



United States Environmental Protection Agency
Office of Enforcement and Compliance Assurance
Office of Criminal Enforcement, Forensics and Training

National Enforcement Investigations Center

NEICVP1417X01

Toxicology Report: Easton Point Fuel Station

NEIC Project: Easton Point VP1417

July 8, 2021

Prepared by:

Keteles, Kristen Digitally signed by Keteles, Kristen
Date: 2021.07.08 09:12:28 -06'00'

Kristen Keteles, Ph.D., Toxicologist

Prepared for:

U.S. Environmental Protection Agency, Region III
Enforcement and Compliance Assurance Division
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
P.O. Box 25227
Building 25, Denver Federal Center
Denver, Colorado 80225

NEIC

CONTENTS

QUALIFICATIONS AND PROFESSIONAL BACKGROUND 3
SUMMARY OF OPINION 4
 TOXICITY OF GASOLINE AND DIESEL 4
 FATE AND TRANSPORT OF GASOLINE AND DIESEL IN THE ENVIRONMENT 5
 EXPOSURE PATHWAYS 5
 EVALUATION OF EASTON POINT FUEL STATION 7
 COMBINED RISKS FOR EASTON POINT FUEL STATION 11
 CONCLUSION 11
REFERENCES 13
APPENDIX A: CURRICULUM VITAE 14

TABLES

Table 1. EJSCREEN 2010 CENSUS SUMMARY REPORT FOR 0.25-MILE RADIUS FROM EASTON
 POINT FUEL STATION 9
Table 2. HUMAN AND ECOLOGICAL EXPOSURE POTENTIAL EVALUATION 12

FIGURES

Figure 1. Conceptual site model showing exposure pathways from a potential release at the
 Easton Point Facility 6
Figure 2. Conceptual site model showing exposure pathways from a potential release at the
 Easton Point Facility 7
Figure 3. EPA EJSCREEN map showing ¼-mile radius around Easton Point Fuel Station 10

APPENDIX

A Curriculum Vitae: Kristen A. Keteles, Ph.D.

QUALIFICATIONS AND PROFESSIONAL BACKGROUND

I, Kristen Keteles, am employed as a toxicologist by the U.S. Environmental Protection Agency (EPA), Office of Enforcement and Compliance Assistance, National Enforcement Investigations Center (NEIC), where I routinely write expert opinion reports and testify on the potential for harm from chemical releases to human health and environment in both civil and criminal litigation. I also serve as the chair of EPA's Risk Assessment Forum Human Health Oversight Committee, a committee of senior EPA scientists tasked with developing Agency-wide guidelines and methods in support of Agency decision-making pertaining to human health risk assessment. I have worked for EPA for more than 12 years, including 7 years as a regional toxicologist/risk assessor, routinely conducting both human health and ecological risk assessments at Superfund hazardous waste sites. I also regularly provide technical expertise to EPA Region 8 and the National Emergency Response and Removal programs regarding threats posed to public health and the environment from spills and releases. Prior to working for EPA, I worked for the National Park Service (NPS), managing natural resource condition assessments to determine risk from threats to NPS resources. Before working for NPS, I was an assistant professor of biology at the University of Central Arkansas, Conway, Arkansas, where I managed a research program assessing the effects of toxic metals in the environment.

I have a Ph.D. from Louisiana State University, Baton Rouge, Louisiana, in zoology and physiology with an emphasis in environmental toxicology. As part of my graduate work, I examined the fate and effects of contaminants in an estuarine food chain. I also have a B.S. in marine science from Coastal Carolina University, Conway, South Carolina. Before beginning my Ph.D. work, I was a senior research associate at the Dartmouth College Superfund Basic Research Program in Hanover, New Hampshire, where I investigated environmental factors that influence the fate and effects of toxic metals in the environment.

My curriculum vitae is included as Appendix A. It includes a list of publications authored by me and a list of all cases in which I have testified as an expert witness.

SUMMARY OF OPINION

This report discusses my opinion regarding an actual or potential harm to human health and the environment from a potential petroleum release from underground storage tanks (USTs) at the Easton Point Fuel Station (the Facility) located at 930 Port Street, Easton, Maryland. I considered the toxicity of the diesel and gasoline fuels stored at the Facility and the receptors in the vicinity of the Facility to determine the potential for human and ecological exposure from a potential or actual release from the Facility. Diesel and gasoline are a complex mixture of petroleum hydrocarbons and fuel additives that are toxic to humans and ecological receptors, and, therefore, exposure could result in harm to human health and the environment. In my evaluation, I considered exposures to residents, recreators, and commercial fisherman, as well as ecological receptors such as birds, fish, and shellfish. A petroleum leak from the Easton Point Facility would likely contaminate groundwater and nearby surface water, the Tred Avon River, which is part of the Chesapeake Bay watershed. Although there is not a high reliance on groundwater for drinking water in the vicinity of the Facility, contamination of the Tred Avon River could likely result in exposure to recreators and commercial fisherman. Furthermore, a petroleum release to the Tred Avon River would be detrimental to the ecology of the Tred Avon River, which is a critical habitat for fish, birds, and shellfish.

TOXICITY OF GASOLINE AND DIESEL

Gasoline and diesel are complex mixtures of hydrocarbons and, therefore, the toxicity is based upon the toxicity of the individual components, especially the aromatic compounds such as benzene, toluene, ethylbenzene, and xylene (collectively referred to as BTEX) and additives.

Exposure to gasoline or diesel vapors through inhalation can result in lung irritation and effects on the nervous system such as dizziness, headaches, tremor, memory loss, confusion, and drowsiness. Ingestion of gasoline in contaminated drinking water can also result in effects on the nervous system (Agency for Toxic Substances and Disease Registry [ATSDR] 2007). Benzene, a component of gasoline and diesel, is a known carcinogen based on sufficient evidence from both animal and human studies (EPA 1998). Benzene primarily affects the blood-forming system, the bone marrow. Therefore, harm to blood cells and the immune system often occurs following exposure to benzene because of damage to bone marrow. Additionally, exposure to benzene results in increased risk of leukemia, predominantly acute nonlymphocytic leukemia, an aggressive and malignant cancer that causes too many immature white blood cells to be produced (ATSDR 2007).

Petroleum hydrocarbons are acutely toxic to aquatic life, and toxicity is dependent upon the water solubility of the individual constituents of the product (National Research Council [NRC] 2003). Gasoline and diesel are highly toxic to aquatic life because of the large amounts of water-soluble BTEX. Additionally, polycyclic aromatic hydrocarbons (PAHs), which tend to adsorb to sediments, can impact benthic organisms and result in uptake through the food chain. Furthermore, chronic, low levels of exposure to petroleum hydrocarbons can result

sublethal effects such as behavioral impairment, effects on reproduction and development, and physiological effects that could have long-term effects on population levels.

FATE AND TRANSPORT OF GASOLINE AND DIESEL IN THE ENVIRONMENT

The Easton Point Fuel Station has four USTs that store petrochemical fuel products such as gasoline and diesel fuel products (*RCRA Subtitle I Inspection Report, UST Compliance Inspection Easton Point*, June 13, 2018). Diesel and gasoline are complex mixtures of hydrocarbons and fuel additives, and exposure potentials are based on the environmental fate of the individual components of the complex mixtures of hydrocarbons and fuel additives, particularly n-alkanes, branched alkanes, naphthalenes, monoaromatics (e.g., benzene), and PAHs (ATSDR 1995). The actual composition depends upon the source of the crude oil used to make the fuel product as well as additives from the manufacture that vary with the time of year. The transport and dispersion of diesel and gasoline are dependent on the water solubility and volatility of the aliphatic and aromatic hydrocarbon fractions. Lower-molecular-weight hydrocarbons may volatilize relatively quickly from both water and soil, while larger aliphatics (greater than C9 chain length) and PAHs may be adsorbed to organic matter in water or soil. Aromatic hydrocarbons such as benzene will be dissolved in the aqueous phase in both soil and water and may undergo volatilization. Once dissolved into groundwater, chemicals from diesel and gasoline can migrate as groundwater flows and be transported to surface water. Volatile organic compounds (VOCs) can vaporize and migrate from groundwater into overlying buildings or can be transported along or through buried utility lines such as gas, sewer, electric, cable, or phone lines.

EXPOSURE PATHWAYS

Risk assessors identify pathways or mechanisms by which people or ecological organisms may be exposed to chemicals at or originating from a site (EPA 1989, EPA 1997). An exposure pathway is the link between environmental releases and how people or organisms might come into contact with, or be exposed to, environmental contaminants (EPA 2019). Gasoline and diesel fuels from USTs can leak into groundwater. Aromatic hydrocarbons such as benzene will dissolve in water, and larger aliphatics and polycyclic aromatic hydrocarbons will adsorb to soil.

If groundwater serves as a drinking water source, people could be exposed to these chemicals from ingestion or through inhalation, from dermal exposure from bathing or showering with it, or from otherwise using it.

If surface water is contaminated due to discharge and flow from groundwater, exposure could occur from recreational use from dermal contact, inhalation of the volatile chemicals, or incidental ingestion during swimming. People could also be exposed to the chemicals from the consuming fish or shellfish that have been contaminated with chemicals from diesel and gasoline that accumulate in tissue, such as PAHs. Commercial fisherman could also be exposed through routes similar to recreational exposures.

CX 46 Page 5 of 23

Once in surface water, fish, shellfish, and birds could be exposed to the volatile organic compounds dissolved in water. Additionally, PAHs would bind to organic matter in sediments and expose the benthos or pelagic organisms through suspended sediment. Uptake by benthic organisms could also result in the contamination of the food chain, including predatory fish and birds.

A conceptual site model (CSM) is a visual representation that is often used to identify sources of contamination and exposure pathways to human or ecological receptors (EPA 2003). A CSM is often used to establish whether there is a likelihood of exposure from contamination at a site. The CSM for the Easton Point Facility includes the source of contamination (UST); mechanism of the potential release; contaminated media (groundwater, surface water, sediment, fish/shellfish); exposure route (dermal exposure, ingestion, inhalation); and human receptors (residents, commercial fisherman, recreators) (Figure 1). Ecological receptors were identified (fish, benthos, birds) (Figure 2). Ecological receptors could be exposed from uptake from water and sediment as well as through the food chain.

Human Health Conceptual Site Model for the Easton Point Facility

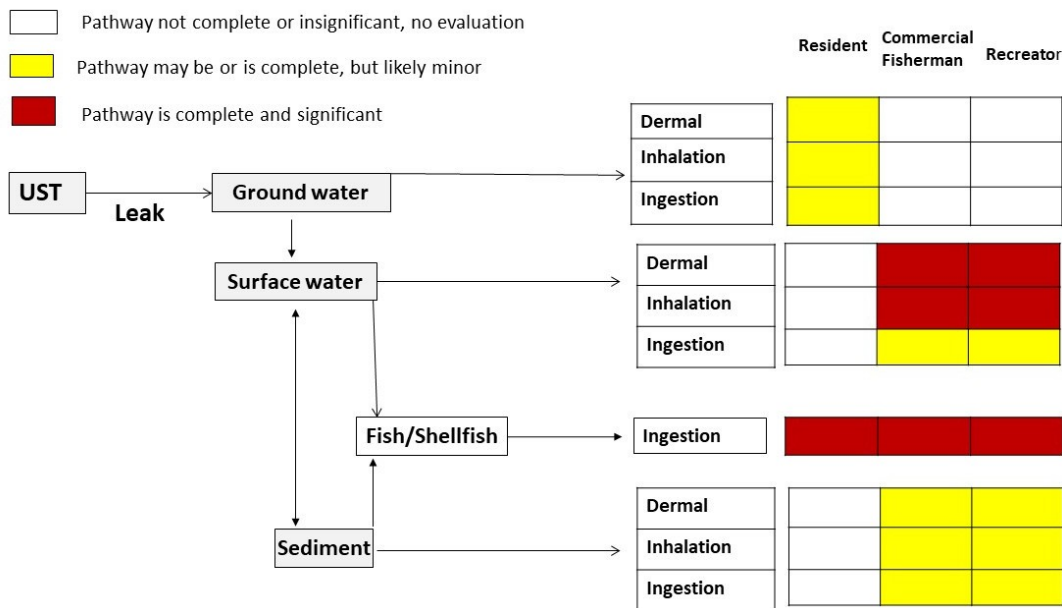


Figure 1. Conceptual site model showing exposure pathways from a potential release at the Easton Point Facility.

Ecological Conceptual Site Model for the Easton Point Facility

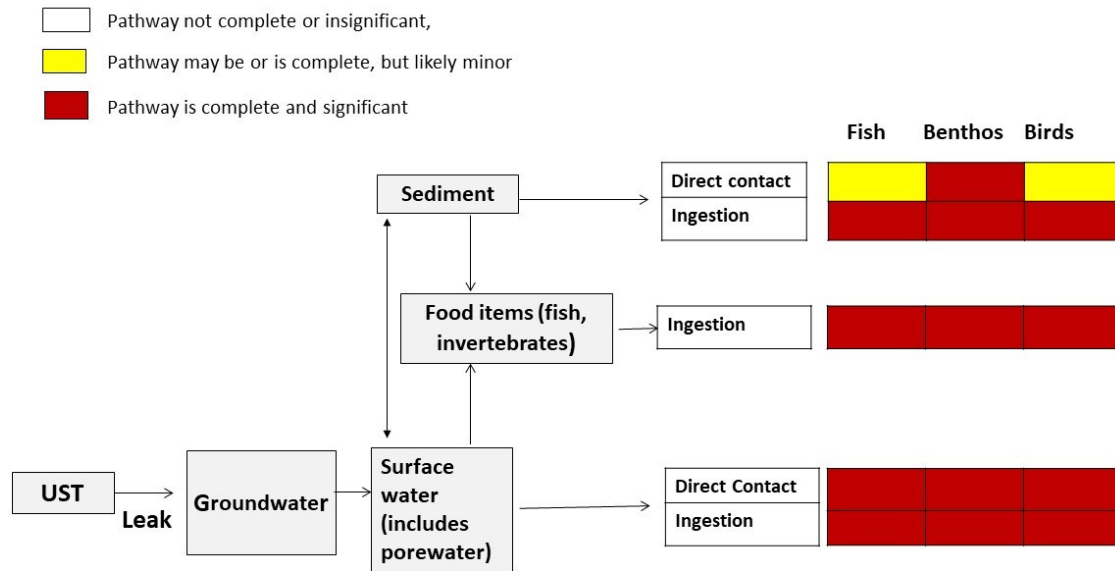


Figure 2. Conceptual site model showing exposure pathways from a potential release at the Easton Point Facility.

EVALUATION OF EASTON POINT FUEL STATION


This report represents my best professional judgment regarding the potential harm to human health and the environment in the local area from an actual or potential release of gasoline or diesel fuel from underground storage tanks at the Easton Point Fuel Facility. I considered human and ecological receptors within a certain radius (population harm factor) and the potential releases that could result in human or ecological exposure (exposure harm factor).

The population harm factor considers how many people are expected to be near the facility within a specific radius and considers the number of housing units that have wells. Homes within close proximity to the facility are given more weight, and homes that rely on groundwater as drinking water are also given more weight. The population harm factor is rated 1 to 5, with 1 representing almost no population and 5 representing a large population such as what would be found in highly urbanized areas with a high density of residential structures. Therefore, the population harm factor represents how many people are expected to be near a facility. According to the 2010 census, there are 102 people living within 0.25 mile of the Easton Point Fuel Station and 75 housing units (Table 1, Figure 3). Additionally, the number of housing units with drinking water wells is also considered in the rating. If no private wells exist within an area, the rating would be a value of 1 and if a high number of housing units (i.e., 75-100 percent) have wells, a 5 would be assigned. The *Report of Joel W. Hennessy of EPA Region III*, April 5, 2021 (Hennessy Report) determined that the census block within a ¼ mile radius of the Easton Point site does not have any housing units with wells. However, the Hennessy Report

found that a water supply well does exist within the census block. In the census block group adjacent to the Easton Point site, on the north, 2 percent of the housing units are on wells. A limited population resides in close proximity to the facility and has very few drinking water wells, so I rated the population harm factor for residents as a 2.


Given the significance of the Chesapeake Bay ecosystem, I also considered ecological populations as well as recreational use of surface water proximate to the Easton Point Fuel Station for the population harm factor. Easton Point is located at the head of the Tred Avon River, which is formed by the confluence of two streams, Tanyard Branch and Papermill Branch (McLaughlin et al. 2018). The Tred Avon River is a tributary of the Choptank River, which is part of the larger Chesapeake Bay estuary. The Chesapeake Bay and its tributaries provide critical habitat for many commercially important species such as oysters, blue crabs, and striped bass. In a survey conducted by the National Oceanic and Atmospheric Administration (NOAA) from 2015-2017, 24 different species of fish were identified in seine and trawl collections at eight sampling stations in the Tred Avon River (McLaughlin et al. 2018). Bay anchovies were the most prevalent species and are essential food sources for the commercially important striped bass, as well as bluefish, weakfish, and waterfowl. Other species collected during the survey of the Tred Avon River included spot, white perch, striped bass, hogchoker, weakfish, and Atlantic croaker. Additionally, the Tred Avon River was designated by the Maryland Department of Natural Resources as an oyster sanctuary (U.S. Army Corps of Engineers [USACE] 2016).

Table 1. EJSCREEN 2010 CENSUS SUMMARY REPORT FOR 0.25-MILE RADIUS FROM EASTON POINT FUEL STATION



EJSCREEN Census 2010 Summary Report

Location: User-specified point center at 38.768071, -76.093454
 Ring (buffer): 0.25-miles radius
 Description: Easton Point Fuel Station



Summary		Census 2010
Population		102
Population Density (per sq. mile)		587
People of Color Population		34
% People of Color Population		34%
Households		68
Housing Units		75
Land Area (sq. miles)		0.17
% Land Area		90%
Water Area (sq. miles)		0.02
% Water Area		10%

Population by Race	Number	Percent
Total	102	
Population Reporting One Race	99	97%
White	71	70%
Black	23	22%
American Indian	0	0%
Asian	3	3%
Pacific Islander	0	0%
Some Other Race	2	2%
Population Reporting Two or More Races	3	3%
Total Hispanic Population	7	7%
Total Non-Hispanic Population	95	93%
White Alone	68	66%
Black Alone	22	22%
American Indian Alone	0	0%
Non-Hispanic Asian Alone	3	3%
Pacific Islander Alone	0	0%
Other Race Alone	0	0%
Two or More Races Alone	2	2%

Population by Sex	Number	Percent
Male	45	44%
Female	57	56%

Population by Age	Number	Percent
Age 0-4	5	5%
Age 0-17	20	20%
Age 18+	82	80%
Age 65+	29	28%

Households by Tenure	Number	Percent
Total	68	
Owner Occupied	39	58%
Renter Occupied	29	42%

Data Note: Detail may not sum to totals due to rounding. Hispanic population can be of any race.
 Source: U.S. Census Bureau, Census 2010 Summary File 1.



Figure 3. EPA EJSCREEN map showing ¼-mile radius around Easton Point Fuel Station.

In addition to commercial fisheries, the Chesapeake Bay and its tributaries, including the Tred Avon River, support recreational fishing, boating, and waterfowl hunting. Recreational boaters and commercial fishermen utilize the Tred Avon River. In fact, approximately 714 boats are registered in the Tred Avon River (USACE 2016). I assigned a population harm factor of 3 for commercial fishing and recreational receptors.

Contamination of the Tred Avon River could result in toxicity to the estuarine life, including shellfish, fish, and waterfowl. Exposure to the contaminants from a potential petroleum release from the Easton Point Facility could harm important prey fish or result in the transfer of pollutants through the food chain and harm predatory fish and seabirds. Therefore, exposure from petroleum hydrocarbons could impair fish, bird, and shellfish populations near Easton Point. Considering the numerous ecological receptors in close proximity to the Facility, I assigned an ecological population harm factor of 5.

The exposure harm factor considers the likelihood that an exposure pathway to receptors exists. Groundwater that serves as a drinking water source would exhibit a high exposure potential. Additionally, the proximity to surface water would result in a high exposure potential to human and ecological receptors. Furthermore, the exposure of fish and shellfish to contaminants from the Easton Point Facility could result in human exposure through the food chain. Additionally, recreational and commercial fishing use of the Tred Avon River could result in exposure from inhalation of the volatile organic compounds or through skin contact or

incidental ingestion. This factor ranges from 1 to 5, with 5 representing a high exposure potential. I reviewed the Hennessy Report to evaluate this factor.

The Hennessy Report determined that there is a high likelihood that a release from the Easton Point Facility would contaminate groundwater. This finding was due to the fact that the depth to groundwater was less than 3 feet and the soil types ranged from clay to sand, with sand predominating at the water table. Furthermore, a past underground release of petroleum products from the McMahan Bulk Fuel Terminal line resulted in contamination of groundwater and the water supply (*Subsurface Investigation Report McMahan Bulk Fuel Terminal*, October 19, 2007). Additionally, the contamination migrated to the river, as evidenced by a visible sheen. The prior release from the McMahan Bulk Fuel Terminal underground line demonstrates a high likelihood of the contamination of groundwater and surface water from a release at the Easton Point Fuel Station. Although the groundwater near the Facility is not a significant drinking water source, previous contamination near the site indicates a high potential for contamination of groundwater and migration to the Tred Avon River. Given the potential exposure to ecological receptors and human recreators and commercial fisherman, I assigned an exposure harm factor of 5 for ecological receptors and an exposure harm factor of 4 for commercial fishing and recreational receptors. I assigned an exposure harm factor of 5 for residents due to likely contamination of shallow groundwater, as well as evidence of previous contamination from an underground line at the McMahan Bulk Fuel Terminal.

COMBINED RISKS FOR EASTON POINT FUEL STATION

Table 2 summarizes my findings discussed above and presents the combined exposure harm factor for human and ecological health obtained by averaging the population harm and exposure harm factors for each receptor. The average combined exposure harm factor for the human and ecological receptors is 4.

CONCLUSION

Petroleum products released from the Easton Point Fuel Station have a high potential to move in the environment and contaminate groundwater and surface water. Although the surrounding population does not have a high reliance on groundwater for drinking water, there is a high potential for contamination of surface water and exposure to ecological receptors, commercial fisherman, and recreators.

Table 2. HUMAN AND ECOLOGICAL EXPOSURE POTENTIAL EVALUATION					
Receptor	Population Evaluation	Population Harm Factor	Exposure Potential Evaluation	Exposure Harm Factor Potential	Combined factor
Residents	One water supply well, 2% of housing units have wells in adjacent census block	2	Shallow groundwater; evidence of previous contamination of groundwater from a previous underground release at an adjacent site	5	3.5
Recreators Commercial Fishers	High recreational use, commercial and recreational fishing, and boating	3	Evidence of previous contamination of surface water from previous underground release at an adjacent site	4	3.5
Ecological	Critical habitat for fish and oysters. Surveys reveal bay anchovy and silversides, important food sources of predatory fish and birds	5	Evidence of previous contamination of surface water from previous underground release at an adjacent site.	5	5
Average		3.33		4.66	4

REFERENCES

ATSDR. 2007. Toxicological Profile for Benzene. U.S. Public Health Service, U.S Department of Health and Human Services, Atlanta, GA.

ATSDR. 1995. Toxicological Profile for Gasoline. U.S. Public Health Service, U.S Department of Health and Human Services, Atlanta, GA.

EPA. 1989. Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual. EPA/540-1-89/001.

EPA. 1997. Ecological risk assessment guidance for superfund: Process for designing and conducting ecological risk assessments - Interim final [EPA Report]. Office of Solid Waste and Emergency Response. EPA/540/R-97/006.

EPA. 1998. Carcinogenic effects of benzene: an update. Prepared by the National Center for Environmental Health, Office of Research and Development. Washington, DC. EPA/600/P-97/001F.

EPA. 2003. Framework for Cumulative Risk Assessment. Office of Science Policy Risk Assessment Forum. EPA/630/P-02/001F.

EPA. 2019. Guidelines for Human Exposure Assessment. Office of Science Policy Risk Assessment Forum. Washington, D.C. EPA/100/B-19/001.

Report of Joel W. Hennessy. 2021. US EPA Region III.

McLaughlin, S.M., A.K. Leight, J.E. Spires, S.B. Bricker, J.M. Jacobs, G.A. Messick, and S. Skelley. 2018. Coastal Ecological Assessment to Support NOAA's Choptank River Complex Habitat Focus Area: Tred Avon River. NOAA Technical Memorandum NOS NCCOS 251. Oxford, MD. 118 pp. (<https://doi.org/10.25923/k2xr-5n27>)

National Research Council (US) Committee on Oil in the Sea: Inputs, Fates, and Effects. Oil in the Sea III: Inputs, Fates, and Effects. Washington (DC): National Academies Press (US); 2003. 5, Biological Effects of Oil Releases. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK220710/>

USACE, Baltimore District. 2016. Final Supplemental Environmental Assessment and Finding of No Significant Impact Oyster Restoration in the Tred Avon River Oyster Sanctuary, Maryland.

RCRA Subtitle I Inspection Report UST Compliance Inspection Easton Point. June 13, 2018. Prepared by Melissa Toffel, EPA Region 3.

Subsurface Investigation Report McMahan Bulk Fuel Terminal. October 19, 2007. Prepared by Miller Environmental.

APPENDIX A: CURRICULUM VITAE

KRISTEN A. KETELES, Ph.D.

Work Address

EPA National Enforcement Investigations Center
Denver Federal Center
PO Box 25227, Bldg 25, Rm 2A-215
Denver, CO 80225
303-462-9313
Keteles.Kristen@epa.gov

Education

Louisiana State University	2001	Ph.D. Biological Sciences, Zoology
Coastal Carolina University	1995	B.S. Marine Science

Field of Specialization and Areas of Interest

- Human Health and Ecological Risk Assessment
- Toxicogenomics (gene expression in response to chemicals)
- Environmental Forensics/Hazard Assessment
- Children's Environmental Health
- Pesticides
- Fate and Effects of Contaminants of Emerging Concern in the Environment

Professional Society Affiliation

Society of Toxicology
Society of Environmental Toxicology and Chemistry

Professional Experience

Senior Toxicologist, EPA National Enforcement Investigations Center (NEIC), 2016-Present

Duties: Provides technical assistance in the field of toxicology to support criminal investigations and prosecutions, including written reports and declarations, and expert witness testimony during trials and sentencings involving intentional poisonings and chemical exposures resulting from criminal negligence. Communicates potential risks from chemical exposure to juries and other lay audiences. Serves on national technical workgroups including the Risk Assessment Forum and the Science Support Panel. Reviews science policy documents and briefs the NEIC director on these documents. Remains active in the field of toxicology by planning and conducting research. Directs data collection and analysis related to risk assessment as well as advanced monitoring research and other studies. Determines risk from chemical exposures to law enforcement and first responders and establishes clearance levels. Serves as chair of the EPA Risk Assessment Forum Human Health Oversight Committee.

CX 46 Page 14 of 23

Toxicologist (National Technical Expert), EPA Region 8, Technical Assistance Unit and Pollution Prevention, Pesticides, and Toxics Unit, Denver CO, 2008-2016

Duties: Provided technical assistance regarding human health and ecological effects from exposure to pesticides, metals (including mercury), volatile organic compounds and other toxics to the public, state and local officials, and other federal agencies; Served as a technical expert on risks and effects of pesticides and toxics (PAHs, VOCs, PCBs, lead, mercury, asbestos); Conducted human health and ecological risk assessments at superfund sites; Assessed risk from exposure to chemicals from spills and releases during Emergency Response operations and established screening levels and clearance levels; Served as technical expert on workgroups to develop guidance and policies to protect human health and the environment from exposure to chemicals; Assisted with the training of pesticide applicators; Provided toxicological expertise to the Children's Environmental Health and Air Toxics Program; Served on the Air Toxics Risk Assessors workgroup and the Chemical Safety for Sustainability Implementation Team. Prepared briefings on technical issues for senior leadership; Conducted research on the effects of endocrine disrupting chemicals on aquatic life using toxicogenomic tools. Presented information at scientific and public meetings. Provided technical assistance in the field of toxicology to support criminal investigations and prosecutions.

Acting Deputy Director, EPA National Enforcement Investigations Center (NEIC), 2011

Duties: Provided management oversight and technical leadership to NEIC's Program Managers and Branch Chiefs to ensure that the overall goals to provide forensic science support to the enforcement community of EPA were achieved. Resolved differences in scientific opinion and developed a framework to address these differences.

Affiliate Faculty, Colorado Christian University, Lakewood CO, 2007-Present

Duties: Teaches Biology (general education), Environmental Science, and Human Genetics and Genomics.

Instructor, Miami University, Oxford OH, 2015-Present

Duties: Teaches online classes in the field of environmental science and conservation including, Biology in the Age of Technology, Primate Biology and Conservation, Great Lakes Ecosystem, and Environmental Stewardship Education.

Lecturer, University of Colorado Denver, Denver, CO, 2009-2011

Duties: Taught graduate course in Environmental Biology.

Coastal Watershed Condition Assessment Coordinator (Contaminants Specialist), National Park Service-Water Resources Division, Contractor with Texas A&M University, 2004-2008

Duties: Assessed threats to public health and natural resources within and adjacent to coastal National Parks; provided technical assistance regarding health effects and natural resource damage during chemical spill response and provided technical expertise for spill contingency planning in coastal National Parks. Coordinated projects working with multiple stakeholders to assess environmental impacts to National Park resources. Assured that projects were

CX 46 Page 15 of 23

completed on time and met the scope of work. Communicated the results of the assessments to Park managers.

Assistant Professor of Biology, University of Central Arkansas, Conway, AR, 2001-2004

Duties: Advised graduate students, maintained a research program in environmental toxicology, taught graduate and undergraduate courses (Environmental Toxicology, Health Effects from Environmental Contaminants, Environmental Science, and Introductory Biology).

Visiting Scientist, Federal Bureau of Investigation, Counter Terrorism Forensic Science Research Unit (FBI-CTFSRU) Quantico, VA, 2003.

Duties: Developed a Polymerase Chain Reaction (PCR) DNA-based method to detect biotreats (*Bacillus anthracis*) in environmental samples.

Adjunct Professor of Biology, River Parishes Community College, Sorrento, LA, 2001

Graduate Research Assistant, Louisiana State University, Baton Rouge, LA, 1999. Effects of PAH on trace metal bioaccumulation in the darter goby, *Gobionellus boleosoma*. Planned and conducted research.

Graduate Research Assistant, Louisiana State University Baton Rouge, LA, 1998. Hazardous Materials Research Center: Fate of PAH contaminants in the environment.

Senior Research Associate, Dartmouth College, Hanover, NH, 1996-1997. Superfund Basic Research Program: Bioaccumulation and biomagnification of toxic metals including mercury in lake foodwebs throughout the Northeastern Region of the U.S.A. Planned research activities, collected data, and briefed leadership including a congressional delegation on the findings of the research.

Workgroups Served On

National Toxicology Program Workgroup
Chemical Safety for Sustainability Implementation Team
Risk Assessment Forum Human Health Oversight Committee, Chair 2020
Science Technology Policy Council Science Support Panel
Air Toxics Risk Assessors
OLEM Human Health Regional Risk Assessors Forum

Presentations

Keteles, K.A. and A. R. Kadry. A Risk-Based Investigation on an Accidental Exposure of a Bison Herd to Chlorophacinone. Society of Toxicology, San Antonio, Texas, March 2018.

Keteles, K.A. Toxicology and Environmental Crimes: Answering, "So what?". Colorado Environmental Crimes Task Force, February 23, 2017.

K.A. Keteles, A.M. Vajda, D. Winkelman, J. Beihoffer, D. Ekman, D.L. Villeneuve, J.M. Lazorchak, A. Jastrow, T. Collette. Use of bioactivity tools to measure estrogenic mixtures below WWTPs

CX 46 Page 16 of 23

with differing treatment technologies. Society of Environmental Toxicology and Chemistry 36th Annual Meeting, Salt Lake City, UT, November 2015.

Dewoskin, R.S., G.L. Diamond, J. Brown, M.H. Follansbee, K.A. Keteles, C.R. Partridge. Predicting Blood Lead Following Short-Term Exposures Using the All Ages Lead Model (AALM), Society of Toxicology, Phoenix, AZ, March 2014.

Keteles, K.A. Schwindt, A.R., Winkelman, D.L., Vajda, A.M., Beihoffer, J. Bioindicators of exposure to Endocrine Active Chemicals, Rocky Mountain Society of Environmental Toxicology and Chemistry Denver, CO, April 2013.

Keteles, K.A. Science for EPA Region 8's Future (invited), National Academy of Sciences National Research Council Committee, Washington, DC, August 8, 2011.

Keteles, K.A. Children's special vulnerabilities to environmental exposures including prenatal and developmental windows of susceptibility, Improving Children's health through federal collaboration speaker series, November 10, 2010.

Keteles, K.A. EPA's response to the Deepwater Horizon Oil Spill, (Invited) America Water Resources Association, Denver CO, August 2010.

Keteles, K.A. Rethinking pristine: Contaminants of emerging concern in high elevation Lakes, Water Professionals Meeting, Fort Collins, CO, Feb 2010.

Keteles, K.A. Why children are not little adults: toxicology 101. Children's Environmental Health Summit, Missoula MT, August 11, 2009.

Keteles, K.A., E. Smith, T. Walter, and D.S. Johnson. Variation in cadmium bioavailability, Society of Environmental Toxicology and Chemistry 25th Annual Meeting, Portland, Oregon, November 2004.

Keteles, K.A., T. Walter, E. Smith, M. Schroeder. Invited Paper. The influence of water quality on trace metal bioavailability. Arkansas Water Resources Meeting, Fayetteville, AR, April 2004.

Keteles, K.A. The influence of nutrients on the toxicity of arsenate and arsenite. Society of Environmental Toxicology and Chemistry 24th Annual Meeting, Austin, Texas, November 2003.

Keteles, K.A. and J.W. Fleeger, The trophic transfer of exoskeleton-associated metals in crustacean prey (*Palaemonetes pugio*) to a fish predator (*Fundulus grandis*). Society of Environmental Toxicology and Chemistry 22nd Annual Meeting, Baltimore, MD, November 2001.
Keteles, K.A. and J.W. Fleeger. The effect of source of exposure on the uptake and partitioning of metals by *Palaemonetes pugio*. Society of Environmental Toxicology and Chemistry 21st Annual Meeting. Nashville, TN, November 2000.

CX 46 Page 17 of 23

Keteles, K.A. and J.W. Fleeger. Uptake and partitioning of metals by *Palaemonetes pugio*. Society of Environmental Toxicology and Chemistry 20th Annual Meeting, Philadelphia PA, November 1999.

Publications

Cavallin, J.E., W. A. Battaglin, J. Beihoffer, B. R. Blackwell, P. M. Bradley, A. R. Cole, D. R. Ekman, R. N. Hofer, J. Kinsey, K. Keteles, R. Weissinger, D. L. Winkelman, and D. L. Villeneuve. Effects-Based Monitoring of Bioactive Chemicals Discharged to the Colorado River before and after a Municipal Wastewater Treatment Plant Replacement. *Environmental Science & Technology* 2021 55 (2), 974-984.

Weissinger, R.H., B.R Blackwell, K.A. Keteles, W. A Battaglin, P.M. Bradley. (2018) Bioactive contaminants of emerging concern in National Park waters of the northern Colorado Plateau, USA. *Science of The Total Environment*. 636: 910–918

Ekman, D.R., K.A. Keteles, J. Beihoffer, J.E. Cavallin, K. Dahlin, J.M. Davis, A. Jastrow, J.M. Lazorchak, M. Mills, M. Murphy, D. Nguyen, A.M. Vajda, D. L. Villeneuve, D.L. Winkelman, and T.W. Collette. (2018) Use of Targeted and Untargeted Effects-based Monitoring Tools to Assess Impacts of Wastewater Effluents on Fish in the South Platte River, CO. *Environmental Pollution* 239: 706–713.

Bai, X, Lutz, A., Carroll, R. Keteles, K., Dahlin, K., Murphy, M., and Nguyen, D. (2018) Evaluating occurrence, distribution, and seasonality of pharmaceuticals and other emerging contaminants in urban watersheds. *Chemosphere*. 200: 133-142.

Jastrow, A., D. Gordon, K. Auger, E. Punska, K. Arcaro, K. Keteles, D. Winkelman, D. Lattier, A. Biales, J. Lazorchak. (2017) Tools to minimize inter-laboratory variability in vitellogenin gene expression monitoring programs. *Environmental Toxicology and Chemistry*. 36 (11), 3102-3107.

Schwindt, A.R., D. Winkelman, K.A. Keteles, M. Murphy, A. Vajda. (2014) An environmental estrogen disrupts fish population dynamics through direct and transgenerational effects on survival and fecundity. *Journal of Applied Ecology*. 51(3), 582-591.

U.S. EPA (Environmental Protection Agency). (Contributing Author) (2010) Integrating Ecological Assessment and Decision-Making at EPA: A Path Forward. Results of a Colloquium in Response to Science Advisory Board and National Research Council Recommendations. Risk Assessment Forum. Washington, DC. EPA/100/R-10/004.

Millward, R.N., Fleeger, J.W., Reible, D.D., Keteles, K.A., Cunningham, B.P. and Zhang, Li. (2001) Pyrene bioaccumulation, effects of pyrene exposure on particle size selection and fecal pyrene content in the oligochaete, *Limnodrilus hoffmeisteri* (Tubificidae, Oligochaeta). *Environmental Toxicology and Chemistry*. 20 (6), 1359–1366.

CX 46 Page 18 of 23

Keteles, K.A. (2001) Metal partitioning in *Palaemonetes pugio* and its role in depuration and trophic transfer. Dissertation, Louisiana State University, Baton Rouge, LA.

Keteles, K.A. and J.W. Fleeger (2001) Metal partitioning among tissues and exoskeleton of *Palaemonetes pugio* and its role in depuration and trophic transfer. *Marine Pollution Bulletin*. 42: 1397-1402.

Awards, Grants, and Fellowships

Gold Medal for Commendable Service (2018), Terminix Enforcement Criminal Team for Outstanding Support to the Terminix Criminal Enforcement Case.

EPA Science Achievement Award (2018), South Platte Endocrine Disruption Study Team, for engagement in a multi-year collaborative research project to advance scientific knowledge and analytic methods regarding the presence of estrogenic chemicals in public water ways.

Bronze Medal for Commendable Service (2017), Boasso America Criminal Case Team in recognition of the Boasso Enforcement Team's outstanding investigative efforts leading to the sentencing of Boasso and nine individual defendants totaling 343 months of incarceration.

Regional Applied Research Effort: "Using a biosensor tool to evaluate the safety of produced water for beneficial reuse during drought conditions in the west", 2017, \$98,440.

EPA Regional Applied Research Effort: "Application of 21st century bioanalytical tools to identify sources and effects of bioactive contaminants associated with select municipal wastewater discharges to the South Platte and Colorado River watersheds" 2017, \$134,000.

EPA Region 8 Office of Enforcement Compliance and Environmental Justice Certificate of Excellence (2016) for exemplary work to quickly resolve a significant pesticide misuse by securing a fast and effective remedy in the Meyers Ranch incident.

Science Achievement Award (2013) for outstanding achievement in cementing partnerships to bridge a critical gap in laboratory capacity with the development of a novel laboratory method for the expedited assessment of the viability of *Bacillus anthracis* from an environmental sample.

EPA Science Award (2012) for initiative and creativity in the use of novel molecular biology methods to detect endocrine active chemicals in the environment.

EPA Bronze Medal for Commendable Service (2011), Chemical Safety for Sustainability Research Program Development Team for design and development of the Chemical Safety for Sustainability Research Program Action plan, which embodies innovative, trans-disciplinary approaches for understanding chemicals and enhancing sustainability.

Regional Methods Initiative: "Development of a Whole Effluent Test for androgenticity and estrogenicity" 2009, \$180,000.

CX 46 Page 19 of 23

Office of Research and Development Pharmaceuticals in the Environment Workshop 2009, \$60,000.

Oak Ridge Institute for Science and Education Fellowship: Visiting Scientist Fellow at the Federal Bureau of Investigation Academy.

URC Faculty Research Grant: "Variation in the uptake of potentially toxic trace metals by aquatic organisms inhabiting agricultural vs. forested watersheds" 2002, \$8,795.00.

University Research Council Summer Stipend: "The Effect of Calcium Limitation on Cadmium Uptake" 2002, \$2,600.

NSF UFE Workshop, "New Approaches and Techniques for Teaching Science: Addressing Environmental Problems to Stimulate Undergraduate Learning."

"The influence of source of exposure on the uptake and partitioning of metals by *Palaemonetes pugio*" National Sigma Xi Grant-in Aid of Research; 1999, \$800.

Litigation Experience: Trials and Depositions

USA v. CMS Energy Corporation; Western District of Michigan, Grand Rapids, MI; February 22, 2018; Deposition at US Department of Justice Environment and Natural Resources Division. Washington, DC.

USA v Raymond Mitchell; Southern District of Georgia, Savannah, GA; March 18, 2016; Testified as an expert witness at the sentencing on the toxicity and potential for harm from exposure to naphthalene.

USA v Ryan Chamberlain; Northern District of CA, San Francisco, CA; February 5, 2016; Testified as an expert witness in a Delbert hearing on the use of toxicity data to determine the lethal effects from exposure to the biological toxins, ricin and abrin.

USA v Carl Kieser; Central District of Illinois, Peoria, IL; October 29, 2014; Testified as an expert witness in a criminal trial on the toxicity of the herbicide, diuron to aquatic life.

USA v Martin Kuna; District of Oregon, Portland; OR, July 22, 2013; Testified as expert witness at the sentencing on the effects of lead on children.

Colorado v. Joseph Loskinski; Weld County District Court, Greeley, CO; December 12, 2012; Testified as an expert witness at the sentencing on the effects and lethality of the rodenticide, strychnine.

Litigation Experience: Expert Reports, Declarations and Affidavits

Expert witness opinion report for *USA v. Edward Miller*; District of Nebraska; April 8, 2020;

Expert opinion report on health effects from exposure to chemicals found at illegal dump sites in Hamilton County, Nebraska.

CX 46 Page 20 of 23

Expert witness opinion report for *USA v. Lloyd Robl*; Western District of Wisconsin, Madison, WI; July 30, 2019; Expert opinion report on health effects from exposure to asbestos.

Expert witness opinion report for *USA v. Total Reclaim Lorch and Zirkle*; Western District of Washington, Seattle WA; March 25, 2019; Expert opinion report on health risks from exposure to mercury from electronic waste.

Declaration for *USA v. Tonawanda Coke Corporation*; Western District of New York, Buffalo, NY; September 17, 2018; Expert opinion on the health effects from exposure to benzene and particulate matter.

Expert witness opinion report for *USA v. Chelsea Environmental-Paul Potter*; Eastern District of VA, Alexandria, VA; August 21, 2018; Expert opinion report on health effects from exposure to asbestos.

Expert witness opinion report for *USA v. CMS Energy Corporation*; Western District of Michigan, Grand Rapids, MI; January 16, 2018; Expert opinion report on risks from the discharge of cement kiln dust leachate.

Expert witness opinion report for *USA v. OE Construction Corporation*; District of Colorado, Denver, CO; June 19, 2017. Expert opinion on health effects from exposure to diesel emissions. Expert witness report for *USA v. Dipen Patel*; Northern District of Indiana, Hammond, IN; January 26, 2017; Expert opinion on health effects from exposure to the pesticide, Doom (active ingredient, dichlorvos).

Declaration for *USA v. Ryan Chamberlain*; Northern District of California, San Francisco, CA; February 5, 2016; Declaration to support the government's opposition to the defendant's motion to exclude expert witness testimony on the use of toxicological data to determine the toxicity of abrin and ricin.

Expert witness report for *USA v. Terminix International Company*; District Court of the Virgin Islands, St. Thomas, VI; December 1, 2015. Expert opinion on the methylbromide exposure incident.

Expert witness report for *USA v. Cenex Harvest States, Inc*; District of Montana, Great Falls, MT; January 22, 2013; Expert opinion on the toxicity of the gases released from a warehouse fire to livestock and human health.

Expert witness report for *USA v. Martin Kimber*; Northern District of New York, Albany, NY; February 2012; Summary of the health hazards of mercury by inhalation exposure.

Expert witness report for *USA v. Seville Colony*; District of Montana, Great Falls, MT; January 17, 2012; Expert opinion on the imminent and substantial endangerment from the illegal application of the rodenticide, strychnine.

CX 46 Page 21 of 23

Expert witness report for *USA v. Bazan et.al.*; United States District Court District of Kansas, Kansas City, KS; March 14, 2011; Expert opinion on the toxicity of the pesticide, methomyl.

Expert witness report for *USA v. Martha Hebert*; Eastern District of Louisiana, New Orleans, LA; November 10, 2011; Expert opinion on the falsification of whole effluent toxicity data.

Expert witness report for the *USA v. Roy Stricklin*; District of Wyoming, Casper, WY; September 8, 2011; Expert opinion on the risks to a population from the exceedance of the drinking water maximum contaminant level for coliform.

AFFIRMATION

I have reviewed my Professional Resume and declare and affirm that the information provided therein is true and correct to the best of my knowledge.

**Keteles,
Kristen**

Digitally signed by
Keteles, Kristen
Date: 2021.07.08
09:13:06 -06'00'

Kristen Keteles, Ph.D.
Toxicologist

Date

CX 46 Page 23 of 23