Letter Health Consultation

MUSGROVE GOLD RECOVERY SITE

TERRELL, KAUFMAN COUNTY, TEXAS

Prepared by
Texas Department of State Health Services

APRIL 20, 2015

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

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KIRK S. COLE
INTERIM COMMISSIONER

April 27, 2015

William Rhotenberry
Federal On-Scene Coordinator
United States Environmental Protection Agency – Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202

RE: Review of Surface Soil Sample Results
Musgrove Gold Recovery Sampling Project – October 2014
Terrell, Kaufman County, Texas

Mr. Rhotenberry:

In response to your request, the Texas Department of State Health Services (DSHS) examined U.S. Environmental Protection Agency's (EPA) October 2014 soil sampling results collected at a residential property in Terrell, Texas, to determine if exposure to the metals in soil could result in adverse health effects to residents living at the property (hereinafter "Musgrove Gold Recovery").

Based on the October 2014 soil sampling results, DSHS and the Agency for Toxic Substances and Disease Registry (ATSDR) conclude that exposure to contaminants in surface soil from the Musgrove Gold Recovery site is not likely to result in adverse health effects for adults or children who currently live at the site. The remainder of this letter health consultation explains how we arrived at this conclusion.

There are several limitations associated with this health consultation. Limitations include: (1) soil sampling results did not distinguish between the different forms of chromium (*i.e.* trivalent and hexavalent); (2) thallium was evaluated using the available EPA Regional Screening Level (RSL) and a provisional reference dose (RfD); (3) conclusions are based on daily exposures to metals in soil using October 2014 data, a point in time that may not be representative of past exposures; and, (4) conclusions are based on exposure assumptions considered to be health-protective, but may over- or underestimate actual risk.

Based on the review of the available data, DSHS and ATSDR have no recommendations at this time. However, if residents are concerned about their health, they should consult with their personal health care provider.

Background and Statement of Issues

The Musgrove Gold Recovery site near Terrell, Kaufman County, Texas, was a gold recovery operation located at a residential property. During operations, circuit boards and stators from electronic and computer devices were submerged in a cyanide and aqua regia[1] mixture to recover gold and other precious metals. In 2005, EPA investigated the site after receiving information that the operator was disposing of hazardous wastes at another location near Lake Lavon. EPA searched the Musgrove Gold Recovery site to obtain additional environmental evidence related to previous gold recovery operations [1].

EPA's investigation at the Musgrove Gold Recovery site included collecting multiple soil samples from three locations: a horse shed, a dirt pile containing muck from the horse stalls, and a vegetable garden [2]. According to EPA, the 2005 results revealed soil containing wastes from the metal extraction operations, but concentrations were below recommended EPA soil screening levels (SSLs). Based on these results, no further investigations were conducted by EPA.

In September 2014, DSHS was asked by EPA to review the 2005 soil sampling results from a health-based perspective. Because of the limited information associated with the data, DSHS could not draw any health-based conclusions so they asked EPA to collect further samples. In October 2014, EPA agreed to collect additional soil samples. DSHS and ATSDR accompanied EPA staff during their site visit to gather homeowners' health-related concerns. DSHS staff was informed that the homeowners purchased the property in 2004 and currently there are three adults and two children (less than 6 years old) residing at the one residence on the property.

Discussion

Data Used

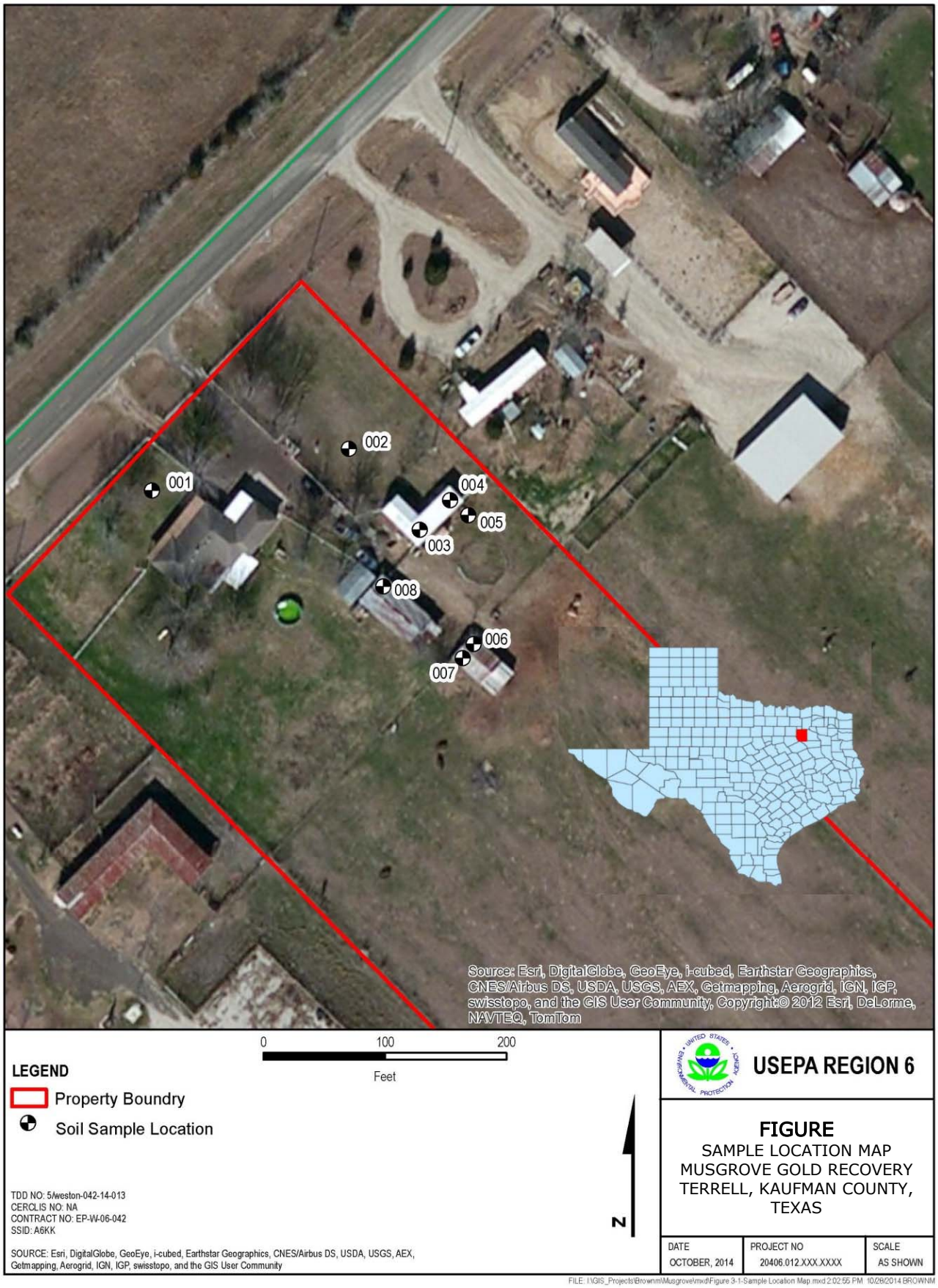
On October 7, 2014, EPA Region 6 staff collected surface soil samples (0-6 inches in depth)[2] from eight locations on the property (Figure 1). Seven of these locations (002-008) were selected based on resident's information regarding where they believed contamination might be present. One background soil sample (001) was collected from an area where residents assumed no previous waste material had been dumped. Each sample was analyzed for cyanide, herbicides, metals, pesticides, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs). Analyses were performed by an EPA-contracted laboratory.

Data reviewed in this report were collected by EPA using standard procedures and were reviewed by EPA for quality assurance/quality control. Thus, DSHS and ATSDR assumed adequate quality assurance/quality control procedures were followed with regard to data collection, chain of custody, laboratory procedures, and data reporting.

[1] Aqua regia is a mixture of hydrochloric and nitric acid.

[2] A subset of soil samples were collected from deeper soil intervals, including 6-12 and 12-24 inches. DSHS only evaluated the sampling results collected from surface soils because people are most likely to come into contact with these soils.

Figure 1. Musgrove Gold Recovery Site Map



Screening Analysis

DSHS evaluated surface soil data by comparing the analytical results for each chemical to screening levels, including health-based comparison values (CVs) published by ATSDR and regional screening levels (RSLs) published by EPA. RSLs are used when ATSDR CVs are not available. Using CVs for screening is considered a conservative approach and protective of individuals that might come into contact with soil contaminants. If the maximum concentration of a given contaminant were higher than the CV, the contaminant was considered a Contaminant of Potential Concern (COPC). It is important to note that exceeding a CV does not indicate that a COPC poses a human health hazard, only that additional evaluation of that contaminant is warranted.

Metals found in surface soil that exceed screening levels are shown in Table 1. No additional chemicals exceeded screening values.

Table 1. Metals (mg/kg) exceeding screening levels in soil samples collected by the U.S. Environmental Protection Agency (EPA) in October 2014 at the Musgrove Gold Recovery site.

Metals	Concentration Range (mg/kg)	Screening Value[a] (mg/kg)	Number of Samples Exceeding Screening Value / Total Number of Samples
Arsenic	3.4-32.0	**15 – child Chronic EMEG[b]** 210 – adult Chronic EMEG	**1/8** 0/8
Thallium	ND-1.6	**0.78 – EPA RSL**	**2/8**

mg/kg – milligrams per kilogram are equivalent to parts per million (ppm).
ND – not detected

[a] Screening levels utilized were: environmental media evaluation guides (EMEGs) published by ATSDR as health-based CVs; and regional screening levels (RSLs) published by EPA. CVs are media-specific (e.g. air, soil, and water) levels below which no adverse health effects are expected to occur. The EPA RSL was taken from the EPA Mid-Atlantic Risk Assessment Regional Screening Level (RSL) Summary Table, January 2015.

[b] Emboldened values indicate the concentrations of a metal exceeded the ATSDR or EPA screening value(s).

Additional metals used in the metal extraction process and detected in soil are discussed below.

Cyanide

Cyanide is one of the main chemicals used in metal extraction processes and thus is a contaminant of interest for residents at this site. Although cyanide was detected in all surface soil samples collected (0.04 to 2.8 mg/kg), the concentrations did not exceed the reference dose media evaluation guide (RMEG) for a child (30 mg/kg) or adult (420 mg/kg); therefore, it is not likely that exposure to cyanide in soil will result in adverse health effects.

Lead

The Centers for Disease Control and Prevention (CDC) has not identified a blood lead level in children that is without risk. Lead was detected in all surface soil samples at low concentrations that ranged from 2.3 to 26.4 mg/kg. ATSDR does not have a CV for lead in soil. Because lead has no known beneficial effects, exposure to lead should be reduced as much as possible; this is especially important for pregnant women and young children [3].

Public Health Implications

Exposure Pathways

In order for a contaminant in soil to be harmful to human health, people must physically come in contact with it through what is known as an "exposure pathway". Residents could be exposed to site-related contaminants by ingestion of or dermal contact with soil containing the contaminant(s) of concern. While dermal exposure to soil can occur, this exposure pathway is considered a minor contributor to the overall exposure to contaminants compared to the ingestion and was not evaluated [4]. DSHS health assessors assumed all exposure was the ingestion of contaminated soil in this evaluation.

Exposure Dose Estimates

Exposure doses, in milligrams per kilograms per day (mg/kg/day), were calculated for each COPC. Soil concentrations were estimated for each COPC by averaging the COPC concentrations found in all eight samples and calculating the upper 95th percentile confidence limit (UCL) of the mean value. The UCL was used as the concentration estimate in all subsequent dose calculations. Standard body weight, ingestion rate, and bioavailability assumptions[3] were also used in these calculations. The following formula was used to calculate an estimated exposure dose for each COPC:

$$\text{Dose (mg/kg/day)} = \frac{\text{Concentration (mg/kg) x intake rate (mg) x exposure frequency x } 10^{-6}\text{ (kg/mg)}}{\text{body weight (kg)}}$$

Hazard quotients (HQs) were calculated[4] to compare estimated exposure doses to health guidelines, such as ATSDR minimal risk levels (MRLs) and EPA reference doses (RfDs) when MRLs are not available. MRLs and RfDs are considered to be safe doses at which no harmful health effects are expected. If an HQ is less than 1, the estimated exposure dose is below the health guideline and adverse non-cancer health effects are not expected. If an estimated exposure dose exceeds a health guideline the dose is then compared to known carcinogenic and non-carcinogenic health effect levels found in the scientific literature. These comparisons are used to determine if adverse health effects are possible and if the exposure poses a health hazard.

An estimated lifetime cancer risk was calculated for arsenic, the only COPC that is a known carcinogen. Estimated cancer risk for arsenic was calculated using the following formula:

$$\text{Risk} = \frac{\text{Dose (mg/kg/day) x cancer slope factor (mg/kg/day)}^{-1}\text{ x exposure (years)}}{\text{Lifetime (years)}}$$

Based on information provided by the residents, the property was purchased in 2004. DSHS assumed that adult residents could be exposed to arsenic in soil at the site for 33 years. In addition, the cancer risk was estimated for children exposed from birth to 21 years as these are the most sensitive ages for exposure. These exposures were averaged over a lifetime of 78 years.

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[3] Standard exposure dose assumptions include children (age 0–21 years) weighing 7.8 to 71.6 kilograms (kg) ingest 100 to 200 milligrams (mg) of surface soil per day and an 80 kg adult (older than 21 years) ingests 100 mg of surface soil per day. The exposure frequency was 1, indicating a daily exposure. Bioavailability was 100%.

[4] The hazard quotient is calculated by dividing the estimated exposure dose by the health guideline, such as the minimal risk level (MRL) or reference dose (RfD).

Pica Behavior

Pica behavior is the recurrent ingestion of unusually high amounts of soil and other non-food items and typically occurs in children less than 6 years old. While experts agree pica behavior exists, there is extensive debate as to the degree to which it occurs, making it difficult to assess potential exposures [5]. During the site visit, DSHS and ATSDR staff did not observe children exhibiting pica behavior.

DSHS compared the concentrations of arsenic detected in soil to CVs calculated for children exhibiting pica behavior. Only one surface soil sample collected from the site exceeded the pica child acute environmental media evaluation guide (EMEG) (10 mg/kg) for arsenic. This sampling location is from an area where access is limited and, therefore, soil pica was not evaluated further.

Surface Soil

As shown in Table 1, arsenic and thallium were the only contaminants found in surface soil that exceeded screening levels and required further analysis. These results are provided in Tables 2 and 3.

Table 2. Estimated exposure doses and hazard quotients (HQs) for children (age 0–21 years) and adults (older than 21 years) exposed daily to surface soil at the Musgrove Gold Recovery site.

Metals	Exposure Point Concentration (mg/kg)[a]	Estimated Exposure Dose (mg/kg/day)[b]	Health Guideline (mg/kg/day)	Hazard Quotient	Non-Cancer Risk Conclusion
Children (age 0–21 years)					
Arsenic	22.8	0.00006 – 0.0004	0.0003 – MRL	0.2 – 1.3	Further evaluation
Thallium	1.5	0.000004 – 0.00003	0.00001 – RfD[c]	0.4 – 2.5	Further evaluation
Adults (older than 21 years)					
Arsenic	22.8	0.00003	0.0003 – MRL	0.1	No further evaluation
Thallium	1.5	0.000002	0.00001 – RfD[c]	0.2	No further evaluation

mg/kg – milligrams per kilogram are equivalent to parts per million (ppm).
mg/kg/day – milligrams per kilogram per day
MRL – minimal risk level

[a] The 95th percentile is used as the exposure point concentration.

[b] The 95th percentile concentration of each contaminant is used to calculate the estimated exposure dose in order to assess a site-specific exposure scenario.

[c] The EPA provisional reference dose (RfD) was used to evaluate non-cancer health risks.

Table 3. Cancer risk estimates for children (age 0–21 years) and adults (older than 21 years) exposed daily to surface soil at the Musgrove Gold Recovery site.

Metals	Exposure Point Concentration (mg/kg)[a]	Estimated Exposure Dose (mg/kg/day)[b]	Cancer Slope Factor (mg/kg/day)	Estimated Cancer Risk	Cancer Risk Conclusion
Children (age 0–21 years)					
Arsenic	22.8	0.00006 – 0.0004	1.5	6.0×10^{-5}	Low increased risk for cancer
Adults (older than 21 years)					
Arsenic	22.8	0.00003	1.5	1.8×10^{-5}	Low increased risk for cancer

mg/kg – milligrams per kilogram are equivalent to parts per million (ppm).
mg/kg/day – milligrams per kilogram per day

[a] The 95th percentile is used as the exposure point concentration.

[b] The 95th percentile concentration of each contaminant is used to calculate the estimated exposure dose in order to assess a site-specific exposure scenario.

Arsenic

Arsenic was present in all surface soil samples at concentrations ranging from 3.4 to 32 mg/kg (Table 1). Only one surface soil sample collected from the site exceeded the child chronic EMEG (15 mg/kg) and no samples exceeded the adult chronic EMEG (210 mg/kg). The remaining samples are below the Texas-specific median soil background concentration for arsenic of 5.9 mg/kg [6].

Estimated exposure doses for children and adults were calculated assuming daily exposures to arsenic in soil. Based on the calculated exposure point concentration of arsenic in surface soil (22.8 mg/kg), the daily estimated exposure doses for children range from 0.00006 – 0.0004 mg/kg/day (Table 2). The highest estimated exposure dose (0.0004 mg/kg/day) is for children between 1 to less than 2 years of age. The daily estimated exposure dose for an adult (older than 21 years) is 0.00003 mg/kg/day.

The exposure dose for children between 1 to less than 2 years of age (0.0004 mg/kg/day) was the only age group that exceeds the MRL for arsenic (0.0003 mg/kg/day). This MRL was derived from a study where no observable adverse effects were noted in humans exposed to 0.0008 mg/kg/day arsenic in drinking water [7]. Estimated exposure doses were below levels at which non-cancer health effects have been observed; therefore, exposure to arsenic in soil at this property is not likely to pose non-cancer human health risks.

Arsenic has been considered a human carcinogen by both oral and inhalation exposure routes [7]. The estimated cancer risk for children (exposed to arsenic in surface soils for 21 years – birth to 21 years) per site-specific information was calculated to be 6.0×10^{-5} (Table 3). This represents a low increased risk for cancer, thus exposure to arsenic in soil is not likely to result in adverse health effects. The estimated cancer risk for adults exposed to arsenic in surface soils for 33 years was calculated to be 1.8×10^{-5} (Table 3), which represents a low increased risk for cancer, thus exposure to arsenic in soil is not likely to result in adverse health effects.

Thallium

Thallium was present in three samples and concentrations ranged from not detected to 1.6 mg/kg. The remaining samples are below the United States median soil background concentration of 0.4 mg/kg [8].

Estimated exposure doses were calculated assuming daily exposures to thallium in soil for children and adults using the exposure point concentration (1.5 mg/kg). The daily estimated exposure doses for children exposed to thallium in soil ranged from 0.000004 – 0.00003 mg/kg/day (Table 2). The highest estimated exposure dose (0.00003 mg/kg/day) is for children between 1 to less than 2 years of age. The daily estimated exposure dose for an adult is 0.000001 mg/kg/day.

The exposure doses for children less than 6 years of age exceed the provisional RfD for thallium (0.00001 mg/kg/day). This RfD was derived from a study where no observable adverse effects were noted in female rats exposed to 0.04 mg/kg/day thallium [9]. Although estimated exposure doses for children exceeded the provisional RfD, they were below levels at which health effects have been observed. Therefore, exposure to thallium in soil at this property is not likely to cause adverse health effects in children or adults.

Conclusion

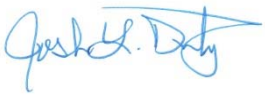
Based on the October 2014 soil sampling results, DSHS and ATSDR conclude that exposure to contaminants in surface soil from the Musgrove Gold Recovery site is not likely to result in adverse health effects for adults or children who currently live at the site.

Recommendation

Based on the review of the available data, DSHS and ATSDR have no recommendations at this time. However, if residents are concerned about their health, they should consult with their personal health care provider.

If you have additional questions regarding this letter, please contact me at 512.776.6641.

Sincerely,



Josh Duty
Environmental Protection Specialist
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CC:
Current Resident(s)

References

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2. Correspondence. William Rhotenberry, Federal On-Scene Coordinator, United States Environmental Protection Agency (EPA). September 3, 2014.

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