"DISTRIBUTION OF LEAD IN SOIL WITHIN A THREE SQUARE MILE AREA OF WEST OAKLAND"

(A Summary Report of a Study Conducted in June 1976)

A Study Conducted By:

George Prziborowski and Howard Okamoto

Bureau of Environmental Health Planning
Division of Environmental Health
Alameda County Health Care Services Agency

INTRODUCTION

Within the two year period prior to the start of this study, several cases of pediatric lead poisoning had been reported in the Oakland area by the Alameda County Health Agency's Lead Project. In the project's "target area", children with lead poisoning are invariably found in run-down neighborhoods. In these neighborhoods, some young children engage in habitual eating of non-food substances (pica), some of which contain lead.

A heavily traveled freeway (Highway 17) bisects the Lead Project's "target area", and the area is generally composed of homes ranging in age from 80 to 100 years old. Also, the area is mixed with numerous industrial businesses.

The Agency's Lead Project has screened over 1,200 children for elevated blood lead levels in the "target area" in West Oakland. The project personnel investigating the environmental conditions related to pediatric lead poisonings have been unable, in some cases, to ascertain whether lead-based paint is the only source of poisoning. In some of the elevated lead cases, the children were not suspected of eating lead-based paint. It was suspected that the soil in the play areas next to the children's homes contained high concentrations of lead and might serve as a source of lead poisoning.

Soil samples were collected from areas adjacent to the homes of the poisoned children and analyzed for lead content.

OBJECTIVE

This surface soil survey was undertaken for the following reason:

To determine the range and general distribution of lead concentrations in surface soils in the vicinity of the Alameda County Lead Project's "target area" and nearby locations.

MATERIALS & METHODS

Approximately 2.5 cm. in depth of top soil was collected by the investigators using a round auger (2 cm. in diameter) as a sampling device. Plastic bags were used to store and transport the soil samples.

Sixty-six soil samples were collected from sites in and near the Lead Project Area as marked on the attached map. Lead concentrations are recorded in parts per million (ppm). Samples were collected in the general area where three cases of pica had previously been discovered and in outdoor play areas of children reported to have had high blood lead levels. Also, samples were collected in the vicinity of freeways and heavily traveled streets that crisscross the area. The total sampling area covered approximately 3 square miles.

Preparatory treatment of the soil samples was carried out in the Environmental Laboratory as follows: the samples were crushed, sifted through a 0.023 inch opening mesh screen and dried at 105°C in a forced air oven until a constant weight was obtained. Extraction* of lead from the soil was done as follows: two grams of sample were transferred to a 50 ml. centrifuge tube. Twenty ml. of 10% HNO_3 were added and the soil was put into suspension using a glass rod to stir the mixture. The sample was placed in a boiling water bath for one hour, shaken and stirred occasionally. The soil was centrifuged down and decanted quantitatively into a 50 ml. volumetric flask. Ten ml. of hot deionized water was added to the centrifuge tube, stirred until the sample was back in suspension, centrifuged down and the supernatant transferred into the volumetric flask containing the acid extract. The washing operation was carried out two more times. The extract was

*The extraction procedure was based on the method developed by the Air and Industrial Hygiene Laboratory, State of California Department of Health, Berkeley, CA.

cooled and adjusted to volume. The volumetric content was mixed and filtered through Whatman 41 filter paper.

An absorbance calibration curve was obtained using Pb standards in 4% HNO_3 solution. A Model 403 Perkin-Elmer absorption spectrophotometer was used to perform the analyses in the Environmental Protection Agency's Alameda laboratory.

RESULTS

Lead values of 66 surface soil samples varied widely, ranging from 28 to 6340 ppm in lead content. The mean lead concentration of the 66 values is 1403 ppm lead. Twenty-two of the 66 surface samples (33%) collected were obtained in the yards of children reported to have high blood lead levels. These samples ranged in lead concentration from 399 to 4181 ppm lead, with a mean value of 1040 ppm. A summary of all samples collected and those collected from the yards of children with high blood lead levels is tabulated in Tables 1 and 2 below. Sampling locations are indicated in Table 3.

Table 1 - All Samples

Range of Lead Content (ppm)	No. of Samples	% of Total	Average ppm Lead
0 - 500	18	27.3	279
501 - 1000	18	27.3	763
1000 - 6340	30	45.4	2462
Total	60	100.0	

Table 2 - Yards of Children With High Blood Lead Levels

Range of Lead Content (ppm)	No. of Samples	% of Total No. of Yards	Average ppm Lead
0 - 500	5	22.7	451
501 - 1000	11	50.0	780
1001 - 4181	6	27.3	2008
Total	22	100.0	

Table 3 - Sample Locations and Analytical Results

Address	Lead Content (ppm)
3rd & Myrtle Streets, Oakland	207
3rd & Cypress Streets, Oakland	718
5th & Pine Streets, Oakland	128
5th & Magnolia Streets, Oakland	690
6th Street between Brush & Castro Sts., Oakland	1956
6th St. between Jefferson & Grove Sts., Oakland	5030
7th & Bay Sts., Oakland	839
7th & Union Sts., Oakland	146
7th & Adeline Sts., Oakland	492
7th St. between Cypress & Union Sts., Oakland	2987
1475 - 9th St., Oakland	990*
10th & Union Sts., Oakland	159
11th & Castro Sts., Oakland	1663
11th & Market Sts., Oakland	46
12th & Adeline Sts., Oakland	28
1371 - 12th St., Oakland	550*
12th St. between Linden & Chestnut Sts., Oakland	1007
14th & Grove Sts., Oakland	856
14th & Center Sts., Oakland (near 1461-14th St.)	441*
1688 - 16th St., Oakland	1000*

Table 3 (cont'd)

Address	Lead Content (ppm)
1620 - 17th St., Oakland	2028*
18th & Cypress Sts., Oakland	3697
764 - 22nd St., Oakland	970*
1070 - 24th St., Oakland	992*
937 - 24th St., Oakland	4181*
24th & Peralta Sts., Oakland	237
24th & Campbell Sts., Oakland	1928
26th & Cypress Sts., Oakland	6340
26th & Wood Sts., Oakland	726
1250 - 28th St., Oakland	1248*
28th & Linden Sts., Oakland	1315
28th & Linden Sts., Oakland	1565
28th & Linden Sts., Oakland	1834
28th & Linden Sts., Oakland	1744
28th & Linden Sts., Oakland	2210
820 - 30th St., Oakland	697*
671 - 32nd St., Oakland	921*
32nd & Ettie Sts., Oakland	1129
32nd & Adeline Sts., Oakland	584
34th & Beach Sts., Oakland	1932

Table 3 (cont'd)

Address	Lead Content (ppm)
34th & Helen Sts., Oakland	2249
831 - 35th St., Oakland	1988*
949 - 35th St., Oakland	580*
862 - 36th St., Oakland	399*
End of Halleck St., 50 yds. east of Smelter, Oak.	259
End of Halleck St., 100 yds. east of Smelter, Oak.	260
Under freeway near Beach St., Oakland	3134
Yerba Buena St. between Haven & Harlan, Emeryville	97
Yerba Buena St. between Watts St. & San Pablo Ave. Emeryville	328
Park Ave. & Harlan St., Emeryville	1604
Park Ave. & Halleck Sts., Emeryville	386
Hollis & Yerba Buena Sts., Emeryville	743
45th & Holden Sts., Emeryville	1993
Beach St. near freeway, Oakland	2275
Peralta St. & West Grand Ave., Oakland	3601
889 Campbell St., Oakland	439*
3504 Magnolia St., Oakland	494*
1804 Adeline St., Oakland	591*
1651 Market St., Oakland	514*
3208 Market St., Oakland	775*

Table 3 (cont'd)

Address	Lead Content (ppm)
2323 Grove St., Oakland	1199*
MacArthur Blvd. between Grove & West Sts., Oakland	5014
MacArthur Blvd. between West & Market Sts., Oakland	4199
MacArthur Blvd. between Market St. & San Pablo Blvd., Oakland	1396
933 Chester St., Oakland	1406*
1004 Chester St., Oakland	482*

* Addresses at which children were reported to have elevated blood lead levels.

DISCUSSION AND CONCLUSION

In general, it is obvious by viewing the map of the sampling area that lead levels are uniformly high near heavily traveled freeways and streets. Lead fallout from traffic may not be the sole source of high lead in the soil sampled; however, lead in soil was extremely high immediately adjacent to Highways 17, 580, and MacArthur Blvd.

Fifty percent of the surface soil samples collected in the yards of children with elevated blood lead levels had lead concentrations ranging from 501 - 1000 ppm, with a mean concentration of 780 ppm (Table 2). Over 27% had concentrations ranging from 1001 - 4181 ppm, averaging 2008 ppm (Table 2). Over 77% of all soil samples collected in the yards of children with elevated blood lead levels contained 501 ppm lead or more.

Three hundred micrograms of elemental lead is considered to be the maximum daily permissible intake (DPI) from all sources for children. As the average intake increases above this value, the entire amount cannot be excreted and accumulation in the body begins.[1]

Calculations based on various lead concentrations in soil indicate that a child would be exceeding the maximum daily permissible intake (DPI) by the following factors if one gram of soil were ingested:

1 gram of soil containing 500 ppm Pb exceeds the DPI by 1.6 times,
1 gram of soil containing 1000 ppm Pb exceeds the DPI by 3.2 times,
1 gram of soil containing 2000 ppm Pb exceeds the DPI by 6.4 times.

Of course, multiples of the DPI will vary with changes in lead concentrations and ingested quantities of soil.

Chronic pediatric lead poisoning can be caused by ingestion of sufficient quantities of soil containing high concentrations of lead.[2] Berg & Zappela[3] reported on a child who became mentally retarded from eating soil containing

2200 ppm lead. It was thought that old paint may have been buried in the soil.

Assay values for lead in surface soils obtained as a result of this survey in West Oakland indicate that very high lead levels do exist. The study has identified an area where surface soil has high lead content and is a possible source of pediatric lead poisoning.

References

1. "Maximum Daily Intake of Lead Without Excessive Body Lead-Burden in Children", Amer. Journal of Diseases of Children, 1971, Oct., Vol. 122, Page 337.

2. "Soil Lead & Pediatric Lead Poisoning in Charleston, S.C.", The Journal of the South Carolina Med. Association, 1970, March, Page 79.

3. "Lead Poisoning in Childhood", J. Mental Deficiency Res., 1964, 8:44 - 53.

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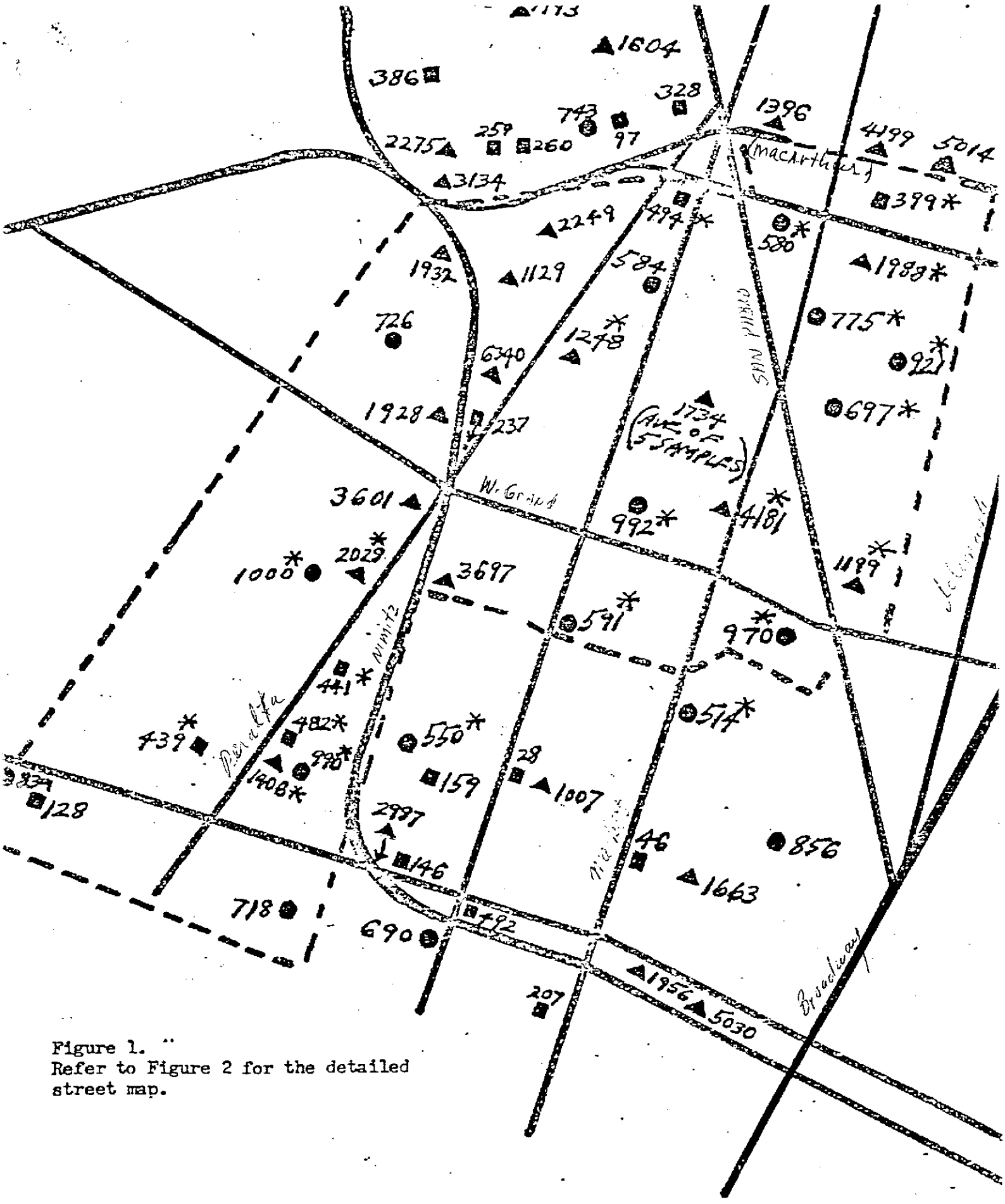
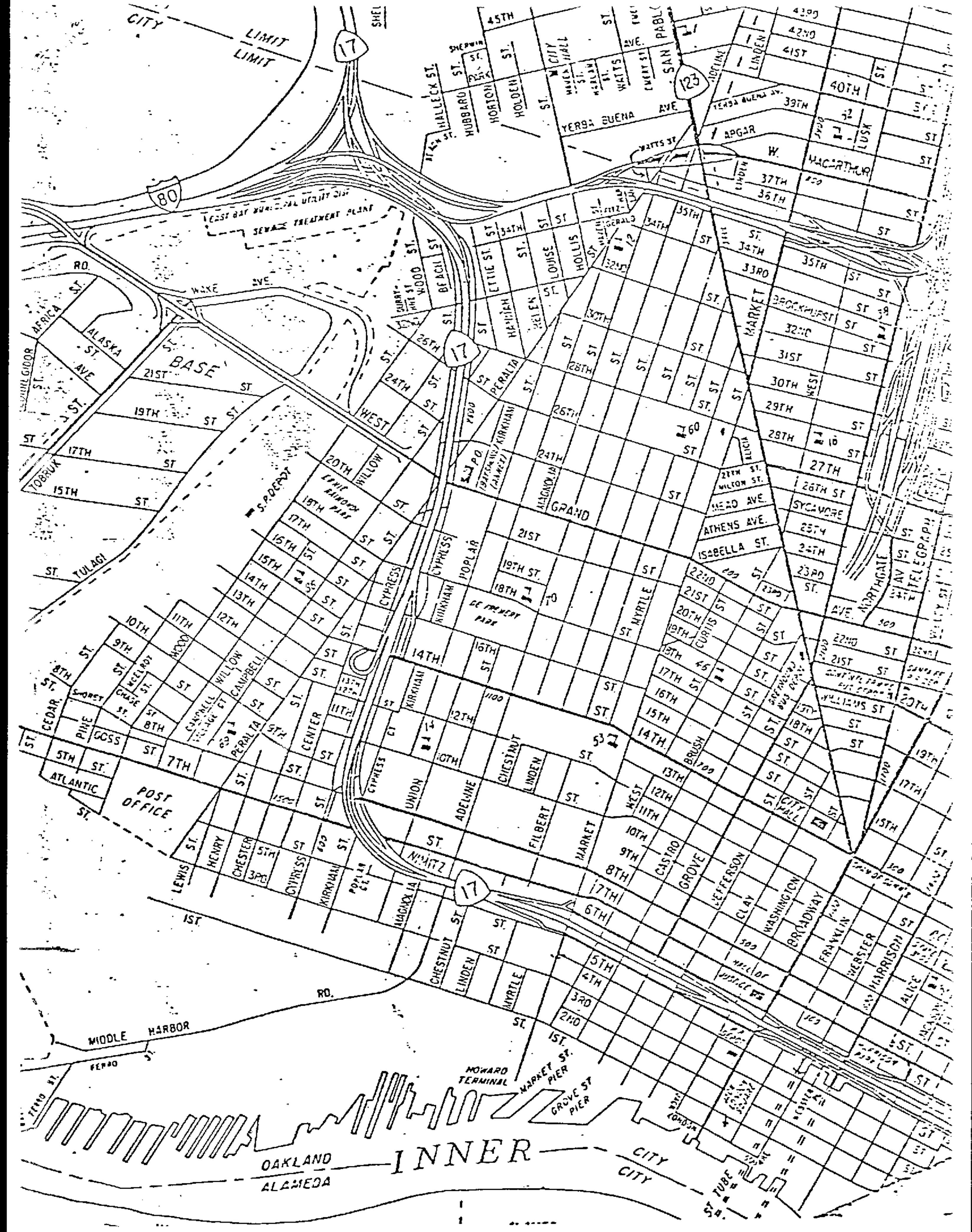


Figure 1.
Refer to Figure 2 for the detailed street map.

* Soil samples collected from yards of children with confirmed high blood lead levels.
■ 0-500 ppm
● 501-1000 ppm
▲ 1001-6340 ppm
Heavily traveled streets and highways ——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1ST
SAN PABLO
LINDEN
HALLECK ST.
HUBBARD
HORTON
HOLDEN
YERBA BUENA AVE.
APGAR
LUSK
W. MACARTHUR
EAST BAY MUNICIPAL UTILITY DIST
SEWAGE TREATMENT PLANT
WAKE AVE.
WOOD
BEACH ST.
ETTIE ST.
HANNAH
HELEN
LOUISE
HOLLIS
MARKET
BROCKHURST
WEST
AFRICA
ALASKA
BASE
TOBRUK
TULAGI
S.P. DEPOT
PERALTA
KIRKHAM
MAGNOLIA
GRAND
WILLOW
CYPRESS
POPLAR
DE FREMERY PARK
MEAD AVE.
ATHENS AVE.
ISABELLA ST.
SYCAMORE
NORTHGATE
TELEGRAPH
MYRTLE
CURTIS
BRUSH
CITY HALL
CAMPBELL
CENTER
CEDAR
PINE
GOSS
ATLANTIC
POST OFFICE
LEWIS
HENRY
CHESTER
UNION
ADELINE
CHESTNUT
FILBERT
CASTRO
GROVE
JEFFERSON
CLAY
WASHINGTON
BROADWAY
FRANKLIN
WEBSTER
HARRISON
ALICE
NIMITZ
MIDDLE HARBOR RD.
HOWARD TERMINAL
MARKET ST. PIER
GROVE ST PIER
OAKLAND
INNER
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