Public Health Assessment

Final Release

HOLCOMB CREOSOTE COMPANY NPL SITE

YADKINVILLE, YADKIN COUNTY, NORTH CAROLINA

EPA FACILITY ID: NCD024900987

Prepared by
North Carolina Department of Health and Human Services
Division of Public Health
Occupational and Environmental Epidemiology Branch

April 28, 2020

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

Foreword

The Health Assessment, Consultation and Education (HACE) program within the North Carolina Department of Health and Human Services (DHHS), Division of Public Health (DPH) has prepared this public health assessment (PHA) in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for the health issues related to hazardous waste. This PHA was prepared in accordance with the methodologies and guidelines developed by ATSDR and DPH.

The purpose of this PHA is to identify and prevent harmful health effects from exposure to hazardous substances in the environment. PHAs focus on health issues associated with specific exposures that have happened in the past, are currently taking place, or are believed to be possible in the future based on current site conditions. The HACE program evaluates data collected from a hazardous waste site, determines if exposures occurred or could occur in the future, reports any potential harmful effects, and then recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time this PHA was conducted and may not be relevant if site conditions or land uses change in the future.

For additional information or questions regarding the contents of this PHA please contact:

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TABLE OF CONTENTS

Summary

INTRODUCTION

The Holcomb Creosote Company site (EPA ID: NCD024900987) was listed on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) in 2012. The Agency for Toxic Substances and Disease Registry (ATSDR) is authorized to evaluate public health issues at NPL sites. In North Carolina, these evaluations are conducted through an ATSDR cooperative agreement program with the North Carolina Department of Health and Human Services (DHHS) Division of Public Health (DPH). DPH is evaluating this site because of its listing on the NPL. The DPH's top priority is to make sure the community near the Holcomb Creosote NPL site has the best information available to protect its health.

Holcomb Creosote Company operated as a coal-tar creosote wood-treating facility from 1951 to 2009. Operations at the site contaminated soil, sediment, surface water, groundwater and fish on and adjacent to the site, including in Dobbins Pond. In 2011, EPA performed an emergency removal action to control the release of hazardous substances from the site. This assessment evaluated surface soil, sediment, surface water, well water and fish data that EPA and the North Carolina Department of Environmental Quality (DEQ) collected prior to and following the EPA's removal activities in 2011 to address past, present and future exposures to residents living near the site.

DPH released an initial version of this public health assessment for a 30-day public comment period on September 6, 2019. DPH held a public availability session in Yadkinville, NC on October 8, 2019. DPH did not receive any public comments.

OVERVIEW

After reviewing the environmental data for the Holcomb Creosote Company NPL site, DPH reached 4 conclusions:

CONCLUSION 1

The health of nearby residents is not expected to be harmed from contact (including touching and accidently ingesting) with soil, sediment, or surface water along the banks of and in Dobbins Pond and the wetlands in the past, present, or future.

BASIS FOR DECISION

Concentrations of contaminants are below levels of concern in surface water in Dobbins Pond and the wetlands near the Holcomb Creosote site. Concentrations of polycyclic aromatic hydrocarbons (PAHs) and some metals were detected in sediment and soil along the banks of Dobbins Pond and in the wetlands. Estimated doses of PAHs in sediment and soil along the banks of Dobbins Pond and in the wetlands are below levels expected to cause adverse health effects. Estimated doses of aluminum and arsenic from incidental ingestion of and direct skin contact with sediment and soil exceed health guidelines for young children (age 1 to 2

	years) who live near the site and were studied further as part of this assessment indicating no health impacts are expected. The amount of aluminum and arsenic that small children could be exposed to is well below levels associated with adverse health effects in animal and epidemiological studies. It should be noted that frequent playing and wading may not be occurring in these areas.
CONCLUSION 2	**The health of individuals that trespass on the site is not expected to be harmed from contact (including touching and accidentally ingesting) with on-site soil (in processing areas), sediment (along the unnamed tributary), or surface water (in unnamed tributary) in the past, present, or future.**
BASIS FOR DECISION	Concentrations of PAHs prior to and following EPA's 2011 removal action were detected in soil, sediment, and surface water on the Holcomb Creosote site. However, estimated doses of PAHs in soil, sediment, and surface water on-site are at levels that are not expected to cause adverse non-cancer health effects. Additionally, a low increased risk of cancer has been calculated with adult and childhood exposures but only after many years of frequent trespassing on the site. However, frequent trespassing is likely not occurring in this area.
CONCLUSION 3	**The health of subsistence and recreational fishers could be harmed from frequently eating fish from Dobbins Pond. An existing statewide fish advisory for mercury is adequately protective of the exposures to recreational and subsistence fishers considered in this assessment with one needed addition which recommends limiting the number of catfish meals that should be consumed from Dobbins Pond.**
BASIS FOR DECISION	Recreational fishers were assumed to have approximately 3 fish meals per month and subsistence fishers were assumed to have 1 fish meal per day as part of this assessment. Chromium, assumed to be hexavalent per DPH guidance and to be health protective, has been found in catfish from Dobbins Pond and two nearby ponds above DPH levels of concern[1], indicating the potential for exposure and subsequent cancer health effects. Following the existing statewide fish advisory for mercury as well as the additional guidance on limiting catfish consumption protects both recreational and subsistence fishers and their families from harmful exposures.
CONCLUSION 4	**The health of nearby residents is not expected to be harmed from drinking water from private wells in the area near the site. However, 4 private wells had low levels of lead in well water samples, and lead in drinking water at any level should be reduced or removed.**

[1] DPH screening levels are calculated using EPA toxicity values and EPA's fish consumption risk assessment guidance. See DPH's *SOP for Fish Consumption Advisories* for more information.

BASIS FOR DECISION

Homes within a ½-mile radius in the direction of groundwater flow away from the Holcomb Creosote site have always been on a municipal water system. Well water data collected in 2012 from private wells within a ½-mile radius and in the opposite direction of groundwater flow from the site indicated that site contaminants have not impacted any of these wells. Lead was detected in 4 private wells, and lead in drinking water at any level should be reduced or removed. Other contaminants not related to site activities were below comparison values.

NEXT STEPS

The DPH recommends the:

- EPA continue to maintain the fences around the landfarm and surface impoundment to ensure people are not exposed to contamination in these areas. Trespassing is discouraged, and individuals should not access the site.
- local health department prevent the installation of new drinking water wells east/southeast of the site, in the direction of groundwater flow away from the site.
- EPA and DEQ continue to monitor sediment, soil and surface water throughout future remedial activities to ensure people are not exposed to harmful concentrations of site contaminants during clean-up.
- people who come in contact with the sediment or soil in this area thoroughly wash with soap and water hands, feet and any skin or clothing that comes in contact with sediment or soil.
- people follow the existing Statewide mercury meal recommendations for eating fish from waterbodies in North Carolina as well as the site-specific expansion of the consumption limit recommendations for catfish from Dobbins Pond:

Statewide Meal Consumption Limit Recommendations for Mercury in Fish[2]	
Women of child-bearing age (15-44 years old), pregnant women, nursing mothers, and children less than 15 years old	**All others**
DO NOT EAT fish HIGH in mercury (includes largemouth bass)	Eat only 1 meal per week of fish HIGH in mercury (includes largemouth bass)
Eat up to 2 meals per week of fish LOW in mercury	Eat up to 4 meals per week of fish LOW in mercury

[2] See Appendix H or the N.C. DPH Fish Advisories web site for a complete list of fish identified as LOW & HIGH in mercury (http://epi.publichealth.nc.gov/oee/fish/advisories.html).

Dobbins Pond Specific Meal Consumption Limit Recommendations for Contaminants in Fish	
Everyone	
Recommendation	**Contaminant of Concern**
Eat up to 1 meal per week of white catfish	Hexavalent Chromium

- owner of Dobbins Pond and the Holcomb Creosote site do outreach to inform local residents of potential health risks associated with contamination from the Holcomb Creosote site.
- DEQ or EPA resample fish from Dobbins Pond for speciated chromium to better understand hexavalent chromium levels in fish tissue and better characterize potential risk from consuming fish to inform a formal fish consumption advisory.
- DEQ or EPA sample fish from Dobbins Pond at least every 5 years in conjunction with the site 5-year review to monitor changes in contaminant levels.

The DPH will:

- review speciated chromium data in fish tissue when available to inform a formal fish consumption advisory;
- continue to work with the local health department to inform and educate the local community about potential health hazards associated with exposure to contaminants from the Holcomb Creosote site and how to reduce exposures. This will include developing and posting signs and distributing factsheets and other health education materials;
- continue to monitor and assess the Holcomb Creosote site as the EPA or DEQ collects additional data and update the fish consumption advisory as appropriate.

LIMITATIONS

There are limitations inherent to the public health assessment process. These include the availability of analytical data collected for a site, the type and quantity of health effect study information, and the risk estimation process itself. High reporting limits greater than screening levels for some contaminants provide additional uncertainty in the data evaluation. To address this, a conservative approach of including these contaminant concentrations in risk estimations as half the reporting limit was used. Additionally, for this evaluation it was assumed that residents living near the site are playing or wading in or around Dobbins Pond and the wetlands daily. This assumption is made to be health protective. These conservative approaches could overestimate potential health risks.

	For this evaluation, the data collected and the health risk assessment of the data are only relevant to the fish species collected at this site. The conclusions and recommendations do not pertain to species not sampled. The data presented in this evaluation are only representative of contaminant concentrations at the time the fish were collected. Additionally, the assumption that all chromium measured in fish tissue samples is hexavalent chromium, per DPH guidance [DPH 2017], is a conservative, health protective approach that may overestimate levels of risk. To ensure protection of public health, highly health protective exposure assumptions were used to evaluate environmental data and interpret the potential for adverse health effects.
FOR MORE INFORMATION	If you have concerns about your health, you should contact your doctor. Staff from the Division of Public Health are available to assist you in talking to your doctor. Contact us by calling (919) 707-5900, or by sending an e-mail to nchace@dhhs.nc.gov and ask for information on the Holcomb Creosote Company NPL site.

Background and Statement of Issues

The Holcomb Creosote Company NPL site (EPA ID: NCD024900987) is located at 5016 U.S. Highway 601, two miles north of Yadkinville in Yadkin County, North Carolina (Appendix A, Figure 1). The site was added to the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) in September 2012. The Agency for Toxic Substances and Disease Registry (ATSDR) is authorized to evaluate public health issues at NPL sites. In North Carolina (N.C.), these evaluations are conducted through an ATSDR cooperative agreement program with the N.C. Division of Public Health (DPH). DPH is evaluating this site because of its listing on the NPL.

Holcomb Creosote Company was a small commercial wood-preserving facility that operated from 1951 to 2009. The property covers approximately 80 acres. The wood-treating operations were focused on approximately 2 acres on the western portion of the property adjacent to Highway 601 (Appendix A, Figure 2). Grace Bible Church (formerly the Yadkin Friends Fellowship) borders the property to the north, vacant wooded land and residences to the east, an agricultural field to the south, and U.S. Highway 601 to the west. An unnamed tributary of North Deep Creek flows north to south through the property. The tributary flows between the former wood-treating operations and a former landfarm[3] to the east; then enters a wetlands area; and finally discharges into Dobbins Pond (Appendix A, Figure 3). Residences surround Dobbins Pond, and residents of these homes fish here. Currently the site is unused and primarily overgrown with vegetation. An abandoned office building and storage building remain on site.

The N.C. Department of Environmental Quality (DEQ) visited the site in 2009 and noted several areas of concern related to contamination. Due to a lack of funds to address the concerns, DEQ referred the site to the EPA in October 2011 [EPA 2012]. Operations at the site resulted in contamination of soil, sediment, surface water, groundwater, and fish with metals and semi-volatile organic compounds (SVOCs), such as polycyclic aromatic hydrocarbons (PAHs), a component of coal-tar creosote used to treat wood. Additionally, asbestos and elemental mercury were found on site [EPA 2012]. In 2011, EPA performed emergency removal activities to control the release of hazardous substances and remove the asbestos and elemental mercury found.

The local groundwater flows from the west/northwest to the east/southeast direction. It is moving generally from the former wood-treating area of the site toward the wetlands and pond. Most homes within a ½-mile radius are located east/southeast of the site, however these homes have always been on the Yadkinville municipal water supply system. Twelve homes within a ½-mile radius of the site have private wells, however all lie upgradient of the site (Appendix A, Figure 4). Demographic information by census block can be found in Appendix B.

The objective of this public health assessment is to determine if contamination from the Holcomb Creosote Company NPL site presents a past, current, or future health hazard to the surrounding community.

[3] A landfarm is an area used to treat waste through bioremediation, or remediation involving living organisms.

DPH released an initial version of this public health assessment for a 30-day public comment period on September 6, 2019. DPH held a public availability session in Yadkinville, NC on October 8, 2019. DPH did not receive any public comments.

Site Visit

Staff from DPH visited the site in February 2012 accompanied by staff from the DEQ, EPA, and Yadkin County Health Department. Additionally, DPH staff visited the site again in November 2016. Photos from both site visits can be found in Appendix C. During the 2012 site visit, DPH observed persons fishing on Dobbins Pond. A public meeting was held during the 2012 site visit at the Yadkin County Volunteer Fire Department (729 State Street, Yadkinville), with 37 residents in attendance. The meeting included EPA, DEQ, and DPH presentations and time for residents to ask questions. After the meeting, community members provided information to DPH staff, and staff answered questions about the site and public health assessment process.

Residents identified that "odors" were common during operations at the wood-treating facility and during the EPA removal activities. We do not have any ambient air data from near the site to evaluate if people may have been exposed while the facility was operating or during removal activities. They also noted surface water run-off from the site during heavy rains. Local residents have also noted that people trespass on the pond to fish despite "no trespassing" and "no fishing" signs posted around Dobbins pond. DPH did not receive any specific health concerns or questions from attendees at the meeting and has not been contacted regarding health issues associated with the site since the meeting.

Discussion

Evaluation Process

Due to the listing of the site on the NPL, DPH evaluated all environmental data available prior to EPA's 2011 removal activities and immediately following these activities. For this assessment, soil, sediment, surface water, and private well water maximum contaminant concentrations are compared to ATSDR media-specific comparison values (CVs). Because ATSDR does not have comparison values for fish tissue, fish tissue average contaminant concentrations by species are compared to DPH screening levels [DPH 2017]. Contaminant concentrations that exceed CVs or DPH screening levels require further evaluation for potential health risk; however, this does not automatically indicate that adverse health effects are expected. Contaminant concentrations that are below CVs or DPH screening levels require no further evaluation, as adverse health effects would not be expected. Only contaminants exceeding CVs or screening levels are discussed in Data and Health Evaluation section of this report and presented in the summary tables in Appendix D (Tables 3 through 32).

For contaminant concentrations exceeding CVs or DPH screening levels, exposure doses are estimated based on site-specific conditions. These estimated exposure doses are compared to health effects data and used to determine whether health effects may occur from contact with contaminants. Maximum contaminant concentrations and 95th percentile values were used for exposure assumptions to represent a reasonable maximum exposure scenario. These assumptions are used to provide a high level of protection.

In addition to a non-cancer health effects evaluation, a cancer risk evaluation is performed. Estimated exposure doses for individual age groups and chemical specific cancer potency factors are used to estimate an increased cancer risk for persons who come in contact with contaminated media. Exposure durations for each age group are averaged over a lifetime of exposure. For fish tissue and environmental media evaluation, cancer risk calculations are made assuming exposure over a 78-year lifetime [DPH 2017; ATSDR 2016b]. Cancer risk is presented throughout this document as the number of additional cancers expected over a lifetime due to contaminant exposure if a certain number of people are exposed. This estimate does not predict the actual number of cancers expected but is rather a tool used for public health decision making.

If there is a potential for health effects from eating fish, the DPH calculates recommended meal limits for individual species. To be highly health protective, these meal limits are calculated based on subsistence fisher exposure parameters. Further discussion of the health effects evaluation process used for this assessment can be found in Appendix E. Exposure parameters used in this assessment can be found in Appendix F.

Exposure Pathway Analysis

Even though a contaminant may be present in the environment, this does not automatically mean that people will be exposed or that there will be adverse health effects. Exposure pathways (how people may come into contact with contaminants in their environment) are evaluated to determine if people have come into contact with site contaminants, or if they may in the future. An exposure pathway is one that contains a source of contamination (e.g.., hazardous waste site), the movement of the contaminant through environmental media (i.e., air, water, or soil), a point of exposure where people come in contact with the contaminated media (e.g., soil or sediment along the edge of a pond), a route of exposure (e.g., eating contaminated soil or fish), and an exposed population of persons that can come in contact with the contaminants.

At the former Holcomb Creosote Company facility, coal-tar creosote traveled off the property in run-off and surface water and dispersed into the floodplain soil, sediment, and fish in the unnamed tributary, Dobbins Pond, and the neighboring wetlands. Additionally, materials from the site seeped into groundwater flowing away from the property. Potentially exposed people include children and adults who trespass on the former facility property or who live in homes surrounding Dobbins Pond and the adjacent wetlands who may be exposed through incidental ingestion of or dermal (skin) contact with contaminated soil, sediment, surface water, well water, or fish. For this evaluation, exposures to soil, sediment, and surface water on-site (former operations areas and unnamed tributary) were evaluated for individuals trespassing on the site. Exposures to soil, sediment, and surface water off-site (wetlands and Dobbins Pond) were evaluated for residents living near the site. Due to the rough terrain surrounding the former facility and a major roadway dividing the site from residences, on-site exposures to trespassers were evaluated beginning at age 11 to adulthood. Off-site exposures to residents living near the site were evaluated beginning at age 1 to adulthood.

See Table 1 below for completed and eliminated exposure pathways identified at the Holcomb Creosote site.

Table 1. Exposure pathways identified at the Holcomb Creosote Company NPL site.

Completed Exposure Pathways						
Pathway Name	**Exposure Pathway Elements**					**Time**
	Source	**Environmental Media**	**Point of Exposure**	**Route of Exposure**	**Exposed Population**	
Fish	Holcomb Creosote site	Fish	Dobbins Pond & Reference Ponds	Ingestion	People eating fish caught in nearby ponds	Past, Present, Future
Off-site Surface Soil	Holcomb Creosote site	Soil	Along banks of Dobbins Pond	Incidental ingestion, dermal contact	Nearby residents	Past, Present, Future
Off-site Surface Water	Holcomb Creosote site	Surface water	Dobbins Pond & Wetlands	Incidental ingestion	Nearby residents	Past, Present, Future
Off-site Sediment	Holcomb Creosote site	Sediment	Dobbins Pond & Wetlands	Incidental ingestion, dermal contact	Nearby residents	Past, Present, Future
On-site Surface Soil	Holcomb Creosote site	Soil	Former operations area	Incidental ingestion, dermal contact	Trespassers	Past, Present, Future
On-site Surface Water	Holcomb Creosote site	Surface water	Unnamed tributary behind former operations area	Incidental ingestion	Trespassers	Past, Present, Future
On-site Sediment	Holcomb Creosote site	Sediment	Unnamed tributary behind former operations area	Incidental ingestion, dermal contact	Trespassers	Past, Present, Future
Ambient Air*	Holcomb Creosote site	Air	On-site & off-site	Inhalation	Nearby residents and former employees	Past
Eliminated Exposure Pathways						
Pathway Name	**Exposure Pathway Elements**					**Time**
	Source	**Environmental Media**	**Point of Exposure**	**Route of Exposure**	**Exposed Population**	
Off-site Groundwater	Holcomb Creosote site	Private well water	Off-site	Ingestion	No private wells in direction of groundwater flow	Past, Present

*No environmental data, pathway not evaluated

Summary of Site Investigations

The DPH evaluated the following EPA and DEQ analytical results for past exposures (prior to 2011 removal action) to residents living near the site:

- Sediment samples from the unnamed tributary, wetlands, and Dobbins Pond collected in 2009 and 2011
- Surface soil samples along the unnamed tributary collected in 2011.

The DPH evaluated the following EPA analytical results for current and future exposures (following 2011 removal action) to residents living near the site:

- Sediment samples from the unnamed tributary, wetlands, and Dobbins Pond collected in 2012 and 2013
- Surface soil samples on-site around the former facility and along Dobbins Pond collected in 2012
- Surface water samples from the unnamed tributary and Dobbins Pond collected in 2013
- Private well water samples collected in 2012 from 10 of 12 wells within a ½-mile radius of the site and 2 monitoring wells
- Fish tissue collected from 2012 to 2014 from Dobbins Pond and 2 nearby Reference Ponds. The reference ponds are located within a few miles of Dobbins Pond and are used to understand background levels of contaminants in the area.

Sediment, surface soil, surface water, and private well water samples were analyzed for volatile organic compounds (VOCs), SVOCs and metals. Surface soil and sediment from the ground surface to depths of three inches are preferred for human health assessments. Surface and sediment samples included in this report were collected from the ground surface to a depth of six inches, reflecting the available surface soil and sediment data collected for this site [ATSDR 2005]. A limited number of soil samples were analyzed for hexavalent chromium in addition to total chromium. Hexavalent chromium was not detected in any of these samples, therefore total chromium measured in soil and sediment samples was assumed to all be trivalent chromium.

The DPH evaluated fish tissue data for exposure to subsistence and recreational fishermen. All fish were analyzed as fillet samples as this is the portion of the fish that people are expected to eat. Fish samples were analyzed as individual fish, and all contaminant concentrations were reported on a wet weight basis. Fish tissue samples were analyzed for SVOCs and metals.

Reporting limits for contaminants of concern in fish tissue (PAHs, arsenic, and chromium) were high, and the lab was not able to detect small concentrations. These reporting limits were greater than DPH fish tissue screening levels, and small concentrations of these chemicals can cause health effects in people. Therefore, DPH used one-half the reporting limit for analytical results listed as not detected in calculating average fish tissue concentrations for these contaminants. Additionally, all chromium in fish was assumed to be hexavalent chromium per DPH's standard operating procedure for fish tissue evaluations and because no samples were analyzed for hexavalent chromium in addition to total chromium.

Data and Health Evaluation

Trespassers: On-Site Past Exposures – Pre-2011Removal Action

Surface Soil

PAHs were detected in 18 of 23 pre-remediation surface soil samples collected from around former processing areas on-site. Dibenzo(a,h)anthracene was detected in 4 of 23 soil samples. CVs were exceeded for total PAHs and dibenzo(a,h)anthracene (Table 3). Other SVOCs, such as dibenzofuran and carbazole, and metals were detected in soil samples; however, these detections were below CVs or, in the case of carbazole, no CVs or health guidelines exist to evaluate further. Estimated incidental ingestion and dermal doses for trespassers on the site from contact with pre-remediation on-site surface soils can be found in Table 4. There is no health guideline value for dibenzo(a,h)anthracene. Estimated exposure doses for total PAHs are below the health guideline for benzo(a)pyrene (0.0003 milligrams per kilogram per day (mg/kg/day)), indicating non-cancer health effects are not expected. A very low increased cancer risk is expected for children (5 in a million) and adults (3 in a million) who trespassed on the site from past contact with PAHs in the surface soils on-site considering decades of exposure. A very low increased cancer risk is expected for children (2 in a million) and adults (1 in a million) who trespassed on the site from past contact with dibenzo(a,h)anthracene in surface soils on-site (Table 5).

Sediment

PAHs were detected in 6 of 7 pre-remediation on-site sediment samples collected from the unnamed tributary. Dibenzo(a,h)anthracene was detected in 5 of 7 sediment samples. CVs were exceeded for total PAHs and dibenzo(a,h)anthracene (Table 3). Other SVOCs, such as dibenzofuran and carbazole, and metals were detected in sediment samples; however, these detections were below CVs or, in the case of carbazole, no CVs or health guidelines exist to evaluate further. Estimated incidental ingestion and dermal doses for trespassers on the site from contact with pre-remediation on-site sediments can be found in Table 4. There is no health guideline value for dibenzo(a,h)anthracene. Estimated exposure doses for PAHs are below the health guideline for benzo(a)pyrene (0.0003 mg/kg/day), indicating non-cancer health effects are not expected.

A very low increased cancer risk is expected for children (6 in a million) and adults (3 in a million) who trespassed on the site from past contact with PAHs in sediments in the on-site unnamed tributary considering decades of exposure. A very low increased cancer risk is expected for children (2 in a million) and adults (1 in a million) who trespassed on the site from past contact with dibenzo(a,h)anthracene in sediments in the on-site unnamed tributary considering decades of exposure (Table 5).

Combined PAHs

Because of the similarities in toxicity and people who may be exposed, DPH added together estimated exposure doses and increased cancer risks for trespassers on the site from exposure to PAHs in surface soil and sediment prior to the 2011 removal activities. Total maximum exposure doses for children and adults did not exceed the health guideline for benzo(a)pyrene (0.0003 mg/kg/day) (Table 21). A low increased cancer risk is expected for children (2 in 100,000) and a very low increased cancer risk for adults (8 in a million) who trespassed on the site from past contact with PAHs in surface soil and sediment on-site (Table 23).

Nearby Residents: Off-Site Past Exposures – Pre-2011Removal Action

Sediment

PAHs were detected in 3 of 7 pre-remediation off-site sediment samples collected from wetlands and Dobbins Pond. CVs were exceeded for total PAHs (Table 6). Metals were detected in sediment samples; however, these detections were below CVs. Estimated incidental ingestion and dermal doses for residents near the site from contact with pre-remediation off-site sediments can be found in Table 7. Estimated exposure doses for PAHs are below the health guideline for benzo(a)pyrene (0.0003 mg/kg/day), indicating non-cancer health effects are not expected. A very low increased cancer risk is expected for children (5 in a million) and is unlikely for adults (<1 in a million) who live near the site from past contact with PAHs in sediments in the wetlands and Dobbins Pond considering decades of exposure (Table 8).

Sediment samples were the only samples taken off-site prior to the 2011 removal activities. Therefore, total maximum exposure doses (Table 22) and estimated increased cancer risk (Table 24) from past contact with PAHs off-site are for contact with sediment only.

Trespassers: On-Site Current and Future Exposures – Post-2011Removal Action

Surface Soil

PAHs were detected in 44 of 55 post-remediation surface soil samples collected from around former processing areas on-site. Dibenzo(a,h)anthracene was detected in 9 of 55 soil samples. CVs were exceeded for total PAHs and dibenzo(a,h)anthracene (Table 9). Other SVOCs, such as dibenzofuran and carbazole, and metals were detected in soil samples; however, these detections were below CVs or, in the case of carbazole, no CVs or health guidelines exist to evaluate further. Estimated incidental ingestion and dermal doses for trespassers on the site from contact with post-remediation on-site surface soils can be found in Table 10. Estimated exposure doses for PAHs are below the health guideline for benzo(a)pyrene (0.0003 mg/kg/day), indicating non-cancer health effects are not expected. There is no health guideline value for dibenzo(a,h)anthracene. A very low increased cancer risk is expected for children (8 in a million) and adults (4 in a million) who trespass on the site from current and future contact with PAHs in the surface soils on-site considering decades of exposure. A very low increased cancer risk is expected for children (2 in a million) and is unlikely for adults (<1 in a million) who trespass on the site from current and future contact with dibenzo(a,h)anthracene in surface soils on-site (Table 11).

Sediment

PAHs were detected in 6 of 7 post-remediation sediment samples collected from the unnamed tributary on-site. Dibenzo(a,h)anthracene was detected in 2 of 7 sediment samples. CVs were exceeded for total PAHs and dibenzo(a,h)anthracene (Table 9). Other SVOCs, such as dibenzofuran and carbazole, and metals were detected in sediment samples; however, these detections were below CVs or, in the case of carbazole, no CVs or health guidelines exist to evaluate further. Estimated incidental ingestion and dermal doses for trespassers on the site from contact with post-remediation on-site sediments can be found in Table 10. Estimated exposure doses for PAHs are below the health guideline for benzo(a)pyrene (0.0003 mg/kg/day), indicating non-cancer health effects are not expected. There is no health guideline available for dibenzo(a,h)anthracene. An increased cancer risk is unlikely for children (<1 in a million) and

adults (<1 in a million) who trespass on the site from current and future contact with PAHs and dibenzo(a,h)anthracene in sediments on-site considering decades of exposure (Table 11).

Surface Water
PAHs were detected in 2 of 2 post-remediation surface water samples collected from the unnamed tributary on-site. Dibenzofuran was detected in 2 of 2 surface water samples. Manganese was detected in 2 of 2 surface water samples. CVs were exceeded for total PAHs, dibenzofuran and manganese (Table 12). Other SVOCs, such as dibenzofuran and carbazole, and metals were detected in surface water samples; however, these detections were below CVs or, in the case of carbazole, no CVs or health guidelines exist to evaluate further. Estimated incidental ingestion doses for trespassers on the site from contact with post-remediation on-site surface water can be found in Table 13. Estimated exposure doses of PAHs, dibenzofuran and manganese are below their respective health guidelines, indicating non-cancer health effects are not expected. An increased cancer risk is unlikely for children (<1 in a million) and adults (<1 in a million) who trespass on the site from current and future contact with PAHs in surface water on-site considering decades of exposure (Table 14).

Combined PAHs
Because of the similarities in toxicity and people who may be exposed, DPH added together estimated exposure doses and increased cancer risks for trespassers on the site from exposure to PAHs in surface soil, sediment and surface water following the 2011 removal activities. Total maximum exposure doses for children and adults did not exceed the health guideline for benzo(a)pyrene (0.0003 mg/kg/day) (Table 21). A low increased cancer risk is expected for children (1 in 100,000) and a very low increased cancer risk for adults (6 in a million) who trespass on the site from current and future contact with PAHs in surface soil, sediment and surface water on-site (Table 23).

<u>Nearby Residents: Off-Site Current and Future Exposures – Post-2011Removal Action</u>
Surface Soil
PAHs were detected in 2 of 13 post-remediation surface soil samples collected from the banks of Dobbins Pond. Arsenic was detected in 5 of 14 soil samples. CVs were exceeded for total PAHs, and arsenic (Table 15). Other metals were detected in soil samples; however, these detections were below CVs.

Estimated incidental ingestion and dermal doses for residents near the site from contact with post-remediation off-site surface soils can be found in Table 16. Estimated child exposure doses for arsenic are slightly above the health guideline (0.0003 mg/kg/day). This dose assumes children are playing in the soil around Dobbins Pond every day. The greatest estimated dose, which is for children ages 1 to 2 years, is well below the no observed adverse effect level (NOAEL) for chronic oral exposure in humans (0.0008 mg/kg/day), based on skin lesions in people exposed to arsenic through well water [ATSDR 2007b]. Additional information on health effects of arsenic and other site-related contaminants can be found in Appendix G. Estimated exposure doses for total PAHs are below the health guideline for benzo(a)pyrene (0.0003 mg/kg/day), indicating non-cancer health effects are not expected.

A very low increased cancer risk is expected for children (7 in a million) and is unlikely (<1 in a million) for adults living near the site from current and future contact with PAHs in the surface soils off-site considering decades of exposure. A low increased cancer risk is expected for children (5 in 100,000) and adults (2 in 100,000) living near the site from current and future contact with arsenic in surface soils off-site (Table 17).

Sediment

PAHs were detected in 11 of 40 post-remediation sediment samples collected from the wetlands and Dobbins Pond. Aluminum was detected in 22 of 22 sediment samples. CVs were exceeded for total PAHs and aluminum (Table 15). Iron was also detected at elevated levels; however, iron is an essential nutrient and was not evaluated further. Other SVOCs, such as dibenzo(a,h)anthracene, and metals were detected in sediment samples; however, these detections were below CVs. Estimated incidental ingestion and dermal doses for residents near the site from contact with post-remediation off-site sediments can be found in Table 16.

Estimated child exposure doses for aluminum are slightly above the health guideline (1.0 mg/kg/day). However, the greatest estimated dose, which is for children ages 1 to 2 years, is well below the lowest observed adverse effect level (LOAEL) for chronic oral exposure in mice (100 mg/kg/day), based on effects on motor function in mice exposed to aluminum through diet [ATSDR 2008]. It is important to note that estimated doses for aluminum assume children are playing in the sediment around Dobbins Pond every day, which may be an overly conservative assumption. Estimated exposure doses for PAHs are below the health guideline for benzo(a)pyrene (0.0003 mg/kg/day), indicating non-cancer health effects are not expected. A low increased cancer risk is expected for children (3 in 100,000) and a very low increased cancer risk for adults (3 in a million) living near the site from current and future contact with PAHs in sediments off-site considering decades of exposure (Table 17).

Surface Water

Arsenic was detected in 2 of 9 post-remediation surface water samples collected from Dobbins Pond. Thallium was detected in 1 of 9 surface water samples. CVs were exceeded for arsenic and thallium (Table 18). Other metals were detected in surface water samples; however, these detections were below CVs. Estimated incidental ingestion doses for residents near the site from contact with post-remediation off-site surface water can be found in Table 19. Estimated exposure doses of arsenic and thallium are below their respective health guidelines, indicating non-cancer health effects are not expected. An increased cancer risk is unlikely for children (<1 in a million) and adults (<1 in a million) living near the site from current and future contact with arsenic in surface water off-site considering decades of exposure (Table 20).

Combined PAHs

Because of the similarities in toxicity and people who may be exposed, DPH added together estimated exposure doses and increased cancer risks for residents near the site from exposure to PAHs in surface soil, sediment and surface water following the 2011 removal activities. Total maximum exposure doses for children and adults did not exceed the health guideline for benzo(a)pyrene (0.0003 mg/kg/day) (Table 22). A low increased cancer risk is expected for children (3 in 100,000) and a very low increased cancer risk for adults (3 in a million) living near

the site from current and future contact with PAHs in surface soil, sediment and surface water off-site (Table 24).

Fish

PAHs were detected in largemouth bass and white catfish from Dobbins Pond and largemouth bass from Reference Pond 1. None of the 17 PAHs that EPA analyzed for exceeded non-cancer screening levels. Information on the cancer risk evaluation process for PAHs can be found in Appendix F. All species' average benzo(a)pyrene (BaP) equivalent concentrations exceeded the DPH BaP screening level for cancer risk of 0.000941 mg/kg (Table 25). Estimated increased cancer risks for subsistence fishers range from 1 additional cancer in 100,000 people from eating white catfish from Dobbins Pond to 3 additional cancers in 100,000 people from eating largemouth bass in Dobbins Pond. Increased cancer risks for recreational fishers range from no increased risk from eating white catfish from Dobbins Pond to 3 additional cancers in a million people for largemouth bass in Dobbins Pond (Table 28).

Total arsenic was detected in largemouth bass from Dobbins Pond (Table 26). The potential for health effects from inorganic arsenic was evaluated only, as little is known about the toxicity of organic arsenic. Organic arsenic is believed to be less toxic than inorganic arsenic. For this evaluation, the DPH assumed that 10% of the total arsenic concentration is inorganic arsenic [EPA 2003]. The average inorganic arsenic concentration found in largemouth bass from Dobbins Pond is below the DPH inorganic arsenic screening level for non-cancer (0.141 mg/kg) but above the screening level for cancer (0.000314 mg/kg). The estimated increased cancer risk for subsistence fishers from eating largemouth bass from Dobbins Pond is 4 additional cancers in a million people. There is no increased cancer risk for recreational fishers from eating largemouth bass from Dobbins Pond (Table 29).

Chromium was detected in largemouth bass and white catfish from Dobbins Pond and channel catfish from Reference Pond 3. Fish were only analyzed for total chromium and not hexavalent chromium. Due to the toxicity of hexavalent chromium and to be highly health protective, all chromium in fish was assumed to be hexavalent chromium per DPH's standard operating procedure for fish tissue evaluations. All species' average hexavalent chromium concentrations exceeded the DPH hexavalent chromium screening level for cancer risk (0.00941 mg/kg). However, all average concentrations were lower than the DPH hexavalent chromium screening level for non-cancer health effects (1.41 mg/kg) (Table 27). Estimated increased cancer risks for subsistence fishers range from 4 additional cancers in 100,000 people from eating channel catfish in Reference Pond 3 to 4 additional cancers in 10,000 people from eating white catfish in Dobbins Pond. Increased cancer risk for recreational fishers ranges from 4 additional cancers in a million people from eating channel catfish in Reference Pond 3 to 4 additional cancers in 100,000 people from eating white catfish in Dobbins Pond (Table 30).

DPH also estimated meal limit recommendations to provide to people eating fish from the waterbodies where fish were collected and determined if enough information is available to issue a fish advisory. These recommendations are calculated using DPH's standard operating procedure for fish tissue evaluations. Additionally, in order to be health protective, meal limits recommendations are calculated for subsistence fishers. A summary of the meal limit recommendations for each contaminant can be found in Table 31. White catfish from Dobbins

Pond are the only species with a meal limit recommendation, based on the average chromium concentration, which was assumed to be all in the hexavalent chromium form, found in this species. This recommendation is to only eat 1 meal per week of white catfish from Dobbins Pond. In addition to this recommendation, largemouth bass fall under DPH's statewide mercury fish advisory. Additional information on the statewide mercury advisory can be found in Appendix H or the Recommendations section below.

Private Well Water
Two VOCs, 2 SVOCs and 14 metals were detected in 14 private well water samples. Lead was detected at low levels in 4 wells. There are no CVs for lead as no amount of exposure to lead is considered acceptable. Lead in drinking water at any level should be reduced or removed. Because the lead levels found were more than 4 times below the EPA's drinking water limit for public drinking water systems, further evaluation of lead in private wells was not done at this time. No other chemicals or metals were detected at concentrations greater than CVs. Three metals detected have no CVs (calcium, magnesium, and potassium). These four metals are essential nutrients and were detected at concentrations within the expected range for groundwater in this area based on the concentrations in the background well samples. Contaminants detected and concentrations can be found in Table 32.

Limitations
There are limitations inherent to the public health assessment process. These include the availability of analytical data collected for a site, the type and quantity of health effect study information, and the risk estimation process itself. High reporting limits greater than screening levels for some contaminants provide additional uncertainty in the data evaluation. To address this, a conservative approach of including these contaminant concentrations in risk estimations as half the reporting limit was used. Additionally, for this evaluation it was assumed that residents living near the site are playing or wading in or around Dobbins Pond and the wetlands daily. This assumption is made to be health protective. These conservative approaches could overestimate potential health risks.

In addition, for the fish tissue evaluation, the data collected and health risk assessment of the data are only relevant to the species collected for this site. The conclusions and recommendations do not pertain to fish species not sampled. The data presented in this evaluation is only representative of contaminant concentrations at the time they were collected. Concentrations could increase or decrease over time. Additionally, the assumption that all chromium measured in fish tissue samples is hexavalent chromium, per DPH guidance [DPH 2017], is a conservative, health protective approach that may overestimate levels of risk.

To ensure protection of public health, highly health protective exposure assumptions were used to evaluate environmental data and interpret the potential for adverse health effects.

Conclusions

After reviewing the environmental data, DPH concludes:

Conclusion 1: The health of nearby residents is not expected to be harmed from contact (including touching and accidently ingesting) with soil, sediment, or surface water along the banks of and in Dobbins Pond and the wetlands in the past, present, or future. Concentrations of contaminants are below levels of concern in surface water in Dobbins Pond and the wetlands near the Holcomb Creosote site. Concentrations of PAHs and some metals were detected in sediment and soil along the banks of Dobbins Pond and in the wetlands. Estimated doses of PAHs in sediment and soil along the banks of Dobbins Pond and in the wetlands are below levels expected to cause adverse health effects. Estimated doses of aluminum and arsenic from incidental ingestion of and direct skin contact with sediment and soil exceed health guidelines for young children (age 1 to 2 years) who live near the site and were studied further as part of this assessment indicating no health impacts are expected. The amount of aluminum and arsenic that small children could be exposed to is well below levels associated with adverse health effects in animal and epidemiological studies. It should be noted that frequent playing and wading may not be occurring in these areas.

Conclusion 2: The health of individuals that trespass on the site is not expected to be harmed from contact (including touching and accidentally ingesting) with on-site soil (in processing areas), sediment (along the unnamed tributary), or surface water (in unnamed tributary) in the past, present, or future. Concentrations of PAHs prior to and following EPA's 2011 removal action were detected in soil, sediment, and surface water on the Holcomb Creosote site. However, estimated doses of PAHs in soil, sediment, and surface water on-site are at levels that are not expected to cause adverse non-cancer health effects. Additionally, a low increased risk of cancer has been calculated with adult and childhood exposures but only after many years of frequent trespassing on the site. However, frequent trespassing is not likely occurring in this area.

Conclusion 3: The health of subsistence and recreational fishers could be harmed from frequently eating fish from Dobbins Pond. An existing statewide fish advisory for mercury is adequately protective of the exposures to recreational and subsistence fishers considered in this assessment with one needed addition which recommends limiting the number of catfish meals that are consumed from Dobbins Pond. Recreational fishers were assumed to have approximately 3 fish meals per month and subsistence fishers were assumed to have 1 fish meal per day as part of this assessment. Chromium, assumed to be hexavalent per DPH guidance and to be health protective, has been found in catfish from Dobbins Pond and two nearby ponds above DPH levels of concern, indicating the potential for exposure and subsequent cancer health effects. Following the existing statewide fish advisory for mercury as well as the additional guidance on limiting catfish consumption protects both recreational and subsistence fishers and their family members from harmful exposures.

Conclusion 4: The health of nearby residents is not expected to be harmed from drinking water from private wells in the area near the site. However, 4 private wells had low levels of lead in well water samples, and lead in drinking water at any level should be reduced or removed. Homes within a ½-mile radius in the direction of groundwater flow away from the Holcomb Creosote site have always been on a

municipal water system. Well water data collected in 2012 from private wells within a ½-mile radius and in the opposite direction of groundwater flow from the site indicated that site contaminants have not impacted any of these wells. Lead was detected in 4 private wells, and lead in drinking water at any level should be reduced or removed. Other contaminants not related to site activities were below comparison values.

Recommendations

The DPH recommends the:

- EPA continue to maintain the fences around the landfarm and surface impoundment to ensure people are not exposed to contamination in these areas. Trespassing is discouraged, and individuals should not access the site.
- Local health department prevent the installation of new drinking water wells east/southeast of the site, in the direction of groundwater flow away from the site.
- EPA and DEQ continue to monitor sediment, soil and surface water throughout future remedial activities to ensure people are not exposed to harmful concentrations of site contaminants during clean-up.
- People who come in contact with the sediment or soil in this area thoroughly wash with soap and water hands, feet and any skin or clothing that comes in contact with sediment or soil.
- People follow the existing Statewide mercury meal recommendations for eating fish from waterbodies in North Carolina as well as the site-specific expansion of the consumption limit recommendations for catfish from Dobbins Pond:

Statewide Meal Consumption Limit Recommendations for Mercury in Fish[4]	
Women of child-bearing age (15-44 years old), pregnant women, nursing mothers, and children less than 15 years old	**All others**
DO NOT EAT fish HIGH in mercury (includes largemouth bass)	Eat only 1 meal per week of fish HIGH in mercury (includes largemouth bass)
Eat up to 2 meals per week of fish LOW in mercury	Eat up to 4 meals per week of fish LOW in mercury
Dobbins Pond Specific Meal Consumption Limit Recommendations for Contaminants in Fish	
Everyone	
Recommendation	**Contaminant of Concern**
Eat up to 1 meal per week of white catfish	Hexavalent Chromium

[4] See Appendix H or the N.C. DPH Fish Advisories web site for a complete list of fish identified as LOW & HIGH in mercury (http://epi.publichealth.nc.gov/oee/fish/advisories.html).

- Owner of Dobbins Pond and the Holcomb Creosote site do outreach to inform local residents of potential health risks associated with contamination from the Holcomb Creosote site.
- DEQ or EPA resample fish from Dobbins Pond for speciated chromium to better understand hexavalent chromium levels in fish tissue and better characterize potential risk from consuming fish to inform a formal fish consumption advisory.
- DEQ or EPA sample fish from Dobbins Pond at least every 5 years in conjunction with the site 5-year review to monitor changes in contaminant levels.

Public Health Action Plan

The purpose of the Public Health Action Plan is to ensure that this public health assessment provides a plan of action designed to mitigate or prevent potential adverse health effects.

Public Health Actions Completed

1. DPH held a public availability session on October 8, 2019 at the Yadkinville Fire Department in Yadkinville, NC to answer questions and hear comments from the local community.
2. DPH prepared a summary factsheet that is available on the Health Assessment, Consultation & Education (HACE) program's website[5].

Public Health Actions Planned

1. DPH will review speciated chromium data in fish tissue when available to inform a formal fish consumption advisory.
2. DPH will continue to work with the local health department to inform and educate the local community about potential health hazards associated with exposure to contaminants from the Holcomb Creosote site and how to reduce exposures. This will include developing and posting signs and distributing factsheets and other health education materials.
3. DPH will continue to monitor and assess the Holcomb Creosote site as the EPA or DEQ collects additional data and update the fish consumption advisory as appropriate.

[5] https://epi.dph.ncdhhs.gov/oee/hace/by_site.html#H

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Report Preparation

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Appendix A

Figures

Figure 1. Holcomb Creosote Company NPL site location, Yadkin County, North Carolina [EPA 2012].

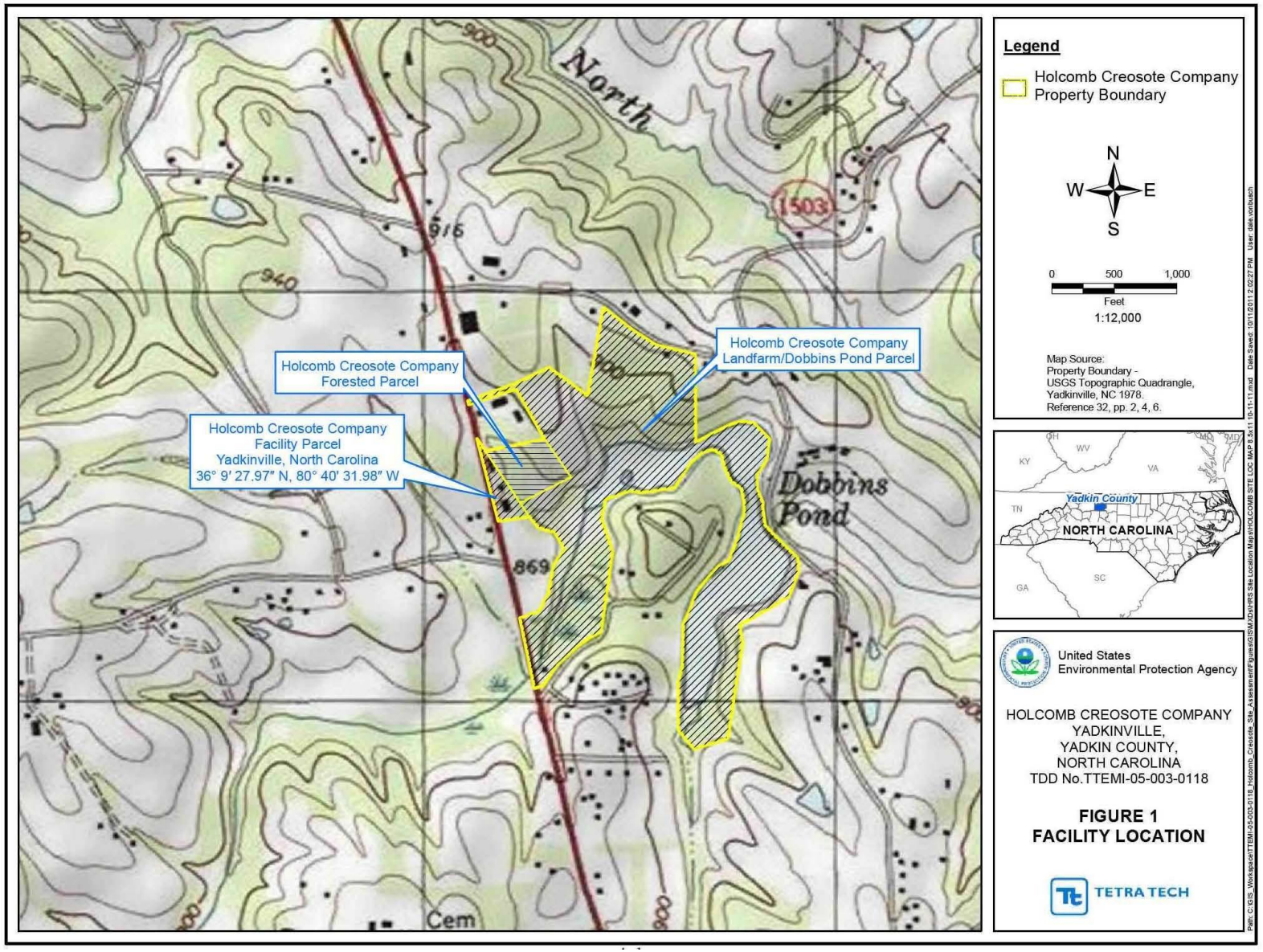


Figure 2. Holcomb Creosote Company former wood-treating facility structures [EPA 2012].

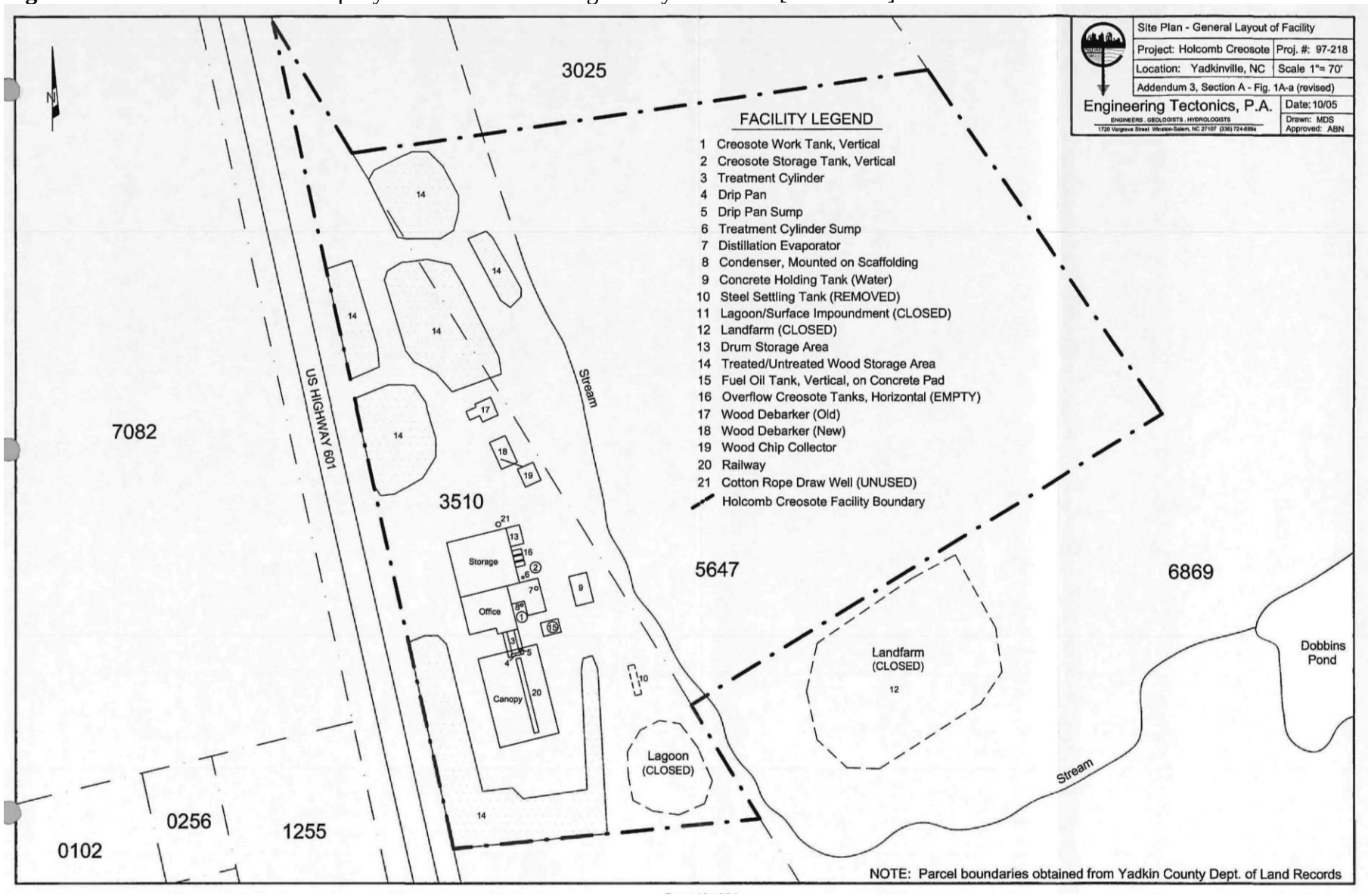


Figure 3. Holcomb Creosote Company NPL site surroundings [EPA 2012].

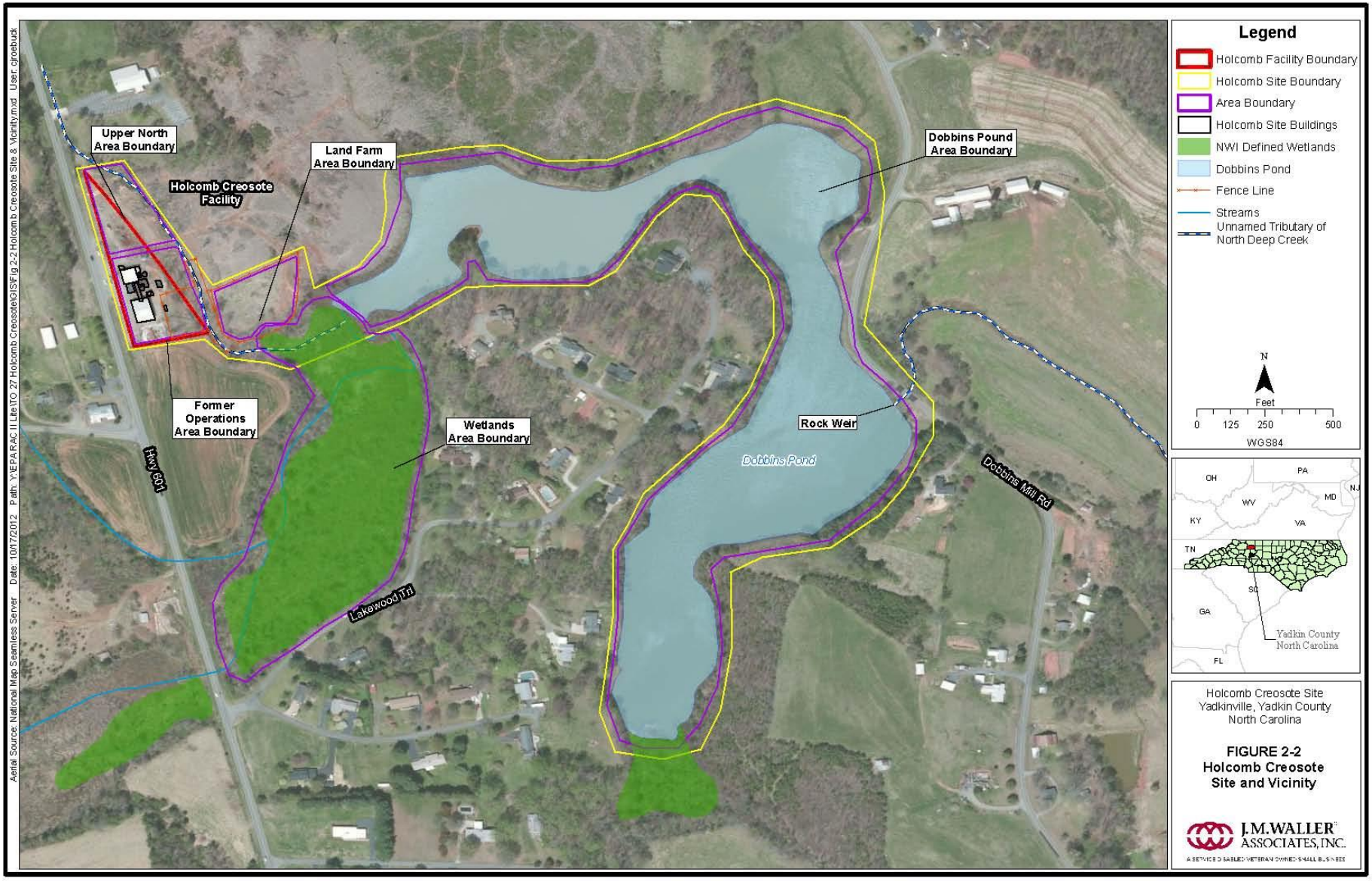
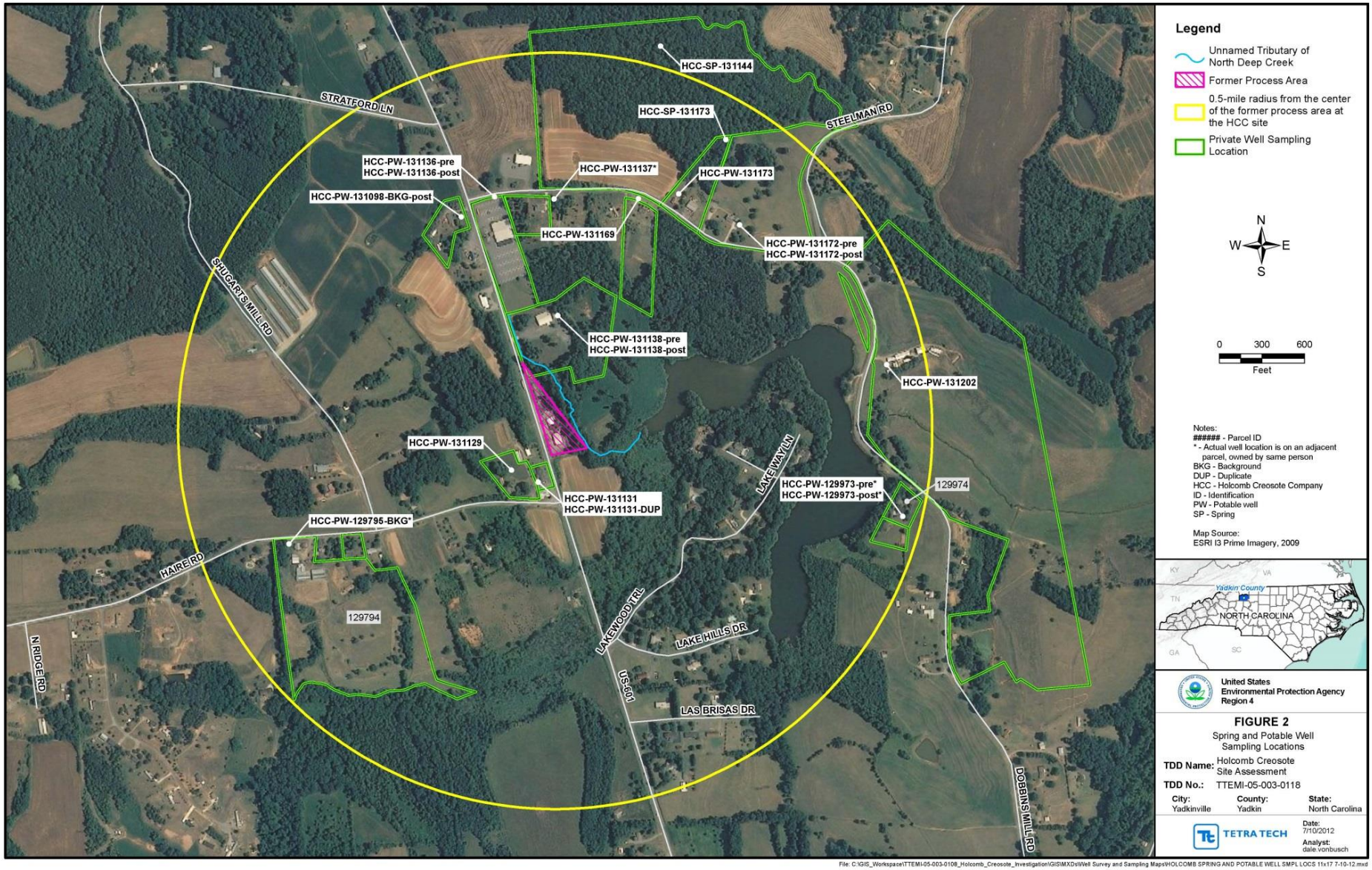


Figure 4. Holcomb Creosote Company NPL site ½-mile radius selected for private well water testing [EPA 2012].



Appendix B

Demographic Data

Figure 5. Population of selected census blocks for the community near the Holcomb Creosote Company NPL site [U.S. Census].

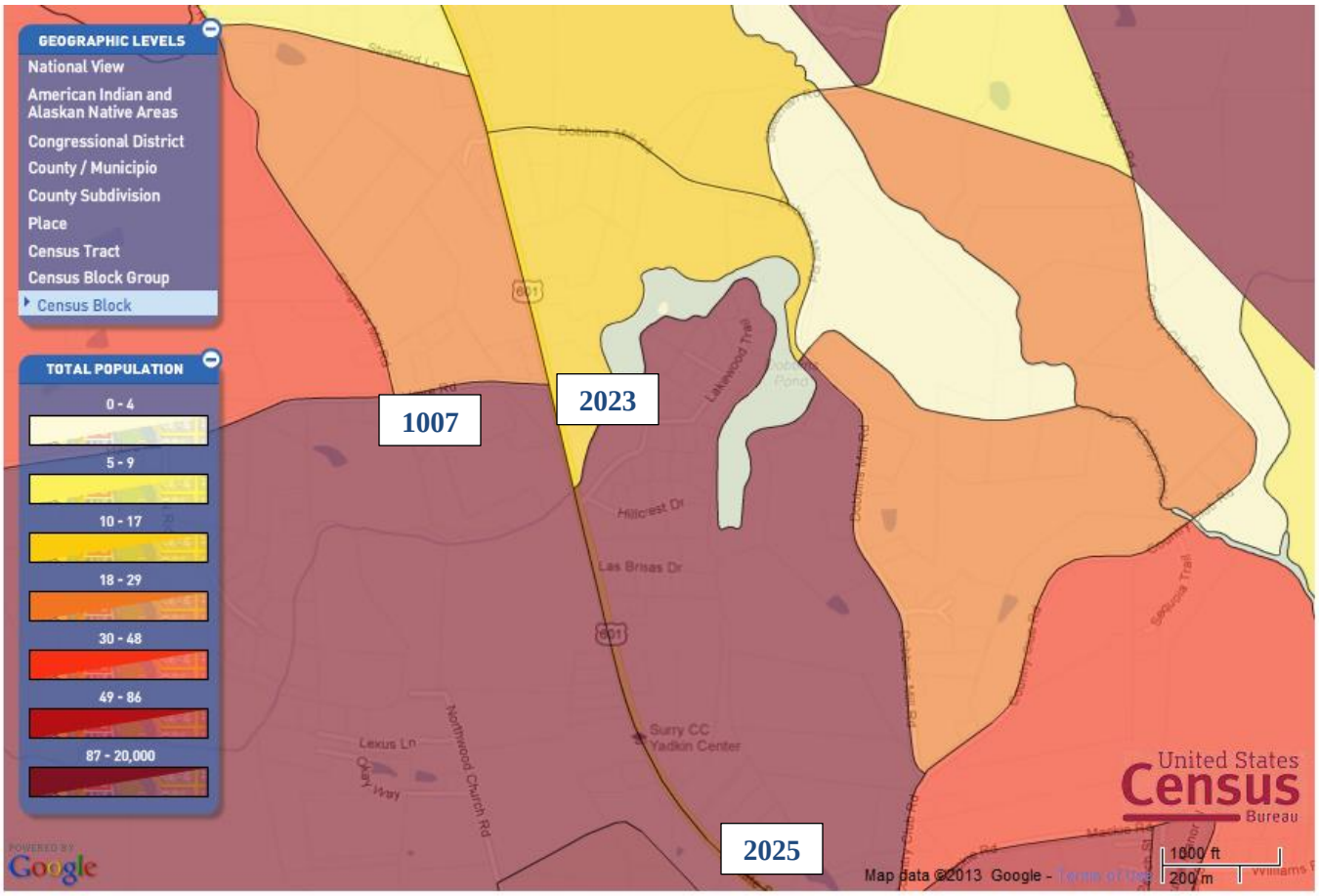


Table 2. Holcomb Creosote Company NPL site demographic data based on Census 2010 figures [U.S. Census].

Holcomb Site	Census blocks 2025, 2023, 1007		Yadkin County		North Carolina		United States	
Total population	134		38,406		9,535,483		308,745,538	
Race								
White	122	91%	34,007	89%	6,528,950	68%		72.40%
African-American	2	1%	1,192	3%	2,048,628	21%		12.60%
Asians	0	0%	78	0.20%	208,962	2%		4.80%
American Indian and Alaska Native alone	0	0%	79	0.21%	122,110	1%		0.90%
Native Hawaiian and Other Pacific Islander	0	0%	12	0.03%	6,604	0.07%		0.20%
Other	8	6%	2,560	7%	414,030	4%		6.20%
Two or more races	2	1%	478	1%	206,199	2%		2.90%
Ethnicity								
Hispanic or Latino	10	7%	3,749	10%	800,120	8%		16.30%
Individuals below poverty level				16%		18%		16%
Education level								
High school diploma or higher				36%		27%	58,653,211	28%
Less than 9th grade				7%		6%	12,317,606	6%
Housing units								
Number of housing units	56		17,341		4,327,528		131,704,730	
Occupied housing units	52	93%	15,486	89%	3,745,155	87%	116,716,292	88.6
Renter occupied housing unit	7	13%	3,692	24%	1,247,255	33%	40,730,218	34.9
Age								
Number of population under 18 years of age	25	19%	8,938	23%	2,281,635	24%	73,910,701	24%
Persons 18 years and over	109	81%	29,468	77%	7,253,848	76%	237,681,218	77%
Percentage of population over 65 years of age	28	21%	6,241	16%	1,234,079	13%	41,385,026	13%
Median household income			40,650		43,916		50,502	
Unemployment rate				10%		12%		9.4% in Dec. 2010

Appendix C

Site Photos

Photo 1. Backfilled surface impoundment. Source: DPH, February 28, 2012.

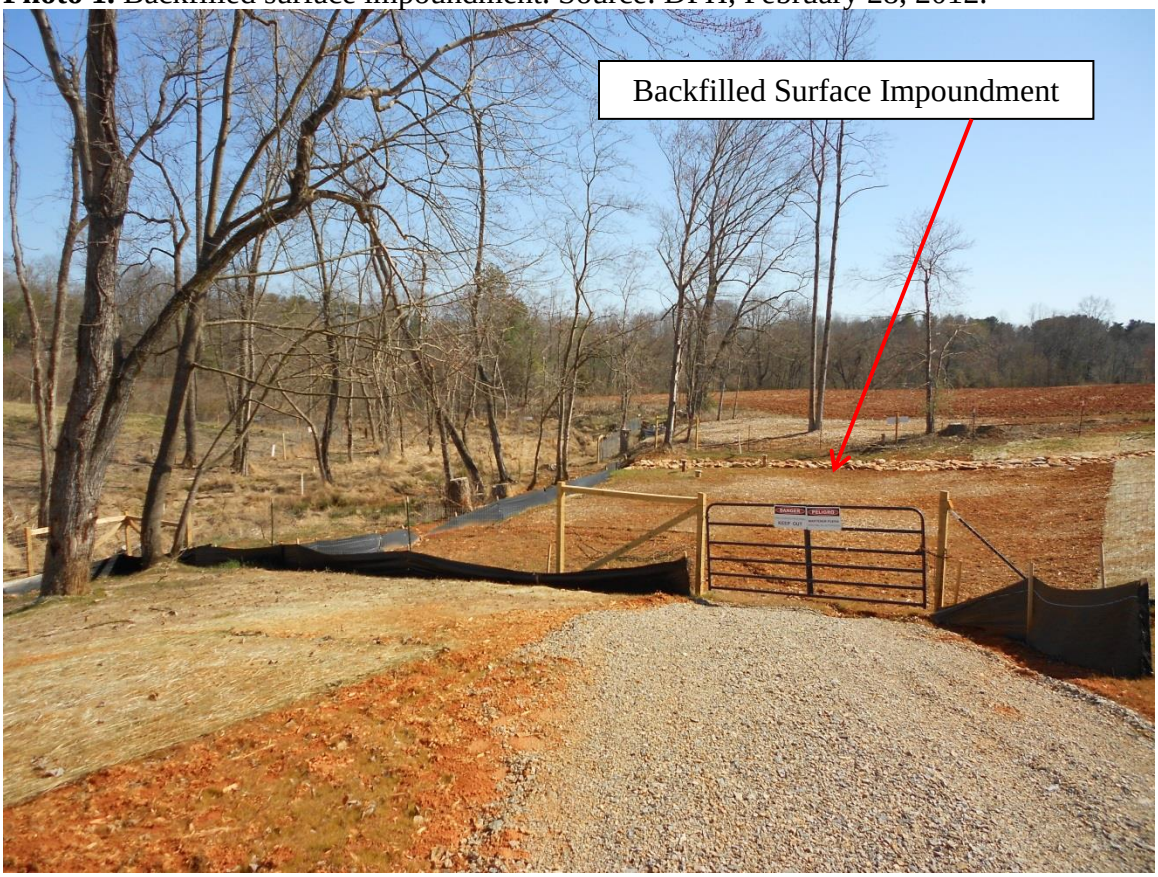


Photo 2. Unnamed tributary flowing through the NPL site. Source: DPH, February 28, 2012.

Photo 3. Looking toward the former landfarm. Source: DPH, February 28, 2012.

Photo 4. Looking north over the excavated section of site backfilled with clean topsoil. Source: DPH, February 28, 2012.

Photo 5. Looking toward the former landfarm. Source: DPH, November 1, 2016.

Photo 6. Abandoned office and storage buildings remaining on site. Source: DPH, November 1, 2016.

Appendix D

Tables

Table 3. Holcomb Creosote Company NPL site. On-site surface soil and sediment samples from ground surface to a depth of 6 inches collected prior to EPA 2011 removal activities. Summary of detected contaminants with detections above comparison values. Concentrations of 16 polycyclic aromatic hydrocarbons (PAHs) tested for are summed to derive "Total PAHs" concentration for screening. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	Number of Samples	Number of Detections	Range of Detections (mg/kg)	No. of Detections Greater than CV	Comparison Values (CV) (mg/kg)	Type of CV
On-Site Surface Soil						
Total PAHs[6]	23	18	0.39 - 290	18	0.11	BaP CREG
Dibenzo(a,h) anthracene	23	4	0.22 - 2.5	4	0.11	EPA Res. Soil RSL
On-Site Sediment						
Total PAHs[6]	7	6	7.05 - 657	6	0.11	BaP CREG
Dibenzo(a,h) anthracene	7	5	0.13 - 2.69	5	0.11	EPA Res. Soil RSL

Notes: mg/kg = milligrams contaminant per kilogram of soil or sediment
CV = comparison value
PAHs = polycyclic aromatic hydrocarbons
BaP = benzo(a)pyrene
CREG = Cancer Risk Evaluation Guide, ATSDR reference value
EPA = U.S. Environmental Protection Agency
Res. Soil RSL = Residential Soil Regional Screening Level

[6]Concentrations for Total PAHs presented here are the sum of all PAHs, except dibenzo(a,h)anthracene, without adjustment for benzo(a)pyrene-equivalency.

Table 4. Holcomb Creosote Company NPL site. On-site surface soil and sediment samples from ground surface to a depth of 6 inches collected prior to EPA 2011 removal activities. Non-cancer evaluation for trespassers on the site using combined incidental ingestion and dermal dose estimates for the maximum detected contaminant concentrations.

Contaminant	Calculated Maximum Ingestion Dose (mg/kg/day)	Calculated Maximum Dermal Dose (mg/kg/day)	Total Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does total exposure dose exceed HG?
On-Site Surface Soil					
BaP-equivalent PAHs	1.2×10^{-5} (child)	7.5×10^{-6} (child)	1.9×10^{-5} (child)	0.0003 EPA RfD	Child NO
	4.1×10^{-6} (adult)	1.9×10^{-6} (adult)	6.1×10^{-6} (adult)		Adult NO
Dibenzo(a,h)anthracene	1.3×10^{-6} (child)	8.1×10^{-7} (child)	2.1×10^{-6} (child)	n/a	n/a
	4.5×10^{-7} (adult)	2.1×10^{-7} (adult)	6.6×10^{-7} (adult)		
On-Site Sediment					
BaP-equivalent PAHs	1.5×10^{-5} (child)	9.7×10^{-6} (child)	2.5×10^{-5} (child)	0.0003 EPA RfD	Child NO
	5.3×10^{-6} (adult)	2.5×10^{-6} (adult)	7.8×10^{-6} (adult)		Adult NO
Dibenzo(a,h)anthracene	1.4×10^{-6} (child)	8.7×10^{-7} (child)	2.2×10^{-6} (child)	n/a	n/a
	4.8×10^{-7} (adult)	2.3×10^{-7} (adult)	7.1×10^{-7} (adult)		

Notes: mg/kg/day = milligrams of contaminant per kilogram of body weight per day
HG = health guideline
BaP = benzo(a)pyrene
PAHs = polycyclic aromatic hydrocarbons
EPA = U.S. Environmental Protection Agency
RfD = Reference Dose
n/a = not applicable (no HG available)
Child dose listed is for children age 11-16 years

Table 5. Holcomb Creosote Company NPL site. On-site surface soil and sediment samples from ground surface to a depth of 6 inches collected prior to EPA 2011 removal activities. Combined increased cancer risk estimates for trespassers on the site from incidental ingestion and dermal (skin) contact with soils and sediments based on maximum contaminant concentrations. Cancer risk calculated separately for children age 11 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency. Total polycyclic aromatic hydrocarbon (PAH) concentration is the sum of the benzo(a)pyrene equivalent concentrations of 16 PAHs analyzed. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	CSF $(mg/kg/day)^{-1}$	Maximum Concentration (mg/kg)	Estimated Increased Cancer Risk (cancer cases per number persons exposed)
On-Site Surface Soil			
BaP-equivalent PAHs	1.0	23.0	5 / million (child)
			3 / million (adult)
Dibenzo(a,h)anthracene	4.1	2.50	2 / million (child)
			1 / million (adult)
On-Site Sediment			
BaP-equivalent PAHs	1.0	29.8	6 / million (child)
			3 / million (adult)
Dibenzo(a,h)anthracene	4.1	2.69	2 / million (child)
			1 / million (adult)

Notes: CSF = cancer slope factor

mg/kg/day = milligrams of contaminant per kilogram of body weight per day

mg/kg = milligrams contaminant per kilogram of soil or sediment

PAHs = polycyclic aromatic hydrocarbons

Table 6. Holcomb Creosote Company NPL site. Off-site sediment samples from ground surface to a depth of 6 inches collected prior to EPA 2011 removal activities. Summary of detected contaminants with detections above comparison values. Concentrations of 16 polycyclic aromatic hydrocarbons (PAHs) tested for are summed to derive "Total PAHs" concentration for screening. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	Number of Samples	Number of Detections	Range of Detections (mg/kg)	No. of Detections Greater than CV	Comparison Values (CV) (mg/kg)	Type of CV
Off-Site Sediment						
Total PAHs[7]	7	3	2.33 - 6.92	3	0.11	BaP CREG

Notes: mg/kg = milligrams contaminant per kilogram of soil or sediment
CV = comparison value
PAHs = polycyclic aromatic hydrocarbons
BaP = benzo(a)pyrene
CREG = Cancer Risk Evaluation Guide, ATSDR reference value

Table 7. Holcomb Creosote Company NPL site. Off-site sediment samples from ground surface to a depth of 6 inches collected prior to EPA 2011 removal activities. Non-cancer evaluation for residents living near the site of combined incidental ingestion and dermal dose estimates for the maximum detected contaminant concentrations.

Contaminant	Calculated Maximum Ingestion Dose (mg/kg/day)	Calculated Maximum Dermal Dose (mg/kg/day)	Total Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does total exposure dose exceed HG?
Off-Site Sediment					
BaP-equivalent PAHs	1.2×10^{-5} (child)	2.6×10^{-6} (child)	1.4×10^{-5} (child)	0.0003 EPA RfD	Child NO
	8.3×10^{-7} (adult)	3.9×10^{-7} (adult)	1.2×10^{-6} (adult)		Adult NO

Notes: mg/kg/day = milligrams of contaminant per kilogram of body weight per day
HG = health guideline
PAHs = polycyclic aromatic hydrocarbons
EPA = U.S. Environmental Protection Agency
RfD = Reference Dose
Child dose listed is for children age 1-2 years

[7]Concentrations for Total PAHs presented here are the sum of all PAHs, except dibenzo(a,h)anthracene, without adjustment for benzo(a)pyrene-equivalency.

Table 8. Holcomb Creosote Company NPL site. Off-site sediment samples from ground surface to a depth of 6 inches collected prior to EPA 2011 removal activities. Combined increased cancer risk estimates for residents living near the site from incidental ingestion and dermal (skin) contact with sediments based on maximum contaminant concentrations. Cancer risk calculated separately for children age 1 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency. Total polycyclic aromatic hydrocarbon (PAH) concentration is the sum of the benzo(a)pyrene equivalent concentrations of 16 PAHs analyzed. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	CSF $(mg/kg/day)^{-1}$	Maximum Concentration (mg/kg)	Estimated Increased Cancer Risk (cancer cases per number persons exposed)
Off-Site Sediment			
BaP-equivalent PAHs	1.0	0.66	5 / million (child)
			<1 / million (adult)

Notes: CSF = cancer slope factor
mg/kg/day = milligrams of contaminant per kilogram of body weight per day
mg/kg = milligrams contaminant per kilogram of soil or sediment
PAHs = polycyclic aromatic hydrocarbons

Table 9. Holcomb Creosote Company NPL site. On-site surface soil and sediment samples from ground surface to a depth of 6 inches collected after EPA 2011 removal activities. Summary of detected contaminants with detections above comparison values. Concentrations of 16 polycyclic aromatic hydrocarbons (PAHs) tested for are summed to derive "Total PAHs" concentration for screening. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	Number of Samples	Number of Detections	Range of Detections (mg/kg)	No. of Detections Greater than CV	Comparison Values (CV) (mg/kg)	Type of CV
On-Site Surface Soil						
Total PAHs[8]	55	44	0.004 - 2,427	20	0.11	BaP CREG
Dibenzo(a,h) anthracene	55	9	0.0021 - 2.10	4	0.11	EPA Res. Soil RSL
On-Site Sediment						
Total PAHs[8]	7	6	1.59 - 29.7	6	0.11	BaP CREG
Dibenzo(a,h) anthracene	7	2	0.17 - 0.24	2	0.11	EPA Res. Soil RSL

Notes: mg/kg = milligrams contaminant per kilogram of soil or sediment

CV = comparison value

PAHs = polycyclic aromatic hydrocarbons

BaP = benzo(a)pyrene

CREG = Cancer Risk Evaluation Guide, ATSDR reference value

EMEG = Environmental Media Evaluation Guide, ATSDR reference value

EPA = U.S. Environmental Protection Agency

Res. Soil RSL = Residential Soil Regional Screening Level

[8]Concentrations for Total PAHs presented here are the sum of all PAHs, except dibenzo(a,h)anthracene, without adjustment for benzo(a)pyrene-equivalency.

Table 10. Holcomb Creosote Company NPL site. On-site surface soil and sediment samples from ground surface to a depth of 6 inches collected after EPA 2011 removal activities. Non-cancer evaluation for trespassers on the site using combined incidental ingestion and dermal dose estimates for the maximum detected contaminant concentrations.

Contaminant	Calculated Maximum Ingestion Dose (mg/kg/day)	Calculated Maximum Dermal Dose (mg/kg/day)	Total Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does total exposure dose exceed HG?
On-Site Surface Soil					
BaP-equivalent PAHs	1.9×10^{-5} (child)	1.2×10^{-5} (child)	3.1×10^{-5} (child)	0.0003 EPA RfD	Child NO
	6.7×10^{-6} (adult)	3.2×10^{-6} (adult)	9.9×10^{-6} (adult)		Adult NO
Dibenzo(a,h)anthracene	1.1×10^{-6} (child)	6.8×10^{-7} (child)	1.7×10^{-6} (child)	n/a	n/a
	3.8×10^{-7} (adult)	1.8×10^{-7} (adult)	5.5×10^{-7} (adult)		
On-Site Sediment					
BaP-equivalent PAHs	1.1×10^{-6} (child)	7.1×10^{-7} (child)	1.8×10^{-6} (child)	0.0003 EPA RfD	Child NO
	3.9×10^{-7} (adult)	1.9×10^{-7} (adult)	5.8×10^{-7} (adult)		Adult NO
Dibenzo(a,h)anthracene	1.2×10^{-7} (child)	7.8×10^{-8} (child)	2.0×10^{-7} (child)	n/a	n/a
	4.3×10^{-8} (adult)	2.0×10^{-8} (adult)	6.3×10^{-8} (adult)		

Notes: mg/kg/day = milligrams of contaminant per kilogram of body weight per day

HG = health guideline

PAHs = polycyclic aromatic hydrocarbons

EPA = U.S. Environmental Protection Agency

RfD = Reference Dose

n/a = not applicable (no HG available)

Child dose listed is for children age 11-16 years

Table 11. Holcomb Creosote Company NPL site. On-site surface soil and sediment samples from ground surface to a depth of 6 inches collected after EPA 2011 removal activities. Combined increased cancer risk estimates for trespassers on the site from incidental ingestion and dermal (skin) contact with soils and sediments based on maximum contaminant concentrations. Cancer risk calculated separately for children age 11 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency. Total polycyclic aromatic hydrocarbon (PAH) concentration is the sum of the benzo(a)pyrene equivalent concentrations of 16 PAHs analyzed. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	CSF $(mg/kg/day)^{-1}$	Maximum Concentration (mg/kg)	Estimated Increased Cancer Risk (cancer cases per number persons exposed)
On-Site Surface Soil			
BaP-equivalent PAHs	1.0	37.5	8 / million (child)
			4 / million (adult)
Dibenzo(a,h)anthracene	4.1	2.10	2 / million (child)
			<1 / million (adult)
On-Site Sediment			
BaP-equivalent PAHs	1.0	2.20	<1 / million (child)
			<1 / million (adult)
Dibenzo(a,h)anthracene	4.1	0.24	<1 / million (child)
			<1 / million (adult)

Notes: CSF = cancer slope factor

mg/kg/day = milligrams of contaminant per kilogram of body weight per day

mg/kg = milligrams contaminant per kilogram of soil or sediment

PAHs = polycyclic aromatic hydrocarbons

Table 12. Holcomb Creosote Company NPL site. On-site surface water samples from the unnamed tributary collected after EPA 2011 removal activities. Summary of detected contaminants with detections above comparison values. Concentrations of 16 polycyclic aromatic hydrocarbons (PAHs) tested for are summed to derive "Total PAHs" concentration for screening. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	Number of Samples	Number of Detections	Range of Detections (µg/L)	No. of Detections Greater than CV	Comparison Values (CV) (µg/L)	Type of CV
On-Site Surface Water						
Total PAHs[9]	2	2	7.14 - 31.8	2	0.011	BaP CREG
Dibenzofuran	2	2	0.62 - 9.3	1	7.9	EPA non-cancer tapwater RSL
Manganese	2	2	72 - 360	1	300	EPA LTHA

Notes: µg/L = micrograms of contaminant per liter of water

CV = comparison value

PAHs = polycyclic aromatic hydrocarbons

BaP = benzo(a)pyrene

CREG = Cancer Risk Evaluation Guide, ATSDR referenced value

EPA = U.S. Environmental Protection Agency

RSL = Regional Screening Level

LTHA = Lifetime Health Advisory

[9]Concentrations for Total PAHs presented here are the sum of all PAHs, except dibenzo(a,h)anthracene, without adjustment for benzo(a)pyrene-equivalency.

Table 13. Holcomb Creosote Company NPL site. On-site surface water samples from the unnamed tributary collected after EPA 2011 removal activities. Non-cancer evaluation for trespassers on the site from incidental ingestion of surface water for the maximum detected contaminant concentrations.

Contaminant	Maximum Concentration (µg/L)	Calculated Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does calculated exposure dose exceed HG?
On-Site Surface Water				
BaP-equivalent PAHs	3.61	6.3×10^{-7} (child)	0.0003 EPA RfD	Child NO
		2.7×10^{-7} (adult)		Adult NO
Dibenzofuran	9.3	1.6×10^{-6} (child)	0.001 PPRTV RfD	Child NO
		6.9×10^{-7} (adult)		Adult NO
Manganese	360	6.3×10^{-5} (child)	0.05 EPA RfD	Child NO
		2.7×10^{-5} (adult)		Adult NO

Notes: µg/L = micrograms of contaminant per liter of water

mg/kg/day = milligrams of contaminant per kilogram of body weight per day

HG = health guideline

PAHs = polycyclic aromatic hydrocarbons

EPA = U.S. Environmental Protection Agency

PPRTV = Provisional Peer Reviewed Toxicity Value

RfD = Reference Dose

Child dose listed is for children age 11-16 years

Table 14. Holcomb Creosote Company NPL site. On-site surface water samples from the unnamed tributary collected after EPA 2011 removal activities. Combined increased cancer risk estimates for trespassers on the site from incidental ingestion of surface water based on maximum contaminant concentrations. Cancer risk calculated separately for children age 11 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency. Total polycyclic aromatic hydrocarbon (PAH) concentration is the sum of the benzo(a)pyrene equivalent concentrations of 16 PAHs analyzed. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	CSF $(mg/kg/day)^{-1}$	Maximum Concentration (µg/L)	Estimated Increased Cancer Risk (cancer cases per number persons exposed)
On-Site Surface Water			
BaP-equivalent PAHs	1.0	3.61	<1 / million (child)
			<1 / million (adult)

Notes: CSF = cancer slope factor

mg/kg/day = milligrams of contaminant per kilogram of body weight per day

µg/L = micrograms of contaminant per liter of water

PAHs = polycyclic aromatic hydrocarbons

Table 15. Holcomb Creosote Company NPL site. Off-site surface soil and sediment samples from ground surface to a depth of 6 inches collected after EPA 2011 removal activities. Summary of detected contaminants with detections above comparison values. Concentrations of 16 polycyclic aromatic hydrocarbons (PAHs) tested for are summed to derive "Total PAHs" concentration for screening. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	Number of Samples	Number of Detections	Range of Detections (mg/kg)	No. of Detections Greater than CV	Comparison Values (CV) (mg/kg)	Type of CV
Off-Site Surface Soil						
Total PAHs[10]	13	2	0.57 - 0.62	2	0.11	BaP CREG
Arsenic	14	5	1 - 31	1	17 child 240 adult	Chronic EMEG
Off-Site Sediment						
Total PAHs[10]	40	11	0.039 - 21.7	10	0.11	BaP CREG
Aluminum	22	22	8,100 - 67,000	4	57,000 child 800,000 adult	Chronic EMEG

Notes: mg/kg = milligrams contaminant per kilogram of soil or sediment

CV = comparison value

PAHs = polycyclic aromatic hydrocarbons

BaP = benzo(a)pyrene

CREG = Cancer Risk Evaluation Guide, ATSDR reference value

EMEG = Environmental Media Evaluation Guide, ATSDR reference value

[10]Concentrations for Total PAHs presented here are the sum of all PAHs, except dibenzo(a,h)anthracene, without adjustment for benzo(a)pyrene-equivalency.

Table 16. Holcomb Creosote Company NPL site. Off-site surface soil and sediment samples from ground surface to a depth of 6 inches collected after EPA 2011 removal activities. Non-cancer evaluation for residents living near the site using combined incidental ingestion and dermal dose estimates for the maximum detected contaminant concentrations.

Contaminant	Calculated Maximum Ingestion Dose (mg/kg/day)	Calculated Maximum Dermal Dose (mg/kg/day)	Total Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does total exposure dose exceed HG?
Off-Site Surface Soil					
BaP-equivalent PAHs	1.5×10^{-5} (child)	3.5×10^{-6} (child)	1.9×10^{-5} (child)	0.0003 EPA RfD	Child NO
	1.1×10^{-6} (adult)	5.2×10^{-7} (adult)	1.6×10^{-6} (adult)		Adult NO
Arsenic	0.00033 (child)	2.8×10^{-5} (child)	0.00035 (child)	0.0003 ATSDR Chronic Oral MRL	Child YES
	2.3×10^{-5} (adult)	4.2×10^{-6} (adult)	2.7×10^{-5} (adult)		Adult NO
Off-Site Sediment					
BaP-equivalent PAHs	5.8×10^{-5} (child)	1.3×10^{-5} (child)	7.1×10^{-5} (child)	0.0003 EPA RfD	Child NO
	4.1×10^{-6} (adult)	1.9×10^{-6} (adult)	6.1×10^{-6} (adult)		Adult NO
Aluminum	1.2 (child)	0.020 (child)	1.2 (child)	1.0 ATSDR Chronic Oral MRL	Child YES
	0.084 (adult)	0.0030 (adult)	0.087 (adult)		Adult NO

Notes: mg/kg/day = milligrams of contaminant per kilogram of body weight per day

HG = health guideline

PAHs = polycyclic aromatic hydrocarbons

EPA = U.S. Environmental Protection Agency

RfD = Reference Dose

ATSDR = Agency for Toxic Substances and Disease Registry

MRL = minimal risk level

Child dose listed is for children age 1-2 years

Table 17. Holcomb Creosote Company NPL site. Off-site surface soil and sediment samples from ground surface to a depth of 6 inches collected after EPA 2011 removal activities. Combined increased cancer risk estimates for residents living near the site from incidental ingestion and dermal (skin) contact with soils and sediments based on maximum contaminant concentrations. Cancer risk calculated separately for children age 1 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency. Total polycyclic aromatic hydrocarbon (PAH) concentration is the sum of the benzo(a)pyrene equivalent concentrations of 16 PAHs analyzed. The PAH dibenzo(a,h)anthracene is not included in "Total PAHs" and is evaluated separately.

Contaminant	CSF $(mg/kg/day)^{-1}$	Maximum Concentration (mg/kg)	Estimated Increased Cancer Risk (cancer cases per number persons exposed)
Off-Site Surface Soil			
BaP-equivalent PAHs	1.0	0.88	7 / million (child)
			<1 / million (adult)
Arsenic	1.5	31.0	5 / 100,000 (child)
			2 / 100,000 (adult)
Off-Site Sediment			
BaP-equivalent PAHs	1.0	3.29	3 / 100,000 (child)
			3 / million (adult)

Notes: CSF = cancer slope factor
mg/kg/day = milligrams of contaminant per kilogram of body weight per day
mg/kg = milligrams contaminant per kilogram of soil or sediment
PAHs = polycyclic aromatic hydrocarbons

Table 18. Holcomb Creosote Company NPL site. Off-site surface water samples from the wetlands and Dobbins Pond collected after EPA 2011 removal activities. Summary of detected contaminants with detections above comparison values. PAHs were not detected in off-site surface water samples.

Contaminant	Number of Samples	Number of Detections	Range of Detections (µg/L)	No. of Detections Greater than CV	Comparison Values (CV) (µg/L)	Type of CV
Off-Site Surface Water						
Arsenic	9	2	3.2 - 3.7	2	0.016	CREG
Thallium	9	1	2.2	1	2	EPA MCL

Notes: µg/L = micrograms of contaminant per liter of water
CV = comparison value
CREG = Cancer Risk Evaluation Guide, ATSDR referenced value
EPA = U.S. Environmental Protection Agency
MCL = Maximum Contaminant Level

Table 19. Holcomb Creosote Company NPL site. Off-site surface water samples from the wetlands and Dobbins Pond collected after EPA 2011 removal activities. Non-cancer evaluation for residents living near the site from incidental ingestion of surface water for the maximum detected contaminant concentrations.

Contaminant	Maximum Concentration (µg/L)	Calculated Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does calculated exposure dose exceed HG?
Off-Site Surface Water				
Arsenic	3.7	3.2×10^{-6} (child)	0.0003 ATSDR Chronic Oral MRL	Child NO
		2.7×10^{-7} (adult)		Adult NO
Thallium	2.2	1.9×10^{-6} (child)	1.0×10^{-5} PPRTV RfD	Child NO
		1.6×10^{-7} (adult)		Adult NO

Notes: µg/L = micrograms of contaminant per liter of water
mg/kg/day = milligrams of contaminant per kilogram of body weight per day
HG = health guideline
PPRTV = Provisional Peer Reviewed Toxicity Value
RfD = Reference Dose
ATSDR = Agency for Toxic Substances and Disease Registry
MRL = minimal risk level
Child dose listed is for children age 1-2 years

Table 20. Holcomb Creosote Company NPL site. Off-site surface water samples from the wetlands and Dobbins Pond collected after EPA 2011 removal activities. Combined increased cancer risk estimates for residents living near the site from incidental ingestion of surface water based on maximum contaminant concentrations. Cancer risk calculated separately for children age 1 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency.

Contaminant	CSF $(mg/kg/day)^{-1}$	Maximum Concentration (µg/L)	Estimated Increased Cancer Risk (cancer cases per number persons exposed)
Off-Site Surface Water			
Arsenic	1.5	3.7	<1 / million (child)
			<1 / million (adult)

Notes: CSF = cancer slope factor
mg/kg/day = milligrams of contaminant per kilogram of body weight per day
µg/L = micrograms of contaminant per liter of water

Table 21. Holcomb Creosote Company NPL site. Non-cancer evaluation for trespassers on the site from exposure to polycyclic aromatic hydrocarbons (PAHs) in surface soil, sediment and surface water using combined incidental ingestion and dermal dose estimates.

Maximum Exposure Dose - Surface Soil (mg/kg/day)	Maximum Exposure Dose - Sediment (mg/kg/day)	Maximum Exposure Dose - Surface Water (mg/kg/day)	Total Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does total exposure dose exceed HG?
Pre-Removal Action					
2.1×10^{-5} (child)	2.7×10^{-5} (child)	n/a	4.8×10^{-5} (child)	0.0003 EPA RfD	Child NO
6.8×10^{-6} (adult)	8.5×10^{-6} (adult)	n/a	1.5×10^{-5} (adult)		Adult NO
Post-Removal Action					
3.3×10^{-5} (child)	2.0×10^{-6} (child)	6.3×10^{-7} (child)	3.5×10^{-5} (child)	0.0003 EPA RfD	Child NO
1.1×10^{-5} (adult)	6.4×10^{-7} (adult)	2.7×10^{-7} (adult)	1.1×10^{-5} (adult)		Adult NO

Notes: mg/kg/day = milligrams of contaminant per kilogram of body weight per day
HG = health guideline
n/a = not applicable, no samples taken or polycyclic aromatic hydrocarbons were not detected
EPA = U.S. Environmental Protection Agency
RfD = Reference Dose
Child dose listed is for children age 11-16 years

Table 22. Holcomb Creosote Company NPL site. Non-cancer evaluation for residents living near the site from exposure to polycyclic aromatic hydrocarbons (PAHs) in surface soil, sediment and surface water using combined incidental ingestion and dermal dose estimates.

Maximum Exposure Dose - Surface Soil (mg/kg/day)	Maximum Exposure Dose - Sediment (mg/kg/day)	Maximum Exposure Dose - Surface Water (mg/kg/day)	Total Maximum Exposure Dose (mg/kg/day)	Health Guideline / Type (non-cancer) (mg/kg/day)	Does total exposure dose exceed HG?
Pre-Removal Action					
n/a	1.4×10^{-5} (child)	n/a	1.4×10^{-5} (child)	0.0003 EPA RfD	Child NO
n/a	1.2×10^{-6} (adult)	n/a	1.2×10^{-6} (adult)		Adult NO
Post-Removal Action					
1.9×10^{-5} (child)	7.1×10^{-5} (child)	n/a	9.0×10^{-5} (child)	0.0003 EPA RfD	Child NO
1.6×10^{-6} (adult)	6.1×10^{-6} (adult)	n/a	7.7×10^{-6} (adult)		Adult NO

Notes: mg/kg/day = milligrams of contaminant per kilogram of body weight per day

HG = health guideline

n/a = not applicable, no samples taken or polycyclic aromatic hydrocarbons were not detected

EPA = U.S. Environmental Protection Agency

RfD = Reference Dose

Child dose listed is for children age 1-2 years

Table 23. Holcomb Creosote Company NPL site. Combined increased cancer risk for trespassers on the site from exposure to polycyclic aromatic hydrocarbons (PAHs) in surface soil, sediment, and surface water. Cancer risk calculated separately for children age 11 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency.

Estimated Increased Cancer Risk - Surface Soil	Estimated Increased Cancer Risk - Sediment	Estimated Increased Cancer Risk - Surface Water	Total Estimated Increased Cancer Risk
Pre-Removal Action			
7 / million (child)	8 / million (child)	n/a	2 / 100,000 (child)
4 / million (adult)	5 / million (adult)	n/a	8 / million (adult)
Post-Removal Action			
9 / million (child)	<1 / million (child)	<1 / million (child)	1 / 100,000 (child)
5 / million (adult)	<1 / million (adult)	<1 / million (adult)	6 / million (adult)

Notes: n/a = not applicable, no samples taken or polycyclic aromatic hydrocarbons were not detected

Table 24. Holcomb Creosote Company NPL site. Combined increased cancer risk for residents living near the site from exposure to polycyclic aromatic hydrocarbons (PAHs) in surface soil, sediment, and surface water in Dobbins Pond or the wetlands. Cancer risk calculated separately for children age 1 to 21 years and adults age 21 and older. Adult cancer risk calculated assuming a 33-year residency.

Estimated Increased Cancer Risk - Surface Soil	Estimated Increased Cancer Risk - Sediment	Estimated Increased Cancer Risk - Surface Water	Total Estimated Increased Cancer Risk
Pre-Removal Action			
n/a	5 / million (child)	n/a	5 / million (child)
n/a	<1 / million (adult)	n/a	<1 / million (adult)
Post-Removal Action			
7 / million (child)	3 / 100,000 (child)	n/a	3 / 100,000 (child)
<1 / million (adult)	3 / million (adult)	n/a	3 / million (adult)

Notes: n/a = not applicable, no samples taken or polycyclic aromatic hydrocarbons were not detected

Table 25. Holcomb Creosote Company NPL site. Fish samples collected in 2012, 2013 and 2014. Summary of sample polycyclic aromatic hydrocarbon (PAH) detections and average concentrations by species. Non-detect concentrations are included in the average concentrations as one-half of the reporting limit.

Polycyclic Aromatic Hydrocarbons (PAHs)						
Species	**Number of samples**	**Number of detections**	**Range of Detections (mg/kg)**	**Average BaP Equivalent Concentration (mg/kg)**	**Does average exceed screening level?**	**NC DPH Screening Level (mg/kg)**
Dobbins Pond						
Largemouth Bass	12	6	0.11 - 60.1	0.0273	Cancer = YES Non-Cancer = NO	0.000941 (cancer), 0.282 (non-cancer)
White Catfish	9	3	0.057 - 0.07	0.00895	Cancer = YES Non-Cancer = NO	
Reference Ponds						
Largemouth Bass[1]	6	3	0.121 - 0.221	0.0224	Cancer = YES Non-Cancer = NO	0.000941 (cancer), 0.282 (non-cancer)
Channel Catfish[2]	3	0	-	-	-	

Notes: PAHs = polycyclic aromatic hydrocarbons

mg/kg = milligrams of contaminant per kilogram of fish tissue (wet weight basis)

BaP = benzo(a)pyrene

NC DPH = North Carolina Division of Public Health

[1]Largemouth bass collected from "Reference Pond 1"

[2]Channel catfish collected from "Reference Pond 3"

Table 26. Holcomb Creosote Company NPL site. Fish samples collected in 2012 and 2013. Summary of arsenic detections and inorganic arsenic average concentrations by species. 10% of total arsenic is assumed to be inorganic arsenic. Non-detect concentrations are included in the average concentrations as one-half of the reporting limit.

Arsenic						
Species	**Number of samples**	**Number of detections**	**Range of Detections (mg/kg)**	**Average Inorganic Arsenic Concentration (mg/kg)**	**Does average exceed screening level?**	**NC DPH Screening Level (mg/kg)**
Dobbins Pond						
Largemouth Bass	6	2	0.032 - 0.033	0.00226	Cancer = YES Non-Cancer = NO	0.000314 (cancer), 0.141 (non-cancer)
White Catfish	6	0	-	-	-	
Reference Ponds						
Largemouth Bass[1]	3	0	-	-	-	0.000314 (cancer), 0.141 (non-cancer)
Channel Catfish[2]	3	0	-	-	-	

Notes: mg/kg = milligrams of contaminant per kilogram of fish tissue (wet weight basis)

NC DPH = North Carolina Division of Public Health

[1]Largemouth bass collected from "Reference Pond 1"

[2]Channel catfish collected from "Reference Pond 3"

Table 27. Holcomb Creosote Company NPL site. Fish samples collected in 2012 and 2013. Summary of chromium detections and average hexavalent chromium concentrations by species. All chromium present is assumed to be hexavalent chromium. Non-detect concentrations are included in the average concentrations as one-half of the reporting limit.

Chromium						
Species	**Number of samples**	**Number of detections**	**Range of Detections (mg/kg)**	**Average Hexavalent Chromium Concentration (mg/kg)**	**Does average exceed screening level?**	**NC DPH Screening Level (mg/kg)**
Dobbins Pond						
Largemouth Bass	6	1	0.89	0.133	Cancer = YES Non-Cancer = NO	0.000941 (cancer), 1.41 (non-cancer)
White Catfish	6	1	3.7	0.707	Cancer = YES Non-Cancer = NO	
Reference Ponds						
Largemouth Bass[1]	3	0	-	-	-	0.000941 (cancer), 1.41 (non-cancer)
Channel Catfish[2]	3	1	0.13	0.081	Cancer = YES Non-Cancer = NO	

Notes: mg/kg = milligrams of contaminant per kilogram of fish tissue (wet weight basis)

NC DPH = North Carolina Division of Public Health

[1]Largemouth bass collected from "Reference Pond 1"

[2]Channel catfish collected from "Reference Pond 3"

Table 28. Holcomb Creosote Company NPL site. Fish samples collected in 2012, 2013 and 2014. Increased cancer risk estimates from eating fish from Dobbins Pond and nearby reference ponds based on average benzo(a)pyrene equivalent polycyclic aromatic hydrocarbon (PAH) concentrations by species. Cancer risk calculated assuming daily ingestion over a 78-year lifetime.

Polycyclic Aromatic Hydrocarbons (PAHs)						
Species	**BaP CSF $(mg/kg/day)^{-1}$**	**Average BaP Equivalent Concentration (mg/kg)**	**Subsistence Fishers Estimated Dose (mg/kg/day)**	**Estimated Increased Cancer Risk for Subsistence Fishers**	**Recreational Fishers Estimated Dose (mg/kg/day)**	**Estimated Increased Cancer Risk for Recreational Fishers**
Dobbins Pond						
Largemouth Bass	1.0	0.0273	2.9×10^{-5}	3 / 100,000	3.0×10^{-6}	3 / million
White Catfish	1.0	0.00895	9.5×10^{-6}	1 / 100,000	9.8×10^{-7}	<1 / million
Reference Ponds						
Largemouth Bass[1]	1.0	0.0224	2.4×10^{-5}	2 / 100,000	2.5×10^{-6}	2 / million

Notes: PAHs = polycyclic aromatic hydrocarbons

BaP = benzo(a)pyrene

CSF = cancer slope factor

mg/kg/day = milligrams of contaminant per kilogram of body weight per day

mg/kg = milligrams of contaminant per kilogram of fish tissue (wet weight basis)

[1]Largemouth bass collected from "Reference Pond 1"

Table 29. Holcomb Creosote Company NPL site. Fish samples collected in 2012 and 2013. Increased cancer risk estimates from eating fish from Dobbins Pond based on average arsenic concentrations by species. Cancer risk calculated assuming daily ingestion over a 78-year lifetime.

Inorganic Arsenic						
Species	**Inorganic Arsenic CSF $(mg/kg/day)^{-1}$**	**Average Inorganic Arsenic Concentration (mg/kg)**	**Subsistence Fishers Estimated Dose (mg/kg/day)**	**Estimated Increased Cancer Risk for Subsistence Fishers**	**Recreational Fishers Estimated Dose (mg/kg/day)**	**Estimated Increased Cancer Risk for Recreational Fishers**
Dobbins Pond						
Largemouth Bass	1.5	0.00226	2.4×10^{-6}	4 / million	2.5×10^{-7}	<1 / million

Notes: CSF = cancer slope factor

mg/kg/day = milligrams of contaminant per kilogram of body weight per day

mg/kg = milligrams of contaminant per kilogram of fish tissue (wet weight basis)

Table 30. Holcomb Creosote Company NPL site. Fish samples collected in 2012 and 2013. Increased cancer risk estimates from eating fish from Dobbins Pond and nearby reference ponds based on average hexavalent chromium concentrations by species. Cancer risk calculated assuming daily ingestion over a 78-year lifetime.

Hexavalent Chromium						
Species	**Hexavalent Chromium CSF $(mg/kg/day)^{-1}$**	**Average Hexavalent Chromium Concentration (mg/kg)**	**Subsistence Fishers Estimated Dose (mg/kg/day)**	**Estimated Increased Cancer Risk for Subsistence Fishers**	**Recreational Fishers Estimated Dose (mg/kg/day)**	**Estimated Increased Cancer Risk for Recreational Fishers**
Dobbins Pond						
Largemouth Bass	0.5	0.133	1.4×10^{-4}	7 / 100,000	1.5×10^{-5}	7 / million
White Catfish	0.5	0.707	7.5×10^{-4}	4 / 10,000	7.7×10^{-5}	4 / 100,000
Reference Ponds						
Channel Catfish[2]	0.5	0.081	8.6×10^{-5}	4 / 100,000	8.9×10^{-6}	4 / million

Notes: CSF = cancer slope factor

mg/kg/day = milligrams of contaminant per kilogram of body weight per day

mg/kg = milligrams of contaminant per kilogram of fish tissue (wet weight basis)

[2]Channel catfish collected from "Reference Pond 3"

Table 31. Holcomb Creosote Company NPL site. Estimated meal limits for fish from Dobbins Pond and nearby reference ponds near the site.

Species	# and type of samples	PAH Cancer Risk Meal Limit	Inorganic Arsenic Cancer Risk Meal Limit	Hexavalent Chromium Cancer Risk Meal Limit	Most Restrictive Meal Limit Estimate	Enough samples to issue FCA?	FCA
Dobbins Pond							
Largemouth Bass	12 ind.	no limit	no limit	no limit	no limit	Yes	Statewide mercury FCA more restrictive
White Catfish	9 ind.	no limit	no limit	1 ml/wk	1 ml/wk	Yes	1 ml/wk
Reference Ponds							
Largemouth Bass[1]	6 ind.	no limit	no limit	no limit	no limit	Yes	Statewide mercury FCA more restrictive
Channel Catfish[2]	3 ind.	no limit	no limit	no limit	no limit	No	no limit

Notes: PAH = polycyclic aromatic hydrocarbon

FCA = fish consumption advisory

ind. = individual fish sample

ml/wk = maximum recommended number of meals per week

One meal is 6 ounces of uncooked fish for adults, or 2 ounces of uncooked fish for children under 15.

[1]Largemouth bass collected from "Reference Pond 1"

[2]Channel catfish collected from "Reference Pond 3"

Table 32. Holcomb Creosote Company NPL site. Summary of private well water samples collected in 2012 within ½-mile radius of the site.

Contaminant	Number of Samples	Number of Detections	Range of detections (µg/L)	No. of Detections Greater than CV	Comparison Values (CV) (µg/L)	Type of CV
Volatile Organic Compounds						
Methyl tert-butyl ether	14	1	0.14J	0	2100 child 7800 adult	Int EMEG
Tetrachloroethene	14	2	0.065J - 0.069J	0	12	CREG
Semivolatile Organic Compounds						
Caprolactam	14	4	1.2J - 1.9J	0	3500 child 13000 adult	RMEG
Isophorone	14	1	16	0	26	CREG
Metals						
Aluminum	14	1	25	0	7000 child 26000 adult	Chronic EMEG
Barium	14	12	18 - 82	0	1400 child 5200 adult	Chronic EMEG
Calcium	14	14	5,800 - 32,000	n/a	n/a	n/a
Hexavalent Chromium	14	4	0.65J - 1.9J	0	6.3 child 23 adult	Chronic EMEG
Copper	14	9	5.3 - 26	0	70 child 260 adult	Int EMEG
Iron	14	3	790 - 1,800	0	2500	NC DWM/DPH HRE
Lead	14	4	1.1 - 3.6	n/a	n/a	n/a
Magnesium	14	14	1,700 - 4,100	n/a	n/a	n/a
Manganese	14	12	2.6 - 280	0	300	EPA LTHA
Nickel	14	13	0.06J - 3.2	0	100	EPA LTHA
Potassium	14	14	1,800 - 4,100	n/a	n/a	n/a
Sodium	14	14	4,300 - 16,000	0	20000	EPA DWA
Vanadium	14	1	7.6	0	70 child 260 adult	Int EMEG
Zinc	14	8	12 - 140	0	2000	EPA LTHA

Notes: µg/L = micrograms of contaminant per liter of water
CV = comparison value
J = indicates estimated concentration
Int EMEG = Intermediate Environmental Media Evaluation Guide, ATSDR referenced value
MCL = Maximum Contaminant Level
RMEG = Reference Dose Media Evaluation Guide, ATSDR referenced value
CREG = Cancer Risk Evaluation Guide, ATSDR referenced value
EMEG = Environmental Media Evaluation Guide, ATSDR referenced value
NC DWM/DPH HRE = North Carolina Division of Waste Management/Division of Public Health - Health Risk Evaluation (January 2015)
TT = Treatment Technique, EPA regulated level
EPA LTHA = U.S. Environmental Protection Agency Lifetime Health Advisory
EPA MCLG = U.S. Environmental Protection Agency Maximum Contaminant Level Goal
n/a = not applicable; calcium, magnesium, and potassium are essential nutrients; there are no comparison values for lead as no amount of exposure is beneficial
EPA DWA = U.S. Environmental Protection Agency Drinking Water Advisory

Appendix E

Health Effects Evaluation Process and Exposure Pathway Analysis

Health Effects Evaluation Process

This section provides a summary of the DPH and the Agency for Toxic Substances and Disease Registry (ATSDR) health effects evaluation process.

The first step in the health effects evaluation process is the "environmental guideline comparison" and involves comparing site contaminant concentrations to water, soil, air, or food chain[11] comparison values (CVs). These comparison values are health protective values derived by ATSDR from exposure default values. For fish tissue, CVs are derived by DPH from default exposure values. During this first step of the screening process, site contaminants are divided into two categories: those exceeding their media specific CVs and those not exceeding CVs. Those contaminant concentrations greater than CVs require a more in-depth evaluation of the potential for adverse health effects. However, concentrations greater than CVs do not automatically indicate adverse health effects are expected. Those contaminant concentrations that are below CVs require no further evaluation, as adverse health effects would not be expected. However, further evaluation may be warranted based on site-specific conditions or community concerns.

The second step in the health effects evaluation process is the "health guideline comparison." This step is a closer look at the contaminants with concentrations greater than CVs from the environmental guideline comparison. The health guideline comparison involves estimating exposure doses[12], based on site-specific conditions, and comparing these doses to health guidelines. Health protective, site-specific dose estimates are developed for both children and adults. For fish tissue evaluations, health protective site-specific dose estimates are developed for both subsistence and recreational fishers. These doses are then compared to ATSDR health guideline values. The health guidelines are derived from epidemiologic and toxicological data from the literature with multiple safety factors applied to be highly health protective. Health guidelines represent daily human exposure levels to a substance that are likely to have no appreciable risk of adverse health effects during specific exposure durations. Important factors in determining the potential for adverse health effects include:

- the concentration of the chemical,
- how long (duration) people are in contact with the chemical,
- how often (frequency) people are in contact with the chemical,
- the type of contact with the chemical (route of exposure), such as drinking, eating, touching or breathing it, and
- the health status of the people exposed.

Site-specific dose estimates for contaminants in which doses exceed health guidelines are also compared to data from animal and human health effects studies to determine the potential for adverse health effects. The health effects data are generally taken from ATSDR or EPA references that summarize human and animal studies that have undergone extensive validation review. Comparisons are made based on the exposure route (ingestion/eating, inhalation/breathing, or dermal/skin contact) and the length of the exposure. Preference is given

[11] Fish and other animals or plants that people can eat.

[12] The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure.

to human study data and chemical doses or concentrations where no adverse health effects were observed. If no human data or no-adverse-effect data are available, animal data or the lowest chemical dose where adverse health effects were observed may be used.

Exposure Pathway Analysis

Even though a contaminant may be present in the environment, this does not automatically mean that people will be exposed or that there will be adverse health effects. Exposure to the contaminant and the possibility of adverse health effects requires that people come in contact with the contaminant through ingestion (eating or drinking), inhalation (breathing), or dermal (skin) absorption. The ability of the chemical to cause adverse health effects will also depend on the amount of chemical a person is exposed to (dose), how long a person is exposed (duration), how often a person is exposed (frequency), and how much and what type of damage the chemical can cause in the body (toxicity). Knowing or estimating the frequency with which people have contact with hazardous substances is essential to assessing the public health impact of exposure to these contaminants.

Individuals or groups of individuals, such as children, the elderly, or persons with weakened immune responses, or other chronic health issues may respond differently to potentially harmful substances. These susceptible populations may have different or heightened responses as compared to most people exposed at the same concentration to a particular chemical in the environment. Reasons for these differences may include genetic makeup, age, health status, nutritional status, and exposure to other toxic substances (such as cigarette smoke or alcohol). These factors may limit that person’s ability to detoxify or eliminate the harmful chemicals from their body or may increase the effects of damage to their organs or alter physiological systems. Child-specific exposure situations and susceptibilities are also considered in DPH health evaluations. For fish tissue evaluations, the use of highly health protective exposure parameters for subsistence fishers in developing fish advisories should also protect children’s health.

Appendix F

Exposure Dose Equations and Cancer Evaluation

Exposure Dose Equations

The equations used to estimate exposure doses from exposure to contaminants at the Holcomb Creosote Company NPL site are shown below. These equations can be found in the ATSDR Public Health Assessment Guidance Manual [ATSDR 2005] or the EPA Risk Assessment Guidance for Superfund [EPA 2004]. Population-specific exposure parameters are consistent with ATSDR and EPA guidance [ATSDR 2016a,c,d,e; EPA 2000, 2011]. For on-site exposures to trespassers on the site, infants age 6 weeks to children less than 11 years are not expected to be playing or wading in the dirt or creek area, therefore this assessment only evaluated exposure scenarios on-site for people beginning at age 11 through adulthood. For off-site exposures to residents living near the site, infants age 6 weeks to 1 year are not expected to be playing or wading in the pond or wetlands, therefore this assessment only evaluated exposure scenarios off-site for people beginning at age 1 through adulthood. For fish exposures, the use of highly health protective exposure parameters for subsistence fishers in developing fish advisories should protect children's health.

Incidental ingestion of contaminants in soil and sediment

Exposure doses for ingestion of contaminants in soil and sediment are calculated using the maximum concentrations of contaminants in milligram per kilogram (mg/kg). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated soil and sediment:

$$ED_s = \frac{C \times IR \times EF \times CF}{BW}$$

Where:

ED_s = exposure dose soil and sediment (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated soil and sediment (mg/day)
EF = exposure factor (unitless)
CF = conversion factor (10^{-6} kg/mg)
BW = body weight (kg)

The exposure factor is an expression of how often and how long a person may contact a substance in the environment. The exposure factor is calculated with the following general equation:

$$EF = \frac{F \times ED}{AT}$$

Where:

F = frequency of exposure (days/year)
ED = exposure duration (years) = 33-year residency [ATSDR 2016b]
AT = averaging time (ED x 365 days/year)

For exposures to trespassers on the site, it was assumed that people may trespass on the site 1 day per week throughout the entire year. Assuming 52.14 weeks are in a year [ATSDR 2016b] and using the above equation, this gives an exposure factor of 0.14 for on-site exposures.

For off-site exposures to residents living near the site, it was assumed that residents may be exposed every day of the year. Using the above equation, this gives an exposure factor of 1 for off-site exposures.

Note: For this assessment, the following values were used to estimate soil and sediment ingestion doses.

Age Range	95th percentile soil/sediment ingestion rate (mg/day)	Body Weight (kg)
1 to <2 years	200	11.4
2 to <6 years	200	17.4
6 to <11 years	200	31.8
11 to <16 years	200	56.8
16 to <21 years	200	71.6
21+ years	100	80.0

Notes: mg/day = milligrams of soil per day
kg = kilograms

Dermal (skin) contact with contaminants in soil and sediment

Exposure doses for dermal contact with contaminants in soil and sediment are calculated using the maximum concentrations of contaminants in milligram per kilogram (mg/kg). The following equation is used to estimate the exposure doses resulting from dermal contact with contaminated soil and sediment [ATSDR 2016d]:

$$DAD_s = \frac{C \times CF \times AF \times ABS_d \times EF \times SA}{BW}$$

Where:

DAD_s = dermal absorbed dose soil or sediment (mg/kg/day)
C = contaminant concentration (mg/kg)
CF = conversion factor (10^{-6} kg/mg)
AF = adherence factor of soil or sediment to skin (mg/cm^2/event)
ABS_d = dermal absorption factor (unitless)
EF = exposure factor (unitless)
SA = skin surface area (cm^2)
BW = body weight (kg)

The exposure factor is an expression of how often and how long a person may contact a substance in the environment. The same on-site and off-site exposure factor equations and values were used for dermal contact as were used for ingestion (see above).

Note: For this assessment, the following values were used to estimate dermal absorbed doses. The skin surface area used for children (<21 years old) includes the face, forearms, hands, lower legs and feet, assuming children are wearing short-sleeved shirts, shorts and no shoes. The skin surface area used for adults (≥21 years old) includes the face, forearms, hands and lower legs, assuming adults are wearing short-sleeved shirts, shorts and shoes.

Age Range	Adherence factor (mg/cm^2/event)	Skin surface area (cm^2)	Body Weight (kg)	ABS_d (PAHs)	ABS_d (Arsenic)
1 to <2 years	0.2	1719	11.4	0.13	0.03
2 to <6 years	0.2	2202	17.4		
6 to <11 years	0.2	3384	31.8		
11 to <16 years	0.2	4967	56.8		
16 to <21 years	0.2	5583	71.6		
21+ years	0.07	5197	80.0		

Notes: mg/cm^2/event = milligrams of contaminant per square centimeter of skin per contact event with soil or sediment
cm^2 = square centimeters of skin available for contact with soil or sediment
kg = kilograms
PAHs = polycyclic aromatic hydrocarbons
ABS_d = dermal absorption factor

Incidental ingestion of contaminants in surface water

Exposure doses for ingestion of contaminants in surface water are calculated using the maximum concentrations of contaminants in micrograms per liter (µg/L). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated surface water:

$$ED_{sw} = \frac{C \times IR \times ET \times EF \times CF}{BW}$$

Where:

ED_{sw} = exposure dose surface water (mg/kg/day)
C = contaminant concentration (µg/L)
IR = intake rate of contaminated surface water (L/hour)
ET = exposure time (hours/day)
EF = exposure factor (unitless)
CF = conversion factor (10^{-3} mg/µg)
BW = body weight (kg)

The exposure factor is an expression of how often and how long a person may contact a substance in the environment. The same exposure factor equation was used for surface water as was used for soil and sediment ingestion (see above).

The following derivation and value were used for the exposure factor for incidental ingestion of surface water by nearby residents and trespassers on the site:

$$F = \frac{1\ day}{week} \times \frac{4.33\ weeks}{month} \times \frac{7\ months}{year} = \frac{30.31\ days}{year}$$

$$EF = \frac{\frac{30.31\ days}{year} \times 33\ \text{years}}{33\ years\ x \frac{365\ days}{year}} = 0.083$$

Note: For this assessment, the following values were used to estimate surface water ingestion doses.

Age Range	Reasonable Maximum Surface Water Ingestion Rate (L/hour)*	Body Weight (kg)	Exposure Time (hours/day)
1 to <2 years	0.12	11.4	1
2 to <6 years	0.12	17.4	
6 to <11 years	0.12	31.8	
11 to <16 years	0.12	56.8	
16 to <21 years	0.12	71.6	
21+ years	0.071	80.0	

Notes: L/hour = liters of water per hour
kg = kilograms
*Reasonable maximum ingestion rates are 97th percentile rates for children (<21 years old) and maximum rates for adults (≥21 years old)

Ingestion of contaminants in fish

Exposure doses for ingestion of contaminants in fish are calculated using the average concentrations of contaminants in milligram per kilogram (mg/kg) per species reported on a wet weight basis. The following equation is used to estimate the exposure doses resulting from ingestion of contaminated fish:

$$ED_f = \frac{C \times IR \times LF \times EF}{BW}$$

Where:

ED_f = exposure dose fish (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated fish (kg/day)
LF = loss factor due to trimming and cooking (only pertains to organic compounds)
EF = exposure factor (unitless)
BW = body weight (kg)

The exposure factor is an expression of how often and how long a person may contact a substance in the environment. The same exposure factor equation was used for fish consumption as was used for soil and sediment ingestion (see above). However, for fish consumption a 78-year lifetime was used for the exposure duration.

The average size of a meal of fish is 0.17 kg or 6 ounces [DPH 2017]. This average meal size was used to come up with meal frequencies and recommendations for this assessment. Based on this meal size and intake rates listed below, recreational fishers are assumed to eat 0.17 kg (6 ounces) of fish per meal and approximately 3 meals per month. Subsistence fishers are assumed to eat 0.17 kg (6 ounces) of fish per meal and one meal per day.

Note: For this assessment, the following exposure parameters were used for people eating fish:

Exposure Parameter	Value	Source
Body Weight (kg)	80	ATSDR 2016a
Subsistence Fisher Intake Rate (kg/day)	0.17	EPA 2000
Recreational Fisher Intake Rate (kg/day)	0.0175	EPA 2000
Exposure Factor	1	Based on daily consumption for a 78-year lifetime
Loss Factor due to Trimming & Cooking (Organics Only)	50%	DPH 2017
Fish Consumption Advisory Acceptable Lifetime Cancer Risk Level	1 in 10,000	DPH 2017
Exposure Duration (years)	78	DPH 2017

Notes: kg = kilogram
kg/day = kilograms of fish per day

Cancer Health Effects Evaluation

Theoretical increased numbers of cancers are calculated for known or suspected cancer-causing contaminants using the estimated site-specific exposure dose and cancer slope factor (CSF) provided in ATSDR health guideline documents. DPH evaluates cancer health effects in terms of possible increased cancer risk over background levels. In North Carolina, approximately 30% of women and 50% of men (about 40% combined), will be diagnosed with cancer in their lifetime from a variety of causes. This is referred to as the "background cancer risk." The term "excess cancer risk" represents the risk on top of the background cancer risk. A "one-in-a-million" excess cancer risk (1/1,000,000 or 10^{-6} cancer risk) means that if 1,000,000 people are exposed to the cancer-causing substance at a certain level every day of their lifetime (considered 78 years), then one cancer above the background number of cancers may develop in those 1 million people. In numerical terms, the background number of cancers expected in 1 million people over their life-time is 40% or 400,000. If they are all exposed to the cancer-causing substance daily throughout their life-time, then 400,001 people may get cancer, instead of the expected 400,000. The expression of the estimated cancer risk is not a prediction that cancer will occur, it represents the upper bound estimate of the probability of additional cancers, and merely suggests that there is a possibility. The actual risk may be much lower, or even no risk.

The estimated cancer risk calculation is:

$$\text{Estimated Cancer Risk} = \text{Dose} \times \text{CSF} \times (\text{ED}/\text{AT})$$

Where:

Estimated Cancer Risk = expression of the cancer risk (unitless)
Dose = site-specific dose of carcinogen (mg/kg/day)
CSF = cancer slope factor ($[\text{mg/kg/day}]^{-1}$), a measure of cancer potency
ED = exposure duration (years)
AT = averaging time, for cancer risk estimates this is 78 years [ATSDR 2016b]

This increased cancer risk estimate does not equal the increased number of cancer cases that will occur in the exposed population, but estimates an excess cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a lifetime or other selected period of exposure.

For specific exposure situations DPH may use exposure periods of less than a lifetime to provide a more realistic estimation of the risks that are known or predicted to have occurred for a particular area. If information on the specifics of the exposure situations at a site are not known, then DPH will always use health protective values to estimate the maximum level of risk that we believe to be realistic.

For on-site soil, sediment and surface water exposure to trespassers on the Holcomb Creosote Company NPL site, child cancer risk (age 6 to 21 years) and adult cancer risk (age 21 years and older) were evaluated separately. For off-site soil, sediment and surface water exposure to residents living near the Holcomb Creosote Company NPL site, child cancer risk (age 1 to 21 years) and adult cancer risk (age 21 years and older) were evaluated separately. Child and adult cancer risks were evaluated separately because people are not expected to remain in the area from childhood through adulthood. For adults, a 33-year residency was used to calculate cancer risk based on ATSDR guidelines [ATSDR 2016b].

For soil and sediment exposure, increased cancer risk was calculated separately for ingestion and dermal exposure and then added together to derive the combined increased cancer risk. For exposure to contaminants through eating fish, a 78-year lifetime was used to calculate cancer risk based on DPH guidance [DPH 2017]. The EPA Integrated Risk Information System (IRIS) cancer slop factor (1.5 $[mg/kg/day]^{-1}$) for inorganic arsenic was used to estimate the increased cancer risk from exposure to arsenic.

Polycyclic Aromatic Hydrocarbons (PAHs)

Benzo(a)pyrene (BaP) is the most studied of the individual PAH compounds and is thought to be the most toxic. To evaluate potential cancer risk associated with exposure to PAHs, the concentrations of individual detected PAH compounds are converted to an equivalent BaP concentration. These are then summed to provide a "BaP-equivalent" concentration for all detected PAHs. BaP-equivalent exposure doses are calculated by multiplying the concentration of individual detected PAH compounds by their toxicity equivalency factor (TEF), a value that relates the relative toxicity of the individual PAH compounds to the toxicity of BaP. The California Environmental Protection Agency has derived a cancer slope factor (4.1 $[mg/kg/day]^{-1}$) for the PAH compound dibenzo(a,h)anthracene. Because this value is available, dibenzo(a,h)anthracene is evaluated separately from other PAHs in this assessment. Due to similarities in the toxicity of PAHs, estimated increased cancer risks from exposure to PAHs, including dibenzo(a,h)anthracene, were summed for on-site and off-site exposures to all media (surface soil, sediment and surface water).

For this assessment, DPH used TEF values derived by California Environmental Protection Agency and supplemented these with DPH TEF values when necessary [CalEPA 2015, DPH 2017]. Below is a table of TEF values used by N.C. DPH to calculate BaP-equivalent concentrations. An estimated BaP-equivalent exposure dose is calculated using media-specific

exposure parameters. Estimated numbers of increased cancers for the combined PAH exposure are calculated by multiplying the EPA IRIS BaP cancer slope factor (1.0 $[mg/kg/day]^{-1}$) by the BaP-equivalent exposure dose.

$$PAH_{BaP\text{-}eq} = PAH_{conc} \times TEF$$

$$\text{Cancer Risk}_{PAHs} = \text{Dose}_{\Sigma BaP\text{-}eq} \times CSF_{BaP}$$

Where:

$PAH_{BaP\text{-}eq}$	= benzo(a)pyrene equivalent PAH compound concentration, mg/kg
PAH_{conc}	= concentration of individual PAH compound, mg/kg
TEF	= toxicity equivalency factor for PAH compound, unitless
$\text{Cancer Risk}_{PAHs}$	= estimated cancer risk from all PAH compounds
$\text{Dose}_{\Sigma BaP\text{-}eq}$	= estimated dose calculated using summed BaP-equivalent PAH concentrations, mg/kg/day
CSF_{BaP}	= benzo(a)pyrene cancer slope factor ($[mg/kg/day]^{-1}$)

PAHs, including dibenzo(a,h)anthracene, are identified as mutagenic carcinogens. For mutagenic carcinogens, age-dependent adjustment factors (ADAFs) are applied to account for infants and children's increased susceptibility to these types of effects. EPA's recommended ADAFs are 10 for children 0 to < 2 years, 3 for children 2 to < 16 years, and 1 for children and adults 16 and older [EPA 2005].

Note: For the cancer risk assessment of PAHs the following toxicity equivalency factor (TEF) values were used. Because dibenzo(a,h)anthracene has a separate cancer slope factor, it is evaluated separately from the other PAHs.

PAH Compound	TEF Value
Benzo(a)anthracene	0.1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Indeno (1,2,3-cd) pyrene	0.1
Acenaphthene	0.001
Acenaphthylene	0.001
Anthracene	0.01
Chrysene	0.01
Fluoranthene	0.001
Fluorene	0.001
2-Methylnaphthalene	0.001
Naphthalene	0.001
Phenanthrene	0.001
Pyrene	0.001
Benzo(g,h,i)perylene	0.01

Sources: CalEPA 2015
Law 2002
Notes: PAH = polycyclic aromatic hydrocarbon
TEF = toxicity equivalency factor

Appendix G

Health Effects of Selected Contaminants

Health Effects of Selected Contaminants

Creosote (PAHs)

Creosote is a mixture of hundreds to thousands of chemicals extracted at high temperatures from beechwood, the creosote bush, or coal. The major chemicals in creosote used for wood treatment are polycyclic aromatic hydrocarbons (PAHs), cresols, and phenols. In the past, wood creosote was used as a disinfectant, a laxative, and a cough treatment [ATSDR 2002b].

Eating food or drinking water contaminated with high levels of creosote may cause a burning in the mouth and throat, and stomach pains. Brief direct contact with large amounts of coal tar creosote may result in a rash or severe irritation of the skin, chemical burns on the surfaces of the eyes, convulsions and mental confusion, kidney or liver problems, unconsciousness, and even death. Longer direct skin contact with low levels of creosote mixtures or their vapors can result in increased light sensitivity, damage to the cornea, and skin damage. Longer exposure to creosote vapors can cause irritation of the respiratory tract [ATSDR 2002a]. People taking large amounts of an herbal supplement containing creosote to treat gastrointestinal problems reported altered taste and drowsiness [ATSDR 2009].

Children exposed to creosote are likely to experience the same health effects as adults exposed to creosote. Children who played on soil contaminated with creosote had more skin rashes than children who played in uncontaminated areas. Studies in animals have shown birth defects in the young of mothers exposed to high levels of creosote during pregnancy, but it is not known whether the same effects would occur in humans. Some animal studies indicate that creosote may cross the placenta and reach the fetus. Because chemical components (PAHs, cresol, phenols) of coal tar creosote may be stored in body fat, they may be found in breast milk and could be passed to nursing infants [ATSDR 2002a].

Long-term exposure to low levels of creosote, especially direct contact with the skin during wood treatment or manufacture of coal tar creosote-treated products, has resulted in skin cancer and cancer of the scrotum. Animal studies have also shown skin cancer from skin exposure to coal tar products. The International Agency for Research on Cancer (IARC) has determined that creosote is probably carcinogenic to humans. The U.S. Environmental Protection Agency (EPA) has determined that coal tar creosote is a probable human carcinogen [ATSDR 2002a].

Aluminum

Animal studies show that the nervous system is a sensitive target of aluminum toxicity. Obvious signs of damage were not seen in animals after high oral doses of aluminum. However, the animals did not perform as well in tests that measured the strength of their grip or how much they moved around. Persons that store large amounts of aluminum in their bodies (as may occur with kidney disease) sometimes develop bone or brain diseases. It is not certain this is caused by the aluminum storage. Some studies show that people exposed to high levels of aluminum may develop Alzheimer's disease, but other studies have not found this to be true. It is not known for certain whether aluminum causes Alzheimer's disease. It is not known if aluminum will affect reproduction in people. Aluminum does not appear to affect fertility in animals [ATSDR 2008].

Children with kidney problems who were given aluminum in their medical treatments developed bone diseases. It does not appear that children are more sensitive to aluminum than adults. Birth defects have not been seen in animals exposed to high amounts of aluminum. It is not known if aluminum will cause birth defects in people. Aluminum in large amounts has been shown to be harmful to unborn and developing animals by delaying skeletal and neurological development. Aluminum is found in breast milk, but only a small amount enters the infant's body through breastfeeding. The carcinogenicity of aluminum to humans has not been classified, but it has not been shown to cause cancer in animals. Aluminum is poorly absorbed in humans following oral (<1%) exposure. Aluminum does not bioaccumulate in plants [ATSDR 2008].

Arsenic

Arsenic is a naturally occurring element found in the Earth's crust. In the environment, it is usually in the form of inorganic arsenic as it is found combined with other elements, such as oxygen or chlorine. Inorganic arsenic occurs naturally in minerals and ores. When this ore is heated at smelters, inorganic arsenic is released into the air. Additionally, arsenic has been used in wood-treating and pesticides. Fish and shellfish can take up arsenic, which can build up in fish tissue [ATSDR 2007a].

Ingestion of inorganic arsenic can lead to irritation of the stomach and intestines, including nausea, vomiting, and diarrhea. Oral exposure to inorganic arsenic may also lead to blood changes, which can cause fatigue, abnormal heart rhythm, and bruising. Long-term exposure to inorganic arsenic commonly leads to patches of darkened skin and warts on the palms, soles, and torso. Breathing high levels of inorganic arsenic can lead to a sore throat, irritated lungs, and skin changes similar to oral exposure. Children exposed to inorganic arsenic will likely have the same health effects as adults. Additionally, children exposed to inorganic arsenic over a long period of time may have lower IQ scores. Studies in animals show that organic arsenic compounds are less toxic than inorganic arsenic compounds [ATSDR 2007a].

Ingestion of inorganic arsenic can increase the risk of skin cancer, in addition to liver, bladder, and lung cancer. The U.S. Department of Health and Human Services (DHHS), IARC, and the EPA have determined that inorganic arsenic is a known human carcinogen [ATSDR 2007b].

Hexavalent Chromium

Chromium is a naturally occurring element found in rocks, animals, plants and soil, where it exists in combination with other elements to form various compounds. Chromium can be found in air, soil, and water following release from manufacturing plants or burning of natural gas, oil, or coal. The main forms of chromium are: chromium (0), trivalent chromium (III), and hexavalent chromium (VI). Chromium (III) is an essential nutrient. Exposure to higher than normal levels of chromium may result in increased chromium levels in blood, urine, expired air, hair, and nails. Generally, hexavalent chromium is the more toxic form [ATSDR 2012a].

The most sensitive targets of hexavalent chromium after ingestion are the gastrointestinal tract (effects include irritation or damage to the stomach and small intestine) and male reproductive system and sperm damage. We do not know if children are more susceptible to health effects from chromium than adults. We do not know if exposure to chromium will result in birth defects or other developmental effects in people. Some developmental effects, such as low birth weight

and changes in development of the skeleton and reproductive system, have been observed in animals exposed to hexavalent chromium [ATSDR 2012a].

The U.S. DHHS, IARC, and the EPA have determined that hexavalent chromium is a known human carcinogen. An increase in stomach tumors was observed in humans and animals exposed to hexavalent chromium in drinking water [ATSDR 2012b].

Appendix H

N.C. DPH Statewide Fish Advisory for Mercury

What fish are safe to eat?

From the North Carolina Division of Public Health

Most fish are good to eat and good for you - high in protein and other nutrients, and low in fat. But some kinds of fish contain high amounts of mercury, which can cause health problems in people, especially children. To help you make the healthiest choices, North Carolina offers the following advice. For more information, see www.epi.state.nc.us/epi/fish/ or call (919)707-5900.

Avoid or limit fish consumption based on the following:	
Women of childbearing age (15 to 44 years), pregnant women, nursing mothers and children under age 15	**All other people**
Do not eat fish from the HIGH in mercury list.	Eat only 1 meal of fish per week from the HIGH in mercury list.
Eat up to 2 meals per week of fish from the LOW in mercury list.	Eat up to 4 meals of fish per week from the LOW in mercury list.

Eat Fish **LOW** in mercury

Ocean Fish		Freshwater Fish
Black drum	Pollock	Bluegill sunfish
Canned light tuna	Pompano	Farm-raised catfish
Cod	Red drum	Farm-raised trout
Crab	Salmon (canned, fresh or frozen)	Farm-raised crayfish
Croaker	Scallops	Tilapia
Flounder	Sheepshead	Trout
Haddock	Shrimp	
Halibut	Skate	
Herring	Southern kingfish (sea mullet)	
Jacksmelt	Spot	
Lobster	Speckled trout (spotted sea trout)	
Mahi-mahi	Tripletail	
Ocean perch	Whitefish	
Oysters	White grunt	

Avoid Fish **HIGH** in mercury

Ocean Fish		Freshwater Fish
Albacore (white) tuna** fresh or canned	Little tunny	Blackfish (bowfin)*
Almaco jack	Marlin	Black crappie***
Banded rudderfish	Orange roughy	Catfish (caught wild)*
Cobia	Shark	Jack fish (chain pickerel)*
Crevalle jack	Spanish mackerel	Largemouth bass (statewide)
Greater amberjack	Swordfish	Walleye in Lake Fontana & Lake Santeetlah (Graham & Swain counties)
South Atlantic grouper (gag, scamp, red and snowy)	Tilefish	Warmouth*
King mackerel	Tuna, fresh or frozen**	Yellow perch*
Ladyfish		

*High mercury levels have been found in blackfish (bowfish), catfish, jack fish (chain pickerel), warmouth, and yellow perch caught south and east of Interstate 85.

**Different species from canned light tuna

***High mercury levels have been found in black crappie caught south and east of Interstate 95.

Spanish version: "¿Cuáles pescados son seguros para comer?"

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