, in light of the fact that fugitive dust is a moderate contributor to the $PM_{2.5}$ and related health impacts. Staff proposes to focus on the highest impact sources of fugitive dust while minimizing water consumption.

Bulk Material Storage and Handling

As cited above, wind erosion at bulk material storage and handling facilities can create significant dust, particularly when handling fine solids like gypsum, or even gravel and sand from rock quarries. The Air District has received numerous complaints about coke dust and coal dust. Coke and coal stockpiles and loading / unloading are unique in that fugitive dust from these products is black and highly visible as compared to geologic dust. Since black coke and coal are sources of nuisance complaints, staff is including coke and coal storage and handling within the broader category of bulk materials. Staff has incorporated new draft requirements to control dust from bulk material storage and handling operations into the proposed amendments to Rule 6-1.

Trackout

Trackout is a concern at bulk material sites, construction sites, and disturbed surface areas including landfills. As mentioned above, water is often used to control dust. Mud can form at these locations, and accumulate on the bottoms of vehicles and vehicle tires. When vehicles leave the work site, they can track mud out onto a public roadway. Over the next 50 - 100 feet of the road, the mud falls off the vehicles and tires. As the mud dries, the dirt remains on the paved road where subsequent traffic can pulverize the dirt into silt, and the turbulence from the passing vehicles entrains the silt into the air. This mud / residual dirt is called trackout. Trackout can be a significant source of $PM_{2.5}$, and can be controlled cost effectively by knocking or washing the mud off the vehicles before they leave the facility. A new rule is proposed separately with its own staff report.

Staff proposes a new rule (new Rule 6-6) to prohibit trackout of mud and dirt onto adjacent public roadways, where subsequent traffic can pulverize the dirt into silt, and turbulence from the passing vehicles entrain the silt into the air. This material is one source of road dust that can readily be controlled.

Paving and Roofing Asphalt Operations

PM emissions from both paving asphalt and roofing asphalt are odorous, as well as estimated to be 95 percent $PM_{2.5}$. Asphalt is applied at high temperatures (250 - 325°F) for paving asphalt, and even higher temperatures (400 - 500°F) for roofing asphalt. Asphalt emits odors, and some of the hot asphalt appears to volatize and then subsequently condense into very small liquid aerosols or solids that take the form of smoke. This is commonly known in the asphalt industry as “blue smoke,” and asphalt fumes from both paving and roofing asphalt are associated with eye, nose and throat irritation. Roofing asphalt is applied at very high temperatures, and there is typically significant smoke and fumes that come from both the heater / storage unit (known as an asphalt kettle), and during application of the hot asphalt on the roof. The smoke is vaporized asphalt that forms odorous liquid aerosols and solid particles ($PM_{2.5}$) when exposed to cooler air. Data conflict regarding whether these fumes are toxic or not. Staff investigated controls for both paving asphalt and roofing asphalt, and could find no cost-effective control methods beyond what is currently done. While a draft rule to address roofing asphalt was presented at workshop, more detailed cost information indicates low-fuming roofing asphalt is only available from one supplier, and the incremental cost is prohibitive. Staff will not move forward with any proposal to control paving asphalt or roofing asphalt at this time.

8. Current Emissions Control Technology and Methods

As noted above, particulate emissions come from two general types of stationary sources. The first type of source involves processing of various solid materials that are contained inside equipment and ducts, so the subsequent emissions are typically emitted through a stack or vent. The second type of source is more general in nature: dust coming from stockpiles of bulk materials, activities during construction projects and from vehicle traffic on unpaved roadways and disturbed surface areas. The control technologies available to address these two broad areas of PM emissions are discussed below.

PM Emissions from Combustion

PM emissions from combustion, and methods to control / prevent these particulates is discussed above. Staff has no recommendations to reduce PM emissions from combustion during this rule-making, but is developing rules as described in the Air District-wide Combustion Strategy included in the 2017 Clean Air Plan. This combustion strategy will focus on improving energy efficiency to reduce the total fuel burned, and analyze specific sources where stack dimensions can be modified to reduce localized impact on neighbors.

Liquid fuels like jet fuel, diesel and fuel oil produce much higher PM emissions than gaseous fuels like natural gas, but are also difficult to control. CARB is phasing in clean burning diesel fuel requirements, which also apply to non-emergency stationary diesel engines. Clean burning diesel fuel coupled with diesel particulate filters can reduce diesel $PM_{2.5}$ by 85 percent.

Solid fuels like petroleum coke (and coal, but no coal is burned the Bay Area) create the highest PM emissions. Although it is less common, several types of sources such as foundries and calciners use incinerators or thermal oxidizers for particulate control. Incinerator efficiencies can range from 25 to 99 percent, depending on the source and incinerator design. Combustion of solid fuels is rare, and must be analyzed on a case-by-case basis.

PM Emissions from Industrial Stacks and Vents

Solid materials are generally moved through an industrial production process with conveyor belts and / or elevators. Particulates can be contained within equipment, or with shrouding or ducts surrounding the conveyors. The equipment or ducts are kept under a slight vacuum by drawing air into the equipment through ducts with suction from an induced draft fan. This slight vacuum keeps the solids from leaking into the surrounding area. The discharge from the fan is routed through a control device, to a stack or vent piping. Three types of control equipment are typically used to abate particulate emissions from stack or vents at industrial facilities:

- Wet mechanical scrubbers and / or cyclones,
- Baghouses, or
- Electrostatic precipitators

If the process is compatible, water is often injected into the suction produced by the induced draft fan to serve as a wet mechanical scrubber (generally known as a roto-clone). If the process is not compatible with water, a cyclone is installed on the discharge of the fan to control the PM emissions. Wet mechanical scrubbers and cyclones are most effective on large particulates. Table 5 (below) shows that neither device is very effective at controlling small particles less than 2.5 microns.

Baghouses and Electro-Static Precipitators (ESP's) are far more effective at controlling small particles less than 2.5 microns. Baghouses use bags made of cloth, or various plastics to filter out particles. The particles collect on the outside surface of the filter cloth, where the particles themselves can establish a filter-cake that serves to filter out additional particulates in the effluent stream. The baghouse is designed to periodically shake or backflow the process stream to remove the filtered particles, collecting these particles for disposal or recycling back into the production process. ESP's are most effective on particles that are susceptible to accepting a positive electrical charge from exposure to high voltage electrodes. Once charged, these particles are then electrically attracted to grounded plates inside the ESP. Similar to the baghouse; the ESP is designed to periodically shake the grounded plates to remove the filtered particles. Table 5 indicates that baghouses and ESP's are far more effective at controlling small particles less than 2.5 microns than cyclones or wet scrubbers.

Table 5: Particle Size versus Percent Abatement Efficiency[11]

Particle Size	Cyclones	Wet Scrubber	Baghouses	ESP's
< PM_{10}	80%	82% - 95%	94% - 99%	94% - 99%
< $PM_{2.5}$	50%	50% - 92%	93% - 99%	90% - 99%

Cyclones and baghouses, or wet mechanical scrubbers and ESP's can be used in tandem to achieve Best Available Control Technology. The first stage (cyclone or wet scrubber) removes the bulk of the larger particulate matter, and the second stage (baghouse or ESP) removes most of the remaining smaller particles. These systems have demonstrated particulate matter removal to levels of 0.001 - 0.002 grains/dry standard cubic foot. The abatement efficiencies shown in Table II-5 are based on EPA's analysis of coal and biomass combustion. These control technologies are not appropriate for all the Bay Area's diverse source types, especially for combustion of liquid and solid fuels.

Wet scrubbers and wet electrostatic precipitators are the only technologies that address condensable PM, because wet scrubbers and ESP's cool the effluent stream with water. As discussed previously, condensable PM starts as a gas, then condenses around a nucleus (typically a solid particle) as it cools in the atmosphere, and remains a liquid aerosol in the ambient air. Cyclones, baghouses, and dry ESP's typically operate at high temperatures, so condensable PM is not controlled because the effluent remains in a gaseous state. It may be possible to improve abatement efficiencies by cooling the gases before they enter the abatement devices. Cooling techniques may be considered in the future as a possible control strategy.

Review of EPA's BACT / LAER and ARB's BACT Clearinghouse

EPA provides a searchable database of current knowledge for Reasonably Available Control Technologies (RACT), Best Available Control Technologies (BACT), and Lowest Achievable Emission Rates (LAER). Use of BACT results in the lowest feasible emissions for a source and is required of significant new permitted sources under Air District Regulation 2, Rule 2: New Source Review. LAER is a summary of installed technology that achieves the lowest emissions in practice. CARB provides a similar database called the BACT Clearinghouse. Staff searched both databases to identify PM_{10} and $PM_{2.5}$ BACT controls for particulate matter sources in other air districts and other states. ARB's BACT Clearinghouse currently has no references for $PM_{2.5}$. EPA's BACT / LAER Clearinghouse provides information for both PM_{10} and $PM_{2.5}$. The EPA's BACT / LAER Clearinghouse search results provide examples of industry specific controls, and indicates the most effective controls were the same for both PM_{10} and $PM_{2.5}$, although the allowable emission rates for each were different. There were no additional technologies identified specifically for $PM_{2.5}$ and no mention of controls for condensable $PM_{2.5}$.

[11] EPA Control Techniques Document for Fine Particulate Matter dated 10/1998.

Control of Fugitive Dust

Prevention of wind erosion is the primary control method used for most fugitive dust. Dust can be generated by a wide variety of human activities, including disturbing natural surface areas where wind can subsequently create windblown dust. Entrained dust from vehicle traffic on both paved and unpaved surfaces can also be significant.

Current Controls – Rule 6-1 and Storm Water Requirements

The Air District currently does not have any regulations that directly target fugitive dust, other than the general opacity limits and the New Source Review requirements in Regulation 2, Rule 2. Section 6-1-301 establishes a Ringelmann No. 1 emission limit, and Section 6-1-302 establishes a 20 percent opacity limit for no more than three minutes in any hour observation period. These provisions do not necessarily prohibit all fugitive dust emissions of concern. Moreover, the average worker at a site that may generate fugitive dust emissions, such as construction sites or bulk materials storage sites, does not readily understand opacity requirements based on the Ringelmann scale. An observer must be rigorously trained and become certified to measure dust plume opacity using the Ringelmann scale, and although Air District inspectors receive such training and certification, few workers in the field do. If workers in the field cannot determine when the dust is excessive, they are unlikely to take any corrective actions. For these reasons, the Air District's current PM regulations do not adequately address fugitive dust emissions.

Many construction sites and other sites where earth-disturbing activities are undertaken are subject to storm water runoff prevention requirements under CEQA and Regional Water Quality Control Board storm water discharge permits. These authorities normally require affected sites to develop Storm Water Pollution Prevention Plans (SWPPP) that utilize Best Management Practices (BMP's) to limit dirt, mud and silt in water runoff into downstream waterways. Some of these SWPPP BMP's also target control of fugitive dust. SWPPP requirements are enforced through a State General Construction Storm Water Permit system that applies to most storm water discharges associated with construction activity. The State General Construction Storm Water Permit (Water Quality Order 2009-0009-DWQ, amended by 2010-0014-DWQ & 2012-0006-DWQ) requires construction sites to electronically file various compliance documents, including a Storm Water Pollution Prevention Plan (SWPPP), to the State Water Board. The Regional Water Quality Control Boards may also issue General Construction Storm Water Permits. These existing requirements mean that many sites are already implementing control measures necessary to prevent significant fugitive dust emissions.

The SWPPP guidance documents provide several Best Management Practices (BMP's) that may be needed to control soil erosion so that excessive dirt and mud do not enter the storm water system and do not pollute downstream waterways. Several of these BMP's also apply to wind erosion, and apply to control of trackout, spills, and soil erosion onto public paved roads. A certified SWPPP preparer must identify site specific BMPs needed to ensure water effluent from a construction site is acceptable. A certified SWPPP inspector must monitor implementation of the required BMP's to ensure the plan is implemented effectively. The SWPPP does not require firm pH (acidity) or turbidity limits because each construction site is unique. However, each SWPPP does identify contingency action levels if storm water quality exceeds limits included in the plan.

The BMP's that are applicable to fugitive dust control includes the following categories:

- Erosion Control
- Sediment Control
- Trackout Control
- Non-Storm Water Management
- Waste Management Materials

Any draft requirements for control of fugitive dust or trackout should be consistent with the SWPPP requirements.

Significant resources exist to help with development and implementation of SWPPP's, including details on BMP's. Examples are:
http://www.dot.ca.gov/hq/construc/stormwater/caltrans_guidance_manual-rev1.pdf
http://www.dot.ca.gov/hq/construc/stormwater/BMP_Field_Master_FullSize_Final-Jan03.pdf
http://www.dot.ca.gov/hq/construc/stormwater/documents/SWPPP_Prep_ManualJune2011.pdf

The best information is available from the California Storm Water Quality Association, for a nominal subscription fee: https://www.casqa.org/resources/bmp-handbooks.

Control Measures

Prevention of wind erosion usually takes one of five approaches:

- Minimize the surface area being disturbed at any given time.
- Apply dust suppression measures when needed.
- Establish wind breaks, and limit work on windy days.
- Limit traffic on disturbed surfaces, and limit vehicle speeds.
- Prevent dirt, mud, and solids spills; and clean up any spills that have the potential to create dust immediately.

As mentioned above, control of wind erosion is currently required for construction projects larger than one acre of disturbed surface area by the State Water Quality Board. They have requirements to develop a SWPPP that follows BMP's to limit dirt, mud and silt in water runoff into downstream waterways, and include dust control.

Control measures by necessity are different in areas where active dust generating operations are underway, as opposed to inactive areas. Dust control measures in active areas include:

- Pre-watering, and keeping disturbed surfaces damp during earth moving operations.
- Keeping dusty materials damp, especially when processing these materials.
- Providing wind barriers or enclosing dusty material handling and storage areas.
- Keeping storage piles covered.
- Limiting vehicle traffic to paved or stabilized surfaces.
- Limiting vehicle speeds.
- Preventing dirt, mud and other solids from being tracked out or spilled onto paved roadways.
- Preventing erosion of dirt or mud onto paved roadways.

Other control techniques for a wide variety of sources are found in Attachment 1-5.

Figure II-2: Water Truck

Water truck used to keep unpaved roadways damp.

Dust control in inactive areas includes:

- Using wind erosion controls, like trees or bushes, wood or rock walls, earthen banks, or permanent wind breaks.
- Appling chemical dust suppressants that will form a crust on the disturbed surface by absorbing moisture from the air.
- Growing vegetative ground cover. Even if the vegetation dries up during the dry season, the plant root systems will prevent wind from eroding the soil

Test methods for soil stabilization are found in Attachment 1-6.

Control of Trackout onto Paved Roads

Facilities that use water to control dust can create a problem with mud that sticks to vehicles and vehicles' tires, then carrying the mud out onto an adjoining paved roadway. Any dirt that accumulates on a paved roadway can and will be pulverized into fine particles by passing vehicle tires, and then entrained into the air by the turbulence from passing vehicles.

Most facilities have a truck "grizzly" bar or a rumble strip to prevent trackout onto the public roadways. Rumble strips are typically a series of pipes or bars on six-inch centers used to shake the vehicle, and dislodge any mud from the vehicle. In addition, these bars or pipes are designed to flex the vehicle's tires, and dislodge mud from between the tire treads before it leaves the property.

Figure II-3: Grizzly used to control Trackout

A critical, and often overlooked element of ensuring a grizzly or rumble strip is effective is to keep the area under the rumble strip clear of accumulated mud. When this area below the grizzly fills with mud, the rumble strip is no longer effective at removing mud from the vehicle or tires.

In addition, some facilities use a truck wash station designed to clean mud from the tires and under-carriage of the vehicle. Other facilities have long paved roads prior to reaching the public traveled roadways that are either washed down or kept clean with street sweepers.

Figure II-4: Truck-wash Station used to control Trackout

There are typically three ways to mitigate road dust:

- Support vegetation on median strips and next to road shoulders to minimize wind erosion,
- Water flush,
- Mechanically sweep or vacuum sweep.

The vegetation strategy is best when built into the design of highways and freeways. Water flushing is effective, but creates the concern of flushing silt into the groundwater.

Street sweeping is often the most practical, and has the advantage of removing trash, litter and various other debris from the roadways. However, mechanical sweepers often create as much dust as they prevent. Some sweeper designs include a water spray ahead of the sweeper to control dust, but that often just wets the silt and allows it to cling to the road or gutter surface, rather than being swept up. Vacuum sweepers are far more effective at collecting and removing road dust. Street sweepers are now available equipped with air jets to blow silt from the cracks in the street, coupled with high capacity vacuum systems to prevent creation of a dust cloud during the sweeping operation, combined with high efficiency air filters on the discharge of the vacuum systems to capture more than 80 percent of PM_{10}. However, even these most effective street sweepers must be operated within strict design guidelines to achieve 80 percent cleanup efficiency. Street sweepers are typically designed to operate at speeds of less than five miles per hour (mph). It is common to see street sweepers operating at 10 – 25 mph, particularly on freeways. At speeds greater than 10 mph, street sweeping can aggravate road dust problems by re-entraining road dust rather than recovering it.

Figure II-5: Street Sweeper

A situation similar to trackout occurs when spills from passing vehicles leave solid materials on the roadway that can be pulverized and entrained into the air. This material is called carryout, and controls include ensuring the vehicle does not leak either solids, or liquids containing solids, and covers for the material so that solids are not blown out of the top of the vehicle at higher speeds. California Motor Vehicle Code, Section 3.3.6 currently has requirements to control spills and carryout.

Control of Asphalt

Control of Paving Asphalt

Paving asphalt is a mixture of asphaltic cement (liquid asphalt from a refinery) combined with gravel to give it strength. Paving asphalt may be applied hot (300 – 350°F), or can be applied at cooler temperatures if solvents or water emulsions are used to keep the asphalt pliable and workable at the lower temperature. When paving asphalt is transferred from a storage bin into a delivery truck (known as load-out), a small portion of the hot asphalt vaporizes, creating smoke and fumes. This smoke is vaporized asphalt that forms odorous liquid aerosols and solid particles ($PM_{2.5}$) when exposed to cooler air. This smoke usually creates a haze that is blue in color, so it is called "blue smoke". Blue smoke can be captured and controlled by drawing the aerosols with an induced draft fan through ducts into a filtration system. These blue smoke abatement systems are currently in place in at least two asphalt plants and being installed in a third asphalt plant in the Bay Area.

Control of Chip Seal Paving Asphalt

Chip seal paving is a technique for lightly traveled roads where existing pavement with cracks can be repaired by spraying hot asphalt onto the cracked pavement so the asphalt will fill the cracks, then spreading light gravel on the asphalt and pressure rolling the gravel smooth. Chip seal asphalt is like paving asphalt, normally applied hot (300 – 350°F). Since this asphalt is sprayed, it can produce a large quantity of blue smoke. Blue smoke abatement is also available for chip seal spray systems. A portable module with an induced draft fan, suction hoods and ductwork are positioned next to the chip seal spray nozzles, and is quite effective at capturing and controlling the blue smoke aerosols.

Control of Roofing Asphalt

Control of smoke and odors from roofing asphalt is a challenge. Smoke and odors come from the asphalt kettle where plugs of roofing asphalt are heated to above 400°F, and smoke and odors occur again when the roofing asphalt is delivered onto the roof, and spread across the rooftop.

BMPs for roofing asphalt kettles include kettle siting to minimize impact on people, temperature control of the asphalt in the kettle (to prevent overheating the asphalt), keeping the kettle closed, and having good seals on the edges of the kettle openings. Compliance with these management practices is driven primarily by safety and efficiency, but also supports emission reduction of both PM and odors.

One roofing asphalt manufacturer has developed a polymer additive that when added to the asphalt creates "low-fuming" roofing asphalt. This polymer floats on the surface of the asphalt to prevent asphalt vaporization, and significantly reduces fumes from the asphalt kettle by 60 – 80 percent. However, this control method does not help reduce emissions during application of the hot asphalt on the roof. This product, known as low-fuming roofing asphalt, appears to be an improvement in worker exposure to fumes as well as providing a reduction in PM emissions and odors. Other roofing asphalt manufacturers have developed a "low-odor" roofing asphalt by adding an odorant to make the smell more pleasing, but it does not reduce smoke or PM emissions.

B. Regulatory History

Air District staff reviewed the existing framework of regulations that address PM emissions sources. The Air District's efforts to further address the health impacts from PM in the ambient air will be implemented on the foundation of these existing regulations. The discussion below describes the current regulatory framework addressing PM emissions, including a review of the Air District's existing PM regulations and how they interplay with state and federal law.

1. Air District Rules / Regulations

The Air District has long been concerned about particulate matter. Regulation 6 was adopted in 1973, and other regulations that address PM, including Regulation 5, Open Burning. However, on-going research and developments in medical science and public health have identified small particulates as having the greatest health impacts. PM regulations that began addressing Total Suspended Particles (TSP) have subsequently focused on PM_{10} and $PM_{2.5}$, and have become more stringent as the health impact of fine particles becomes clearer. The Air District's lack of attainment with the California Ambient Air Quality Standards requires that we take strong regulatory action to address PM.

There are currently eleven Air District rules directly addressing PM emissions:

- **Regulation 2, Permits, Rule 2: New Source Review**: This rule requires new and modified sources of specified "criteria" pollutants, including PM, to implement BACT to limit emissions. The BACT standard is a technology-forcing requirement that requires new or modified sources to install the latest "state-of-the-art" emissions control technology.
- **Regulation 5, Open Burning**: This rule prohibits open fires within the San Francisco Bay Area, with certain important exceptions.
- **Regulation 6, Particulate Matter, Rule 1: General Requirements**: This rule contains the Air District's general limitations on PM emissions, and is the rule for which the Air District is currently proposing amendments. This rule is described in more detail in the staff report for the proposed amendments to Rule 6-1.
- **Regulation 6, Particulate Matter, Rule 2: Commercial Cooking Equipment**: This rule limits the PM_{10} emissions from charbroilers used in restaurants.
- **Regulation 6, Particulate Matter, Rule 3: Wood Burning Devices**: This rule prohibits wood burning during wintertime "Spare the Air" alerts.

- **Regulation 6, Particulate Matter, Rule 4: Metal Recycling and Shredding Operations**: This rule requires metal recyclers to develop and implement site-specific emissions control plans approved by the Air District.
- **Regulation 6, Particulate Matter, Rule 5: Particulate Emissions from Refinery Fluidized Catalytic Cracking Units**: This rule establishes a limit of 10 parts per million by volume, dry (ppmvd) ammonia from FCC's, or requires the refinery to conduct operational testing and source tests to establish enforceable ammonia emission limits that minimize total $PM_{2.5}$ emissions.
- **Regulation 9, Inorganic Gaseous Pollutants, Rule 13: Nitrogen Oxides, Particulate Matter, and Toxic Air Contaminants from Portland Cement Manufacturing**: This rule requires that TSP emissions (as measured by EPA Test Method 5) are less than 0.04 pounds per ton of clinker produced from the kiln, and less than 0.04 pounds per ton of clinker produced from the clinker cooler. In addition, emissions from any miscellaneous operations or emission point must meet opacity limits of no more than 10 percent for no more than cumulative three minutes in any hour observation period. Each facility must also implement a wide variety of Fugitive Dust Mitigation Control Measures.
- **Regulation 10: Standards of Performance for New Stationary Sources**: This rule incorporates the EPA's requirements for New Source Performance Standards (NSPS) by reference into the Air District's regulations.
- **Regulation 12, Miscellaneous Standards of Performance, Rule 4: Sand Blasting**: This rule requires sand blasting operations to meet stack opacity limits of no more than 20 percent for no more than cumulative three minutes in any hour observation period.
- **Regulation 12, Rule 13: Foundry and Forging Operations**: This rule requires foundry and forging operations to develop and implement site specific emissions control plans approved by the Air District.

The Air District has adopted and updated these rules periodically over time.

Source Specific Bay Area PM Regulations

The Air District currently has a few PM rules that apply broadly to all sources, and several additional rules that apply to specific industries and categories of PM sources. As the Air District moves forward to further control PM emissions, staff will consider each large source category of PM emissions and determine the best approach to control that source category. Such initiatives will be undertaken in separate rulemaking projects. Proposed new Regulation 6: Common Definitions and Test Methods has been developed to provide the over-arching definitions and test methods for the current PM rules and potential future source-specific regulations.

2. State Regulations

Most CARB PM-related regulations are directed at mobile sources – primarily diesel engines. With respect to stationary sources, state law authorizes local air districts to adopt PM regulations and leaves the ultimate decision of how best to regulate stationary source PM emissions to each district's Board of Directors. California air pollution control laws set standards for several specific source categories, such as pile-driving hammers, sandblasting operations, and portable diesel equipment in order to ensure statewide consistency, and state law provides guidelines for the local air districts to regulate agricultural burning.

3. Federal Regulations

Federal law also leaves the primary role in regulating PM emissions from stationary sources to local agencies. The EPA has promulgated regulations to limit criteria pollutants from new and modified sources known as New Source Performance Standards (NSPS), as well as regulations aimed at the toxic air quality impacts known as National Emissions Standards for Hazardous Air Pollutants (NESHAP). The federal NSPS and NESHAP encompass a wide variety of specific stationary source categories, as listed in Attachment 1-4. The federal regulations delegate responsibility to enforce these requirements to the local air quality agencies. The Air District has incorporated the NSPS requirements by reference into Air District regulations in Regulation 10; and it enforces the NESHAP by incorporating the NESHAP standards into Air District permit conditions for affected sources, which are enforceable by the Air District under the California Health & Safety Code. Beyond these requirements, the federal Clean Air Act also authorizes local districts to adopt additional, more stringent requirements as needed to achieve the National Ambient Air Quality Standards.

C. Technical Review of Control Technologies

Current controls were described above (Section II.A.8). Two additional control technologies appear to be equally effective at controlling fugitive dust, and use less water.

1. Water Misting Systems

Figure II-6: Fugitive Dust Control with Portable, Adjustable Water Mist

Water and dust suppressants have been used to control fugitive dust. Water sprays are most effective when wetting a stockpile or an unpaved road to prevent fugitive dust. Water sprays are generally not effective when used to wet and control a fugitive dust plume that has already formed from wind erosion, truck traffic, or some active operation that generates dust. Water fog and water mist systems are much more effective at wetting dust particles and use less water. Well-designed water fog / mist systems generate small water droplets that are about the same size (10 – 50 microns) as the dust particles. Water droplets that are roughly the same size as the dust particles are far more effective at controlling dust plumes.

2. Wind Screens

Figure II-7: Fugitive Dust Control with Wind Screen

Windscreens are very effective at reducing wind velocity, and significantly reduce wind erosion. To be most effective, wind screens are typically as tall as any operation or stockpile they are designed to protect, and will reduce wind effect for a distance of eight to ten times the height of the wind screen downwind. As an example, a ten-foot-tall stockpile would need a ten-foot-tall windscreen, and the wind screen would protect the stockpile up to 80 – 100 feet downwind from the wind screen. Windscreens are typically constructed with up to 50 percent porosity (i.e. the screen has about 50 percent open area to allow 50 percent of the wind to blow through the screen). This reduces the velocity of the wind on the stockpile by 50 percent, and reduce wind erosion by more than 70 percent.

III. PROPOSED AMENDMENTS

Air District staff proposes new Regulation 6: Common Definitions and Test Methods to provide the over-arching definitions and test methods for current PM rules and any potential future source-specific rules. Proposed new Regulation 6 would address two broad categories:

- Definitions that apply to more than one rule.
- Test methods that apply to more than one rule.

This new regulation is intended to provide the foundation upon which existing regulations exist and new source specific rules can be developed.

A. Common Definitions

The definitions in Regulation 6 are those that are used in more than one PM rule. The intent is to provide the definition in one place where any future amendments to the definition can be made.

There are many forms of PM, so as specific rules focus on PM_{10}, $PM_{2.5}$, condensable PM, or PM precursors, the common definitions can be found in a single location.

B. Administrative Requirements

The general provisions in proposed new Regulation 6 are an expectation of monitoring and corrective actions needed to be in compliance with the standards, an emergency exemption, and monitoring and record keeping requirements.

Section 6-102 requires that each person responsible for PM emissions must provide and maintain a means to observe or monitor their operations. This provision is based on Air District experience where a facility may have been exceeding PM emissions limits, and claimed a defense of not being aware of the excessive emissions. Each owner / operator must establish a management system that monitors and holds itself accountable to meet the various requirements and emissions limits (confirming no visible emissions, or no change in visible emissions), or actions such as monitoring trackout to determine if any corrective actions are needed.

The visible emissions limits are typically based on opacity (or equivalent number on the Ringelmann Chart) using EPA Method 9 or related test methods as the assessment method. Since most facilities do not have a person certified to assess opacity using EPA Method 9, these facilities may simply monitor any visible emissions to determine whether the emissions are visible or not, and if the appearance of the emissions (size, shape, or degree to which it obscures the observer's view) changes. While monitoring is not expected to be a certified assessment of visible emissions, the observation should be done with the sun positioned behind the observer to give the most valid perspective, as required in EPA Method 9. Any significant change in visible emissions represents an early indication that corrective actions may be needed.

Section 6-110 provides a general exemption for agricultural sources, as described in Regulation 1-110.9.

C. Test Methods

The test methods listed in Regulation 6 are those that are used in more than one PM rule. The intent is to provide a single location for listing all associated test methods, where any future amendments to the listing can be made. In addition, as other forms of PM are regulated, the specific test methods for PM_{10}, $PM_{2.5}$, condensable PM, or PM precursors can be added.

Sampling, instrumentation and assessment of visible emissions / opacity are based on specific procedures cited in the Manual of Procedures. Assessment of opacity is conducted in accordance with Modified EPA Method 9 or equivalent as provided by the Manual of Procedures, Volume, 1, Part 1.

D. Comparative Analysis

Regulation 6 is a foundational regulation that provides the common definitions and test methods for other Regulation 6 rules that address PM emissions. As such, there are no direct comparison regulations that need to be addressed, or comparisons of emission limits that need to be made.

IV. EMISSIONS and EMISSIONS REDUCTIONS

This section of the Staff Report summarizes the emission reduction benefits that would result from the proposed regulation and the costs involved. Proposed new Reg. 6 is a foundational regulation, to provide the basis for future industry and source specific future regulations. As a result, no emissions reductions are expected from implementation of this regulation.

A. Emission Reductions Expected

No emission reductions are expected from proposed new Regulation 6.

V. ECONOMIC IMPACTS

Economic impacts are assessed by the cost effectiveness of proposed proposed emission controls, and a socioeconomic assessment of affected industries.

Regulation 6 is a foundational regulation for the existing PM rules, and any new source specific rules that may be developed in the future. No controls are required under proposed new Reg. 6, so no costs are incurred. Future administrative costs are expected to be reduced with definitions and test methods located in one regulation, rather than being repeated.

A. Socioeconomic Impacts

Review of Potential Economic and Job Impacts with a Socioeconomic Analysis

The Air District contracts with an independent consultant to conduct a Socioeconomic Analysis of potential economic impacts from the definitions and test methods in new Regulation 6, and the associated proposed amendments to Rule 6-1. The consultant has made an initial assessment of any economic impacts based on the new Regulation 6 and proposed amendments to Rule 6-1, and this staff report. The Socioeconomic Impact Analysis is included as Appendix A.

Independent Socioeconomic Analyses will be made on any proposed new source specific rules. The economic impacts on different industries differ, so will be analyzed separately. There may be overlap between the bulk material storage and handling requirements in the amendments to Rule 6-1, and new Rule 6-6: Prohibition of Trackout so those economic impacts may be evaluated together.

This final proposed rule language and staff report have been used to complete the Socioeconomic Analysis. The Socioeconomic Analysis will be included in the final regulatory package, posted for public review and comment at least 30 days before the Public Hearing. At the Public Hearing, the Air District Board of Directors will consider the final proposal, and public input before taking any action on the new Regulation 6 and amendments to Rule 6-1.

B. District Impacts

Staff anticipates improved efficiency in administering PM rules with the clarifications made in proposed Regulation 6, and the proposed amendments made to Regulation 6, Rule 1: General Requirements. The Manual of Procedures, Evaluation of Visible Emissions has been amended to incorporate the Cumulative Time method, and the Time Averaged method of assessing opacity from Type B emission points.

Compliance test requirements are now explicit, and testing frequency is defined based on PM emissions rates. Compliance & Enforcement staff and Source Test staff may have to review more source test information as this information comes into the Air District, but the incremental time required is not significant.

VI. REGULATORY IMPACTS

A regulatory impact analysis is required by H&SC Section 40727.2. This analysis compares the proposal to other Air District, State and federal rules addressing the same sources. The following table provides this regulatory impact analysis.

Regulation 6 H&SC Section 40727.2 Regulatory Analysis

Section	**Description** (paraphrased)	**Comparable State or Air District Provision**	**Comparable Federal Provision**	**Discussion**
6-101	Description / Purpose	No equivalent requirements	No equivalent requirements	Foundational document – applies to all Regulation 6 source specific rules
6-102	Expectation of Compliance	Various monitoring requirements	Various monitoring requirements	Establish expectation to monitor operations in a manner sufficient to prevent violations
6-200	Definitions	Consistent with SCAQMD Rule 102, SJVUAPCD Rule 1020	Consistent with EPA Source Test Methods 5, 9, 201a, 202, 203a,b,c	Provide consistency for all Regulation 6 rules
6-300	Standards	None	None	Foundational document
6-400	Administrative Requirements	Consistent with SCAQMD Rule 403, SJVUAPCD Rule 1020	No specific monitoring requirements	Emissions monitoring to ensure compliance with emission or limitation requirements
6-500	Monitoring and Records	Consistent with Regulation 1		Refers to Regulation 1 monitoring and records requirements
6-600	Manual of Procedures	Consistent with EPA Source Test Methods 5, 9, 22, 201a, 202, 203a,b,c	Consistent with EPA Source Test Methods 5, 9, 22, 201a, 202, 203a,b,c	Clarification of test methods needed for each sub-set of particulate matter

A complete listing of the applicable federal standards is found in Attachment 1-4.

VII. ENVIRONMENTAL IMPACTS

Review of Potential Environmental Impacts Under CEQA

The Air District contracts with an independent consultant to conduct a California Environmental Quality Act (CEQA) analysis of potential environmental impacts of the new Regulation 6, and proposed amendments to Rule 6-1. The consultant has conducted an initial assessment of any environmental impacts based on the new Regulation 6, the proposed amendments to Rule 6-1, and this staff report.

Similarly, CEQA analyses have been conducted on the other new source specific proposed rules. The CEQA analysis, attached as Appendix B, combines the analysis to review all impacts of the proposed new Regulation 6, proposed amendments to Rule 6-1, and the proposed new Rule 6-6 together all as one project, so that the cumulative impact of these proposals can be assessed and considered.

The combined CEQA analysis shows that no significant environmental impacts are expected, and a Negative Declaration has been prepared. The CEQA Negative Declaration will be included in the final proposal, posted for public review and comment at least 30 days before the Public Hearing. At the Public Hearing, the Air District Board of Directors will consider the final proposals, and public input before taking any action on the new Regulation 6 and amendments to Rule 6-1, and before acting on new Rule 6-6: Prohibition of Trackout.

VIII. RULE DEVELOPMENT / PUBLIC PARTICIPATION PROCESS

Rule Development Process

The Air District's 2010 Clean Air Plan addressed PM, including PM's significant health impacts, and was approved on September 15, 2010. The 2010 Clean Air Plan included Stationary Source Measure SSM 6: General Particulate Matter Emission Limitation. In addition to developing amendments to Rule 6-1 to satisfy SSM 6, staff started work on this regulatory project in April 2010 by reviewing the entire inventory of PM emissions; and identifying source categories where PM (particularly $PM_{2.5}$) emissions are significant, where the Air District has authority, and where the potential for substantial PM reductions are available.

The proposed amendments to Rule 6-1 are part of a rule-making process that began with the 2010 Clean Air Plan, and addresses a commitment by the Air District's Board of Directors to review Regulation 6, Rule 1, identified as Stationary Source Measure SS31 in the Air District's 2017 Clean Air Plan. Proposed new Regulation 6 and propsoed amendments to Regulation 6, Rule 1 begin to fulfill these important commitments to reduce PM emissions and improve public health.

Staff based the proposed amendments to Rule 6-1 on the 2011 emissions inventory. Staff identified the source categories to be considered during development of potential amendments, and identified the largest sources in each category. Staff selected 55 of the largest permitted stationary sources, and visited each one to better understand each facility's business, each unique emissions source and discuss potential control techniques available to reduce PM emissions. In addition, concerns about the lack of information regarding particle size distribution, possible sources of condensable PM, and potential secondary PM formation were discussed.

Staff visited eight facilities that store and handle petroleum coke and coal to ensure the unique issues with these solids were incorporated into the rule development process. Staff used the information from these visits to develop the draft amendments and two source specific rules, and to estimate the emission reductions that could be achieved by implementing these draft rule changes.

Staff conducted eight workshops throughout the Bay Area from January 30 – February 8, 2017. These workshops were conducted in parallel with Open House forums for the 2017 Clean Air Plan. Many stakeholders voiced concern that the PM workshops were diminished by being scheduled with the Clean Air Plan Open Houses, and the combined Open House / workshop format prevented staff from making a formal presentation of the preliminary drafts of each rule or engage in direct questions / answers. Others felt the personal interaction with staff regarding the preliminary drafts of each rule provided better opportunity for genuine discussion, including questions / answers.

Comments received after the workshops provided additional input regarding the process used for outreach to the wide variety of affected parties. Many indicated that they had not heard about the workshops at all, or only at the last minute. The Public Outreach and Consultation process described below in Section B was not as effective as staff would have preferred, so staff will mail Public Hearing notices to each Air District permitted facility with any significant PM emissions, and mail Public Hearing notices to additional facilities with similar Standard Industrial Classification (SIC) codes or North American Industry Classification System (NAICS) codes from a business database used by the Socioeconomic Analysis contractor called InfoUSA, including bulk material storage and handling and construction companies.

Proposed new Regulation 6 will provide the foundational regulation for current PM rules, and potential future source specific rules. Proposed new Regulation 6 rule language, and this accompanying staff report are the next step in the rule development process. Staff anticipates that proposed new Regulation 6, and proposed amendments to Rule 6-1 will be considered together at a Public Hearing. One other proposed new source specific rule, Rule 6-6, and associated staff report may also be considered at that Public Hearing.

The CEQA Analysis has been conducted with the proposed new Regulation 6, propose amendments to Rule 6-1, and the other proposed new source specific rule all considered one project, so that the cumulative impact of these proposals can be considered. The socioeconomic analysis for each project were conducted separately.

B. Public Outreach and Consultation

In analyzing the inventory of PM emissions and source categories where PM (particularly $PM_{2.5}$) emissions are significant, where the Air District has authority, and the potential for substantial PM reductions, staff consulted with the following interested and affected parties:

Businesses	Governmental Agencies
Morton Salt - Newark	CALTRANS District 4 - Oakland
Cargill – Newark	Bay Area Regional Water Quality Board - Oakland
Criterion Catalysts - Pittsburg	North Coast Regional Water Quality Board – Santa Rosa

CertainTeed Gypsum – Napa	Bay Area Rapid Transit – Richmond Maintenance Yard
Maxwell House – San Leandro	Alameda County
C & H Sugar – Crockett	Contra Costa County
Con Agra – Oakland	Marin County
CEMEX – Oakland	Napa County
CEMEX – Clayton	Santa Clara County
Strategic Materials – San Leandro	San Francisco City & County
Dutra Materials – San Rafael	San Mateo County
Superior Supplies – Santa Rosa	Solano County
Granite Rock – Redwood City	Sonoma County
Hanson Aggregates – Clayton	Contra Costa County Sanitary District
Bodean / Mark West Quarry – Santa Rosa	City of Hayward
PABCO Gypsum – Redwood City	City of Napa
Georgia Pacific Gypsum - Antioch	City of Oakland
Syar - Napa	City of San Jose
Syar – Santa Rosa	City of San Rafael
Syar - Vallejo	City of Santa Rosa
Soiland Quarry - Cotati	
Langley Hill Quarry - Woodside	**Industry Associations**
Granite Construction – Santa Clara	Association of Building Contractors
Granite Construction – San Jose	Associated Roofing Contractors of the Bay Area Counties
Willowbrook Feeds – Petaluma	California Asphalt Pavement Association
Hunt & Behrens – Petaluma	Construction Industry Air Quality Coalition
Owens-Corning – Santa Clara	Northern California Engineering Contractors
Owens-Brockway - Oakland	
Waste Management – San Leandro	
Zanker Road Material Processing – San Jose	
Waste Management - Altamont	
Redwood Landfill	
Guadalupe Landfill	
Ox Mountain Landfill – Half Moon Bay	
Clover Flat / Upper Valley Resources	
Potrero Hills Landfill	
Stavin	
McGuire & Hester Construction - Oakland	
Ghilotti Bros. Construction – San Rafael	
Universal Building Services - Richmond	
Statewide Sweeping – Milpitas	
Levin Richmond Terminal	
Lehigh Cement	
Phillips 66 Coker	
Phillips 66 Coke Calciner	
Shell Coker	
Tesoro Coker	

Valero Fluid Coker	
APS West	
Carbon Inc.	

These discussions led to a review of the Storm Water Pollution Prevention Plan (SWPPP) Best Management Practices, and the suggestion that any proposed requirements should be consistent with SWPPP requirements.

As described above, feedback indicates that outreach could have been more comprehensive. Public Hearing notices will be mailed to all District permitted facilities with significant PM emissions, and to all entities with similar Standard Industrial Classification (SIC) codes or North American Industry Classification System (NAICS) codes from a business database used by the Socioeconomic Analysis contractor called InfoUSA, including construction firms.

Public Hearings are the next step in the rulemaking process. Air District staff will publish the Public Hearing package for new Regulation 6: Common Definitions and Source Test Methods; and proposed amendments to Regulation 6, Rule 1: General Requirements. Air District staff will accept written comments, will respond to all comments received and will present final proposals to the Air District's Board of Directors for their consideration. Response to comments is included as Appendix A of this staff report.

IX. CONCLUSION / RECOMMENDATIONS

Pursuant to the California Health and Safety Code section 40727, before adopting, amending, or repealing a rule the Board of Directors must make findings of necessity, authority, clarity, consistency, non-duplication and reference. This section addresses each of these findings.

A. Necessity

"'Necessity' means that a need exists for the regulation, or for its amendment or repeal, as demonstrated by the record of the rulemaking authority." H&SC section 40727(b)(1).

Proposed new Regulation 6: Particulate Matter–Common Definitions and Source Test Methods is needed to provide a foundational regulation with definitions and test methods that are common to one or more source specific regulations. Amendments to Regulation 6, Rule 1: General Requirements are needed to update emission limits that have not been reviewed for more than 20 years, and to clarify compliance testing requirements and test methods. The update to emissions limits are needed because the Bay Area is not yet in attainment for either PM_{10} or $PM_{2.5}$ California Ambient Air Quality Standards.

B. Authority

"'Authority' means that a provision of law or of a state or federal regulation permits or requires the regional agency to adopt, amend, or repeal the regulation. H&SC section 40727(b)(2)."

The Air District has the authority to adopt this rule under Sections 40000, 40001, 40702, and 40725 through 40728.5 of the California Health and Safety Code.

C. Clarity

"'Clarity' means that the regulation is written or displayed so that its meaning can be easily understood by the persons directly affected by it." H&SC Section 40727(b)(3)

Proposed Regulation 6 is written so that its meaning can be easily understood by the persons directly affected by them. Further details in the staff report clarify the proposals, delineate the affected industry, compliance options, and administrative requirements for the industries subject to this rule.

D. Consistency

"'Consistency' means that the regulation is in harmony with, and not in conflict with or contradictory to, existing statutes, court decisions, or state or federal regulations." H&SC Section 40727(b)(4)

The proposed new rule is consistent with other Air District rules and not in conflict with state or federal law.

E. Non-Duplication

"'Nonduplication' means that a regulation does not impose the same requirements as an existing state or federal regulation unless a district finds that the requirements are necessary or proper to execute the powers and duties granted to, and imposed upon, a district." H&SC Section 40727(b)(5)

Regulation 6 is non-duplicative of other statutes, rules or regulations.

F. Reference

"'Reference' means the statute, court decision, or other provision of law that the district implements, interprets, or makes specific by adopting, amending, or repealing a regulation." H&SC Section 40727(b)(6)

Implementing, interpreting or making specific the provisions of the California H&SC Sections 40000, 40001, 40702 and 40727.

The proposed rule has met all legal noticing requirements, have been discussed with the regulated community and other interested parties, and reflect consideration of the input and comments of many affected and interested stakeholders.

G. Recommendations

Air District staff recommends adoption of proposed Regulation 6: Common Definitions and Source Test Methods; and amendments to Regulation 6, Rule 1: General Requirements, and approval of the CEQA Negative Declaration.

REFERENCES

1. BAAQMD 2010 Clean Air Plan, September 15, 2010
2. BAAQMD 2017 Clean Air Plan, April 19, 2017
3. BAAQMD Regulation 5: Open Burning
4. BAAQMD Regulation 6, Rule 2: Commercial Cooking Equipment
5. BAAQMD Regulation 6, Rule 3: Wood Burning Devices
6. BAAQMD Regulation 12, Rule 4: Sandblasting
7. BAAQMD Board Resolution 1390
8. BAAQMD Advisory Council, Ultrafine Particles: Ambient Monitoring and Field Studies presentation, 2/8/2012
9. BAAQMD Advisory Council, Ultrafine Particles: Ambient Monitoring and Field Studies presentation, Philip M. Fine, SCAQMD, 2/8/2012
10. BAAQMD Advisory Council, Concentrations of Ultrafine Particles and Related Air Pollutants on and Near Roadways and Other Urban Microenvironments presentation, Eric Fujita, Desert Research Institute, Reno, NV, 2/8/2012
11. BAAQMD Understanding Particulate Matter: Protecting Public Health in the San Francisco Bay Area, November 2012, page 72
12. EPA Stationary Source Control Techniques Document for Fine Particulate Matter, October 1998
13. EPA Test Methods 5, 5B, 5F, 9, 17, 22
14. EPA Test Methods 201A, 202, 203A, 203B, 203C
15. EPA RACT/BACT/LAER Clearinghouse
16. EPA AP42, Fifth Edition, Volume 1, Chapter 13: Miscellaneous Sources, 13.2
17. EPA, Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures; EPA-450-92-004; September 1992.
18. California Health and Safety Code, §41700
19. California Health and Safety Code, §40000, §40001, §40702, §40725 - 40728,
20. California Air Resources Board - CALIFORNIA EMISSION INVENTORY AND REPORTING SYSTEM (CEIDARS), Particulate Matter (PM) Speciation Profiles, 7/28/2009
21. South Coast Air Quality Management District, Rules 401, 403, 403-1, 404, 405, 444, 445, 1105-1, 1112-1, 1133-1, 1137, 1155, 1156, 1157, 1158, 1186, 1186-1
22. San Joaquin Valley Air Pollution Control District, Rules 4101, 4103, 4106, 4201, 4202, 4203, 4303, 4901, 8011, 8021, 8031, 8041, 8051, 8061, 8071, 8081
23. San Joaquin Valley Air Pollution Control District, Draft Staff Report, BACM Amendments to Regulation VIII (Fugitive PM_{10} Prohibitions), 9/27/2001
24. San Joaquin Valley Air Pollution Control District, Draft Staff Report – Appendix C, Cost Effectiveness Analysis of Regulation VIII (Fugitive PM_{10} Prohibitions), 9/27/2001
25. Sacramento Air Quality Management District, Rules 401, 403, 404, 405, 406, 407, 409, 417, 421
26. Maricopa County, Arizona Regulation III, Rule 310: Fugitive Dust from Dust-Generating Operations
27. Maricopa County, Arizona Quick Reference Dust Control Guide
28. Northeast States for Coordinated Air Use Management, Assessment of Control Technology Options for BART-Eligible Sources, March 2005

29. California Water Resources Control Board, Construction Storm Water Program, http://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.shtml
30. 2009-0009-DWQ Construction general permit *(effective July 1, 2010)*
31. California Storm Water Quality Association, Storm water Best Management Practice Handbook Portal: Construction

APPENDICES

A. Comments and Responses
B. Socioeconomic Analysis
C. CEQA Analysis

Attachment 1: Background Research on Bay Area PM Emissions