An Analysis of Children's Blood Lead Levels in the Area Around the Exide Site

At the initial request of Cal EPA, the California Department of Public Health's Childhood Lead Poisoning Prevention Branch analyzed blood lead data for children living in the area around the Exide site located in the city of Vernon in Los Angeles County. The analysis area was chosen based on maps provided by the Department of Toxic Substances Control that showed census tracts within 1.3 miles, 1.7 miles and 2 miles from the Exide site. In order to identify children living in this area, we selected from our database individuals younger than six years of age at the time of their blood lead test during calendar year 2012 who lived in the following cities or zip codes:

Bell, Bell Gardens, Commerce, Cudahy, East Los Angeles, Huntington Park, Maywood, Vernon, Walnut Park.

Zip codes 90022, 90023, 90040, 90058, 90063, 90201, 90255, and 90270. These zip codes include the cities listed above as well as areas of the City of Los Angeles and unincorporated areas that are in the area of interest.

We will refer to this area as the Exide Analysis Area.

The Childhood Lead Poisoning Prevention Branch receives blood lead results from laboratories and other providers for all California residents. By law these results are submitted electronically. The lab data typically contains patient name, address, date of birth, provider and lab information, and lead test result, which may include the reporting threshold level (results are often reported as being below a certain threshold, such as "< 3.0 µg/dL") and the draw method (such as capillary or venous). The data are stored in a large relational database called RASSCLE.

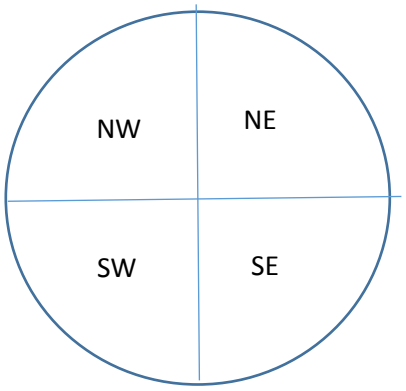
The study population comprised all children age younger than six years living in the Exide Analysis Area who had a blood lead test result reported to the State for a specimen obtained during 2012. The State works to ensure complete reporting of all blood lead analyses. Results that were not submitted to the State, however, would not be included in the analysis. Results were classified as having higher lead levels if they were ≥ 4.5µg/dL (micrograms of lead per deciliter of whole blood). In those occasions where a lab reported a result as "< 5 µg/dL" the result was classified in the < 4.5 group. Each individual was counted only once, using their highest blood lead level during 2012. The child's residence at the time of their highest BLL in 2012 was the one used for geographic analyses. We excluded the five results that were determined to be false positives, and also excluded duplicates and clerical errors. Children with higher BLLs who had a prior level of ≥ 4.5 at a different address were also excluded. A total of 11,702 children met the conditions for inclusion in the analysis. Of these, 285 (2.44%) had levels ≥ 4.5 µg/dL, and 18 (0.15%) had levels ≥ 9.5 µg/dL (the CDC's older level of concern).

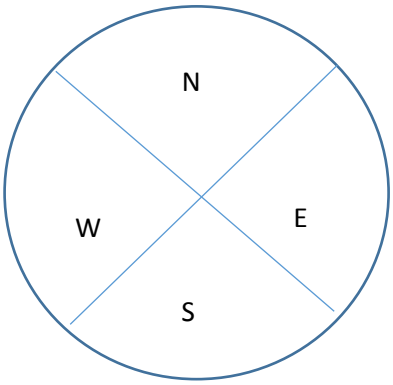
The Exide Analysis Area lies about five miles southeast of downtown Los Angeles. The area that is within a half a mile of the Exide site is primarily industrial and is crossed by numerous railroad lines and the Los Angeles River. Outside this area are mixed residential and industrial areas. Several of the busiest and oldest freeways in Southern California pass through these neighborhoods. Most homes and apartments were built before 1960. A very high proportion of the residents are Hispanic. In 2012, of 11,702 young children tested in the Analysis Area, the nearest child's residence was 0.62 miles from the plant, while the furthest residence from the Exide site was 4.4 miles.

We geocoded 97.6% of the children's addresses to a precise latitude and longitude, which allowed for calculation of the straight-line distance to the Exide site and the compass direction from the site. We were able to assign census tracts, based on the 2010 US Census boundaries, for 97.7%, including 98.2% of those with levels ≥ 4.5. Demographic data and housing characteristics for the census tracts were obtained from the US Census website using the five-year averages from the 2012 American Community Survey. Note that these data are self-reported by the resident. The number and proportion of children with higher BLLs and the location of the census tract with respect to the Exide site are shown in Table 1. We excluded from the table tracts with fewer than 50 young children tested that were outside a two-mile radius from the Exide site. There were three census tracts at least partly within the two-mile buffer zone in which fewer than 50 young children were tested. Data from these tracts were aggregated with adjacent tracts that had similar characteristics. No census tract had more than two children with blood lead levels ≥ 9.5 µg/dL. In seven of the tracts more than 5% of children had BLLs ≥ 4.5 (tracts 530901, 533602, 534403, 534803, 533701, 531602, and 532604), while six tracts had no children with BLLs above that level.

Looking first at the univariate effect of distance from the child's residence at the time of their blood draw, children with higher blood lead levels lived slightly nearer to the Exide site (Table 2a) and there was a moderate increase in risk associated with living less than a mile from the plant site (see Table 2b). The proportion of these children with levels of 4.5+ was 3.58%, compared with 2.41% among those who lived in the Analysis Area but farther than 1 mile from the plant (Odds ratio = 1.50, 95% confidence interval 0.85—2.65). For comparison, across all of Los Angeles County in 2012, 1.95% of children age younger than six years had BLLs above 4.5, and 0.22% had levels of 9.5+. A total of 363 children were tested who lived less than a mile from the plant, representing about 3% of the total number of young children in the full analysis. We divided the Analysis Area into five distance zones, with the first three zones based on the original 1.3, 1.7, and 2-mile buffers. Univariate risk of having a higher BLL generally decreased as the distance from the plant decreased, although the effects were smaller in Zones 2-4, with confidence intervals crossing an OR of 1 (see Table 2c). Note that the risk was higher for those living within 1.3 miles than for those living less than a mile. A number of the higher BLLs in the 1.0--1.3 mile range lived very near one of the freeways.

To assess the effect of direction we divided the study area into quadrants centered on the Exide site in two different ways to better identify effects that may overlap quadrants (see diagrams below).





In univariate analyses, the areas to the East and South and Southeast of the Exide site were at lowest risk, with the biggest contrast between the Northwest and Southeast quadrants. (Tables 2d and 2e)

Because the presence of lead hazards in a home is highly dependent on the age of the structure, we examined this risk in several ways: by the proportion of pre-1940 housing in the census tract, the proportion of pre-1950 housing, and the proportion of pre-1980 housing. The US Census reports this data in 10-year categories and a median for the entire tract. (Use of the actual year built for a sub-sample of the data is described below.) Housing built before 1980 is usually assumed to have some lead hazards as the lead content in consumer paint products was not strictly limited until 1978. Using each of the three different year-built cut points demonstrated the expected relation of age of housing stock to risk of higher blood lead levels. The univariate effects were most striking in the older housing groups. (See Tables 2f, 2g, and 2h). The proportion of children living in census tracts with > 40% of housing built before 1940 with BLLs of 4.5+ was 3.11%, compared with 1.87% of those who lived in tracts with < 20% pre-1940 residences (OR= 1.69, 95% CI 1.13—2.52).

Age, sex, race, and ethnicity are also important risk factors for lead exposure. We do not obtain race or ethnicity from the laboratory reports. Demographic characteristics of the census tract where the child lived were used as a proxy. The tracts in the Analysis Area have very high proportions of Hispanic residents. The number of children of other racial/ethnic groups was too few too analyze. Children living in tracts in which more than 95% of children younger than age five years were of Hispanic ethnicity, which accounted for 89% of the study population, had a proportion with BLLs of ≥ 4.5 of 2.54%, versus 1.62% in tracts in which fewer than 90% of the young children were Hispanic (OR=1.59, 95% CI 0.65—3.88). See Table 2i. As seen in other studies, young boys had a higher risk than girls: 2.70% had levels of 4.5 + vs. 2.15% of girls (OR 1.26, 95% CI 1.00-1.60) (See Table 2j) Most of the increase in risk among boys is due to the relatively higher risk in the two older age categories relative to girls (Tables 2l and 2m). Toddlers in the age groups from 9 months to 2.5 years had somewhat higher risk than those 2.5 through five years of age (Table 2k), although boys in the older age group continued to experience elevated risk (Tables 2l and 2m). Babies younger than 9 months had the highest risk; however, few children are routinely screened at this age unless there are reasons to suspect lead exposure, such as those born to a mother exposed during pregnancy, having a lead-poisoned sibling, or the presence of symptoms.

To account for differences in the effect of distance related to direction, we analyzed the effect within each compass quadrant (Table sets 3a and 3b). Using the N,S,E,W scheme we observe generally low levels in the East and South quadrants. The Long Beach Freeway (I-710) passes north-south through Zone 2 of the East quadrant. The South quadrant shows a monotonic decrease in risk as distance from the plant site increases. In the West, the most distant Zone had the highest risk. The condition of the homes in this area is generally poorer and there are a number of industrial metal recycling sites. In the North, there is a decreasing trend from the nearest to the farthest zones. A number of the higher BLLs in North Zone 1 were very near the Santa Ana Freeway (I-5). Analyses using the NW/NE/SW/SE scheme produced fairly similar results.

We used logistic regression models to look at the effects of multiple potential predictors simultaneously on the risk of having a higher BLL using SAS PROC LOGIST v.9.4. Variables were modelled categorically or, when appropriate, as continuous variables (See Table 4). The first set of models replicate the univariate analyses in Table 2. Median year built and distance are modeled as continuous variables, with the *b* coefficients representing the change in risk for each more recent calendar year the average residence in that tract was built and for each additional mile further away from the Exide site, respectively. We also modeled distance after transforming the variable based on the inverse of the distance squared as distance effects may diminish in a non-linear fashion. Models were constructed adding terms for known or potential confounders. Generally, the effects of distance became attenuated

when other predictors were added to the model, both in the magnitude of the distance effect and in higher *p* values. For example, the univariate effect of distance produced a *b* = -0.17 with a *p*-value of 0.03, while a more saturated model that also contained median year built, directional quadrant, age group, and sex reduced the *b* to -0.09 with a *p*-value of about 0.30. Some modest effect for living less than a mile from the plant site remained after controlling for other risk factors. Age of housing in the census tract remained an important predictor. Using the proportion of homes in the census tract built before 1940 or before 1950 were not better predictors than median year built. Increased risk of higher BLLs remained associated with living in the North and West quadrants relative to the South and East, and in the Northwest, Northeast, and Southwest quadrants relative to the Southeast.

In addition to the geographic analysis of the 11,702 children in the Exide Analysis Area, we performed a sub-study in which the actual age of the child's home was used instead of the US Census median age of housing data for their census tract (which was based on the residents' self reports). We attempted to obtain from the Los Angeles County Assessor's Office the year of construction for all the children with blood lead levels of 4.5 +, and a similarly sized sample of children with levels below 4.5. There was sufficient information to obtain the age of the home for 277 of 278 children with higher BLLs and 290 of 292 of the sampled children with lower levels. We then conducted analyses using standard case-control methodology and multivariate logistic regression modeling. (See table 5). Cases were more likely to live in older homes than controls. As in the larger data set, the effect of distance diminished substantially after controlling for confounding variables. A large increased risk was noted for living in a home built before 1925 (multivariate-adjusted OR = 2.00, 95% CI 1.37—2.91), while those living in more recently constructed dwellings had similar risk in the multivariate analyses.

Study Limitations and Strengths

Our analysis is limited to children younger than age six living in the defined geographic Analysis Area who were tested for lead during the year 2012. Results from other time periods may be different, as may analyses of the effects in older children or adults. In this analysis we only examined the determinants of higher blood lead levels, using a dichotomous outcome variable (BLL ≥4.5 µg/dL or < 4.5). Subtle changes in the mean levels of children's blood lead would not have been detectable using this method. Because so many results were reported as falling below a certain threshold level (such as "< 3.0 µg/dL") we were not able to estimate mean or median lead levels. Although we have blood results for over 11,000 children in the geographic area around the plant, fewer than 300 had levels ≥ 4.5 µg/dL. Consequently, when considering multiple factors at the same time, some cell sizes became quite small, limiting the precision of stratified and multivariate analyses. Some effect of distance from the Exide plant at a range of less than a mile, or less than 1.3 miles, remained after accounting for a number of other risk factors; however, there were relatively few observations in this area (for example, there were 13 children with BLLs ≥ 4.5 living within a mile of the plant), so the effect estimates are imprecise. We did not include in the analyses other potential determinants of risk, including proximity to freeways and busy surface streets, and the locations of other current or historic point source lead emitters. Further, data on cultural factors related to risk of elevated blood lead levels, such as use of traditional folk remedies containing lead, or use of lead-glazed ceramics in the home, were not available for these children.

Despite these limitations, our findings were consistent with expectations of known lead risk factors, providing important empiric validity. Our electronic blood lead reporting system captures a very high fraction of lead tests done on California children. We were able to successfully geocode a very high proportion of the children's home addresses, allowing precise calculation of the distance and compass direction from the Exide site for use in the analyses. Although we analyzed data from 2012 only, lead

deposits are usually not transient and can remain in the environment for decades. Although we could not calculate mean blood lead levels, large effects in mean levels due to the Exide plant should have also manifested to some degree in the distribution of higher blood lead levels. Our multivariate analyses were able to account for other important determinants in addition to the distance and direction from the Exide plant. The importance of the age of housing as an independent risk factor and potential confounder was reinforced in a case-control substudy we conducted that used the actual age of the child's residence. This substudy provided further validation of the multivariate analyses that found a diminished effect of distance from the plant on risk of higher blood lead levels when other risk factors were taken into account.

Table 1. Census tracts (2010 boundaries) of children age < 6 years tested in 2012 living in the Exide Analysis Area. Tracts with fewer than 50 children tested have been excluded or aggregated.

Census Tract (excludes "6037" prefix)	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	% Census tract in 1.3 mi Buffer	% Census tract in 1.7 mi Buffer	% Census tract in 2 mi Buffer	Notes
203200	0	51	0.00%				3 mi N (off map)
203800	5	132	3.79%				2.3 mi N
203900	2	72	2.78%		15%	65%	1.7--2.2 mi N
204110	3	71	4.23%				2.5 mi N/NW
204120	4	91	4.40%			50%	N/NW
204600* + 206050	3	80	3.75%				2--2.5 mi NW. *Counts aggregated with 206050
204700	2	144	1.39%		5%	35%	NW
204810	5	137	3.65%	1%	60%	97%	N/NW
204820	2	55	3.64%	15%	99%	100%	NW
204910	3	93	3.23%	35%	100%	100%	N
204920	2	75	2.67%	100%	100%	100%	N/NW
205110	4	147	2.72%		40%	85%	NW
205120	4	117	3.42%	35%	80%	99%	NW
206050*					2%	15%	NW *Counts aggregated with 204600
530301	1	50	2.00%				2.5--3 mi NE (off map)
530302	2	157	1.27%				2.5--3 mi NE (off map)
530500	1	106	0.94%				2.3--2.6 mi NE
530601	0	80	0.00%				2.5 mi N/NE
530700	1	59	1.69%				3.5 mi N
530801	10	201	4.98%				3 mi N
530802	0	77	0.00%				3 mi N
530901	7	115	6.09%				2.5 mi N
530902	4	106	3.77%				3 mi N
531000	5	153	3.27%				2.5 mi N/NE
531101	4	134	2.99%			30%	N
531102	3	108	2.78%			7%	N
531201	6	163	3.68%		40%	95%	N
531202	3	137	2.19%	5%	95%	100%	N

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531301	6	160	3.75%	50%	100%	100%	N/NE
531302	8	167	4.79%	95%	100%	100%	N/NE
531502	1	67	1.49%		60%	100%	NE
531503	2	86	2.33%		15%	40%	NE
531504	3	108	2.78%			25%	NE
531602	6	118	5.08%		15%	70%	NE
531603	1	104	0.96%				NE
531604	1	92	1.09%			5%	NE
531701	5	159	3.14%				NE
531702	1	146	0.68%		0%	40%	E/NE
531800	3	135	2.22%				2.5 mi E/NE (off map)
531901	1	167	0.60%				2.5 mi E/NE (off map)
531902	3	99	3.03%				2.5 mi E/NE (off map)
532302* + 532400	4	136	2.94%	65%	85%	98%	E/NE. Counts aggregated with 532400
532303	2	96	2.08%		10%	20%	75% off map
532304	4	99	4.04%	10%	20%	25%	50% off map
532400*				50%	65%	80%	Contains Exide site. 15% off map to W. *Counts aggregated with 532302
532500	1	109	0.92%		10%	70%	SW
532603	3	118	2.54%				2.3--2.5 mi SW (label off map)
532604	5	99	5.05%				2.3--2.5 mi SW
532605	2	95	2.11%				2--2.3 mi SW
532606	4	125	3.20%			5%	SW
533103	2	128	1.56%				SW
533104	3	131	2.29%				SW
533105	1	100	1.00%			30%	SW
533106	2	60	3.33%				2 -- 2.3 mi SW
533107	4	117	3.42%				2.2--2.4 mi S/SW
533201	0	83	0.00%		7%	95%	S/SW

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533202	1	76	1.32%			20%	S/SW
533203	2	58	3.45%				2.2 mi S/SW
533300	6	145	4.14%	100%	100%	100%	S/SW
533401	4	148	2.70%	100%	100%	100%	S
533402	2	107	1.87%	100%	100%	100%	S
533403	2	75	2.67%	50%	99%	100%	S/SE
533501	1	86	1.16%	10%	100%	100%	S/SW
533502*				10%	100%	100%	S *Counts aggregated with 533503
533503* + 533502	2	101	1.98%	5%	100%	100%	S/SE *Counts aggregated with 533502
533601	2	129	1.55%		25%	100%	S
533602	9	163	5.52%			50%	S
533603	3	223	1.35%				2.1--2.3 mi S
533701	6	113	5.31%	40%	100%	100%	SE
533702	2	120	1.67%		65%	100%	S/SE
533703	0	131	0.00%		15%	60%	SE
533803	1	160	0.63%			30%	SE
533804	3	135	2.22%			15%	SE (label not visible on map)
533805	1	99	1.01%				SE (label not visible on map)
533806	4	135	2.96%				SE (label not visible on map)
533901	2	188	1.06%				2.3--2.5 mi SE (not on map)
533902	1	124	0.81%				2.5 mi SE (not on map)
534001	4	166	2.41%				2.5 mi SE (not on map)
534002	1	139	0.72%				2.5 mi SE (not on map)
534101	1	57	1.75%				2.3 mi SE (label not visible on map)
534102	3	184	1.63%				2.4 mi SE (not on map)
534201	3	151	1.99%				2.7 mi SE (not on map)
534202	4	209	1.91%				2.7 mi SE (not on map)

Table 1. Census tracts (2010 boundaries) of children age < 6 years tested in 2012 living in the Exide Analysis Area. Tracts with fewer than 50 children tested have been excluded or aggregated.

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534203	1	102	0.98%				2.9 mi SE (not on map)
534301	0	150	0.00%				2.6 mi S/SE (not on map)
534302	1	116	0.86%				2.7 mi SE (not on map)
534403	5	92	5.43%				2.2--2.4 mi S
534404	1	131	0.76%				2.3--2.5 mi S/SE
534405	1	154	0.65%				2.3--2.5 mi S/SE (label not visible on map)
534406	1	137	0.73%				2.5 mi SE (not on map)
534501	5	165	3.03%				2.3--2.5 mi S/SW
534502	2	118	1.69%				2.2--2.4 mi S
534700	4	127	3.15%				2.3--2.5 mi SW
534802	2	106	1.89%				2.4--2.6 mi SW
534803	9	166	5.42%				2.5 mi SW
534804	4	127	3.15%				2.6 mi SW

Notes for blood lead data

Data from RASSCLE surveillance database archive of 12/17/2014. Some additional corrections have been made.

* Measures are in µg/dL (micrograms per deciliter) of whole blood

All results of blood lead analyses are reportable under California law, and the State works to ensure complete reporting. Results that are not submitted to the State, however, would not be included here.

Those blood lead levels reported from the analyzing laboratory as "< 5 µg/dL" are included in the category "BLL < 4.5"

Each individual is counted only once, using their highest blood lead level during 2012.

If an individual moved between two jurisdictions, then the child's residence at the time of their highest blood lead level is the one counted.

Includes census tracts with at least 50 children age < 6 years tested during 2012.

We were unable to identify the census tract for 270 children, including 5 with elevated lead levels.

* We aggregated blood lead result counts for census tracts that lie at least partly within a two-mile radius from the Exide site, but which had fewer than 50 children tested during 2012. Adjacent tracts with similar characteristics were aggregated.

Data should be considered as preliminary and subject to revision.

Table 2

Analysis based on children in the RASSCLE-2 database age < 6 years at the time of their blood draw in 2012
who had sufficient address information to geocode and census tract their location (n=11,705)
There was insufficient accurate information to geocode the addresses of 277 children.
Outcome variable is having had a blood lead level of 4.5 mcg/dL or greater during 2012, excluding false positive results.

2a.	**BLL ≥ 4.5**	**BLL < 4.5**	
Mean distance from Exide (in miles)	2.36	2.46	p-value for t-test of equal means = 0.03
Median distance from Exide (in miles)	2.45	2.52	
Distance from Exide (in miles)--Range	0.84--4.22	0.62--4.39	

2b.

Distance of child's home at time of blood draw from Exide site	**Children age < 6 years with BLL ≥ 4.5 in 2012**	**Total number of children age < 6 yrs with blood lead test in 2012**	**% of children with BLL ≥ 4.5**	**Odds Ratio**	**95% Confidence Interval**
< 1 mile	13	363	3.58%	1.50	0.85--2.65
≥ 1 mile	267	11,062	2.41%	ref	

2c.

Zone (distance of child's home at time of blood draw from Exide site)	**Children age < 6 years with BLL ≥ 4.5 in 2012**	**Total number of children age < 6 yrs with blood lead test in 2012**	**% of children with BLL ≥ 4.5**	**Odds Ratio**	**95% Confidence Interval**
1 (< 1.3 mi)	36	982	3.67%	1.82	1.19--2.77
2 (1.3--1.69 mi)	29	1,062	2.73%	1.34	0.85--2.10
3 (1.7--1.99 mi)	28	1,249	2.24%	1.09	0.69--1.73
4 (2.0--2.99 mi)	129	5,308	2.43%	1.19	0.87--1.63
5 (3.0--4.5 mi)	58	2,824	2.05%	ref.	
Total	280	11,425	2.45%		

2d

Quadrant (distance of child's home at time of blood draw from Exide site)	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
East (NE - SE)	41	2,036	2.01%	1.10	0.75--1.63
West (NW - SW)	76	2,590	2.93%	1.70	1.24--2.33
North (NW - NE)	96	3,134	3.06%	1.62	1.16--2.26
South (SW- SE)	67	3,665	1.83%	ref.	
Total	280	11,425	2.45%		

2e.

Quadrant (distance of child's home at time of blood draw from Exide site)	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
Northwest (W - N)	39	1,226	3.18%	1.98	1.31--2.98
Northeast (N - E)	96	3,574	2.69%	1.66	1.19--2.31
Southwest (S - W)	88	3,141	2.80%	1.73	1.24--2.43
Southeast (E - S)	57	3,484	1.64%	ref.	
Total	280	11,425	2.45%		

2f.

Percent of housing in census tract built before 1940	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
< 20%	72	3,856	1.87%	ref.	
20% - 29.9%	72	2,898	2.48%	1.34	0.96--1.86
30 - 39.9%	98	3,461	2.83%	1.53	1.13--2.08
> 40%	37	1,189	3.11%	1.69	1.13--2.52
Total	279	11,404	2.45%		

2g.

Percent of housing in census tract built before 1950	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
< 30%	38	2,248	1.69%	ref.	
30% - 39.9%	45	1,587	2.84%	1.70	1.10--2.63
40 - 59.9%	161	6,440	2.50%	1.49	1.05--2.13
> 60%	35	1,129	3.10%	1.86	1.17--2.96
Total	279	11,404	2.45%		

2h.

Percent of housing in census tract built before 1980	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
< 70%	24	1,259	1.91%	ref.	
70% - 79.9%	19	1,125	1.69%	0.88	0.48--1.62
80 - 89.9%	101	3,899	2.59%	1.37	0.87--2.15
> 90%	135	5,121	2.64%	1.39	0.90--2.16
Total	279	11,404	2.45%		

2i.

Percent of children age < 5 years in census tract who were Hispanic	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
< 90%	5	309	1.62%	ref.	
90% - 94.9%	17	991	1.72%	1.06	0.39--2.90
95% - 100%	257	10,099	2.54%	1.59	0.65--3.88
Total	279	11,399	2.45%		

2j.

Sex	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
Female	123	5,708	2.15%	ref.	
Male	162	5,993	2.70%	1.26	1.00--1.60
Total	285	11,701	2.44%		

2k.

Age Group	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
< 9 months	2	46	4.35%	2.24	0.54--9.39
9 mos -- 1.49 yrs	103	3,874	2.66%	1.35	1.02--1.79
1.5 -- 2.49 yrs	85	2,998	2.84%	1.44	1.07--1.94
2.5 -- 5.99 yrs	95	4,784	1.99%	ref.	
Total	285	11,702	2.44%		

2l. Among Girls

Age Group	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
< 9 months	2	20	10.00%	7.38	1.65--33.0
9 mos -- 1.49 yrs	50	1,841	2.72%	1.85	1.20--2.87
1.5 -- 2.49 yrs	36	1,488	2.42%	1.65	1.03--2.63
2.5 -- 5.99 yrs	35	2,359	1.48%	ref	
Total	123	5,708	2.15%		

2m. Among Boys

Age Group	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL ≥ 4.5	Odds Ratio	95% Confidence Interval
< 9 months	0	26	0.00%	undefined	--
9 mos -- 1.49 yrs	53	2,032	2.61%	1.06	0.73--1.54
1.5 -- 2.49 yrs	49	1,510	3.25%	1.32	0.90--1.94
2.5 -- 5.99 yrs	60	2,425	2.47%	ref	
Total	162	5,993	2.70%		

Data is preliminary and subject to change

The relation of distance and direction from Exide site to risk of elevated blood lead levels among children < 6 years of age tested in 2012

Table 3a

Zone (distance of child's home at time of blood draw from Exide site)	EAST QUAD: Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval	WEST QUAD: Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval
1 (< 1.3 mi)	2	113	1.77%	0.92	0.21--4.12	10	331	3.02%	0.55	0.26--1.19
2 (1.3--1.69 mi)	4	145	2.76%	1.45	0.47--4.48	4	154	2.60%	0.47	0.16--1.40
3 (1.7--1.99 mi)	4	213	1.88%	0.98	0.32--3.01	7	277	2.53%	0.46	0.19--1.10
4 (2.0--2.99 mi)	17	834	2.04%	1.07	0.52--2.18	34	1,435	2.37%	0.43	0.25--0.75
5 (3.0--4.5 mi)	14	731	1.92%	ref		21	393	5.34%	ref	
Total	41	2,036	2.01%			76	2,590	2.93%		

Zone (distance of child's home at time of blood draw from Exide site)	NORTH QUAD: Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval	SOUTH QUAD: Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval
1 (< 1.3 mi)	17	340	5.00%	5.05	1.85--13.8	7	198	3.54%	2.44	1.01--5.92
2 (1.3--1.69 mi)	16	520	3.08%	3.05	1.11--8.38	5	243	2.06%	1.40	0.51-3.80
3 (1.7--1.99 mi)	11	461	2.39%	2.35	0.81--6.81	6	298	2.01%	1.37	0.54--3.47
4 (2.0--2.99 mi)	47	1,328	3.54%	3.52	1.39--8.91	31	1,711	1.81%	1.23	0.68--2.20
5 (3.0--4.5 mi)	5	480	1.04%	ref		18	1,215	1.48%	ref	
Total	96	3,129	3.07%			60	3,665	1.64%		

The relation of distance and direction from Exide site to risk of elevated blood lead levels among children < 6 years of age tested in 2012 Table 3b

Northwest (W - N) QUAD

Zone (distance of child's home at time of blood draw from Exide site)	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval
1 (< 1.3 mi)	6	130	4.62%	1.46	0.56--3.81
2 (1.3--1.69 mi)	9	278	3.24%	1.01	0.44--2.32
3 (1.7--1.99 mi)	8	319	2.51%	0.78	0.33--1.84
4 (2.0--2.99 mi)	16	461	3.47%	ref*	
5 (3.0--4.5 mi)	0	38	0.00%		
Total	39	1,226	3.18%		

*** Aggregated zones 4+5 as ref**

Northeast (N - E) QUAD

Zone (distance of child's home at time of blood draw from Exide site)	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval
1 (< 1.3 mi)	14	324	4.32%	2.78	1.29--5.98
2 (1.3--1.69 mi)	12	384	3.13%	1.99	0.90--4.39
3 (1.7--1.99 mi)	8	396	2.02%	1.27	0.52--3.09
4 (2.0--2.99 mi)	49	1,657	2.96%	1.88	1.01--3.48
5 (3.0--4.5 mi)	13	813	1.60%	ref	
Total	96	3,574	2.69%		

Southwest (S - W) QUAD

Zone (distance of child's home at time of blood draw from Exide site)	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval
1 (< 1.3 mi)	9	329	2.74%	0.54	0.24--1.20
2 (1.3--1.69 mi)	2	129	1.55%	0.30	0.07--1.31
3 (1.7--1.99 mi)	6	253	2.37%	0.47	0.19--1.17
4 (2.0--2.99 mi)	50	2,005	2.49%	0.49	0.29--0.83
5 (3.0--4.5 mi)	21	425	4.94%	ref	
Total	88	3,141	2.80%		

Southeast (E - S) QUAD

Zone (distance of child's home at time of blood draw from Exide site)	Children age < 6 years with BLL ≥ 4.5 in 2012	Total number of children age < 6 yrs with blood lead test in 2012	% of children with BLL≥ 4.5	Odds Ratio	95% Confidence Interval
1 (< 1.3 mi)	7	199	3.52%	2.32	0.98--5.45
2 (1.3--1.69 mi)	6	271	2.21%	1.44	0.58--3.55
3 (1.7--1.99 mi)	6	281	2.14%	1.39	0.56--3.42
4 (2.0--2.99 mi)	14	1,185	1.18%	0.76	0.39--1.47
5 (3.0--4.5 mi)	24	1,548	1.55%	ref	
Total	57	3,484	1.64%		

Data is preliminary and subject to change

Table 4
Logistic regression models

Outcome = BLL ≥ 4.5

Variables in model	*b*	Odds Ratio	95% Confidence Interval	*p* value
Univariate analyses				
Age				
< 9 months	0.81	2.24	0.54--9.39	0.27
9 mos -- 1.49 yrs	0.30	1.35	1.02--1.79	0.04
1.5 -- 2.49 yrs	0.36	1.44	1.07--1.94	0.02
2.5 -- 5.99 yrs	ref	ref		
Female	ref	ref		
Male	0.23	1.26	1.00--1.60	0.06
Zone				
Zone 1 (vs 5)	0.60	1.82	1.19--2.77	0.01
Zone 2 (vs 5)	0.29	1.34	0.85--2.10	0.21
Zone 3 (vs 5)	0.09	1.09	0.69--1.73	0.70
Zone 4 (vs 5)	0.17	1.19	0.87--1.63	0.28
Quadrant				
East (vs S)	0.09	1.10	0.75--1.63	0.62
North (vs S)	0.52	1.70	1.24--2.33	<0.01
West (vs S)	0.48	1.62	1.16--2.26	<0.01
Northeast (vs SE)	0.51	1.66	1.19--2.31	<0.01
Northwest (vs SE)	0.68	1.98	1.31--2.98	<0.01
Southwest (vs SE)	0.55	1.73	1.24--2.43	<0.01
Distance (in miles)	-0.17	0.84	0.72--0.98	0.03
Inverse of Distance squared (in miles)	0.45	1.57	1.05--2.35	0.03
Median year built (Census Tract)	-0.02	0.98	0.96--0.99	< 0.01
Controlling for distance and median year built simulaneously				
Distance (in miles)	-0.13	0.88	0.75--1.03	0.10
Median year built (Census Tract)	-0.02	0.98	0.97--0.99	< 0.01

Controlling for distance and quadrant simulaneously				
Models used 11,404 observations				
Distance (in miles)	-0.10	0.90	0.77--1.06	0.22
East (vs S)	0.10	1.11	0.75--1.64	0.62
North (vs S)	0.48	1.62	1.17--2.24	<0.01
West (vs S)	0.45	1.57	1.12--2.20	0.01
Distance (in miles)	-0.09	0.91	0.77--1.07	0.26
Northeast (vs SE)	0.47	1.60	1.15--2.24	0.01
Northwest (vs SE)	0.60	1.83	1.19--2.82	0.01
Southwest (vs SE)	0.51	1.67	1.19--2.36	<0.01
Controlling for zone and quadrant simulaneously				
Models used 11,425 observations				
Zone 1 (vs 5)	0.44	1.55	1.01--2.39	0.05
Zone 2 (vs 5)	0.14	1.16	0.73--1.83	0.54
Zone 3 (vs 5)	-0.04	0.97	0.61--1.53	0.88
Zone 4 (vs 5)	0.08	1.09	0.79--1.50	0.61
East (vs S)	0.10	1.11	0.75--1.64	0.61
North (vs S)	0.49	1.64	1.19--2.26	<0.01
West (vs S)	0.44	1.56	1.11--2.18	0.01
Zone 1 (vs 5)	0.41	1.51	0.98--2.33	0.06
Zone 2 (vs 5)	0.11	1.12	0.70--1.79	0.64
Zone 3 (vs 5)	-0.11	0.90	0.56--1.44	0.66
Zone 4 (vs 5)	0.00	0.92	0.67--1.27	1.00
Northeast (vs SE)	0.49	1.63	1.17--2.29	<0.01
Northwest (vs SE)	0.66	1.93	1.25--2.99	<0.01
Southwest (vs SE)	0.53	1.70	1.20--2.42	<0.01

Controlling for quadrant, distance and median year built simulaneously
Models used 11,425 observations
Models used 11,432 observations

Distance	-0.10	0.91	0.77--1.07	0.25
East (vs S)	0.01	1.01	0.68--1.52	0.95
North (vs S)	0.38	1.46	1.03--2.06	0.03
West (vs S)	0.34	1.41	0.98--2.02	0.09
Median year built	-0.01	0.99	0.97--1.00	0.06
Distance	-0.10	0.91	0.77--1.07	0.26
Northeast (vs SE)	0.36	1.43	0.99--2.05	0.05
Northwest (vs SE)	0.49	1.64	1.04--2.58	0.03
Southwest (vs SE)	0.41	1.50	1.04--2.17	0.03
Median year built	-0.01	0.99	0.97--1.00	0.14

Controlling for quadrant, distance, median year built, child's age group, and sex simulaneously

Distance (in miles	-0.09	0.88	0.78--1.08	0.29
East (vs S)	0.01	1.01	0.67--1.51	0.96
North (vs S)	0.36	1.44	1.02--2.03	0.04
West (vs S)	0.35	1.42	0.99--2.03	0.06
Median year built	-0.02	0.99	0.97--1.00	0.06
Age < 9 months (vs 2.5--5.99 yrs)	0.81	2.25	0.54--9.48	0.27
Age 9 mos -- 1.49 yrs (vs 2.5--5.99 yrs)	0.32	1.38	1.04--1.84	0.03
Age 1.5 -- 2.49 yrs (vs 2.5--5.99 yrs)	0.39	1.48	1.10--2.00	0.01
Male (vs Female)	0.21	1.24	0.97--1.57	0.08
Inverse of Distance squared (in miles)	0.32	1.38	0.91--2.09	0.14
East (vs S)	0.00	1.00	0.67--1.50	0.98
North (vs S)	0.36	1.43	1.01--2.03	0.04
West (vs S)	0.34	1.40	0.97--2.01	0.07
Median year built	-0.01	0.99	0.97--1.00	0.04
Age < 9 months (vs 2.5--5.99 yrs)	0.83	2.29	0.54--9.61	0.26
Age 9 mos -- 1.49 yrs (vs 2.5--5.99 yrs)	0.32	1.38	1.04--1.84	0.03
Age 1.5 -- 2.49 yrs (vs 2.5--5.99 yrs)	0.39	1.48	1.09--2.00	0.01
Male (vs Female)	0.21	1.23	0.97--1.57	0.08

Distance	-0.09	0.92	0.78--1.08	0.30
Northeast (vs SE)	0.35	1.42	0.99--2.04	0.06
Northwest (vs SE)	0.48	1.62	1.03--2.55	0.04
Southwest (vs SE)	0.42	1.52	1.05--2.19	0.03
Median year built	-0.01	0.99	0.97--1.00	0.15
Age < 9 months (vs 2.5--5.99 yrs)	0.81	2.24	0.53--9.40	0.27
Age 9 mos -- 1.49 yrs (vs 2.5--5.99 yrs)	0.33	1.39	1.05--1.86	0.02
Age 1.5 -- 2.49 yrs (vs 2.5--5.99 yrs)	0.40	1.49	1.10--2.02	0.01
Male (vs Female)	0.21	1.23	0.97--1.57	0.09
Controlling for quadrant, distance, proportion pre-1940 housing, child's age group and sex simulaneously				
Distance (in miles	-0.07	0.93	0.79--1.09	0.36
East (vs S)	0.06	1.07	0.71--1.59	0.76
North (vs S)	0.39	1.48	1.03--2.11	0.03
West (vs S)	0.39	1.48	1.04--2.11	0.03
20% - 29.9% pre-1940 housing (vs < 20%)	0.19	1.15	0.81--1.63	0.27
30 - 39.9% pre-1940 housing (vs < 20%)	0.25	1.22	0.87--1.72	0.14
> 40% pre-1940 housing (vs < 20%)	0.32	1.21	0.77--1.91	0.14
Age < 9 months (vs 2.5--5.99 yrs)	0.81	2.25	0.54--9.46	0.27
Age 9 mos -- 1.49 yrs (vs 2.5--5.99 yrs)	0.32	1.38	1.04--1.84	0.03
Age 1.5 -- 2.49 yrs (vs 2.5--5.99 yrs)	0.39	1.48	1.10--2.00	0.01
Male (vs Female)	0.21	1.23	0.97--1.57	0.08
Controlling for quadrant, distance, proportion pre-1950 housing, child's age group and sex simulaneously				
Distance (in miles	-0.07	0.93	0.79--1.09	0.40
East (vs S)	0.05	1.07	0.71--1.59	0.79
North (vs S)	0.38	1.48	1.03--2.11	0.05
West (vs S)	0.35	1.48	1.04--2.11	0.03
30% - 39.9% pre-1950 housing (vs < 30%)	0.26	1.15	0.81--1.63	0.30
40 - 59.9% pre-1950 housing (vs < 30%)	0.14	1.22	0.87--1.72	0.50
> 60% pre-1950 housing (vs < 30%)	0.26	1.21	0.77--1.91	0.35
Age < 9 months (vs 2.5--5.99 yrs)	0.80	2.25	0.54--9.46	0.27
Age 9 mos -- 1.49 yrs (vs 2.5--5.99 yrs)	0.33	1.38	1.04--1.84	0.03
Age 1.5 -- 2.49 yrs (vs 2.5--5.99 yrs)	0.39	1.48	1.10--2.00	0.01
Male (vs Female)	0.21	1.23	0.97--1.56	0.08

Controlling for quadrant, distance < 1 mile to Exide site, median age of housing, child's age group and sex simulaneously				
Distance < 1 mile	0.32	1.40	0.79--2.28	0.28
East (vs S)	0.00	1.01	0.67--1.51	0.98
North (vs S)	0.38	1.47	1.04--2.08	0.03
West (vs S)	0.35	1.42	0.99--2.04	0.06
Median year built	-0.02	0.99	0.97--1.00	0.04
Age < 9 months (vs 2.5--5.99 yrs)	0.82	2.26	0.54--9.51	0.27
Age 9 mos -- 1.49 yrs (vs 2.5--5.99 yrs)	0.33	1.39	1.04--1.85	0.03
Age 1.5 -- 2.49 yrs (vs 2.5--5.99 yrs)	0.40	1.48	1.10--2.01	0.01
Male (vs Female)	0.21	1.24	0.97--1.57	0.08

Controlling for quadrant, distance < 1 mile to Exide site, median age of housing, child's age group and sex simulaneously				
Distance < 1 mile	0.36	1.44	0.81--2.54	0.21
Northeast (vs SE)	0.37	1.45	1.01--2.08	0.05
Northwest (vs SE)	0.55	1.73	1.11--2.68	0.02
Southwest (vs SE)	0.43	1.54	1.06--2.21	0.02
Median year built	-0.01	0.99	0.97--1.00	0.14
Age < 9 months (vs 2.5--5.99 yrs)	0.81	2.24	0.53--9.41	0.27
Age 9 mos -- 1.49 yrs (vs 2.5--5.99 yrs)	0.33	1.39	1.05--1.86	0.02
Age 1.5 -- 2.49 yrs (vs 2.5--5.99 yrs)	0.40	1.49	1.10--2.02	0.01
Male (vs Female)	0.21	1.23	0.97--1.56	0.09

Table 5
Case Control substudy using actual age of home

Using Los Angeles County Tax Assessor's records we recorded the actual age of housing for 270 cases (with BLLs >= 4.5) and 290 controls.

	Cases	Controls	
Year of construction (mean)	1937	1943	p-value for t-test of equal means < 0.01
Year of construction (median)	1930	1941	
Year Built Range	1885--2008	1903--2012	
Mean distance from Exide (in miles)	2.36	2.45	p-value for t-test of equal means = 0.17
Median distance from Exide (in miles)	2.45	2.60	
Distance from Exide (in miles)--Range	0.84--4.22	0.82--4.39	

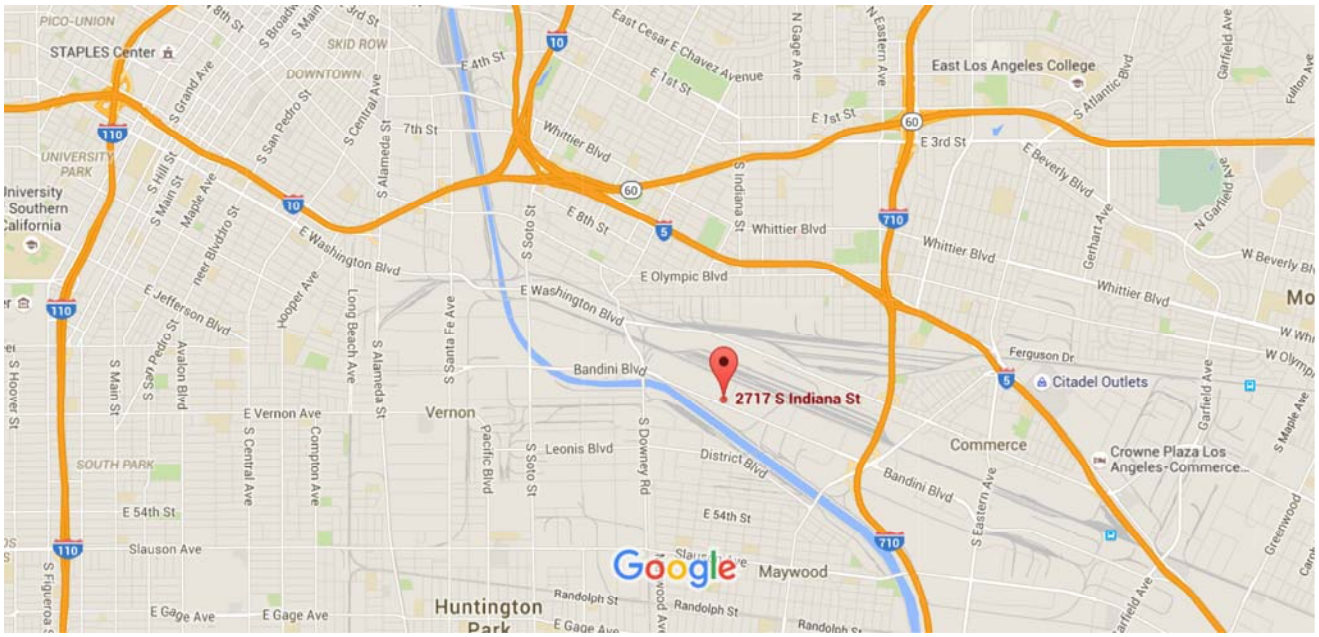
Outcome = BLL ≥ 4.5

Variables in model	***b***	**Odds Ratio**	**95% Confidence Interval**	***p* value**
Distance (in miles)	-0.15	0.86	0.70--1.07	0.17
Inverse of Distance squared	0.30	1.35	0.74--2.45	0.32
Distance < 1 mile from Exide	0.05	1.05	0.48--2.31	0.89
Median year built (Tract)	-0.02	0.98	0.96--0.99	<0.01
Actual year of construction	-0.01	0.99	0.98--1.00	<0.01
Home built prior to 1925 (vs 1925+)	0.80	2.22	1.55--3.17	<0.01
Home built prior to 1979 (vs 1979 +)	0.24	1.27	0.65--2.49	0.49
Home built prior to 1925 (vs 1979+)	0.83	2.31	1.13--4.75	0.03
Home built 1925 -1949 (vs 1979+)	-0.07	0.93	0.46--1.88	0.84
Home built 1950 -1978 (vs 1979+)	-0.01	0.99	0.48--2.07	0.98
Controlling for distance and actual year built simultaneously				
Distance (in miles)	-0.10	0.91	0.73--1.12	0.36
Actual year of construction	-0.01	0.99	0.98--1.00	<0.01

Controlling for distance and quadrant simultaneously				
Distance	-0.10	0.90	0.77--1.0	0.22
East (vs S)	0.10	1.11	0.75--1.64	0.62
North (vs S)	0.48	1.62	1.17--2.24	<0.01
West (vs S)	0.45	1.57	1.12--2.20	0.01
Distance	-0.05	0.95	0.76--1.19	0.66
Northeast (vs SE)	0.65	1.91	1.21--3.00	0.01
Northwest (vs SE)	0.80	2.22	1.20--4.11	0.01
Southwest (vs SE)	0.35	1.42	0.91--2.22	0.12
Controlling for distance, quadrant and actual year built simultaneously				
Distance	-0.03	0.97	0.77--1.21	0.77
East (vs S)	0.07	1.07	0.64--1.79	0.80
North (vs S)	0.60	1.82	1.15--2.89	0.01
West (vs S)	0.25	1.28	0.81--2.02	0.28
Actual year built	-0.01	0.99	0.98--1.00	0.01
Distance	-0.04	0.97	0.77--1.21	0.76
Northeast (vs SE)	0.55	1.73	1.09--2.75	0.02
Northwest (vs SE)	0.60	1.82	0.96--3.44	0.06
Southwest (vs SE)	0.25	1.29	0.82--2.03	0.27
Actual year built	-0.01	0.99	0.98--1.00	0.01

Controlling for distance, quadrant and home built pre-1925 simultaneously				
Distance	-0.02	0.98	0.79--1.23	0.88
East (vs S)	0.13	1.15	0.68--1.93	0.60
North (vs S)	0.53	1.70	1.06--2.71	0.03
West (vs S)	0.30	1.35	0.86--2.13	0.19
Home built pre-1925	0.68	1.97	1.35--2.88	<0.01
Distance	-0.02	0.98	0.79--1.23	0.89
Northeast (vs SE)	0.51	1.67	1.05--2.66	0.03
Northwest (vs SE)	0.49	1.64	0.86--3.12	0.13
Southwest (vs SE)	0.23	1.26	0.80--1.99	0.32
Home built pre-1925	0.69	2.00	1.37--2.91	<0.01

Google Maps 2717 S Indiana St



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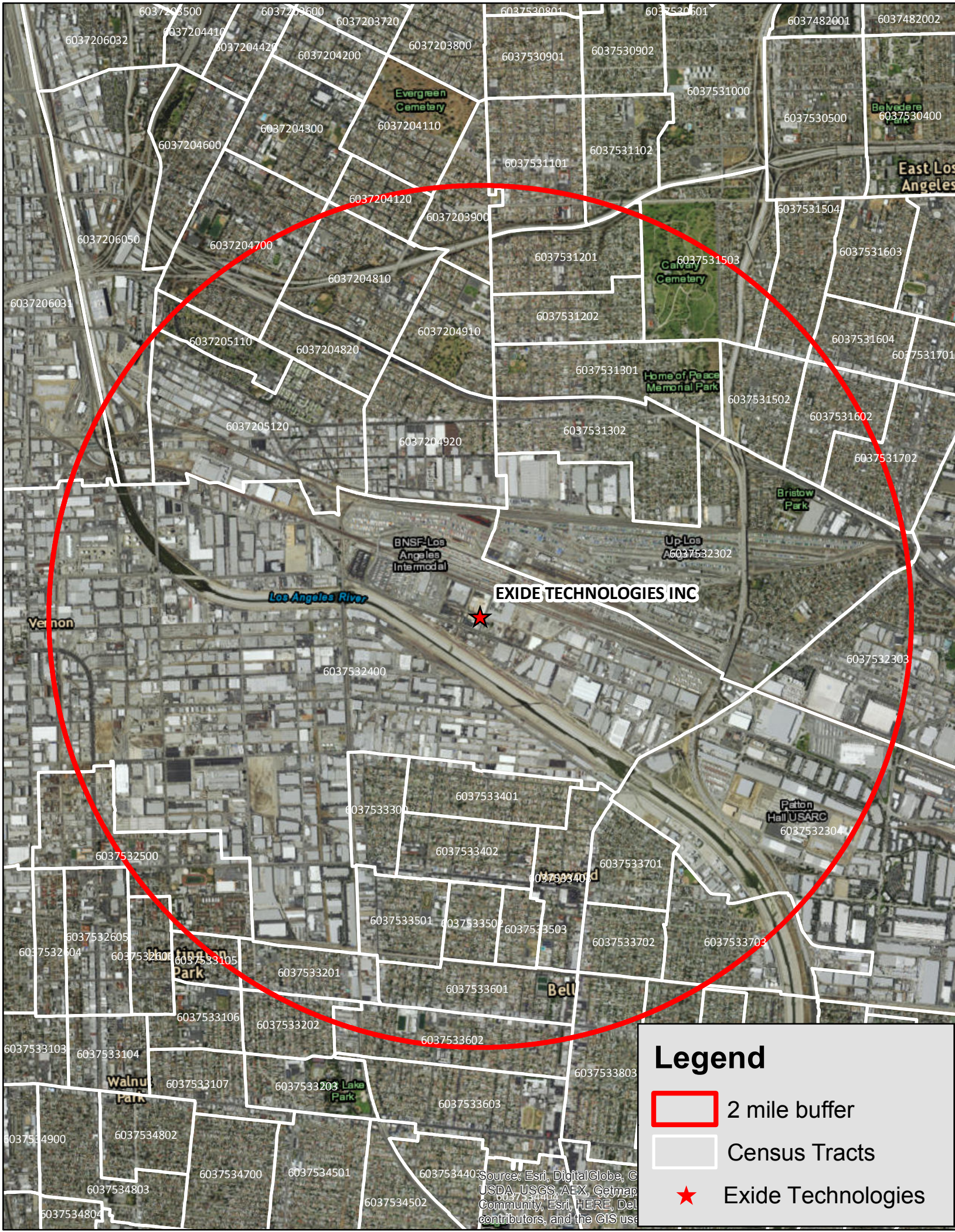
EXIDE TECHNOLOGIES INC
Legend
2 mile buffer
Census Tracts
Exide Technologies
Los Angeles River
Vernon
BNSF-Los Angeles Intermodal
Evergreen Cemetery
Calvary Cemetery
Home of Peace Memorial Park
Bristow Park
Patton Hall USARC
East Los Angeles
Walnut Park
Source: Esri, DigitalGlobe, G
USDA, USGS, AEX, Getmap
Community, Esri, HERE, Del
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