# Health Consultation

**Review of the Texas Commission on Environmental Quality's (TCEQ's) 2011 Expanded Assessment Soil Samples for the Dona Park Neighborhood Corpus Christi, Nueces County, Texas**

March 27, 2013
Revised April 11, 2013

TEXAS
Department of
State Health Services

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**Summary**

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| **INTRODUCTION** | In March 2011 the Texas Commission on Environmental Quality (TCEQ) sampled locations in the Dona Park Neighborhood, Corpus Christi, Texas, to determine if the concentrations of environmental contaminants exceed soil action levels.<br><br>The TCEQ requested the Texas Department of State Health Services (DSHS) to evaluate the March 2011 data to determine if the soil contaminant concentrations could potentially increase the risk for adverse health effects for neighborhood residents. |
| **CONCLUSION 1** | DSHS concluded that children who regularly ingest residential soil could experience small increases in blood lead levels. |
| **BASIS FOR DECISION** | Using the Agency for Toxic Substances and Disease Registry (ATSDR) Framework to Guide Public Health Assessment Decisions at Lead Sites and analyzing each residence as an independent exposure scenario, children who ingest soil on a daily basis could experience increases in their blood lead level ranging from 0.11 micrograms per deciliter (µg/dL) to 2.89 µg/dL. All children tested by DSHS in July 2011 had blood lead levels below the current reference value. |
| **CONCLUSION 2** | The DSHS concluded that cadmium levels found in soil samples collected in the Dona Park Neighborhood are not expected to result in adverse health effects in adults or children. |
| **BASIS FOR DECISION** | Many of the soil cadmium levels exceeded the Comparison Value (CV) for children; however, cadmium is a cumulative toxicant and the CV was based on adverse effects at age 55 after life-long exposure. Since the scenario used to estimate child exposure only applies to children, and would not continue until age 55, it is not likely that the levels found in this neighborhood would result in adverse health effects in children. |

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| **CONCLUSION 3** | The DSHS concluded that it is possible for cadmium to be taken up out of the soil and to be present in fruits and/or vegetables grown in the soil; however, this pathway is not expected to present a significant health risk for children or adults. |
| **BASIS FOR DECISION** | Current vegetable cadmium data were not available, but past studies have shown a positive relationship between cadmium levels in soil and cadmium levels in tomatoes grown in the soil. However, upper-bound estimates of cadmium intake through consumption of home-grown fruits and vegetables indicated that this source of exposure contributed only 0.58% to 2.1% to the anticipated cadmium intake from soil. Thus, home-grown fruit and vegetable consumption does not appear likely to contribute significantly to over-all cadmium exposures for adults or children. |
| **NEXT STEPS** | • DSHS will continue to work with environmental agencies and local health authorities to provide exposure prevention education.<br>• Upon request the DSHS will review additional environmental sampling results as they become available. |
| **FOR MORE INFORMATION** | If you have concerns about your health, you should contact your health care provider. For more information about this Health Consultation you can call the Texas Department of State Health Services and ask to speak with Amanda Kindt in the Health Assessment and Toxicology Program at (800) 588-1248. |

## Purpose and Health Issues

In response to community concerns, the Texas Commission on Environmental Quality (TCEQ) asked the Texas Department of State Health Services (DSHS) to evaluate the potential public health implications of contaminants found in soil samples collected in the Dona Park neighborhood.

A list of acronyms and abbreviations used in this report is included in Appendix A. Background information about cadmium and lead is included in Appendix B. The Table and Figure are included in Appendix C. Information about the environmental contamination screening process is included in Appendix D.

## Background

The Dona Park Neighborhood is located south of the former American Smelting and Refining Company (ASARCO) facility which, from 1941 to 1985, produced high grade zinc. While operating as a smelter, emissions were released from a discharge smokestack located approximately 950 feet northwest of the neighborhood. Between 1988 and 2002, the facility operated as Encycle, a waste management facility. Activities at the site ceased in 2005 [1].

Environmental investigations and sampling events first began in this area in 1994 and were followed by extensive residential soil removal actions. In addition to the environmental testing, the Texas Department of Health (TDH), predecessor agency to the Texas Department of State Health Services (DSHS), conducted blood and urine screening for Dona Park residents in 1994 and 1995. Blood samples were analyzed for lead and urine samples were analyzed for cadmium. While 5.8% of the children tested had blood lead levels greater than the Centers for Disease Control and Prevention's (CDC's) blood lead level of concern at that time (10 micrograms per deciliter or µg/dL), the source of these exposures (soil lead, lead paint, or other sources of lead in the home) was unknown. Urinary cadmium levels were not consistent with excess exposure to cadmium [2].

Residents remained concerned that previous clean-up efforts were inadequate, and they were concerned about the safety of eating fruits and vegetables grown in the soil. In response to those concerns, the Texas Commission on Environmental Quality (TCEQ) conducted a pilot study in 2010 and sampled soil from 59 residential lots identified by community members. The TCEQ compared the results to their Protective Concentration Limits (PCLs) and found arsenic exceeded its PCL in one sample, cadmium and lead exceeded their respective PCLs in two samples, and mercury exceeded its PCL in four samples [1].

In March 2011, the TCEQ collected additional soil samples from residential front and/or back yards and a playground area not addressed in the 2010 Pilot Study. The TCEQ removed soil from the back yards of five residences with either cadmium or lead levels above their respective PCLs and replaced it with clean backfill [3]. The TCEQ asked the DSHS, Health Assessment and Toxicology Program, to evaluate the public health implications of contaminants found in soil during the March 2011 sampling event [4].

In July 2011 DSHS conducted additional blood and urine metals screening for residents living in the Dona Park, Manchester Place, and Academy Heights Neighborhoods. Blood samples were analyzed for cadmium, lead, and mercury and urine samples were analyzed for arsenic, cadmium, and lead. Results for the people tested in the screening indicated no unusual exposures to these metals [5].

**Environmental Data**

## Sample Collection and Analysis

TCEQ's initial field sampling plan called for the collection of soil samples from up to 230 residential lots in the neighborhood near the former ASARCO/Encycle facility, to be analyzed for cadmium, lead, mercury, and zinc. Analysis of samples for lead, cadmium, and zinc was done per approved Environmental Protection Agency (EPA) Method 6200, utilizing a field portable X-ray fluorescence (XRF) instrument with a minimum of 10% of the samples analyzed by a fixed laboratory by Inductively Coupled Plasma-Mass Spectroscopy analyses per EPA Method 6020A. Because the action level for mercury is below the XRF mercury reporting limits, soil samples had to be sent to the lab for mercury analysis.

Consent to collect soil samples was obtained for 184 properties, with the following breakdown:

- Samples were collected only from residences not covered in the 2010 Pilot Study,
- 177 residences were sampled in both the front and back yards,
- 6 residences were sampled in the front yard only, and
- 1 church playground was sampled.

The top one inch of soil was collected at 10 separate locations in each front or back yard using a random sample pattern. The 10 individual samples were combined, composited, and sieved into a single homogeneous sample. Five, 5-gram cups of soil were withdrawn from the composited sample from each sampling area (front yard, back yard, or other sampled area). In all, 5 composite samples were analyzed via XRF from each of 361 sampling areas, representing 183 residence front yards, 177 residence back yards, and a neighborhood church playground. Consequently, this health consultation evaluates a total of 1,805 soil sample results collected and analyzed by the TCEQ in March 2011. The document containing the detailed soil sample methodology and results (as outlined in this section) is referred to as the 2011 Expanded Assessment [6].

Sample material from the 57 residences north of Gale Street (those closer to the ASARCO/Encycle facility) were split in half to facilitate both laboratory and XRF analyses; one half was sent to the lab for the analysis of mercury, and the other half was analyzed in the field for lead, zinc, and cadmium, using XRF. Low levels of mercury were detected in the lab-measured samples, but the concentrations did not exceed the TCEQ's applicable PCL. Consequently, the TCEQ did not perform mercury analysis for the remaining samples collected south of Gale Street (more distant from the ASARCO/Encycle facility) [7].

## Quality Assessment and Quality Control

In preparing this report, the DSHS relied on the data provided by the TCEQ as being collected according to approved quality assurance project plans and assumed adequate quality assurance/quality control procedures were followed. The TCEQ implemented the Pilot Study and the Expanded Assessment Field Sampling Plans in accordance with the TCEQ Quality Assurance Project Plan, Document No. 200919.7.

## Screening Assessment of Results

Contaminants were screened for further evaluation by comparing reported concentrations to contaminant-specific health-based Comparison Values (CVs) for non-cancer and cancer health effects. Health-based CVs and their usage in the screening process are explained further in Appendix D. Cadmium and lead were the only contaminants identified as being of potential concern; mercury and zinc were eliminated from further consideration because none of the measured levels exceeded screening CVs.

## Exposure Pathways

People can be exposed to contaminants by breathing, eating, drinking, or coming into physical (skin) contact with contaminated media (e.g., air, water, soil). Since it is normal for people to unintentionally ingest small quantities of soil through routine daily activities, and small children in particular have a tendency to put their fingers in their mouths, we identified incidental ingestion of soil as a significant exposure pathway for this site. Additionally, because some of the contaminants associated with this site (particularly cadmium) can be taken up into fruits and vegetables grown in contaminated soil, we identified the eating of home grown fruits or vegetables as additional plausible exposure pathways. Since lead, cadmium, and zinc are poorly absorbed through the skin, dermal absorption was not considered to be a significant exposure pathway. Preliminary evaluation of a worst-case scenario involving the airborne exposure pathway indicated that exposures through inhaled dust would produce exposures over 300 times lower than those produced by ingesting 200 milligrams (mg) of soil per day with the same concentration of lead as present in the airborne dust. Also, most of the yards in the neighborhood are largely covered with grass or other ground cover, which reduces the likelihood of significant airborne contaminated dust. Consequently, the airborne pathway also was eliminated as a significant source of exposure for neighborhood residents.

## Exposure Evaluation and Public Health Implications

Cadmium in Residential Soil

Cadmium was detected in 1,358 of the 1,805 XRF measurements (75%) representing 326 of the 361 areas from which measurements were taken. Measured concentrations ranged from none detected to 50.04 milligrams per kilogram (mg/kg) with an overall average concentration of 14.26 mg/kg. None of the samples collected exceeded cadmium comparison values for adults (70 mg/kg); however, 267 (74%) of the 361 total samples collected exceeded the chronic cadmium Environmental Media Evaluation Guide (EMEG) for children of 5 mg/kg (Table 1). Determining the public health significance of cadmium in soil is not as straightforward as most contaminants because cadmium is a cumulative toxicant. For cadmium exposure to result in adverse health effects, cadmium levels in the kidney cortex need to build up above the critical level of approximately 200 micrograms per gram (µg/g) [8].

The chronic oral Minimal Risk Level (MRL) for cadmium was derived from a conservative estimate of a daily cadmium intake that would increase the risk for kidney effects after 50+ years of exposure. The MRL was based on studies that found cadmium levels in the kidney cortex would begin to exceed the critical level by age 55 after long-term exposures [8]. However, since childhood exposures are limited to the childhood period and the tolerable exposure levels increase fairly rapidly as the child grows up, it is unlikely that anyone living in this neighborhood could be exposed to sufficient quantities of cadmium for a long enough time to cause kidney damage by age 55. This could only theoretically happen if the residential soil concentrations exceeded the adult chronic EMEG value of 70 mg/kg and the person were to live in the same home and be exposed to the soil for 55 years. Consequently, it is extremely unlikely that measured cadmium levels in the yards studied, would be sufficient to cause any adverse health effects in either children or adults.

Cadmium in Home-Grown Fruits and Vegetables

Since cadmium exposures could possibly occur through consumption of home-grown fruits and vegetables, grown in cadmium-contaminated soil, we performed additional conservative calculations to estimate the potential contribution of the consumption of these foods to overall cadmium exposures. For this calculation, we assumed cadmium concentrations equal to the highest reported levels in market basket surveys of fruits (0.027 mg/kg) and vegetables (0.125 mg/kg) [8]. For the consumption rates, we used the 95$^{th}$ percentile home-grown fruit and vegetable consumption rates for children ages 1–6 years (4.2 grams per kilogram per day (g/kg/day) and 6.6 g/kg/day, respectively) [9]. The contribution from home-grown fruit was found to be 4.39 x $10^{-7}$ milligrams per kilogram per day (mg/kg/day), and the contribution from home-grown vegetables was 3.19 x $10^{-6}$ mg/kg/day. Thus, the total additional contribution to the cadmium dose was 3.63 x $10^{-6}$ mg/kg/day. Depending on soil cadmium levels, the average daily dose for a 1-6 year old, 16.1 kg child, ingesting 200 mg soil per day varies from 1.77 x $10^{-4}$ to 6.22 x $10^{-4}$ mg/kg/day. Thus, home-grown fruits and vegetables only contributed an additional 0.58% to 2.1% to the exposure doses received from soil ingestion. Consequently, the contribution of home-grown fruits and vegetables to the total daily cadmium dose was considered to be insignificant compared to soil exposures.

Lead

Detectable levels of lead were found in all of the soil samples collected and tested by XRF. Concentrations ranged from 6.18 to 692.74 mg/kg, and the average concentration for all 1,805 samples was 149.8 mg/kg. Seven soil sampling locations (either front yard or back yard) had average concentrations that exceeded the EPA's soil screening value of 400 mg/kg.

Instead of comparison values, the Agency for Toxic Substances and Disease Registry (ATSDR) has developed a framework to determine the potential adverse health effects associated with exposure to lead at a site [10]. Environmental data are used to predict increases in blood lead levels to determine if a site poses an unacceptable risk. Using the ATSDR Framework to Guide Public Health Assessment Decisions at Lead Sites [10] and the average concentration of lead found in neighborhood soil samples, children regularly ingesting neighborhood soil could experience a 1.02 µg/dL increase in their blood lead level.

Soil sample results also were averaged for each individual residence to evaluate the likely average soil lead exposures for children living at that residence. The average soil levels for 177 residences were based on 10 sample measurements (5 from the front yard and 5 from the back yard); for the remaining 6 residences and the church playground, the averages were based on 5 front yard sample measurements. Average soil lead levels for individual residences ranged from 16.3 mg/kg to 424.4 mg/kg with an average residential soil lead level of 150.4 mg/kg.

Using the ATSDR Framework to Guide Public Health Assessment Decisions at Lead Sites [10] and analyzing each residence as an independent exposure scenario, children who ingest soil on a daily basis could experience increases in their blood lead level ranging from 0.11 µg/dL to 2.89 µg/dL.

**Discussion**

Although none of the samples collected exceeded cadmium comparison values for adults (70 mg/kg), 267 of the 361 total samples collected exceeded the calculated chronic cadmium EMEG for children of 5 mg/kg. However, since cadmium is a cumulative toxicant that would only start causing signs of kidney toxicity after 50+ years of exposure [8], and childhood exposure levels would only occur for a few years, we would not expect any significant possibility of adverse effects on the kidneys in children.

While recent data regarding cadmium levels in home-grown fruits and vegetables from this neighborhood were not available, our analysis of maximum cadmium levels from market basket surveys [9] and upper 95$^{th}$ percentile consumption levels of fruits and vegetables [9] would tend to indicate that this exposure pathway would not add significantly to the cadmium body burden for children or for adults.

Biological data collected by the DSHS in 1995 and 2011 support these conclusions for cadmium. Residents tested during both screenings did not have cadmium in their bodies above levels of health concern [2,5].

Using the average concentration of lead found in neighborhood soil samples, children who ingest soil on a daily basis could experience a 1.02 µg/dL increase in their blood lead level. Considering each residence as an independent exposure scenario, children who regularly ingest soil could experience a 0.11 µg/dL to 2.89 µg/dL increase in their blood lead level. All children tested by DSHS in July 2011 had blood lead levels below 5 µg/dL, CDC's current reference value for children[1] [5].

[1] The reference value of 5 µg/dL is a reference value, defined as the 97.5$^{th}$ percentile of blood lead levels found in U.S. children aged 1-5 years for two consecutive cycles of the National Health and Nutrition Examination Survey (NHANES). The current value is based on results from the 2007-2008 and 2009-2010 NHANES [11].

## Conclusions

Based on available information we concluded that:

1. Children who regularly ingest residential soil could experience small increases in blood lead levels. Using the ATSDR Framework to Guide Public Health Assessment Decisions at Lead Sites and analyzing each residence as an independent exposure scenario, children who ingest soil on a daily basis could experience increases in their blood lead level ranging from 0.11 µg/dL to 2.89 µg/dL. All children tested by DSHS in July 2011 had blood lead levels below the current reference value.
2. The soil cadmium levels reported in the TCEQ's 2011 Expanded Assessment are all below the adult chronic soil EMEG and are not likely to result in adverse health effects for either adults or children.
3. Conservative estimates of cadmium exposures through consumption of home-grown fruits and vegetables indicated that this pathway is not likely to contribute significantly to over-all cadmium exposures for either adults or children.

## Recommendations

Parents worried about their children being exposed to lead should take precautionary measures to decrease their child's potential exposure to lead-contaminated soils by:

- washing children's hands often to remove soil,
- preventing children from ingesting contaminated soil,
- regularly cleaning their house of dust and tracked-in soil, and
- washing children's toys regularly.

## Public Health Action Plan

The public health action plan for the site contains a description of actions that have been or will be taken by the DSHS and other government agencies at the site. The purpose of the public health action plan is to ensure that this public health consultation both identifies public health hazards and provides a plan of action designed to mitigate and prevent harmful human health effects resulting from breathing, drinking, or touching hazardous substances in the environment. Included is a commitment on the part of the DSHS to follow up on this plan to ensure that it is implemented.

Public health actions that have been taken include:

- Completion of a Letter Health Consultation for the Dona Park neighborhood on July 5, 2011.
- The 2011 removal and replacement of soil from five residences in the Dona Park neighborhood that exceeded the TCEQ's Protective Concentration Limits (PCLs).

Public health actions that will be implemented:

- DSHS will continue to work with environmental agencies and local health authorities to provide exposure prevention education.
- DSHS will review additional environmental sampling results as they become available, upon request.

# Report Preparation

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## Appendix A: Acronyms and Abbreviations

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|---|---|
| ASARCO | American Smelting and Refining Corporation |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| CDC | Centers for Disease Control and Prevention |
| CREG | Cancer Risk Evaluation Guides |
| CV | Comparison Value |
| DSHS | Texas Department of State Health Services |
| EMEG | Environmental Media Evaluation Guide |
| EPA | Environmental Protection Agency |
| g/kg/day | gram per kilogram per day |
| IARC | Integrated Agency for Research on Cancer |
| LOAEL | Lowest Observed Adverse Effect Level |
| µg/dL | microgram per deciliter |
| µg/g | microgram per gram |
| mg | milligram |
| mg/kg | milligram per kilogram |
| mg/kg/day | milligram per kilogram per day |
| MRL | Minimal Risk Level |
| N/A | Not Applicable |
| ND | Not Detected |
| NHANES | National Health and Nutrition Examination Survey |
| NOAEL | No Observed Adverse Effect Level |
| PCL | Protective Concentration Limit |
| RfD | Reference Dose Media Evaluation Guide |
| RMEG | Reference Media Evaluation Guide |
| TCEQ | Texas Commission on Environmental Quality |
| TDH | Texas Department of Health |
| XRF | X-ray fluorescence |

## Appendix B: Metals Information

### Cadmium

Cadmium is a naturally occurring element in the earth's crust and is most often present as a mineral combined with other elements, such as oxygen, chlorine, or sulfur. Cadmium has many uses in industrial settings and consumer products, including batteries, pigments, metal coatings, plastics, and some metal alloys [8].

People are most likely exposed to cadmium through food and cigarette smoke. Most cadmium that enters the body, and that is not eliminated through the feces or urine, goes to the kidney and liver and can be stored there for many years. The human body can change most cadmium to a form that is not harmful, but too much cadmium in the body can overload the liver and kidney's ability to change the cadmium to a harmless form. Ingesting food or water with very high cadmium levels can severely irritate the stomach causing vomiting and diarrhea, while ingesting lower levels of cadmium over a long period of time can cause the buildup of cadmium in the kidneys. If the level in the kidneys becomes too high it can lead to kidney damage and also cause bones to become fragile and break easily [8].

Currently cadmium is listed as both an animal and human carcinogen by the inhalation route, but it has not yet been shown to cause cancer in animals or humans by the oral route. The United States Department of Health and Human Services has determined that cadmium compounds may reasonably be anticipated to be carcinogens, and the International Agency for Research on Cancer (IARC) has determined that cadmium is carcinogenic to humans, based on limited human data and studies in rats [8].

### Lead

Lead is a naturally occurring metal that is found in the earth's crust and is usually found combined with one or more other elements to form various lead compounds. Lead and lead alloys are commonly found in pipes, storage batteries, weights, ammunition, cable covers, and sheets used to shield people from radiation. Lead is also used as a pigment in paints, dyes, ceramic glazes, and in caulk, but the amount of lead used in these products has been reduced in recent years [10].

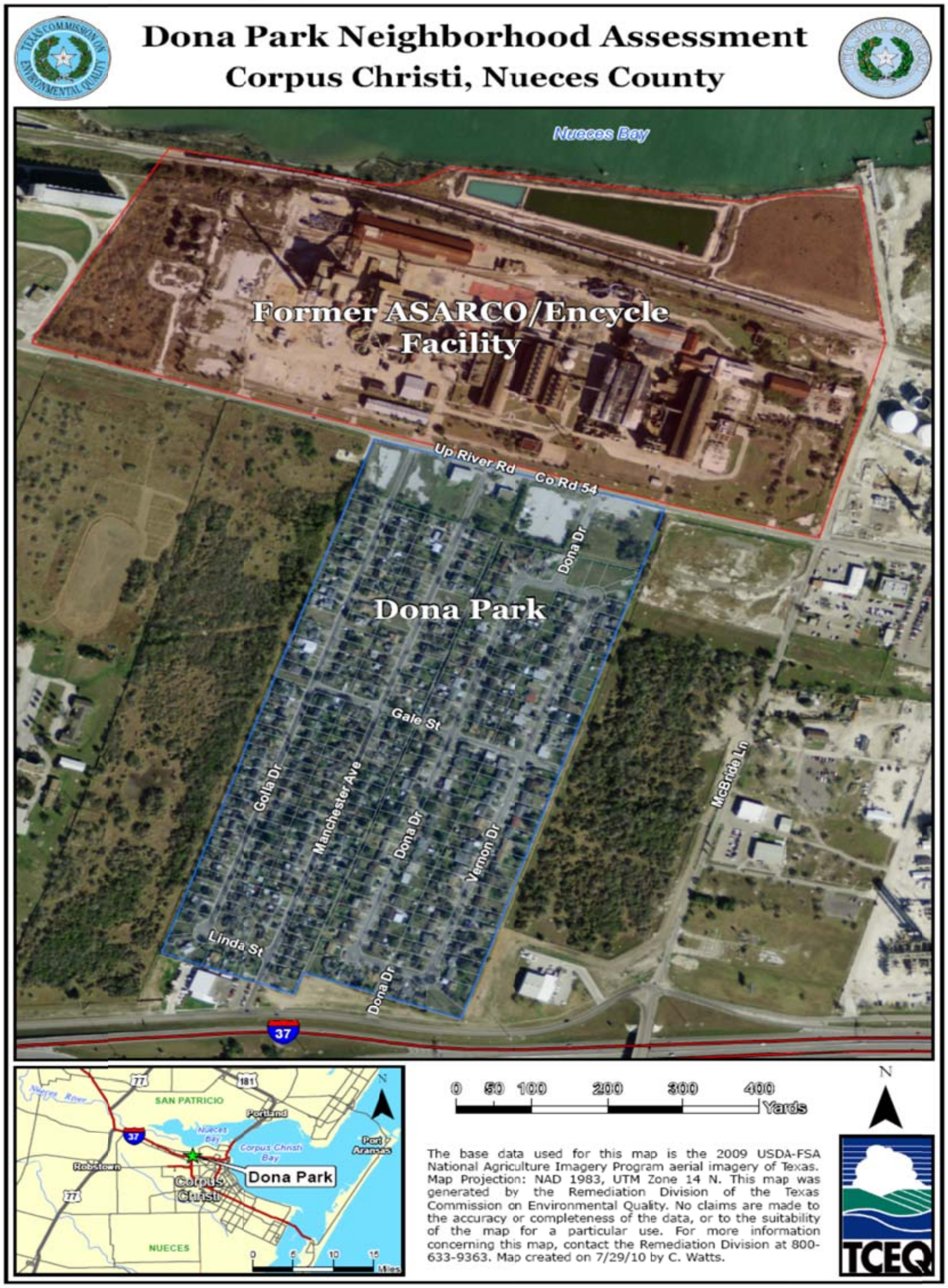
People can be exposed to lead through inhalation, ingestion, or skin contact. Lead, which is breathed in (or inhaled), can pass through the lungs and quickly enter the blood stream. Larger particles that are breathed in can be coughed up and swallowed. People can also swallow (or ingest) lead-contaminated food or drinking water. Most lead that enters the body is swallowed, but very little of it will actually enter the blood stream and travel to other parts of the body; however, children absorb 50% of lead that is ingested. If lead particles come into contact with the skin, a small portion will be absorbed. Lead compounds that are easily absorbed through the skin (e.g. leaded gasoline) are no longer available to the general public [10].

The effects of lead are the same when it is breathed in or swallowed. In adults and children, the nervous system is the main target for lead toxicity. Children exposed to excessive amounts of lead in early childhood may experience neurodevelopmental delays, behavior disturbances, and learning disabilities, decreased language abilities, and reduced IQ. In occupational settings, long-term exposure to lead has resulted in decreased performance in some tests that measure nervous system function. Excessive exposure may also result in finger, wrist, or ankle weakness and it could also cause a small increase in blood pressure (middle-aged and older people). At high exposures, lead can damage the brain and kidneys in both adults and children. In pregnant women, exposure to high levels could cause miscarriage. In men, high exposure levels can damage organs responsible for sperm production [10].

The United States Department of Health and Human Services has determined that lead and lead compounds are reasonably anticipated to cause cancer in humans based on limited evidence. The EPA has determined that lead is a probable human carcinogen. The IARC has determined that inorganic lead and lead compounds are not classifiable as to their carcinogenicity in humans based on inadequate evidence from human and animal studies [10].

**Appendix C: Table and Figure**

**Figure – Map of Sampling Area**



| Table: Metals Detected in 2011 Expanded Assessment Soil Samples Compared to Comparison Values (CV) | | | | |
|---|---|---|---|---|
| **Contaminant** | **Concentration Range (mg/kg)** | **Areas with Detects/Total Areas Sampled** | **Comparison Value (mg/kg)** | **# of Areas Exceeding CV Value** |
| **Cadmium** | ND-50.04 | 326/361 | 70 (Chronic EMEG Adult)<br>5 (Chronic EMEG Child) | 0<br>267 (Child) |
| **Lead** | 6.18-692 | 361/361 | No CV Available | N/A |
| **Mercury** | 0.03-2.25 | 111/111 | 200 (Chronic EMEG Adult)<br>20 (Chronic EMEG Child) | 0<br>0 |
| **Zinc** | 81.33-7,064.35 | 361/361 | 210,000 (Chronic EMEG Adult)<br>15,000 (Chronic EMEG Child) | 0<br>0 |

CV = Comparison Value
mg/kg = milligram per kilogram
ND = Not Detected
EMEG = Environmental Media Evaluation Guide
N/A = Not Applicable

## Appendix D: Environmental Contamination Screening Process

We identified potential contaminants of concern by comparing reported concentrations to contaminant-specific health-based Comparison Values (CVs) for non-cancer and cancer health effects. CVs for non-cancer health effects are called Environmental Media Evaluation Guides (EMEGs) or Reference Dose Media Evaluation Guides (RMEGs) and are based either on the Agency for Toxic Substances and Disease Registry (ATSDR's) Minimal Risk Levels (MRLs) or the Environmental Protection Agency (EPA's) Reference Doses (RfDs), respectively. MRLs and RfDs are estimates of a daily exposure to a contaminant that is not likely to result in adverse non-cancer health effects. CVs used to evaluate cancer health effects are known as Cancer Risk Evaluation Guides (CREGs) and are based on EPA's chemical-specific cancer slope factors and an estimated lifetime cancer risk of one-in-one million persons exposed for a lifetime.

Contaminants that exceed environmental guidelines do not necessarily pose a public health threat; however, further evaluation of these contaminants, to determine the potential public health significance, is assessed by reviewing and integrating relevant toxicological information with plausible site-specific exposure scenarios [12].

The presence of chemical contaminants in the environment does not always mean that people will come into contact with the chemical or that any contact with the chemical will harm people's health. Whether effects could occur depends on: (1) the toxicological properties of the contaminant; (2) how much of the contaminant people could be exposed to; (3) the way the contaminant gets into the body (e.g., breathing, eating, drinking, skin/eye contact); and (4) how often people are exposed. Characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status also can influence how people react to such exposures [12].

The toxicological properties of the chemical, how people are exposed, how often they are exposed, and the amount that they are exposed to, all influence whether harm is possible. People can be exposed to contaminants by breathing, eating, drinking, or coming into physical contact with media (e.g., air, water, soil) containing the contaminant. This Health Consultation examines the types of chemicals found at this site, the concentrations found in each of the media (e.g., air, water, and soil), whether there is any potential for exposure, and whether identified exposures could be sufficient to affect people's health. Exceeding an environmental guideline does not necessarily mean that a contaminant represents a public health threat, but it does indicate that the contaminant warrants further evaluation [12].

We further evaluate samples by estimating an exposure dose using site specific data and plausible exposure scenarios. When an estimated exposure dose exceeds the MRL it might be compared to a No Observed Adverse Effect Level (NOAEL) and/or Lowest Observed Adverse Effect Level (LOAEL) to determine whether observable health effects are likely [12].