sierra research

Review and Evaluation of UC Davis Delta Group Study Entitled "Deposition of Coarse Toxic Particles in Wilmington, California"

prepared for:

Pacific Coast Chapter
Institute of Scrap Recycling Industries (ISRI)

June 17, 2009

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Review and Evaluation of UC Davis Delta Group Study Entitled "Deposition of Coarse Toxic Particles in Wilmington, California"

I. Introduction

The Pacific Coast Chapter, Institute of Scrap Recycling Industries (ISRI) retained Sierra Research to evaluate the conclusions and underlying analysis of a report entitled "Deposition of Coarse Toxic Particles in Wilmington, CA" prepared by the University of California at Davis-based Delta Group (Delta Group) for the Department of Toxic Substances Control (DTSC) (Delta Group Report). The report was issued by DTSC in April 2009.

According to the Delta Group Report, the UC Davis Delta Group obtained, analyzed, and drew conclusions from samples of ambient particulate matter collected at a sampling location at the Wilmington CA Fire Station, located across a waterway from the Terminal Island portion of the Port of Los Angeles (POLA). SA Recycling LLC owns and operates an automobile/appliance shredder (shredder) on Terminal Island, within the POLA.

There are numerous mobile emission sources in the surrounding POLA area, such as ocean going vessels, harbor craft, cargo handling equipment, rail locomotives, and heavy-duty vehicles. There are also several large stationary sources in the vicinity of Terminal Island and the Wilmington Fire Station. For example, the Long Beach SERRF municipal solid waste incinerator is located approximately 1.74 miles southeast of the Fire Station and 0.7 miles east of the Terminal Island automobile/appliance shredder, and the BP West Coast Products refinery is located approximately 2 miles northeast of the shredder. In addition, there are other source areas upwind or potentially upwind of the Fire Station not considered in the Delta Group Report, such as vehicle exhaust from the major roadways surrounding the Fire Station and legacy dust from the days when leaded gasoline was still in use.

In addition to the confounding effects of multiple potential sources, a significant factor in the analysis of the data and identification of originating sources is the particle size of the particulate matter (PM). This factor requires careful evaluation.

In 1987, the U.S. Environmental Protection Agency (EPA) replaced the earlier Total Suspended Particulate (TSP) air quality standard with a PM_{10} standard. The PM_{10} standard focuses on smaller particles that are likely responsible for adverse health effects because of their ability to reach the lower regions of the respiratory tract. In 1997, EPA issued the fine particle standards. The fine particle standard, or $PM_{2.5}$ standard, further focuses on the significant association between exposure to fine particles ($PM_{2.5}$) and adverse health effects.[1] In California, the California Air Resources Board (CARB)

[1] U.S. Environmental Protection Agency (EPA) Particulate Matter Standards (http://www.epa.gov/air/particlepollution/standards.html)

replaced the earlier suspended PM standards with a PM_{10} (or respirable PM) standard in 1983. In 2002, the CARB adopted new, revised PM standards for outdoor air, lowering the annual PM_{10} standard and establishing a new annual standard for $PM_{2.5}$[2]. As a result, particulate matter (PM) emissions are generally measured in these two size ranges: particles that are less than 10 µm diameter (PM_{10}) and particles that are less than 2.5 µm diameter ($PM_{2.5}$). The Delta Group Report described particles between 10 to 2.5 µm in size as "coarse" particles, particles less than 2.5 µm in size as "fine" particles, and particles less than 0.25 µm as "very fine" particles.

Typically, particles that are larger than $PM_{2.5}$ in size are largely derived from mechanically generated particulate matter (e.g., soil dust, or particles formed by abrasion, crushing and grinding actions such as occur in a shredder), while particles smaller than $PM_{2.5}$ in size are nearly always derived from chemically formed particles and condensing aerosols, generally created by combustion sources of emissions and atmospheric chemical reactions.[3] This distinction is critical to the analysis of potential sources impacting ambient air measurements at a given location.

The shredder is a mechanical device used to separate ferrous metal from automobiles, appliances, and other scrap metal items. There is no combustion associated with the operation of the shredder. As a result, we expect that the particulate emissions from the shredder would be dominated by particles larger than 10 µm in size, with decreasing fractions of coarse and fine particles, and virtually no particles in the very fine size range.

Our report identifies some key discrepancies between the data and the conclusions of the Delta Group Report. The main findings and conclusions of our evaluation are summarized below.

II. Summary

Assuming that the Delta Group[4] properly collected and analyzed samples taken from the Fire Station, we conclude from our evaluation described below in Section III that the Delta Group Report reaches a number of conclusions that are not supported by, or are inconsistent with, the data presented in that Report.

---

[2] Ambient Air Quality Standards (AAQS) for Particulate Matter, CARB website (http://www.arb.ca.gov/research/aaqs/pm/pm.htm)

[3] See, e.g., 70 FR 65992 (Nov. 1, 2005)

[4] It is important to note that the techniques used by the Delta Group to measure ambient concentrations are not federal reference methods, nor are they traceable to federal reference methods. Consequently, these measurements cannot properly be compared with air quality standards that are based on these methods.

In particular, we find that:

- The Delta Group Report's conclusion that iron and lead are "unambiguous tracers" for emissions from the shredder is not supported by the measured data. First, the Delta Group Report failed to demonstrate why lead and/or iron would not be a tracer for other readily identifiable, nearby sources of lead and/or iron emissions in the area, and the Delta Group Report does not attempt to distinguish the impacts of the shredder from these other emission sources. Second, the particle size signatures measured by the Delta Group are not consistent with particulate matter generated from a mechanical process such as automobile/appliance shredding. Furthermore, some of the peak concentrations of these compounds were measured during times when the shredder was not in operation; and some of the peak concentrations of these compounds were measured during times when winds were not blowing from the shredder towards the monitor, or both. All of these facts indicate the presence in the area of other sources of lead and iron emissions in the measured particle size ranges. In short, the conclusion that all of the lead measured at the Wilmington Fire Station is attributable to the shredder, regardless of wind direction or whether the shredder was even operating, is absurd on its face from a meteorological and pollutant transport perspective; is not supported by any analysis contained in the Delta Group Report; and is inconsistent with the presence of numerous sources of lead in the vicinity of the Wilmington Fire Station.

- The Delta Group Report presents the concentrations of lead and other pollutants in units of parts per million, by weight, in the associated particulate matter (referred to as aerosols in the Delta Group Report). These units are meaningless from an air quality or public health perspective. The Delta Group Report did **not** present the necessary ambient particulate concentrations or the calculations needed to determine the concentrations of these pollutants that are inhalable, such that the appropriate ambient lead concentrations could be compared to the applicable state and federal ambient air quality standards for lead. Yet, the authors somehow, without presenting any ambient particulate concentration data, reach the conclusion that the lead concentrations measured exceeded certain allowable health standards.

Section III of this report presents a detailed discussion of these issues.

III. Discussion and Analysis

A. Delta Group Report Principal Conclusion #1

"Elemental and mass values from the UC Davis DELTA Group 8 DRUM impactor, with DTSC personnel, support, and execution, have delivered unambiguous tracers of the impact of the Terminal Island auto/appliance shredder on Wilmington. These tracers overlap known hours of shredder operation and transport on south winds, and are confirmed by evidence of upwind aerosols from the harbor, including natural sea salt and the vanadium/nickel/sulfur pollution of ocean going ships using bunker oil as fuel." (First paragraph, Executive Summary)

1. The Delta Group Report authors claim to have identified iron and lead as the "unambiguous tracers of the impact of the Terminal Island auto/appliance shredder" based on:

- **local meteorology**: "[t]wo sites were chosen for our analysis, the Terminal Island (TI) Source Dominated site and the Wilmington Community Center (SP) site. The aerosol sampling site at Fire Station 49 is almost exactly half way between these two sites, and thus falls on the wind trajectory. The shredder itself lies slightly to the east, and has a wind trajectory direction of roughly 160°, or from the SSE, to the sampling site and Wilmington Community Center." (Paragraph below Figure 4, p. 7) From the wind direction and wind speed data at those monitoring sites, the authors established that "[t]he overlap of the winds, with a typical 7 AM to 7 PM trajectory from the south in daytime, and Northwest at night, provides an overlap with shredder operations."
- **"lack of" open soil source**: "… coarse iron normally comes from soil, but there is almost no open soil upwind of the Wilmington Fire Station 49. The iron signature simply should not be there." (First paragraph, p. 15)
- **correlation between the lead and iron peaks with the optimum winds for transport (from the shredder) to Wilmington**: "The high lead values, as well as iron and other elements, peak when the wind is blowing from the shredder to Wilmington." (Last paragraph, p. 2) and "As shown below [Figures 30 and 31], both lead and iron were seen when winds were optimum for transport to Wilmington." (Last paragraph, p. 25)

a. Local meteorology

The Delta Group Report authors obtained the wind direction and wind speed data from a network of four air monitoring stations that are located within the Port of Los Angeles (POLA) and Port of Long Beach (POLB). These monitoring stations provide a comprehensive set of air pollutant and meteorological data to evaluate the air quality within the San Pedro Ports area.[5] In the POLA 3rd Annual Monitoring Report (May, 2007 – April, 2008),[6] wind roses were created for the 3rd year of meteorological data collected at each station, and they are presented in Figure 1, together with the locations of the

[5] The Port of Los Angeles, Air Quality Monitoring Program (http://www.portoflosangeles.org/environment/air_quality.asp)

[6] "Air Quality Monitoring Program at the Port of Los Angeles, Summary of Data Collected during the Third Year – May 2007 – April 2008", Feb 2009 (http://caap.airsis.com/Documents/POLA-Air-Quality-2009-Report-030309v2.pdf)

Wilmington Fire Station sampling site, the Terminal Island shredder (SA Recycling Facility), and other nearby stationary sources.

In Figure 1, the wind roses graphically show the frequency of occurrence of wind speed and direction at a site for the entire period from May 2007 to April 2008; they readily indicate the directions in which emissions are most frequently transported. They also show that the predominant wind patterns at each station were considerably different, indicating that the Port area experiences complex air flow patterns reflecting a combination of nearby terrain, inland mountains, and onshore/offshore diurnal patterns.

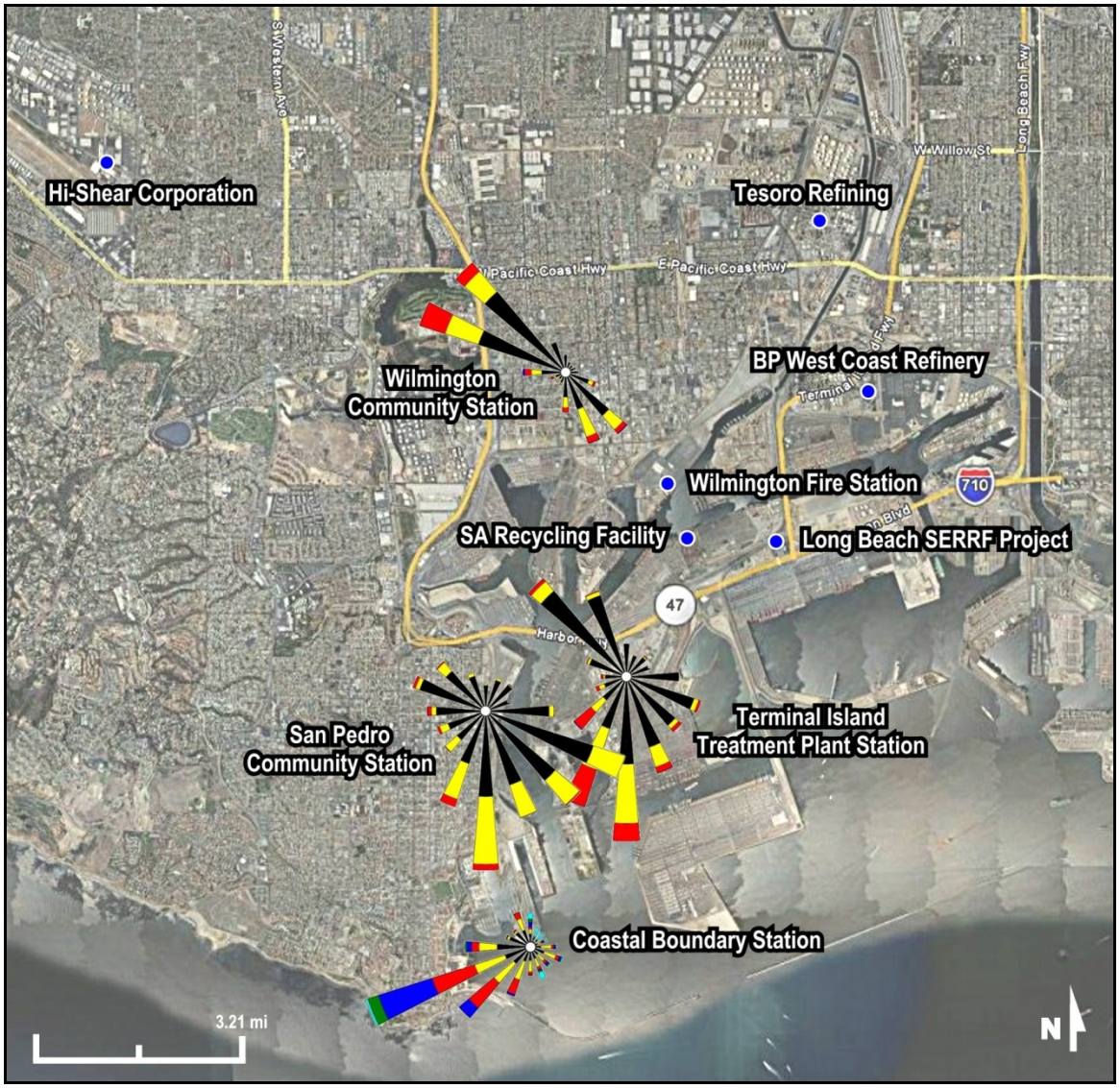

Figure 1. Wind Roses for the POLA Air Monitoring Network Stations. The locations of the Wilmington Fire Station Sampling Site, the SA Recycling Facility (Terminal Island Shredder), and other nearby stationary sources are also shown.

The Delta Group Report authors attempted to isolate the impact of shredder emissions using hourly wind direction data, claiming that measurements during the hours for which wind coming from a direction "roughly 160°, or from the SSE, to the sampling site" would be representative of shredder emissions. However, due to the complex wind patterns in the area, there are multiple sources in a variety of directions that could impact measurements made at the Wilmington Fire Station sampling site

b. "Lack of" open soil sources

The Wilmington Fire Station 49 sampling location is in an area that can be strongly affected by a diurnal sea breeze. Coarse iron can therefore come from soils derived from the Los Angeles area and blown out to sea the evening before. Coarse PM (2.5 – 10 μm in diameter) will deposit from air blown out to sea every night. Given an average residence time over the sea of 12 hours for a Southern California air mass, virtually all the coarse PM originally present in the air below a height of about 50 feet will deposit. The higher the original level, however, the more likely the particles will be brought onshore again. Particles can reach high levels above the ground due to turbulent mixing resulting from soil disturbance (e.g., vehicle traffic) or solar insolation. PM_{10} concentrations measured at Long Beach during the week of August 16, 2008,[7] when the Delta Group began its measurements, were approximately 24 $\mu g/m^3$; $PM_{2.5}$ levels were about half of that concentration – 12 $\mu g/m^3$. Thus, coarse PM concentrations during that week were approximately 12 $\mu g/m^3$ (the difference between the PM_{10} and $PM_{2.5}$). Because we assume release heights of at least 15 m above the ground, we use a slightly lower, uniformly mixed coarse PM concentration of 10 $\mu g/m^3$.

For a 5 mph wind speed (estimated average from Figure 2 of the Delta report), 12 hours at sea implies a 60 mile trajectory over the sea. i.e., 30 miles out to sea and 30 miles back from the sea. We also assume a particle with a typical soil density of 2.5 g/cm^3, and we assume that 2/3 (rough estimate from Table 2 of the Delta Group report) of the mass fraction is in the size range 2.5 to 10 $\mu g/m^3$.

To compute fractions of suspended particulate that would settle out of the air, an online deposition velocity model was used to perform this calculation.[8] The results are shown in Table 1.

The data show that coarse-mode particles can come onshore with the wind blowing from the sea, and these particles can contain a significant soil component.

Although there are few large soil sources "upwind of the Wilmington Fire Station 49" during predominant wind patterns (aside from open soil at the shredder site), it is unreasonable to neglect the

[7]Obtained from the California Air Resources Board, Air Quality Data Statistics database http://www.arb.ca.gov/adam/welcome.html

[8] http://www.filtration-and-separation.com/settling/settling.htm*, accessed on October 15, 2006. This simple gravitational settling model is based on equations favored by EPA Region 10 staff*

two large grading site areas on Terminal Island. One of the two grading sites is only approximately 0.4 miles

Table 1. Estimated Remaining Coarse Particulate Matter in the Wind Coming Back from the Ocean at Various Releasing Heights

Release Height (m)	Remaining Coarse PM (%)
15	3%
20	6%
25	10%
30	14%
35	17%
40	21%
45	24%
50	27%

All calculations started with coarse PM at 10 $\mu g/m^3$.

east of the Wilmington Fire station; the other site is approximately one mile southeast of the Wilmington Fire Station. The on-going grading operations at these other nearby areas can be detectable sources for coarse mode iron measured at the Fire Station. Therefore, the shredder is not the only possible source for the coarse iron observed in the Delta Report.

c. Correlation between the lead and iron peaks with the optimum winds for transport (from the shredder) to Wilmington

The Delta Group Report presents data for three sets of dates when periods of "peak"[9] lead and iron concentrations were observed in support of its conclusion that the shredder is the "unambiguous" source of the "impacts" at the Fire Station. We examined the wind direction, lead, and iron data during the time of the Delta Group study for each of these "peak" periods, and identified frequent and significant inconsistencies between reported lead and iron measurements and times when the wind was blowing in the direction from the shredder toward the fire station, and periods of shredder operation.

In order for the shredder to be the "unambiguous" source for the high lead and iron levels observed at the Wilmington Fire Station, the lead and iron peaks should be observed when the wind is blowing from the shredder to Wilmington at the same time the shredder is operating, and should not be observed when winds are blowing from other directions. However, we have found that the peaks were seldom observed at times when both conditions were met, and were observed at times when neither condition was met.

In the figures presented in the following sections of this report, the coarse mode iron and lead peaks are denoted by the red dashed lines; the peaks for the finer modes (e.g. 5.0 to 2.5 µm) of iron and lead are

[9] It is important to note that the use of the word "peak" here, as well as in the Delta Report, simply denotes concentrations that are mathematically higher than others, and does not suggest any adverse health impacts.

denoted by black dashed lines. Though the Delta Group report indicates that the shredder operations are "typically 5 AM to circa 1 PM, then an evening shift" (p. 6), daytime shredder operating hours were obtained from SA Recycling production data[10], and these operating hours data, provided by SA Recycling, are highlighted in grey shadings in Figure 2 and Figure 3.

(1) Wind Direction, Lead and Iron Data for August 14 to August 18

Figure 2 contains excerpts of Figures 29 to 31 of the Delta Group Report, showing the wind direction at the Port of Los Angeles and the ambient iron and lead concentrations measured at the Wilmington Fire Station 49.

The peaks in coarse mode iron and lead on the evening of August 15, 18:00, occurred when winds were not blowing from the general direction of the shredder although the shredder was in operation. The other major peaks for coarse iron and coarse lead appear around midnight on August 17. Although the wind directions are generally in the direction of blowing from the shredder towards the fire station, these latter peaks occurred at a time when the shredder was not operating and therefore could not have impacted the sampler.

Peaks for the finer modes of iron and lead on August 15 appeared around noon. These peaks occurred at the time the shredder was in operation and the wind was optimal for transport. However, if these peaks were associated with the shredder, they should have been accompanied by corresponding coarse-mode peaks; they were not—the coarse and fine-mode peaks are shifted in time by several hours. In addition, the second set of observed peaks for the finer modes of iron and lead on this day appeared in the evening around 6 PM, when the shredder was not operating and therefore would not have impacted the sampler.

(2) Wind Direction, Lead and Iron Data for August 21 to August 24 and September 7 to September 10

Figure 3a contains excerpts of Figures 33, 36, and 37 from the Delta Report; it shows the wind direction at the Port of Los Angeles and the ambient iron and lead concentrations measured at the Wilmington Fire Station 49.

The sample data from August 21 to August 24 further illustrate the inconsistencies between the sample data and the authors' claim of identifying iron and lead as the "unambiguous tracers" for the Terminal Island Shredder. Only one set of iron and lead peaks (mainly in the size of 5.0 to 2.5 µm)—on August 23 around 9 AM— was observed but those peaks occurred neither when the wind direction was optimum nor the shredder was in operation. No significant peaks in the coarse iron and/or lead measurements were observed during this sampling period. Once again, if iron and lead were, in fact, tracers for emissions from the shredder, coincident peaks would have been expected for both larger and smaller particle size ranges.

[10] Production data is supplied by SA Recycling via private communication.

Also, no other prominent peaks of iron and lead in any size ranges were observed during these dates. Two "soft" peaks were observed, such as those in the evening of August 21 and the morning of August 24. One of these peaks appeared to occur when the shredder was in operation (evening of August 21) *and* the wind direction was optimum for transport from the shredder to the Wilmington Fire Station. The other "soft" peak (morning of August 24) occurred when the shredder was not in operation and the wind direction was unfavorable for transport (i.e. blowing from the Wilmington Fire Station sampling site to the shredder).

Figure 3b contains the excerpts of Figures 41 to 43 from the Delta Report, showing the wind direction[11] at the Port of Los Angeles and the ambient iron and lead[12] concentrations measured at the Wilmington Fire Station 49 from September 7 to September 10. Two sharp peaks of iron and lead in the 5.0 to 2.5 µm size range were observed on September 9—one at noon and one at midnight. The noon peaks on September 9 can, in theory, be attributed to shredder operations, as the wind direction was also favorable for transport. However, the midnight peaks on the same day occurred when the wind direction was unfavorable and the shredder was not operating.

[11]The caption of Figure 41 is believed to be mislabeled as "wind velocity." According to the title of the graph and presentation of the data, Figure 41 is indeed showing wind direction data from Sept. 7 to Sept. 10.

[12]The caption of Figure 43 indicates that those are iron data. However, the heading of the same figure indicates that the data are for lead. Also, the iron data are already presented in Figure 42. Therefore, we assume that there is a typographical error in the caption of Figure 43, and that Figure 43 indeed presents lead data.

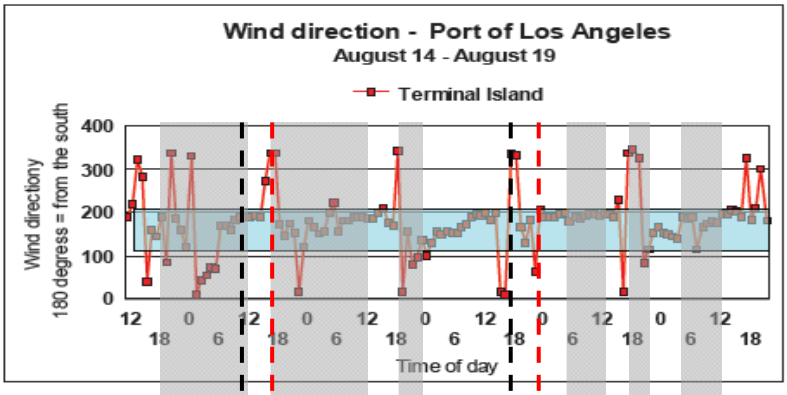

Figure 29 Local wind direction – August 14 to August 18. The shaded area is ± 45° from the direction of the shredder.

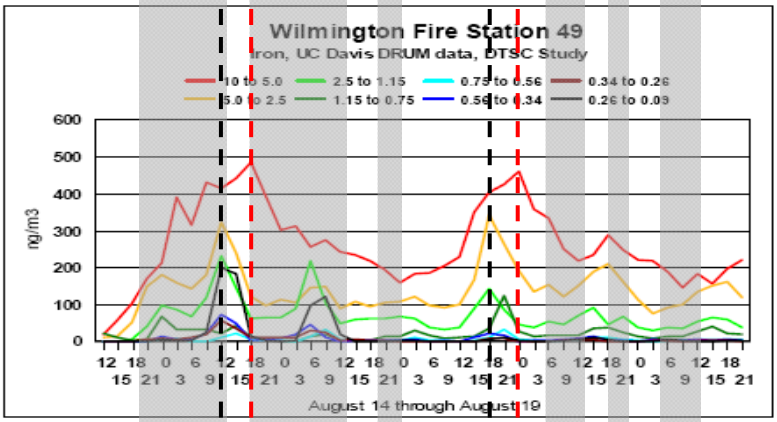

Figure 30 DRUM/S-XRF elemental data, iron, August 14 to August 18

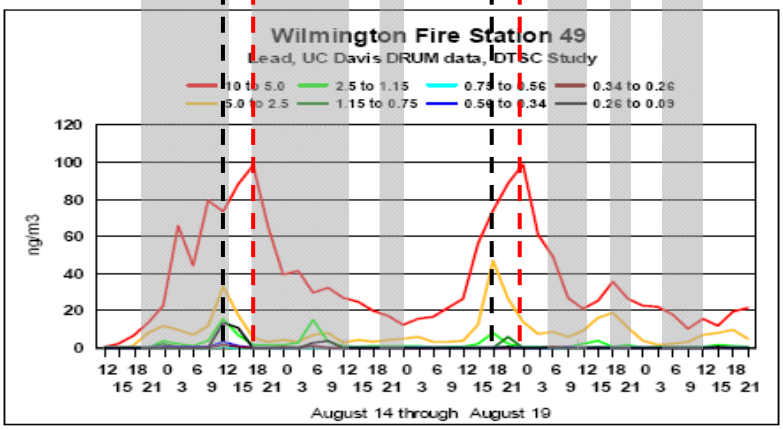

Figure 31 DRUM/S-XRF elemental data, lead, August 14 to August 18

Figure 2. Wind Direction data from the Port of LA (Figure 29); Lead (Figure 30) and Iron (Figure 31) data at the Wilmington Fire Station 49 from August 14 to August 18. Excerpts of Figures 29 to 31 are obtained from the UC Davis Delta Group report. Red dashed lines show periods of "peak" coarse-mode concentrations; black dashed lines show periods of "peak" finer mode concentrations. Gray bands indicate nominal periods of shredder operation; production data was supplied by SA Recycling.

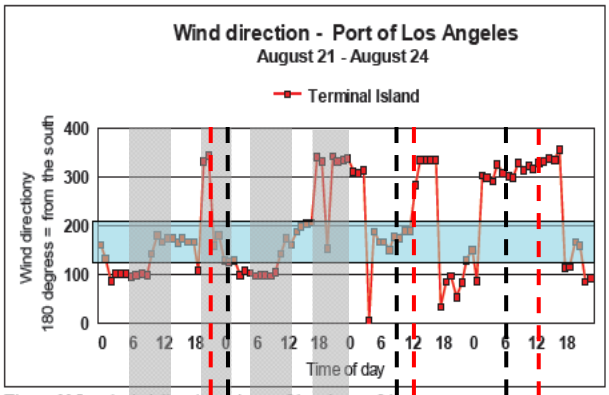

Figure 33 Local wind direction – August 21 to August 24

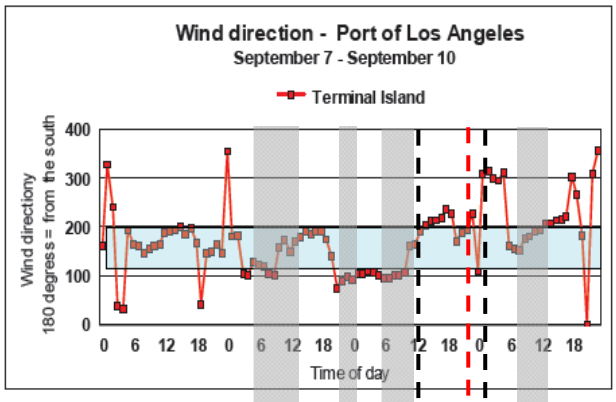

Figure 41 Local wind velocity – September 7 through September 10

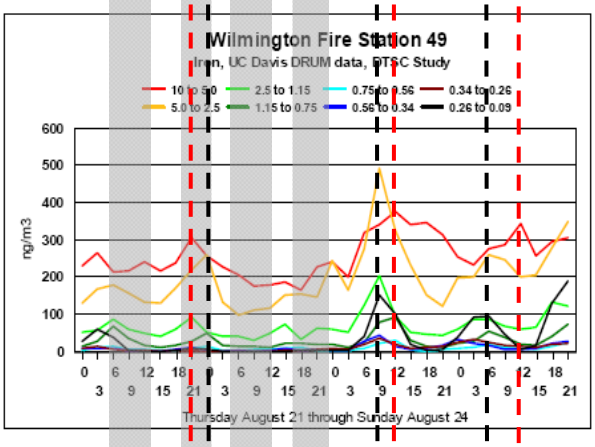

Figure 36 DRUM/S-XRF elemental data – iron

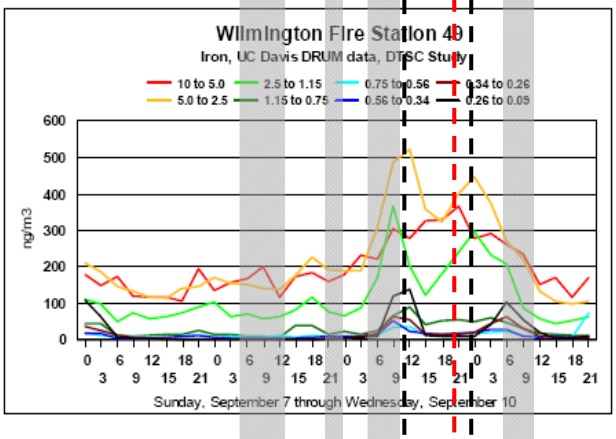

Figure 42 DRUM/S-XRF elemental data – iron

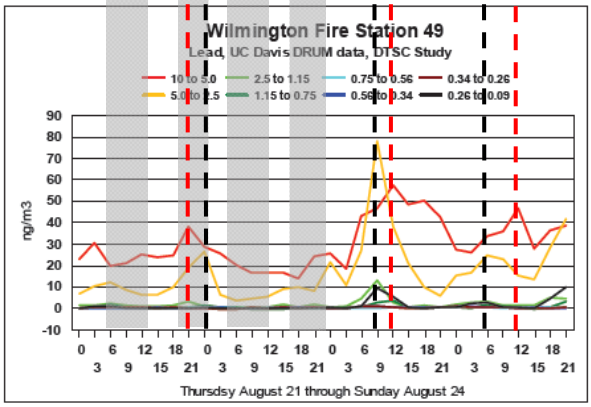

Figure 37 DRUM/S-XRF elemental data – lead

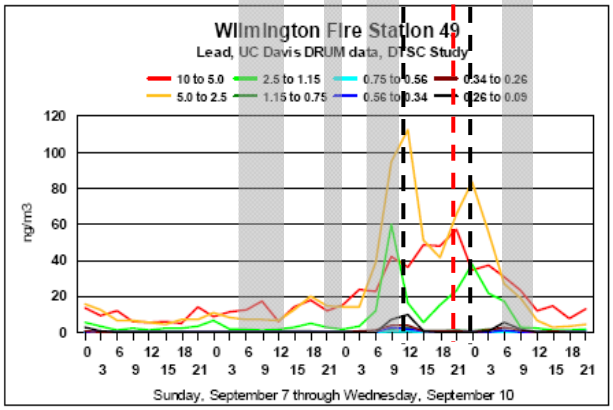

Figure 43 DRUM/S-XRF elemental data – iron

(a) Thursday, Aug. 21 through Sunday, Aug. 24 (b) Sunday, Sept. 7 through Wednesday, Sept. 10

Figure 3. Wind Direction data from the Port of LA; Iron and Lead data at the Wilmington Fire Station 49. (a) from Aug. 21 to Aug. 24 (Figures 33, 36 and 37); (b) from Sept. 7 to Sept 10 (Figures 41 to 43). Excerpts of all figures are obtained from the UC Davis Delta Group report. Red dashed lines show periods of "peak" coarse-mode concentrations; black dashed lines show periods of "peak" finer mode concentrations. Gray bands indicate nominal periods of shredder operation; production data was supplied by SA Recycling.

The report notes that "This period [Sept 7 to Sept 10] is interesting because despite favorable meteorology, there was minimal shredder source impact on Sunday and Monday," and further suggests that "[c]learly, details of shredder operations and feed stock are key to further analysis." (Last paragraph, p. 33) Since levels of lead and iron measured during the evening of Monday, September 8, when the shredder was in operation, are comparable to those measured on Sunday, September 7, when the shredder was shut down, the authors seem to suggest that the "feed stock" for the shredder operations on Monday, September 8 contained insignificant levels of iron and lead. However, the production data[10] provided by SA Recycling indicates that typical "feed stock" was used for the day (Sept 8). Regardless, if there is a certain "feed stock" that would produce lead and iron emission levels similar to those occurring when the shredder is shut down, iron and lead are then not unambiguously representative of shredder operation and therefore cannot be used as tracers for shredder emissions.

While it could be hypothesized that the lack of coincident peaks for coarser and finer particles containing lead and iron is simply a function of the differences in transport characteristics of differently sized particles, neither the data nor the science support this hypothesis. In the first place, the measured data indicate some time periods when the coarser particle peaks (red dashed lines) precede the finer particle peaks (black dashed lines), by several hours (see, e.g., the peaks at 20:00 on August 21 and at 21:00 on September 9). In contrast, the measured data indicate that during several periods the finer particle peaks (black dashed lines) precede the coarser particle peaks (red dashed lines) by several hours (see, e.g., the peaks on August 15, August 17, and August 23). If there was some mechanism through which either larger or smaller particles were lost from the transported air mass from the shredder to the fire station, such a pattern would have been observed consistently in the data; it was not.

In the second place, all of these particles are of a size of 10 microns and smaller; at this size, particles behave in much the same manner as gases, and would all move at the same speed and in the same direction.

In summary, if the lead/iron particles in both size categories had originated from the same emission source, they would have arrived at the fire station at the same time. The differences in the times when peaks have been observed for larger and smaller particles suggest that there are multiple sources for these particles, and not a single, "unambiguous" source. Furthermore, the fact that peaks in the concentrations for lead and iron are not consistently observed during periods of facility operation and meteorology conducive to transport to the fire station, combined with the fact that peaks are, in fact, observed during periods when neither the wind direction is optimal nor the shredder is in operation, confirms that there are sources of these metals other than the shredder facility.

In conclusion, the wind direction, lead, and iron data provided in the report are insufficient to support the connection between the shredder and the high iron and lead values. In fact, the data confirm that there are other, and likely multiple, emission sources that contribute to the values measured at the fire station.

2. The authors further assert the legitimacy of using iron and lead as tracers for the impact of the Terminal Island shredder because they are "*confirmed by the evidence of upwind aerosols from the harbor, including natural sea salt and the vanadium/nickel/sulfur pollution of ocean going ships using bunker oil as fuel*."

The report states that vanadium, nickel, and sulfur are "a unique source [-] the combustion of heavy, sulfur rich bunker oil in ocean going ships," (first sentence, p. 20) and that these elements exhibit "highly correlated patterns on the daytime winds that blow across the shredder to the Wilmington sampling site" (2nd sentence, first paragraph, p. 18). Therefore, the report concludes, this data "provides an industrial tracer of sources upwind of the shredder, thus identifying trajectories that cross the shredder site before they arrive in Wilmington" (second paragraph, p. 20).

If we accept the authors' choice of vanadium, nickel, and sulfur as the signature for the combustion of heavy, sulfur-rich bunker oil in ocean going ships, and the ocean going ships are upwind of, and indicative of, other industrial sources (in addition to the Terminal Island shredder), the logical deduction would be that the samples collected at the Wilmington Fire Station originated from multiple emitting sources, and not from a single, "unambiguous" source. Thus, this hypothesis and argument by the authors of the Delta Group Report is inconsistent with, and undermines, their conclusion that there can be no other sources of the iron and lead observed at the Wilmington Fire Station.

Moreover, in order for iron and lead to be the "unambiguous tracers" for the shredder, with the ocean going ships shown to be contributing sources, the authors must assume that the emissions from the combustion of heavy, sulfur-rich bunker oil in ocean going ships do not contain any iron or lead. No data are provided to support this assumption.

Following the authors' assumption, the sulfur/vanadium/nickel results suggest that the samples collected at the Wilmington Fire Stations are affected by the port-related activities in the nearby Port of Los Angeles (POLA) and Port of Long Beach (POLB). Together, POLA and POLB comprise a significant source of air emissions in the region. In 2007, the estimated emissions of particulate matter (PM_{10}) and diesel particular matter (DPM) from the Port of Los Angeles were reported to be 944 and 860 tpy, respectively.[13] The port-related emissions of PM_{10} and DPM were estimated to be 925 and 824 tpy for the Port of Long Beach,[14] respectively.

The inventory data for both POLA and POLB are summarized in Table 2[13,14]; these data show that the port-related activities in POLA and POLB can be significant sources of particulate emissions in the area.

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[13]Summary of 2007 Emission Estimates obtained from Table ES.8 of "Port of Los Angeles Inventory of Air Emissions – 2007" http://www.portoflosangeles.org/DOC/REPORT_Air_Emissions_Inventory_2007.pdf

[14] Summary of 2007 Emission Estimates obtained from Table ES.8 of "The Port of Long Beach Air Emissions Inventory – 2007" http://www.polb.com/environment/air_quality/emissions.asp

Table 2. 2007 Port-Related Emissions by Category (tpy) for the Port of Los Angeles and the Port of Long Beach

	PM_{10}	$PM_{2.5}$	DPM	NOx	SOx	CO	HC
2007 Port-related Emissions by Category for the Port of Los Angeles[13], tpy							
Ocean-going vessels	416	333	333	6,142	3,718	587	267
Harbor craft	53	49	53	1,281	1	348	85
Cargo handling equipment	46	43	45	1,662	2	919	81
Rail locomotives	60	54	60	1,675	55	268	94
Heavy-duty vehicles	370	340	370	7,343	6	2,529	445
Total	**944**	**817**	**860**	**18,102**	**3,781**	**4,652**	**973**
2007 Port-related Emissions by Category for the Port of Long Beach[14], tpy							
Ocean-going vessels	492	394	391	7,072	4,460	676	301
Harbor craft	49	45	49	1,211	1	321	77
Cargo handling equipment	39	36	39	1,339	1	334	46
Rail locomotives	49	44	49	1,336	47	217	75
Heavy-duty vehicles	296	273	296	5,964	5	2,048	365
Total	**925**	**791**	**824**	**16,923**	**4,513**	**3,596**	**865**

Lead and/or iron, and other toxic air contaminants, can be found in the exhaust from the combustion of diesel and residual oil fuels in ocean going vessels, harbor craft, cargo handling equipment, locomotives, and heavy-duty trucks at the ports. Since iron is not a toxic or hazardous air pollutant, its emissions are not routinely reported. To examine the likelihood that port activities are iron- and/or lead-emitting sources, we obtained typical PM chemical profiles for some common combustion processes related to Port activities.[15] Table 3 shows three selected chemical profiles for particulate emissions: marine vessels that use liquid fuel, residual oil combustion, and distillate oil combustion. Though the profiles indicate that only trace amounts of lead and/or iron can be found, it is still incorrect to assume the shredder is the single source of lead and/or iron. Looking only at the lead associated with distillate (diesel) fuel combustion (0.55% of PM_{10} by mass), as shown in Table 3, and based on the estimated DPM emissions from POLA and POLB in 2007 presented in Table 2, lead emissions associated with diesel fuel combustion from port-related activities would be approximately 18,500 pounds per year.

[15] Particulate matter chemical profiles for source categories - PMPROF (Excel file), obtained from http://www.arb.ca.gov/ei/speciate/dnldopt.htm

Table 3. Selected Speciation Profile Used in ARB Modeling

	Marine Vessels-Liquid Fuel			Fuel Combustion-Residual			Fuel Combustion-Distillate		
Chemicals	**Wt % of PM**	**Wt % of PM_{10}**	**Wt % of $PM_{2.5}$**	**Wt % of PM**	**Wt % of PM_{10}**	**Wt % of $PM_{2.5}$**	**Wt % of PM**	**Wt % of PM_{10}**	**Wt % of $PM_{2.5}$**
Arsenic	--	--	--	0.03	0.04	0.05	0.53	0.54	0.55
Barium	--	--	--	0.05	0.05	0.05	--	--	--
Cadmium	--	--	--	--	--	--	0.05	0.05	0.05
Calcium	5	5	5	0.55	0.55	0.55	--	--	--
Chromium	--	--	--	0.55	0.55	0.55	0.53	0.54	0.55
Cobalt	--	--	--	0.05	0.05	0.05	--	--	--
Copper	--	--	--	0.05	0.05	0.05	--	--	--
Elem carbon	4	4	4	22.76	20.18	6	15	15	15
Lead	**--**	**--**	**--**	**--**	**--**	**--**	**0.55**	**0.55**	**0.55**
Iron	**0.55**	**0.55**	**0.55**	**2.83**	**3.17**	**4**	**--**	**--**	**--**
Manganese	--	--	--	0.05	0.05	0.05	--	--	--
Molybdenum	--	--	--	0.05	0.05	0.05	--	--	--
Nickel	--	--	--	0.55	0.55	0.55	0.05	0.05	0.05
Nitrates	--	--	--	0.05	0.05	0.05	3.86	3.94	4
Potassium	--	--	--	0.36	0.42	0.55	--	--	--
Selenium	--	--	--	0.04	0.05	0.05	0.05	0.05	0.05
Silicon	0.55	0.55	0.55	--	--	--	--	--	--
Strontium	--	--	--	0.05	0.05	0.05	--	--	--
Sulfates	15	15	15	44.12	50.26	65	25	25	25
Tin	--	--	--	--	--	--	0.05	0.05	0.05
Titanium	--	--	--	0.05	0.05	0.05	0.05	0.05	0.05
Vanadium	0.55	0.55	0.55	0.55	0.55	0.55	--	--	--
Zinc	--	--	--	--	--	--	0.55	0.55	0.55
Other	74.35	74.35	74.35	27.25	23.28	21.75	53.73	53.62	53.55

Source: Particulate matter chemical profiles for source categories - PMPROF (Excel file), obtained from http://www.arb.ca.gov/ei/speciate/dnldopt.htm

In fact, the correlation between vanadium, nickel, and sulfur concentrations is not established in the Delta Group report, indicating that, for these metals as well, there are multiple sources. Figure 4 below presents the joint vanadium-nickel plot (Figure 21[16]) presented in the Delta Group report. As shown in Figure 4, the authors of the Delta Group report failed to include sulfur to show the correlation between the three elements. It is unclear if the sulfur data follow or support the nickel and vanadium data.

[16] The label "Bunker Oil" in the heading of the Figure 21 can be misleading because the figure is not showing typical emissions from bunker oil combustion; rather, the figure is showing the ambient data for nickel and vanadium for particle sizes ranging from 0.26 to 0.09 µm

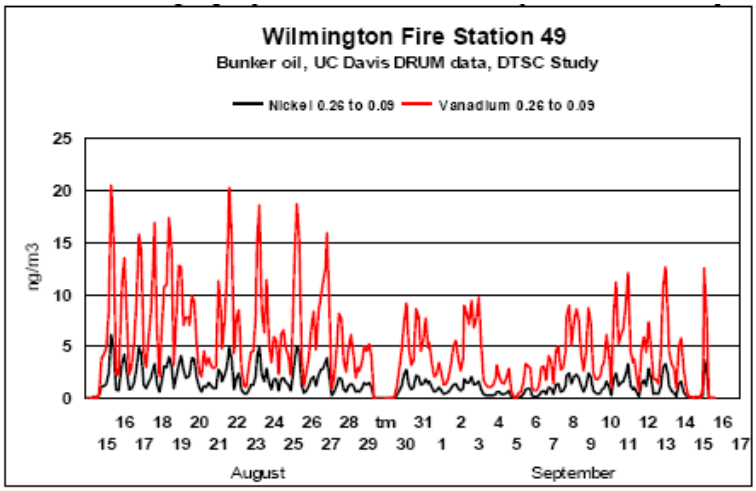

Figure 21 DRUM elemental data – nickel and vanadium

Figure 4. Ambient Levels of Nickel and Vanadium measured for particle sizes 0.26 to 0.09 µm at the Wilmington Fire Station 49 (Figure 21 in the Delta Group report)

Consequently, the vanadium/nickel/sulfur data do not support the use of lead as the "unambiguous tracers" for the Terminal Island shredder. On the contrary, they confirm that the samples collected at the Wilmington Fire Station are affected by additional, contributing emitting sources in the area, and to the extent that these other emitting sources result in emissions of iron and/or lead, these sources contribute to the "peak" concentrations measured at the Wilmington Fire Station.

B. Principal Conclusion #2 of the Delta Group Report

"This proves that all the lead seen in any wind direction is caused by shredder operations, current and past" (p. 40)

1. The Delta Group report claims that the shredder is the only source of lead emissions in the area despite the presence of other, known lead emission sources in the vicinity. The report fails to acknowledge or explore the contribution of lead emissions to the Wilmington sampling site from other nearby emitting sources.

As shown in Figure 5 below, there are a number of large stationary emission sources close to the SA Recycling facility on Terminal Island. For instance, a number of stationary facilities reported significant lead emissions: the Long Beach City SERRF Project (SCAQMD Facility ID 44577); the BP West Coast Products (SCAQMD Facility ID 131249); the Tesoro Refining and Marketing Company (SCAQMD Facility ID 800436); and the Hi-Shear Corporation (SCAQMD Facility ID 11192). Table 4 shows the facility emission inventory for the criteria pollutants and selected trace metals for these stationary sources.[17]

[17] Emission Inventory is obtained from the CARB database: http://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php

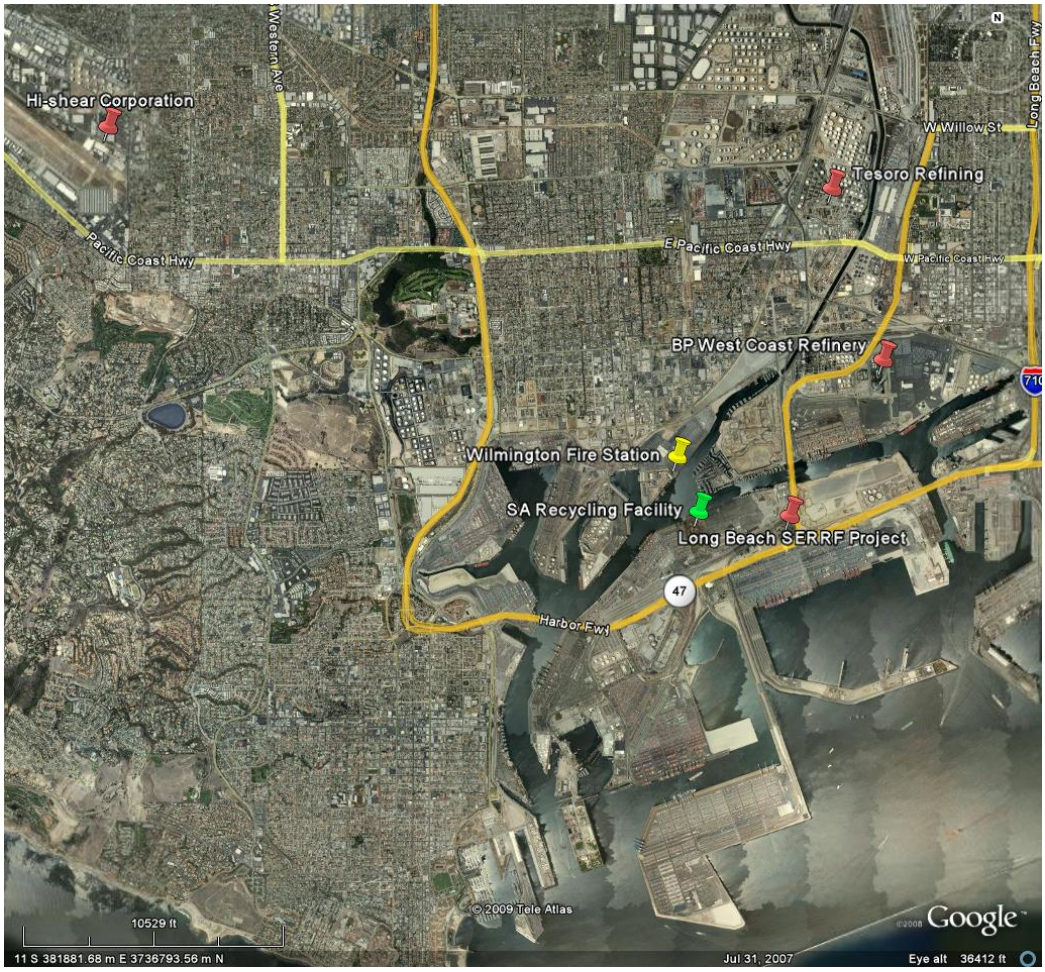

Figure 5. Location of the Wilmington Fire Station, the SA Recycling Facility on the Terminal Island, and Other Nearby Sources for Lead and Particulate Emissions

According to annual emission inventory data reported by the California Air Resources Board, the nearby SERRF municipal solid waste incinerator reported lead emissions of 66 lbs/year; the BP West Coast Products Refinery reported 97 lbs/year; the Tesoro Refining and Marketing Company reported 309.4 lb/yr; and the Hi-Shear Corporation reported 170.3 lb/yr of lead emissions. These data clearly show that the report fails to consider the potential contributions from nearby lead emission sources to the Wilmington area, in addition to the mobile source emissions discussed in the preceding section. Furthermore, at least three of these emission sources (municipal solid waste incinerator and two oil refineries) produce these emissions from processes, such as combustion, that would result in the formation of relatively smaller particles containing lead, in contrast to the larger particles generated by the shredder. Thus, these other emission sources are more likely to be the origins of the fine and very fine lead particles measured by the Delta Group.

Table 4. Facility Emission Inventory for the Additional Emitting Sources in the Area

POLLUTANT	Long Beach City SERRF Project (ID 44577)	BP West Coast Products (ID 131249)	Tesoro Refining and Marketing Co (ID 800436)	Hi-Shear Corporation (ID 11192)
Data for 2007	Criteria Pollutant Emissions (Ton/yr)			
TOG	64.4	7.6	281.5	8.2
ROG	10.7	5.2	220.6	5.0
CO	83.4	0.9	205.7	1.9
NOx	328.2	209.8	855.4	7.8
SOx	14.3	168.0	351.7	0.1
PM	18.3	41.7	396.7	0.6
PM_{10}	5.7	39.6	318.4	0.6
$PM_{2.5}$	3.9	37.3	257.4	0.6
	Toxic Air Contaminant Emissions (lb/yr)[a]			
Arsenic	1.1	5.1	7.3	0.03
Cadmium	4.7	21.5	4.6	2.9
Copper	0.003	--	22.6	0.07
Cr(VI)	0.7	0.4	1	0.1
Lead	**65.7**	**97.0**	**309.4**	**170.3**
Manganese	0.002	--	368.2	0.05
Mercury	0.001	--	3.8	0.03
Nickel	71.3	39.4	131.2	0.1
Selenium	0.002	--	759.3	0.04

[a] The toxic emission inventory data provided here may have been developed over several years and are the most recent information available at ARB for this inventory year. Many facilities are only required to update their toxic emission data if there has been an increase in emissions. Therefore, the toxic emission data presented here should generally be viewed as maximum emission values which may have decreased since this information was reported.

In summary, the conclusion that all of the lead measured at the Wilmington Fire Station is attributable to the shredder, regardless of wind direction, is absurd on its face from a meteorological and pollutant transport perspective; is not supported by any analysis contained in the Delta Group Report; and is inconsistent with presence of numerous sources of lead in the close vicinity of the Wilmington Fire Station.

2. The authors claim to be able to "*distinguish diesel and auto emissions from Shredder emissions*" (Additional topic 4, p. 36)

The Delta Group Report authors reason that since diesel emission from trucks, trains, and forklifts in the area are widely distributed, diesel tracers—including zinc (Zn), phosphorous (P), and sulfur (S)—should show up in the record when the winds are in all directions other than from the shredder. The authors conclude that, due to a lack of such a signature, the impact of diesel emissions is an insignificant contributor to their measurements. (Second paragraph, p. 36)

First, it is incorrect to include sulfur as a signature element for diesel combustion. California diesel fuel regulations set a limit of 15 parts per million by weight, effective June 2006.[18] This means that the sulfur content of diesel fuel is now comparable to the sulfur content of natural gas.

Zinc and phosphorous can serve as tracers for some diesel emissions because they come from the additive in the lubricating oils used by some diesel engines.

However, diesel emission tracers such as zinc and phosphorous cannot represent all "diesel emission from trucks, train, and forklifts in the area." For instance, diesel truck and construction equipment engines do use lubricating oils with an additive that contains zinc and phosphorous, but locomotive engine lubricating oils do not include any additives containing zinc. Therefore, even if zinc (and phosphorous) can be used as the signatures for some diesel emissions, an absence of such signatures does not rule out other contributing sources of diesel emissions in the area, such as diesel emission from ships or locomotives.

The report's authors suggest (without presenting any supporting data) that shredder waste is known to contain "Lead (Pb), Copper (Cu), Zinc (Zn), Iron (Fe), Cadmium (Cd), Mercury (Hg), and Arsenic (As)." (Last paragraph, p. 36) The authors go on to suggest that since zinc is common to both diesel emission and shredder waste, the amount of zinc that is not associated with lead and iron (as they are the "unambiguous tracers" for shredder emissions) can be attributed to diesel emissions. The authors then report that every zinc peak but one (August 27) occurs with the "typical" shredder elements (i.e. lead and iron); therefore, the authors conclude, no impacts from diesel emissions are observed in the sample.

As discussed in an earlier section of this report, the validity of using lead and iron as the definitive tracers for the shredder is highly questionable, and is not supported by the data in the Delta Group Report. Moreover, the authors of the Delta Group Report do not provide an explanation for disregarding the zinc peak that occurred on August 27. If the August 27 zinc peak cannot be seen as an anomaly, the entire zinc profile may be an indication of additional, unknown emitting sources in the area. The authors did not provide sufficient data/reasoning to support the claim that all of the diesel emissions in the vicinity of Terminal Island and Wilmington can be distinguished from the shredder emissions.

[18] California Diesel Fuel Regulations (13 CCR 2281)

3. The conclusive evidence for "*all the lead seen in any wind direction is caused by shredder operations, current and past*" appears to be the strong iron-lead correlation in the coarse (10 to 5.0 µm) and intermediate (5.0 to 2.5 µm) aerosol modes.

The Delta Group Report authors hypothesize that the source of the coarse particles (10 to 5.0 µm) seen at Fire Station 49, even when the wind was blowing the shredder emissions away from the station, is fugitive or resuspended dust from years of contamination by the shredder. The authors did not provide any data to justify such a claim. It is unclear how the authors determined that the observed coarse mode particles were not recently generated by other lead-emitting sources in the area.

The authors then deduce that all of the lead seen in the area is caused by the shredder operation, current and past, since the iron-lead relationship of the coarse-mode particles from years of contamination is the same as that of the intermediate mode (5.0 to 2.5 µm), which the authors allege is only present when the shredder is running and the winds are from the south. Given the other well-documented sources of lead in the area, and the issues discussed above associated with claiming lead and iron as tracers for the shredder, the iron-lead relationship cannot serve as the definitive proof (or even any proof at all) for the shredder emissions. The same iron-lead relationships observed in the Delta Group Report can be, and in fact are more likely to be, the result of a combined impact of all lead and iron emitting sources in the area.

C. Principal Conclusion #3 of the Delta Group Report

"The presence of the very fine iron indicates a high energy and/or high temperature process, as iron from soil is essentially absent from aerosols below 1 µm in size. The fact that this tracks with very fine lead and occurs only on winds from the shredder identify the shredder as the source." [sic] (p. 31)

The Delta Group Report asserts, without presenting sufficient supporting data, that the very fine lead containing particles (< 0.25 µm) come from the shredder. As the authors mention that "[t]he fine mode lead has unknown sources, …" (below Figure 16, p.17), it is unclear where the authors establish the fact that very fine lead originates from the shredder; we imagine that this assertion is tied to the implication (throughout the entire report) that the shredder is the unique source for lead. As we discussed earlier, this implication is not supported by the monitoring data presented in the report, and the authors neglect to mention various lead emitting sources in the area, as discussed in the previous section.

Since the shredder operations are mechanical, it is unlikely (if not impossible) for the shredder to be the dominant source for the very fine particles (< 0.25 µm) measured at the Wilmington Fire Station. The size range of the very fine particles (< 0.25 µm) suggests that these particles were created through a combustion process rather than through the mechanical generation of dust particles. Dust particles are typically much larger in size. Therefore, it is doubtful that the shredder is the main source of very fine lead. The fact that the very fine iron tracks very fine lead (without additional supporting data) is insufficient to prove that they are coming from the same, single source. Moreover, the fact that very fine lead and iron occur only when winds are from the direction of the shredder does not prove that the

shredder is the only source for them, as the report also suggests that the ocean going ships using bunker oil as fuel are an upwind emitting source, according to the vanadium/nickel/sulfur results; other port activities at the nearby locations upwind of the shredder may also impact the measurements at the Wilmington sampling site. As shown above in Tables 2 and 3, diesel fuel combustion from port-related activities is a non-trivial source of lead emissions in the area.

In summary, there is no evidence to suggest, and the physics of particle formation contradict, the idea that a mechanical process such as shredding can generate very fine lead containing particles. Rather, the presence of very fine lead containing particles is almost certainly indicative of a combustion source where lead is contained in the material being combusted. Municipal solid waste and distillate fuels are two such examples.

D. Principal Conclusion #4 of the Delta Group Report

"The data indicate the presence of many metals measured at the Wilmington Fire Station 49, including lead, that occur in coarse particles that will readily settle onto the ground. The concentrations routinely exceed the DTSC limit of 1,000 ppm for all of the 3 size modes of particles larger than 1 µm particle diameter." (Executive Summary, second paragraph, p. 1)"

The Delta Group report compares the lead concentration in particulates collected at the Wilmington Fire Station 49 sampling site to the hazardous waste regulatory threshold for total lead. The report implies that airborne particulates (such as the coarse mode lead in the size range of 10 to 5.0 µm) will readily settle to the ground, and the settling of these particles, containing hazardous material, can be regarded as a disposal of hazardous waste. This theory does not reflect the aerodynamic characteristics of particles of this size. Furthermore, the comparison of measured concentrations of lead within ambient particulates with DTSC limits is wholly inappropriate. A comparison of the measured concentrations with ambient air criteria demonstrate that unhealthful levels of lead were not observed.

The fact that air emissions are not regulated as a hazardous waste is not an oversight or a technicality. Rather, emissions of criteria pollutants (such as particulate matter) and toxic air contaminants (such as lead) are regulated by agencies such as the U.S. Environmental Protection Agency (EPA), Air Resources Board (ARB), and local air quality districts (such as the South Coast Air Quality Management District, SCAQMD). In addition, occupational air quality standards are established by the California Division of Occupational Safety and Health (Cal/OSHA) and the Occupational Safety and Health Administration (OSHA) to protect worker safety.

The Clean Air Act requires the EPA to set National Ambient Air Quality Standards (NAAQS) to protect public health; the State of California has also established ambient air quality standards. For particulate matter (PM_{10} and $PM_{2.5}$), the standards are listed in Table 5.

Table 5. National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards for Particulate Matter

Pollutant	Federal EPA Standards[a]		CARB Standards[b]	Averaging Times
	Primary Standards[c]	Secondary Standards[d]		
Particulate Matter (PM_{10})	Revoked[e]		20 µg/m^3	Annual (Arithmetic Mean)
	150 µg/m^3 [f]		50 µg/m^3	24-hour
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3 [g]	Same as Primary	12 µg/m^3	Annual (Arithmetic Mean)
	35.0 µg/m^3 [h]		--	24-hour

[a] Obtained from EPA website: http://www.epa.gov/air/particlepollution/standards.html
[b] Obtained from CARB website: http://www.arb.ca.gov/research/aaqs/pm/pm.htm
[c] Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.
[d] Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.
[e] Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the agency revoked the annual PM_{10} standard in 2006 (effective December 17, 2006).
[f] Not to be exceeded more than once per year on average over 3 years.
[g] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
[h] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).

The US EPA has also established National Ambient Air Quality Standards (NAAQS), pursuant to the federal Clean Air Act, for pollutants that are considered harmful to public health and the environment. The NAAQS for lead are presented in Table 6.[19]

[19] There is a California Ambient Air Quality Standard for lead—it is 1.5 µg/m^3 on a 30-day average basis, and hence is much less stringent than the NAAQS of 0.15 µg/m^3 on a rolling 3-month average basis.

Table 6. National Ambient Air Quality Standards (NAAQS) for Lead

	Primary Standards[a]		Secondary Standards[b]	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Lead	0.15 µg/m^3	Rolling 3-month Average	Same as Primary	
	1.5 µg/m^3	Quarterly Average	Same as Primary	

Source: Obtained from EPA website: http://www.epa.gov/air/criteria.html

[a] Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.

[b] Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The average lead concentration in particulate matter collected over the entire Delta Group Study period was 1359 ppmw (parts per million, by weight) for particles of 10 µm and smaller. This concentration (as well as other, similar, concentrations presented in the Delta Group report), represents the ratio of the mass of lead (or other compounds of interest) to the mass of particulates in the size range specified. To translate these concentrations into values that can be compared with relevant air quality measures, these concentrations have to be multiplied by the average concentrations of particulate matter in ambient air for the same size range, and over the same time period.

Table 7 shows the 24-hour averaged PM_{10} measurements at the POLA Wilmington Monitoring Station[20]. This station is located at the Saints Peter and Paul Elementary School (SPPS) in the City of Wilmington. This is the closest air quality monitoring station to the Wilmington Fire Station Sampling site. The average PM_{10} concentration during the sampling period reported by the Delta Group was approximately 31.9 µg/m^3.

Combining the reported average lead concentration in PM_{10} (1359 ppmw) and the average PM_{10} concentration in the area (31.9 µg/m^3) results in an ambient concentration of 0.04 µg/m^3,[21] well below the NAAQS, which is applied on a 3-month average basis (recognizing that concentrations may be acceptably above the NAAQS for shorter time periods).

The California Division of Occupational Safety and Health (Cal/OSHA) Lead Standard[22] is largely identical to the Occupational Safety and Health Administration (OSHA) Lead Standard[23]. Both of them have set a

[20] 24-hr averaged PM_{10} measurements obtained from the San Pedro Bay Ports' Real-time Air Quality Monitoring Site (http://caap.airsis.com/) from August 14, 2008 to September 15, 2008.

[21] 31.9 µg/m^3 PM_{10} x 1359E-6 ppmw (lead in PM_{10}) = 0.043 µg/m^3 lead (PM_{10} size)

[22] California Code of Regulations, Title 8, Subchapter 7, 5198 (http://www.dir.ca.gov/title8/5198.html)

[23] Occupational Safety and Health Standards, Lead, 29 CFR Part 1910 subpart Z Standard Number 1910.1025 http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10030

Table 7. PM_{10} Concentrations at the POLA Wilmington Monitoring Station (8/15/2008 to 9/15/2008)

Date	PM_{10} ($\mu g/m^3$, 24-hr average)	Date	PM_{10} ($\mu g/m^3$, 24-hr average)
8/14/2008	38.2	9/1/2008	4.8
8/15/2008	33.3	9/2/2008	14.5
8/16/2008	28.7	9/3/2008	43.7
8/17/2008	28.8	9/4/2008	32.3
8/18/2008	28.3	9/5/2008	44.7
8/19/2008	27.6	9/6/2008	39.8
8/20/2008	28.8	9/7/2008	49.6
8/21/2008	25.7	9/8/2008	43.3
8/22/2008	22.5	9/9/2008	34.3
8/23/2008	34.9	9/10/2008	26.8
8/24/2008	29.7	9/11/2008	28.5
8/25/2008	31.2	9/12/2008	31.3
8/26/2008	38.8	9/13/2008	39.3
8/27/2008	34.0	9/14/2008	45.8
8/28/2008	49.7	9/15/2008	56.2
8/29/2008	31.2		
8/30/2008	3.4		
8/31/2008	4.6		

permissible exposure limit PEL (enforceable) of lead in workplace air at 50 $\mu g/m^3$ averaged over an 8-hour workday for workers in general industry, and an action level of lead at 30 $\mu g/m^3$ at 8-hour average. In contrast, the lead concentration in particulate matter reported by the Delta Group for "peak" periods was 3316 ppmw; this is equal to a nominal ambient concentration of 0.11 $\mu g/m^3$,[24] again well below the action level and the PEL of the Cal/OSHA and OSHA standards.

The data presented in the Delta Group Report do not support the conclusion that operation of the shredder facility constitutes a hazard to public health due to emissions of air pollutants from the facility. Rather, the data presented indicate ambient concentrations of lead measured at the Wilmington Fire Station are attributable to multiple emission sources that may or may not include the shredder facility and, nonetheless, are well within the state and federal ambient air quality standards, and are below all Cal/OSHA and OSHA action and exposure levels.

[24] 31.9 $\mu g/m^3$ PM_{10} x 3316E-6 ppmw (lead in PM_{10}) = 0.106 $\mu g/m^3$ lead (PM_{10} size)