Oregon Department of Justice Petition

Oregon Aviation Watch, a 501(c)(3) non-profit organization whose mission is to enhance and protect the quality of life for Oregon residents by eliminating the adverse impacts of aviation activity, respectfully requests the Oregon Department of Justice to conduct an investigation of the Oregon Department of Environmental Quality (DEQ) and the Port of Portland (Port) regarding aviation lead emissions generated by the Hillsboro Airport and other airports located in Washington County.

Lead is a pernicious neurotoxin and probable carcinogen. An extensive body of literature now links elevated blood lead levels, even in very low amounts, with Attention Deficit Hyperactivity Disorder (ADHD), a disorder that can result in devastating effects on children, their families and society. Lead toxicity is also associated with conduct and antisocial disorder, an increase in violent behavior, birth defects, miscarriages and a host of other negative impacts.

The Centers for Disease Control (CDC) has warned that "No safe blood lead level in children has been identified. Even low levels of lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement. And effects of lead exposure cannot be corrected."[1]

According to the EPA, "…lead can adversely affect the nervous system, kidney function, immune system, reproductive and developmental systems and the cardiovascular system. Lead exposure also affects the oxygen carrying capacity of the blood. The lead effects most commonly encountered in current populations are neurological effects in children and cardiovascular effects (e.g., high blood pressure and heart disease) in adults. Infants and young children are especially sensitive to even low levels of lead, which may contribute to behavioral problems, learning deficits and lowered IQ."[2]

Summary

A review of Port and DEQ documents reveals major discrepancies and inconsistencies in the airborne lead concentrations estimated by these agencies. There are also indications that the amount of lead released into the air by aviation activity was underestimated. The bulleted items below summarize the reasons *Oregon Aviation Watch* is submitting this petition. Please see the individual subheadings on these topics for more detailed information and citations.

- The Environmental Protection Agency (EPA) has identified the Hillsboro Airport (HIO) as the largest facility source of lead emissions in Oregon.
- HIO ranks 21st in the nation among nearly 20,000 airports in lead emissions. According to Port of Portland (Port) estimates, HIO released 0.7 tons per year (tpy) of lead into the air in 2007 during the Landing and Take-Off (LTO) mode of flight. The Port forecasts that these emissions will increase to 0.8 tpy by 2016 and 0.9 tpy by 2021.
- HIO came into existence as a grassy airstrip in 1928. Forty years later, the Port of Portland assumed ownership, yet in the nearly half century it has operated this facility it has never measured lead in the soil or air in the vicinity of this airport.
- Neither the Port nor DEQ has ever actually measured lead air levels at HIO or any other airport in Washington County. The levels reported by these agencies are based solely on estimates.
- The evidence suggests that HIO air lead levels may be higher than current estimates reflect.
    1. There is a significant discrepancy in the time the Port factored in for the Landing and Take-Off (LTO) mode of flight. The Port estimated 10 minutes whereas the EPA factors in 16 minutes. The Port offered no explanation for why it chose a shorter LTO phase.
    2. Neither the Port nor DEQ factored in pre-flight engine run-ups in their estimates even though the EPA has described run-ups as "the most important contributor to peak air Pb [lead] concentrations" at and in the vicinity of an airport.

3. DEQ did not factor cruise phase lead emissions into their Portland Air Toxics Solutions (PATS) study model. According to the EPA, based on 2008 estimates, an additional 5.3 tons of lead was released in Oregon when aircraft were flying above 3,000 feet. In light of the significant amount of flight activity that occurs in Washington County, there is a high likelihood that much of the cruise phase lead emissions are impacting Washington County residents.

- In 2005 DEQ concluded that air concentrations of lead in the vicinity of the Hillsboro Airport exceeded the Clean Air Act's National Ambient Air Quality Standard (NAAQS). Subsequently, the Port, which owns the Hillsboro Airport, commissioned a study (CDM Study) that concluded air concentrations of lead in the vicinity of HIO did not exceed the NAAQS for lead. *Oregon Aviation Watch* (OAW) questions why DEQ estimates were discarded and replaced by the airport owner's estimates. OAW is also concerned about the exclusion of public participation and input in the CDM study as well as the lack of peer review. It is worth noting that the study does not include the names of the CDM consultants who performed and carried out the study. Moreover, no specific authors were identified in the CDM study.

- Following the Port's CDM study, DEQ withdrew its initial findings and removed lead from DEQ's PATS list of toxins. Notably the CDM Study did not include ground "run-up" lead emissions. The Port explained that the EDMS model used for the CDM Study estimates "is not enabled to calculate run-up emissions." An EPA methodology for estimating lead emissions during the run-up mode was available 7 months prior to the completion of the CDM study, yet the Port evidently chose to ignore this information.

- The 2005 DEQ PATS lead study only included 13 airports even though the EPA identified more than 65 airports listed as facility sources of lead in the 3-county study area (Multnomah, Washington and Clackamas Counties) and an additional 26 in two of the bordering jurisdictions (Columbia and Clark Counties). Data from the neighboring jurisdictions is included because the DEQ factored in airports from Columbia County (Scappoose Industrial Airpark) and Clark County (Pearson Field and Grove Field Airport) in the PATS study. Per the EPA, Scappoose and Pearson are the top facility sources of lead emissions in their respective counties. Grove Field is second largest source of lead emissions in Clark County.

- Given the deficiencies inherent in the way the Port and DEQ arrived at their lead estimates, *Oregon Aviation Watch* believes there are credible reasons to seek a third party objective analysis based on actual monitoring as opposed to agency estimates.

- The EPA is currently engaged in a study of 15-17 airports in an effort to determine the concentration of lead emissions at general aviation airports. Evidence obtained from the EPA suggests that the FAA is relocating run-up activities away from EPA monitors in an attempt to downplay the contribution of run-ups at airports. The inconsistencies in how and where monitors were placed at the various airports brings into question the validity and reliability of the study.

- *Oregon Aviation Watch* is shocked by U.S. Department of Justice, FAA and Port assertions that these agencies are under no obligation whatsoever to address HIO lead emissions unless and until emission levels reach a *de minimis* threshhold of 25 tons. The agencies point to EPA regulations to justify their rationale. Lead is known to be toxic at miniscule levels. The Centers for Disease Control has determined that there is no safe level of lead in a child's blood. These findings suggest that it is morally and ethically imperative that government agencies immediately cease their cavalier policy of relying on inhumane, inadequate and antiquated regulations in the interest of promoting aviation interests while willfully compromising the health, well-being, and livability of area residents.

- *Oregon Aviation Watch* also questions Port and DEQ support for reliance on conventional industry practices as opposed to environmental standards for measuring lead emissions. It has become

abundantly clear in recent months that DEQ's policy of tacitly accepting industry conventions on behalf of major polluters has led to frighteningly high levels of exposure to lead and other toxic pollutants throughout the Portland metropolitan region.

Because of the serious and dire nature of this situation, *Oregon Aviation Watch* is seeking an Oregon Department of Justice investigation into this matter.

Supporting Information

Background

Washington County is the second most populated county in Oregon.[3] Over the years, due to aggressive lobbying by the Port of Portland (Port) and aviation interests, it has evolved into a major hub of pilot training and recreational flight activity. The largest public use general aviation airport in the state, the Port owned and operated Hillsboro Airport (HIO), is located within this jurisdiction. This airport, situated on approximately 900 acres in the City of Hillsboro, is surrounded on three sides by residential communities and on the fourth by farmland.

As a result of the excessive use of HIO, in conjunction with the lack of environmental oversight, HIO has become the largest facility source of lead pollution in Oregon with estimated emissions of 0.7 tons per year (tpy) in 2007.[4] Out of nearly 20,000 airports nationwide, HIO ranks in the top one percent, 21st in the nation in lead emissions.[5] Federal Aviation Administration (FAA) forecasts project that HIO lead emissions will climb to 0.8 tpy in 2016 and 0.9 tpy by 2021[6], however, the construction of a third runway at this airport has nearly doubled HIO's capacity, thus lead and other toxic emissions may increase well beyond the Port estimates.

Alarmingly, an Environmental Impact Statement (EIS) at HIO has never been performed, even though over the course of its 86 year history HIO has expanded from a grassy airstrip located on 100 acres to a 900 acre airport with three runways. A review of Environmental Protection Agency (EPA), Port and FAA documentation reveals that during this same time frame HIO has become one of the biggest facility sources of a host of air toxins, including lead, throughout the region.[7]

General Aviation Activity - Primary Source of Airborne Lead Emissions

The EPA National Emissions Inventory (NEI) database tracks various toxic pollutants throughout the U.S. A search of the 2011 NEI table on lead emissions in Oregon yielded 512 sources, over 80% of which (417) were airports.[8] HIO, which primarily serves student pilots and recreational enthusiasts, was listed as the largest facility source of lead emissions statewide. Many of the pilots who frequent this airport fly piston-engine airplanes and helicopters that still rely on leaded aviation fuel (avgas).

Due to serious health risks associated with lead, this highly toxic substance was phased out of automotive fuel between 1973 and 1996 and banned as a paint additive by 1978. Notwithstanding the known dangers associated with this heavy metal, the general aviation industry persists in using leaded fuel. Per EPA estimates, of the 950 tons released nationwide in 2008, more than half were from piston-engine aircraft.[9] By contrast, commercial aircraft use unleaded jet fuel. For this reason general aviation airports often, but not always, release far more lead into the environment than commercial passenger airports.

As a result, residents, including children and pregnant women, living within the vicinity of Oregon's more than 450 general aviation airports are likely breathing air containing lead especially in light of the EPA finding that, “Lead concentrations in air increase with proximity to airports where piston-engine aircraft operate.”[10] Reliable studies revealed that children living in close proximity to an airport had higher blood lead levels. After completing a study of airports in six North Carolina Counties, the Duke University researchers concluded that,

> …living within 1000 m [2/3 mile] of an airport where aviation gasoline is used may have a significant effect on blood lead levels in children. Our results further suggest that the impacts of aviation gasoline are highest among those children living closest to the airport.[11]

Lead Emissions During the Landing and Take-off Cycle (LTO)

The EPA determines lead emissions for individual airports by estimating the time that aircraft spend in various modes during the landing and take-off (LTO) cycle. This phase of flight includes taxi/idle-out, takeoff, climb-out, approach and taxi/idle-in but not the cruise phase. Consideration is also given to whether the aircraft has one or two engines, the concentration of lead in the fuel, and the retention of lead in the engine and oil.[12]

According to the 2011 EPA NEI database, HIO emitted 0.58 tons per year (tpy), which translates into 1160 lbs.[13] However, Port of Portland and Federal Aviation Administration documentation suggests that this is a low estimate. In their Environmental Assessment on the proposed third runway at HIO, the Port estimated emission levels of 0.7 tpy in 2007 based on "10.0 total minutes of aircraft taxi/idle time..."[14] Port documentation on this topic provided no explanation as to why other LTO modes such as take-off, climb-out, and approach were not considered. Nor did the agency differentiate between taxi-idle-in and taxi-idle out. By contrast, the EPA factors in 16 minutes for the LTO cycle.[15] These significant discrepancies suggest that the Port may have underestimated actual emission levels by shaving 6 minutes off the LTO cycle.

Per the EPA:

> Local scale impacts of piston engine aircraft emissions on air quality are expected to be greatest in areas immediately downwind of the airport from aircraft takeoff and run-up check locations…Runways are oriented so that aircraft have the maximum opportunity to be aligned with the prevailing wind.[16]

At the Hillsboro Airport prevailing winds blow from the south from October through April. During the highest volume airport usage months, May through September, they blow from the northwest.[17]

Based on prevailing winds, the areas downwind of HIO to the southeast and north of the airport would be most likely impacted by the lead emissions, yet there is no actual air monitoring or blood lead level testing in place to address this situation.

Though DEQ set up a temporary monitor at the Hillsboro Hare Field in 2013-2014, its placement about a mile west of the airport was not aligned with the prevailing winds. As such it was not positioned to capture LTO lead emissions from HIO. As explained by DEQ,

> DEQ is not siting the monitor specifically to sample lead and the sampling methodology will use instruments that capture fine particles that are 10 microns or smaller, rather than the large particle methodology EPA is using to analyze lead near airport runways.[18]

Neither the Port nor DEQ Factored Run-Ups into Their Emission Estimates

Detailed data obtained from modeling and monitoring lead emissions at and in the vicinity of the Santa Monica Airport, a general aviation facility that typically logs half as many operations as HIO, was published by the EPA in February of 2010, 7 months prior to the release of the Port's CDM HIO lead study. This document set forth a methodology for monitoring lead emissions during the run-up mode.

> Because EDMS does not include run-up mode, the average fuel consumed was estimated based on fuel consumption data derived from engine operation manuals…[19]

Also included in the report was a comment from the director of a flight school,

> Dr. Richard Pat Anderson, the Director of the Flight Research Center at Embry-Riddle Aeronautical University in Daytona, Florida who reported that their experienced pilots conduct run-up checks for a total of 1 minute and their pilots in training for 2 minutes…[20]

The study concluded that during both the summer and winter months, ground run-up pre-flight engine checks were "the most important contributor to peak air Pb [lead] concentrations."[21] An EPA memo dated November 2010 also emphasized the high level of lead emissions associated with run-up operations,

> The location of the predicted maximum lead concentration(s) at airports is downwind of the area(s) where pilots conduct the preflight run-up checks and take-off. [22]

However, despite the availability of this information, the Port CDM lead study failed to include run-up emissions. *Oregon Aviation Watch* raised this concern in testimony submitted on the proposal to construct a third runway at HIO. In response the Port stated,

> The commentator is correct that the emissions modeling did not specifically include aircraft engine run-ups. The FAA requires the use of EDMS to evaluate aircraft/airport emissions, and this model is not enabled to calculate run-up emissions. Research is currently underway to develop ways to capture engine run-ups in emission models; however, an industry-accepted standard approach to such modeling has not yet been adopted.[23]

It is worth noting that the EPA was well aware of the shortcomings of the FAA modeling system for estimating lead emissions,

> EDMS has a limited number of piston engine aircraft in its aircraft data and is currently not set up to calculate metal emissions and thus, it is not a readily available tool for determining airport lead emissions related to aircraft operations.[24]

This suggests that though the FAA has known for decades that lead was banned from automotive fuel due to its high level of toxicity and potential to cause irreversible health impacts, the FAA has not yet developed a modeling system to calculate what the EPA has identified as "the most important contributor to peak air Pb [lead] concentrations." In the absence of an effective modeling system, the Port, FAA, and DEQ had the option of actually measuring lead emissions but chose not to. As a result the estimated lead emissions, not only at HIO, but at all Oregon airports, are almost certainly underreported.

As far as the "industry-accepted standard approach" for estimating lead and other toxic emissions, the failure to prepare an Environmental Impact Statement (EIS) at HIO despite the fact that this facility has been polluting the air with lead and a host of other toxins for more than eight decades provides ample evidence that the industry standard is far more focused on accruing profits by minimizing and marginalizing valid public health concerns. In addition, the Flint, Michigan lead contaminated water tragedy has made it abundantly clear that industry and government standards are shamefully negligent in addressing serious environmental and public health issues.

In the final analysis, even though the EPA had developed a detailed methodology for measuring the run-up mode of flight, the Port and FAA chose to ignore it. In addition, DEQ colluded by accepting the Port's flawed HIO lead study without fully analyzing it.

Significance of Run-ups in the EPA Airport Lead Study

It is also worth noting that the FAA has engaged in a strategy that may contribute to inaccurate readings on the concentration of lead emissions caused by run-up procedures. This came to light in an October 2013 interagency EPA email entitled *Update for Chris Grundler on Aviation Lead Activities* obtained through a public records request. Grundler is the Director of the Office of Transportation and Air Quality (OTAQ) for the EPA.[25]

The EPA study related to lead emissions at 17 U.S. airports found that two of the airports – San Carlos and McClellan – were found to have lead emissions in excess of EPA Clean Air Act standards. The manager of the San Carlos airport argued that the reason for the higher lead levels at San Carlos was that "the monitors were placed where the planes rev their engines to test them right before takeoff. She said she called other airports involved in the study and was told those monitors were placed farther away from where the planes perform their 'run-up.'"[26] The lack of consistency in how monitors were placed at the various airports raises important questions about the validity of the study. In any case, the update mentioned earlier reads as follows:

> The two monitors that exceeded the Pb NAAQS (at the San Carlos Airport in San Mateo County and the McClellan Palomar Airport in San Diego County) are being relocated from the maximum impact/ambient air location by the local air agencies due to logistical issues.
>
> - The monitor at San Carlos Airport will be relocated to a site 160m from the maximum impact/ambient air area.
> - The monitor at the McClellan Palomar Airport will be relocated to a site 275m from the maximum impact/ambient air area.[27]

This maneuvering triggers suspicions that the federal government may be intentionally downplaying actual lead level readings and impacts at the airports included in the study. Thus the chances of obtaining accurate lead emission readings at any of these airports are now in question.

Neither Port or DEQ Factored in Cruise Phase Emissions

The landing and take-off cycle does not include lead emissions released during the cruise phase. In the words of the EPA,

> For inventory purposes, lead emitted outside the LTO [landing and take-off] cycle occurs during aircraft cruise mode and portions of the climb-out and approach modes above the mixing height (typically 3,000 ft.). This part of an aircraft operation emits lead at various altitudes as well as close to and away from airports.[28]

In the case of HIO, nearly 2/3 of the 212,543 operations in 2011 were local touch and go training maneuvers[29] and as such remained under 2,000 feet, well below the mixing height.

Per EPA estimates based on 2008 operational counts, an additional 5.3 tons of lead were released over Oregon during the cruise phase[30] which occurs when aircraft fly above 2,000 feet. Due to the location of multiple airports within close proximity to HIO, in conjunction with the intensive flight training activity throughout the area, there is a high likelihood that much of this additional tonnage was, and is continuing to be, released over Washington County homes, neighborhoods, schools, day care centers, assisted living facilities, recreational areas, water sources, and prime farmland.

The EPA NEI identified a number of other airports in Washington County as sources of lead emissions including Stark's Twin Oaks, Skyport, North Plains Gliderport, Sunset Airpark, Olinger Residential Airpark, and a number of smaller facilities.[31] All of the above named airports are located within less than eight miles of the Hillsboro Airport, which further concentrates the pollution burden on Washington County residents. In addition, flights from airports in neighboring jurisdictions such as Scappoose in Columbia County and McMinnville in Yamhill County also train and engage in recreational flying over the area.

Impacts of Lead on Human Health and the Ecosystem

Lead is a pernicious neurotoxin and probable carcinogen. An extensive body of literature now links elevated blood lead levels, even in very low amounts, with Attention Deficit Hyperactivity Disorder (ADHD), a disorder that can result in devastating effects on children, their families and society. The symptoms of ADHD include extreme hyperactivity, impulsivity, inattentiveness and distractibility. ADHD often co-occurs with conduct and oppositional defiant disorders.

Blood lead levels less than 1 mcg/dL, well below the 5 mcg/dL reference value established by the CDC in 2012, contribute to the development of this disorder. As stated by Dr. Joel Nigg et al,

> …ADHD, both as a diagnosis and as a symptom dimension, is associated with blood lead levels at low exposure, levels, even below 2.5mcg/dL."[32]

> "Blood lead levels from 1 to 10 µg/dL are associated with lower child intelligence quotient (IQ), weaker executive cognitive abilities, behavior symptoms of ADHD and diagnosis of ADHD in community surveys.[33]

More recently, a 1/17/16 Oregon Health Sciences University (OHSU) release verified that researchers have found a higher incidence of ADHD in some children exposed to very small amounts of lead in amounts much lower than the current CDC reference value of 5 micrograms per deciliter of blood

> Scientists at OHSU Doernbecher Children's Hospital have defined the first causal link between blood lead exposure and attention deficit hyperactivity disorder in humans. While previous studies have associated lead blood levels with ADHD, research published in Psychological Science is the first to confirm previous hypotheses that exposure to lead in miniscule amounts typical in the U.S., or less than 10 parts per billion, increases symptoms in some individuals with ADHD.[34]

The Centers for Disease Control (CDC) has warned that "No safe blood lead level in children has been identified. Even low levels of lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement. And effects of lead exposure cannot be corrected."[35]

As explained by the EPA,

> Once taken into the body, lead distributes throughout the body in the blood and is accumulated in the bones. Depending on the level of exposure, lead can adversely affect the nervous system, kidney function, immune system, reproductive and developmental systems and the cardiovascular system. Lead exposure also affects the oxygen carrying capacity of the blood. The lead effects most commonly encountered in current populations are neurological effects in children and cardiovascular effects (e.g., high blood pressure and heart disease) in adults. Infants and young children are especially sensitive to even low levels of lead, which may contribute to behavioral problems, learning deficits and lowered IQ.[36]

In Hillsboro, more than 26 percent of the population are persons under the age of 18, and 8.4 percent are under 5 years old.[37]

The EPA also warns about the deleterious effect of lead on ecosystems:

> Lead is persistent in the environment and can be added to soils and sediments through deposition from sources of lead air pollution…Elevated lead in the environment can result in decreased growth and reproductive rates in plants and animals, and neurological effects in vertebrates. [38]

As explained by the Agency for Toxic Substances and Disease Registry (ATSDR), "Once lead falls onto the soil, it sticks strongly to soil particles and remains in the upper layer of soil…Lead may remain in soil particles or sediment in water for many years."[39]

Aviation emissions contribute to the toxic build-up in air, soil and water. According to the EPA, "Lead emissions, especially those at altitude, undergo dispersion and eventually deposit to surfaces, and lead deposited to soil and water can remain available for uptake by plants, animals and humans for long periods of time."[40]

DEQ PATS Study Related to Airport Lead Emissions

In 2005, the Oregon Department of Environmental Quality (DEQ) "…created the Portland Air Toxics Solutions (PATS) project to work with local communities to develop air toxics reduction strategies for the Portland region, including portions of Multnomah, Washington and Clackamas Counties."[41] The PATS project estimated air concentrations of a number of toxics, including lead. Maps were created which depicted areas where toxins were estimated to exceed safe levels. Of concern is that DEQ only considered a small number of the multiple lead sources located within the study area.

In their review of air toxics released by airports, in addition to the three jurisdictions noted above, the agency included an airport in Columbia County and two in Clark County. For the purposes of the PATS study only 13 airports were considered. Three were located in Washington County – HIO, Stark's Twin Oaks, and Skyport – all of which primarily facilitate pilot training and recreational flights. It is worth mentioning that the property upon which Skyport is located is zoned for exclusive farm use (EFU). Since public airports are not permitted in EFU zones it remains unclear as to why the state and county are allowing this facility to function in this capacity.

Of the remaining 10 airports, three were located in Multnomah County, one in Columbia County, four in Clackamas County, and two in Clark County.

These 13 airports represent a small fraction of the airports located in the study area. By comparison, the 2011 EPA NEI provides a much more extensive list of facility sources of lead and other pollutants. Per the EPA, in the 5 county area discussed below there are 119 lead sources, 94 of them airports.[42]

- Washington County - 22 facility sources of lead. All but one are airports, yet the PATS study only factored in 3 airports in this jurisdiction – Hillsboro, Stark's Twin Oaks and Skyport.

- Multnomah County - 33 facility sources of lead, 15 are airports. Only 3 airports in this jurisdiction were considered in the PATS model – Troutdale, PDX, and the Portland Downtown Heliport. The Port owned PDX and Troutdale airports rank number one and number three, respectively, in the 2011 EPA NEI database as facility sources of lead emissions in Multnomah County.

- Clackamas County - 31 facility sources of lead. All but 2 are airports. Mulino Airport and Sandy River Airport, which are the top two facility sources of lead emissions in Clackamas County along with Country Squire and Valley View Airport.

- Columbia County - 9 facility sources of lead, 5 are airports. Scappoose Airpark was the only Columbia County airport considered in the PATS study. It is the number one facility source of lead in this jurisdiction; Vernonia Airport ranks second.

- Clark County – 24 lead sources, all but 3 are airports with Pearson Field holding the top spot. Only Pearson and Grove Field Airport emissions were considered for the PATS lead study.

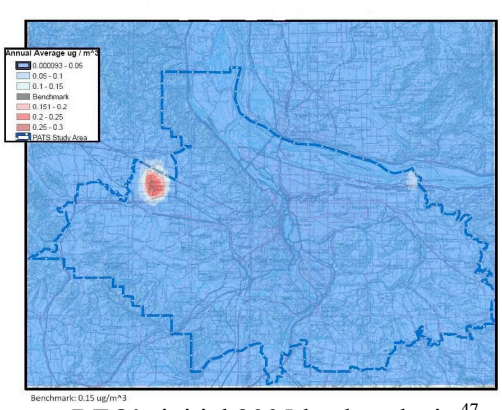
DEQ documentation regarding the 2010 PATS projections for 2017 revealed that, for the purposes of the study, the Port of Portland provided air toxic release estimates associated with PDX, HIO, Troutdale and Mulino. All other airport emissions were estimated by DEQ.[43]

DEQ Finding that Lead Concentrations at HIO Exceeded NAAQS

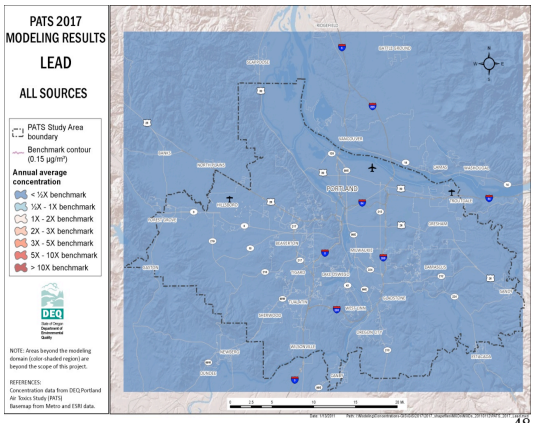
When the 2005 PATS map for lead was released,[44] DEQ initially concluded that lead concentrations in the vicinity of HIO exceeded the Clean Air Act's National Ambient Air Quality Standards (NAAQS).[45]

The maps below were released to *Oregon Aviation Watch* by DEQ in response to a 2011 public records request. The map on the left illustrates DEQ's initial 2005 PATS findings which shows significant lead exceedances in the vicinity of HIO. The map on the right is a DEQ map issued after the Port of Portland, the owner and operator of the airport, commissioned a study which refuted DEQ's initial findings.

In response to the Port sponsored study, DEQ withdrew its initial findings, aligned with the polluter and issued a second map asserting that the lead exceedances in the vicinity of the airport had disappeared. Based on the Port's study, lead was subsequently removed from the DEQ PATS list of air toxins that exceeded benchmark standards. As a result lead is no longer included as an air toxic of concern in the PATS study maps released by DEQ in January of 2011.[46]



DEQ's initial 2005 lead analysis.[47]

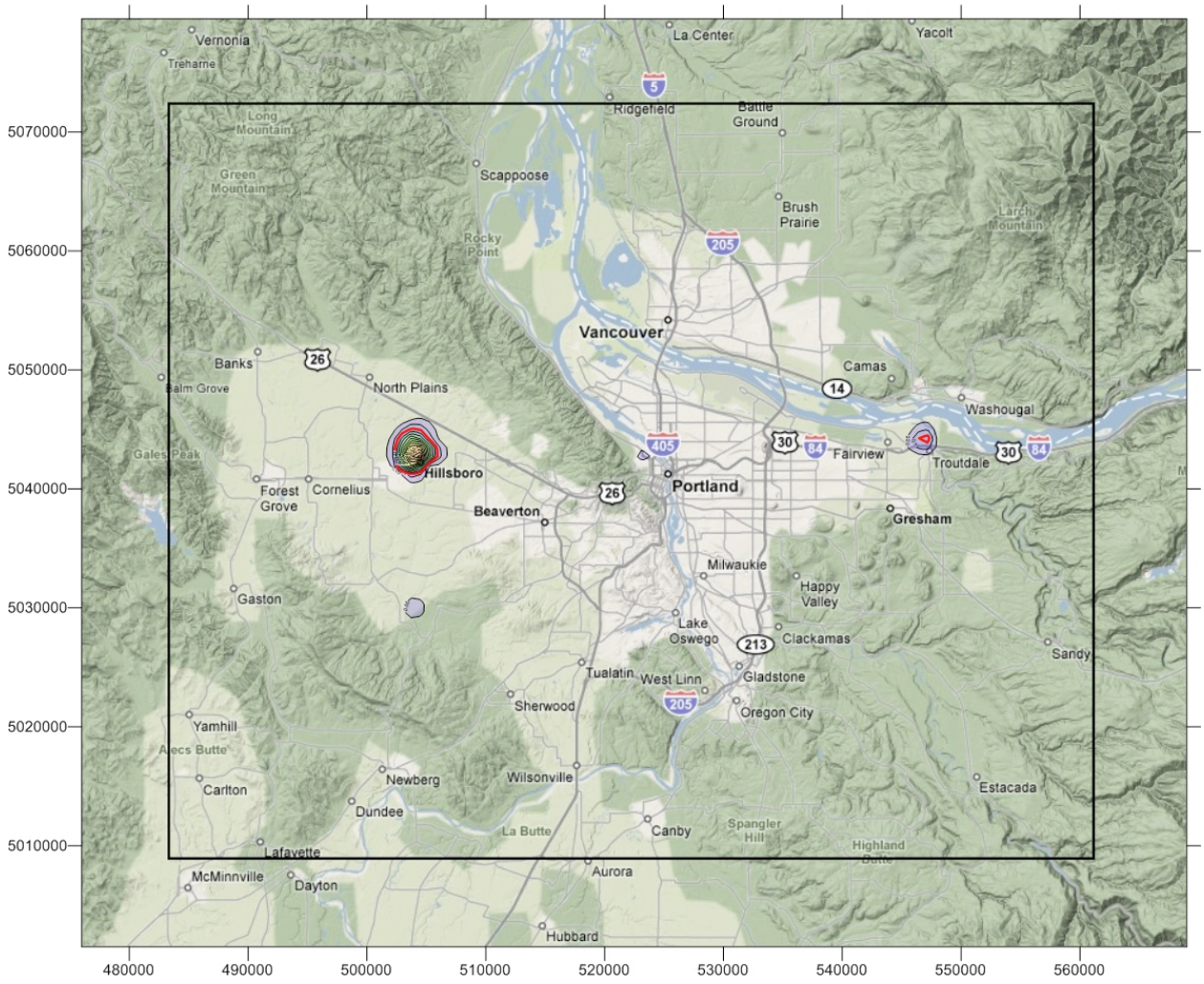


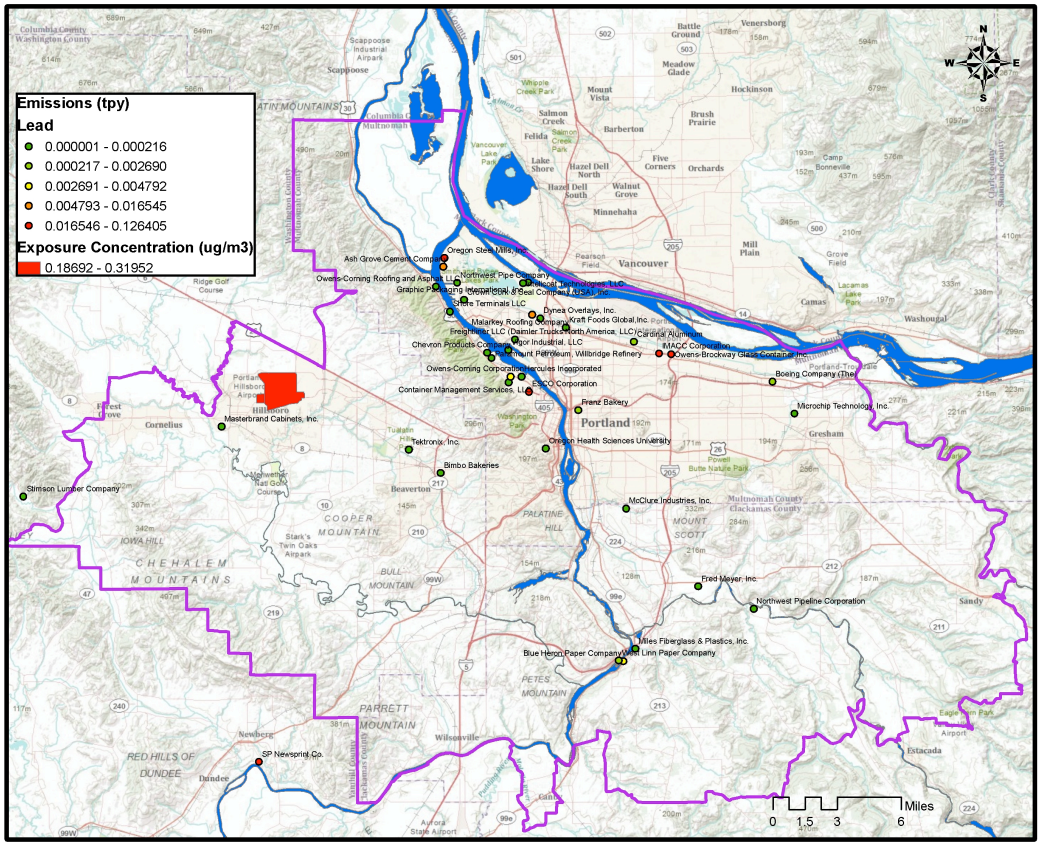
Hillsboro Airport owner's 2010 analysis[48]

DEQ admitted that the agency did not conduct "an analysis to compare the study to its Portland Air Toxics Solutions model."[49] Neither the Port nor DEQ engaged in any actual monitoring. Instead, both agencies relied on assumptions and computer modeling. In addition, neither the Port nor DEQ modeled or measured pre-fight ground run-up lead emissions, which the EPA has identified as "the most important contributor to peak air Pb [lead] concentrations."[50] In essence, DEQ allowed the owner of the largest facility source of airborne lead pollution in the entire state to write its own ticket.

Below are two additional maps released to *Oregon Aviation Watch* by DEQ in response to a 2011 pubic records request. Both pertain to the 2005 PATS lead analysis which revealed high lead concentrations in excess of Clean Air Act standards in the vicinity of HIO.

All Sources PATS Annual average: Lead (ug/m3)





Port-Commissioned CDM Hillsboro Airport Lead Study

The cozy relationship between DEQ and the Port of Portland (a quasi-government agency with both municipality and corporate status but no elected representation) serves as a prime example of how DEQ acquiesces to industry at the expense of peoples' health. The Port had a vested business and economic interest in denying DEQ's findings. Towards this end it hired a private consulting firm, CDM, to perform a study, the results of which contradicted DEQ's own study. The Port imposes a flowage fee on every gallon of fuel sold at HIO thus profits from the sale of toxic fuels. It also receives money from the various airport businesses that dispense and utilize leaded fuel. Despite this glaring conflict of interest, DEQ allowed the agency responsible for these high lead readings to perform its own study. The very nature of this arrangement negated any possibility of an unbiased, third party objective analysis.

The CDM lead study,[51] which was released in September 2010, was performed without peer review or public input. Neither the Port nor DEQ engaged in any actual monitoring. Instead, both agencies relied on assumptions, estimates and computer modeling. Neither the Port nor DEQ modeled or measured ground run-up pre-flight engine checks, a procedure that the EPA has identified as "the most important contributor to peak air Pb [lead] concentrations."[52] Though DEQ is responsible for aircraft emissions that occur on the ground, it does not appear that this agency modeled or monitored ground run-up activity at HIO or any other Oregon airport.

According to the DEQ:

> The CDM POP [Port of Portland] Hillsboro Airport Lead Study (DEQ ref. 711) shows a lead estimate of 0.632 tpy for Hillsboro Airport, allowing for an additional runway constructed by

> 2017. The DEQ lead projection for Hillsboro Airport, made with the Metro Growth Factor and not allowing for an additional runway, is 0.782 tpy. The CDM projection is 20% less than the DEQ estimate, however DEQ staff believe the CDM estimate is more accurate, so 0.632 is used here. [53]

The key phrase in the above quote is "DEQ staff *believe…*" which indicates that DEQ has replaced scientific rigor, study and actual monitoring with a set of beliefs promulgated by the Port of Portland. Despite the glaring 20% lead estimate discrepancy between DEQ and Port findings, no effort was made to actually monitor emission levels. Instead DEQ simply capitulated to the study performed by a private consultant hired by the Port. It is also worth noting that the Port's own 2014 supplemental environmental assessment on the impact of adding a third runway at HIO forecast that lead emissions would increase from 0.7 tpy to 0.8 tpy by 2016 and 0.9 tpy by 2021.

In addition to the failure to factor in lead emissions from run-ups, there were also significant discrepancies between EPA guidelines and the Port's approach to estimating lead emissions. According to the EPA,

> For inventory purposes, lead emitted outside the LTO [landing and take-off] cycle occurs during aircraft cruise mode and portions of the climb-out and approach modes above the mixing height (typically 3,000 ft.). This part of an aircraft operation emits lead at various altitudes as well as close to and away from airports.[54]

However, the Port commissioned CDM lead study modeled dispersion at altitudes lower than 3,000 ft. such as 100, 300 and 500 meters, and did not consider emissions in aircraft above 619 meters, (approximately 2,012 feet of altitude). Thus it is likely that if all landing and take-off emissions below 3,000 feet were included in the Port estimate, lead emissions at HIO would likely be higher than current Port estimates.

Environmental Crisis

The greater Portland region is currently in the throes of an environmental crisis. In recent months an embarrassed DEQ has set up a number of continuous monitoring sites in the vicinity of Bullseye Glass. The alarming results led Governor Brown to take immediate action. Per a 5/19/16 *Oregonian* article,

> "Oregon Gov. Kate Brown has directed the state Department of Environmental Quality to issue a cease and desist order against Southeast Portland's Bullseye Glass. The agency issued the order Thursday. It comes after monitoring at a nearby daycare showed lead levels four times higher than the 24-hour benchmark. Bullseye was told to halt the use of lead, arsenic, beryllium, cadmium, all chromium compounds, cobalt, manganese, nickel, and selenium in any uncontrolled furnace for the next 10 days."[55]

In addition to the lead emissions released into the air by glass manufacturers, it has recently come to light that elevated drinking water lead levels have been detected in public schools in Portland[56] and Beaverton.[57] Actions taken to address this grave situation stand in stark contrast to the treatment received by Washington County residents who are routinely exposed to a host of toxins, including lead, spewed by HIO and surrounding airports.

USDOJ, FAA, and Port Dismissive of HIO Lead Emissions

Even though it is well known that HIO is the largest facility source of lead pollution in the entire state, close to a ton per year, not a single government agency has ever engaged in a site specific program to monitor air quality around HIO for lead and other toxic emissions. In this regard, it appears that the Governor appointed, Senate approved Port of Portland Board of Commissioners receives a special waiver allowing them to poison the environment, erode livability and compromise the health of area residents.

Due to concerns about already high levels of lead emissions and other pollutants as well as noise, *Oregon Aviation Watch* appealed a Port/FAA decision to construct a third runway at the Hillsboro Airport, an expansion that has the potential to nearly double operations at this facility. Arguments presented in the legal documents submitted by the FAA, U.S. Department of Justice (USDOJ), and the Port of Portland reveal the degree to which federal and state agencies collude with major polluters such as HIO.

An 11/4/14 brief signed by Maggie Smith from the U.S. Department of Justice Environment and Natural Resources Division, argues that according to OAR 340-218-0020 sources of lead pollution in Oregon are only required to obtain an Air Contaminant Discharge Permit "if their lead emissions exceed 10 tons/year."[58]

Smith also maintains that, "The EPA has set a *de minimis level for lead at 25 tons/year,*" and asserts that the 0.1 ton per year increase forecast for HIO "comes nowhere close to this threshold." To further justify the USDOJ and FAA's position Smith states, "The EPA is the federal agency tasked with protecting air quality and establishing NAAQS [National Air Quality Standards]." She then proceeds to defer to the EPA's expertise on this matter.[59] Sadly the USDOJ and FAA lightly brush aside HIO lead emissions without any serious consideration of the potential effects on children:

> …the FAA fully considered the potential impacts of lead on children and reasonably concluded that any impact from the project would be well below the threshold for significance…the record demonstrates that these issues are well understood and have been thoroughly considered by the EPA whose guidance the FAA has followed…[60]

Needless to say, *Oregon Aviation Watch* (OAW) vigorously disagrees with the above sited agency arguments. As noted by OAW attorney, Sean Malone,

> Respondents [U.S. Department of Justice, FAA, and Port of Portland] concede that the project could emit 200 pounds of lead in addition to the 1600 pounds emitted annually by 2016…Contrary to the Port's argument…200 pounds of lead is 'meaningful' and 'measurable,' and, under no circumstances, could 200 pounds of a neurotoxin measured in millionths of a gram be considered *de minimis*, especially in light of the negative and disproportionate effects on children.[61]

USDOJ, FAA and Port Rationalize Their Failure to Consider Full Impact of HIO Lead Emissions

The USDOJ and FAA briefs also disavowed agency responsibility for evaluating the full impact of HIO lead emissions:

> …the Petitioners unreasonably conflate the impact of the project with the impact of the operation of Hillsboro Airport as a whole…the FAA was only required to evaluate the potential impact of construction of the runway, not operation of the entire airport.

In this way, the agencies sidestep all responsibility for monitoring the impact of releasing a ton of lead into the air each year. Their spurious arguments serve as a prime example of how government agencies systematically maneuver to justify and rationalize their indifference to the environment and the greater good.

Port of Portland Refuses to Provide Baseline Analysis of Lead

Lead is a toxin that is known to accumulate in the soil. Yet in response to concerns raised by *Oregon Aviation Watch* stressing the importance of obtaining baseline levels for lead dispersion and deposition, the Stoel Rives attorneys Beth Ginsberg and Jason Morgan, hired to represent the Port of Portland, claim,

"…there is no obligation to conduct a baseline analysis to satisfy NEPA [National Environmental Protection Act]…More specifically, there is no statutory or regulatory requirement to establish a 'baseline'

as part of an EA" and further argue that the construction of the runway 'has virtually no effect on the environment'"[62] The Port's attorneys also contend that there is no evidence

> …that 200 pounds of lead emitted into the atmosphere over the course of a year (and over a large geographic area) would have any meaningful (or even measurable) impact on lead levels in the soil. As the FAA explained, EPA set a *de minimis* emission level at 25 tons per year, below which 'no further analysis would be required.' The 200 pounds identified by Barnes is only 0.4% of EPA's *de minimis* threshold.[63]

In the end the Port wrote off these lead emissions as "virtually insignificant." Like their counterparts at the FAA and U.S.DOJ they pointedly ignored the 0.7 to 0.8 tpy already emitted by HIO on an annual basis. Apparently the Port believes that though HIO has pumped multiple tons of lead into the environment over the past 86 years and fully intends to continue releasing upwards of a ton per year for the foreseeable future; this has no significant impact on the environment.

In response to the Port's argument, *Oregon Aviation Watch* attorney, Sean Malone, pointed out that:

> Despite general aviation aircraft emitting lead for over 8 decades at HIO and above the City of Hillsboro, the FAA has never disclosed the environmental effects from aircraft operations. For that reason, disclosing the baseline for lead is essential to determining the total impact of indirect effects of lead dispersion and deposition in and around HIO and the City of Hillsboro, and this Court has required that agencies adequately disclose the baseline…[64]

Port of Portland Denies Lead Emission Impacts on Surrounding Community

Per a recently released Washington County Public Health Department report,

> In Washington County, population lead poisoning statistics are not comprehensive and many at risk children are not being tested. Of the 45,000 children under the age of six in Washington County, approximately 3% (on average 1260 children) are tested for elevated blood lead levels per year.[65]

This same report states that "Environmental sampling data (air, soil, and water) for the Hillsboro Airport is limited"[66] and went on to suggest that "More data on the presence (or absence) of lead contamination in the soils in and around the Hillsboro Airport would allow for a more comprehensive exposure assessment."[67]

Rather than taking a cautious and conscientious approach in the interest of protecting the environment and public health, the Port opted to exploit this absence of data. Per their brief,

> …there is no industry accepted information to indicate that residents in the vicinity of Hillsboro Airport have been exposed to concentrations of lead from the aircraft that would cause 'the kinds of health impacts indentified by Barnes.[68]

Given that no mandated blood lead level testing has ever been done in the vicinity of HIO, nor has a Health Impact Assessment ever been performed and in the absence of any actual site specific lead monitoring at HIO, these statements are baseless. Given the seriousness of the situation, the pervasive failure to engage in health assessments to measure lead emission impacts is indicative of the profound negligence exercised by elected officials as well as local, state and federal agencies. Would the Port's attorneys suggest that lead polluting industries such as Bullseye Glass, flight training companies and the Port of Portland set the standard? This is laughable. What is desperately needed is a non-biased, objective third party analysis of the situation. Ideally this would have been performed by DEQ, but in accord with their well established reputation for aligning with industry polluters this has never been done.

The Port's attorneys also claim that actual measurements for lead

> …are not required by FAA's NEPA regulations and neither the EPA nor ODEQ has yet to require lead monitoring at the Hillsboro because the nature of HIO (including total emissions, meteorology, and proximity to sources) does not create a significant potential for NAAQS violations.[69]

It is certainly curious in this regard that a small facility like Bullseye Glass, whose emission levels are not even included in the 2011 EPA NEI, has been found to contribute to elevated lead levels at a neighboring daycare center in Portland and as such has prompted the DEQ to place air monitors in the nearby vicinity and prohibit the use of lead in an uncontrolled furnace.[70] Yet the Port, FAA and USDOJ insist that HIO, the largest facility source of lead in the entire state, has no significant impact. The fact that no government agency ever cared enough to monitor lead emissions or mandate blood lead level testing does not mean there are none.

City of Hillsboro Collusion with Port

It is worth noting at this juncture that in January of 2010, the City of Hillsboro passed an airport zoning ordinance, which, if implemented, would have further elevated aviation interests over and above everyone else. One condition of the zoning was to require developing property owners within more than a mile of HIO to sign an "avigation easement" forcing them to forfeit their rights to defend themselves from the negative impacts of aviation activity.

The zoning included a provision which gave the City on behalf of the Port "the right to subject the property to noise, vibrations, fumes, dust, and fuel particle emissions associated with normal aircraft activity." In other words, the ordinance was designed to allow the Port and the City to be held harmless for emissions of lead and other toxins onto the properties of neighboring landowners and area residents. Thankfully, the Oregon Land Use Board of Appeals (LUBA) found the zoning to be unconstitutional and issued a complete reversal.[71]

Conclusion

The arguments put forth by the agencies are both disturbing and frightening. To blithely ignore the impact of dumping lead on a community in the absence of monitoring or safeguards certainly sheds light on how children were so wantonly poisoned via government-sponsored policies in Flint, Michigan. The HIO situation indicates that negligent policies of a similar magnitude run rampant throughout every level of government.

In the present situation, there appears to be a consortium of government agencies including but not necessarily limited to the U.S. Department of Justice, the FAA, EPA, Oregon DEQ, the Port of Portland, Washington County, and the City of Hillsboro - all of whom seem more than willing to sweep under the rug, the glaring need for a comprehensive environmental review of the impact of the Hillsboro Airport. A full EIS is needed to determine if lead emissions and other toxins emitted by this facility pose a threat to the local community. Clearly the agencies and government entities discussed above have demonstrated a commitment to advocating on behalf of the less than one-third of one percent of Oregon's population who train or engage in recreational or business flights out of this facility but none fulfill their obligation to the other 99 and two-thirds percent who are forced to breathe the foul air left in their wake.

Oregon Aviation Watch is petitioning the Oregon Department of Justice to investigate the DEQ and Port of Portland for the reasons set forth above. To highlight some of the keys concerns:

- Lead is a pernicious health hazard that impacts entire communities and disproportionally impacts children.
- Recent revelations in Flint, Michigan, and in Portland, Oregon, reveal patterns of complicity between polluters and the regulatory agencies responsible for protecting the public from lead pollution.

- The EPA has identified Hillsboro Airport (HIO) as the largest facility source of airborne lead emissions in Oregon.
- The Port of Portland, owner and operator of HIO, has managed the airport for nearly a half century. During that time it has pursued a strategy of aggressive growth and expansion. The airport is now surrounded on three sides by residential neighborhoods. At no time in its 86 year history has HIO completed an Environmental Impact Statement (EIS).
- The Port of Portland has been aided and abetted in shirking its responsibility to control lead pollution at HIO by Oregon DEQ, the FAA, the USDOJ, Washington County, and the City of Hillsboro. A thorough investigation might well reveal other players. We have provided examples illustrating that the Port has dragged its feet on measuring and monitoring actual levels, has chosen estimation methods that are technically flawed, and that Oregon DEQ and the FAA, supposedly the regulatory agencies in the situation, have encouraged this behavior, even adopting the results of the offending polluter's own privately-commissioned study in lieu of an unbiased, objective third party analysis.
- DEQ's 2005 analysis estimating lead concentrations above the NAAQS at HIO was discounted by DEQ based on the study commissioned by the Port of Portland, the owner and operator of the facility.
- The CDM HIO lead study did not account for lead emissions released during the run-up mode of flight which the EPA has identified as the "most important contributor to peak air PB [lead] concentrations."
- The 2005 DEQ PATS study only included a small fraction of the multiple facility sources of lead listed in the EPA NEI.

Oregon has reached a critical juncture. Instead of continuing to rationalize the widespread lead pollution caused by HIO and other Washington County airports, the state can and should take immediate, definitive steps to ameliorate this very serious problem. For the sake of current and future generations, *Oregon Aviation Watch* urges the Oregon Department of Justice to immediately commence a full scale, comprehensive investigation.

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[1] Update on Blood Lead Levels in Children. Lead: What Do Parents Need to Know to Protect Their Children? Centers for Disease Control. Available on-line at http://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm. Accessed on 5/22/16.

[2] What are the Effects of Lead on Human Health. Basic Information About Lead Air Pollution. EPA website. Available on-line at https://www.epa.gov/lead-air-pollution/basic-information-about-lead-air-pollution#how

[3] According to the Oregon Blue Book, the population of Washington County in 2013 was 550, 990. (2015-2016) Pg. 252.

[4] Hillsboro Airport Parallel Runway 12L/30R. Draft Environmental Assessment. Volume 2 Appendices. Prepared for Port of Portland by CH2MHILL. (October 2009). Pg. C3 1-2.

[5] EPA Memorandum from Marion Hoyer and Meredith Pedde to the Lead NAAQS Docket EPA-HQOAR-2006-0735. (11/8/10). Pg. 2-3. Available on-line at https://www3.epa.gov/otaq/regs/nonroad/aviation/memo-selc-airport-mon-stdy.pdf.

[6] Hillsboro Airport Parallel Runway 12L/30R. Draft Supplemental Environmental Assessment. Appendix E – Air Quality Technical Memo. Prepared for Port of Portland by Barrilleaux, J. and Dowlin R. (3/15/13). Pg. 9-11.

[7] To review the 2011 EPA National Emissions Inventory on various pollutants go to the EPA NEI available on-line at https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data. From there scroll down to the Google Fusion and Maps table and click on the specific pollutant. When the data appears click on the blue tab to filter by state, county, facility type or other preferred option.

[8] Ibid.

[9] Lead ISA Final Report with Errata Sheet. 2013 Final Report: Integrated Science Assessment for Lead. U.S. Environmental Protection Agency. (June 2013). EPA/600/R-10/075F. Pg. lxxviii. Available online at https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=255721#Download.

[10] Advance Notice of Proposed Rulemaking on Lead Emissions from Piston-Engine Aircraft Using Leaded Aviation Gasoline: Regulatory Announcement. U.S. Environmental Protection Agency (EPA.). (April 2010). Available online at https://www3.epa.gov/otaq/regs/nonroad/aviation/420f10013.pdf. .

[11] Miranda, M.L., Anthopolos, R., Hastings D. A geospatial analysis of the effects of aviation gasoline on childhood blood lead levels. Children's Environmental Health Initiative, Nicholas School of the Environment. Duke University. (July 2011). Available on-line at http://ehp.niehs.nih.gov/1003231/.

[12] Lead Emissions from the Use of Leaded Aviation Gasoline in the United States - Technical Support Document. (EPA20-R-08-020). U.S. Environmental Protection Agency. Assessment and Standards Division Office of Transportation and Air Quality. (October 2008). Pg. 3-4. Available at http://nepis.epa.gov/Exe/ZyPDF.cgi/P1004MXJ.PDF?Dockey=P1004MXJ.PDF.

[13] To review the 2011 EPA National Emissions Inventory on various pollutants go to the EPA NEI available on-line at https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data. From there scroll down to the Google Fusion and Maps table and click on the specific pollutant. When the data appears click on the blue tab to filter by state, county, facility type or other preferred option.
[14] Hillsboro Airport Parallel Runway 12L/30R. Draft Environmental Assessment. Volume 2 Appendices. Prepared for Port of Portland by CH2MHILL. (October 2009). Pg. C3 1-2.
[15] Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory. EPA-420-B-10-044. (December 2010). Pg. 17. Available on-line athttp://www.epa.gov/otaq/regs/nonroad/aviation/420b10044.pdf.
[16] Hoyer, M and Pedde, M. Memorandum - Selection of Airports for Airport Monitoring Study. Environmental Protection Agency (11/18/10). Pg.4. Available online at http://www.epa.gov/otaq/regs/nonroad/aviation/memo-selc-airport-mon-stdy.pdf.
[17] Western Regional Climate Center website available online at http://www.wrcc.dri.edu/htmlfiles/westwinddir.html.
[18] DEQ Places Air Quality Monitor in Hillsboro. Fact Sheet. DEQ. (Last updated 2/5/13). Available on-line at http://www.deq.state.or.us/aq/toxics/docs/FSatMonitorHillsboro.pdf.
[19] Development and Evaluation of an Air Quality Modeling Approach for Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline. Environmental Protection Agency. EPA-420-R-10-007. (February 2010). Pg. 32-33. Available on-line at https://www3.epa.gov/nonroad/aviation/420r10007.pdf.
[20] Ibid. Pg. 68.
[21] Ibid. Pg.. 71.
[22] Hoyer M . and Pedde, M. Selection of Airports for the Airport Monitoring Study: Memorandum. EPA, NAAQS Docket EPA-HQ-OAR-2006-0735. 11/18/10. Pg. 7.
[23] Hillsboro Airport Parallel Runway 12L/30R. Final Supplemental Environmental Assessment. Volume 2 (Appendices G and I.) Prepared by Port of Portland. (February 2014). Pg. G.9-51.
[24] Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory. EPA-420-B-10-044. (December 2010). Pg. 11.http://www.epa.gov/otaq/regs/nonroad/aviation/420b10044.pdf.
[25] Transportation and Air Quality. EPA. Available on-line at https://www3.epa.gov/otaq/grundler-bio.htm.
[26] Kinney, Aaron. EPA: San Carlos Airport Has High Levels of Lead Fuel Emissions. The Mercury News. (6/19/13). Available on-line at http://www.mercurynews.com/ci_23487563/epa-san-carlos-airport-has-high-levels-lead.
[27] Update for Chris Grundler on Aviation Lead Activities. Released by EPA in Response to a FOIA request. (October 2013). Available on-line at http://oregonaviationwatch.org/docs/7a._Update_for_Chris_Grundler_on_Aviation_Lead_Activities.pdf.
[28] Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory. EPA-420-B-10-044. (December 2010). Pg. 17. Available at http://www.epa.gov/otaq/regs/nonroad/aviation/420b10044.pdf.
[29] Hillsboro Airport Terminal Area Forecast (TAF). Detail Report. Federal Aviation Administration (FAA). (January 2013).
[30] Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory. EPA-420-B-10-044. (December 2010). Pg. 19-20. Available on-line at http://www.epa.gov/otaq/regs/nonroad/aviation/420b10044.pdf.
[31] To review the 2011 EPA National Emissions Inventory on various pollutants go to the EPA NEI available on-line at https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data. From there scroll down to the Google Fusion and Maps table and click on the specific pollutant. When the data appears click on the blue tab to filter by state, county, facility type or other preferred option.
[32] Nigg, JT, Nikolas, M, Knottnerus, GM, Cavenaugh, K, Frederici, K. Confirmation and Extension of Association of Blood Lead with Attention-Deficit/Hyperactivity Disorder (ADHD) and ADHD Symptom Domain at Population-Typical Exposure Levels. J Child Psychol Psychiatry. (January 2010) 51(1): 58-65. Available online at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2810427/.
[33] Nigg, JT, Knottnerus, GM, Martel MM, Nikolas, M, Cavenaugh, K, Karmaus, W, Rappley, MD. Low Blood Lead Levels Associated with Clinically Diagnosed Attention Deficit/Hyperactvity Disorder and Mediated by Weak Cognitive Control. Biological Psychiatry. V. 63 Issue 3. pgs. 325-31. (2/1/08).
[34] Study First to Confirm Causal Link Between Lead Exposure and ADHD. About OHSU. Oregon Health Sciences University website. (1/7/16). Available on-line at https://www.ohsu.edu/xd/about/news_events/news/2016/1-7-study-first-to-confirm-cau.cfm.
[35] Update on Blood Lead Levels in Children.Lead: What Do Parents Need to Know to Protect Their Children? Centers for Disease Control. Available on-line at http://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm. Accessed on 5/22/16.
[36] What are the Effects of Lead on Human Health. Basic Information About Lead Air Pollution. EPA website. Available on-line at https://www.epa.gov/lead-air-pollution/basic-information-about-lead-air-pollution#how
[37] Hillsboro, Oregon Quick Facts. U.S. Census Bureau. Available on-line at https://www.census.gov/quickfacts/table/PST120214/4134100,00,41.
[38] What are the Effects of Lead on Human Health. Basic Information About Lead Air Pollution. EPA website. Available on-line at https://www.epa.gov/lead-air-pollution/basic-information-about-lead-air-pollution#how.
[39] 1.2 What Happens to Lead When it Enters the Environment? Public Health Statement for Lead. ATSDR. Cas # 7439-92-1. (August 2007). Available on-line at http://www.atsdr.cdc.gov/phs/phs.asp?id=92&tid=22.

[40] Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory. EPA-420-B-10-044. (December 2010). Pg. 17. Available on-line at https://www.epa.gov/otaq/regs/nonroad/aviation/420b10044.pdf.
[41] Air Quality. Air Toxics. Portland Air Toxics Solutions. ODEQ. Available on-line at http://www.deq.state.or.us/aq/toxics/pats.htm.
[42] To review the 2011 EPA National Emissions Inventory on lead go to the EPA NEI available on-line at https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data. From there scroll down to the Google Fusion and Maps table and click on lead. When the lead data appears click on the blue tab to filter by state, county, facility type or other preferred option.
[43] Document provided by DEQ in response to an OAW public records request. Available on-line at http://oregonaviationwatch.org/docs/PATS_2017_AIRPORT_EMISSIONS.pdf.
[44] Portland Air Toxics Solutions Project Modeled Lead Data and the Hillsboro Airport. Air Quality Planning. DEQ-11-AQ-051.(Last updated 1/20/12 by Sarah Armitage) Oregon Department of Environmental Quality. Available on-line at http://oregonaviationwatch.org/docs/LeadCloudGraphics/DEQ-11-AQ-051.pdf.
[45] Maps and a discussion on these exceedances is included in a 4/4/12 article by Oregon Aviation Watch. Available on-line at http://www.oregonaviationwatch.org/articles/OAW-LeadCloudOverOregon.php
[46] PATS 2017 Pollutants Modeling Study Maps. Air Quality: Air Toxics. Oregon Department of Environmental Quality. (1/25/11). Available on-line at http://www.deq.state.or.us/aq/toxics/docs/pats/15pollutantsAboveSummary.pdf.
[47] Portland Air Toxics Solutions Project Modeled Lead Data and the Hillsboro Airport. Air Quality Planning. DEQ-11-AQ-051.(Last updated 1/20/12 by Sarah Armitage) Oregon Department of Environmental Quality. Available on-line at http://oregonaviationwatch.org/docs/LeadCloudGraphics/DEQ-11-AQ-051.pdf.
[48] Portland Air Toxics Solutions Project Modeled Lead Data and the Hillsboro Airport. Air Quality Planning. DEQ-11-AQ-051.(Last updated 1/20/12 by Sarah Armitage) Oregon Department of Environmental Quality. Available on-line at http://oregonaviationwatch.org/docs/LeadCloudGraphics/DEQ-11-AQ-051.pdf.
[49] Portland Air Toxics Solutions Project Modeled Lead Data and the Hillsboro Airport. Air Quality Planning. DEQ-11-AQ-051.(Last updated 1/20/12 by Sarah Armitage) Oregon Department of Environmental Quality. Available on-line at http://oregonaviationwatch.org/docs/LeadCloudGraphics/DEQ-11-AQ-051.pdf.
[50] Development and Evaluation of an Air Quality Modeling Approach for Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline. Environmental Protection Agency. EPA-420-R-10-007. (February 2010). Pg. 71. Available on-line at https://www3.epa.gov/nonroad/aviation/420r10007.pdf.
[51] Hillsboro Airport Parallel Runway 12L/30R Final Supplemental Environmental Assessment. Prepared by Port of Portland for the Federal Aviation Administration (FAA). Vol. 1 Appendix F. (February 2014). Available on-line at http://www.portofportland.com/pdfpop/HIO_SEA_Final_AppA.pdf.
[52] Development and Evaluation of an Air Quality Modeling Approach for Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline. Environmental Protection Agency. EPA-420-R-10-007. (February 2010). Pg. 71. Available on-line at https://www3.epa.gov/nonroad/aviation/420r10007.pdf.
[53] Document provided by DEQ in response to an OAW public records request. Available on-line at http://oregonaviationwatch.org/docs/PATS_2017_AIRPORT_EMISSIONS.pdf.
[54] Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory. EPA-420-B-10-044. (December 2010). Pg. 17. Available on-line at https://www.epa.gov/otaq/regs/nonroad/aviation/420b10044.pdf.
[55] Governor Brown Directs Cease and Desist Order to Bullseye Glass. Oregonian/Oregonlive. (5/19/16). Available on-line at http://www.oregonlive.com/portland/index.ssf/2016/05/gov_kate_brown_directs_cease_a.html.
[56] Monahan, Rachel. Portland District Failed to Disclose Excessive Lead Levels at 47 Schools Buildings. Willamette Week. (5/31/16). Available on-line at http://www.wweek.com/news/2016/05/31/portland-district-failed-to-disclose-excessive-lead-levels-at-47-school-buildings/.
[57] Manning, Rob. Lead Discovered in Beaverton Middle School Water Fountains. Oregon Public Broadcasting. (5/23/16). Availalbe on-line at http://www.opb.org/news/article/beaverton-oregon-lead-discovered-middle-school-water-fountains/.
[58] Michelle Barnes, Et Al., v. The Federal Aviation Administration and The Port of Portland. In the U.S. Court of Appeals for the Ninth Circuit. No. 14-71180. (11/4/14). Pg. 46-47. Available on-line at http://www.oregonaviationwatch.org/docs/HIO_2014-34-1-FAA_Brief.pdf.
[59] Ibid. Pg. 44.
[60] Ibid. Pg. 48.
[61] Michelle Barnes Et. Al. v the Federal Aviation Administration and Port of Portland. Petitioners' Reply Brief in the U.S. Court of Appeals for the Ninth Circuit. No. 14-71180. (12/2/14). Pg. 5-7. Available on-line at http://www.oregonaviationwatch.org/docs/HIO_2014-41-1-Reply_Brief.pdf.
[62] Michelle Barnes, Et Al., v. The Federal Aviation Administration and Port of Portland. Port of Portland's Opposition Brief. In the U.S. Court of Appeals for the Ninth Circuit. No. 14-71180. (11/17/14). Pg. 11-13.
[63] Ibid.
[64] Michelle Barnes Et. Al. v the Federal Aviation Administration and Port of Portland. Petitioners' Reply Brief in the U.S. Court of Appeals for the Ninth Circuit. No. 14-71180. (12/2/14). Pg. 7-8.
[65] Baumann, Christina and Davis, Matthew. Lead Emissions for the Hillsboro Airport and Public Health: An Overview of the Issue and Options for Further Characterization of Risks. Washington County Public Health Department. (June 2016). Pg. 7.
[66] Ibid. Pg. 1.

[67] Ibid. Pg. 10.
[68] Michelle Barnes, Et Al., v. The Federal Aviation Administration and Port of Portland. Port of Portland's Opposition Brief. In the U.S. Court of Appeals for the Ninth Circuit. No. 14-71180. (11/17/14). Pg. 24.
[69] Ibid. Pg. 25.
[70] DEQ and Bullseye Sign Agreement that Ensures State Oversight of Use of Hazardous Metals in Production, DEQ.(6/16/16). Available on-line at http://www.oregon.gov/newsroom/Pages/NewsDetail.aspx?newsid=1142.
[71] Michelle Barnes vs. City of Hillsboro LUBA No. 2010-011, Final Order. (June 30, 2010), pg. 17.