Public Health Assessment

Final Release

KERR-MCGEE CHEMICAL LLC SITE

JACKSONVILLE, DUVAL COUNTY, FLORIDA

EPA FACILITY ID: FLD039049101

Prepared by
Florida Department of Health

DECEMBER 30, 2013

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR's Cooperative Agreement Partner pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 45-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

PUBLIC HEALTH ASSESSMENT

KERR-MCGEE CHEMICAL LLC SITE

JACKSONVILLE, DUVAL COUNTY, FLORIDA

EPA FACILITY ID: FLD039049101

Prepared by:

Florida Department of Health
Division of Disease Control and Health Protection
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Table of Contents

Foreword

The Florida Department of Health (DOH) evaluates the public health threat of hazardous waste sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry in Atlanta, Georgia. This health consultation is part of an ongoing effort to evaluate health effects associated with metals and pesticides from the Kerr-McGee hazardous waste site in Jacksonville, Florida. The Florida DOH evaluates site-related public health issues through the following processes:

■ Evaluating exposure: Florida DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is on the site, and how human exposures might occur. The US Environmental Protection Agency (EPA) provided the information for this assessment.

■ Evaluating health effects: If we find evidence that exposures to hazardous substances are occurring or might occur, Florida DOH scientists will determine whether that exposure could be harmful to human health. We focus this report on public health; that is, the health impact on the community as a whole, and base it on existing scientific information.

■ Developing recommendations: In this report, the Florida DOH outlines, in plain language, its conclusions regarding any potential health and offers recommendations for reducing or eliminating human exposure to contaminants. The role of the Florida DOH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions for other agencies, including the EPA and the Florida Department of Environmental Protection. If, however, an immediate health threat exists or is imminent, Florida DOH will issue a public health advisory warning people of the danger, and will work to resolve the problem.

■ Soliciting community input: The evaluation process is interactive. The Florida DOH starts by soliciting and evaluating information from various government agencies, individuals or organizations responsible for cleaning up the site, and those living in communities near the site. We share any conclusions about the site with the groups and organizations providing the information. Once we prepare an evaluation report, the Florida DOH seeks feedback from the public.

If you have questions or comments about this report, we encourage you to contact us.

Please write to: Bureau of Epidemiology
Public Health Toxicology Section
Florida Department Health
Randy Merchant
4052 Bald Cypress Way, Bin # A-08
Tallahassee, FL 32399-1712

Or call us at: 850 245-4401 or toll-free in Florida: 1-877-798-2772

Summary

INTRODUCTION	At the Kerr-McGee hazardous waste site, the Florida Department of Health (DOH) and the US Agency for Toxic Substances and Disease Registry (ATSDR) serve the public by using scientific information included in ATSDR's Toxicological Profiles, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful toxic substances. The Kerr-McGee site is a vacant property at 1611 Talleyrand Avenue in Jacksonville, Duval County, Florida. In a 2003 report, Florida DOH assessed the public health threat based on environmental data collected through the end of 2001. The purpose of this report is to assess the public health threat based on environmental data collected since then. Florida DOH began this report in September 2009 when the US Environmental Protection Agency (EPA) proposed adding this site to the National Priorities List (NPL).
CONCLUSION #1	In this report, Florida DOH and ATSDR conclude that drinking water, surface water, and sediments in the area around the Kerr-McGee hazardous waste site are not expected to harm people's health. The reason for this is that municipal water is not contaminated and people cannot access surface water and sediment, so these exposure pathways are incomplete.
BASIS FOR DECISION #1	The City of Jacksonville supplies drinking water to the residents near the Kerr-McGee site. The banks of Deer Creek are muddy and overgrown with vegetation making it totally inaccessible. Sediments in the St. Johns River near the site are below 20 to 38 feet of water.
NEXT STEPS #1	Ensure that in the future people do not have access to contaminated groundwater, surface water, and sediments.
CONCLUSION #2	In their 2003 assessment report, Florida DOH and ATSDR concluded that future on-site residents accidentally eating very small amounts of arsenic and lead in surface soil on the Kerr-McGee site could harm their health. This remains a public health hazard.
BASIS FOR DECISION #2	Surface soil on the Kerr-McGee hazardous waste site is contaminated with high levels of arsenic and lead. As detailed in the 2003 public health assessment report, if land use changed to residential, children could be

exposed to arsenic and lead by putting soiled hands or toys in their mouth. Adults could also be exposed to arsenic and lead by eating or smoking with unwashed hands.

Swallowing arsenic at the highest levels measured in surface soil on this site for more than a few days could cause respiratory irritation, abnormal heart beat, stomach/intestinal problems, liver problems, anemia, and muscle problems. These same exposures for more than a year could cause damage to the heart, circulatory system, lungs, kidneys, liver, and gastrointestinal tract. In addition, they could cause a moderate increased risk of skin and liver cancer.

Swallowing lead at the highest levels measured in surface soil on this site could cause anemia, lower IQ test scores, heart abnormalities, slower growth, and increased blood pressure.

NEXT STEPS #2	Tronox Inc., the responsible party, or EPA should continue to prevent trespass or site reuse until they clean the soil to appropriate state standards.
CONCLUSION #3	Florida DOH and ATSDR cannot conclude whether breathing contaminated dust or skin contact with contaminated soil on the site could harm current maintenance workers. Long-term inadvertent ingestion of soil could cause a "low" estimated increased risk of cancer in current maintenance workers. Because future air-borne air concentrations are unknown, Florida DOH and ATSDR cannot conclude whether breathing contaminated dust during future testing, remediation, construction, or development could harm workers.
BASIS FOR DECISION #3	Mowing the grass on the site creates dust. On-site air monitoring has been inadequate to determine airborne contaminant concentrations. It is not possible to estimate the health risk for current maintenance workers from dieldrin and dioxins absorbed through the skin. Although current inadvertent ingestion of contaminants in soil by maintenance workers is not likely to cause any non-cancer illness, long-term exposure could cause a "low" estimated increased risk of cancer. This estimate may overestimate the current risk to current maintenance workers. The actual risk is likely lower. Any future testing, remediation, construction, or development that removes vegetation or disturbs the contaminated soil can create contaminated dust.
NEXT STEPS #3	Tronox Inc. should ensure they protect current maintenance workers from contaminated dust when mowing the grass. The workers should avoid skin

contact with contaminated soil, and wash their hands before eating or smoking to avoid inadvertent soil ingestion (swallowing).

Tronox Inc. should evaluate the impact of contaminated airborne dust before any future testing, remediation, construction, or development that removes vegetation or disturbs contaminated soil. The responsible party should also control dust generation and monitor air quality during any future testing, remediation, construction, or development that removes vegetation or disturbs contaminated soil.

CONCLUSION #4	Florida DOH and ATSDR cannot conclude whether there is a risk for current maintenance workers or future residents from exposure to radiological contaminants in on-site surface soil.
BASIS FOR DECISION #4	Laboratory analysis of surface soil for radiological contaminants was inadequate. The radiological analysis had problems that require retesting.
NEXT STEPS #4	Tronox Inc. should retest surface soil for naturally occurring radiological elements using a certified laboratory familiar with environmental contamination. The laboratory should perform radiochemical separation prior to counting, use the chemical fluoroscopic technique to measure uranium as total uranium, and compare with the activity concentration of uranium-238 alone.
FOR MORE INFORMATION	If you have concerns about your health or the health of your children, you should contact your health care provider. You may also call Randy Merchant with the Florida DOH toll-free at 877-798-2772 and ask for information about the former Kerr-McGee hazardous waste site.

Background and Statement of Issues

In September 2009, the US Environmental Protection Agency (EPA) proposed adding the Kerr-McGee hazardous waste site to their National Priorities List (NPL). In March 2010, EPA finalized addition of the Kerr-McGee site to the NPL. The Florida Department of Health (DOH) first assessed the public health threat at this site in 2003 [ATSDR 2003]. The purpose of this current public health assessment (PHA) report is to assess the public health threat based on environmental test data collected since then.

Site Description

The 31-acre Kerr-McGee hazardous waste site at 1611 Talleyrand Avenue is in a highly industrialized area on the St. Johns River in Jacksonville, Duval County, Florida 32206-5435 (Figures 1, 2, and 3). The site is roughly rectangular in shape; 1,800 feet east to west and 900 feet north to south. The site is fenced along its northern boundary with the Jaxport facility and along its western boundary on Talleyrand Avenue. Two gates in the fence along Talleyrand Avenue provide site access. The south end of the site is bordered by Deer Creek (a small tributary of the St. Johns River) and undeveloped tidal wetlands belonging to CSX Transportation. The east side borders the St. Johns River (Figure 4) (Appendix A - Photo 1) [Shaw 2006]. For this PHA, Florida DOH/ATSDR define on-site as the area within the Kerr-McGee property boundaries. They define off-site as the area outside of the Kerr-McGee property boundaries (Figure 4).

The site can be roughly divided into four parts. The pesticide and herbicide buildings, the facility office, the fly-flake disposal area, a surface impoundment, and a reported burn area occupied the northwestern portion. The dredge/fill area, the former sulfur storage tank, and the former acid plant occupied the northeastern portion. The former fertilizer building dominated the southeastern portion. The southwestern portion included the former pesticide storage warehouse and the specialty product warehouse (Figure 4). Only the foundations of these buildings remain [Shaw 2006].

Site Background Chronology

From 1893 to 1978 Kerr-McGee formulated, packaged, and distributed fertilizers. In the 1950s Kerr-McGee started pesticide formulation [AECOM 2008].

Kerr-McGee blended pesticides with inert materials for commercial and consumer use. They formulated all liquid pesticide and herbicide products in the Fasco building in the northwestern portion of the site. EPA detected aldrin, chlordane, dieldrin, endrin, benzene hexachloride (BHC), endosulfan, heptachlor, methoxychlor, malathion and toxaphene in this area [EPA 2010b].

A former employee reported that Kerr-McGee burned empty pesticide containers in an area north of the Fasco building [Shaw 2006]. Kerr-McGee also apparently used a small part of the north-central portion of the site as a burn area. In 1994, drillers found bags, pallets, wood, concrete and other debris in the some of the boreholes drilled north of the herbicide building (Figure 4). There are no available records as to the frequency of these burnings [Shaw 2006]. Since dioxins are byproducts of burning, they tested soil in this area for dioxins.

From 1984 to 2005, under the jurisdiction of the Florida Department of Environmental Protection (DEP) and the EPA, the responsible party conducted several environmental studies to define the nature and extent of the contamination. They found volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and metals at concentrations exceeding Florida DEP and EPA cleanup standards in the soils, groundwater, and sediments [EPA 2010a].

In November 2000, Florida DOH attended an EPA-sponsored public meeting. In 2001, Florida DOH and Duval CHD attended two more public meetings. Also in 2001, Florida DOH attended an International Longshoremen's Union meeting. In addition to unloading chemicals from ships, some of the longshoremen also worked at Kerr-McGee. They were concerned about their exposures to fertilizers, herbicides, pesticides, and sulfuric acid gas.

In March 2002, Florida DOH visited the site and attended an EPA-sponsored public meeting. EPA explained what chemicals they found and their plans for additional testing. Most of the people were concerned about the number of abandoned industrial sites in their neighborhood. They viewed Kerr-McGee as another long-term contributor to adverse environmental conditions in their community. They were concerned about restoring the quality of area surface water and soil.

In January 2003, Florida DOH mailed 45 area physicians information on the health assessment process, site-related chemicals, and materials to assist in taking an environmental exposure history. In February 2003, Florida DOH mailed a fact sheet to 400 addresses within a half-mile of the site and requested site-related health concerns. The fact sheet also announced the availability of the draft PHA report and summarized its findings. Florida DOH invited the public to provide comments on the draft report. Later that month, Florida DOH held two open house meetings. In August 2003 Florida DOH finalized their PHA report which addressed public comments.

In 2005, a consultant for Tronox Inc. assessed the human health risk from exposure to site-related contaminants. This assessment assumed the site would remain industrial. Exposure scenarios included an on-site maintenance worker who mowed the grass, a future industrial worker, a trespassing child, and future construction workers. Based on estimated concentrations of site contaminants inhaled as fugitive dust, the assessment concluded that nearby residents would not be exposed to an unacceptable risk or hazard resulting from exposure to site contaminants [Shaw 2005].

In January 2006, a consultant for the Tronox Inc. completed a remedial investigation. Their report included site background/history, hydrogeological information, and 2000-2005 test results for on-site soil, groundwater, Deer Creek/ St. John River sediment, and surface water contamination. In 2006, CSX removed petroleum-contaminated soil/sediment along Deer Creek on their site just west of Tallyrand Avenue [Shaw 2006]. Later in 2006, the responsible party's consultant recommended placing a 12-inch thick sand cap over 2.45 acres of impacted sediment in the St. Johns River.

EPA proposed adding this site to the NPL in September 2009 and finalized its addition in March 2010. Currently the site is vacant and EPA is overseeing testing and evaluation of remediation alternatives. There has been no cleanup on the site.

Site Visits

Florida DOH staff visited the site in April 2001, March 2002, and February 2003. They observed grasses, palmettos, pines, and wetland vegetation covering most of the site. Because of the vegetation, there appeared to be little dust generation, except driving on the dirt roads or mowing when it is dry. They saw the concrete foundations of former buildings. The western site boundary on Talleyrand Avenue was fenced and the two gates were posted with no trespassing/hazardous waste signs. They did not observe any physical hazards or detect any particular odors. Deer Creek was muddy and overgrown with vegetation. On both sides of Talleyrand Avenue the creek had absorbent booms to collect oil and grease. The area was mostly industrial with few residences within 0.25 miles of the site.

In January 2010, Duval CHD staff visited the site and the surrounding area. The main and side gates were locked and secured. The site itself was covered with grass and had visible monitoring wells but no signs of unauthorized activities (Appendix A - Photos 2-5). The concrete foundations of the former buildings were covered with vegetation, trees, and shrubs. Deer Creek was overgrown with vegetation and had trash near Talleyrand Avenue. The water in the creek near the Talleyrand Avenue bridge was cloudy and brown (Appendix A - Photo 6). The fence along the Talleyrand Avenue was intact with no signs of unauthorized entry and/or trespassing. The fence had several visible hazardous waste warning signs. One section of the fence along Talleyrand Avenue was, however, leaning toward the street (Appendix A - Photos 7 and 8). In May 2010, EPA and Duval CHD again visited the site to check the fence [DOH 2010a]. In June 2010, EPA reported the fence was repaired.

Previous Health Assessment

Florida DOH's 2003 public health assessment report concluded that in the past the site may have been a public health hazard for workers, and residents northwest of the site may have been exposed to dust. Florida DOH concluded on-site surface soil, St. Johns River/Deer Creek sediments, and shallow groundwater both on and off the site are contaminated with agricultural chemicals and metals. The Florida DOH, however, was not aware of any persons who were exposed to contaminated soil, sediments, shallow groundwater, or fish or shellfish in the St. Johns River near the site. Because site access was restricted and Deer Creek was overgrown with vegetation, Florida DOH concluded the site was not a current public health hazard.

Florida DOH did, however, conclude the site might be a future public health hazard if people were to ingest, inhale, or have skin contact with contaminated surface soil, shallow groundwater, or St. Johns River sediments. If land use changes and children or adults are exposed for more than a few days to the highest soil arsenic concentrations, they would likely suffer a number of symptoms and illnesses including respiratory irritation, abnormal heart beat, stomach/intestinal problems, liver problems, anemia, and muscle problems. These same exposures for more than a year could cause damage to the heart, circulatory system, lungs, kidneys, liver, and gastrointestinal tract. In addition, they could cause a moderate increased risk of skin and liver cancer [ATSDR 2003].

In the 2003 PHA, DOH recommended:

1. Site access should continue to be restricted until the responsible party cleans the site. Kerr-McGee should maintain the fence and warning signs, site workers should control dust generation, monitor air quality for metals and chlorinated pesticides, and wear respiratory protection during any future mowing, sampling, cleanup, remodeling, utilities installation, or construction activities that would disturb soils or remove vegetation. People should not drink contaminated groundwater from the shallow aquifer under or near the Kerr-McGee site, or use it in any enclosed space where they could inhale chemicals that escape from it. People should avoid exposure to contaminated sediments dredged from the St. Johns River.

2. Testing of fish and shellfish for metals and pesticides if in the future people eat fish or shellfish from the St. Johns River near the site. Kerr-McGee, however, is not the only source of contamination for fish and shellfish along this stretch of the St. Johns River [ATSDR 2003].

Demographics

The closest neighborhood is about 0.2 mile northwest of the site, west of the Jacksonville Electric Authority (JEA) Substation (Figure 3) (Appendix A- Photo 9). The City of Jacksonville supplies drinking water to this neighborhood and surrounding areas. There are no known potable water wells within 1-mile of the site [DOH 2010b].

Land Use

Jones Chemicals borders the Kerr-McGee site on the south, Toyota on the north, and the St. Johns River on the east. West across Talleyrand Avenue from the site are several industrial sites including Independent Recycling of Florida (Appendix A - Photo 10), Industrial Water Services (Appendix A - Photo 11), JEA, and Southeast Toyota Paint Shop (Figure 3). There are several nearby industrial properties and services including: Flicking Land Holdings (warehouse), Barco, Financial Sources, Lil Champ gas station, North Florida Erection Co, and vacant industrial properties [DOH 2010b].

Deer Creek is a small tidally-influenced tributary of the St. Johns River just south of the Kerr-McGee site. Deer Creek drains the southern part of the Kerr-McGee site, industrial areas to the south, and industrial areas to the west including CSX and FMC. There are no houses on the creek, only industrial properties. There is no recreational use of Deer Creek. A nearby wastewater lift station failed numerous times in recent years allowing thousands of gallons of untreated sewage to overflow into Deer Creek. There is little access to Deer Creek. The banks of the creek are overgrown with vegetation (grasses, small trees and bushes) and the ground itself is muddy, further restricting access. Deer Creek from the Kerr-McGee site to the St. Johns River is totally inaccessible. In May 2010, EPA and Duval County Health Department (CHD) staff did not see any sign of creek access.

The Kerr-McGee site is zoned waterfront industrial. Land use is “Water-Dependent/Water Related” with “Industrial Water” (Figure 2). Domestic/industrial sewer systems, stormwater, and agricultural runoff have impacted the St. Johns River near the Kerr-McGee site [Shaw 2005].

There is no planned future residential use of the site. Other land uses within a ¼ mile radius of the Kerr-McGee site include: heavy industrial, light industrial, community/general commercial, and low density residential [Shaw 2005]. Schools near Kerr-McGee include:

- Axon Elementary School - 1 mile to the northwest,
- John Love Elementary School - 2/3 of a mile to the northwest,
- Brown School - 2/3 of a mile to the west,
- Gilbert Junior High School – 3/4 of a mile to the west, and
- Oakland School – approximately 1 mile to the southwest.

Community Health Concerns

Nearby residents have reported a number of health concerns including allergies, asthma, bronchitis, cancer, diabetes, kidney problems, low birth weight, miscarriages, nerve damage, skin problems, and stroke.

Discussion

Environmental Data

In 2002, 2004, and 2005, consultants collected 64 soil samples (0-12 inches deep) on the Kerr-McGee site and six soil samples nearby (Figure 5). Because these samples were from 0 to 12 inches deep and not from the surface (0-3 inches deep), their use introduces additional uncertainty in the exposure estimate. The consultants analyzed these samples for metals, pesticides, dioxins, and radiological contaminants [Shaw 2006]. Table 3 summarizes the highest concentrations found in the on-site soil samples. Based on these tests, Florida DOH selected arsenic, gamma-BHC, DDT, dieldrin, dioxins (2,3,7,8-TCDD), and lead as contaminants of concern.

For the purpose of this assessment, testing of on- and off-site soil for metals, pesticides, and dioxins was adequate. The laboratory analysis for radiological contaminants, however, was inadequate. To avoid matrix interferences, the laboratory should perform radiochemical separation prior to counting. The laboratory should measure uranium as total uranium by the chemical fluoroscopic technique to compare with the activity concentrations of uranium-238 alone. The laboratory should be certified and familiar with environmental TENORM contamination.

Exposure Pathway Analyses

Chemical contamination in the environment can harm your health, but only if you have contact with those contaminants (exposure). Without contact or exposure, there is no harm to health. If there is contact or exposure, how much of the contaminants you contact (concentration), how often you contact them (frequency), for how long you contact them (duration), and the danger of the contaminant (toxicity) all determine the risk of harm.

Knowing or estimating the frequency with which people could have contact with hazardous substances is essential to assessing the public health importance of these contaminants. To decide if people can contact contaminants at or near a site, Florida DOH looks at human exposure pathways. Exposure pathways have five parts. They are:

1. a source of contamination like a hazardous waste site,
2. an environmental medium like air, water, or soil that can hold or move the contamination,
3. a point where people come into contact with a contaminated medium like water at the tap or soil in the yard,
4. an exposure route like ingesting (contaminated soil or water) or breathing (contaminated air),
5. a population who could be exposed to contamination like nearby residents.

Florida DOH eliminates an exposure pathway if at least one of the five parts referenced above is missing and will not occur in the future. Exposure pathways not eliminated are either completed or potential. For completed pathways, all five pathway parts exist and exposure to a contaminant has occurred, is occurring, or will occur. For potential pathways, at least one of the five parts is missing, but could exist. Also for potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

Compared to ingestion (eating/drinking) and inhalation (breathing), the risk from dermal exposure (skin absorption) is usually insignificant. Since, however, some of the pesticides at this site can be absorbed through the skin; this report assesses the risk from dermal exposure.

Currently there are three complete exposure pathways and one potential exposure pathway (Tables 1 and 2).

Completed Exposure Pathways

In the past, on-site maintenance workers were exposed to contaminated soil via inadvertent ingestion and skin absorption. They were also exposed to contaminated dust via inhalation. These same workers are currently being exposed and will likely continue to be exposed in the future (Table 1).

Potential Exposure Pathways

Future Worker Dust Inhalation

In the future, on-site construction workers and workers near the site could be exposed via inhalation of contaminated dust (Table 2).

Future Residential Soil Ingestion

In the future, on-site residents could be exposed to via inadvertent ingestion of contaminated soil (Table 2).

Eliminated Exposure Pathways

Inadvertent Ingestion of Contaminated Deer Creek Sediments and Surface Water

The banks of Deer Creek are overgrown with vegetation (grasses, small trees and bushes) and the ground is muddy which further restricts access. Deer Creek from the Kerr-McGee site to the St. Johns River is totally inaccessible. Therefore, there is little possibility of exposure to contaminants in water or sediments in Deer Creek.

Ingestion and Inhalation of Contaminated Dust at Distant Residences

The nearest residents live about a ¼ mile from the site and are not likely to be exposed to contaminated dust. Therefore, DOH eliminates inhalation of contaminated dust by nearby residents as current or future exposure pathways.

Exposures to Contaminated St. Johns River Sediments, Fish and Surface Water

Even though contaminated sediments in the St. Johns River near the site are present, they are 20 to 125 feet off-shore and under 20 feet to 38 feet of water. So, currently there is little chance of exposure from ingesting these sediments. Therefore, the Florida DOH eliminates ingestion of contaminated sediments from the St. Johns River near the site as an exposure pathway.

Fishing from the St. Johns River near the site is limited. The water along the shoreline is deep and swiftly moving. The Duval CHD reports that although people may eat fish and shellfish from other parts of the St. Johns River, the strong current and industrial ship traffic on this part of the river make pleasure or subsistence fishing from small boats unlikely. There is also no shore access near the site. Therefore, the Florida DOH eliminates eating fish or ingesting surface water from the St. Johns River near the Kerr-McGee site as an exposure pathway.

Ingestion of Contaminated Groundwater

There are no active potable wells within 1 mile of the site. There is, however, an inactive well, an irrigation well, and a limited use well within one mile of the site. The inactive well has been inactive since 2001. Neither Florida DOH nor Florida DEP has any data for the irrigation or limited use well [DOH 2010b]. Because no one is drinking groundwater within a mile of the site and the groundwater flow is towards the St. Johns River and Deer Creek, the Florida DOH eliminates drinking contaminated groundwater as an exposure pathway.

Public Health Implications

Health scientists look at what chemicals are present and in what amounts. They compare those amounts to health guidelines. These guidelines are set far below known or suspected levels associated with health effects. Florida DOH uses guidelines developed to protect children. If chemicals are not present at levels high enough to harm children, they would not likely harm adults.

This public health assessment also considers health concerns of nearby residents and explores possible associations with site-related contaminants. This assessment requires the use of assumptions, judgments, and relies on incomplete data. These factors contribute to uncertainty in evaluating the health threat. Assumptions and judgments in the assessment of the site's impact on public health err on the side of protecting public health and may overestimate the risk.

Florida DOH estimates the health risk for individuals exposed to the highest measured level of contamination. Florida DOH provides site-specific public health recommendations on the basis of toxicological literature, levels of environmental contaminants, evaluation of potential exposure pathways, duration of exposure, and characteristics of the exposed population. Whether a person will be harmed depends on the type/amount of contaminant, how they are exposed, how long they are exposed, how much contaminant is absorbed, genetics, and individual lifestyles.

After identifying contaminants of concern, Florida DOH evaluates exposures by estimating daily doses for children and adults. Kamrin [1988] explains the concept of dose as follows:

> "…all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus, the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.
>
> Thus instead of using the amount that is administered or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus, 1 ounce administered to a 1-pound rat is equivalent to 2,000 ounces to a 2,000-pound (1-ton) elephant. In each case, the amount per weight is the same; 1 ounce for each pound of animal."

This amount per weight is the *dose*. Toxicology uses dose to compare toxicity of different chemicals in different animals. We use the units of milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day) to express doses in this assessment. A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds.

To calculate the daily doses of each contaminant, Florida DOH used standard and other factors needed for dose calculation [ATSDR 2005b; EPA 1997]. We assume that people are exposed daily to the maximum concentration measured. We also assumed that 100% of the ingested chemical was absorbed into the body. The percent actually absorbed into the body is likely less.

ATSDR groups health effects by duration (length) of exposure. Acute exposures are those with duration of 14 days or less; intermediate exposures are those with duration of 15 – 364 days; and chronic exposures are those that occur for 365 days or more (or an equivalent period for animal exposures). ATSDR Toxicological Profiles also provide information on the environmental transport and regulatory status of contaminants.

We assumed the current maintenance worker could be exposed to contaminants in the top three inches of soil while working on the site. Pathways for exposure to this soil include inadvertent ingestion (swallowing), inhalation of contaminated dust, and skin absorption. However, since we do not have sampling data for surface soil (0-3 inches); we used data from the top 12 inches of soils. Use of samples from 0 to 12 inches deep and not from the surface (0-3 inches deep), however, introduces additional uncertainty in the exposure estimate.

We estimated the dose for inadvertent ingestion (swallowing) of soils using the following formula:

$$D = (C \times IR \times EF \times CF) / BW$$

D = exposure dose (milligrams per kilogram per day or mg/kg/day)
C = contaminant concentration (milligrams per kilogram or mg/kg)
IR = intake rate of contaminated sediment (milligrams per day or mg/day)
EF = exposure factor (unit less)
CF = conversion factor (10^{-6} kilograms per milligram or kg/mg)
BW = body weight (kilograms or kg)

$$EF = F \times ED / AT$$

EF = exposure factor (unit less)
F = frequency of exposure (days/year)
ED = exposure duration (years)
AT = averaging time (days) (ED x 365 days/year for non-carcinogens; 70 years x 365 days/year for carcinogens)

For non-carcinogens, we estimated an exposure factor for the adult maintenance worker of 0.025. Exposure to the on-site soils is 9 days a year for the adult maintenance worker.

EF adults, noncancer = (9 days per year) (10 years) / (10 years x 365 days/year) = 0.025

Table 3 summarizes the estimated dose for each contaminant of concern from inadvertent ingestion (swallowing) of on-site soils by the maintenance worker:

We compared estimated exposure doses to ATSDR chemical specific minimal risk levels (MRLs). MRLs are comparison values that establish exposure levels many times lower than levels where no effects were observed in animals or human studies. The MRL is designed to protect the most sensitive, vulnerable individuals in a population. The MRL is an exposure level below which non-cancerous harmful effects are unlikely, even after daily exposure over a lifetime. Although we considered concentrations at or below the relevant comparison value reasonably safe, exceeding a comparison value does not imply that we expect adverse health effects.

If contaminant concentrations were above comparison values, we further analyzed exposure variables (for example, duration and frequency), toxicology of the contaminants, past epidemiology studies, and the weight of evidence for health effects. We used chronic MRLs where possible because exposures are usually longer than a year. If chronic MRLs were not available we used intermediate length MRLs [ATSDR 2005b].

For cancer, we estimated the increased risk by multiplying the estimated dose by the EPA cancer slope (potency) factor. Because of large uncertainties in the way scientists estimate cancer risks, the actual cancer may be as low as zero. If no cancer slope factor existed, the increased cancer risk could not be quantified.

We usually estimate the cancer risk from lifetime (70 year) exposure (i.e. EF adults = 1). In some cases we estimate the cancer risk from exposure over a significant portion of the lifetime (at least 35 years). Studies of animals exposed over their entire lifetime are the basis for calculating most cancer slope factors. For workers on this site, we estimated the cancer risk from a 10-year exposure.

EF adults, cancer = (9 days per year) (10 years) / (70 years x 365 days/year) = 0.0035

Too little is known about the combined toxic effect of multiple contaminants to assess the health risk from exposure to mixtures. Therefore this report assessed the health threat based on exposure to individual contaminants.

Although procedures exist to quantify the amount of contaminants absorbed through the skin from water, there are no corresponding procedures to quantify skin absorption from soil by the on-site maintenance worker [ATSDR 2005b].

The Florida DOH is unaware of any air monitoring or dust data at the Kerr-McGee site. Therefore, it is not possible to estimate how much contamination is inhaled by the on-site maintenance worker or could be inhaled by future workers. If land use changes, Florida DOH recommends dust suppression and air monitoring during remediation/development.

Arsenic

Arsenic is a naturally occurring metal widely distributed in soil. It is usually found combined with oxygen, chlorine, and sulfur. Most arsenic compounds have no smell or special taste [ATSDR 2007a]. Arsenic was likely used in pesticides produced at Kerr-McGee.

Arsenic, like most metals, is not well absorbed through the skin. If you get arsenic contaminated soil on your skin, only a small amount will go through your skin into your body, so skin contact is usually not a health risk [ATSDR 2007a]. The lack of air monitoring data prevents an evaluation of the risk from breathing arsenic contaminated dust.

Non-Cancer Illnesses

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest arsenic levels is unlikely to develop non-cancer illnesses. The maximum adult arsenic dose (6×10^{-5} mg/kg/day) is less than ATSDR's chronic MRL (3×10^{-4} mg/kg/day) and thus unlikely to cause non-cancer illnesses (Table 3).

Cancer Risk

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest arsenic levels over a 10-year period is at a "low" estimated increased risk of skin cancer (Table 3). Multiplying the maximum arsenic dose (9×10^{-6}) mg/kg/day) by the EPA cancer slope factor of 1.5 $(mg/kg\text{-}day)^{-1}$ results in a "low" estimated increased cancer risk of 1 in 100,000 (0.00001 or 1×10^{-5}). This means a maintenance worker exposed to the highest level of arsenic in the on-site soil for 9 days per year for 10 years would have a one in 100,000 increased chance of cancer.

To put this risk into context, the American Cancer Society estimates that one out of every three Americans (or 33,333 in 100,000) will be diagnosed with some form of cancer in their lifetime. Adding this estimate of the increased cancer risk from lifetime exposure to arsenic in these soils would increase the cancer incidence from 33,333 in 100,000 to 33,334 in 100,000.

gamma-Benzene Hexachloride (BHC)

Benzene hexachloride (BHC) is also known as hexachlorocyclohexane. It is a man-made chemical that exists in different forms called isomers. alpha-BHC, beta-BHC and gamma-BHC are three of these isomers. EPA found all three BHC isomers on the Kerr-McGee site but only concentrations of the gamma isomer were above ATSDR comparison values. Technical grade BHC was once used as an insecticide in the U.S. and was made up of alpha, beta, delta and epsilon isomers. All the insecticidal properties of BHC, however, are in the gamma isomer. gamma-BHC (also known as Lindane) was used in a 1% solution to treat scabies. gamma-BHC is a white solid that may vaporize into the air. It has not been produced in the U.S. since 1976. All these isomers remain in soils at hazardous waste sites because they persist in the environment. Algae and fungi can break down these isomers in soils and sediments but the process takes a very long time [ATSDR 2005a].

Studies examining the dermal toxicity of gamma-BHC in humans are limited. Most of the information is derived from cases in which gamma-BHC was dermally applied as a scabicide. gamma-BHC in topical creams and lotions is efficiently absorbed through the skin. Although it has been reported that these lotions contain 1% gamma-BHC, it is not possible to quantify the amount of gamma-BHC to which these individuals were exposed, because of the different area of skin treated [ATSDR 2005a]. The lack of air monitoring data prevents an evaluation of the risk from breathing gamma-BHC contaminated dust.

It is unlikely that skin contact with gamma-BHC contaminated soil at the Kerr-McGee site will cause illness. The highest concentration of gamma-BHC measured in on-site soil before 2001 (424 mg/kg or 0.04%) is 25 times lower than the concentration in lotions people used to treat scabies (1%).

Non-Cancer Illnesses

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest gamma-BHC levels for less than a year is not likely to suffer non-cancer illnesses. The maximum adult gamma-BHC dose (1×10^{-6} mg/kg/day) is less than ATSDR's intermediate length (14-365 days) oral MRL (1×10^{-5} mg/kg/day) and thus are not likely to cause non-cancer illnesses (Table 3). Because there are few studies of the toxicity of gamma-BHC from exposure longer than a year, the long-term risk for site maintenance workers is uncertain.

Cancer Risk

The U.S. Department of Health and Human Services has determined that gamma-BHC may reasonably be anticipated to cause cancer in humans. The International Agency for Research on Cancer has classified gamma-BHC as possibly carcinogenic to humans. EPA has determined that there is suggestive evidence that gamma-BHC is carcinogenic, but the evidence in not sufficient to assess its human carcinogenic potential. There is not a cancer slope factor for gamma-BHC. Therefore, we cannot estimate the risk of cancer for a maintenance worker who inadvertently ingests (swallows) very small amounts of surface soils from the site (Table 3).

Dichlorodiphenyltrichloroethane (DDT)

Dichlorodiphenyltrichloroethane (DDT) is a pesticide once widely used to control insects on agricultural crops and insects that carry diseases. After 1972, it was no longer used in the U.S. Now it is only used in a few countries to control malaria. Technical grade DDT may also contain 1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethane (DDD) and dichlorodiphenyldichloroethane (DDE). DDT does not occur naturally in the environment.

DDT does not enter the body through the skin very easily. Compared to ingestion and inhalation, skin absorption of DDT is insignificant [ATSDR 2002b]. The lack of air monitoring data prevents an evaluation of the risk from breathing DDT contaminated dust.

Non-Cancer Illnesses

A maintenance worker, who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest DDT levels for less than a year, is not likely to suffer non-cancer illnesses. The maximum adult DDT dose (6×10^{-6} mg/kg/day) is less than ATSDR's intermediate length (14-365 days) oral MRL (5×10^{-4} mg/kg/day) and thus are not likely to cause non-cancer illnesses (Table 3). Because there are few studies of the toxicity of DDT from exposure longer than a year, the long-term risk for site maintenance workers is uncertain.

Cancer Risk

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest DDT levels over a 10-year period is at an "extremely low" estimated increased risk of cancer (Table 3). Multiplying the maximum DDT dose (9×10^{-7} mg/kg/day) by the EPA cancer slope factor of 0.34 $(mg/kg\text{-}day)^{-1}$ results in an "extremely low" additional estimated increased cancer risk of 3 in10 million (0.0000003 or 3×10^{-7}). This means a maintenance worker exposed to the highest level of DDT in the on-site soils for 10 years would have a three in 10 million increased chance of cancer from this exposure.

To put this risk into context, the American Cancer Society estimates that one out of every three Americans (or 3,333,333 in 10,000,000) will be diagnosed with some form of cancer in their lifetime. Adding this estimated increased cancer risk from lifetime exposure to DDT in these on-site soils would increase the cancer incidence from 3,333,333 in 10,000,000 to 3,333,336 in 10,000,000.

Dieldrin

Dieldrin was once used as an insecticide and is not found naturally in the environment. It has a mild chemical odor and is a white or tan powder. From the 1950s to 1970s, dieldrin was used extensively on crops as an insecticide. Up until 1987 it was used for killing termites. It is no longer produced or used in the U.S.

Dieldrin is absorbed rapidly through the skin [ATSDR 2002a]. It is not possible, however, to quantify the amount absorbed through the skin from contact with dieldrin-contaminated soil [ATSDR 2005b]. The lack of air monitoring data prevents an evaluation of the risk from breathing dieldrin contaminated dust.

Non-Cancer Illnesses

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest dieldrin levels is not likely to suffer non-cancer illnesses. The maximum adult dieldrin dose (4×10^{-7} mg/kg/day) is less than the ATSDR chronic oral MRL (5×10^{-5} mg/kg/day) and thus is not likely to cause any non-cancer illnesses (Table 3).

Cancer Risk

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest current dieldrin levels over a 10-year period is at a "very low" estimated increased risk of cancer (Table 3). Multiplying the maximum dieldrin dose (6×10^{-8} mg/kg/day) by the EPA cancer slope factor of 16 $(mg/kg\text{-}day)^{-1}$ is below a "very low" additional estimated increased cancer risk of 1 in a million (0.000001 or 1×10^{-6}). This means a maintenance worker exposed to the highest level of dieldrin in the on-site soils for 10 years would have a one in a million increased chance of cancer from this exposure.

To put this risk into context, the American Cancer Society estimates that one out of every three Americans (or 333,333 in 1,000,000) will be diagnosed with some form of cancer in their lifetime. Adding this estimate increased cancer risk from lifetime exposure to dieldrin in these soils would increase the cancer incidence from 333,333 in 1,000,000 to 333,334 in 1,000,000.

Dioxins - 2,3,7,8-Tetrachlorodibenzo-p-dioxins Toxicity Equivalence (TCDD-TEQ)

Chlorinated dibenzo-p-dioxins (dioxins) including 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) are formed as a contaminant in the manufacture of various chlorinated pesticides and herbicides, and releases to the environment have occurred during the use of these chemicals. Because dioxins remain in the environment for a long time, contamination from past pesticide and herbicide use may still be of concern at this site. In addition, improper storage or disposal of these pesticides and waste generated during their production can lead to dioxin contamination of soil and water.

2,3,7,8-TCDD is one of the most toxic and extensively studied of the dioxins Based on results from animal studies, scientists have learned that they can express the toxicity of other dioxins as a fraction of the toxicity attributed to 2,3,7,8-TCDD [ATSDR 1998].

Although data for people are lacking, it is reasonable to assume that dioxins can be absorbed through the skin. There is some evidence, however, that dioxins tightly bound to soil particles are not readily absorbed by the skin [ATSDR 1998]. Either way, it is not possible to quantify the amount absorbed through the skin from contact with contaminated soil [ATSDR 2005b]. The lack of air monitoring data prevents an evaluation of the risk from breathing dioxin contaminated dust.

Non-Cancer Illnesses

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soil from the site with the highest 2,3,7,8-TCDD levels is unlikely to suffer non-cancer illnesses. The maximum adult 2,3,7,8-TCDD dose calculated from the maximum on-site soil concentration (7×10^{-12} mg/kg/day) is less than ATSDR's oral chronic MRL (1×10^{-9} mg/kg/day) and thus is not likely to cause non-cancer illnesses (Table 3).

Cancer Risk

A maintenance worker who inadvertently ingests (swallows) very small amounts of surface soils from the site with the highest 2,3,7,8-TCDD levels over a 10-year period is at an “extremely low” estimated increased risk of cancer (Table 3). Multiplying the maximum 2,3,7,8-TCDD dose (1×10^{-12} mg/kg/day) by the cancer slope factor of 130,000 $(mg/kg\text{-}day)^{-1}$ results in an “extremely low” estimated increased cancer risk of 1 in 10 million (0.0000001 or 1×10^{-7}). This means a maintenance worker exposed to the highest level of 2,3,7,8-TCDD in the on-site soils for 10 years would have a 1 in 10 million increased chance of cancer from this exposure.

To put this risk into context, the American Cancer Society estimates that one out of every three Americans (or 3,333,333 in 10,000,000) will be diagnosed with some form of cancer in their lifetime. Adding this estimate increased cancer risk from lifetime exposure to 2,3,7,8-TCDD in the soils would increase the cancer incidence from 3,333,333 in 10,000,000 to 3,333,334 in 10,000,000.

Lead

Lead is a naturally occurring metal that can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining and manufacturing. Adults and children may be exposed to lead by hand-to-mouth contact after exposure to lead-containing soil or dust. Most exposure to lead comes from accidental ingestion rather than dermal exposure. Environmental exposure to lead has long been recognized as a public health problem particularly among children. Excessive concentrations of lead in soil have been shown to increase blood lead levels in young children (ATSDR 1999, 2005).

Lead, like most metals, is not well absorbed through the skin. Soil that contains lead may get on your skin, but only a small portion of the lead will pass through your skin and enter your blood. The only kinds of lead compounds that easily penetrate the skin are the additives in leaded gasoline, which is no longer sold to the general public. Therefore, the general public is not likely to encounter lead that can enter through the skin [ATSDR 2007b]. The lack of air monitoring data prevents an evaluation of the risk from breathing lead contaminated dust.

In 2012 the Advisory Committee on Childhood Lead Poisoning Prevention emphasized the importance of preventing lead exposure rather than responding after exposure has already taken place. The committee recommended a reference value based on the 97.5th percentile of the blood lead level distribution among children 1–5 years old in the United States (currently 5 µg/dL) to identify children with elevated blood lead levels. Approximately 450,000 children in the United States have blood lead levels higher than this reference value [CDC 2013].

Non-Cancer Illnesses

Estimated blood lead levels more accurately predict health effects than traditional dose estimates. Using EPA’s Integrated Exposure Uptake Biokinetic (IEUBK) model, Florida DOH estimates that exposure to the highest concentration of lead in surface soil on the Kerr-McGee site (1,400 mg/kg) would result in less than 5 micrograms of lead per deciliter blood (µg/dL) in on-site maintenance workers. In general, adults with blood lead levels less than 5 µg/dL are not likely to suffer any non-cancer illness [ATSDR 2007b]. For adult workers, the U.S. Occupational Safety and Health Administration recommends an evaluation when blood lead levels exceed 40 µg/dL.

If children live or play on the site in the future, the highest concentration of lead in the on-site surface soil is a health hazard. Exposures may cause anemia, lower IQ test scores, heart abnormalities, slower growth, and increased blood pressure [ATSDR 2003].

<u>Cancer Risk</u>

There is no conclusive proof that lead causes cancer in humans. The U.S. Department of Health and Human Services has determined that lead is reasonably anticipated to be a human carcinogen based on limited evidence from studies in humans and sufficient evidence from animal studies. EPA has determined that lead is a probable human carcinogen. The International Agency for Research on Cancer has determined that inorganic lead is probably carcinogenic to humans [ATSDR 2007b].

EPA has not established a cancer slope factor for lead with which to quantify an increased cancer risk.

Health Outcome Data

Florida DOH epidemiologists did not evaluate area cancer rates because there is not an identified completed exposure pathway for nearby residents, very few people live near the site, and only a few maintenance workers go on the site.   Also the maximum estimated increased cancer risks from exposure to carcinogens in on-site surface soils are “low” to “extremely low.”

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometime engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults; this means they breathe dust, soil and vapors close to the ground. A child’s lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body system of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children’s health.

If in the future site land use changed to residential, children exposed to the highest soil arsenic and lead concentrations would likely suffer a number of symptoms and illnesses.

Community Health Concerns Evaluation

The Florida DOH evaluated community health concerns. Currently, there is little potential for exposure of nearby residents to contaminants from this site. Past exposures to airborne contaminated dust from the Kerr-McGee site, however, are unknown.

Allergies

Because of the lack of air monitoring data, it is not possible to estimate the risk of allergies for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

An allergy is a very common disorder. It is caused when the immune system wrongly identifies a harmless substance as an illness causing threat. An allergen is a harmless substance that triggers an immune system response. An allergic reaction occurs after the body has been sensitized, after repeated exposures to an allergen. The immune system mistakenly reacts to the allergen as it would to a harmful virus or bacteria. An antibody is then produced to defend the body. When the antibody makes contact with the allergen, chemicals (histamine is the most common) are produced that trigger allergy symptoms. The most common symptoms are itchy, watery eyes, sneezing, runny nose, hives, and inflammation of the nasal passages. In severe cases, allergies can cause anaphylaxis shock. The most common allergens are plant pollens, dust mites, mold, pet dander, medications (like aspirin or penicillin), and certain foods. The cause of allergies is still being investigated. It is known that heredity and environment are risk factors in the development of allergies. Allergies affect a large number of people in the United States. Approximately one in five Americans has a chronic allergy (AMA 2003).

Asthma

Because of the lack of air monitoring data, it is not possible to estimate the risk of asthma for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Asthma is a chronic but reversible immunological condition that causes inflammation, excessive mucous secretion (phlegm) and constriction (narrowing) of the lung's airways. Asthma can produce coughing, wheezing, and shortness of breath. A wide variety of environmental factors may trigger an asthma attack. Factors include cold air and allergens (pet dander, dust mites, pollen). It can also be prompted by inhaling an irritant (cigarette smoke, pollution). Strenuous exercise, stress, and anxiety can also trigger attacks. The stimuli that trigger asthma attacks are different for each person who has asthma. Asthma attacks can vary widely in how severe they are and how long they last. It affects at least 17 million people in the United States and is becoming more widespread. It can affect people of any age or gender, but tends to begin in childhood. The incidence of asthma is highest in cities where there is more pollution (MERCK 2003, AMA 2003). Asthma and allergies are the most common causes of respiratory and breathing problems in the United States.

Breathing high levels of arsenic dust can cause a sore throat and irritated lungs.

Inadvertent ingestion (swallowing) of arsenic in soil on the Kerr-McGee site is not expected to cause a higher incidence of respiratory problems for the maintenance worker. In general, respiratory effects have not been widely associated with repeated oral ingestion of low arsenic doses. Some studies have reported minor respiratory symptoms such as cough, sputum, rhinorrhea and sore throat in people with repeated oral exposure to 0.03-0.05 mg/kg/day, but only at doses 30-50 times higher than the highest estimated oral dose at Kerr-McGee [ATSDR 2007a].

Bronchitis, chronic

Because of the lack of air monitoring data, it is not possible to estimate the risk of chronic bronchitis for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Bronchitis is the inflammation of the bronchi, the airways that connect the windpipe to the lungs, resulting in a persistent cough that produces considerable quantities of sputum (phlegm). Acute bronchitis is of sudden onset and short duration and chronic bronchitis is persistent over a long period and reoccurs over several years. Both are more common in smokers and in areas with high atmospheric pollution.

Bronchitis is regarded as chronic when sputum is coughed up on most days during at least three consecutive months in at least two consecutive years. The disease commonly results in widespread narrowing and obstruction of the airways in the lungs. It often coexists with (and may contribute to the development of) another lung disease, emphysema, in which the alveoli (air sacs) in the lungs become distended. Chronic bronchitis and emphysema together are sometimes called chronic obstructive pulmonary disease (COPD).

Cigarette smoking is the main cause of chronic bronchitis. It stimulates the production of mucus in the lining of the bronchi and thickens the bronchi's muscular walls and those of the bronchioles (smaller air ways of the lungs), resulting in narrowing of these air passages. The passages then become more susceptible to infections, which cause further damage. Atmospheric pollution can have the same effect.

Approximately 3,000 persons per 100,000 in the US suffer from chronic bronchitis. Most are over 40 and male suffers outnumber female suffers two to one. The disease is most prevalent in industrial cities and in smokers. COPD accounts for about 30 deaths per 100,000 in the US per year.

As the disease progresses, often with the development of emphysema, the lungs become more resistant to the flow of blood, resulting in pulmonary hypertension (increased pressure in the arteries that supply blood to the lungs), and in stain on the right side of the heart due to its increase work in pumping blood through the lungs. Edema (swelling cause by fluid collection) then develops in the legs and ankles due to the back pressure in blood vessels as a result of the heart failure.

Those with chronic bronchitis usually have two or more episodes of acute viral or bacterial infection of the lungs every winter. To relieve breathlessness, the physician may prescribe an inhaler containing a bronchodilator (a drug that relaxes and widens the bronchi). The disease often shows an inexorable progression with increasing shortness of breath [AMA 1989].

Workers exposed to arsenic often report irritation of the mucous membranes of the nose and throat, which may lead to bronchitis [ATSDR 2007a]. There is only limited evidence that inhalation of dioxins can cause bronchitis [ATSDR 1998].

Cancer

Because of the lack of air monitoring data, it is not possible to estimate the risk of cancer for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Cancer is very common. The American Cancer Society estimates that one in three Americans will be diagnosed with some form of cancer during their lifetime and one in four Americans will die of cancer. Cancer is second only to heart disease as a cause of death in the U.S. (ACS 2006). Cancer is not just one disease, but a group of them. Cancer happens when something damages the way the body controls a group of cells. After that, cells grow rapidly and no longer in a normal way. Growths that are cancerous or malignant can form within any tissue or organ system. Malignancies are usually grouped into two categories:

- Non-tumor forming - This includes leukemia, which is a type of cancer in which white blood cells displace normal blood cells. Lymphoma is another type, which starts in the lymph nodes.
- Tumor forming - This includes carcinoma, which is kind of tumor that starts in the surface layer of an organ or body part and may spread to other parts of the body. They commonly occur more often in older people. A second kind of tumor-forming cancer is sarcoma. This tumor grows in connective tissue like muscle, bone, fat or cartilage.

Risk factors for cancer include family history, age (60% of all cancers in the US occur in people over 65), environmental factors (cigarette smoking, alcohol consumption, pollution from industrial waste, and radiation), geography, diet (high in saturated fat/high alcohol intake), viral infections, and inflammatory diseases [MERCK 2003].

Excluding non-melanoma skin cancer, the most common types of cancer in Florida are prostate (men), breast (women), lung/bronchus, colorectal, bladder, head/neck, uterine (women), and non-Hodgkin’s lymphoma [DOH 2006].

Death

Because of the lack of air monitoring data, it is not possible to estimate the risk of death for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Diabetes

Because of the lack of air monitoring data, it is not possible to estimate the risk of diabetes for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Diabetes is a group of metabolic (which means it is has to do with how the body changes food into energy) disorders that occur when blood sugar (glucose) levels are not properly controlled. As a result, blood sugar stays in the blood. When that happens, it can damage cells, organs and tissues. Insulin is one of several hormones that control the body's blood sugar level. Insulin allows glucose to move from the blood into the liver, muscles and fat cells where these cells use it for fuel. The most common form of the disorder is diabetes mellitus (Type I and Type II). The most common symptoms of Type I are: frequent urination, excessive thirst, unexplained weight loss and general fatigue. Many times, Type II diabetes shows no symptoms at first. Slowly over time, the affected person begins to show Type I symptoms. In Type I diabetes, the insulin a person's body makes stops or is greatly decreased. People who have this form of diabetes often need daily insulin shots. Type I usually affects children and young people. It can also occur in adults with pancreas damage. In Type II diabetes, the body is insulin-resistant or unable to use the insulin the pancreas makes. Type II diabetes commonly affects adults. In the United States, 90% of diabetics have the Type II form of the disease. Besides a strong sign that diabetes occurs in families, obesity (being overweight for someone's height by 20% or more) is the major risk factor (AMA 2003).

Slight increases in the risk of diabetes have been observed in some studies of people exposed to dioxins [ATSDR 1998].

Kidney Failure

Because of the lack of air monitoring data, it is not possible to estimate the risk of kidney failure for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

The main function of the kidneys is to filter and cleanse the blood. The kidneys also keep the body's balance of water and filter/rid the body of metabolic wastes and electrolytes (such as sodium and potassium). The kidneys also help control blood pressure by regulating sodium levels in the blood. The kidneys make an enzyme called rennin that controls blood pressure. In addition, the kidneys secrete hormones that help control the production of red blood cells and the growth and upkeep of bones.

When kidneys do not work correctly, it can take many forms including acute/chronic kidney failure, nephritis (or inflammation), blood vessel disorders and tubular/cystic kidney disorders. Acute kidney failure is the sudden inability of the kidneys to filter metabolic waste products from the blood. Acute kidney failure can result from any disease that disrupts kidney function, decreases blood flow to the kidneys or obstructs urine flow. Chronic kidney failure is the slow decline in the kidney's ability to filter metabolic waste. Chronic kidney failure can result from the same disorders that lead to acute kidney failure. The two most common causes of chronic kidney failure are diabetes mellitus and hypertension (high blood pressure). Nephritis is inflammation of the kidneys. In general, this can happen when someone has an infection, has an immune response, or was exposed to a toxin. When the blood vessels in the kidneys are not working as they should, it can lead to kidney damage, blood pressure going up and kidney failure. There are many known causes of these kinds of disorders including: blockages in renal (kidney) arteries, inflammation of blood vessels and injury to kidneys or blood vessels around them. Tubular and cystic kidney disorders get in the way of the kidney's filtration system. When that happens, cysts can form. Most kinds of tubular and cystic kidney problems disorders are genetic and occur in families (AMA 2003, MERCK 2003).

Ingestion of arsenic is associated with kidney cancer. Organic arsenic pesticides cause kidney damage in rats and mice [ATSDR 2007a]. DDT and gamma-BHC can cause kidney damage in rats [ATSDR 2002b and 2005a]. Dieldrin can cause kidney damage in people [ATSDR 2002a]. At high levels of exposure, lead can severely damage the kidneys in adults or children [ATSDR 2007b].

Low Birth Weight

Because of the lack of air monitoring data, it is not possible to estimate the risk of low birth weight for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Studies suggest that arsenic is associated with low birth weight. These studies, however, are not definitive [ATSDR 2007a].

Miscarriage

Because of the lack of air monitoring data, it is not possible to estimate the risk of miscarriage for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Miscarriage is the loss of a pregnancy before the fetus fully develops (usually before 20 weeks). 15 – 20% of all pregnancies end in miscarriage. Vaginal bleeding (with or without pain) is the most common symptom of miscarriage. If bleeding occurs during pregnancy, a woman should consult a doctor immediately. Women past the age of 35 are at a greater risk of miscarriage. Women who smoke or have certain illnesses, such as diabetes, lupus or hormonal imbalance, are at a greater risk of miscarriage. Doctors do not completely understand the causes but they are often times linked with physical problems in the mother. These problems include uterine fibroids (benign growths in the womb), abnormally shaped uterus and scar tissue. In some instances, problems with the genetic material in the fetus may cause miscarriages (AMA 2003).

Chronic exposure of humans to inorganic arsenic in the drinking water has been associated with excess incidence of miscarriages, stillbirths, preterm births, and infants with low birth weights [ATSDR 2007a]. Decreases in fertility, altered levels of sex hormones, reduced production of sperm, and increased rates of miscarriages were found in animals exposed to dioxin (2,3,7,8-TCDD) in food. It is unclear, however, if these same effects occur in people exposed to dioxin [ATSDR 1998]. In pregnant women, high levels of exposure to lead may cause miscarriage [ATSDR 2007b].

Nerve Disease

Because of the lack of air monitoring data, it is not possible to estimate the risk of nerve disease (neuropathy) for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Neuropathy is disease, inflammation, or damage to the peripheral nerves, which connect the central nervous system, or CNS (brain and spinal cord), to the sense organs, muscles, glands, and internal organs. Symptoms caused by neuropathies include numbness, tingling, pain, or muscle weakness, depending on the nerves affected.

Most nerve cell axons (the conducting fibers that make up nerves) are insulated within a sheath of a fatty substance call myelin, but some are unmyelinated. Most neuropathies arise from damage or irritation either to the axons of to their myelin sheaths. An axon may suffer thinning, complete loss of, or patchy loss of its myelin sheath. This may cause a slowing or complete block to the passage of electrical signals.

In some cases of neuropathy, there is no obvious or detectable cause. Among the many specific causes are diabetes mellitus, dietary deficiencies (particularly of B vitamins), persistent excessive alcohol consumption, and metabolic upsets such as *uremia*. Other causes include leprosy, lead poisoning, or poisoning by drugs.

Nerves may become acutely inflamed. This often occurs after a viral infection (for example, in Guillain-Barre syndrome). Neuropathies may result from autoimmune disorders such as rheumatoid arthritis, systemic lupus erythematosus, or periarteritis nodosa. In these disorders, there is often damage to the blood vessels supplying the nerves. Neuropathies may occur secondarily to malignant tumors such as lung cancer, or this lymphomas and leukemias. Finally, there is a group of inherited neuropathies, the most common being peroneal muscular atrophy.

The symptoms of neuropathy depend on whether it affects mainly sensory nerve fibers or motor nerve fibers. Damage to sensory nerve fibers may cause numbness and tingling, sensations of cold, or pain often staring in the hands and feet and spreading toward the body center. Damage to motor fibers may cause muscle weakness and muscle wasting.

Damage to nerves of the autonomic nervous system may lead to blurred vision, impaired or absent sweating, episodes of faintness, associated with falls in blood pressure, and disturbance of gastric, intestinal, bladder, and sexual function, including incontinence and impotence. Some neuropathies are linked with particular symptoms (for example, very painful neuropathies may arise in diabetes mellitus and in alcohol dependence).

To determine the extent of damage, studies of nerve conduction are performed, along with EMG tests, which record the electrical activity in muscles. To determine the cause of neuropathy, blood tests, X rays, nerve or muscle biopsy (removal of tissue for analysis), and various other tests may be required.

When possible, treatment is aimed at the underlying cause. For example, in diabetes mellitus, scrupulous attention to the control of the blood sugar level affords the best chances for recovery. Other people may need to stop drinking alcohol, or if a nutritional deficiency has been diagnosed, may be given injections of vitamins such as thiamine (vitamin B_1).

If treatment is successful and the cell bodies of the damaged nerve cells have not been destroyed, a full recovery from the neuropathy is possible [AMA 1989].

A common effect following both oral and inhalation exposure to inorganic arsenic is the development of peripheral neuropathy characterized by numbness in the hands and feet that may progress into a painful "pins and needles" sensation. This can progress further to muscle weakness, wrist-drop and/or ankle-drop, diminished sensitivity, and altered reflex action. Following removal from exposure, the neuropathy is only partially reversible and what recovery does occur is generally slow [ATSDR 2007a].

The overall evidence from case reports and epidemiological studies showed that exposure to dioxins is associated with signs and symptoms of both central and peripheral nervous system shortly after exposure. In some cases, the effects lasted several years. However, evaluation of individuals 5 to 37 years after the last exposure has not revealed any long-lasting abnormalities [ATSDR 1998].

Lead can cause peripheral neuropathy in both children and adults [ATSDR 2007b].

Skin Problems

Because of the lack of air monitoring data, it is not possible to estimate the risk of skin problems for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.
The skin is the largest and most vulnerable organ of the body. Although skin problems are seldom life-threating, many can be severely debilitating. Major categories of skin problems include:

- Infection and inflammation. Dermatitis and eczema may be caused by an allergic reaction to substance such as nickel, a detergent, a plant, or a drug.

- Tumors: both non-cancerous and cancerous such as basal cell carcinoma, squamous cell carcinoma, and malignant melanoma.
- Burns
- Ulcers of the leg, which are common in the elderly, may be caused by poor blood flow as the result of atherosclerosis or by swelling associated with heart failure.
- Radiation: all forms of radiation including overexposure to sunlight are damaging to the skin.
- Autoimmune disorders including lupus erythematosus, vitiligo (pure white patches), and dermatomyositis (a specific skin rash) [AMA 1989].

Perhaps the single-most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. These include patches of darkened skin and the appearance of small "corns" or "warts" on the palms, soles, and torso, and are often associated with changes in the blood vessels of the skin. Skin cancer may also develop. If you have direct skin contact with high concentrations of inorganic arsenic compounds, your skin may become irritated, with some redness and swelling. The arsenic containing pesticide dimethylarsinic acid (DMA) is known to cause eczema [ATSDR 2007a].

DDT and gamma-BHC can cause minor skin irritation [ATSDR 2002b and 2005a]. Exposure to dioxins can cause chloracne, a severe skin disease characterized by acne-like lesions. Chloracne generally occurs on the face and upper body. It is more severe than acne, harder to cure, and can be more disfiguring. In milder cases of chloracne, the lesions heal after several months. In mores severe cases, the lesions may last for many years. Dioxins can also cause red skin rashes, discoloration, and excessive body hair [ATSDR 1998].

Stroke

Because of the lack of air monitoring data, it is not possible to estimate the risk of stroke for nearby residents from inhalation of contaminated dust in the past when the Kerr McGee facility was operational.

Stroke is damage to part of the brain cause by interruption to its blood supply or leakage of blood outside of vessel walls. Sensation, movement, or function controlled by the damaged area is impaired. Strokes are fatal in about one third of cases and are a leading cause of death in developed countries.

The two most important risk factors for stroke are hypertension (high blood pressure), which weakens the walls of arteries, and atherosclerosis (thickening of the lining of arterial walls), which narrow arteries.

Other risk factors for stroke include atrial fibrillation (a type of irregular heart beat), a damaged heart valve, and a recent heart attack. All of these conditions can cause blood clots in the heart that may break off and migrate to the brain. A raised level of red cells in the blood, a high level of fatty substances in the blood, diabetes mellitus, and smoking also increase the risk of stroke by increasing the risk of hypertension and/or atherosclerosis.

In the US, the overall incidence of stroke is about 200 people per 100,000 population annually. The incidence rises steeply with age and is higher in men than women.

Weakness or paralysis on one side of the body is one of the more common effects of a serious stroke. About half of patients recover more or less completely from their first stroke [AMA 1989].

Conclusions

1. Currently there is no hazard for nearby residents because there are no completed exposure pathways. Nearby residents rely on municipal water and are not likely to contact contaminated surface water and sediments.

2. Since there has been no site cleanup, recommendations in the 2003 Public Health Assessment report still apply. If in the future, site land became residential and children or adults are exposed for more than a few days to the highest on-site soil arsenic and lead concentrations, they could suffer a number of symptoms and illnesses.

3. The current risk from breathing contaminated dust by on-site maintenance workers is unknown because of the lack of on-site air monitoring. The current risk from skin (dermal) contact with contaminated soil by on-site maintenance workers is also unknown. Although dieldrin and dioxins are likely absorbed through the skin, it is not possible to quantify the amount or estimate the health risk. Although inadvertent ingestion of soil by maintenance workers is not likely to cause any non-cancer illness, current long-term exposure could cause a "low" estimated increased risk of cancer of 1 in 100,000 (0.00001 or 1×10^{-5}). This is a high estimate and may overestimate the risk to the workers. The actual risk is likely lower. The future risk from breathing contaminated dust by workers during testing, remediation, construction, or development that may occur is unknown.

4. The risk for past, current, and future site workers and possible future residents from exposure to radiological contaminants in surface soil is unknown. This is because the laboratory analysis of surface soil for radiological contaminants was inadequate.

Recommendations

1. Nearby residents should avoid contact with contaminated groundwater, surface water, or sediments.

2. Until the site is cleaned up, the responsible party should continue to restrict site access and continue to maintain the fence and warning signs.

3. The responsible party should ensure maintenance workers are protected from contaminated dust when mowing the grass, avoid skin contact with contaminated soil, and wash their hands before eating or smoking to avoid inadvertent soil ingestion (swallowing). Before any remediation, excavation, or development occurs, the responsible party should evaluate the impact of contaminated dust from the site on future on-site and nearby workers. The responsible party should control dust generation during any future testing, remediation, construction, or development that removes vegetation or disturbs the soil. The responsible party should monitor both on-site and off-site air quality for metals and chlorinated pesticides during any future remediation or development.

4. The responsible party should test surface soil (0-3 inches) for naturally occurring radiological elements. To avoid matrix interferences found in the 2005 data set, the laboratory should perform radiochemical separation prior to counting. They should use the chemical fluoroscopic technique to measure uranium as total uranium and compare with the activity concentration of uranium-238 alone. The responsible party should use a certified laboratory familiar with environmental TENORM contamination.

Public Health Action Plan

This section describes what the federal ATSDR and the Florida DOH plan to do at this site. The purpose of a Public Health Action Plan is to reduce any existing health hazards and to prevent any from occurring in the future.

Actions Undertaken

1. In January 2003, Florida DOH mailed 45 local physicians information about the site, the health assessment process, and site-specific chemicals. In February 2003, Florida DOH distributed a fact sheet and held a public meeting to discuss the findings of their draft public health assessment report and to solicit public comment.

2. In an August 2003 public health assessment report, Florida DOH found the Kerr-McGee site may have been a health threat to workers in the past. They also found the site was not a current public health hazard because of the lack of public access.

3. In 2008, EPA proposed a plan to address site contamination.

4. In this report Florida DOH assess the public health threat since the last assessment in August 2003.

Actions Underway

1. EPA continues to oversee site maintenance activities (clearing, mowing, and access restriction) and the groundwater monitoring program.

Actions Planned

1. Florida DOH will continue to evaluate additional environmental test results, as necessary.

2. Florida DOH will work with EPA to ensure the above recommendations are implemented.

3. EPA will continue to oversee site remediation and/or ensure deed restrictions warn future property owners of remaining contaminated soil, sediments, and groundwater.

4. EPA will develop a cleanup plan (record of decision) and will solicit community input.

5. ATSDR will review future radiological test data.

Author and Technical Advisors

Florida DOH Author and Designated Reviewer
Randy Merchant
Public Health Toxicology
Division of Disease Control and Health Protection
850 245-4299

US ATSDR Reviewer
Jennifer Freed and Alan Parham
Technical Project Officers
Division of Community Health

References

[AECOM 2008] Additional Sediment Sampling Report. Kerr-McGee Chemical LLC Site, Jacksonville, Florida. December 2008.

[AMA 1989] American Medical Association. Encyclopedia of Medicine . Charles B. Clayman, MD, Medical Editor. Random House Reference. New York.

[AMA 2003] American Medical Association. Complete Medical Encyclopedia. JB Leinkin and MS Lipsky, eds. Random House Reference. New York.

[ATSDR 1998] Agency for Toxic Substances and Disease Registry Toxicological Profile for Chlorinated Dibenzo-p-dioxins (CDDs). Atlanta: US Department of Health and Human Services. December 1998.

[ATSDR 2002a] Agency for Toxic Substances and Disease Registry Toxicological Profile for Aldrin and Dieldrin. Atlanta: US Department of Health and Human Services. September 2002.

[ATSDR 2002b] Agency for Toxic Substances and Disease Registry Toxicological Profile for DDT, DDE and DDD. Atlanta: US Department of Health and Human Services. September 2002.

[ATSDR 2003] Florida Department of Health. Public Health Assessment for the Kerr-McGee Site in Jacksonville. August 2003

[ATSDR 2005a] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Hexachlorocyclohexanes . Atlanta: US Department of Health and Human Services. August 2005.

[ATSDR 2005b] Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual (Update). U.S. Department of Health and Human Services. January 2005.

[ATSDR 2007a] Agency for Toxic Substances and Disease Registry Toxicological Profile for Arsenic. Atlanta: US Department of Health and Human Services. August 2007.

[ATSDR 2007b] Agency for Toxic Substances and Disease Registry Toxicological Profile for Lead. Atlanta: US Department of Health and Human Services. August 2007.

[ATSDR 2010] Agency for Toxic Substances and Disease Registry Soil Comparison Values. Atlanta: US Department of Health and Human Services. April 2010.

[CDC 2013] Centers for Disease Control and Prevention. CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations in “Low Level Lead Exposure Harms Children: A Renewed Call of Primary Prevention.” Accessed October 8, 2013 at http://www.cdc.gov/nceh/lead/acclpp/CDC_Response_Lead_Exposure_Recs.pdf.

[Census Bureau 2000] http://www.census.gov/main/www/cen2000.html. Viewed March 2010.

[DOH 2006] Florida Department of Health. Cancer Cluster Investigations: What Are They? What do They Do? Nine-page booklet. 2006. Tallahassee, Florida.

[DOH 2010a] Florida Department of Health. Email correspondence Robenson Joseph, EPA to Susan Skye, DOH re: site data and site visit. January 2010 to June 2010.

[DOH 2010b] Florida Department of Health. Email correspondence Rhuli Lang, DOH to Susan Skye, DOH . Private Well Information. May 6, 2010 and May 26, 2010.

[EPA 1997] Environmental Protection Agency. Exposure Factors Handbook, Volumes I, II, and III. EPA/600/P-95/002Fa,b,c.

[EPA 2010a] Environmental Protection Agency. http://www.epa.gov/region4/waste/npl/nplfln/kerrmcfl.htm. Viewed May 2010.

[EPA 2010b] Environmental Protection Agency http://www.epa.gov/superfund/sites/docrec/pdoc1806.pdf recently viewed on June 4, 2010.

[EPA 2010c] Environmental Protection Agency. http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList&list_type=alpha&view=B recently viewed on June 5, 2010.

[Kamrin 1988] Kamrin, M.A. A Primer on Toxicology Principles and Applications. Lewis Publishers, Chelsea MI. 1988.

[MERCK 2003] The Merck Manual of Medical Information. Second Home Edition. Pocket Division of Simon & Schuster, Inc. 2003. New York.

[Shaw 2005] Shaw Environmental. Final Human Health Risk Assessment for Kerr-McGee. November 2005.

[Shaw 2006] Shaw Environmental. Final Remedial Investigation Report for Kerr-McGee Chemical LLC. January 2006.

Table 1. Completed Human Exposure Pathways at the Kerr-McGee Hazardous Waste Site

COMPLETED PATHWAY NAME	COMPLETED EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Inadvertent Soil Ingestion	Past On-Site Waste Disposal	Surface Soil	On-Site	Ingestion	Maintenance Workers	Past, Present, and Future
Dust Inhalation	Past On-Site Waste Disposal	Dust	On-Site	Inhalation	Maintenance Workers	Past, Present, and Future
Skin Absorption	Past On-Site Waste Disposal	Surface Soil	On-Site	Skin Absorption	Maintenance Workers	Past, Present, and Future

Table 2. Potential Human Exposure Pathways at the Kerr-McGee Hazardous Waste Site

POTENTIAL PATHWAY NAME	POTENTIAL EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Future Worker Dust Inhalation	Past On-Site Waste Disposal	Dust	On-Site and Nearby	Inhalation	On-Site Workers and Nearby Workers	Future
Future Residential Soil Ingestion	Past On-Site Waste Disposal	Surface Soil	On-Site	Ingestion	Future On-Site Residents	Future

Table 3. Maximum On-Site Soil Concentration, Estimated Maintenance Worker Dose, and Increased Cancer Risk from Inadvertent Ingestion

Chemical	Maximum On-Site Soil Concentration (0-12" deep) (mg/kg)	Estimated Maximum Maintenance Worker Inadvertent Soil Ingestion Dose-Non Cancer (mg/kg/day)	ATSDR Minimal Risk Level (mg/kg/day)	Estimated Maximum Worker Inadvertent Soil Ingestion Dose-Cancer (mg/kg/day)	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Source of Oral Cancer Slope Factor	Estimated Increased Cancer Risk
Arsenic	1,800	6×10^{-5}	3×10^{-4} (chronic)	9×10^{-6}	1.5	EPA IRIS	1×10^{-5} ("low")
gamma-BHC	39	1×10^{-6}	1×10^{-5} (intermediate)	2×10^{-7}	none	NA	NA
DDT	180	6×10^{-6}	5×10^{-4} (intermediate)	9×10^{-7}	0.34	EPA IRIS	3×10^{-7} ("extremely low")
Dieldrin	12	4×10^{-7}	5×10^{-5} (chronic)	6×10^{-8}	16	EPA IRIS	1×10^{-6} ("very low")
Dioxins (2,3,7,8-TCDD)	0.0002	7×10^{-12}	1×10^{-9} (chronic)	1×10^{-12}	130,000	California	1×10^{-7} ("extremely low")
Lead	1,400	NA	none	NA	none	NA	NA

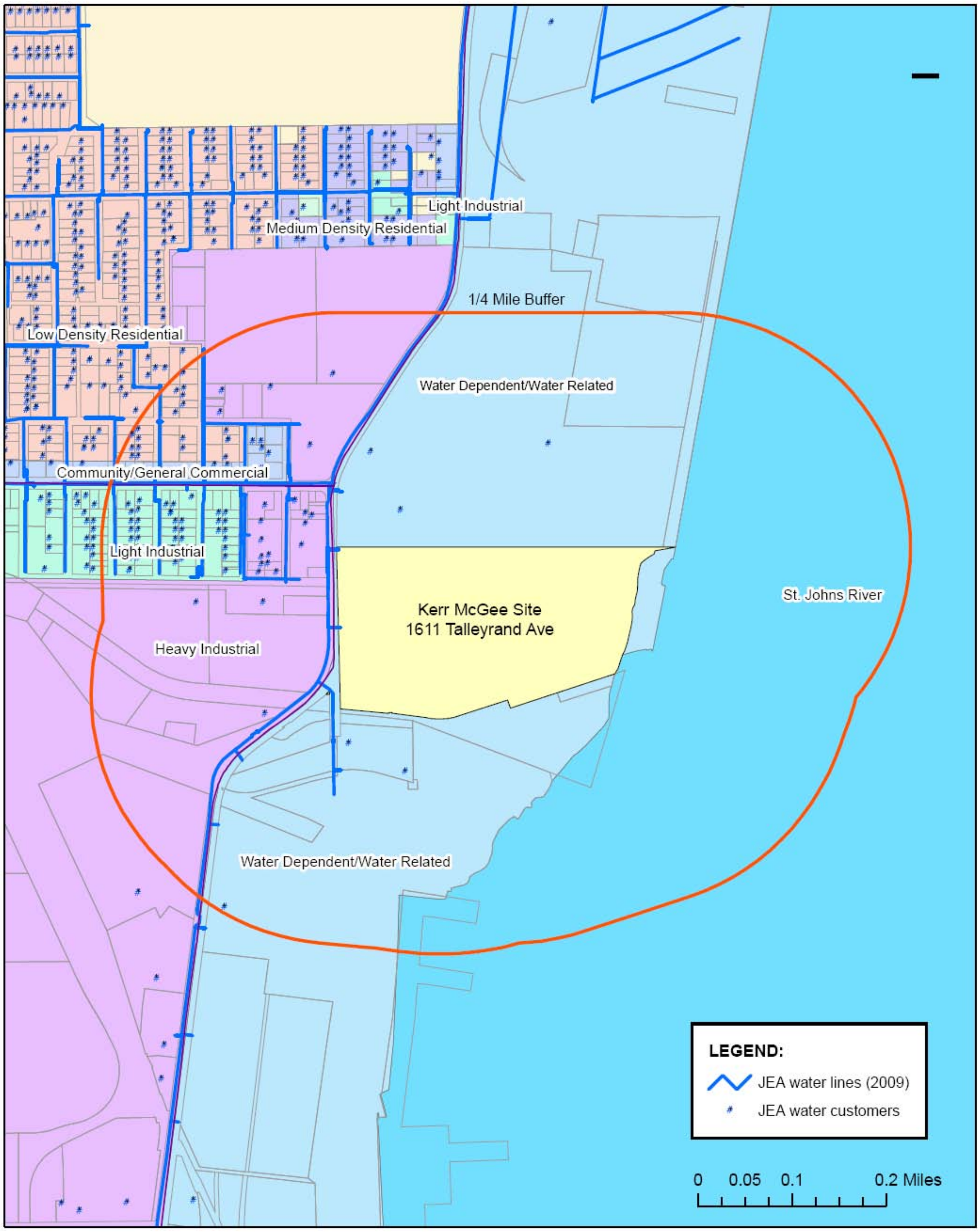
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
NA = non-applicable
MRL = ATSDR minimal risk level
EPA IRIS = US Environmental Protection Agency Integrated Risk Information System [EPA 2010b]

EMEG = ATSDR environmental media evaluation guide
gamma-BHC = gamma-benzenehexachloride
TCDD = tetrachlorodibenzodioxin

FIGURE 1
Site Location Map

Source: [AEM 2010]

FIGURE 2
Land Use Near the Kerr-McGee Site



Source: Duval CHD, 2010

FIGURE 3
Industrial Sites in the Vicinity of Kerr-McGee Site

Source: Duval CHD, 2010

FIGURE 4
Facility Layout

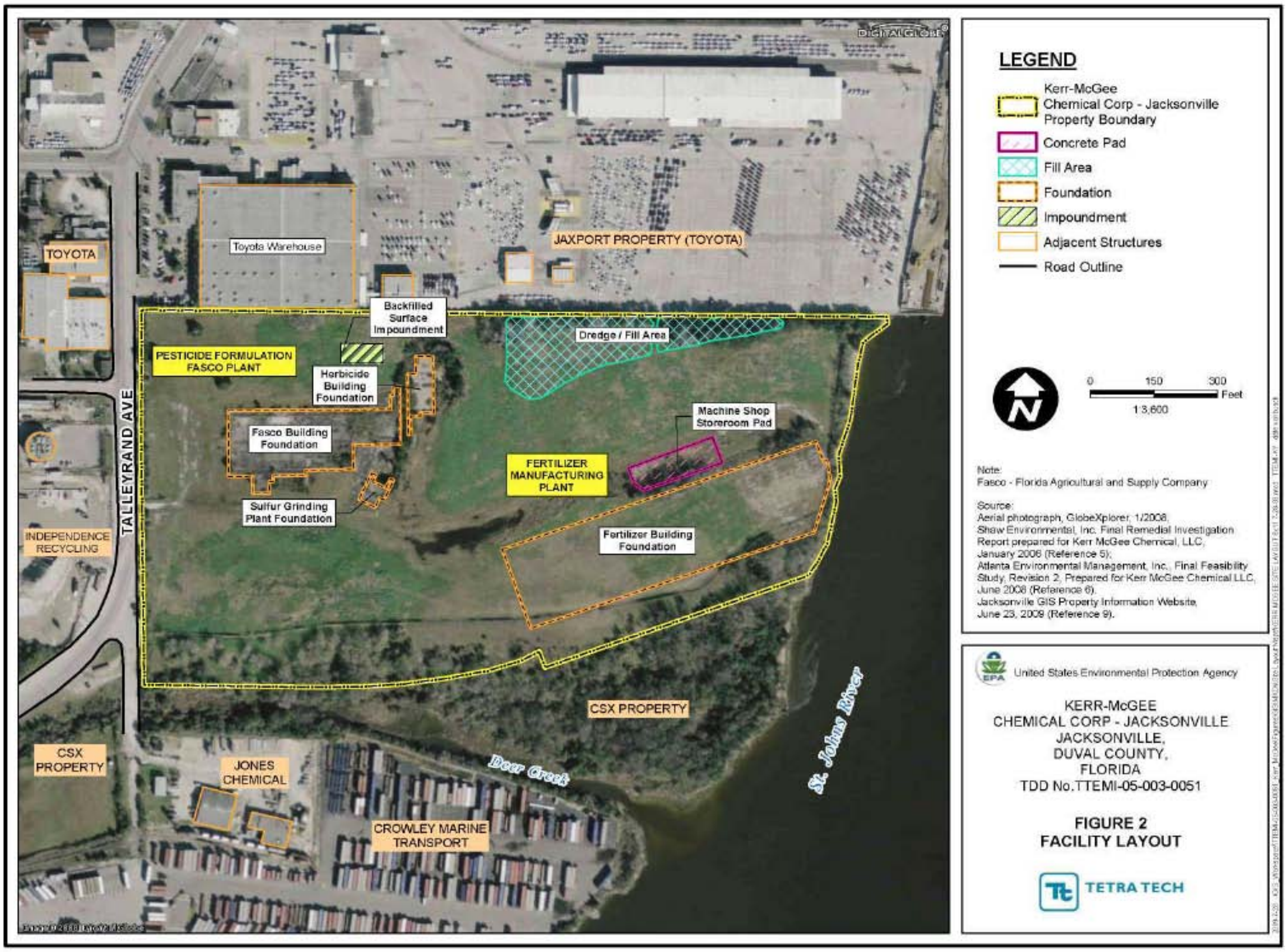
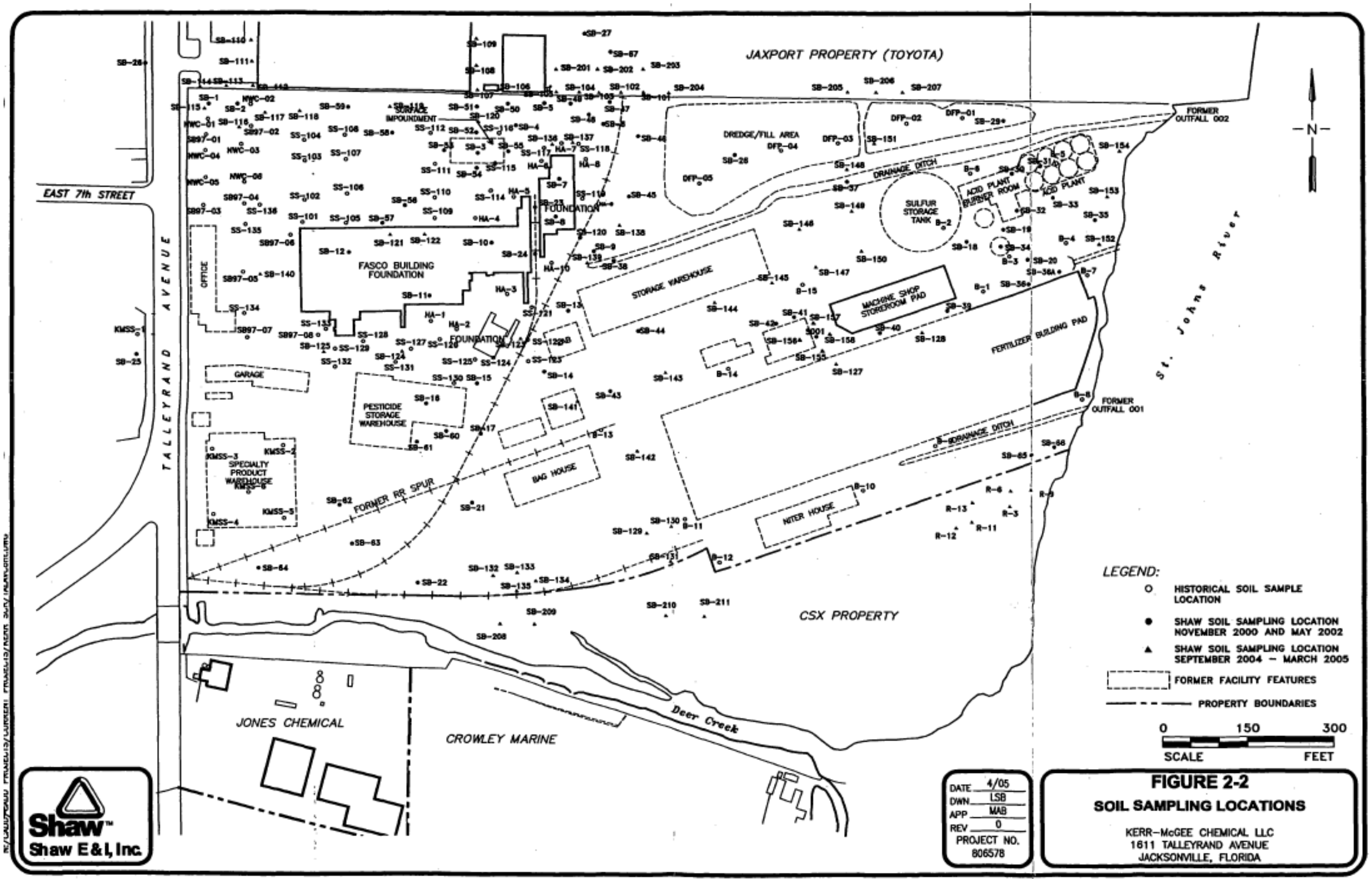


FIGURE 5. 2002 and 2004 Soil Sample Locations



Source: [Shaw 2006]

Appendix A
Photographs

Photo 1
St. Johns River looking northeast from the Kerr-McGee site

Photo 2
Main entrance to the middle of the Kerr-McGee site, facing east from Talleyrand Avenue, across from the Independent Recycling of Florida site.

Photo 3
Monitoring wells on the Kerr-McGee site looking south-southeast (toward Jones Chemical) from the main entrance on Talleyrand Avenue

Photo 4
Kerr-McGee site looking east–northeast from the main entrance

Photo 5
Kerr-McGee site looking south-southeast (toward Jones Chemical) from the main entrance

Photo 6
Deer Creek looking east from Talleyrand Avenue

Photo 7
Kerr-McGee fence looking north along Talleyrand Avenue from the main entrance

Photo 8
Kerr-McGee fence along Talleyrand Avenue

Photo 9
Intersection of 7^{th} Street and Talleyrand Avenue

Photo 10
Independent Recycling of Florida & Industrial Water Services looking west-northwest across Talleyrand Avenue from the main entrance to Kerr-McGee

Photo 11
Industrial Water Services looking east on 7th Street

APPENDIX B – RISK OF ILLNESS, DOSE RESPONSE/THRESHOLD, AND UNCERTAINTY IN PUBLIC HEALTH ASSESSMENTS

Risk of Illness

In this health assessment, the risk of illness is the chance that exposure to a hazardous contaminant is associated with a harmful health effect or illness. The risk of illness is not a measure of cause and effect; only an in-depth health study can identify a cause and effect relationship. Instead, we use the risk of illness to decide if the site needs a follow-up health study and to identify possible associations.

The greater the exposure to a hazardous contaminant (dose), the greater the risk of illness. The amount of substance required to harm a person's health (toxicity) also determines the risk of illness. Exposure to a hazardous contaminant above the minimum level increases everyone's risk of illness. Only in unusual circumstances, however, do many people become ill.

Information from human studies provides the strongest evidence that exposure to a hazardous contaminant is related to a particular illness. Some of this evidence comes from doctors reporting an unusual incidence of a specific illness in exposed individuals. More formal studies compare illnesses in people with different levels of exposure. However, human information is very limited for most hazardous contaminants, and scientists must frequently depend upon data from animal studies. Hazardous contaminants associated with harmful health effects in humans are often associated with harmful health effects in other animal species. There are limits, however, in only relying on animal studies. For example, scientists have found some hazardous contaminants are associated with cancer in animals, but lack evidence of a similar association in humans. In addition, humans and animals have differing abilities to protect themselves against low levels of contaminants, and most animal studies test only the possible health effects of high exposure levees. Consequently, the possible effects on humans of low-level exposure to hazardous contaminants are uncertain when information is derived solely from animal experiments.

Dose Response/Thresholds

The focus of toxicological studies in humans or animals is identification of the relationship between exposure to different doses of a specific contaminant and the chance of having health effect from each exposure level. This dose-response relationship provides a mathematical formula or graph that we use to estimate a person's risk of illness. The actual shape of the dose-response curve requires scientific knowledge of how a hazardous substance affects different cells in the human body. There is one important difference between the dose-response curves used to estimate the risk of non-cancer illnesses and those used to estimate the risk of cancer: the existence of a threshold dose. A threshold dose is the highest exposure dose at which there is no risk of illness. The dose-response curves for non-cancer illnesses include a threshold dose that is greater than zero. Scientists include a threshold dose in these models because the human body can adjust to varying amounts of cell damage without illness. The threshold dose differs for different contaminants and different exposure routes, and we estimate it from information gathered in human and animal studies. In contrast, the dose-response curves used to estimate the risk of cancer assume there is no threshold dose (or, the cancer threshold dose is zero). This assumes a single contaminant molecule may be sufficient to cause a clinical case of cancer. This assumption is very conservative, and many scientists believe a threshold dose greater than zero also exists for the development of cancer.

Uncertainty

All risk assessments, to varying degrees, require the use of assumptions, judgments, and incomplete data. These contribute to the uncertainty of the final risk estimates. Some more important sources of uncertainty in this public health assessment include environment sampling and analysis, exposure parameter estimates, use of modeled data, and present toxicological knowledge. These uncertainties may cause risk to be overestimated or underestimated. Because of the uncertainties described below, this public health assessment does not represent an absolute estimate of risk to persons exposed to chemicals at or near the Kerr-McGee site.

Environmental chemistry analysis errors can arise from random errors in the sampling and analytical processes, resulting in either an over- or under-estimation of risk. We can control these errors to some extent by increasing the number of samples collected and analyzed and by sampling the same locations over several different periods. The above actions tend to minimize uncertainty contributed from random sampling errors.

There are two areas of uncertainty related to exposure parameter estimates. The first is the exposure-point concentration estimate. The second is the estimate of the total chemical exposures. In this assessment, we used maximum detected concentrations as the exposure point concentration. We believe using the maximum measured value to be appropriate because we cannot be certain of the peak contaminant concentrations, and we cannot statistically predict peak values. Nevertheless, this assumption introduces uncertainty into the risk assessment that may over- or under-estimate the actual risk of illness. When selecting parameter values to estimate exposure dose, we used default assumptions and values within the ranges recommended by the ATSDR or the EPA. These default assumptions and values are conservative (health protective) and may contribute to the over-estimation of risk of illness. Similarly, we assumed the maximum exposure period occurred regularly for each selected pathway. Both assumptions are likely to contribute to the over-estimation of risk of illness.

There are also data gaps and uncertainties in the design, extrapolation, and interpretation of toxicological experimental studies. Data gaps contribute uncertainty because information is either not available or is addressed qualitatively. Moreover, the available information on the interaction among chemicals found at the site, when present, is qualitative (that is, a description instead of a number) and we cannot apply a mathematical formula to estimate the dose. These data gaps may tend to underestimate the actual risk of illness. In addition, there are great uncertainties in extrapolating from high-to-low doses, and from animal-to-human populations. Extrapolating from animals to humans is uncertain because of the differences in the uptake, metabolism, distribution, and body organ susceptibility between different species. Human populations are also variable because of differences in genetic constitution, diet, home and occupational environment, activity patterns, and other factors. These uncertainties can result in an over or underestimation of risk of illness. Finally, there are great uncertainties in extrapolating from high doses to low doses, and controversy in interpreting these results. Because the models used to estimate dose-response relationships in experimental studies are conservative, they tend to overestimate the risk. Techniques used to derive acceptable exposure levels account for such variables by using safety factors. Currently, there is much debate in the scientific community about how much we overestimate the actual risks and what the risk estimates really mean.

Appendix C – Response to Public Comment

On May 2, 2013, the Florida DOH posted the April 24, 2013 draft public health assessment on its web page. On May 20, the Florida DOH mailed a community update fact sheet to approximately 300 businesses and residents near the Kerr-McGee site. This update summarized the draft report and solicited public review and comment. Florida DOH received one e-mail comment from a nearby business owner/resident and two sets of written comments from nearby residents during the public comment period ending June 10, 2013.

Comment #1: Family members have suffered multiple miscarriages, nerve disease, and some—including a 5-year-old—have died.

Response #1: In a previous public health assessment report [ATSDR 2003], Florida DOH/ATSDR concluded

> "Historical working conditions, the absence of personal protective equipment, and reports from former workers led Florida DOH to believe past working condition may have posed a public health hazard for workers on and near the site. Because the nearest residences are about 500 feet northwest of the site, Florida DOH believes nearby residents may have also been exposed to site dust in the past."

Florida DOH/ATSDR added miscarriages, nerve disease, and death to the list of community health concerns section in this public health assessment.

Comment #2: Husband and wife have lived in this area for 44 years and suffer chronic bronchitis, allergies, kidney failure, stroke, diabetes, and skin problems.

Response #2: Florida DOH/ATSDR added these illnesses to the list of community health concerns section in this public health assessment.

Comment #3: Fences should have been erected around the detention ponds to prevent automobiles accidents and access by children.

Response #3: Currently, access to the Kerr McGee site is restricted by a fence and there are no detention ponds on the site.

Glossary

Absorption
The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with **chronic**].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure]**.

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
An estimated risk of for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see **route of exposure**].

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Environmental media
Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA
United States Environmental Protection Agency.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching), and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

mg/kg
Milligram per kilogram.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites]**

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action
A list of steps to protect public health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard, no apparent public health hazard**, **indeterminate public health hazard**, **public health hazard**, and **urgent public health hazard**.

Public meeting
A public forum with community members for communication about a site.

Receptor population
People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Remedial Investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

RfD
See **reference dose**.

Risk
The probability that something will cause injury or harm.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see **uncertainty factor]**

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Substance
A chemical.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents which, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.