POTENTIAL HEALTH AND ENVIRONMENTAL IMPACTS

OF LEAF BLOWERS

Report to the California Legislature

CALIFORNIA AIR RESOURCES BOARD

OCTOBER 29, 1999

1.0 EXECUTIVE SUMMARY

Introduction

Senator John Burton introduced California Senate Concurrent Resolution No. 19 (SCR 19) February 23, 1999, which was chaptered May 21, 1999. The resolution requests the Air Resources Board (ARB) to prepare and submit a report to the Legislature on or before January 1, 2000, "summarizing the potential health and environmental impacts of leaf blowers and including recommendations for alternatives to the use of leaf blowers and alternative leaf blower technology if the state board determines that alternatives are necessary." The goal of this report is to summarize for the California Legislature existing data on health and environmental impacts of leaf blowers, to identify relevant questions not answered in the literature, and suggest areas for future research.

As per SCR 19, this report includes a comprehensive review of existing studies of the impacts of leaf blowers on leaf blower operators and on the public at large, and of the availability and actual use of protective equipment for leaf blowers. The receptors identified by the resolution are humans and the environment; sources of impacts are exhaust, noise, and dust. Because the Legislature specified that ARB use existing information, staff conducted no new studies. In order to locate existing data, staff searched the published literature, contacted potential resources and experts, and requested data from the public via U.S. mail and through a web page devoted to the leaf blower report.

The methodology followed for this report depends on both the objectives of SCR 19 and available data. As staff discovered, in some areas, such as exhaust emissions, much is known; in other areas, such as fugitive dust emissions, we know very little. For

both fugitive dust and noise, there are few or no data specifically on leaf blower impacts. For all hazards, there have been no dose-response studies related to emissions from leaf blowers and we do not know how many people are affected by those emissions. Therefore, staff determined to provide the Legislature with a report that has elements of both impact and risk assessments.

The body of the report comprises three components: hazard identification, review of health effects, and a characterization of the potential impacts of leaf blowers on operators and bystanders. In Chapter 3, the emissions are quantified as to specific hazardous constituents, the number of people potentially exposed to emissions is discussed, and laws that seek to control emissions are summarized. Chapter 4 reviews health effects, identifying potential negative health outcomes of exposure to the identified hazards. Chapter 5 is a synthesis of hazard identification and health effects, characterizing potential health impacts that may be experienced by those exposed to the exhaust emissions, fugitive dust, and noise from leaf blowers in both occupational and non-occupational setting. In addition, Chapter 6 comprises a discussion of research needs to make progress toward answering some of the questions raised by this report, and Chapter 7 briefly describes engine technologies that could reduce exhaust emissions, and discusses methanol fuel and alternatives to leaf blowers.

The leaf blower was invented by Japanese engineers in the early 1970s and introduced to the United States as a lawn and garden maintenance tool. Drought conditions in California facilitated acceptance of the leaf blower as the use of water for many garden clean-up tasks was prohibited. By 1990, annual sales were over 800,000 nationwide, and the tool had become a ubiquitous gardening implement. In 1998,

industry shipments of gasoline-powered handheld and backpack leaf blowers increased 30% over 1997 shipments, to 1,868,160 units nationwide.

Soon after the leaf blower was introduced into the U.S., its use was banned as a noise nuisance in two California cities, Carmel-by-the-Sea in 1975 and Beverly Hills in 1978. By 1990, the number of California cities that had banned the use of leaf blowers was up to five. There are currently twenty California cities that have banned leaf blowers, sometimes only within residential neighborhoods and usually targeting gasoline-powered equipment. Another 80 cities have ordinances on the books restricting either usage or noise level or both. Nationwide, two states, Arizona and New Jersey, have considered laws at the state level, and five other states have at least one city with a leaf blower ordinance.

The issues usually mentioned by those who object to leaf blowers are health impacts from noise, air pollution, and dust. Municipalities regulate leaf blowers most often as public nuisances in response to citizen complaints. Two reports were located that address environmental concerns: the Orange County Grand Jury Report, and a series of reports from the City of Palo Alto City Manager's office. The City of Palo Alto reports were produced in order to make recommendations to the City Council on amending their existing ordinance. The Orange County Grand Jury took action to make recommendations that would “improve the quality of life in Orange County,” and recommended that cities, school districts, community college districts, and the County stop using gasoline-powered leaf blowers in their maintenance and clean-up operations. The major findings of each are similar: leaf blowers produce exhaust emissions,

resuspend dust, and generate high noise levels (Table 1). The implications of these findings for human health, however, were not documented or based on scientific studies.

Description of the Hazards

Hazard identification is the first step in an impact or risk assessment. Each of the three identified hazards are examined in turn, exhaust emissions, dust emissions, and noise. For each, the hazard is described and quantified, and the number of people potentially exposed to the hazard is discussed. For exhaust emissions the number of people potentially impacted is as high as the population of the state, differing within air basins. Fugitive dust emissions impact a varying number of people, depending on one's proximity to the source, the size of the particles, and the amount of time since the source resuspended the particles. Finally, we also discuss laws that control the particular hazard.

Exhaust emissions from leaf blowers consist of the following specific pollutants of concern: hydrocarbons from both burned and unburned fuel, and which combine with other gases in the atmosphere to form ozone; carbon monoxide; fine particulate matter; and other toxic air contaminants in the unburned fuel, including benzene, 1,3-butadiene, acetaldehyde, and formaldehyde. Exhaust emissions from these engines, while high compared to on-road mobile sources on a per engine basis, are a small part of the overall emission inventory. Emissions have only been controlled since 1995, with more stringent standards taking effect in 2000. The exhaust emissions from leaf blowers are consistent with the exhaust emissions of other, similar off-road equipment, such as string trimmers. Manufacturers have developed several different methods to comply with the standards and have done an acceptable job certifying and producing engines that are below the regulated limits.

Dust emissions from leaf blowers are not part of the inventory of fugitive dust sources. ARB, therefore, does not have official data on the quantity of fugitive dust resuspended by leaf blowers. To what extent leaf blowers are efficient mechanisms for entraining total suspended particulates and smaller particles in ambient air needs to be measured, using leaf blowers to clean selected surfaces that are representative of actual leaf blower usage. Available data indicate that the PM10 emissions impact from fugitive dust suspended by leaf blowers is small, but probably not insignificant. Previous emission estimates range from less than 1% to 5% of the statewide PM10 inventory. For example, the ARB previously estimated statewide fugitive dust emissions to be about 5 percent of the total, and the Sacramento Metropolitan AQMD estimated leaf blower fugitive dust emissions to be about 2 percent of the Sacramento county PM10 air burden. A more definitive estimate of leaf blower fugitive dust emissions will require research to verify appropriate calculation parameters, determine representative silt loadings, measure actual fugitive dust emissions through source testing, and identify the chemical composition of leaf blower-generated fugitive dust.

Noise is the general term for any loud, unmusical, disagreeable, or unwanted sound, which has the potential of causing hearing loss and other adverse health impacts. While millions of Californians are likely exposed to noise from leaf blowers as bystanders, given the ubiquity of their use and the increasing density of California cities and towns, there is presently no way of knowing for certain how many are actually exposed, because of the lack of studies. In contrast, it is likely that at least 60,000 lawn and garden workers are daily exposed to the noise from leaf blowers. Many gardeners and landscapers in southern California are aware that noise is an issue and apparently

would prefer quieter leaf blowers. Purchases of quieter leaf blowers, based on manufacturer data, are increasing. While little data exist on the noise dose received on an 8-hr time-weighted-average by operators of leaf blowers, data indicate that some operators may be exposed above the OSHA permissible exposure limit. It is unlikely that more than 10% of leaf blower operators and members of the gardening crew, and probably a much lower percentage, regularly wear hearing, eye, or breathing protective gear, thus exposing them to an increased risk of hearing loss. The sound quality of gasoline-powered leaf blowers may account for the level of annoyance reported by bystanders.

Review of Health Effects

Potential health effects of the hazards range from mild to serious. Airborne PM is not a single pollutant, but rather is a mixture of many subclasses of pollutants, each containing many different chemical species. Many epidemiological studies have shown statistically significant associations of ambient PM levels with a variety of negative health endpoints, including mortality, hospital admissions, respiratory symptoms and illness, and changes in lung function. Carbon monoxide exposure causes health effects ranging from subtle changes to death. At low exposures, CO causes headaches, dizziness, weakness, and nausea. Children and people with heart disease are particularly at risk from CO exposure. Some toxic compounds in gasoline, in particular benzene, 1,3-butadiene, acetaldehyde, and formaldehyde, are carcinogens. Ozone, formed from chemical reactions of hydrocarbons and nitrogen dioxide in the presence of sunlight, is a strong irritant and exposures can cause airway constriction, coughing, sore throat, and shortness of breath. Finally, noise exposures damage hearing, and causes other adverse

health impacts, including interference with communication, rest and sleep disturbance, changes in performance and behavior, annoyance, and other psychological and physiological changes that may lead to poor health.

Potential Health Impacts of Leaf Blowers

Health effects from hazards identified as being generated by leaf blowers range from mild to serious, but the appearance of those effects depends on exposures: the dose, or how much of the hazard is received by a person, and the exposure time. Without reasonable estimates of exposures, ARB cannot conclusively determine the health impacts from leaf blowers; the discussion herein clearly is about potential health impacts. The goal is to direct the discussion and raise questions about the nature of potential health impacts for those exposed to the exhaust emissions, fugitive dust, and noise from leaf blowers in both occupational and non-occupational settings.

For the worker, the analysis suggests concern. Bearing in mind that the worker population is most likely young and healthy, and that these workers may not work in this business for all of their working lives, we nonetheless are cautioned by our research. Leaf blower operators may be exposed to potentially hazardous concentrations of CO and PM intermittently throughout their workday, and noise exposures may be high enough that operators are at increase risk of developing hearing loss. While exposures to CO, PM, and noise may not have immediate, acute effects, the potential health impacts are greater for long term exposures leading to chronic effects.

Noise and PM effects should be protected against by the use of respirators and earplugs or muffs. Employers should be more vigilant in requiring and ensuring their employees wear hearing protection. Regulatory agencies should conduct educational and

enforcement campaigns, in addition to exploring the extent of the use of protective gear. Exposures to CO are more problematic; there are no CO filters, but engine modification can reduce CO exhaust emissions. More study of CO exposures to leaf blower operators is warranted to determine whether the potential health effects discussed herein are actual effects or not.

Describing the impacts on the public at large is more difficult than for workers because people's exposures and reactions to those exposures are much more variable. Bystanders are clearly annoyed by the noise and dust from leaf blowers. They can be interrupted, awakened, and may feel harassed, to the point of taking the time to contact public officials, complain, write letters and set up web sites, form associations, and attend city council meetings. These are actions taken by highly annoyed individuals who believe their health is being negatively impacted. In addition, some sensitive individuals may experience extreme physical reactions, mostly respiratory symptoms, from exposure to the kicked up dust.

On the other hand, others voluntarily purchase and use leaf blowers in their own homes, seemingly immune to the effects that cause other people such problems. While these owner-operators are likely not concerned about the noise and dust, they should still wear protective equipment - dust masks and ear plugs - and their exposures to CO are a potential problem and warrant more study.

Recommendations

The Legislature asked ARB to include recommendations for alternatives in the report, if ARB determines alternatives are necessary. This report makes no recommendations for alternatives. Based on the lack of available data, such conclusions

are premature at this time. Of course, ARB can certainly recommend reducing exhaust emissions from the engines, particularly of carbon monoxide and unburned fuel. For noise, the ARB has no Legislative mandate to control noise emissions, but the evidence seems clear that quieter leaf blowers would reduce worker exposures and protect hearing, and reduce negative impacts on bystanders. Research is needed to better understand the issues relating to the health and environmental issues from leaf blowers. Research needs are discussed throughout the report and again in Appendix H.

Fugitive dust emissions are more problematic. The leaf blower is designed to move relatively large materials, which requires enough force to also blow up dust particles. Banning or restricting the use of leaf blowers could reduce fugitive dust emissions, but there are no data on fugitive dust emissions from alternatives, such as vacuums, brooms, and rakes. In addition, without a more complete analysis of potential health impacts, costs and benefits of leaf blower use, and potential health impacts of alternatives, such a recommendation is not warranted. Some have suggested that part of the problem lies in how leaf blower operators use the tool, that leaf blower operators need to show more courtesy to passersby, shutting off the blower when people are walking by, and that too many leaf blower operators blow dust and debris into streets, leaving the materials to be resuspended by passing vehicles. A more complete understanding of the amount of dust resuspended by leaf blower use and alternative cleaning equipment is needed to guide decision-making, but in the meantime, interested stakeholders could join together to propose methods for leaf blower use that might reduce dust generation, and develop and promote codes of conduct by workers who operate leaf blowers.