An Exploration of Hazardous Waste in Los Angeles County

Team Hazardous Waste

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Client: Natural Resources Defense Council

1. INTRODUCTION

Hazardous waste is waste that poses substantial or potential threats to public health or the environment (US EPA, 2016). Preliminary research into hazardous waste in Los Angeles County, conducted as part of the UCLA IoES Environmental Report Card (2015), has highlighted the lack of data on the volumes and types of wastes generated. While the U.S. Environmental Protection Agency (EPA) Toxic Release Inventory (TRI) program provides detailed data on chemical constituents in hazardous wastes, it does so only for very large facilities that meet the federal reporting requirements under this program. Search results from the California Department of Toxic Substances Control (DTSC) website indicate that total wastes transferred are three orders of magnitude greater than that from just TRI-reporting facilities, with a total estimated number of generators two orders of magnitude greater than the number of TRI-reporting facilities. DTSC data searches as recently as 2014 provided only limited information on waste type.

This level of uncertainty is a barrier to establish baseline information on hazardous wastes in the County, and for subsequent analyses of this important aspect of environmental condition, such as trends in generation over time, ultimate disposal location, transportation methods and proximity of waste generation, transfer and disposal sites to underserved communities.

1.1 Clients

Natural Resources Defense Council (NRDC) is a non-profit international advocacy group. Its goal is to ensure the rights of all people to the natural, unpolluted environment. NRDC Los Angeles Office has done significant work in the County such as protecting underserved communities, which are disproportionately affected by various environmental issues. It has collaborated with UCLA IoES to conduct environmental projects for years. Given our client's current work on lead as well as the Exide issue, this project targeted both the overview of hazardous waste generation and lead-containing air emissions in Los Angeles County. Based on our findings, we made recommendations for improving hazardous waste regulation to NRDC as well as additional stakeholders, which include California DTSC, U.S. EPA and County of Los Angeles and member cities.

1.2 Research Questions and Deliverables

In order to meet the client's request, we addressed the following research questions in this project:

- What is the total volume of hazardous waste generated annually in Los Angeles County and what are the recent trends?
- What is the ultimate disposition of these wastes?
- What proportion of hazardous waste generation is related to lead and what are the health implications?
- What is the spatial distribution of hazardous waste generators, transfer stations and disposal/ recycling facilities within Los Angeles County?
- How is the indirect generation of hazardous waste through air emissions and ultimate disposition in soil currently addressed in existing regulations? And are there facilities in LA County where this may pose a problem?
- Are underserved communities disproportionately impacted by hazardous waste generation, transport, treatment or disposal?

In addition, we produced the following deliverables:

- A literature review on hazardous waste regulations in California, risks posed by hazardous wastes (especially lead), and previous studies evaluating hazardous waste management and/or regulations.
- A report including summary statistics and graphics describing our main findings.
- GIS analysis and maps that examine and describe the spatial distribution of the largest traditional hazardous waste generators and highest lead emitting facilities in proximity to sensitive populations, residential areas, poverty ratios, and early education schools.
- Recommendations for improvements in recordkeeping, tracking, data availability, enforcement, or other aspects as revealed through research.

2. BACKGROUND

2.1 Regulations and Reporting Requirements

2.1.2 Federal Regulations

At the federal level, two major pieces of legislation define the role that EPA plays concerning hazardous waste. The Resource Conservation and Recovery Act (RCRA), passed in 1976, established the standards and responsibilities of the EPA when it comes to dealing with hazardous waste; specifically, it established "cradle to grave" initiatives that ensured the agency would create guidelines and mechanisms to deal with this type of waste from generation to ultimate disposition. This was followed by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as “Superfund.” This legislation was designed to assist the EPA in establishing legal liability for those responsible for hazardous waste sites.

2.1.2.1 RCRA

RCRA defines a solid waste as any discarded material (40 CFR § 261.2 (a)). Under this definition, a discarded material is one that is abandoned, stored before treatment, recycled, or incinerated (40 CFR§ 261.2 (a) (i)). Additionally, RCRA expands this definition to include “inherently waste-like materials” – i.e. materials that contain documented toxic materials (40 CFR § 261.2 (d)) This definition is purposely vague, and has been applied to solids, sludge, liquids, semisolids or even contained gaseous materials (EPA 2002).

In order be considered a hazardous waste, material must meet certain criteria. First, it must be a solid waste (40 CFR § 261.3 (2) (a)). Second, it must contain some kind of harmful substance, including threshold amounts of certain solvents such as benzene (40 CFR § 261.3 (a) (2) (iv) (A)). In addition, any materials that are created through certain industrial processes automatically qualify (40 CFR § 261.3 (a) (2) (iv) (D)). Furthermore, any solid waste that contains even trace amounts of hazardous materials is considered hazardous waste by the RCRA (40 CFR § 261.3 (a) (2) (iv).

The definitions under RCRA have been challenged in many court cases. For example, in August of 2014, a judge in California denied a request by the National Resources Defense Council to classify particulate matter in diesel exhaust as solid waste (Center for Community Action et. al. 2014). According to the NRDC, the particulate matter constituted a solid, hazardous waste emitted into the air. As such, it fell under RCRA’s jurisdiction (Center for Community Action et. al. 2014). However, the judge denied the motion, arguing instead that the “disposal” clause of the RCRA bore no mention of “emitting” at all – and thus did not fall under the RCRA but rather the Clean Air Act (Center for Community Action et. al. 2014). This case underscores the importance of wording in RCRA.

In addition to defining hazardous wastes, RCRA covers permitting, transportation and disposal. Under the law, any business or establishment involved in the “treatment, storage, and disposal of large volumes of hazardous waste at treatment, storage and disposal facilities” must obtain a permit from the EPA in order to operate. These Treatment, Storage, and Disposal Facilities (TSDFs) are land disposal restrictions, groundwater monitoring, and cleanup.

While all TSDFs are required to have a permit, generators are not. Hazardous waste generators must have an EPA ID, but otherwise do not fall under the same restrictions as TSDFs (California Office of Administrative Law, 2015a). However, this does not imply that generators are unregulated. Facilities that produce this waste are closely monitored through reports that indicate the type and volume of the toxic released (California Office of Administrative Law. (2015a)) as well as the journey the hazardous waste embarked on when transported to facilities (California Office of Administrative Law. (2015b)).

2.1.2.2 CERCLA

The RCRA is not only the federal law that regulates hazardous waste. The CERCLA was established in 1980 in order to provide the EPA with actual, punitive powers. According to RCRA Orientation Manual developed by the EPA's Office of Resource of Conservation and Recovery, the RCRA's sole focus on current and future waste management made it impossible to hold past polluters responsible for their actions. In fact, the only way to do so was to declare the site a federal disaster area, as then President Carter did with Love Canal in 1978. CERCLA was passed to remedy this deficit with punitive authority.

First, it did so by providing expanding the definitions of what constituted a pollutant. The statute not only absorbed the RCRA's definition of hazardous waste, but expanded it to include "other toxic pollutants regulated by the Clean Air Act (CAA), the Clean Water Act (CWA), and the Toxic Substance Control Act (TSCA)" (Office of Conservation and Recovery 2014). Additionally, the Act established criteria through which former landowners could be held liable for illegal and hazardous dumping. Overall, the CERCLA had very little to do with actual hazardous waste enforcement protocols; rather, it merely expanded the definition of what a "waste" was and provided avenues through which EPA could remediate already polluted sites.

2.1.3 State Level Regulations

While the RCRA and CERCLA constitute the core of federal requirements, there are much broader efforts at the state level to regulate hazardous waste as well. Specifically, in California, there are additional agencies and laws that more stringently police hazardous waste.

In California law, hazardous waste is defined much more specifically. Any waste that causes, or considerably adds to, an increase in mortality or to an irreversible illness is considered hazardous. The state determines this in four ways: ignitability, corrosivity, reactivity, and toxicity.

Ignitability follows three chemical phases: liquid, non-liquid, and gas. If liquid has a flash point (lowest temperature where there is enough flammable vapor to ignite) less than 140°F it is described as ignitability. Moreover, if a non-liquid substance and a compressed gas are capable of causing fire under standard temperature and pressure (32°F, 1 atm) through spontaneous chemical changes, adsorption or friction, they are considered a threat and ignitable (DTSC).

Corrosivity is the ability to chemically and slowly damage materials. Any aqueous chemical that is either very acidic (pH ≤ 2) or very basic (pH ≥ 12.5) while any non-aqueous chemical mixed with water produces a solution that has the pH levels stated earlier are considered corrosive (DTSC).

Dangerous and generally unpredictable, reactivity requires long and thorough criteria, which is specific to each chemical. The criteria consist of definitions, specific characteristics, and a detailed chart of different chemicals, their composition, and their effects on health. A more general definition: reacting violently, potentially forming explosive, or emits toxic gases, vapors or fumes that present a danger to environmental and human health when mixed with water is considered a hazardous waste. It must be kept in mind that each chemical has certain traits that are unique to one another.

As demonstrated, hazardous waste faces much more scrutiny under California law. Additionally, the state has it's own agency in charge of regulating waste: the Department of Toxic Substance Control (DTSC)

2.1.3.1 California's Department of Toxic Substance Control

Facilities within California are required to follow specific procedures to properly identify, classify, list, and delist hazardous waste (DTSC, 2010a). DTSC's reporting scheme categorizes hazardous waste facilities into three main sectors: Generators, Transporters, and TSDFs. Generators can be considered a person, site, or process that produces hazardous waste that is listed in Chapter 11 of California's hazardous waste regulation (California Office of Administrative Law, 2015a). They are further categorized as Small Quantity Generators (SQG) or Large Quantity Generators (LQG) depending on the monthly waste produced.

LQGs are generators that produce "1,000 kg [2,200 lbs.] or more of hazardous waste per month and/or more than 1 kg [220 lbs.] of acutely or extremely hazardous waste per month" (DTSC, 2010a). SQGs are generators that produce "less than 1,000 kg of hazardous waste per month and/or 1kg or less of acutely or extremely hazardous waste per month" (DTSC, 2010a). LQGs are required to submit the Biennial Report, Tank Release Response, Manifest and Consolidated Manifest, and a Manifest Exception Report to DTSC (DTSC 2015a).

The manifest includes information on where the hazardous waste is transported to, where it generated from, and the hazardous waste volumes that were transported. The resulting document is submitted to DTSC (California Office of Administrative Law, 2015b). Each Uniform Manifest includes 6 copies. In California, the generator is required to "send a copy to DTSC if the waste is generated in California, handled by a permitted facility in California or is imported or exported from California," and must be submitted within 30 days of shipping (DTSC, 2007). In addition, TSDF also sends a copy to DTSC within 30 days of receiving the hazardous waste (DTSC, 2007). The manifest serves as a way to identify any discrepancies of the type, quantity, or residue of hazardous waste (EPA, n.d.).

The requirements for an LQG also vary depending on their actual facility operations. LQGs that only generate hazardous waste must submit the Report biennially on odd-numbered years by March 1st (DTSC, 2010b). In contrast, LQGs that "ship hazardous waste off site to a TSDF, or who treat, store, or dispose of hazardous waste on site, may be required to submit a Biennial Report to DTSC by March 1 of each even-numbered year" (DTSC, 2010c). SQGs, on the other hand, are only required to submit the Manifest and Consolidated Manifest to DTSC (DTSC, 2015a).

DTSC heavily regulates transportation as well. Facilities that ship hazardous waste off-site must complete a hazardous waste manifest that must be shipped along with the hazardous waste. The shipping document is called the Uniform Hazardous Waste Manifest and is completed and signed throughout the lifecycle of the hazardous waste – from generators to transporters to TSDFs.

2.1.3.1 Enforcement and Inspections

In order to regulate the handling of hazardous waste, all TSDFs are required a permit (EPA, 2015). Permits for handling hazardous waste are provided by RCRA. They are effective for a maximum duration of ten years. The duration of a permit is determined by the strain the waste has on environmental and human health. The DTSC reviews each permit five years after the date of permit issuance or reissuance. Most facilities that handles hazardous waste require permits, however, generators and transporters do not require permits even if generators then store the waste for short periods of time before transporting it to a different site (EPA, 2015). To ascertain a facility is compliant, inspections are forced on factories, plants, transfer facilities, waste disposal sites, construction sites, and any other area that stores, handles, treats, processes, or disposes hazardous waste. Inspectors must follow the detailed procedure provided in Chapter 6.5 of Division 20 of the Health and Safety Code under the Official California Code of Regulations (CCR), Title 22. This guidance is extremely detailed. It tells an inspector to first arrive at the inspecting site in a clearly marked vehicle then how to enter the factory, plant, construction site, etc., what to look for as soon as they enter (some aren't as obvious), how to carry out samples and conduct analyses in great detail, and how to photograph and keep well-written reports (DTSC, 2014).

2.1.3.2 Clean Air Act

This is a federal law that regulates air emissions from both stationary and mobile sources. This is the law that allows the EPA to make National Ambient Air Quality Standards with the sole purpose of protecting public health by regulating the emission of hazardous air pollutants. Furthermore, there is both a federal Clean Air Act and the

California Clean Air Act, which has stricter standards compared to the Federal Clean Air Act.

2.1.3.3 AQMD

Air emissions of lead are also considered hazardous. Once lead is airborne, not only is it harmful to inhale, lead settles back to the ground where it can potentially come into direct contact with individuals. South Coast Air Quality Management District, popularly called AQMD, is an air pollution control agency that regulates Los Angeles, Riverside and San Bernardino Counties. AQMD exists to implement state and federal air quality standards. These standards are "health based" which protect even the most sensitive individuals from getting ill with a margin of safety. The health based levels and limits are set by the EPA in the federal Clean Air Act. More specifically, they enforce the California Clean Air Act, which is more stringent that the Federal Clean Air Act. Facilities with permits must constantly submit reports regarding emission, equipment, and upkeep of their facilities to AQMD. The governing board at AQMD submits plans and regulations to California Air Resources Board and EPA. The Air Quality Management Plan is the framework that AQMD adopt to get industry and business into compliance. Businesses are issued permits by AQMD if they emit any type of known air pollutant. This is to ensure compliance with air quality standards.

AQMD also has the authority to regulate and enforce toxic and hazardous air emissions in the same way as air quality standards. In the case of an air pollution violator, they can either be referred to the state or federal court, or can be issued a civil penalty of thousands of dollars per day. The amount set is proportional to the amount of damage inflicted on the community or the individual. It develops plans and regulations to meet public health standards by lowering emission rates from industry and business, which are stationary sources of air pollution.

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Rules, Laws, and Permits Specifically for Lead Emitting Facilities

2.1.3.3.1 Rule 1420

The purpose of this rule is to reduce air emissions of lead from point sources. It applies to all facilities that process any sort of lead or lead containing materials which include primary and secondary lead smelters, foundries, lead-acid battery manufacturers/recyclers, lead oxide, brass, and bronze products.

After July 1, 1994, emissions cannot exceed 1.5 micrograms per cubic meter ($\mu g/m^3$) that is averaged over 30 days beyond the property line of a facility. Also, emissions cannot exceed 10% opacity for more than 3 minutes per 60 minutes. All stack emissions must be captured and vented at 98% efficiency. Those that process more than 10 tons must have constant monitoring equipment. Sampling is conducted by facilities themselves collecting 24-hour samples for 30 days straight, then one 24-hour sample every 6 days. This is averaged at the end of the month. Then these samples must be submitted to AQMD within 3 days. This rule was adopted September 11, 1992 and was last updated on July 1st, 1994

2.1.3.3.2 Rule 1420.1

Rule 1420.1 applies specifically to lead-acid battery recycling facilities that process more than 50,000 pounds of lead in a day. As of January 1st of this year, the rule mandates that these facilities cannot exceed air lead emissions of 0.110 micrograms per cubic meters averaged over a 30-day period. The rule stipulates that as of January 1st of 2017, the air emissions must drop to 0.100 micrograms per meters cubed. Should these standards not be met, AQMD will leverage penalties against the facility and force it to curtail production. In addition to these restrictions, lead-acid battery recycling facilities must still follow 1420. Rule 1420.1 was adopted November 5, 2010, and was last revised in September of 2015.

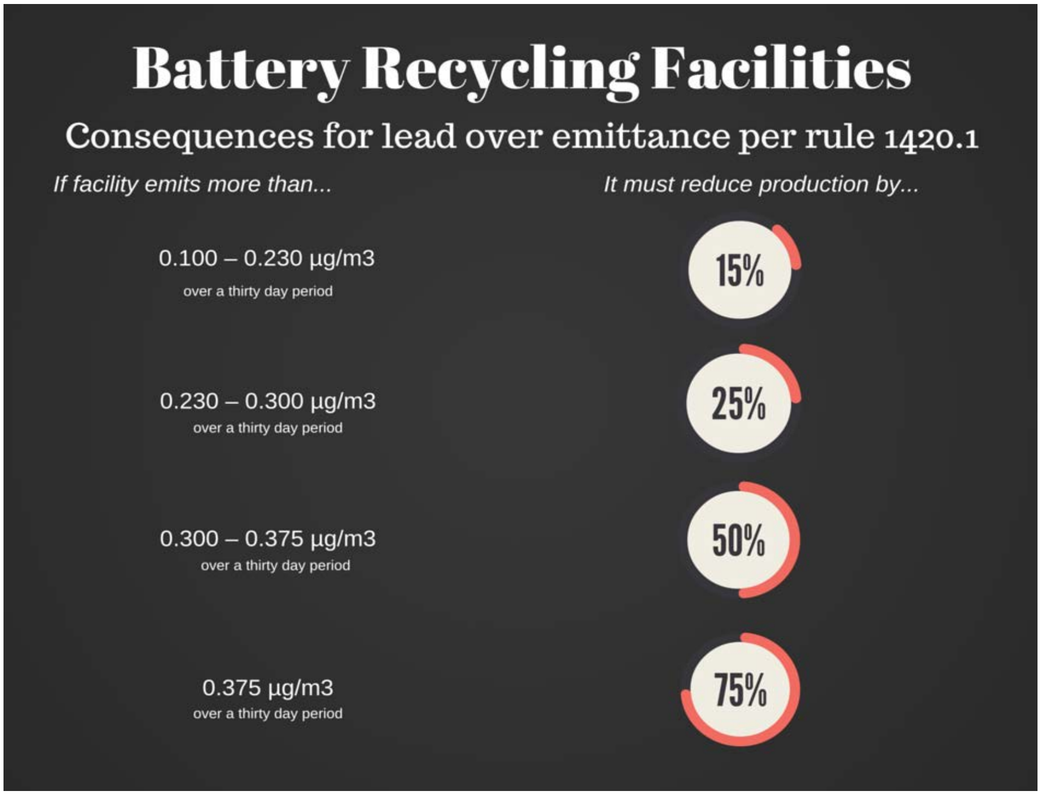


Figure 2.1.1 Mandatory production curtailments for excessive lead emissions based on r 1420.1

2.1.3.3.3 Rule 1420.2

This rule specifically applies to all facilities who own or operate a metal melting facility that melts over 100 tons or more of lead per year. It states that lead cannot exceed the following limits:

As of October 2, 2015, ambient air concentrations of lead cannot exceed .150 �g/m^3 averaged over 30 days. In the period of July 1,2016- March 31, 2018, if ambient air concentrations exceed .12 �g/m^3 over 30 consecutive days, facilities must submit a compliance plan. After April 1st, 2018, ambient air concentrations cannot exceed .100 �g/m^3.

Starting March 1, 2016, all facilities must submit a plan to Executive Officer. These include installing lead monitoring devices, enclosure of emission sources, engineering wind drafts, cleaning, inspections, maintenance, and source testing.

After October 2, 2015, the facility must control fugitive lead dust by 99.97% efficiency. After March 1, 2016, all emissions need to be vented through a lead emission control device that operates at a minimum 99% efficiency. This equates to a rate of .003 pounds/hr. The process of how they monitor is similar to Rule 1420. These detailed reports must be sent to the executive Officer every 15^{th} month on emission data starting November 2, 2015. If you are subjected to this rule, you are not subjected to rule 1420.

2.1.3.3.4 Title V

This is a federal program that standardizes air quality permits and the permitting process for major sources of emissions. This major source is defined as a facility that emits hazardous or criteria air pollutant (HAP), or has the potential to emit (PTE) equal to or greater than the Major Source Thresholds. These thresholds are regionally based; they are different standards for different air basin locations. It comes from Title V of the Federal Clean Air Act and requires AQMD to submit enforceable operating permits and to send them to the EPA for approval.

2.1.4 Regulatory Reporting Requirements

2.1.4.1 Toxic Release Inventory (TRI)

The Toxic Release Inventory, or TRI, is a publically available database of toxic chemicals reported by certain hazardous waste facilities. The reporting system is mandated under the Emergency Planning and Community Right-to-Know Act (Office of Conservation 2014). Each year, U.S. facilities from different sectors are mandated to report the concentration of released chemicals that are toxic to human health and the environment (Environmental Protection Agency [EPA], 2013a). Specifically, those that are required to report to TRI must meet certain criteria: (1) facility is a specific industry, (2) employs more than 10 full-time employees, (3) manufactures/processes more than 25,000 lbs. of a TRI-listed chemical or uses more than 10,000 lbs. of a listed chemical in a year (EPA, 2013b).

For identification purposes, hazardous waste facilities are additionally assigned a designated six-digit code by the North American Industry Classification System (NAICS). The NAICS code not only assists in identification, but in determining reporting obligation; whether or not a hazardous waste facility has to submit TRI-required forms depends on the code assigned. A representation of the requirements are shown in Table 1 below:

Table 2.1.1. TRI-covered Hazardous waste facilities (EPA, 2013c)

Hazardous Waste Type	Waste Collection (5621)	Waste Treatment & Disposal (5622)	Remediation and Other Management Services (5629)
NAICS Code Covered	562112 - Hazardous Waste Collection	All six-digit industry codes	562920 - Materials Recovery Facilities
Caveats	Reporting ONLY required for facilities primarily practicing solvent recovery services on a contract or fee basis (previously classified under SIC 7389, Business Services, NEC)	Six-digit industry codes that require reporting only if RCRA-regulated: ● 562211 – Hazardous Waste Treatment & Disposal ● 562212 – Solid Waste Landfill ● 562213 – Solid Waste Combustors & Incinerators	Reporting only required if facility is RCRA-regulated

2.1.5 Comparison of Reporting Requirements for TRI and DTSC

The reporting requirements for hazardous waste under Federal TRI reporting are different from what is reported to DTSC. For TRI, the reporting requirements are directed only towards specific chemicals that are defined as toxic to human health and the environment. EPA requires facilities to report on less than 600 different toxic chemicals and on the amount that is emitted through air, water, or land. The reporting thresholds for hazardous waste for the two reporting schemes also differ. TRI only requires reports from facilities that emit more than 25,000 lbs. of a TRI-listed chemical or otherwise uses more than 10,000 lbs. of a listed chemical in a given year. However, DTSC requires LQGs to report if they generate more than 2,200 lbs. of a RCRA non-acute hazardous waste in a month or if they generate more than 220 lbs. of an acute or dangerous hazardous waste in one month. As indicated, TRI reports on particular listed chemical unlike DTSC, which reports on hazardous waste as a mixture of hazardous waste materials. This also indicates that more facilities are likely to report to DTSC because their hazardous waste thresholds are lower than with TRI.

DTSC has more extensive reporting requirements than just TRI. The only required form for TRI is Form R for each TRI-chemical. In comparison, hazardous waste generators under DTSC have to submit a Biennial Report that includes the Site ID Form and GM forms. In addition, DTSC requires that the generators and TSDFs submit the Manifest report. The Manifest report is required along each consecutive hazardous waste handling. In summary, TRI only focuses on chemicals emitted from a specific sector, but DTSC assesses the lifecycle of the hazardous waste and tries to identify any discrepancies of between generators, transporters, and TSDFs.

2.2 Types of hazardous waste and generation processes

The predominant source of hazardous waste in the United States is industrial. Chemical manufacturing, primary metal production and fabrication, and petroleum processing encompasses about 90% of hazardous waste generated (JRank, 2016). The top pollutants from chemical manufacturing are pesticides, volatile organic compounds, chromium, and lead. Other pollutants include acids and bases, spent solvents, and organic constituents. From metal manufacturing, top constituents are heavy metals and cyanide. Furthermore, petroleum refineries generate wastes that include benzene in the wastewater and sludge from the refining processes. In the sludge, it consists of cadmium, copper, lead, and nickel. These pollutants toxicity make the waste generated from industrial activity hazardous. These chemicals can degrade the environment and can bioaccumulate in wildlife and humans. (EPA, 2015)

Furthermore, other industrial generators include the printing industry, leather products manufacturing, paper industry, and the construction industry. In the printing industry, there are heavy metal solutions, waste inks with chromium, lead, and barium, solvents such as trichloroethylene, methylene chloride, and xylene. Ink sludges containing heavy metals are the pollutants associated. As for the leather products manufacturing, chromium, kerosene, methyl ethyl ketone, TCE, and toluene are the prominent polluting chemicals produced. The various industrial activities listed here are to demonstrate the mass amounts of chemicals present in the industrial waste. (EPA, 2015) However, studies related to hazardous waste generators are limited. The limited availability signifies there is not enough information present about which sectors generate considerable amounts of hazardous waste.

Other sources of hazardous waste include agricultural and household activities. Farms are the major source of agricultural waste. It predominantly includes pesticides and herbicides. Using fertilizer for crops and plants leads to fluoride waste accumulation. In some cases, this chemical biomagnifies when ingested and leads to skeletal and muscle pain. Furthermore using manure generates soluble nitrates that can migrate to enter the groundwater supply. Household wastes include batteries, pharmaceuticals, furniture polishes, stain removers, disinfectants, paints, vehicle and equipment fluids, used oils, and many more. (EPA, 2016)

Another common source is contaminated soils from site cleanups. Often times, the hazardous wastes generated at these sites are to remediate soil or groundwater contamination using hazardous chemicals. It could also be due to leakages or spills. Former industries that produce hazardous materials are members of the leakage and spill sites. (Grasso et. al, 2009) The number of these sites and the amount of soil contaminated is not readily found. Only from the Environmental Report Card related to soil contamination remains the sole source of information.

Table 2.2.1. Types and Sources of Hazardous Waste

Type of Hazardous Waste	Sources
Industrial	Chemical manufacturing, primary metal production and fabrication, petroleum processing, printing, leather products manufacturing, paper, and construction
Agricultural	Farms- pesticides/herbicides
Household	Batteries, pharmaceuticals, furniture polishes, stain removers, disinfectants, paints, vehicle and equipment fluids, and used oils
Site Cleanups	Groundwater remediation, leakages, and spills

2.3 Lead

Exposure to and uptake of lead have consequently increased and caused significant public health issues. Lead in the body is distributed to brain, liver, kidney and bones, and is stored in the teeth and bones where it accumulates over time. At high levels of human exposure, lead can damage almost all organs and organ systems such as the central nervous system, kidneys and blood, culminating in death at excessive levels. At low levels, enzymatic activities and other biochemical processes are affected, and psychological and neurobehavioral functions are impaired (WHO Fact Sheet N°379, 2015). Pregnant women are relatively more susceptible to high-level lead exposure, which can cause miscarriage, stillbirth, premature birth, low-birth weight, as well as minor malformations.

Children, who are undergoing body development, are also considered a vulnerable population due to the incomplete development of their detoxification systems. Currently, most of the research examines lead exposure and human health with a particular focus on children's health. Young children absorb 4-5 times as much ingested lead as adults from a given source. Their innate curiosity and their age-appropriate hand-to-mouth behavior also increase the risk of lead exposure because of their mouthing and swallowing lead-containing or lead-coated objects. Lead exposure to children at early stage of development can cause slowed growth, hearing problems, and profound and permanent impacts on the development of the brain and nervous system, such as behavior and learning problems, lower IQ and hyperactivity, and anemia (EPA, 2015). Many studies have found a significant association between early lead exposure and cognitive performance in childhood.

The well-known Port Pirie cohort study evidenced the association between childhood lead exposure and adults' cognitive deficits and concluded that cognitive deficits due to environmental lead exposure in early childhood were only partially reversed by a subsequent decline in the levels of lead found in the blood (Tong et al., 1998). Scientists have speculated that lead may increase cancer risk, but it remains unknown, as experimental studies have shown little evidence. Possible mechanisms, in which lead may play a role in carcinogenesis, are associated with oxidative damage, apoptosis induction, altered cell signaling pathways, inhibition of DNA synthesis and damage repair, as well as interaction with DNA-binding proteins (IARC 2006; Restrepo et al. 2000; Silbergeld 2003). While the carcinogenicity of lead still remains a focus by the public, an increasing volume of relevant studies have been conducted to investigate if lead is truly a cancer-causing threat to human health.

2.4 Exposure pathways

2.4.1 Overview

An exposure pathway is the link between environmental releases and populations that may come into contact with or be exposed to environmental contaminants (ATSDR, 2005). Significant pathways for hazardous waste to enter the environment include soil, water and air. These pathways could result directly in ingestion, inhalation, and skin contact. Additionally, as hazardous waste moves through physical pathways, it can simultaneous move through biological pathways to accumulate in food sources. Within each pathway, chemicals can transform, dilute, concentrate, or interact with other chemicals present, which potentially affect toxicity. Because of the interconnectedness of each pathway, multiple lines of evidence should be followed to avoid potential biases inherent in any single line and to reduce uncertainties imposed by spatial and temporal variability of data (DTSC, 2011).

In their Public Health Assessment Guidance Manual, the Agency for Toxic Substances and Disease Registry (ATSDR) describes five elements of an exposure pathway. These include the contaminant source/release, environmental fate and transport, exposure point, exposure route, and potentially exposed populations (ATSDR, 2005). Pathways are considered complete when all five elements are present, indicating direct evidence or a strong likelihood that people have in the past or present come into contact with a contaminant (ATSDR, 2005). However, a complete pathway is not always indicative of a public health hazard. In fact, the likelihood of significant exposure is often small.

Studies that investigate human exposure to toxicants through different mediums generally rely on models that predict the movement of material in the environment. For example, in an assessment of a certain air pollutant, an air dispersion model is created to estimate the concentration of chemicals in the air that result from the emissions of an incinerator (Sedman et al., 1994). Residual levels of the chemical that eventually deposit in soil or water are then determined. The chemicals that move into organisms, such as plants or fish, are also estimated. Understanding these processes are often crucial to risk assessments and remediation procedures.

2.4.2 Terrestrial Pathways

When hazardous waste is deposited on the ground, it is susceptible to transport through various other physical pathways. With precipitation, hazardous materials can move horizontally and vertically through the ground, leaching through soil horizons and eventually contaminating groundwater aquifers. At the surface, hazardous material can contaminate surface waters through runoff and become resuspended in air, transporting contaminants to other locations.

When hazardous waste is placed below the surface, it is in closer proximity to groundwater, and may eventually cause groundwater contamination. However, complex physical and chemical processes, such as hydrologic transport and reactions in the soil, affect the mobility and retention of waste in soil. Sorption (absorption and adsorption) and desorption occur between soil and hazardous material and can prevent, retard, or repel the movement of contaminants by groundwater (Hook, 1978). The porosity of a soil can speed up transport of gases towards the atmosphere or solids through soil horizons and aquifers. Through laboratory studies, it was found that clay, which has high porosity, strongly attenuated metals such as lead, cadmium, mercury, and zinc through precipitation (Hook, 1978). Some interactions in the soil can cause contaminants to move quickly through groundwater. Additionally, reactions are dependent on the pH and redox potential of the soil.

While environmentally persistent contaminants are often associated with shallow soil contamination, VOCs like benzene or trichloroethylene are often not found in soil due to their tendency to transfer to the atmosphere (Hadley and Sedman, 1990). This generally means that this class of contaminants is not well contained when released to soil.

Heavy metals can be particularly dangerous due to their ability to accumulate in soil and ultimately in plants that organisms can ingest. A study on stack metal emissions from hazardous waste incinerators suggests that metal (resulting from stack emissions) becomes immobilized by soil retention capacity and equilibrated with native ions causing them to behave as native metals (Sedman et al, 1994).

Contaminants in soil can off-gas and seep into the air of homes and commercial buildings (ASRTD, 2005). The movement of volatile chemicals and gases indoor is known as a vapor intrusion pathway. Vapor intrusion is a complex pathway as volatile chemicals may react with existing background concentrations, possibly amplifying the magnitude of a health effect.

Entrained gas in soil can leach into buildings, potentially causing major detrimental health effects. This movement of toxic vapors is especially concerning because it is a highly direct pathway to humans, essentially ensuring contact as opposed to vapors released outdoors. Typically, most homes have cable lines, gas lines, or water and sewer mains underground. These lines can provide openings in soil and act as conduits for soil gas migration, resulting in indoor air pollution (Altshuler and Burmaster, 1997). Adding to the concern is the lack of understanding of soil gas migration due to inadequate modeling techniques and understanding of specific chemicals in soil.

2.4.3 Aerial Pathways

The most common type of aerial pathway is incineration. Incinerators burn hazardous waste for waste destruction and, in some cases, energy recovery. They have the ability to destroy the toxic material of hazardous waste, but are not an effective method for treating metals, which are noncombustible. While it is possible for incinerators to release hazardous waste directly into terrestrial environments, the main pathway for pollutants into the environment is through emissions into the atmosphere as hazardous waste is burned (National Research Council, 2000). Incinerators can produce two classifications of pollutant that move through distinct pathways. Ash and slag, one of the types of pollutants, are deposited in locations such as landfills. Movement of gaseous and particulate pollutants is dependent on wind speed, stack height, atmospheric stability, diffusion coefficients and chemical interactions (Hook, 1978). Typically, particulates concentrations are highest near the facility and decrease in volume with distance. Additionally, hazardous waste in gaseous forms travels greater distances. A public health issue with incinerators is their effect on local and regional air quality. Furthermore, products of incinerators can result in contamination of surface- and groundwater through their eventual movement into terrestrial and aquatic pathways.

Metals are especially prevalent toxics released from hazardous waste incinerators. Ones that are of particular concern include arsenic, beryllium, cadmium, chromium, lead, and mercury. Inhalation pathways are a considerable concern as they can result in a direct exposure to lungs, resulting in respiratory problems or other chronic illnesses. The concentration of volatile chemicals indoor is generally low but persistent, often resulting in long-term exposure and potential chronic health effects. Inhalation exposure pathways from vapor intrusion differ from other pathways because there is relatively less research than other pathways for risk assessors to evaluate the dangers (USEPA, 2002). Furthermore, complications often arise when discerning vapor intrusion contaminants from background sources.

3. METHODOLOGY

3.1 General Methodology

Facility INformation Detail (FIND)	This database allows the public to view information on AQMD regulated facilities. The information comes from their internal enterprise database. It lists: facility details, equipment list, compliance, emissions, hearing board, and transportation
Emissions Data Inquiry	This database shows criteria and toxic air emissions that are collected annually through AQMD's Annual Emission Reporting Program.
Hazardous Waste Tracking System (HWTS)	HWTS is an online public database maintained by the Department of Toxic Substance Control (DTSC) that can run 10 public reports. It generates reports with information on hazardous waste shipments for generators, transporters, treatment, storage, and disposal facilities.
RCRAInfo	RCRAInfo Search is a tool that retrieves data from the RCRAInfo database in Envirofacts, a website managed by the USEPA.

Table 3.1: List of databases with description of information gathered

Our research examined the different ways hazardous waste can be managed, particularly through regulating and reporting agencies. As seen by the delay in action taken by regulatory agencies with respect to Exide Technologies, it is apparent that a significant gap exists in the regulatory scheme between lead released to air as stack or fugitive emissions, and therefore regulated by SCAQMD, and the that volume which eventually deposits onto the ground, becoming hazardous waste regulated by DTSC under CERCLA. Hence, we focused on two main categories of hazardous waste- traditional hazardous waste as regulated by the Department of Toxic Substance Control (DTSC) and air emissions from facilities with Air Quality Management District (AQMD) emission limits for lead (Figure 1). With traditional hazardous waste, we investigated the total number of generators, total volumes generated in LA County and their ultimate disposition. We also investigated facilities that have AQMD permits for air lead emissions by looking at total volumes of lead emitted and comparing amounts reported through AQMD to those reported under TRI. We examined the violation and enforcement history of facilities, the spatial distribution of the largest emitters using GIS, and information gathered from site visits to inform us of priority areas of focus. Further information about databases we used can be found in Table 3.1.

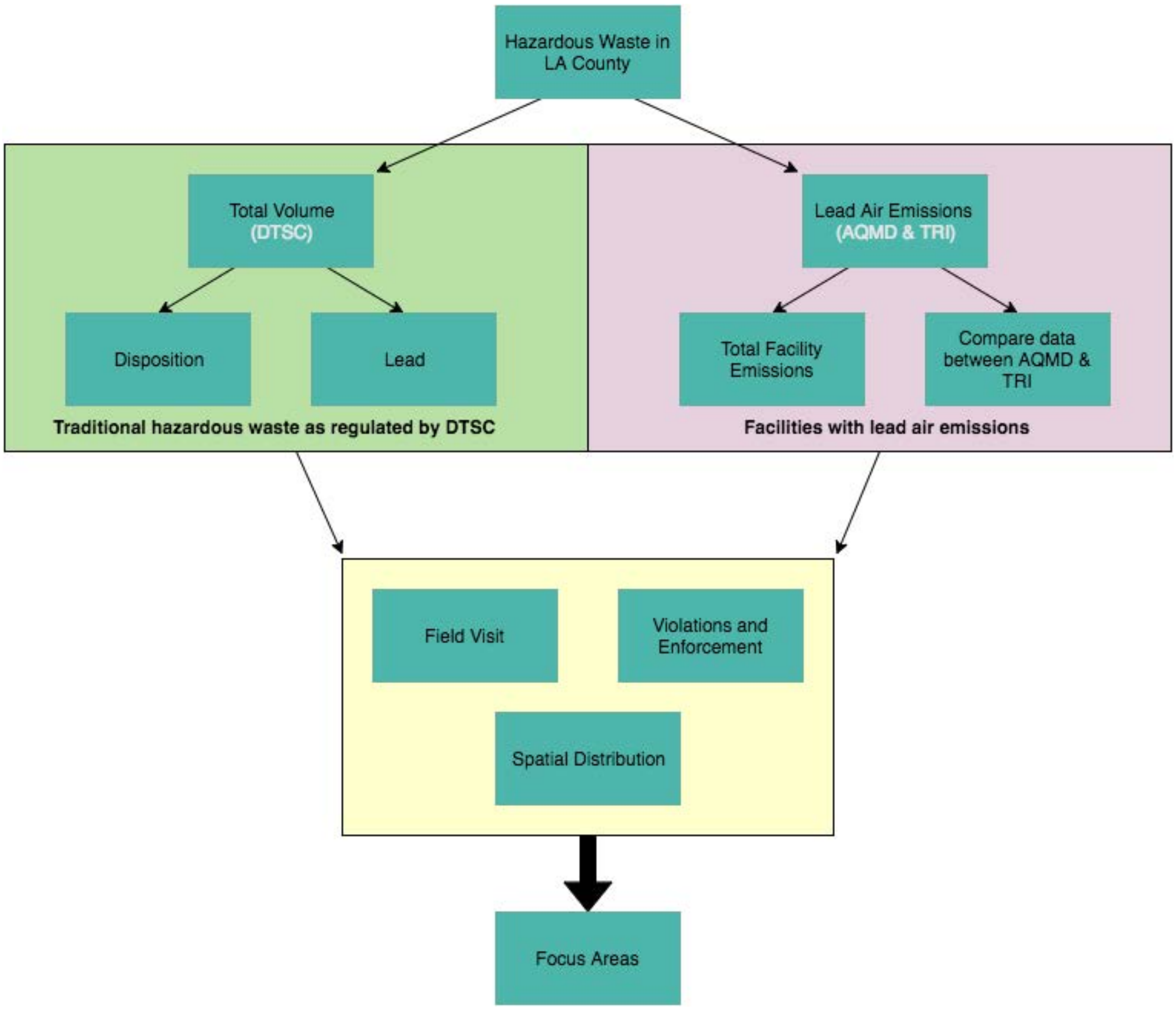


Figure 1. Diagram of the methodology shows the two main pathways we used to approach our research questions.

3.2 DTSC-Regulated Hazardous Waste in LA County

The Hazardous Waste Tracking System (HWTS) is an online public database maintained by the Department of Toxic Substance Control (DTSC). It generates reports with information on hazardous waste shipments for generators, transporters, treatment, storage, and disposal facilities. There are 10 public reports that can be run (Appendix A1). Information is available from 1993 to the present, however, the website notes that starting in 2004, total counts of manifests and tonnage may be overstated due to duplicate manifest totals. This is because the same volume of waste may be manifested from generator to storage facility, and then again from storage to disposal or treatment.

3.2.1. Generators in LA County

Because the HWTS reports did not indicated a method to search for generators, we filed a public records request with the Chatsworth DTSC Office for a list of generators in LA County. We were referred from a member from the Filing Department to the Enforcement and Emergency Response Program. This staff member was able to perform an internal query for all active generators in LA County. We also used the RCRAInfo Search to find a list of large quantity generators (LQGs) in LA County. We then ran a search for small quantity generators (SQGs), which returned a relatively small number of facilities. The RCRAInfo database notes searches that return a large volume of data may terminate prematurely due to system limitations, so we suspect the system was not able to handle the search. Thus, we subtracted the number of LQGs from the total active generators acquired from DTSC staff to approximate the number of active small and large quantity generations in LA County. Further details on how this report was created are provided in Appendix A.

3.2.2 Finding the highest lead-emitting active hazardous waste generators

Using the “Total Yearly Tonnage by Entity Type Report” in the HWTS, a search was performed for generators in LA County that had a total tonnage greater than 1,000 for the years 2010-2014. Further details on how this report was created are provided in Appendix A. This data, which included the company’s name, EPA ID number and the tons by waste code, was compiled in Excel to create a list of facilities that generated consistently in 2010-2014. We defined these facilities as having generated any volume of waste (over 1,000 tons) in every year between 2010-2014. Although all companies on this list were identified as generators, further investigation revealed that some companies were primarily transporters of hazardous waste that collected small volumes from multiple facilities (such as used oil). We chose to exclude these companies from our analysis. However, facilities that performed other environmental services, such as waste treatment or recycling, and produced hazardous waste from their processes, remained in our analyses. We then summed the tonnage and created a list of 10 facilities that generated the most hazardous waste over the five-year study period. We performed summary statistics on these facilities for total and average tonnage.

3.2.3 Total volumes of hazardous waste generation

In order to develop an estimate of the total volume of hazardous waste generated, we used the "Total Yearly Tonnage by Waste Code Report" in the HWTS, to produce a list of all DTSC waste codes with corresponding tonnages generated within Los Angeles County from 2010-2014. In each year, the tonnage of all waste codes was summed to estimate the total volume of hazardous waste generated in LA County. This annual tonnage was compared to the individual waste code that contributed the largest volume. Further details on how this report was created are provided in Appendix A.

We summed the total annual tonnage for the top 11 generators and chose to include Exide Technologies Inc, because the facility contributed a significant volume. We then divided these values by the total annual tonnage in LA County to estimate the proportion of hazardous waste these top facilities contributed to overall hazardous waste generation in LA County.

3.2.4 Transport, Storage and Ultimate Disposition

As a first step in characterizing the movement and ultimate disposition of hazardous wastes generated in LA County, we attempted to obtain the manifests of the top generators identified above. Initially, we filed a public records request with the Chatsworth DTSC Office for copies of manifests or manifest ID numbers for three facilities from 2010-2014. We were informed that they were not able to provide us with manifest ID numbers remotely, but we could either pay to have the copies of manifests made or we could go down to the Chatsworth office to view them. To be cost effective and have constant and convenient access to the documents, we next attempted to obtain the manifest ID numbers from another source. We called different DTSC employees, and one at the Sacramento Regional Office was able to provide manifest ID numbers for four of the top generators or environmental services facilities.

We analyzed three of the four facilities that generated the most hazardous waste between 2010-2014, as reported by DTSC: Quemetco, Clean Harbors Wilmington, and Tesoro Refinery. We used manifest ID numbers to look up manifests reports with the HWTS search tool "Find Specific Manifests". Due to the large volume of manifests, we selected twelve days spread throughout the year to provide a snapshot of hazardous waste management activities. For each shipment that occurred on those days, we looked at the state and RCRA waste code, management method code, tons generated, and shipment location.

3.3 Lead-containing air emissions in LA County

As mentioned previously, there is a regulatory disconnect between hazardous waste (in the solid form) and air emissions of toxic chemicals. We then chose to focus on lead air emissions specifically, because facilities such as Exide, have caused irreversible environmental and health effects. This current tragedy motivated us to investigate other potential facilities that are also releasing lead into the air, which can ultimately lead to soil contamination.

3.3.1 Highest lead-emitting facilities in LA County

We used both TRI and AQMD data to identify facilities that have consistently had the highest lead-containing stack air emissions in LA County during the 5-year period from 2010 to 2014. We mapped the locations of these facilities using GIS with a combination of population characteristics (see details in Section 3.5) to evaluate surrounding land use and population characteristics.

To select the facilities of the most interest, we first downloaded five Excel data files of annual California toxic release records for 2010 to 2014 from the TRI website. See Appendix A for steps to obtain data. We then extracted data for LA County to obtain a list of top 20 facilities that had highest annual stack air emissions of lead or lead compounds. Fugitive air emissions were not considered during the 5-year period because values were less than two pounds. By combining and comparing the five annual lists of 20 facilities, we ultimately selected 10 facilities that were consistently in the list through 2010 to 2014. Throughout this paper, the 10 facilities are collectively referred to as "highest lead-emitting consistent facilities."

We combined TRI reported data for both lead and lead compounds, which together we refer to as lead-containing air emissions. We treated them as the same because there are no human studies on lead compounds that have demonstrated their carcinogenicity, even though large doses of some lead compounds have caused cancer in experimental animals (US EPA, 2011 and National Toxicology Program, 2014). In addition, there is currently no separate Chemical Abstract Service (CAS) Registry Number assigned for lead compounds (CAS No. 7439-92-1 for Lead) (National Toxicology Program, 2014). The TRI categorized lead as carcinogenic, but lead compounds as non-carcinogenic. Thus, within the scope of this project, we combined both into lead-containing air emissions.

3.3.2 Total lead-containing air emissions from 2010 to 2014 in LA County

We calculated the total lead-containing air emissions in pounds per year (lbs/yr) for all TRI-reporting facilities within LA County from 2010 to 2014. We did this both with and without Exide in order to eliminate the predominant effect of Exide, which allowed us to determine whether the remaining emissions had significant decreases in the total lead-containing air emissions throughout the five years. Graphs were generated for each facility's lead-containing air emissions from 2010 to 2015.

3.3.3 Historic total lead air emissions for highest lead-emitting facilities

We were also interested in the historic total emissions of each of the highest lead-emitting facilities throughout all their years of operation. This data was obtained from the TRI Explorer Facility Profile. See Appendix A for steps to obtain data. We typed in the facility name and address and downloaded its respective CSV file containing data on all the lead and lead compounds air emissions throughout the years. The earliest year of accessible data was 1987. We extracted "Fugitive Air" and "Stack Air" emission data from 1987 to 2014. We also extracted the combination of fugitive and stack air emissions from 1987 to 2014. However, there are some years where facilities have no reported lead and lead compound emissions, but do have other chemical emissions. We included fugitive air emissions in these calculations because in early years, fugitive air emissions sometimes exceeded stack air emissions.

3.3.4 Comparison of AQMD and TRI Reported Values for Lead Air Emissions

Since AQMD and TRI both have annual emissions values reported for lead, we compared the two data sets in order to make sure that the more publicly accessible TRI reports are correctly reflecting the AQMD reported emissions. We did this for the top 20 lead emitters, as determined through TRI. The emission data from AQMD was derived via FIND, a portal on the AQMD website that provides public emissions data. FIND (Facility Information Detail) contains multiple inputs for search queries, such as facility name, address, year, or AQMD ID number. We searched each facility's name in the Top 20 list from each year and cataloged our results. We used the value for lead (inorganic) in pounds per year as shown under Criteria Pollutants. We made note of missing data and if there were any discrepancies between the facility address in the two databases. The sum of TRI fugitive and stack air emissions was compared to AQMD values of each facility for years 2010-2014, using TRI values as a baseline for percent difference.

3.3.5 Public Records Request and Notice of Violations

After establishing a consistent highest lead-emitting polluters list from 2010-2014, we put in public records requests asking for Notice of Violations and Permits for all lead containing materials that these industries process and emit. However, due to the logistical scale of acquiring such documents, as of this writing we have received only 6: the Tesoro Refinery in Wilmington, Phillips 66 in Los Angeles, Ramcar Industries, Quemetco, Exxon Mobil's Torrance Refinery, and the Trojan Battery Company in Santa Fe Springs.

Additionally, to expedite data gathering of violations, we examined violations for the highest lead-emitting recurring facilities over the five-year time period using the FIND database. Facilities were searched by name and verified using addresses and Title V permits. Clicking the "violations" tab revealed a list of violations with date of issue. We examined each violation individually and cataloged any that showed violations of rule 1420/1420.1/1420.2 or specifically stating lead in the violation document. We also looked at violations prior to 2010 to understand the facility's history and made note of any repeat occurrences.

3.3.6 Calling AQMD

Numerous calls were made to AQMD in regards to questions that arose when interpreting permits and information from their online database. The two main workers that answered some of our questions were Shalini George and Christopher Ravenstein, an inspector. Shalini explained where to find staff reports and rules for lead, and Chris explained the general inspection process, and highlighted some of the deficiencies he found with the current system.

The TRI lists lead and lead compounds when reporting lead air emissions. AQMD on the other hand simply puts lead (inorganic) on every database regarding lead emissions. This prompted a to call AQMD and clarify the meaning of when they list lead (inorganic) since for the same facility TRI stated they were releasing lead compounds. Shalini George indicated that AQMD calculates the amount of elemental lead contained in air emissions. The majority of lead emissions are in the form of lead compounds; it is rare to have pure lead emitted.

3.4 Finding Violations, Enforcement Actions & Penalties

Echo is an EPA website that provides integrated compliance and enforcement information for about 800,000 regulated facilities nationwide. It includes EPA, state, local and tribal environmental agency enforcement data for the past five years and quarterly compliance data for the past three years. Echo has data from various of environmental laws and regulatory agencies' databases. We used the following relevant information:

- Environmental Laws:
    - The Clean Air Act (CAA)
    - Resource Conservation Recovery Act (RCRA)
- Databases:
    - Resource Conservation Recovery Act Information (RCRAInfo)

- Toxic Release Inventory (TRI)

From this information, inspection dates and findings, violations, enforcement actions, and penalties assessed are publicly available. Echo has a user-friendly interface and interactive maps with it. You can search for any particular facility or explore the facilities around communities.

The local agencies that are responsible for the enforcement of CAA and RCRA are CAEPA Air Resource Board and DTSC, respectively. From Echo, we were able to obtain our facilities of interest's enforcement and compliance history as well as TRI's chemical data, which tells us how much of each chemical a facility is emitting. From the list of the highest lead-emitting facilities in LA county we obtained in Section 3.2.1., we turned to Echo to see if any violations had occurred at these facilities. In Section 5.4 we discuss our findings/drawbacks from using Echo.

3.5 Spatial analysis/GIS

3.5.1 Spatial Distribution of High-Priority Facilities

We mapped the highest lead-emitting sites that consistently emitted the highest amount of lead-containing air emissions, as well as hazardous waste generators that consistently generated the largest amount of hazardous waste in LA County from 2010-2014. We performed a batch geocode for all facilities and used the World Geodetic Survey 1984 geographic coordinate system for all layers.

3.5.2 Population Characteristic Analysis

We used a 1.7-mile radius buffer to analyze population demographics around the aforementioned high-priority facilities. This cutoff was selected to be consistent with the radius that DTSC plans to use to test soil around the former Exide plant in Vernon (Southern California Public Radio, 2016).

Sensitive population was one of the population demographics we examined. We acquired age demographics datasets from TIGER products, which are spatial extracts from the Census Bureau's MAF/TIGER database (TIGER, n.d). We used the most recent Census tracts for the year 2010. We defined "sensitive population" as those under 10 years of age and over 65 years of age, consistent with the definition used by CalEnviroScreen 2.0 (Rodriquez, 2014). To calculate sensitive population that falls within the designated buffer, we used the "Polygon to centroid" tool to convert the polygon features of the TIGER dataset to point features. We then only selected and aggregated centroid points that fell inside the defined buffer zone for each facility.

The specific ArcGIS tools used, in consecutive order were: buffer, clip, intersect, and dissolve. After a buffer of 1.7-mile radius was assigned across the facilities, the buffer layer served as a clip feature for the sensitive population layer. We used the intersect and dissolve tools on the clipped output to calculate sensitive population for each facility.

Poverty characteristics were analyzed using the USA Poverty Ratio provided by ESRI, which is based on data collected by the U.S. Census Bureau's American Community Survey (ACS) for 2013 for the previous 12 months. The map compares the amount of households that were living above the poverty line to the number of households living below.

3.5.3 Land Use Characteristics Analysis

We used the Southern California Association of Governments (SCAG) 2005 dataset to characterize land use surrounding high-priority facilities. We used the parent SCAG land use code, 1100, to identify land use defined as “Residential.” We determined the total amount of area classified as residential land use within a 1.7-mile radius for each high-priority facility. Similar to the method performed for sensitive population analysis, we used four ArcGIS tools utilized to calculate the area: buffer, clip, intersect, and dissolve. This process ensured that the calculated residential land use fell within a 1.7-mile buffer for each facility.

3.5.4 Proximity to School Location Analysis

We acquired GIS data for school locations for the year 2016 from the Los Angeles GIS Data Portal. The dataset originates from the Location Management System (LMS), which is a collaborative effort to identify public and non-public locations in Los Angeles County. The information extracted for our purposes were locations identified as “Early Childhood Education and Head Start” and “Public Elementary Schools.” The same process described in Section 3.4.3 was used to determine the amount of schools within a 1.7 mile radius for each high-priority facility.

4. RESULTS

4.1 DTSC-Regulated Hazardous Waste in LA County

4.1.1 Generators in LA County

There were 25,845 active hazardous waste generators in Los Angeles County as of April 2016. There were a total of 2,236 large quantity generators, defined as generators of 1,000 kg or more of hazardous waste per month (excluding universal wastes) and/or more than 1 kg or acutely or extremely hazardous waste per month (DTSC, 2015). The remaining 23,609 facilities are small quantity generators. (Figure 4.1.1).

The number of facilities that generated over 1,000 ton (907,185 kg) annually between 2010-2014 ranges from a low of 77 in 2011 to a high of 92 facilities in 2014 (Figure 4.1.2). During the 5-year study period, the highest lead-emitting generators all averaged over 10,000 tons, with Clean Harbors Wilmington generating the most at 60,918 tons per year on average (Figure 4.1.3). Of the highest lead-emitting facilities, seven were environmental cleanup services, two were oil refineries, and one was a lead battery recycler (Figure 4.1.3).

Figure 4.1.1: Count of small and large quantity generators in LA County as of April 2016

Figure 4.1.2: Number of facilities that generated over 1,000 tons annually between 2010-2014

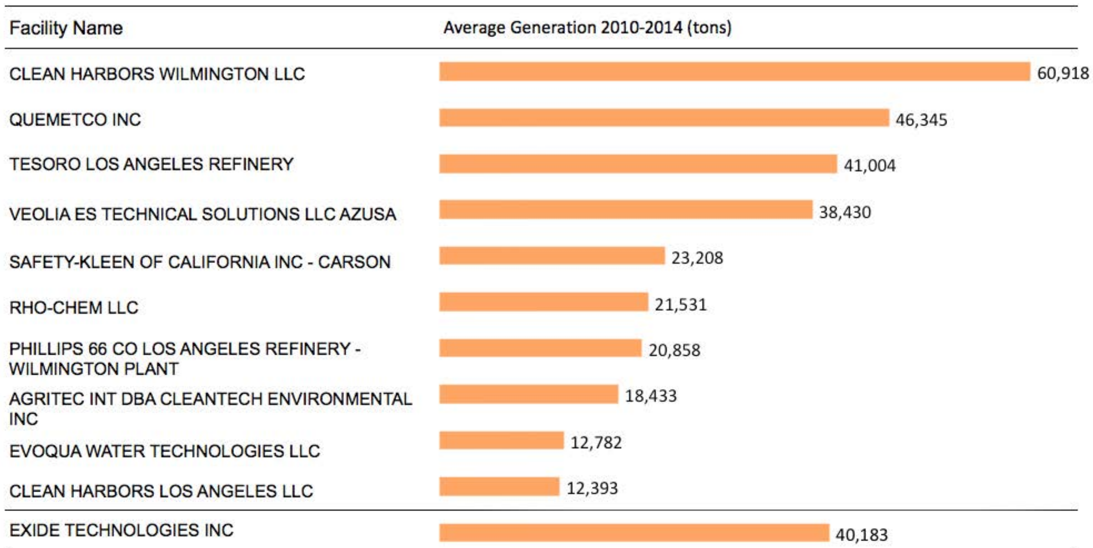


Figure 4.1.3: Highest lead-emitting hazardous waste generators and Exide Technologies Inc. between 2010-2014 with corresponding average generation over the five-year period.

4.1.2 Total volumes of hazardous waste generation

Throughout 2010-2014, hazardous waste generation, excluding contaminated soil from site cleanups, was relatively consistent. Volumes generated in 2010-2012 were constant; there was a spike in 2013, and then a decrease in 2014 (Figure 4.1.4). The lowest tonnage was generated in 2012 with 839,365 tons and the highest tonnage was generated in 2013 with 2,195,916 tons. The spike in 2013 was due to contaminated soil cleanup at Pechiney Cast Plate. The facility generated 1,383,156 tons of hazardous waste, which constitutes 81%, of the estimated volume generated in 2013. From 2010-2012, waste oil and mixed oil was the waste code that contributed the highest volume of hazardous waste, making up 27-28% of the total annual tonnage. In 2013-2014, the waste code that made up the largest proportion of hazardous waste was contaminated soil from site cleanups, which comprised 64% and 33% of total annual tonnage, respectively. Further details can be found in Table 4.1.1.

Despite the top generators representing a very small fraction of total active generators, they contribute a significant volume to overall hazardous waste production (Figure 4.1.5). Between 2010-2012 and 2014, these facilities were responsible for over 30% of total hazardous waste generation in LA County. In 2013, the top generators only represented 12% of total annual tonnage because of cleanup activity at Pechiney Cast Plate, which was not a consistently top generator.

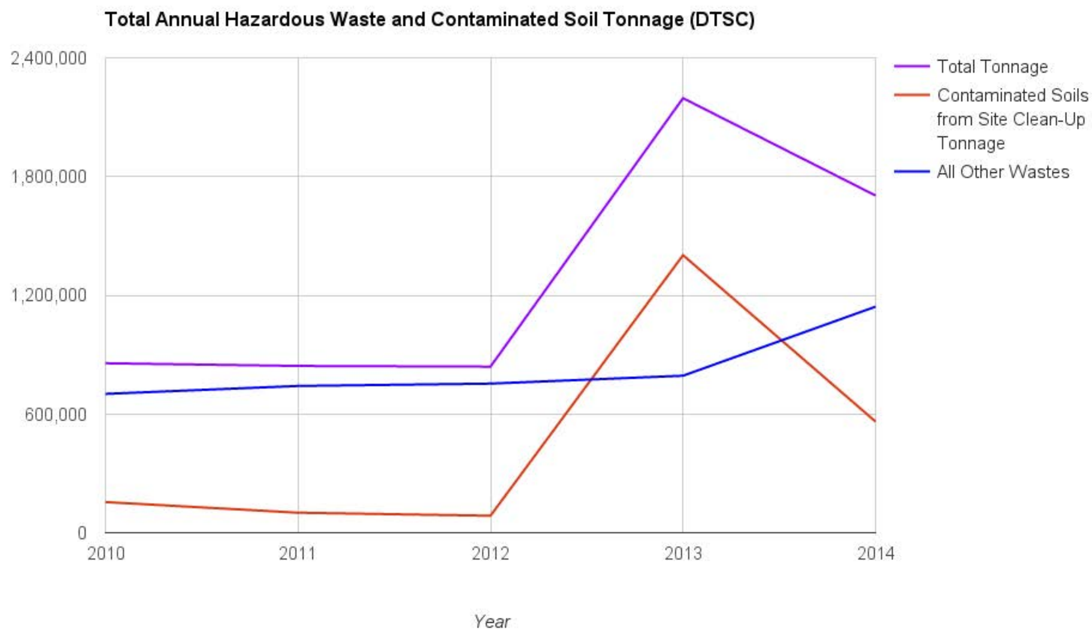


Figure 4.1.4: Total annual hazardous waste tonnage broken down by contaminated soil and all other waste tonnage between 2010-2014

Table 4.1.1: Top waste code volume compared to total annual tonnage between 2010-2014

Top Waste Code By Volume (DTSC)				
Year	**Top Waste Code***	**Total Tons of Top Waste**	**Total Tons Annual Waste**	**% of Total**
2010	WASTE OIL AND MIXED OIL	240,994	856,386	28%
2011	WASTE OIL AND MIXED OIL	236,677	842,847	28%
2012	WASTE OIL AND MIXED OIL	228,254	839,365	27%
2013	CONTAMINATED SOILS FROM SITE CLEAN-UP	1,402,589	2,195,916	64%
2014	CONTAMINATED SOILS FROM SITE CLEAN-UP	561,591	1,703,934	33%
*Out of all waste codes, this category contributed the greatest volume during that specific year				

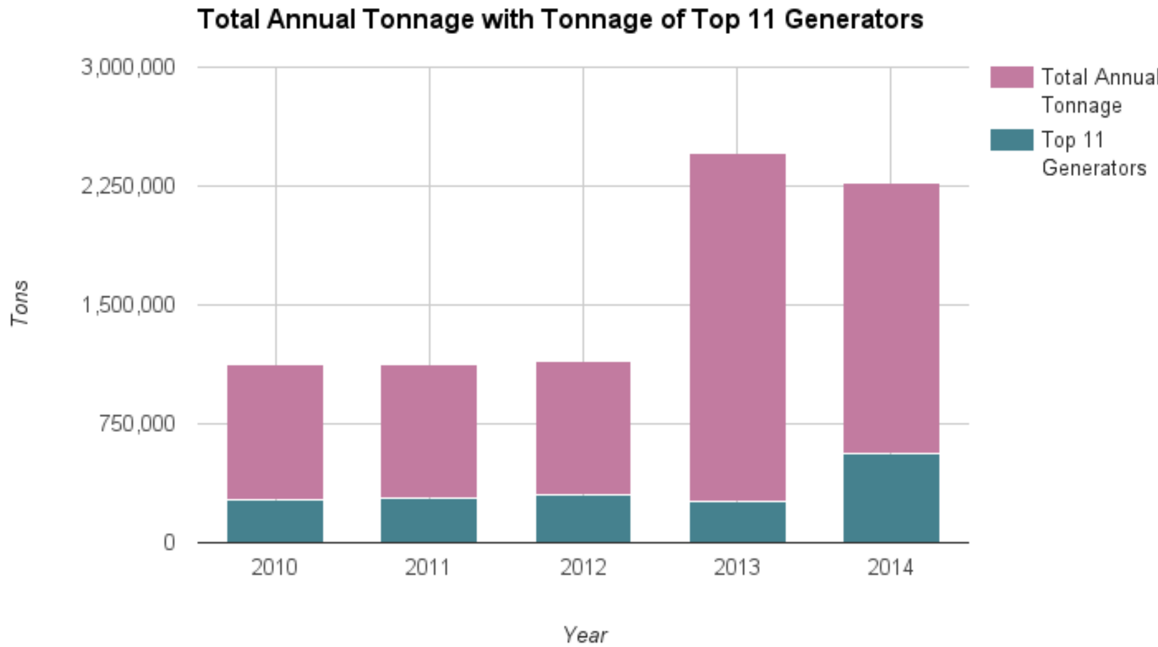


Figure 4.1.5: Total annual tonnage for top 11 generators and portion of annual tonnage attributed to top 11 generators from 2010-2014

4.1.3 Transport, Storage and Ultimate Disposition

In order to understand the complexity of hazardous waste management, we created a snapshot of the transport, storage and disposition of Quemetco, Clean Harbors Wilmington, and Tesoro Los Angeles Refinery (Table 4.1.2). For just 12 randomly selected days spread throughout 2014, Quemetco Inc. generated 1041 tons, with an average of 19 tons per manifest entry. Of that tonnage, 59% had explicit RCRA lead waste codes and 71% was transported out of state for reclamation, recovery, or landfill disposal. During those same 12 days, Clean Harbors Wilmington generated 882 tons, with an average of 7 tons per manifest entry. Of that tonnage, 7% had an explicit RCRA lead waste code and 51% was transported out of state for reclamation, recovery, storage, transfer, destruction, treatment or landfill disposal. For 12 days in 2014, Tesoro's Los Angeles Refinery generated 124 tons of hazardous waste with 3% having explicit RCRA lead waste codes and 20% being sent out of state.

Table 4.1.2: Summary of hazardous waste generation for 12 days in 2014

Facility	Total Tonnage	Average Tonnage	Explicitly Lead Related Tonnage	% Explicitly Lead Related Tonnage	Tonnage Transported Out of State	% Tonnage Transported Out of State
QUEMETCO INC	1041	19	611	59%	744	71%
CLEAN HARBORS WILMINGTON LLC	882	7	61	7%	448	51%
TESORO REFINING & MARKETING COMPANY-LOS ANGELES REFINERY	124	6.8	4	3%	25	20%

To investigate even further, we created summary diagrams for Quemetco and Clean Harbors Wilmington for three days in April. Based on management method codes, hazardous waste can follow four broad "management routes" – (1) reclamation and recovery, (2) storage and transfer, (3) destruction or treatment prior to disposal at another site, and (4) landfill disposal. In three days in April, the 244 tons of hazardous waste generated at Quemetco either went to reclamation and recovery or to landfill disposal, most of which went out of state (Figure 4.1.6). For those same three days, the 100 tons of hazardous waste generated at Clean Harbors Wilmington was divided among all 4 management routes, with a 55% going to landfill disposal (Figure 4.1.7).

Figure 4.1.6: Summary diagram of hazardous waste management for three days in April 2014 for Quemetco Inc.

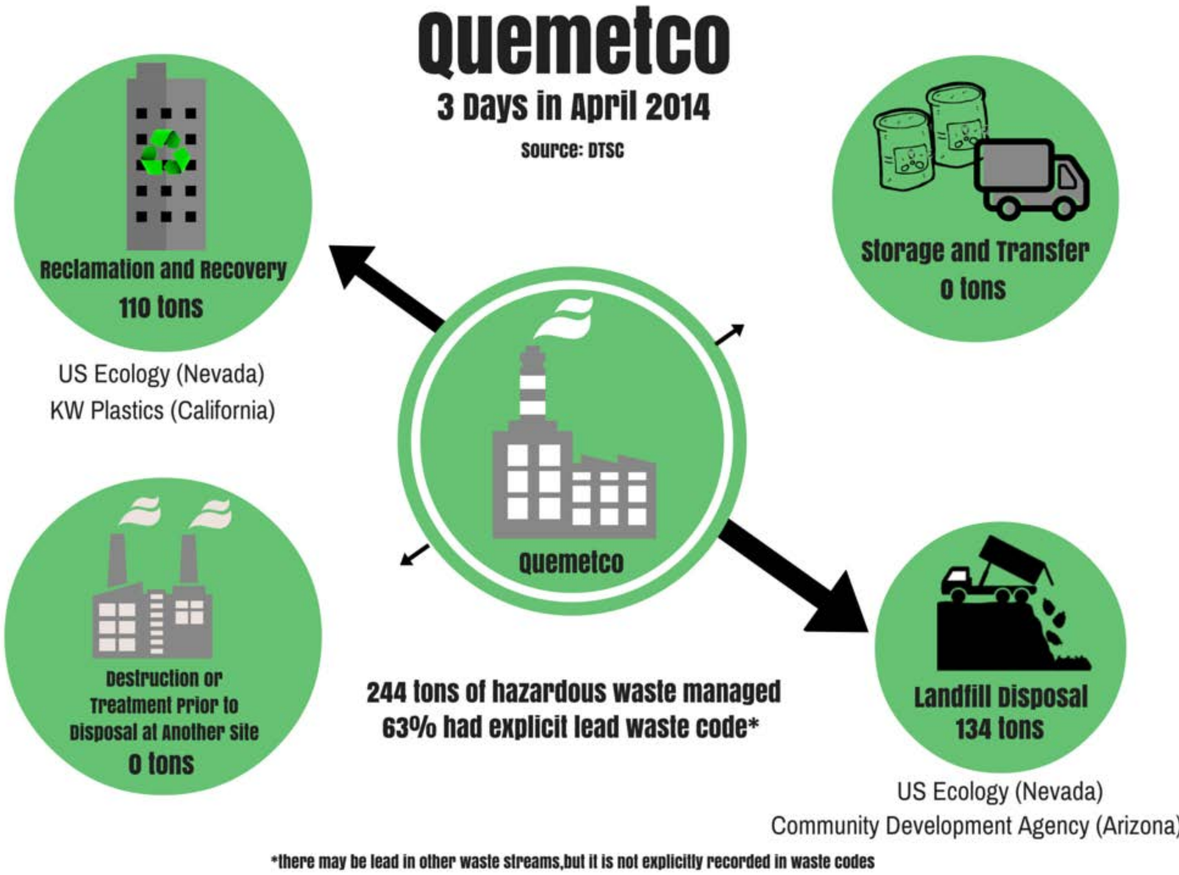
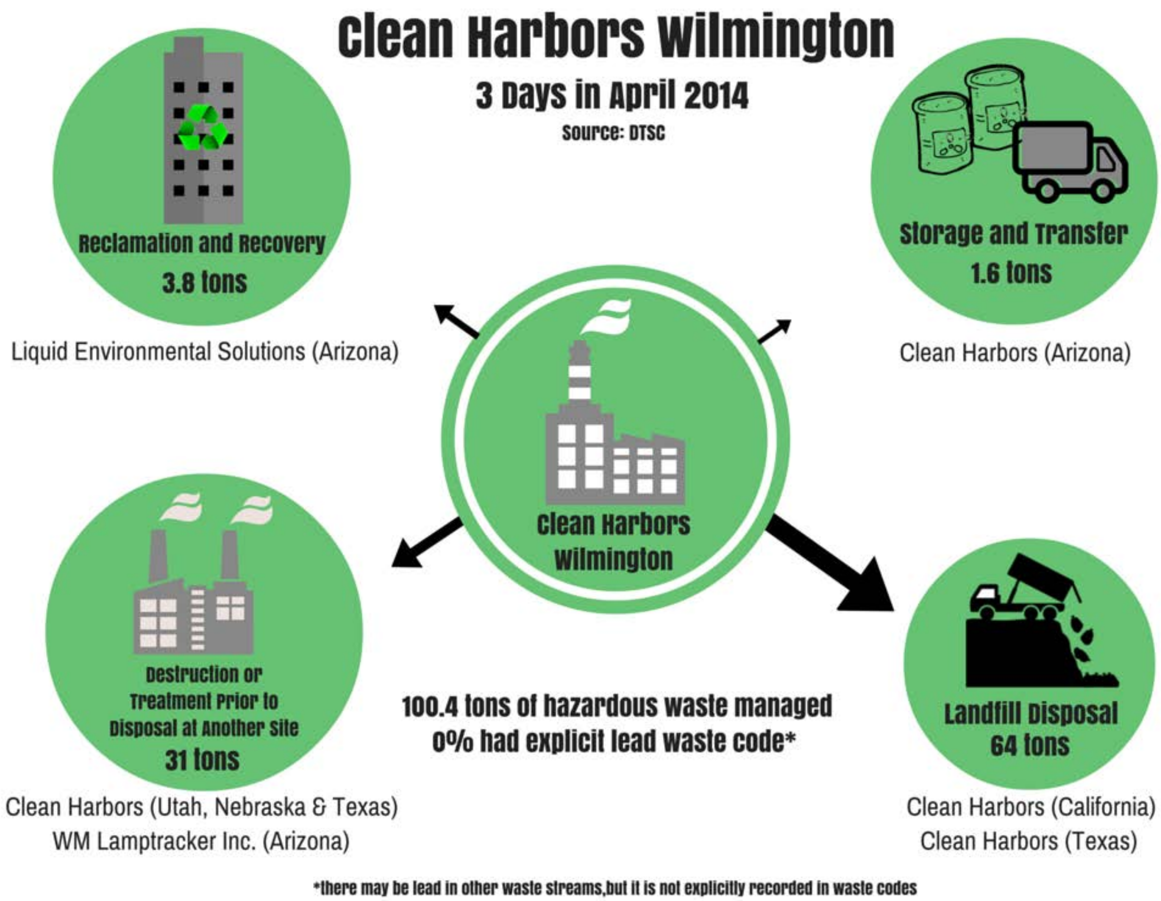


Figure 4.1.7: Summary diagram of hazardous waste management for three days in April 2014 for Clean Harbors Wilmington



4.2 Lead-containing air emissions in Los Angeles County

4.2.1 High-emitting facilities in Los Angeles County

Figure 4.2.1 shows the average annual lead-containing air emissions from the 10 highest lead emitting facilities. The amount of lead-containing air pollutants emitted by these ten facilities ranged from approximately 10 to 84 lbs/yr, which in total represented 50% (excluding the Exide) of the five-year countywide average emissions (714 lbs/yr). Although we are focusing on active facilities and Exide is now shut down, we have included it here for comparison. The top three are Tesoro - Wilmington, Exxon-Mobil - Torrance and Owens-Brockway - Vernon, all of which averaged over 50 lbs/yr throughout the five years.

Facility Name	City	Average Emissions 2010-2014 (lbs/yr)
EXIDE TECHNOLOGIES	LOS ANGELES*	252.8
TESORO WILMINGTON CALCINER	WILMINGTON	84.3
EXXONMOBIL OIL - TORRANCE REFINERY	TORRANCE	76.7
OWENS-BROCKWAY GLASS CONTAINER - 23	VERNON	65.1
CHEVRON PRODUCTS CO	EL SEGUNDO	32.3
TESORO LA REFINERY	WILMINGTON	26.2
PHILLIPS 66 LA REFINERY - WILMINGTON	WILMINGTON	22.3
TROJAN BATTERY CO LLC- Ann ST	SANTA FE SPRINGS	15.2
ULTRAMAR INC WILMINGTON REFINERY	WILMINGTON	11.5
RAMCAR BATTERIES INC	COMMERCE	10.1
QUEMETCO INC	CITY OF INDUSTRY	9.6

*Facility is located in Vernon, CA, but TRI report shows the facility in Los Angeles.

Figure 4.2.1. The average annual lead-containing air emissions from the 10 highest lead emitting facilities in Los Angeles County, from 2010 to 2014. Exide Technologies was included for comparison.

4.2.2 Total lead-containing air emissions from 2010 to 2014 in Los Angeles County

Table 4.2.1 shows the cumulative amount of stack air emissions throughout the five years from the highest lead-emitting emitting facilities, plus Exide. All of the ten facilities had emissions one order of magnitude less than the Exide's. After the extreme case of Exide, Tesoro Wilmington Calciner has the highest lead stack emissions followed by ExxonMobil. The range of values (excluding Exide) differs by an order of magnitude. All but one of these facilities are either battery manufacturers/recyclers or petroleum refineries.

Figure 4.2.2 shows the annual total lead-containing air emissions from the highest emitting facilities in Los Angeles County throughout the five years. The total lead-containing air emissions in the Los Angeles County had generally decreased from 2010 to 2014. The trend of the total emissions including the Exide's (dark blue) largely fluctuated, which matched that of the Exide's emissions alone (light blue). There was a sharp decrease between 2010 and 2011, a slight increase in the following three years and a decrease from 2013 to 2014. The trend of the total emissions excluding the Exide's showed a different pattern. However, the remainder (red) did not fluctuate as much as we took off the dominant facility Exide. There was little change or decrease in the total emissions through the five years.

This table below shows the total stack air lead emissions from 2010 to 2014. Numbers were totaled from the TRI Basic Data Files. Values for Exide Technologies are shown for comparison purposes.

Table 4.2.1. Total lead containing air emissions from the highest lead-emitting lead emitting facilities from 2010-2014

Facility Name	City	5 Year Total Lead Containing Air Emissions (lbs)
EXIDE TECHNOLOGIES -INDIANA ST.	LOS ANGELES*	1264
TESORO WILMINGTON CALCINER	WILMINGTON	422
EXXONMOBIL OIL CORP – TORRANCE REFINERY	TORRANCE	384
OWENS-BROCKWAY GLASS CONTAINER INC PLANT 23	VERNON	326
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	EL SEGUNDO	165
TESORO LOS ANGELES REFINERY	WILMINGTON	131
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	WILMINGTON	111
TROJAN BATTERY CO LLC- Ann ST	SANTA FE SPRINGS	76
ULTRAMAR INC WILMINGTON REFINERY	WILMINGTON	58
RAMCAR BATTERIES INC	COMMERCE	50
QUEMETCO INC	CITY OF INDUSTRY	48

*Facility is located in Vernon, CA, but TRI report shows the facility in Los Angeles.

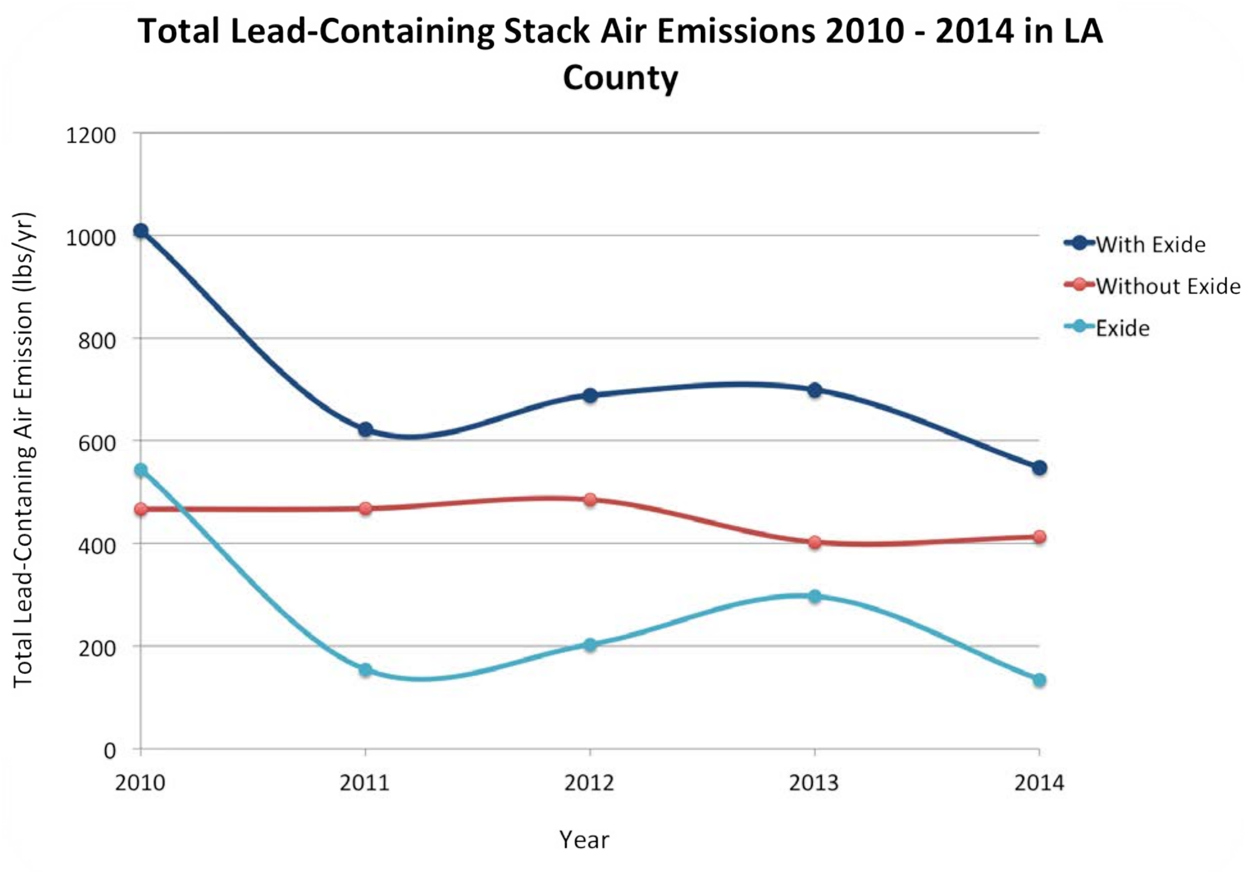


Figure 4.2.2. The five-year trend of the annual total lead-containing air emissions in the Los Angeles County from 2010 to 2014. The dark blue curve indicates the annual total emissions with Exide Technologies included. The light blue curve indicates the annual emissions of Exide alone. The red curve indicates the

4.2.3 Historic Total Lead Air Emissions for Highest Emitting Facilities

Figure 4.2.3 shows the range of emissions throughout the facilities' operation years. Of facilities still in operation, Quemetco Inc. has the highest total lead air emissions throughout its operating years. However, total emissions from Quemetco are an order of magnitude less than those of Exide Technologies, and emissions from the next highest facility, Tesoro, are two orders of magnitude less than Exide. Breakdowns by stack and fugitive emissions are shown in Table 4.2.2. Historically, fugitive emissions comprised up to 18% of total lead air emissions; however, regulatory changes in 2001 resulted in significant reductions in fugitive emissions.

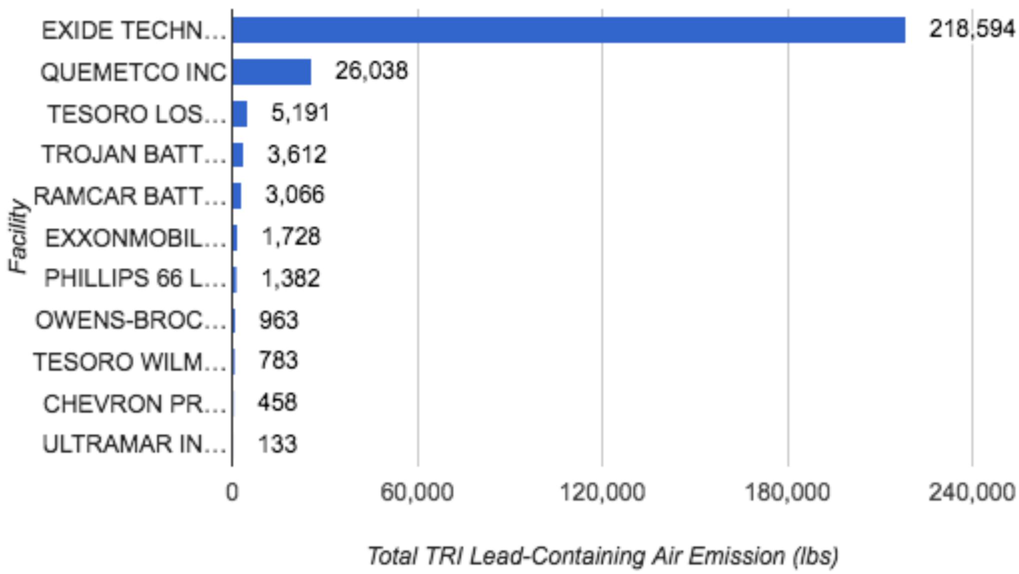


Figure 4.2.3. Historic Totals for the 10 highest lead emitting facilities since 1987.

Table 4.2.2. Table of Historic Totals for the highest lead-emitting Consistent Facility's Lead-Containing Air Emission since 1987.

Facility	Total TRI Lead Stack Air Emission (lbs)	Total TRI Lead Fugitive Air Emission (lbs)	Total TRI Lead Air Emission (lbs)
EXIDE TECHNOLOGIES	178,994	39,600	218,594
QUEMETCO INC	23,209	2,829	26,038
TESORO LOS ANGELES REFINERY	4,431	760	5,191
TROJAN BATTERY CO LLC- Ann ST	2,103	1,509	3,612
RAMCAR BATTERIES INC	2,991	75	3,066
EXXONMOBIL OIL CORP - TORRANCE REFINERY	1,465	263	1,728
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	1,382	683	1,382
OWENS-BROCKWAY GLASS CONTAINER INC PLANT 23	960	3	963
TESORO WILMINGTON CALCINER	783	0	783
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	418	40	458

ULTRAMAR INC WILMINGTON REFINERY	132	1	133

4.3 Violations issued from AQMD to highest lead-emitting Facilities

Highest Lead Air Emitting facilities from 2010-2014	AQMD Lead Violations		Significant Other Violations Not related to Lead
	From 2010-2104	Prior to 2010	
OWENS-BROCKWAY GLASS CONTAINER INC PLANT 23	none	none	not reporting, NOx, SOx
EXXONMOBIL OIL CORP – TORRANCE REFINERY	none	none	VOC
TESORO WILMINGTON CALCINER	none	none	No Notices of Violation
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	none	none	VOC, NOx. Not submitting reports on time
TROJAN BATTERY CO LLC- Ann ST	NOT LISTED	NOT LISTED	N/A
ULTRAMAR INC WILMINGTON REFINERY	None	none	leaky/faulty equipment
TROJAN BATTERY CO LLC- Clark ST	NOT LISTED	NOT LISTED	N/A
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	none	none	faulty equipment that leads to violations of sumps/water separators, VOC, visible emissions, and nuisance. Failure to meet requirement of permit to operate/title V permit.
QUEMETCO INC	none	3	N/A

RAMCAR BATTERIES INC	NOT LISTED	NOT LISTED	N/A

4.3.1. This table summarizes the AQMD violation history for each of the highest lead-emitting facilities. Derived from AQMD's FIND.

This table illustrates that, prior to 2010, there are no lead violations. There are, however, significant violations at nearly every facility regarding VOC's and other issues. However, those fall beyond the scope of our project.

4.4 AQMD-Issued Permits

The permits corroborated what was found on the AQMD database.
As illustrated in figure 4.4.1, most Notices of Violations did not pertain specifically to lead; in fact, none of these facilities were sanctioned for excess lead emissions after 2010, although many were cited for excesses of volatile organic compounds or nitrogen oxide emissions.

While there were no lead violations of note to consider, the documents did aid in drawing a clearer picture of how AQMD permits facilities. This will be further explored in the Discussions section below.

4.5 Spatial Analysis/GIS

4.5.1 Spatial Distribution of High-Priority Facilities

The spatial distribution of the high-priority hazardous waste generators and lead air-emitting facilities is shown in Figure 4.5.1. Two regions had a concentration of high-priority facilities--one is near East Los Angeles, extending from Huntington Park to Commerce, and the second hot spot is in Wilmington.

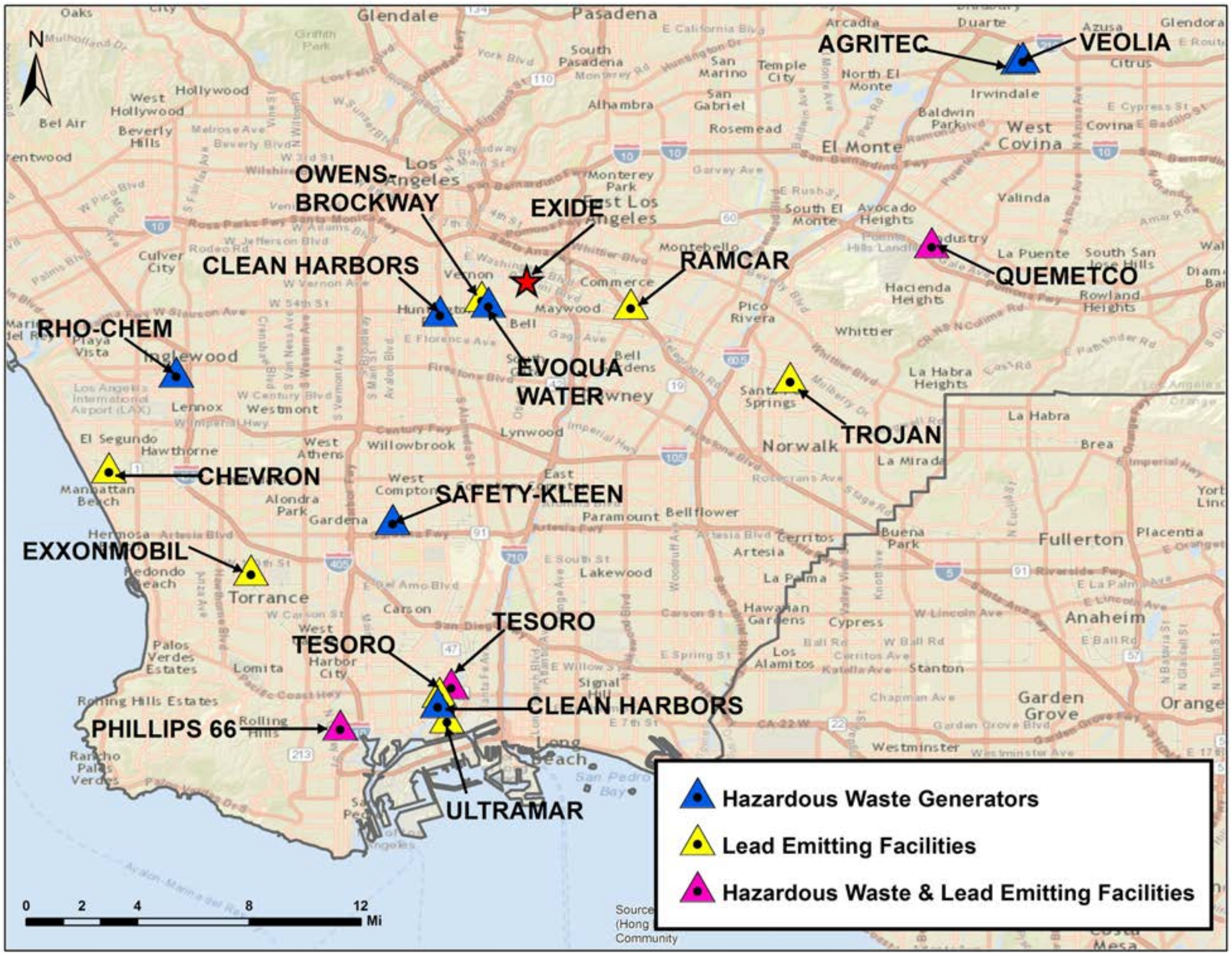


Figure 4.5.1: Spatial distribution of high-priority facilities, including large quantity generators and the top facilities for lead air emissions in Los Angeles County between 2010-2014.

4.5.2 Population Characteristics Analysis

The number of sensitive individuals living in proximity (1.7 mile radius) to the largest hazardous waste generators in the County ranged from approximately 480 to 30,000 people (Figure 4.5.3). Clean Harbors in Los Angeles, Evoqua, and Rho-Chem were the three facilities located near the highest-amount of sensitive population, in descending order.

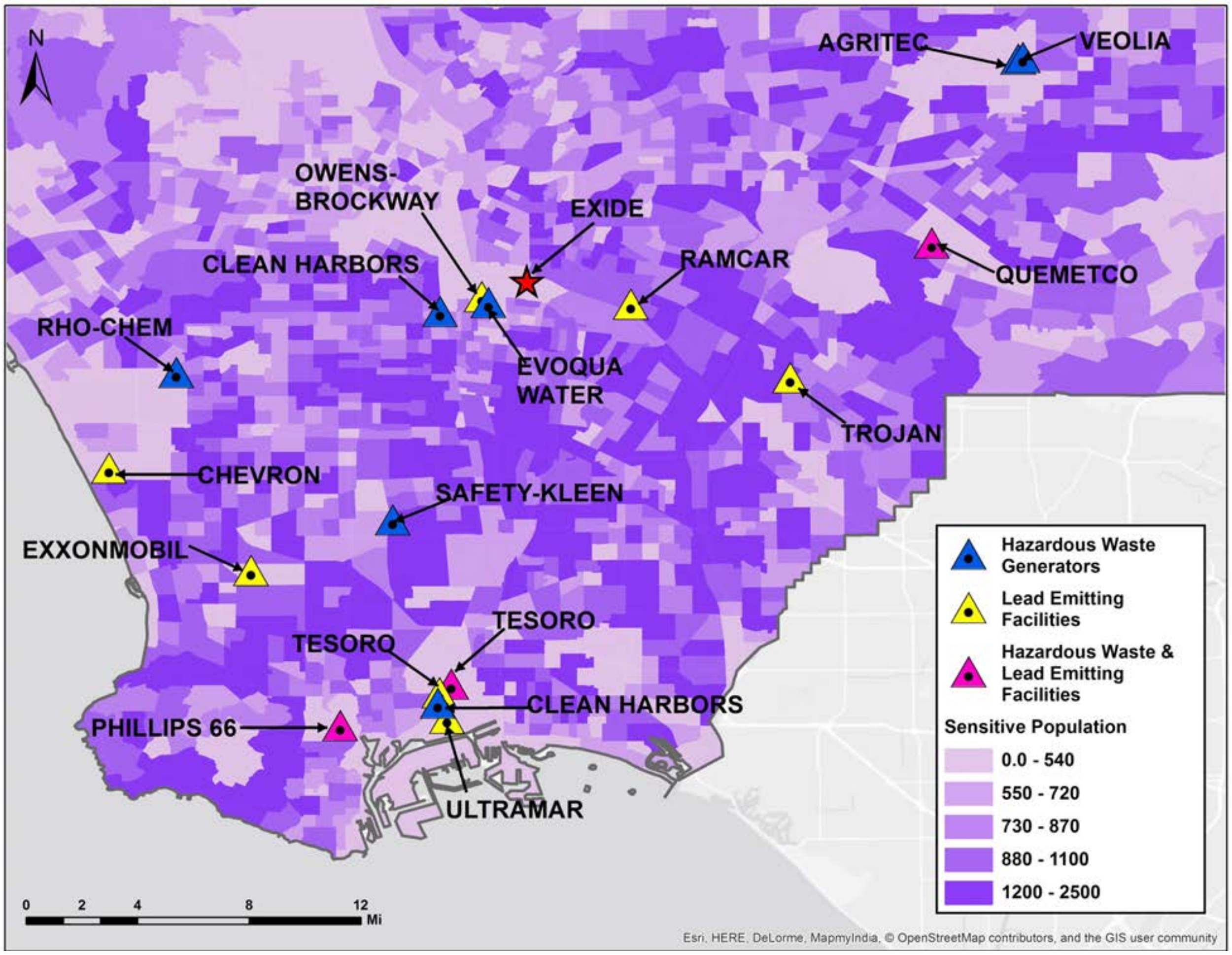


Figure 4.5.2. Spatial characteristics of sensitive population (<10 years and >65 years of age), based on census tracts, near high-priority facilities.

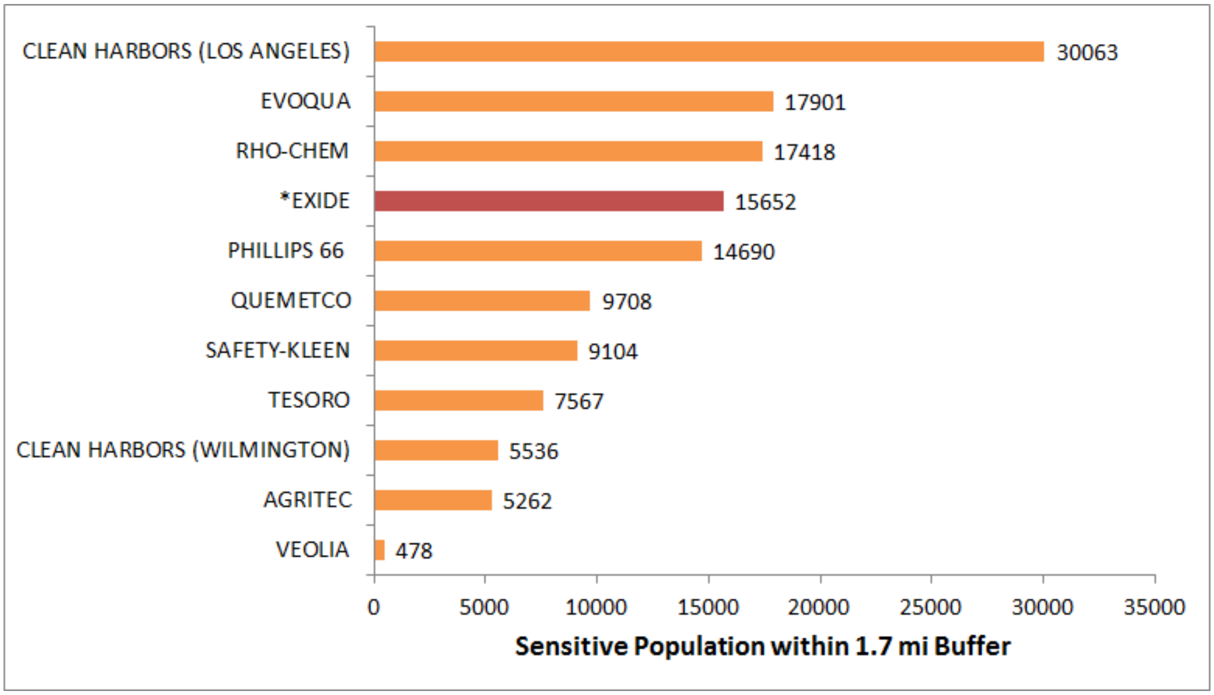


Figure 4.5.3: Sensitive population (<10 years and >65 years) within a 1.7-mile radius from highest lead-emitting hazardous waste generators in Los Angeles County. *Exide was included for comparison purposes.

Sensitive individuals living near lead air-emitting facilities ranged from approximately 3,000 to 16,000 people (Figure 4.5.4). Owens-Brockway, Phillips 66, and Trojan Battery were located near the largest amount of sensitive populations. A total of sensitive population of 97, 866 live near the highest lead-emitting lead air-emitting facilities.

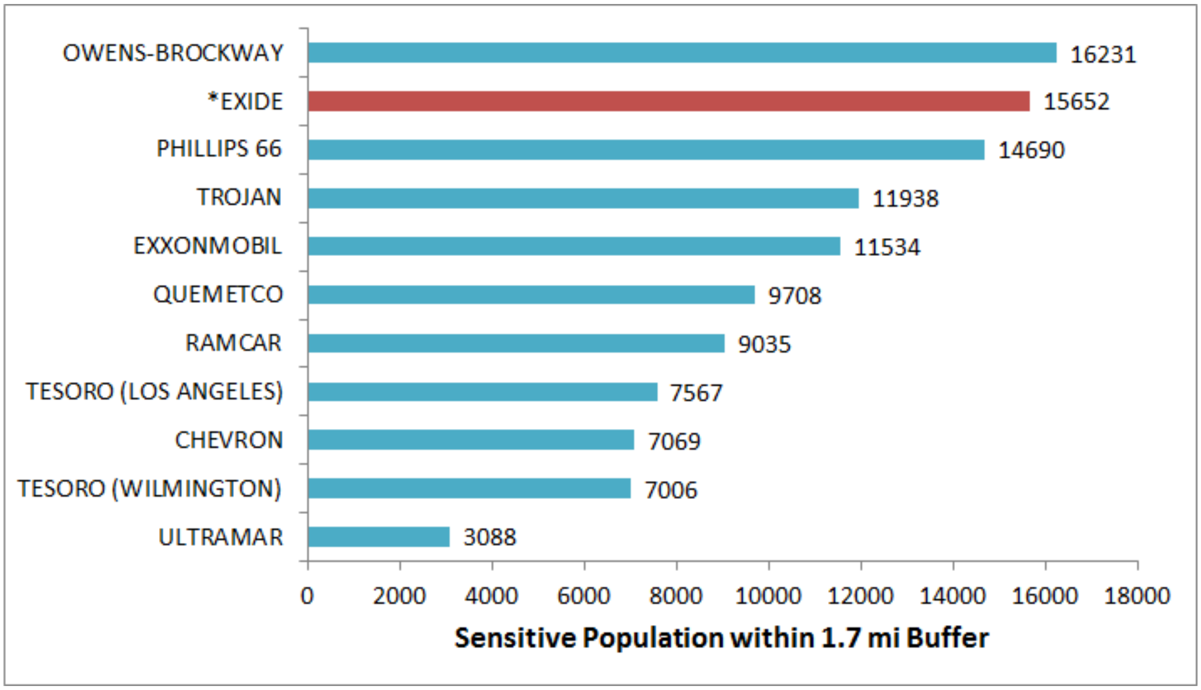


Figure 4.5.4: Sensitive population (<10 years and >65 years) within a 1.7-mile radius from highest lead-emitting lead air-emitting facilities in Los Angeles County. *Exide was included for comparison purposes.

Figure 4.5.5 shows the spatial characteristics of poverty levels near the high-priority facilities. Areas that are colored green on the map "have a higher than normal number of households living above compared to below poverty. Orange areas on the map have a higher than normal number of households living below the poverty line compared to those above in that same area" (ESRI, 2015). As shown in Figure 4.5.5, the two regions with the highest concentration of facilities--near East Los Angeles and Wilmington--are located among the highest ratio of households living below the poverty level.

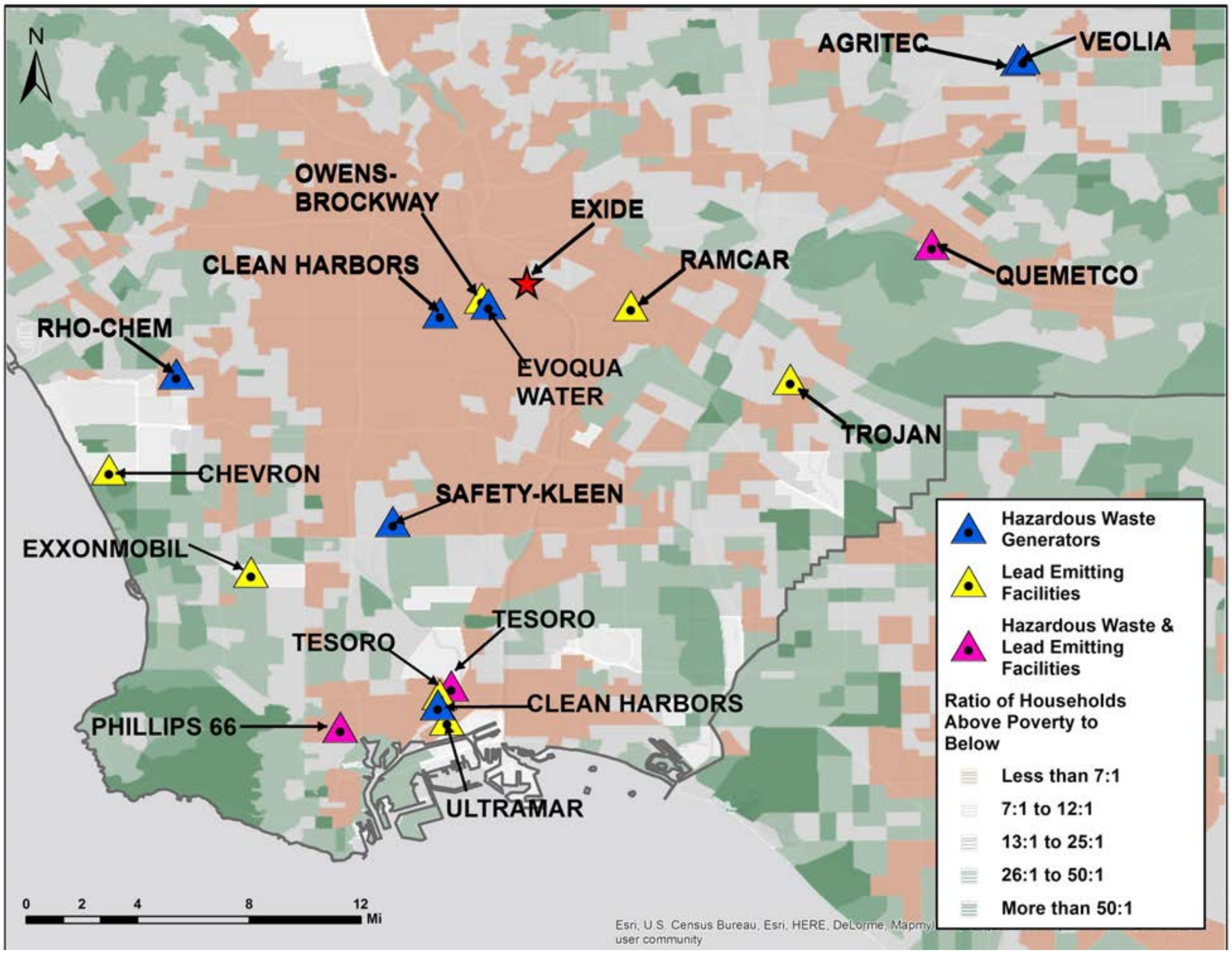


Figure 4.5.5: Poverty ratios near high-priority hazardous waste generators and lead air emitting facilities in Los Angeles County.

4.5.3 Land Use Characteristics Analysis

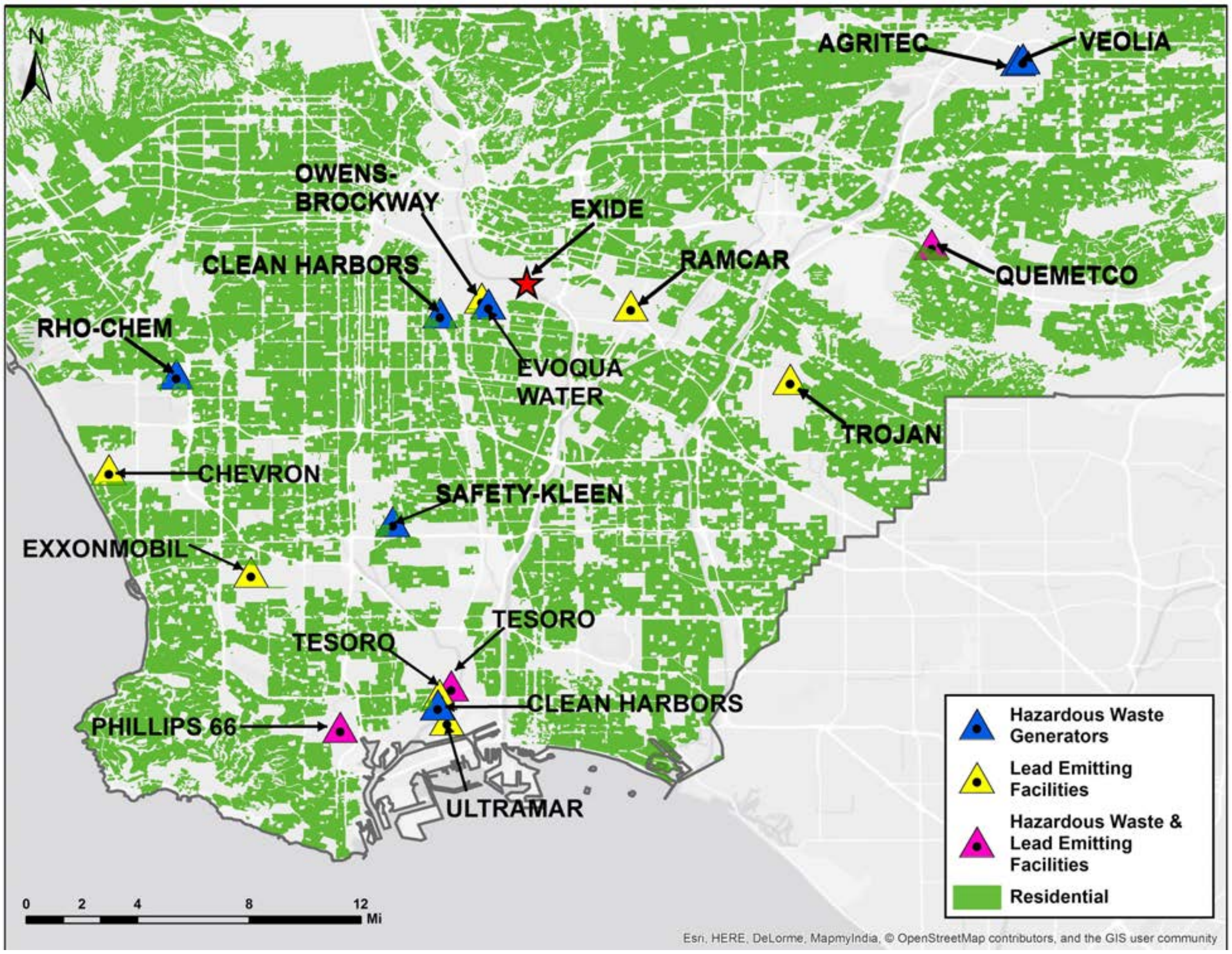


Figure 4.5.6 Spatial characteristics of residential land use near the high-priority hazardous waste generators and lead air-emitting facilities in Los Angeles County.

Areas designated for residential land use within a 1.7-mile radius from the highest lead-emitting hazardous waste generators ranged from 3 to 12 square kilometers. Rho-Chem, Quemetco, and Clean Harbors in Los Angeles are located near highest amount of residential land area (Figure 4.5.6, Figure 4.5.7). Furthermore, facilities that emit the highest amount of lead air emissions are located near residential land areas, ranging from 2 to 10 square kilometers. In this case, Quemetco, ExxonMobil, and Trojan Battery are located near the highest amount of residential land use.

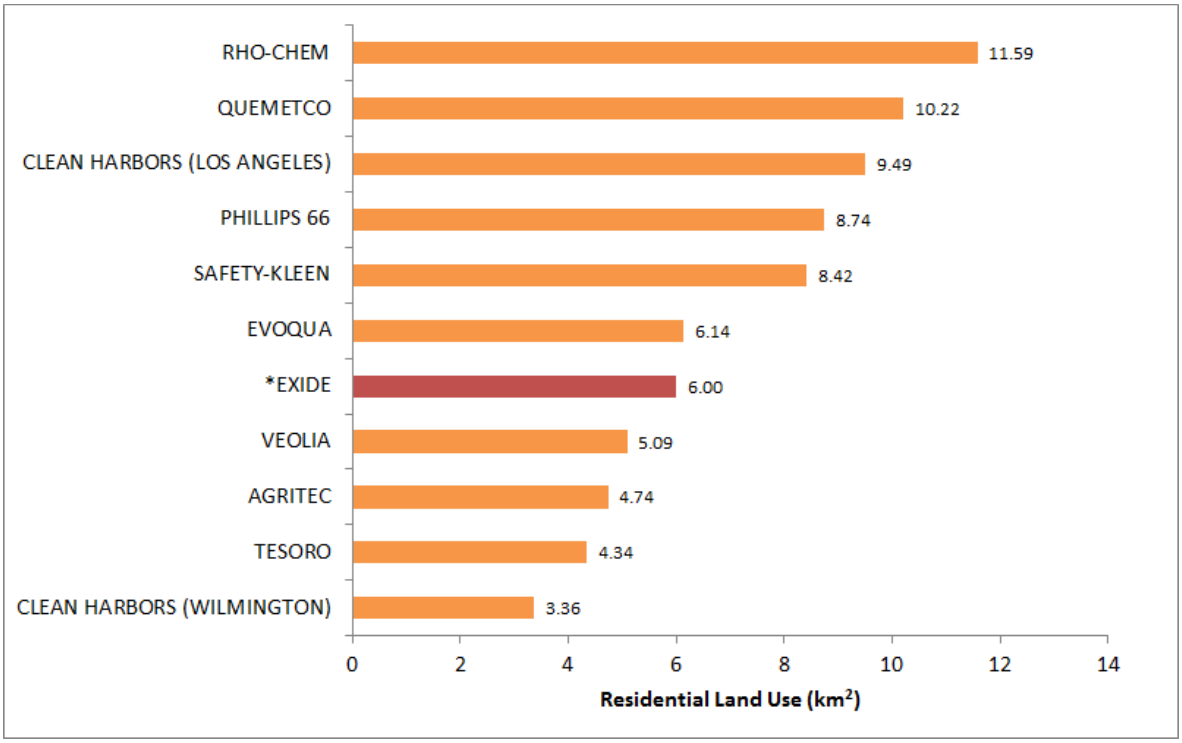


Figure 4.5.7 Residential land use within a 1.7-mile radius from highest lead-emitting hazardous waste generators in Los Angeles County. *Exide was included for comparison purposes.

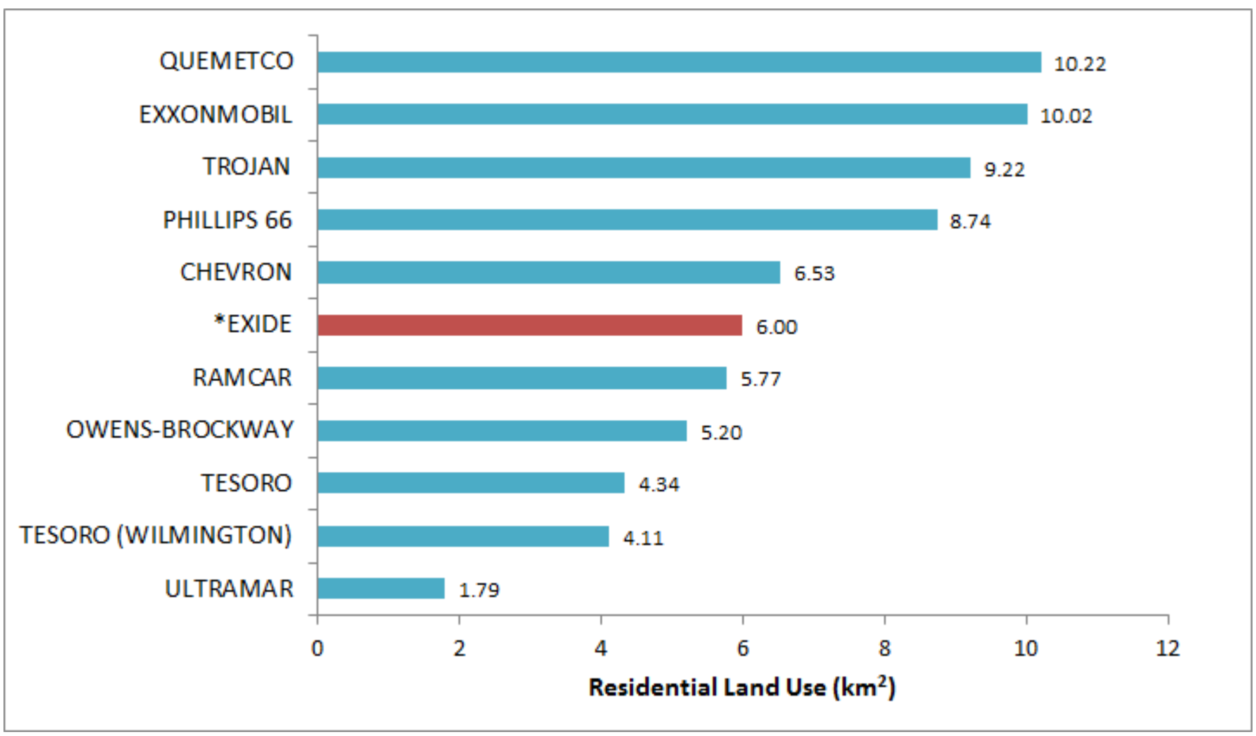


Figure 4.5.8 Residential land use within a 1.7-mile radius from highest lead-emitting lead air-emitting facilities in Los Angeles County. *Exide was included for comparison purposes.

4.5.4 Proximity to Schools

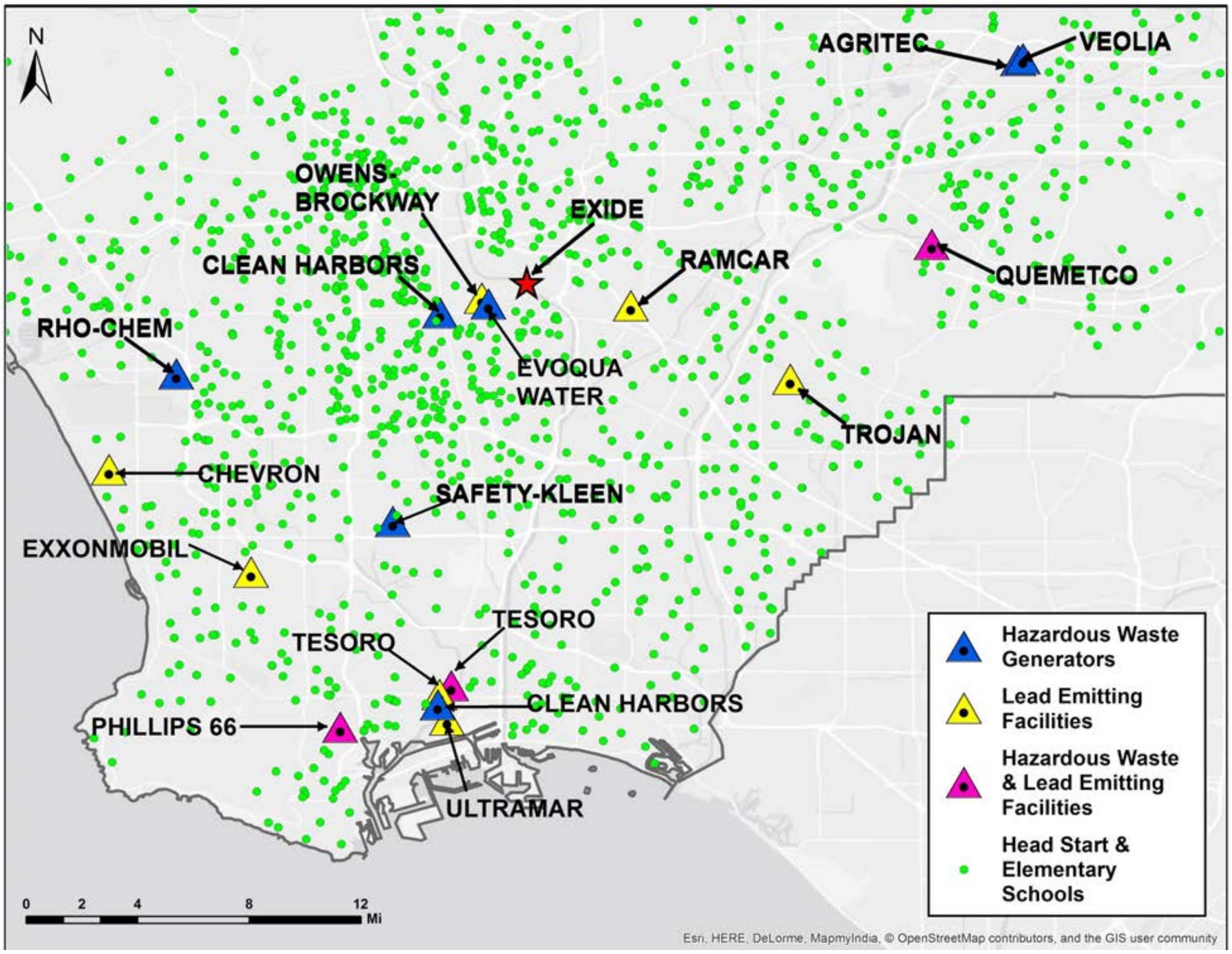


Figure 4.5.8 Spatial Characteristics of early childhood education, head start, and public elementary schools near high-priority hazardous waste generators and lead air-emitting facilities.

The highest number of head start and public elementary schools are located near Clean Harbors, Phillips 66 Refinery, and Quemetco (in descending order). We found that 8 to 37 schools are located within a 1.7-mile radius from the largest hazardous waste generators in Los Angeles (Figure 4.5.9). In terms of highest lead air emitting facilities, the highest number of schools located within a 1.7 miles radius was located near Phillips 66, Quemetco, and Owens-Brockway (in descending order). The number of schools ranged from 4 to 36 locations within the designated buffer from the highest lead air emitting facilities.

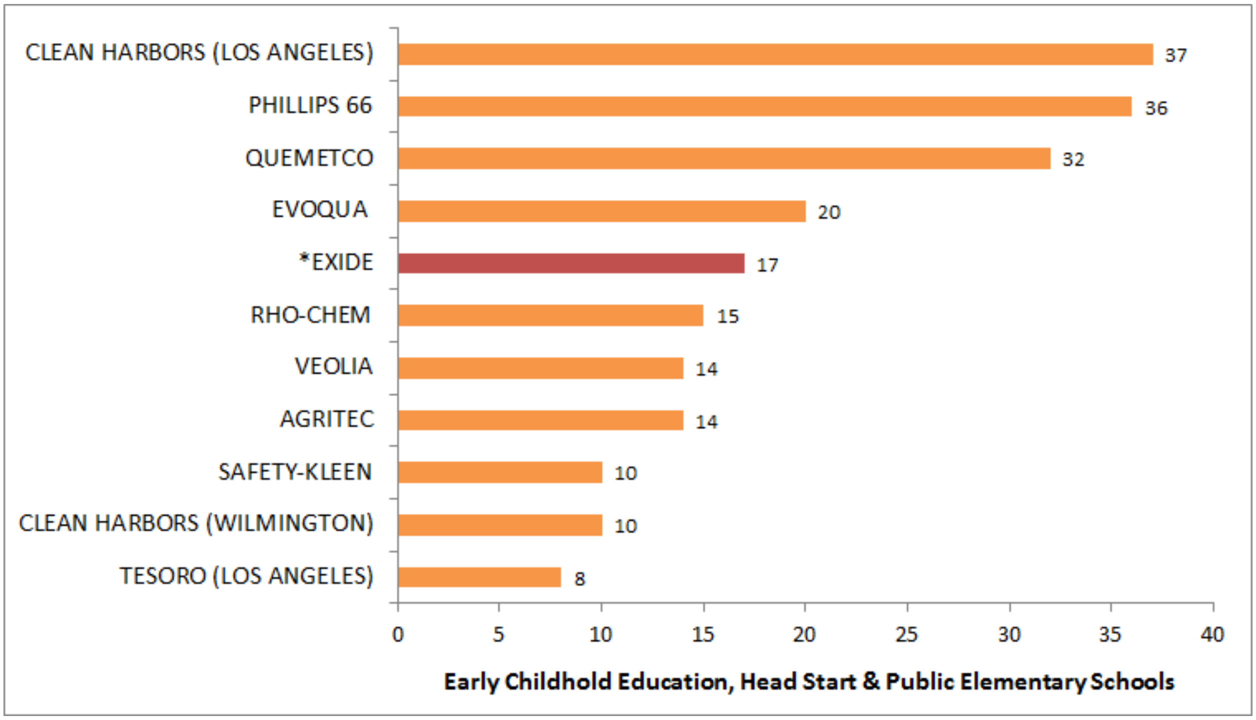


Figure 4.5.9 Early childhood education, head start, and public elementary schools within a 1.7-mile radius from highest lead-emitting hazardous waste" generators in Los Angeles County. *Exide was included for comparison purposes.

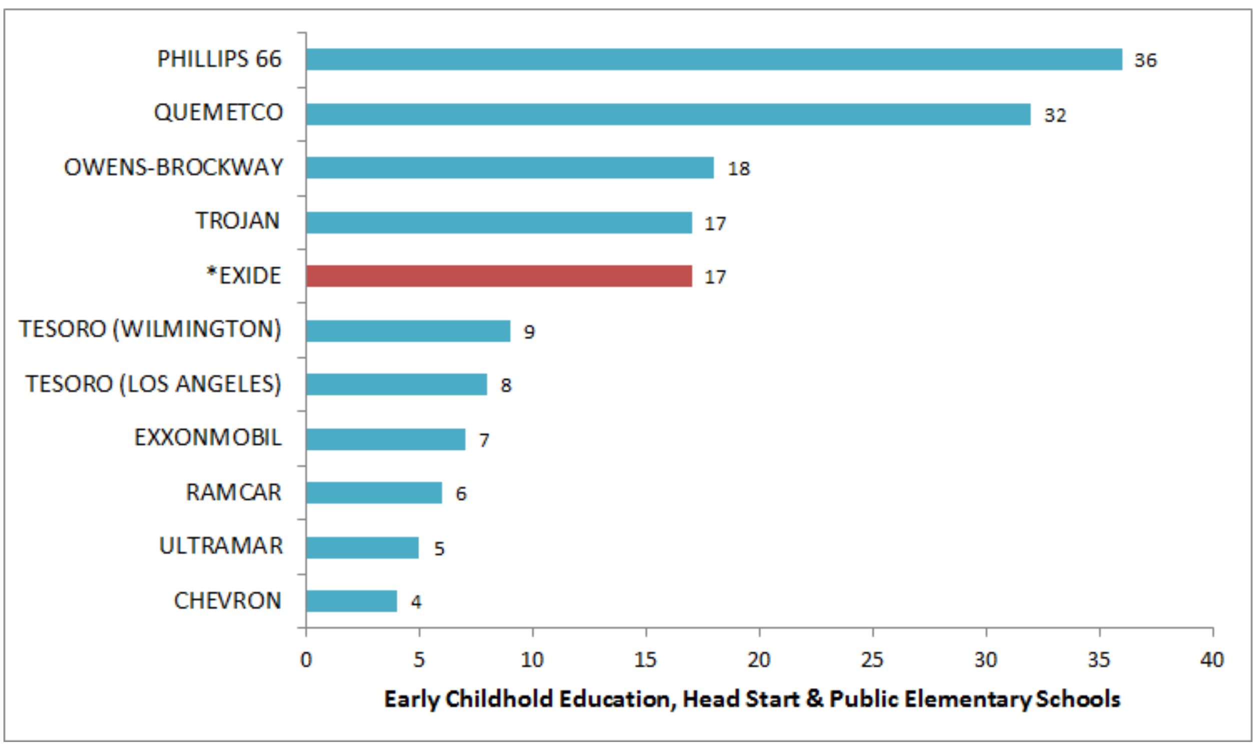


Figure 4.5.10 Early childhood education, head start, and public elementary schools within a 1.7 mile radius from highest lead-emitting lead air emitting facilities in Los Angeles County. *Exide was included for comparison purposes.

5. DISCUSSION

5.1 DTSC-Regulated Hazardous Waste in LA County

Our analysis into the overall generation of hazardous waste within LA County revealed the complexities of hazardous waste management and potential issues with various databases and the existing framework of regulatory agencies. Out of over 25,000 active generators in LA County, only a small number of facilities are responsible of generating the majority of hazardous waste. According the 2015 Environmental Report Card, average municipal waste generation, not including recycled waste, was approximately 9.6 million tons. This volume encompasses over 12% of the average municipal waste generation (not including recycled waste) in LA County during that same time period. This represents a significant volume, especially given the harmful properties of hazardous waste. Some of the largest hazardous waste generators were concentrated in Wilmington, East Los Angeles, and the City of Industry. Furthermore, large volumes were also found to be transported outside of the state, which contributes to local greenhouse gas emissions.

The most prevalent waste types by volume were waste oil / mixed oil and contaminated soil from site cleanups. Large volumes of waste oil and mixed oil are most likely the result of small amounts from multiple facilities consolidated by environmental services companies, whereas volumes of contaminated soil are likely the result of large cleanup efforts at an individual facility. The fact that environmental services companies can be listed as the generator of record for some types of hazardous wastes, although allowed by law, makes understanding sources and trends more complicated. It prevents tracing volumes back to the original generator, obscuring the record of how much waste is actually being generated by a company.

Our research was limited by accessibility and availability of data, both online and through public records requests. When data was not available online, we contacted a local DTSC office. While initially a staff member from the Regional Records Office attempted to answer our questions, we were redirected to a DTSC Environmental Scientists, who provided many details about hazardous waste processes, but was unable to obtain most of the data from our public request. For example, the DTSC Environmental Scientist was able to provide basic numbers on how many active hazardous waste generators existed in LA County, but could not provide us with anything more specific. Additionally, we requested manifests of top generators from

2010-2014, but were told that due to the complexity and length of the data, they would be unable to provide it. We finally reached out to a DTSC Project Manager at the Regional Office in Sacramento who was able to provide us manifest numbers.

The volume of manifests and the documents themselves presented issues and opportunities for data discrepancies. From 2010-2014, Exide Technologies had over 4,700 manifests. The massive number of documents can prevent officials from thoroughly examining the management of hazardous waste to determine if there is noncompliance. With the manifest numbers, we were only able to access DTSC reports on the manifests, as opposed to the actual document. DTSC manifest reports only note one waste code, whereas a facility can put up to six on a manifest, which can obscure chemicals constituents. Upon speaking to a DTSC employee, it did not seem as if there was a standardized system for how one waste code is selected to put online. The manifest reports indicated the transporter of the waste and TSD facility that the waste was transported to. Beyond that, we were unable to determine what occurred next with the waste, making it difficult to understand the ultimate disposition of the waste.

5.2 Potential Sites for Soil Lead Testing

The highest lead-emitting facilities included four refineries, three battery recyclers, one oil company, one glass manufacturer and one calciner. Exide had been extensively investigated and, recently, DTSC requested Quemetco to conduct soil testing in surrounding neighborhoods due to suspected lead contamination. Our data showed that the Exide and the Quemetco were the highest lead-containing air emitters in the Los Angeles County based on historic total emissions since 1987. Our spatial analysis also suggested that sensitive populations around both facilities were relatively high (Figure 4.5.4); more than 15,000 and 9,700 people reside near Exide and Quemetco, respectively. From the highest lead emitters, Quemetco is sited near the highest residential area (Figure 4.5.8) and is in close proximity to 32 early education schools (Figure 4.5.10).

Our analysis of historical lead contamination coupled with population characteristics suggests that other lead-emitting facilities in Los Angeles County may warrant soil testing. Potential sites for soil testing may include Tesoro Los Angeles Refinery, Trojan Battery, Ramcar, Exxonmobil, Phillips 66, Owens-Brockway, Chevron and Tesoro Wilmington Calciner. Besides Exide and Quemetco, the five facilities with the highest cumulative lead emissions over 1,000 lbs are Tesoro LA Refinery, Trojan Battery, Ramcar, Exxonmobil and Phillips 66 (Figure 4.2.3). These five facilities were targeted mainly because of such relatively high emissions; they were all located in areas where sensitive population, residential land use and/or schools are concentrated. Trojan Battery, for instance, is located close to more than 11,000 individuals that are vulnerable to lead exposure--that is, a larger sensitive population than what was found near Quemetco. Another potential facility of interest is Owens-Brockway since it resides near the largest group of sensitive population. Although Owens-Brockway's historic emission is not high as that of Exide's or Quemetco's, the fact that it located near a large group of vulnerable individuals may be of concern. This example indicates that surrounding attributes are important and play a crucial role in determining whether a site should be considered for lead soil testing. There are sensitive receptors around each facility, and each facility has its own unique set of attributes of concern. Future research is needed for more conclusive results.

As for historic total lead emissions, fugitive emissions were much higher than stack air emissions prior to 2001. (Table 4.2.2). However, post 2001, EPA published a regulation on fugitive air emissions. Since then, emissions decreased significantly (US EPA, 2001). However, the confidence of fugitive air estimation could be relatively low because it is difficult to record emission should a leak occur or if it escapes the doors and windows. Therefore, the historic total emissions could be based on a low level of confidence. The above facilities were suggested based on currently available data and were of the highest priority of soil testing. In fact, facilities that emit lead should be considered for further monitoring for potential health impacts.

5.3 Databases' Inconsistencies and Issues

5.3.1 TRI Inconsistencies

To interpret the five-year trend of lead-containing air emissions in the Los Angeles County, the sharp decrease between 2010 and 2011 corresponded to Exide's reduction in 2011. However, on the AQMD database, we found that the lead-containing air emissions from Exide reported was 555 lbs/yr (Table 4.2.4.1), which was even higher than 2010's emissions on the graph (Figure 4.2.2). We thus presumed that this decrease may actually be a discrepancy between TRI and AQMD reports. The decrease in 2014 may be attributed to the legal investigation of Exide. Furthermore, we found several typos and inconsistencies in the TRI database. For example, in the table below, the Exide Technologies is located in city Vernon, not Los Angeles; the Tesoro LA Refinery (with the same address and TRI ID) had three different records for the same chemical. These typos and inconsistencies caused significant confusion when interpreting the data.

TRI_FACILITY_ID	FACILITY_NAME	STREET_ADDRESS	CITY	COUNTY	ST	ZIP	CHEMICAL	UNIT_O	5.2_STACK_AIR
90058GNBNC2717S	EXIDE TECHNOLOGIES	2700 S INDIANA ST	LOS ANGELES	LOS ANGELES	CA	90058	LEAD COM	Pounds	185.2
90744TXCRF2101E	TESORO LOS ANGELES REFINERY	2101 E PACIFIC COAST HWY	WILMINGTON	LOS ANGELES	CA	90744	LEAD COM	Pounds	0
90744TXCRF2101E	TESORO LOS ANGELES REFINERY	2101 E PACIFIC COAST HWY	WILMINGTON	LOS ANGELES	CA	90744	LEAD COM	Pounds	25.02
90744TXCRF2101E	TESORO LOS ANGELES REFINERY	2101 E PACIFIC COAST HWY	WILMINGTON	LOS ANGELES	CA	90744	LEAD COM	Pounds	11

Figure 5.2.1. Typos and inconsistencies found in the TRI database.

5.3.2 AQMD Issues

As for the AQMD database, the issues with contacting and receiving data from AQMD were numerous. AQMD's website does not allow the user to download data. For each facility, for every year, we had to go back to the main search link and put in a new criteria for the search. It involved opening, clicking, copying and pasting information into Excel. Additionally, there were at times missing or incorrect data; for example, the address of a certain facility may be listed differently than the address in the TRI database. Also, while searching the website would randomly crash and trigger an "under maintenance" message that prevented further searches. Switching to another computer, however, would allow us to continue searching, which suggested that there wasn't actually a maintenance issue.

Contacting AQMD was no better. Almost every attempt was a failure, as our call would be redirected to another person who would redirect to another department. Once the redirections finished, our call would end with us leaving a voicemail for a worker. On several occasions, the number they would leave on a voicemail back would be a disconnected number.

5.3.2.1 AQMD Permitting Problems and Findings

The permits discussed in section 4.3.1 underscored significant issues with AQMD. The process of retrieving permits was long and arduous, often taking weeks to receive. As of June 10th, we have still not received permits regarding all 10 facilities. However, the permits did provide us channels to explore how AQMD permits are issued. Figure 5.2.2 illustrates the general AQMD inspection process. After consulting with the inspector of note on a permit, he explained that emission results are kept on record by the facilities themselves. Then, on random days, inspectors will arrive on the premise and check to ensure those documents are properly filled out. They will additionally inspect equipment and test the air emissions themselves to see if they match the data recorded by the companies.

Figure 5.3.2. AQMD Inspection Process

The inspector added that larger facilities must continually monitor lead throughout the day. These devices are also inspected. For smaller facilities, AQMD requires that they contract with an outside company to measure their air emissions. These documents are kept on record for inspectors.

Additionally, information from the permits illuminated AQMD's decision-making process. The Ramcar permit contained information on the daily amount of raw lead material that the facility was allowed to process, many of which permitted in excess of 50,000 lbs of lead a day. It was explained that all companies, when applying for permits, submit a packet with what equipment they will use and what cleaning equipment they will use to scrub the lead from the air. Based on the efficiency of the processing and scrubbing equipment, an AQMD engineer then works backwards from the lead emission standard and the efficiency of the equipment to determine the appropriate amount of poundage that the facility can process. While the permits were unable to demonstrate any distinct problems with lead, they did illuminate the process through which these facilities are controlled.

Figure 5.3.3 Overview of AQMD lead permitting.

5.3.3 ECHO Violations Information Drawbacks

From the Echo database, most of the top facilities are in violations of the CAA and RCRA; some even consistent in violations for every quarter of the year. It became suspicious to us whether these facilities have been approached by the regulatory agencies.

We researched more into the procedure for finding violations, enforcement methods, and the length of time it will take to resolve a violation. According to EPA's website there are several factors EPA and the State of California consider in determining what facilities to inspect: facility size (smaller facilities are inspected less frequently), citizen tips, statutory requirements, violation history, potential for environmental harm, demographics, industry type, and geographic initiatives (EPA, 2016). Because of their limited staff, it is not possible to inspect every regulated facility every year therefore spot-checks are performed sporadically. Also, they mainly rely on self-reporting information. This also explains why some facilities "N/A" listed for violations. It's not necessarily because the facility is in complete compliance (which is still a possibility), it could mean because of their limited staff smaller facilities may receive less inspections than larger ones — they may not be inspected every five years. Thus, this leads to EPA relying on self-reporting as a bridge between this drawback. Once a facility receives the attention of a regulatory agency, the time it is required for the facility to comply mainly depends on the severity of the violations and the size of the facility. It could take months to years for a resolution. EPA recognizes this issue and are working towards a more efficient approach. Therefore, lack of reliable information and long bureaucratic procedures pose obstacles to further examine violations for our target facilities.

6. RECOMMENDATIONS

Our investigation indicated that there is an enormous volume of hazardous waste being generated, stored, and transported in LA County, yet it is difficult to understand where the waste is going. Addressing the lack of tracking would be an essential method to understand hazardous waste and potentially finding sources of noncompliance. This could include a more comprehensive system that is subject to regularly review to ensure consistencies in data. Additionally, having a database that directly uploads information online, as opposed to paper manifests, could reduce mistakes that occur during data input. Furthermore, tracking volumes of waste through chemical constituents, such as lead or arsenic, could allow regulatory agencies to pinpoint hazardous waste that can pose large public health threats and increase accountability and consistency by allowing agencies to verify level reported through TRI.

Furthermore, we found there is little communication between DTSC and AQMD. Prior to the Exide scandal, there was virtually no communication between the agencies. However, it was only seen during the Exide scandal there was extensive communication between DTSC and AQMD. Since particulates that are released into the air that settle in the soil are still not accounted for; there is no agency explicitly responsible for regulating this. There needs to be proactive agency collaboration in order to close the regulatory gap. We strongly recommend agencies to establish a regulatory monitoring system to account for the potential hazardous waste generated by air emissions. To determine potential hazardous waste sites from lead air emissions, we have found that there is a multitude of sensitive receptors. There are facilities that emit large amounts but could not have large sensitive population or a large number of schools. Therefore, we strongly recommend further analysis to determine which facilities are in need for lead soil monitoring and testing.

As for data accessibility, we have found that gathering information regarding hazardous waste is tedious, confusing, error prone, incomplete, and ambiguous. Different data information is found on all different databases; to look up what is needed needs to be done in a very specific manner. An idealistic recommendation is to compile all data into one, easily accessible place. When information is compiled all into one place, it will be easier for comparison and data analysis. Along with that, it was found in all that the agencies had their own private database, and was much more detailed that what was found through the online public database. This information should be published online alongside the information that is already present to the public online. Additionally, the facility ID numbers are different for all facilities. Some facilities are even classified as different types under different databases. Standardizing the facility ID numbers between all databases would make for a smoother comparison process.

Overall, the amount of hazardous waste that is documented both aerially and through manifests is an astronomical amount. And with all these documented reports comes bureaucracy, some disorganization, and confusion. As a broad statement, it would be worth all agencies to become more efficient and “tidy up” how they go about reporting, inspecting and documenting what is required for hazardous waste, as well as engage in joint efforts to examine other facilities to protect the public of any possible second Exide scandals.

APPENDICES

Appendix A- Accessing Databases

Figure A1: Ten public reports found in DTSC's Hazardous Waste Tracking System

RCRAInfo Search

1. Visit the RCRAInfo Search: https://www3.epa.gov/enviro/facts/rcrainfo/search.html
2. Under "Geography Search", enter "Los Angeles" as the county
3. Under "Handler Universe", select "Other Universes" and "Large Quantity Generator" in the drop down menu
4. Click "Search"

Total Yearly Tonnage by Waste Code Report

1. Visit the HWTS Reports: http://hwts.dtsc.ca.gov/report_list.cfm
2. Click on "Total Yearly Tonnage by Waste Code Report"
3. Click on "County" and select "Los Angeles" from the drop-down menu
4. Select a year
5. Click "Find"

Total Yearly Tonnage by Entity Type Report

1. Visit the HWTS Reports: http://hwts.dtsc.ca.gov/report_list.cfm
2. Click on "Total Yearly Tonnage by Entity Type Report"

3. Click on “County” and select “Los Angeles” from the drop down menu
4. Select “Generator” from the drop-down menu
5. Select a year
6. For Total Tonnage, select “Greater than 1000”
7. Click “Find”

Selection of high-emitting facilities in Los Angeles County
TRI total lead air emissions from 2010 to 2014 in Los Angeles County

1. Vist the TRI Basic Data Files: Calendar Years 1987 - 2014: https://www.epa.gov/toxics-release-inventory-tri-program/tri-basic-data-files-calendar-years-1987-2014
2. Select a year
3. Click “CA” from the drop-down menu
4. Click “Go”
5. An excel sheet should download
6. Sort by “County” and then by “Compound”

Historic Total Lead Air Emissions for highest lead-emitting Consistent Facilities

1. Visit TRI Facility Profile Report via EPA TRI Explorer: https://iaspub.epa.gov/triexplorer/tri_release.facility
2. Select “Enter a ZIP Code” in the drop-down menu of “Geographic Location”
3. Enter the corresponding ZIP code (obtained from TRI Basic Data Files) of identified facilities in the appeared window
4. Click “Generate Report”
5. Click on the name of the facility of interest
6. It directs you to the Facility Profile Report page
7. Scroll to the bottom of the page and click on “Download all data”
8. An excel sheet should download
9. Sort by “Chemical”

Appendix B- highest generators facility lists

Table B1: Yearly tonnage between 2010-2014 and total and average tons generated during 2010-2014 for the highest generators and Exide Technology Inc.

Facility	2010	2011	2012	2013	2014	Tons Generated (2010-2014)	Average Tons Generated (2010-2014)
CLEAN HARBORS WILMINGTON LLC	42,778	46,352	53,218	59,814	102,426	304,588	60,918
QUEMETCO INC	46,823	54,366	51,267	39,583	39,688	231,727	46,345
TESORO REFINING & MARKETING COMPANY-LOS ANGELES REFINERY	9,312	5,333	5,923	6,754	177,698	205,020	41,004
VEOLIA ES TECHNICAL SOLUTIONS LLC AZUSA	30,671	34,041	57,797	34,147	35,492	192,148	38,430
SAFETY-KLEEN OF CALIFORNIA INC - CARSON	26,658	29,214	25,132	15,216	19,820	116,040	23,208
RHO-CHEM LLC	17,280	17,411	22,741	19,371	30,851	107,654	21,531
PHILLIPS 66 CO LOS ANGELES REFINERY - WILMINGTON PLANT	24,522	30,817	18,821	15,586	14,546	104,292	20,858
AGRITEC INT DBA CLEANTECH ENVIRONMENTAL INC	13,042	15,614	17,045	22,354	24,110	92,165	18,433
EVOQUA WATER TECHNOLOGIES LLC	13,296	13,438	13,486	12,258	11,430	63,908	12,782
CLEAN HARBORS LOS ANGELES LLC	13,924	11,684	11,003	10,926	14,427	61,964	12,393
EXIDE TECHNOLOGIES INC	29,648	25,802	25,523	26,404	93,538	200,915	40,183

***Provides environmental services**

Appendix C- highest lead-emitting facility lists

Facility	City	Emission (lbs/yr)					
		2010	2011	2012	2013	2014	5 Year Trend
EXIDE TECHNOLOGIES - INDIANA ST.	LOS ANGELES*	525	136	185	283	135	
TESORO WILMINGTON CALCINER	WILMINGTON	78.8	81.5	95.4	79.6	86.2	
EXXONMOBIL OIL CORP - TORRANCE REFINERY	TORRANCE	99.8	72.6	68.9	71.4	71	
OWENS-BROCKWAY GLASS CONTAINER INC PLANT 23	VERNON	48.2	60.2	59.4	61	96.8	
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	EL SEGUNDO	36.3	35.9	36	28.3	28.6	
TESORO LOS ANGELES REFINERY	WILMINGTON	25.07	24.85	25.02	27.62	28.29	
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	WILMINGTON	24.2	18.9	20.9	23.7	23.7	
TROJAN BATTERY CO LLC- Ann ST	SANTA FE SPRINGS	14.3	11.11	15.49	15.96	19.13	
ULTRAMAR INC WILMINGTON REFINERY	WILMINGTON	9.75	18.54	9.5	10.3	9.5	
RAMCAR BATTERIES INC	COMMERCE	11.6	14	13.72	10.02	0.97	
QUEMETCO INC	CITY OF INDUSTRY	11.21	9.6	11.21	11.21	4.72	

Figure B1: highest lead-emitting Facility 5 Year Trend Graphs

This figure shows the 5-year trend of stack air lead emissions of the highest 10 lead emitting facilities with Exide Technologies for comparison.

Appendix C: Comparison of the values reported to TRI and AQMD.

In order to assess the accuracy of TRI and AQMD data, we compared emission values for top emitters reported on both databases. If the TRI data was consistently lower than AQMD, or vice versa, it would call into question the efficacy of the testing measures between the two organizations, TRI being “self reported” and AQMD an official agency reported. In order to quantify these discrepancies, we calculated the percent difference between the TRI and AQMD numbers, and looked for any sort of large pattern. However, these discrepancies appeared to be isolated instances and there were no trends or consistent underreporting of TRI data compared to AQMD data.

Facility Name	AQMD emissions (lb/yr)	TRI emissions	Percent Difference
	2010		
EXIDE VERNON PLANT	607.418	525	15.7%
OWENS-BROCKWAY GLASS CONTAINER PLANT 23	48.22	48.3	-0.2%
EXXONMOBIL OIL CORP - TORRANCE REFINERY	99.44	102.1	-2.6%
TESORO WILMINGTON CALCINER	25.089	78.8	-68.2%
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	N/A	24.7	N/A
TROJAN BATTERY CO LLC- Ann ST	12.659	14.3	-11.5%
ULTRAMAR INC WILMINGTON REFINERY	9.2	9.864	-6.7%
TROJAN BATTERY CO LLC- Clark ST	6.05	?	
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	29.596	33.6	-11.9%
QUEMETCO INC	11.21	11.21	0.0%
RAMCAR BATTERIES INC	N/A	11.6	N/A
	2011		

Facility Name	AQMD	TRI	Percent Diff.
EXIDE VERNON PLANT	554.91	205.07	170%
OWENS-BROCKWAY GLASS CONTAINER PLANT 23	56.877	72.6	-21.7%
EXXONMOBIL OIL CORP - TORRANCE REFINERY	75.541	71.1	6.2%
TESORO WILMINGTON CALCINER	N/A	60.3	N/A
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	N/A	36.3	N/A
TROJAN BATTERY CO LLC- Ann ST	12.659	11.11	13.9%
ULTRAMAR INC WILMINGTON REFINERY	10.65	18.681	-43.0%
TROJAN BATTERY CO LLC- Clark ST	6.119	6.12	0.0%
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	28.524	30	-4.9%
QUEMETCO INC	9.602	9.6	0.0%
RAMCAR BATTERIES INC	N/A	14	N/A
	2012		
Facility Name	AQMD	TRI	Percent Diff.
EXIDE VERNON PLANT	254.413	254.4	0.0%
OWENS-BROCKWAY GLASS CONTAINER PLANT 23	59.361	59.48	-0.2%
EXXONMOBIL OIL CORP - TORRANCE REFINERY	69.881	68.9	1.4%
TESORO WILMINGTON CALCINER	N/A	95.4	N/A
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	20.823	31	-32.8%
TROJAN BATTERY CO LLC- Ann ST	15.474	15.49	-0.1%
ULTRAMAR INC WILMINGTON REFINERY	10.416	9.716	7.2%

TROJAN BATTERY CO LLC- Clark ST	6.055	6.12	-1.1%
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	31.67	33.1	-4.3%
QUEMETCO INC	9.817	11.21	-12.4%
RAMCAR BATTERIES INC	0.149	13.72	-98.9%
Facility Name	2013		
	AQMD	TRI	Percent Diff.
EXIDE VERNON PLANT	317.948	351.78	-9.6%
OWENS-BROCKWAY GLASS CONTAINER PLANT 23	61.017	61.08	-0.1%
EXXONMOBIL OIL CORP - TORRANCE REFINERY	73.469	71.4	2.9%
TESORO WILMINGTON CALCINER	79.368	79.6	-0.3%
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	23.688	23.9	-0.9%
TROJAN BATTERY CO LLC- Ann ST	15.707	15.96	-1.6%
ULTRAMAR INC WILMINGTON REFINERY	9.816	10.4	-5.6%
TROJAN BATTERY CO LLC- Clark ST	6.175	6.4	-3.5%
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	30.336	32.8	-7.5%
QUEMETCO INC	6.779	11.21	-39.5%
RAMCAR BATTERIES INC	0.785	10.02	-92.2%
Facility Name	2014		
	AQMD	TRI	Percent Diff.
EXIDE VERNON PLANT	211.73	204.14	3.72%
OWENS-BROCKWAY GLASS CONTAINER PLANT 23	96.784	96.87	-0.089%

EXXONMOBIL OIL CORP - TORRANCE REFINERY	70.571	71	-0.604%
TESORO WILMINGTON CALCINER	85.973	86.2	-0.263%
PHILLIPS 66 LOS ANGELES REFINERY WILMINGTON PLANT	23.744	23.9	-0.653%
TROJAN BATTERY CO LLC- Ann ST	19.125	19.13	-0.026%
ULTRAMAR INC WILMINGTON REFINERY	9.619	9.6	0.198%
TROJAN BATTERY CO LLC- Clark ST	8.486	8.49	-0.047%
CHEVRON PRODUCTS CO DIV OF CHEVRON USA INC	33.521	35	-4.226%
QUEMETCO INC	4.728	4.72	0.169%
RAMCAR BATTERIES INC	N/A	0.97	N/A

Appendix C shows the percent difference of TRI vs. AQMD reported values for the top lead emitting facilities. These results show that there was no significant difference on TRI’s self reported values compared to AQMD inspector values.

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