# ENVIRONMENTAL THREAT PERCEPTION IN SOUTHWEST PENNSYLVANIA: A QUALITATIVE STUDY OF LOCAL EXPERT OPINION

by

**Greer Alyson Tiver**

BS, BA, University of Pittsburgh, 2006

Submitted to the Graduate Faculty of

the Graduate School of Public Health in partial fulfillment

of the requirements for the degree of

Master of Public Health

University of Pittsburgh

2010

UNIVERSITY OF PITTSBURGH

GRADUATE SCHOOL OF PUBLIC HEALTH

This thesis was presented

by

Greer Alyson Tiver

It was defended on

and approved by

Thesis Director: Martha Ann Terry, PhD
Assistant Professor
Department of Behavioral and Community Health Sciences
Graduate School of Public Health, University of Pittsburgh

Conrad Daniel Volz, DrPH, MPH
Assistant Professor
Department of Environmental and Occupational Health
Graduate School of Public Health, University of Pittsburgh

James Butler, DrPH, MEd
Assistant Professor
Department of Behavioral and Community Health Sciences
Graduate School of Public Health, University of Pittsburgh

Christopher R. Keane, ScD
Assistant Professor
Department of Behavioral and Community Health Sciences
Graduate School of Public Health, University of Pittsburgh

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Much recent national and international focus has been placed on environmental threats and their relationship to ecological and public health concerns. In order to address problems at a local level, a Pittsburgh Regional Environmental Threat Analysis (PRETA) is presently underway. As part of this project, ten in-depth interviews were conducted with experts in environmental fields to collect a range of ideas and observations about local environmental threats from those who work with these issues regularly. Experts' individual perceptions on current environmental problems and priorities in the southwest Pennsylvania region were gathered and analyzed qualitatively. Interviews reveal major threats to ecology and public health, including threats: (1) to water quality by Combined Sewer Overflow (CSO) and wet weather events, (2) to air, water, and human safety from coal combustion and processing, (3) of a lack of equity, or lack of environmental justice, and finally, (4) of new and unknown chemicals and contaminants in the water supply, again posing risks to the quality of water resources. Using open-ended questions, experts cited organizations involved in prevention or remediation of threats, and overall themes were discovered from interview material. Major areas broached by informants included prevention, improved policy and regulation, and improved public education. This assessment of the state of environmental threats in the southwest Pennsylvania region is significant to public health because of the strong impacts that environmental issues have on the short and long-term physical and mental health of the population. By gathering threat

perceptions and recommendations from local experts, this study notes the current state of affairs, informs the larger PRETA project, and creates a launch point for further work in ecological and environmental public health improvement.

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# 1.0 INTRODUCTION

The water that people rely on to drink and the air they breathe, soil in which to nurture plants, are necessities for human and other forms of life. Amenities such as waterways for recreation, transportation, and aesthetic beauty, forest lands, wild life, fresh air, and open space are not required for existence but are certainly valued for their contribution to quality of life.

Environmental conditions affect every person and living organism in their ability to thrive on a daily basis. At present, a number of activities, for the most part human-made, but also including natural events, threaten the ability of all creatures to have access to the vital resources on which they depend. Water and air quality are jeopardized, and dangerous conditions incompatible with life are becoming more common.

In southwest Pennsylvania, degraded water and air quality pose public health threats by instigating a range of diseases and damages to respiratory, neurological, immune, and other functions of the human body. Exposure to specific chemicals, such as heavy metals, is associated with known problems in human fetal development and life-long syndromes of decreased mental and physical ability. The extent of environmentally based human health damages are more recently becoming understood, and losses to quality of life, productivity, and societal costs are attributed to these exposures.

Yet, instead of operating under guiding principles of protection and responsibility, hazardous materials are being released into the environment to reach short-term goals of productivity and consumption, while ignoring longer-term goals of prevention and sustainable living. In order to address these problems regionally, information was collected about those

threats known to exist, as well as their associated consequences. Only after the problems are identified and understood can comprehensive plans to prevent damages and ensure environmental and public health be created.

## 2.0 BACKGROUND

The city of Pittsburgh, Pennsylvania, and the surrounding region shape the gateway to the Ohio River valley, located in the Eastern United States. Situated at the point where the Allegheny and Monongahela Rivers converge to form the Ohio River is the downtown area of the city of Pittsburgh. At one of the lowest spots in the region, Point State Park, the meeting point of the three rivers, sits 710 feet above sea level. This is in stark contrast with the surrounding area, comprised of plateaus and slopes throughout the city rising to 1,300 feet (Aurand, 2006). The entire region is full of valleys, mountains, and uneven topography, as may be seen on the map below. These topographical features make the area visually appealing, exciting for hikers and cyclists, and complicated for travel and tasks such as water management.


**Figure 1. Topographical Map of Pittsburgh, Pennsylvania**
**Source: Google Maps, 2010**

Historically, Pittsburgh was known for steel production, and the region for its coal, among other heavy industries. Today, the city is recognized as a center for medical technology, robotics, and education, but the industrial legacy lingers and plays a substantial role in the present issues faced by the region.

## 2.1 ENVIRONMENTAL ISSUES IN SOUTHWEST PENNSYLVANIA

Due to the irregular topography, history of industry, and economic and political forces in the region, a number of environmental issues presently affect or threaten the city of Pittsburgh and a ten-county southwest Pennsylvania region. While some of these environmental and public health issues are experienced in other places in the United States, as well as the rest of the world, the combination of these is unique to this region, and thus provides a unique challenge to overcome.

Below are brief descriptions of four environmentally challenging issues of particular concern to southwest Pennsylvania and the greater Pittsburgh area.

### 2.1.1 Combined Sewer Overflow and Wet Weather Events

The city of Pittsburgh and much of the adjacent area rely on an outdated network of municipally owned pipes to deliver their sanitary sewage to the Allegheny County Sanitary Authority (ALCOSAN) processing facility. In older homes and municipalities, storm water capturing facilities are combined with the sewers that transport raw sewage. Due to the age of the system (in many places, over 100 years old), a large amount of rain or groundwater may leak into the deteriorating underground pipes, which greatly increases the volume of wastewater to be managed. Because of these leaks and an increase in new residential and commercial structures that are linked into the ALCOSAN system, the volume of wastewater delivered to the water treatment plant on a dry day frequently approaches the daily processing capacity of that plant. However, on a day when rain or snowmelt occurs, and the storm water is washed from the streets

into the shared sewer system, the problem is magnified and volume capacity may be quickly overtaken (3 Rivers Wet Weather [3RWW], 2010).

Two factors in particular further compound the problem of managing a large volume of water. Firstly, the steep slopes that make up a good deal of this region contribute greatly to the speed and power with which storm water reaches the valley level of the rivers and the location of the ALCOSAN plant. Secondly, with much human development, paved, impermeable surfaces (e.g. parking lots, shopping center roofs) have replaced areas that used to be covered by natural vegetation, which was able to capture and slowly absorb surplus water. Now these areas are very quickly drained of that excess water, and especially at higher elevations, this contributes further to the unmanageable velocity and volume of runoff water that accumulates during wet weather.

In order to maintain the safety of the processing facility when these situations occur, and to avoid an overload as the storm water rushes in, emergency outflow gates are opened at over one hundred locations along local waterways. These releases allow some wastewater to leave the system before treatment, in order to stabilize the flow volume and allow the plant to operate and continue to process and clean water at capacity (3RWW, 2010). However, this overflow wastewater is released directly into the Allegheny, Monongahela, and Ohio rivers, as well as smaller tributary streams, as a combination of storm water runoff and raw sanitary sewage. Overflow gates are no longer legal to build, but exist in this area from a time predating sewage treatment, when all sanitary sewage was sent directly into the rivers. As may be expected, an influx of raw sewage into the waterways greatly increases fecal coliform bacteria[1] and levels of other bacteria and viruses as well as many chemicals in the rivers, which serve as the local

[1] While bacteria levels do not necessarily pose a danger to human health, they are often used as an indicator of the microbial quality of water, including presence of feces and related known pathogens (EPA, 2006).

source of drinking water. While public drinking water is processed to a safe level for healthy consumers, concerns remain for its quality as a habitat for aquatic species and a venue for recreation.

Combined sewer overflows (CSOs), as described above, occur frequently in the three rivers and their tributaries in and around the city of Pittsburgh. The Allegheny County Health Department (ACHD) issues CSO advisories when water quality is expected to be unsafe or unadvisable for human contact (e.g. swimming, fishing, jet skiing, rowing). These advisories are logged and reported publicly only during the recreational boating season, May 15 – September 30. In 2009, 42 days during the recreational season were advisory days, on which the public was cautioned not to come in contact with river or stream water, and those with weakened immune systems were more strongly cautioned. In 2008, 48 CSO advisory days were reported between May 15 and September 30 (ACHD, 2009). Since the start of CSO Advisories in 1995, on as many as 70 days during one recreational boating season (51% of days) citizens were cautioned that river and stream waters were unsafe for human contact (3RWW, 2010).

During the last decade, the Environmental Protection Agency (EPA) has created a consent agreement with the 83 municipalities, including the city of Pittsburgh, that contribute waste and storm water to the ALSCOSAN plant, to mitigate its consistent violations of the federal Clean Water Act. This decree, enacted in 2007, requires a drastic reduction of combined sewer overflows per year, as well as complete elimination of illegal sanitary sewer overflows, among other changes to protect the quality of the water in the Allegheny, Monongahela, and Ohio rivers (Consent Decree, 2007). ACHD and the Pennsylvania Department of Environmental Protection (DEP) will provide local enforcement of the changes to the ALCOSAN system required by the EPA in order to come into compliance with the Clean Water Act (3RWW, 2010).

### 2.1.2 Coal Combustion

Pennsylvania fuels more than half (54%) of its electrical energy use with coal-fired power plants and is home to four of the ten dirtiest power plants in the United States (America's Power, 2010; EIP, 2007). Forty coal-fired power plants are currently in operation in Pennsylvania, with 13 of these located within the ten-county southwest Pennsylvania region. However, 65%, or 13,194 Megawatts, of the 20,475 Megawatts produced in Pennsylvania are produced in the region surrounding Pittsburgh, creating an unbalanced burden of air emissions and water risks from coal combustion in this region (SourceWatch, 2010). Plants located in southwest Pennsylvania emit chemical pollutants into the air, including sulfur dioxide ($SO_2$), nitrous oxides (NOx), tiny particulate matter (PM), mercury, lead, carbon monoxide (CO), ammonia ($NH_3$), a variety of volatile organic compounds (VOCs), and more. Emissions from each power plant differ, based upon characteristics of the coal burned, the age of the boiler units, and the filtration systems in place to capture some of the most dangerous pollutants before they are released into the air. Newer plants generally have better filtration systems, built to comply with contemporary air quality standards. And yet, coal-fired power plant boilers built in the 1950s are still functioning in southwest Pennsylvania, with an average unit age of 42.1 years and a range from 58 to six years. Regional plants include three of the nation's top fifty most polluting, ranked on $SO_2$ emissions, with Keystone Generating Station in Indiana County ranking second worst in the United States (EIP, 2007). Sulfur dioxide is a known source of particle pollution (PM), and contributes to the production of acid rain as well as a number of associated health impacts, such as respiratory and cardiovascular damage. Even more plants in the southwest Pennsylvania ten-county region are ranked high as problematic polluters for other materials. A different set of three coal-fired power plants from this region, including the Bruce Mansfield Power Station in

Beaver County, were ranked in the top fifty for volume of nitrogen oxides ($NO_x$) emission, and another - Elrama Power Plant in Washington County - for its high rate of emission of the same pollutant (EIP, 2007). Nitrogen oxides are also known for their contribution to particulate pollution, damage to sensitive aquatic environments, and production of ground level ozone, leading to respiratory problems in humans. The aforementioned Keystone plant was also ranked in the top fifty for emissions of mercury, a known neurotoxin, which is especially harmful for developing human fetuses. Clearly, older plants are even more hazardous than newer plants that were built to more stringent air quality standards, though all continue to produce harmful airborne chemicals while they are in operation.

A number of studies have shown associations between human and/or ecological health impacts and exposure to emissions from coal combustion. Tang, et al. (2008) show decreased developmental quotients (DQs) in two-year-old children with prenatal exposure to pollutants, including polycyclic aromatic hydrocarbons (PAHs), lead, and mercury, released through coal combustion at a power plant near their mother's homes in Tongliang County, China. These toddlers showed delays in motor and language development, and social skills, as well as physical features, such as decreased birth head circumference. Dubnov, Barchana, Rishpon, and others (2007) found impairments of pulmonary function and development in a cohort of 1492 schoolchildren living near a coal-fired power plant in Israel, even though the power station was not exceeding local air pollution standards. In another study by Trasande, et al. (2006), researchers examined prenatal exposure specifically to mercury and determined that mercury emissions exclusively from coal-fired power plants were responsible for an estimated 231 cases of mental retardation, and an associated $1.3 billion lost on medical, childcare, and lost

productivity annually for children in the United States with decreased cognition. Much higher estimates were calculated for U.S. children receiving mercury exposure from all sources.

Across the population, air pollution, including largely coal combustion, has been associated with increases of 5% and 3% in male and female cancer deaths, respectively, in the United States (Grant, 2009). Grant found respiratory, digestive tract, urogenital, female, blood, and skin cancers to be associated with increases in air pollution, especially PAHs and black carbon aerosols, such as those produced by the combustion of coal, diesel, and wood. Additionally, Levy, Baxter, and Schwartz (2009) demonstrate how very difficult it is to link health outcomes to emissions from a specific coal-fired power plant, or even a specific region. Yet they comment that if all costs, including human health, were sent to the consumer, coal would be unlikely to remain a key player in the United State's electricity production (Levy, Baxter, & Schwartz, 2009).

Coke is carbonized coal, or coal heated through pyrolysis (heating in the absence of air) in order to burn off impurities but maintain the carbon content, creating a material to be used in the production of steel (World Bank, 1998). During the coke making process, many gases and particles are released as the raw coal material is heated, and some of these escape as fugitive emissions from the processing plant. Coke ovens are a major source of air pollution, emitting PM, methane, benzene, $NH_3$, CO, hydrogen sulfide, hydrogen cyanide, $NO_x$, sulfur oxides ($SO_x$), a variety of VOCs, and PAHs, (World Bank, 1998). Similar to the health implications of coal-fired power plants, coke ovens pose a variety of human and ecological health threats, including carcinogenic effects on humans from PAHs and benzene, as just two examples (Harvey, 1991).

However, newer technologies can produce steel through a direct reduction process, eliminating the need for coke manufacturing in order to produce steel.

A great deal of coal combustion waste (CCW) is created in the southwest Pennsylvania region and is comprised of the materials in coal that could not be burned for power generation or other uses. Heavy metals and other contaminants that were not burnt in processing are then greatly concentrated in CCW, presenting a much more hazardous condition than the coal from which it came. CCW is a leachable mixture of carbon, sulfur compounds, nitrates/nitrites, toxic trace elements, radionuclides, and mutagenic PAHs (Volz, 2009). About 131 million tons of CCW are produced annually in the United States (Tenenbaum, 2009). And about 71.1 million tons, or 55%, of CCW produced each year is flyash, a material captured in filters after coal combustion, and is comprised of microscopic spheres containing mostly silica, iron, aluminum, and calcium (Tenenbaum, 2009). CCW is the second largest waste stream in the nation, with only municipal solid waste (MSW) contributing more.

CCW may be stored in surface impoundments or used as fill for abandoned mines, stored wet or dry in lined or unlined landfills, with varying degrees of stability. CCW may also be recycled into an array of construction products, used in the production of concrete, wallboard, paving materials and more. Flyash, in particular, is valuable for creating bricks that harden without baking (Tenenbaum, 2009). An estimated 23% of CCW produced in the United States, more than 30 million tons, is used this way (Tenenbaum, 2009). So, debate arises over the classification of CCW as hazardous or not, because these materials are currently used in a variety of construction materials and projects with no observed damage. And yet, this classification allows for tons of flyash to be stored in dammed pools, in semi-liquid form, where they will be

exposed to plant and animal life and leach materials out into local water supplies. Many of the chemicals found in CCW have known ecological and human health impacts; water leachate from flyash has been shown to be genotoxic to human blood cells (Chakraborty & Mukherjee, 2009). But, argument continues about the level of risk involved with CCW dumps, especially whether chemicals are accessible to moving surface or ground water, or if dams and other structural entities keep the risk minimal.

When stored in large pools (wet surface impoundments), CCW has created massive ecological and public health safety hazards, such as that at the Tennessee Valley Authority plant. In December 2008, a dike broke on a wet surface impoundment of the Kingston Fossil Plant in Harriman, Tennessee, which was storing millions of gallons of CCW. Subsequently, approximately 5.4 million cubic yards of flyash sludge was released into a branch of the nearby Emory River, destroying homes and flowing through streets along its way. In southwest Pennsylvania, many local people are very concerned about the potential for a similar event, in addition to the environmental and human health impacts that may already be taking place due to storage facilities of this nature.

In a southwestern Pennsylvania news report, both environmentalists and other citizens spoke of their anxiety over the "Little Blue" flyash dump in Beaver County. One local man commented that all of the trees near the dump had been killed, and wildlife was likewise depleted (KDKA, 2009). The Little Blue Run Residual Waste Disposal Impoundment in Beaver County, Pennsylvania, contains the solid and liquid wastes from the Bruce Mansfield coal-fired power plant, and covers 1,300 acres. This pool is approximately thirty times the size of the flyash spill from the Kingston Fossil Plant in Tennessee, which is considered the worst environmental disaster in United States history. The EPA is still working to clean up that

disaster, and local rivers are expected to be closed off through May 2010 (EPA: Region 4, 2010). If the CCW dump pool at Little Blue Run were to burst, no one really knows how devastating the damages could be on regional ecology, water sources, and public health.

### 2.1.3 Persistent Lead and Environmental Justice

According to the United States Environmental Protection Agency (EPA) (2010), "Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." Maintenance of this protection is vital to adequately protect all members of a population.

A common threat to environmental justice may be seen where industry has been allowed to build hazardous, polluting projects near low-income neighborhoods, where people are less likely to have the financial resources or political leverage required to wage and win a fight against a large corporation. Another instance may be when polluting entities are held to less strict standards of water or air quality by government authorities, often because of their economic value to regulating and/or policy-making authorities or the entire region, creating a situation where certain members of the population may be put at a higher risk for disease. Immunocompromised people (e.g. HIV/AIDS+ individuals, chemotherapy recipients) or other special populations (e.g. children, elderly people) may be more vulnerable to harm than healthy adults. Any situation where equity of risks and protections across all people is not maintained, or especially when equal involvement in decision making about these environmental issues cannot be established, can become a situation of injustice. Those regarding environmental protections and contaminants pose a particularly egregious problem, as they can affect large numbers of

people and ecological systems in ways for which no remediation can be made after damage has been done.

One of many examples of a lack of environmental justice may be observed in children of low-income families or other circumstances that create an increased risk of exposure to lead, a heavy metal. Lead can be ingested or absorbed through respiration, and can persist within the brain for about two years, and for decades within bone tissue. Lead can also be transferred to a developing fetus in utero or through breast milk, if the mother has been significantly exposed, even prior to pregnancy (Lidsky & Schneider, 2003). This heavy metal has been long identified as creating neurotoxic effects when absorbed into the body, with a marked increase in damage on the developing brains and bodies of young children, particularly those aged 0-5 years. Both cognitive deficits and behavioral problems have been observed in children exposed to lead. Lidsky and Schneider (2003) reviewed many studies of long-term lead effects in children ranging from newborn to adulthood, revealing decreases in intelligence quotient (IQ) as well as impaired attention and diminished fine motor skills with increasing blood levels of lead. These neuropsychological deficits discovered in childhood have been noted to last into adulthood, creating lifelong problems and damage for these people. In severe cases of childhood lead exposure, especially in children two years or younger, children will first exhibit lethargy, abdominal cramps, loss of appetite, and irritability; these symptoms progress to vomiting, clumsiness, and finally coma and seizures, often resulting in mental retardation (Lidsky & Schneider, 2003). In adults, exposure to lead is less likely to cause these drastic effects, as the nervous system is already developed, but will cause illness, including fatigue, memory loss, muscle pain and weakness, as well as miscarriage in women and decreased sperm count in men (Mayo Clinic, 2009). Finally, exposure to lead was strongly implicated in increased juvenile

adjudication in a study by Needleman and colleagues (2002). This research by Needleman, et al. provides a link between lifetime lead exposure and behavioral choices leading to court appearance and legal judgment; this information is particularly powerful in the case against lead as a major source for environmental injustice. Those children environmentally exposed to lead may suffer losses in IQ, decreased social and behavioral skills, and consequently, lower grades and achievement, and potentially even life in incarceration. Unequal protection from exposure to this serious a threat is a gross injustice, especially for children.

The removal of lead from gasoline has proven to be a public health benefit across all age groups, protecting adults and children from lead poisoning, mainly by respiratory means. However, because of its historical prevalence, lead levels remain high in many areas, in soil and along areas of previous high automotive traffic. Any ingestion of this soil, through urban gardening or overt consumption (as may happen with small children), or respiration of raised dust from this soil, can pose a hazardous exposure pathway. A well-known major source of lead exposure for children under five years, today, is older housing. Raising and lowering windows coated with leaded paint, even under unleaded layers, may chip at some of this old paint, creating airborne particles of lead-based paint. Additionally, children (and some adults) have been known to practice *pica* or ingestion of non-food substances, such as paint chips, providing a direct pathway of exposure to lead from that paint. Tenants and low-income families may not be able to easily modify their homes in order to eradicate the threat of lead exposure, and so, some people may receive an unequally high exposure risk to a chemical known to produce long-term damaging effects. This is why the risk of exposure to lead has been illustrated as an issue of environmental justice.

### 2.1.4 Unknown Chemicals in the Water Supply

As discussed above, storm water runoff and CSOs contribute to the presence of unknown chemicals that may reach the water supply. Chemical runoff from highways and other areas with heavy automobile traffic contaminates water with oil, fuel, antifreeze, and other substances. Agricultural areas create runoff that may contain pesticides and herbicides as well as animal waste products and byproducts. Landfills may leak contaminated rainwater and other chemicals as they leach through the floor of the damaged or aged liners (Kjeldsen, et al., 2002).

One potential source of chemicals that is not particularly well understood, and therefore poses an unknown threat, is that of human consumption products. Personal care products (e.g. shampoo), pharmaceuticals, and any other products that are washed (e.g. household cleaners) or flushed down the drain enter the water supply. Additionally, the purification process for treatment of drinking water does not target and remove many of these chemicals.

Below are a few groups of chemical threats of particular concern to the quality of the regional water supply.

Legacy chemicals are a largely unknown threat, and may be found to contain dangerous and even illegal chemicals. The term "legacy," as used in this paper, refers to any chemicals or pollutants left as vestiges of previous industry or other historical activities. An unknown array of these exists in the ten-county southwestern Pennsylvania region, found in soil and waterways along roads from years of automotive pollution and runoff, in unmarked underground storage tanks, unreported or illegal hazardous dumping sites, many closed industrial sites, and any number of other locations. The potential types of hazards are also quite numerous, and often only reported to environmental and government officials when citizens observe strange odors and sights, or plant, wildlife, and human health problems.

Methyl tertiary butyl ether (MTBE), a gasoline additive, is one example of a chemical that was used historically in the southwestern Pennsylvania region. Recently, this chemical has been found in local well fields used for fresh water supplies. These well fields are not particularly close to any highways or major traffic areas, demonstrating that this chemical, like many others, can move within surface and groundwater in unknown ways. MTBE in drinking water supplies will render them unsafe for consumption, as current research indicates that this chemical may be a human carcinogen. Yet according to the EPA, MTBE is still used as a gasoline additive in about 25% of the United States (EPA, 2008). However, municipal solutions are available for remediation of this threat, as well as home treatment options, as long as MTBE levels are monitored to catch areas of contamination. Of course, both monitoring and remediation processes create additional charges to clean water supplies, but the danger to consumers could be great, if monitoring is not in place.

Another glaring example of legacy chemicals and their continued effects on current water quality has garnered recent attention at a seventy-two acre site in Armstrong County, along the Allegheny river, that was previously owned and operated by Pittsburgh Plate Glass (PPG) Industries, Inc. Commonly known as the PPG glass dump, this site was used for disposal of glass production refuse through the 1960s, and has been found to drain highly alkaline solution, at a mean pH 10.8[2], putting aquatic life in this area of the river at serious risk. Other hazardous metals, including arsenic, mercury, and lead exceeded US EPA Drinking Water Standards at this site, while copper and manganese were also found to be present in excess (Michanowicz, 2009). Health of aquatic species in this area is in serious jeopardy. As well as the health of a local

[2] A pH of 10.8 is near that of ammonia. Fish cannot survive in water with at or above pH 10.10, and will flee (Michanowicz, 2009).

municipality that obtains its drinking water from a source less than one mile down river from this legacy drainage site. People also use the area for recreation, which may be putting their health at risk.

Overall, the most dangerous factor regarding chemicals in this category is that no comprehensive public record of them exists, if any record exists at all. No one knows for sure the location, contents, effects, and ecological and public health implications of these historically used and disposed materials. These are threats that will need to be rigorously monitored to understand and protect water supplies.

When water seeps into coal mines through natural processes, like rainfall or snowmelt, chemical reactions may occur as the water flows along open mine walls. Especially in mines that have been abandoned and are no longer regularly pumped free of water for worker safety, water can acidify before it drains back to surface waterways, as precipitation and water levels change. Drainage from abandoned coal mines is typically highly acidic due to formation of sulfuric acid when mined areas are exposed to air and water, and also contains a heavy load of iron, either dissolved or precipitated as ferric oxide. As it drains from old mines and enters nearby streams and rivers, this highly acidic water may contaminate them so badly that waterways become biologically 'dead,' destroying the habitat of essentially all resident species (NRC, 2005). The Pennsylvania Department of Environmental Protection estimates that more than 1,700 miles of flowing water in the state continue to be degraded by drainage from hundreds of abandoned mines throughout the state. Figure 2 shows a stream in southwest Pennsylvania that has been affected by acid mine drainage; the bright orange color is from the high iron content, but the high acidity is reflected by the lack of thriving aquatic species.

**Figure 2. Acid Mine Drainage in Peter's Creek Watershed**
**Source: Peters Creek Watershed Association**

The federal government, under the Clean Water Act, technically requires treatment of acidic discharges from mines before the drainage water is allowed to flow into natural waterways. However, the ability or requirement to treat acidic mine drainage water is contingent upon the existence of a responsible party. Mines abandoned decades ago are still endangering waterways today, but many of the companies responsible for their previous operation no longer exist or have declared bankruptcy, and are not financially viable to contribute to water remediation. When acid mine discharges occur without anyone responsible to prevent impending damages, they are called orphan mine discharges. As of July 2007, the state Department of Environmental Protection is aware of 57 high volume (outflow greater than 100

gallons per minute) orphan mine discharges in the ten-county region surrounding Pittsburgh; these are in addition to mine drainage locations for which the responsible party is solvent (DEP, 2007). These acid mine discharges are currently contaminating regional waterways at rates exceeding 7,500 gallons per minute, with low pH (acidic), high iron content water, damaging natural ecological systems and degrading sources of drinking water (DEP, 2007).

However, the most common treatment for acidified mine water, introduction of alkaline substances (e.g. limestone products), is often not a total solution. These are used to counter the acidity of the mine water by producing a more balanced pH, but they further contaminate the water with foreign substances and contribute to the water's load of total dissolved solids (TDS), which negatively impacts aquatic life and water quality.

Furthermore, even at mines where acidified drainage water is receiving treatment, this process is still not a long-term solution. Instead, these mines will continue to create and release the same type of damaging, acidified wastewater, whenever water is exposed to them. As soon as pumping and treatment of the contaminated water ceases, acid mine water will again be created and released, causing problems similar to those in mines that never received treatment. Unfortunately, at this time, no cost-effective, long-term solution to this problem exists.

Another recent water quality issue concerns the Marcellus shale, which is a deep layer of sedimentary rock found in eastern North America, approximately one mile beneath the surface for most of its area, and composed of high levels of organic materials. The Marcellus shale is found beneath the majority of Pennsylvania, including the entire southwestern region, as well as the greater area of New York, Ohio, West Virginia, Maryland, the Western edge of Virginia, and even small areas of Kentucky and Tennessee.


**Figure 3. Marcellus Shale Formation**
**Source: American Association of Petroleum Geologists**

In 2002, the United States Geological Survey (USGS) estimated that the Marcellus shale contained 1.9 trillion cubic feet of natural gas, most of which may be available by hydrofracing (USGS, 2002). By 2008, estimates by professors from Pennsylvania State University and the State University of New York (SUNY) Fredonia had risen to 50 trillion cubic feet, and by November 2008, based on its own production information, the Chesapeake Energy Corporation raised estimates to a high of 363 trillion cubic feet, an amount that could supply the current usage

needs of the entire United States for fifteen years (USGS, 2009). Additionally in 2008, prices for natural gas reached an unprecedented summer peak of $10.82 per thousand cubic feet, after at around $2.00 from the late 1970s through 2000. Unsurprisingly, incentive for drilling in the Marcellus shale has risen sharply in recent years.

One type of natural gas drilling, hydraulic fracturing, also known as "hydrofracing" or "fracking" has greatly increased in the Marcellus shale during the last several years, as demand for natural gas has risen. Hydraulic fracturing in the Marcellus shale poses a serious danger to the quality and quantity of fresh water available for citizens and can result in a number of other types of environmental and ecological degradation.

The most useful technology by which to reach these stores of natural gas, hydraulic fracturing of the sedimentary rock, may cause massive environmental and ecological damage that is not yet fully quantifiable. The drilling process requires the use of millions of gallons of fresh water for each drill site, approximately three million gallons per drilling event (USGS, 2009). This fresh water is essentially consumed in the process, as over one hundred chemicals are added to it, comprising about 15,000 gallons of chemicals per drill, and creating a hazardous solution unless it can be very thoroughly treated. These additives are used to eliminate friction during drilling, prevent growth of algae in the well, and otherwise aid the extraction of natural gas. However, drilling companies consider information about the contents of these chemical mixtures to be proprietary, and so, they cannot be easily monitored or regulated by the EPA or state Departments of Environmental Protection.

As of winter 2010, drilling companies are not required to disclose the chemicals used in their "fracking" water or wastewater and are exempt from restrictions placed on other companies by the federal Safe Drinking Water Act (SDWA), through President Bush's Energy Policy Act of

2005 (LWV, 2010). And yet, these mixtures have been found to contain known human carcinogens, such as benzene, and other dangerous chemicals that pose serious threat to ground and surface waters, both for human use and the ecological viability for many other habitant species. Several pieces of legislation are currently in the U.S. Congress regarding hydraulic fracturing; one of these, the Fracturing Responsibility and Awareness of Chemicals (FRAC) Act, seeks to allow regulation of fracking water by forcing companies to disclose all chemicals they use, as well as remove the exemption for natural gas drilling under the protections of the Safe Drinking Water Act (LWV, 2010).

As drilling and consumption of valuable natural resources have preceded the development of regulations specific to natural gas drilling, many local people and scientists are very concerned about the damage occurring to one of southwestern Pennsylvania's, and the entire region's most valuable resources, abundant fresh water. Loss in the quantity and quality of fresh water in southwestern Pennsylvania could irreversibly impact the safety and well-being of forests and farmlands, waterways, wildlife, and the public's health. Hydraulic fracturing threatens water supplies in several ways: by consuming huge quantities of fresh water, potentially impacting local water resources and availability; by degrading small watersheds and surrounding land through carriage of heavy equipment and supplies on rural roads and lands not able to handle that traffic; and by creating massive volumes of contaminated wastewater, for which no cost effective and safe treatment process has yet been developed. This third concern may be prove to be the most severe, as experts predict that problems created through hydraulic fracturing may persist indefinitely, and lack of good treatment and disposal methods may lead to illegal dumping activity. Illegal dumping of fracking wastewater has been implicated as a possible cause (along with acid mine drainage) of toxic algae blooms that led to a massive loss of

aquatic life and biodiversity in thirty miles of waterway in September 2009, along the southern border of Pennsylvania and into West Virginia, especially in an area called Dunkard Creek (Ward, 2009; Hopey, 2009).

One of the major concerns with hydraulic fracturing wastewater relates to safe drinking water. Residents in Colorado and other states where significant hydraulic fracturing has taken place have reported encountering bizarre water problems, such as flammable water coming through their faucets, or more commonly, waters with chemical odors or tastes (Goodman, 2010). Hydraulic fracturing chemicals often include diesel products, which, in high enough concentration, can contaminate a water source and render it flammable, and in lower amounts, make it unsafe for human or animal use. Other complaints have been made by residents affected by local natural gas drilling regarding the quality and availability of their water supply, but as regulation is lacking, little can be done to adequately monitor or help remediate these situations.

The hydraulic fracturing process for extraction of natural gas was not widely used until a few years ago, especially not in southwestern Pennsylvania, where the Marcellus shale was too deep underground and too difficult to reach to be a profitable drilling location. With the demand for natural gas increasing, the potential for widespread damage and water contamination is looming, and yet, still not fully understood, which poses a major threat to the safety of natural ecology and public health, as well as the viability of the southwestern Pennsylvania, and larger Appalachian region.

Consumer products and pharmaceuticals present a varied potential source of water quality threat. Pharmaceuticals and other personal care products, whether ingested or used topically and washed off the body, become a stream of waste that eventually enters the sanitary sewer system. Items

in this mix may include the natural by-products of ingested pharmaceuticals, such as hormonal contraceptives and hormonal replacement therapies, medical radioactivity, chemotherapy drugs, and other strong chemicals that are not recommended for anyone without a doctor's prescription. Likewise, shampoo, toilet bowl cleaner, shaving cream, dish detergent, and similar personal and home care products also make their way down drains to the sanitary sewers. However, many of these chemicals are not removed during the cleaning process before wastewater is released back into the rivers, nor are they screened for during the filtration process to which drinking water is subject before it returns to the tap.

Upon reaching the rivers, these materials and their by-products come in contact with aquatic life. Some personal care products, dietary supplements, and pharmaceutical estrogens may act as endocrine-disrupting chemicals on organisms exposed to them. A number authors have written about sexual changes in aquatic life, particularly increases in the female:male ratio, decreased male fertility, and intersex fish – male fish with feminine reproductive system ducts or immature oocytes in their testes, associated with estrogenic compounds in the water where they were found (Jobling and colleagues, 2006; Gross-Sorokin, Roast, & Brighty, 2006). Endocrine disrupting chemicals have been linked to male reproductive disorders, birth defects, and cancer (Volz, 2007; Sanderson & van den Berg, 2003). Filtration and monitoring for pharmaceuticals and personal care products may be advisable to protect aquatic populations, as well as the source of drinking water.

## 2.2 PITTSBURGH REGIONAL ENVIRONMENTAL THREAT ANALYSIS (PRETA)

The Pittsburgh Regional Environmental Threat Analysis (PRETA) is a project being conducted by the Center for Healthy Environments and Communities, led by Conrad Daniel Volz, DrPH, MPH, faculty in the Department of Environmental and Occupational Health, Graduate School of Public Health at the University of Pittsburgh. This project was requested and is being funded by The Heinz Endowments to provide a comprehensive view of environmental issues and impacts in southwest Pennsylvania. The geographic area being examined for this study is the ten-county southwestern Pennsylvania region, as defined by the Southwestern Pennsylvania Commission, including the counties of Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Lawrence, Washington, and Westmoreland (SPC, 2010).

The foci of this project comprise both environmental ecology and an emphasis on environmental impacts on public health. An important aim of this project is to guide decision-making for future projects, investments, and programs to remediate, halt, or lessen environmental threats, preserve the ecology of the region, and protect the health of the public (Volz, et al. 2009).

In the initial phase of PRETA, qualitative interviews were conducted to gather prospective information about environmental threats in the southwestern Pennsylvania region, as perceived by experts in the area of environmental health and sciences. In the next phase, a survey will be distributed to residents in an online format, based on information collected in the qualitative interviewing step. The survey will ask about perceptions of local environmental issues in area communities, townships, and the region. Next, best practices will be looked at, from academic research literature, government reports, and environmental and public health non-profits, in order to compile a library of resources to best address impending environmental

threats. Additionally, information on current activities and programs dealing with threats will be examined, including those being conducted by governmental, academic, environmental and watershed protection organizations. Threat reduction activities already in progress will be assessed for their efficacy and potential for future advances. Known environmental and public health threats will continue to be tracked and indicators developed and benchmarked against other regions (CHEC, 2009). Updates and information will be shared with the public throughout the progression of the project, on the website of the Center for Healthy Environments and Communities, through the Graduate School of Public Health at the University of Pittsburgh (http://www.chec.pitt.edu/Projects.html#PRETA).

The major goals of PRETA are to begin by looking at environmental and public health threats, as well as potential solutions and best practices, as discussed above, through key informants and responses by local residents and organizations. Then, the objectives will be to monitor and track environmental and public health threats over time, forecast changes due to these threats, rank threats strategically, including their importance and impact on public health and the economy, and finally to diffuse the results to relevant organizations, institutions, or other community groups that may need or benefit from them (CHEC, 2009).

# 3.0 METHODS

Interviews were conducted as part of the larger Pittsburgh Regional Environmental Threat Analysis (PRETA) by CHEC. CHEC received approval from the University of Pittsburgh Institutional Review Board prior to interview recruiting.

Expert opinions were sought in order to find a range of views and areas of experience, while involving a population of informants that are generally educated, well-informed, and invested in the accurate representation of environmental issues. The author and another researcher conducted interviews with experts in the fields of environmental sciences, advocacy, media, and policy. Open-ended questions were used to guide a conversation about the issues that informants found to be most concerning, at present, in the ten-county southwestern Pennsylvania region.

## 3.1 EXPERT INTERVIEWS

Experts were chosen from a list developed by the staff at CHEC. Expert informants were academics and researchers, leaders of advocacy organizations, and well-informed members of the media. Policy-makers were sought as informants, but none was able to participate. CHEC contacted potential expert informants by mail to request their participation. These candidates were then contacted with a follow-up telephone call during which they confirmed or declined

serving as key informants, and to answer any preliminary questions they might have about the project.

The author scheduled meetings with ten experts who agreed to be interviewed. Interviews lasted approximately one hour, and all interviews were digitally audio recorded. Informants were asked in advance, and again before the start of the interview if they were comfortable with recording their responses for accuracy during analysis, and were reminded that responses were confidential before they agreed. Interview sessions were conducted by Greer Tiver (GT) and Samantha Malone (SM) (Communications Specialist at CHEC) between November 2009 and January 2010. Often, both interviewers were present during an interview, allowing for more extensive note taking and providing another perspective for probative questioning.

Interviewers read a prepared introduction to each informant prior to beginning the interview proper, giving a brief overview of the project goals and desired project outcomes. Additionally, the term 'environmental threat' was clarified: "for the purposes of this project, an environmental threat could include any concerns pertaining to the general ecology of the region, as well as public health hazards, or any factor that may affect or relate to these."

Interviewers asked each expert the same set of open-ended questions, and interviewers asked additional probing questions when more information seemed relevant or more explanation was needed. Often, researchers asked informants for elaboration in an area in which they seemed to be particularly knowledgeable. One interviewee excused herself due to another commitment before all questions were addressed. On several occasions, interviewees answered specific questions before they were even asked, and so, interviewers reworked the interview schedule accordingly.

The first and principal question asked informants to share what they perceived to be the major environmental threat(s) to the southwest Pennsylvania region, as well as their reasons for choosing this/these item(s). Based on responses, follow-up questions were asked regarding particular contaminants or hazards of concern, known and suspected sources of the threat, and known associations of this threat with human health or ecological outcomes. Interviewers asked informants to elaborate on connections to related concerns and any gaps in knowledge or information about this issue. Other questions asked about any policies or programs in place to address identified threats, organizations working on these, and the informant's opinion on how well these were working. Finally, interviewers requested information on known best practices in the area(s) mentioned, as well as any recommendations, including those for decreasing, eliminating, or remediating the previously discussed threats. The full interview introduction and schedule can be found in Appendix A.

## 3.2 DATA ANALYSIS: CODING

Nine of the ten recorded interviews were transcribed in their entirety by GT and SM, while one interview recording was distorted by background noise, allowing only portions of this recording to be audible. Therefore, this tenth compromised interview recording is not included in the analysis. The nine transcribed texts were read through for first impressions of themes and recurring identified issues and threats. The first reader (GT) created inductive codes to identify major topic areas, including identified threats, gaps in information, recommendations and best practices, as well as a few individual codes referring to governance, policy and regulation, environmental justice, and more. Codes were then compared and discussed with the second

reader (SM) for agreement on one of the interview scripts. Through discussion, both readers were able to reach coding consensus. All interviews were reviewed and coded by the first reader. Example codes are provided in the results section.

A matrix was created to identify which topics were discussed by which participants. In this table, frequencies were counted for those items addressed as important by the most experts. Items mentioned, when recombined to make up the broader domains of threats, sources, or gap areas, created a system by which to prioritize. Top ranking threats and sources, as well as noted gaps are included in the Results section, while important themes are addressed later in the Discussion section.

# 4.0 RESULTS

Ten in-depth interviews were conducted with experts in environmental fields to gather information on their perceptions of environmental threats in the southwestern Pennsylvania region. Interviews were semi-structured, allowing for a fine-tuned view into each informant's experience. The interviews included questions about known hazard sites and contaminants, as well as natural events or other factors that could present a risk to human health or the general ecology of the region.

The author reviewed the recorded interviews, and subsequently, gave codes to emergent themes and particular threats. For example risks posed by combined sewer overflow on water quality or air pollution from coal combustion were coded as THR.H2O.CSO and THR.AIR.COAL respectively, and could most easily be read as a THReat on water (H2O) by combined sewer overflows (CSOs) and a THReat on AIR quality by COAL combustion and processing. Codes were created for other identified threats in the same manner. Another commonly addressed issue was coded as GAP.INFO.HLTH, a GAP in understanding or lack of INFOrmation regarding HeaLTH, especially a lack of scientific information linking the environmental issue(s) at hand to particular health outcomes. Other gaps were also discussed and coded, such as those regarding public education about and understanding of some issue, indicated by GAP.EDUC, or those regarding a deficiency in the realm of policy and regulation, with a sub-code for a particular gap in the enforcement of standing regulations, indicated by

GAP.POLREG.ENF. Codes for common themes were also created, including those reflecting an informant's discussion of quality of life (QOL), BALANCE between protection of the natural world and human consumption, and environmental justice (JUST) for those impacted by environmental threats.

More than 50 distinct interconnected environmental threats and themes were discussed in the process of conducting expert interviews for the initial step of PRETA. Those threats discussed most often across all informant interviews were given priority, considering the impacts of ecological and public health significance associated with each. For this thesis, the major topic areas to be discussed include (1) the threat to water quality by CSOs and wet weather events, (2) the threats to air, water, and human safety from coal combustion and processing, (3) the threat of a lack of equity, or lack of environmental justice, with an example of lead exposure, and (4) the threats of new and unknown chemicals and contaminants in the water supply, again threatening the quality of water resources.

Discussion of each theme presents key informant descriptions, then organizations involved in preventing or creating solutions for the problem, gaps and challenges addressed by experts, and finally, their recommendations and noted best practices.

## 4.1 COMBINED SEWER OVERFLOW (WET WEATHER EVENTS)

### 4.1.1 Threats

All informants spoke about wet weather events as a threat to the environment and public health. Seven specifically discussed Combined Sewer Overflows (CSOs), and one explained the situation very well:

> Our sewer system is very, very susceptible to overflows, even on a light rain day. And we, under EPA guidelines, we have to reduce overflow volumes, overflow frequencies, events…depending on how wet of a season we have, [we need to reduce] seventy-five or more events a year, down to four or five events a year. That's a huge task. We're talking about billions and billions of gallons of water that needs to be removed from the system, or stored, or provided some supplemental treatment in wet weather. [2][3]

Seven other interviewees referenced an array of wet weather events, including flooding and related property damage, contaminated roadway runoff into waterways, and concern over the volume and flow of storm water. One expert commented,

> when I see these photographs of people up on their porch roofs being rescued by, you know, a municipal public works department dump truck and you find out that their houses are ruined…or they buy three water heaters in two years because every time they put one in it [flood water] comes through and takes it out, or a furnace. That's the immediate human impact. [4]

Five participants spoke about the effects of the increase in paved, impervious surfaces in the region on storm water management and flow. Impermeable surfaces, particularly in the form of new housing and commercial developments, and especially problematic at higher elevations, are

[3] [x] Bracketed numbers reflect an identification number assigned to each informant, and the speaker being quoted.

likely to have a greater impact on the path of storm water. The same informant as above continued,

> We were talking about the fact that it's not just that side of things, flood damage. It's also the fact that we don't recharge our streams. We have all this water, but it goes running off in a hurry because we've done a good job of paving over the higher elevation places. You never notice all our malls are up on top and all our little towns are down in the valley. Guess who gets whose water? And it's not the right way to develop land. [4]

Informants spent a good deal of time speaking about the threats to human and ecological health posed by CSOs and wet weather events, as well as those to the local economy and recreational opportunities, affecting the overall quality of life. One informant notes that,

> we're really struggling with the sewer overflow thing… It's a public health threat. It's a recreational and amenity threat, we know. What's the figure? Half the days in the recreation season are the days when the county health department says, 'don't go in the water'. Fifty percent of the best days, we can't be in the water. That's just wrong.

Disjointed governance was also a topic of concern for this regional problem. Many experts commented that water and flooding have no political boundaries and must be addressed on a regional and watershed basis, as opposed to individual municipal jurisdiction. One expert asks, "how do you solve a problem that 83 separate elected boards with 530 plus or minus officials will be making all the decisions?" He then remarks, "…that's not sustainable. That's got to change." [4]

### 4.1.2 Organizations and Programs Involved

3 Rivers Wet Weather was the organization most mentioned for working on solutions to this group of threats, followed by the Allegheny County Health Department. More upstream solutions and initiatives were discussed in relation to Riverlife and the Nine Mile Run Watershed

Association. Several informants alluded to the existence of some sort of federally mandated improvement project for the water treatment system, and one discussed at length the specific federal consent agreement between the EPA and ALCOSAN, in place to help Allegheny County reach compliance for the three rivers with the national Clean Water Act.

### 4.1.3 Gaps and Challenges

Key informants brought up a number of deficits in policy, regulation, and governance concerning wet weather events. They noted major shortcomings in the development of new policy and regulation, as well as enforcement of current regulatory codes, as serious problems. Experts recognized these deficiencies as significantly inhibiting any work underway to control the threat of contaminated water and flood damage. Lack of cooperation among the disparate municipalities and levels of government with control over water issues posed a substantial challenge, according to informants, in trying to solve this regional problem. As quoted above, experts are concerned that the 83 municipalities served by the ALCOSAN plant do not have a unified system of piping and transporting waste, nor a singular regulation process for building new structures that will require connection to both the sanitary and storm water systems. Perhaps more importantly, informants expressed concern that the city of Pittsburgh and the other 82 municipalities, in conjunction with ALCOSAN, do not yet have a unified plan for managing current and future system uses and installations in order to reach the standards of the Clean Water Act (CWA), as required by the consent agreement with the EPA.

Separate governance may lead to significant water quality problems in permitting and encouraging new construction projects. Increases in impervious surfaces that come with new buildings and parking lots, where grass and trees used to be, were frequently discussed as a

serious threat to the reduction of combined sewer overflows and flooding events. Furthermore, problems with management of storm water were similarly attributed to decreases in natural plant life and absorbent surfaces upon clearing of land for new construction. One informant talked about the interaction between municipal control over water issues and economic drive: "there's a lot of competition between both municipal governments, between county governments, and that kind of economic competition really drives sprawl, as opposed to tries to figure out a regional solution for how to address [it]." [10] Then, referencing better practices seen in Southeastern Pennsylvania, the same informant remarks,

> "It's about doing it in the way that protects your water resources, and that protects open space. And so, there's been a lot more effort of municipal governments to manage development better, and to decrease the environmental impacts. And that's a mentality which is not nearly so prevalent in southwest Pennsylvania, so that's kind of a hole, I think." [10]

### 4.1.4 Best Practices and Recommendations

Informants made two major recommendations to improve the problems of combined sewer overflow and related wet weather events. Firstly, a call was made to unify control and decision-making authorities for all of the known causes and symptoms of this issue, whether through city-county consolidation, creation of a new unified regulatory entity, or by other means. Experts also encouraged expediting the process to meet the standards set in the consent decree between the EPA and the ALCOSAN. One expert enthusiastically recommended an approach to the wet weather problem on a larger scale for the region:

> What we need to be focusing on is, is changing the governments, the way they operate, maintaining our water resources, and looking at new initiatives, such as green infrastructure… and bringing in those kinds of alternatives into the mix, which is a complete change of the way that municipalities might be thinking. It's not building a tank and a treatment plant, or building bigger pipe. It's planting trees, greening streets, rain gardens, collecting... [2]

Morgantown, West Virginia was given as an example for creating a good source of funding for expensive storm water management. Instead of increasing taxes to cover the costs of updating and improving their storm water management system, which this expert notes would make citizens unhappy; they simply created a storm water authority for the city. Residents and businesses then are required to pay storm water management fees, similar to other utility fees, that go directly for that service. Therefore, the funding requirements are met, and citizens are generally comfortable with where their money is going.

Another informant cited a local best practice in the development of a North Hills Council of Governments in order to address watershed wet weather management. A cooperative effort of municipalities to the north of the city of Pittsburgh has increased practices of using 'green infrastructure' and more prudent construction projects regarding storm water runoff. This expert states that the council of governments recognized that the storm water from an "inappropriate pattern of land use" in their higher elevation communities was doing damage to the neighborhoods below them who had experienced increased, damaging floods in recent years, and so, they chose to take responsibility for fixing this problem through better planning and management.

## 4.2 COAL COMBUSTION

### 4.2.1 Threats

Eight of nine experts specifically addressed the threats of coal combustion and industrial processing of coal to the regional environment and public health. Air quality was the chief concern in this area, broached by all informants. They discussed air quality problems and threats related to the use of coal as fuel for electricity in coal-fired power plants, as well as a primary material in coke, as a precursor to steel production. Six of nine interviewees talked about human health threats associated with pollutants and hazards created by coal combustion; these included a few well-understood health connections, such as increased incidence of asthma and respiratory problems near coal-burning sources, as well as increased cardiovascular events when particulate matter levels are high. Additional health problems were discussed, some with more limited scientific evidence supporting association with coal combustion, like increased lung and other cancer incidence[4]. Contaminants, such as particulate matter smaller than 2.5microns in diameter ($PM_{2.5}$), benzene, mercury, and other heavy metals were discussed in relation to asthma, cardiovascular events (e.g. myocardial infarction), cancers, general difficulty breathing (e.g. chronic bronchitis) and poor health. Informants recommended more research in this area, in order to fully understand links and causal pathways, to better address the human health threats with which they were concerned.

[4] Causal pathways for cancers are often confounded with long timelines, latent onset of disease, and other lifestyle factors, such as cigarette smoking; so, a clear association with a coal combustion source is difficult to determine.

Six interviewees specifically talked about regional coke making facilities as sources of particularly harmful and localized air pollution, citing previous studies finding increased respiratory diseases and related health impacts in the vicinity of these ovens. Experts spoke about human health concerns with probable links to coal processing by-products. These were in relation to emissions from the Neville Island coke works, and particularly from one of the local 'hot spots' of greatest concern, Clairton Coke Works. One participant said, "there's significant benzene coming from the Clairton Coke Works, it's a byproduct of the coke process…particulates, benzopyrene, which is a product of incomplete combustion, and it's a carcinogen… coal tar derivatives…" [3]; another notes that, "studies have already shown that they have twenty times the national average…risk of getting cancer in that area [Clairton, Glassport, and Liberty boroughs[5]]" [1]. Another states succinctly, "I think that we know that if Clairton Coke Works keeps operating, that there are going to be continued risks of cancer and other problems." [8]

Four informants discussed air quality problems related to coal-fired power plants located upwind, in the Ohio Valley, adding to air pollution issues created locally. One expert comments,

> we're kind of in this unfortunate situation of both having our own sources and then having stuff [airborne coal combustion waste chemicals] coming up to us. …we have like this giant cluster of coal-burning power plants here and then immediately to our west. So, that combination is kind of our problem… [10]

A number of hazardous substances have been mentioned as waste products of coal combustion, but in reference specifically to the dangers of mercury released into the environment by coal-fired power plants, one informant said,

[5] Clairton is the city in which the Clairton Coke Works is located. Liberty and Glassport are neighboring municipalities.

> …it's one thing to talk about acid rain. Well, that's all very nice, so, the trees grow less well, the fish don't do as nicely. You know, it degrades the environment generally, and of course, there are other economic impacts, too. But mercury is a *neurotoxin*! …the real ugly one[s] [are] the neurological toxins… [4]

Like the concerns voiced over coke processing facilities, carcinogenic and neurotoxic properties of many of the common releases of coal-fired power plants were a major concern. As the same informant continued, "That sort of thing stresses me, because it's about long-term values, children, future generations…" [4].

Experts expressed great concern over coal combustion as a source of many potential dangers to ecological and human health in the southwest Pennsylvania region. Coal combustion and processing were discussed as causal or associated factors implicated for damaging health effects, with examples in air, water, and soil contamination. Issues of public safety, public health, and environmental justice were also related to wastes created by coal processing.

Six experts voiced concern about water quality impacts associated with coal use; these include the immediate and future dangers of mine waste storage breakout events. CCW, including flyash (combusted coal waste material), as well as acidified mine water, pose major threats if they enter into local streams and water systems. Four informants cited legacy issues from historical coal mining as threatening water quality, including the above-mentioned acid mine water breakouts. One informant discussed mine subsidence as a danger to waterways, especially in re-routing natural streams and flows of water.

### 4.2.2 Organizations and Programs Involved

Informants most frequently identified the Group Against Smog and Pollution (GASP) as a champion for air quality, both related to coal combustion and other air pollution issues (e.g.

diesel engine exhaust). The Allegheny County Health Department, Division of Air Quality was discussed as an important player in air quality, as was Clean Water Action. The Center for Coalfield Justice and the Mountain Watershed Association were mentioned as two of many community organizations focused on environmental and health issues related to the impacts of coal mining. Citizens for Pennsylvania's Future/PennFuture, was discussed as a statewide advocate for clean water, air quality, and mining issues related to the many aspects of coal use.

### 4.2.3 Gaps and Challenges

Experts frequently cited outdated regulations and lack of enforcement as the major deficiencies in controlling for public health and ecological safety in this area. One expert spoke specifically about the regulations in Allegheny County:

> Allegheny County has many major sources of pollution, many more than many other counties in the state. And yet, our air toxics policies are extremely dated – twenty-five to thirty years old, I believe, certainly over twenty years old, the county air toxics policies and regulations. They need to be updated. By not updating them, the Allegheny County Health Department and county government, I think, are playing Russian roulette with the health of county residents. 'We don't want to know. What we don't know won't hurt us' –I think that's a really bad policy. They're concerned about scaring away businesses, but certainly, no good, modern business is going to want to relocate or even expand in an area where there [are] air toxic issues. Yeah, we need to get a better handle on those. [1]

In relation to the outdated air pollution regulations, several informants discussed or alluded to coal-fired power plants that were 'grandfathered in' under Clean Air Act and local air toxics regulations. Informants reported that officials allowed these plants to continue operating under their own supervision, with emissions greater than those permitted by local air quality policies, because they were in operation previous to instatement of these policies. Experts pointed out that some of the dirtiest and most hazardous plants have been allowed to continue operation,

without facing regulations placed on newer plants and other industries. They also indicated that these allowances were made due to historical political and economic alliances, as well as the earlier assumption that these older facilities would soon close and not continue to operate for as long as they have.

Coal combustion solid wastes pose another set of problems in southwestern Pennsylvania, according to experts. One commented that "The regulations on what to do with all the coal combustion wastes, the flyash, are pretty bad. Again, Pennsylvania's been sort of a leader in the country for having bad regs [regulations] for this. …In general, we haven't addressed that very well." [10]

Lack of clear policy and regulation to control handling of coal waste products is a significant gap, and creates a good deal of conflict, even among environmental scientists and advocates. One expert spoke about a current policy debate, whether flyash should be classified as hazardous or not. One side of the argument is that in a large pool for waste storage, this material constitutes a potential threat to human safety and water quality. However, if not classified as a hazardous material, it may be used in concrete and similar building materials, judged to be fairly safe by the speaker. Distinctions such as this further complicate regulation and enforcement, but these are the realities that need to be addressed by policy-makers, according to expert informants.

### 4.2.4 Best Practices and Recommendations

As experts mentioned previously, utilizing flyash solid waste material to create new, useful, and generally safe products (e.g. construction materials) was suggested as a best practice for dealing with already extant waste product, but not to encourage further creation.

A major challenge is the divide in opinion, even among environmental advocates, regarding the acceptability of continued coal combustion for electricity generation. Some experts felt it was reasonable to maintain coal use with improved air filtration and water protection, while others felt it necessary to find cleaner sources of energy altogether and no longer depend on coal in this way.

One expert spoke about coke manufacturing processes for steel production. He emphasized that this intermediary step of coke production to create steel is outdated, and strongly recommended a shift to cleaner, more efficient steel production techniques that are available and preferable.

Finally, informants made numerous suggestions to update and create tighter clean air regulations, and also advocated for better enforcement of any new or existing rules.

## 4.3 PERSISTENT LEAD AND ENVIRONMENTAL JUSTICE

### 4.3.1 Threats

Four informants reported specific concerns about environmental justice and the inequity present in distribution of risks, as well as protections in place for different populations.

Seven of nine experts noted that it was important to create policies and regulations to protect all members of the population, especially those people who are more susceptible to or compromised by a particular environmental threat. Immunocompromised people, like HIV/AIDS+ individuals, or those receiving chemotherapy, as well as other sub-populations such as children and elderly people were given as examples of special populations of concern. These

seven informants strongly recommended that regulatory policies be developed to protect all members of society, including those at greater risk because of some personal factor, including the neighborhood in which they reside and/or socio-economic status. The last two factors were noted to correlate with urban residency, older housing and potential childhood exposure to lead-based paint, among other environmental risks.

Four interviewees were particularly concerned about lead exposure, especially in children, which was cited as a strong example of a lack of environmental justice. Informants expressed that this problem was persisting, despite mitigation efforts, and poses a serious danger to children's neurological development. Informants traced the major source of exposure to older housing and lead-based paint, as well as exposure through contaminated urban soil, though they noted that lead removal from gasoline was a public health victory and had greatly lowered the risk of lead exposure to the general public. One expert commented,

> …we still know we have a problem with lead in the residential…sector. We don't use lead based paint anymore, but you can find lead in soil around houses, lead in paint chips, lead in the double hung windows abraded sufficiently to be a respiratory pathway risk. And there you're talking about, not so much about adults, as permanent effect on behavior and IQ in children. …You're going to love this one [showing us a journal article] …correlations between exposure to lead and adjudicated, what's the term they use? 'status as adjudicated', in other words, court involved youth. [4]

After summarizing this example of environmental injustice, discussing the article and the study's strength, as well as the weight of the cumulative and permanent effects of lead exposure on children, he added: "And once you get it [lead exposure] in there, you're set for the rest of this syndrome. And that's unfortunate. That's just plain wrong, in fact. People are impacted in ways that are beyond their control." [4]

Another informant discussed the concerns of lead persisting in the soil, due to many years of usage of leaded gasoline, especially in areas that are or once were dense and busy with

automotive traffic. After the interviewer questioned further about potential exposures, he went on to discuss soil contamination as a public health education issue for urban gardeners:

> There's a problem because we know there's a lot of lead in the soil, in fact we've measured the lead in the soil – it's high. As the wind blows that soil around, you know, it gets airborne and then it settles, it gets airborne and then it settles…it keeps doing that. As a result, when you have food that's growing, like, let's say a head of lettuce – that head of lettuce is going to get lead deposited on it from soil, and unless you wash it off really well, then you could be ingesting that lead. And much less of a problem for adults, but definitely a problem for kids. If they eat a diet that has a very high fraction of urban grown vegetables that are not peeled, then unless they are washed very carefully, those kids could be ingesting a lot of lead. And that could be a problem. [8]

Other issues were also noted as sources of environmental injustice, such as exposure to point source air pollution, like that from coal-fired power plants, chemical companies, or highways, and susceptibility of homes or neighborhoods to damaging flooding.

### 4.3.2 Organizations and Programs Involved

Informants noted Healthy Home Resources as an effective and helpful program in the city of Pittsburgh, working to address lead issues in particular. Additionally, the Lead Safe Pittsburgh Coalition was a group comprised of stakeholders from different areas, including the health department, scientists, and policy makers, as well as landlords and tenants, working on the same issues. This organization was deemed an effective project while funded by a grant from the EPA but is no longer active.

### 4.3.3 Gaps and Challenges

One interviewee critiques the public health system as sometimes missing the key concept of environmental justice:

> …looking at how to design policies that address equity…one problem that I see in the public health world is that we're always so resource strapped, that we always go for the 'biggest bang for the buck,' which makes sense. But, …if we always do that, we'll always only work on heart disease, because it's the thing that kills people… I think from the public's perspective, they're really looking to public health protections to kind of insure that we're as safe as we can be, and that it's even for everyone. I think sometimes there are public health problems that the public perceives, which public health people [workforce] don't, because they're like, 'well, it only affects three people, so we're not going to work on that.' [10]

The same informant voices other concerns about equity and makes recommendations about studying pollution issues at a community level, so as to capture information about those communities most at risk,

> So, it's sort of a question of, are we designing policies, are we looking at what kind of impact the policies…the equity of them? …[Standards] get averaged out, and it's like, 'well, overall, the impact's only going to affect this percentage, and we think that's acceptable'. But the trouble is that it's not equal. If that percent of it was evenly spread over the whole population…you could make an argument for it, at least, on a policy base. … So, it's sort of a combination of: we don't always think about that kind of thing when we design standards, and then the other thing is that we don't know – because we don't study based at a community level very much. And we don't listen to what the community is telling professionals about where the problems are coming from… [10]

The experts who spoke about environmental justice recognized many gaps in the system that ideally should be protecting entire populations, everyone and everything. These were mainly in the area of policy, recognizing that current policies do not protect everyone equally.

### 4.3.4 Best Practices and Recommendations

Within one critique above, a strong recommendation was made to listen to the community, listen to and for people's complaints and concerns about the health of the world around them. This expert notes that the people living in a situation know it best, not necessarily the policy makers or scientists.

In relation to lead exposure, involvement of community members was definitely recommended. It was noted as especially important to garner the involvement of parents, public health and medical professionals, tenants and landlords, and other stakeholders.

Overall, seven of nine informants made a point to discuss the necessity of considering all people within a population when creating policy to protect the public health, which they seem to believe is a standard toward which science is moving, but slowly.

## 4.4 UNKNOWN CHEMICALS IN THE WATER SUPPLY

### 4.4.1 Threats

All nine informants expressed concern about the quality and quantity of water available in the region, each citing a number of different threats. Related to the more specific threat of CSO discussed above, eight informants talked about unknown chemicals entering the water supply through storm water runoff. Many of these chemicals were from automobile and diesel engine usage on high-speed roadways, or herbicides and pesticides used in yards or more agricultural areas of the ten-county region.

Recent increases in natural gas drilling led four informants to speak at length about the dangers of water fracturing for gas acquisition, especially in the Marcellus shale, which experts fear may present currently unknown and irreparable damages to ground water and well water sources. One expert emphasizes his concern:

> It is a water factor. Most assuredly a water issue, it's on everybody's tongue now: Marcellus Shale. The way I see Marcellus Shale is we have the potential to create another monstrous environmental legacy, damage…legacy issue, the same way we did it one hundred years ago with coal. We're still dealing with acid mine

> drainage today because we made a fortune on coal, and it will never go away until the rain stops coming down. … We have the opportunity to repeat that on the same massive scale in this state, and New York, and West Virginia probably, and that's economically driven. But it concerns me greatly that somebody in one hundred years will be trying to clean up the legacies. And again, we're not talking about surface legacies, or the air pollution sort of issue where when you stop emitting, the problem goes away. But if you foul up the groundwater, and the subsoil, and the strata, it's wrecked. The water tables will be wrecked. … And that's a tough one because it's just… I heard it called a gas rush. We're in the middle of a gas rush. Forget oil rush, forget gold rush, we got a gas rush! [4]

Chemicals used in the fracturing process, some known carcinogens, as well as the total dissolved solids (TDS) content of the wastewater, were listed as prime concerns for four interviewed experts. One stated:

> Well, in the area of water, I think that the major threat right now is natural gas drilling. …the drawing of that water from a variety of sources, that may or may not be affected in terms of their volume and flow, the chemical contaminants that are added to that water, and how they're injected underground, what happens to them there, how they come out of the ground, and how they're disposed of. All are probably…there are issues involved with…that whole continuum of water use by the natural gas industry. [1]

Further expert commentary centered around the seemingly largest issue of contaminated waste water from hydraulic fracturing processes and the negative impacts it may have:

> The human health [and] water impacts from gas well drilling, higher levels of total dissolved solids that cannot be removed from public drinking water supplies, will affect some people with different immunity deficiencies, could potentially have other health effects for the general population. Certainly, there's an aesthetic effect, an equipment effect… The damage that high TDS [total dissolved solids], water with high TDS levels has on industrial machinery, household machinery, including dishwashers, …clothes washers, all of that stuff could be affected… an economic impact. [1]

Five informants spoke about concerns for the safety of untested, unregulated well water commonly used in rural parts of southwestern Pennsylvania. A variety of legacy chemicals, which can move through groundwater at differing rates, as well as high bacteria levels from poor sanitary sewage management or natural causes (e.g. wildlife activity) were discussed as potential

well water contaminants that could prove harmful for human ingestion. One informant, who depends on well water for his home drinking water and helps to manage this resource for his home municipality, makes a point:

> We're running into issues in our well system. We have ground water wells for drinking water, with chemicals that people no longer use…ending up in the wells. So there are legacy issues from historic dumping or historic leaking underground storage tanks, things like that. Some of the gasoline additives are MTBE, methyl tertiary butyl ether, which was used in…frankly, I didn't know until a few years ago that it was actually used in this region. [2]

Other informants also mentioned MTBE contamination, both along heavily used roadways and at legacy sites where auto mechanic shops or similar facilities once existed, often with no record of the condition in which their site was left.

Four informants discussed the presence of pharmaceuticals, including antibiotics and estrogenic compounds or endocrine disrupters, in drinking water sources through human medication usage, as a poorly understood and potentially dangerous threat. One informant mentioned the recently newsworthy, potentially harmful plasticizer, bisphenol A, by name, in expressing frustration about how consumer and marketing decisions can be swayed much more easily than governmental regulatory policies: "…endocrine disruptors, BPA…of course now BPA seems to be the nightmare word and it's gonna be gone because WalMart said so, but not because we had any courage to ban it."[4] Meanwhile, three others stated that they were concerned over many known and unknown chemicals, including those from personal care products and cleaning solvents that have been found in drinking water sources, and have already been studied for their health impacts on aquatic life. Another expert points out research that has been conducted on other species living in the local water supply: "…we've got a lot of good amphibian [and] fish information, but it's moving uncomfortably closer to humans," –

addressing observed disease and mutation in aquatic species, effects often disregarded by the public and policy makers for their relation to human health.

One informant spoke at length about the need for better regulation of home and personal care products, suggesting a system similar to that currently in place for pharmaceuticals.

> The screening process is not nearly…it's not strict enough, but it's also that you have to demonstrate that there's some pretty significant damage for the government agencies to want to actually prevent you from using it [new product]. And part of the problem is – until you use it on a large scale, you may not see that damage. … We would rather see a situation where you need to demonstrate that this has been tested enough that you can say it's safe, or have some certainty of safety before using it on a large scale. A little bit more like how pharmaceuticals are put on the market. … We don't do that very well with our…with chemicals in other products. Which is not, I think, substantially different from pharmaceuticals, a pharmaceutical is just a different type of chemical. [10]

Two experts addressed radioactive wastes. One discussed decommissioned industrial sites, "where uranium was refined. And where a lot of waste was dumped, and then subsequently, never really cleaned up." [3] The other discussed a potential danger in radiation therapy as a source of water quality contamination and threat.

> We just don't realize that a lot of what we take in in the hospitals or that we're given for our health, actually winds up in the sewers and out. A good example: in our research, we use a little bit of radioactivity…We're highly regulated; we're not allowed to dispose of anything. If you had a thyroid cancer, …they'll give you radioactive iodine to kill your thyroid…then your body excretes it, and the half-life of the radioactive iodine is about a few days or so…it's going right out the toilet, and into the system. From one thyroid patient, there's more radioactivity released into the environment than what we probably use in five years in the lab. [5]

These informants recognized that therapeutic radiation is completely unregulated once administered to the patient, in stark contrast with institutional regulation, and could pose a danger to aquatic plants and animals, as well as source waters for human consumption.

The list of possible water contaminants could extend almost indefinitely, according to this group of experts, but another example summarizes the major theme of prevention, which was found within all of the interviews. This informant was speaking in reference to the water quality effects of concentrated animal feeding operations (CAFOs), another of many threats raised as probable issues for water quality.

> …it's probably a lot *easier to not put things into the system, rather than have to take them out of the system afterwards*. So, if you provide alternatives, if you come up with better ways of treating the chickens or the turkeys, etc., so they don't get the bacteria that you'd have to give roxarsone[6], if you don't have to give the drug, that's better. [5] (Emphasis added.)

### 4.4.2 Organizations and Programs Involved

Many of the same organizations working on issues surrounding wet weather events and protecting water quality from combined sewer overflows are, unsurprisingly, also interested in other threats to water. Clean Water Action was identified by several informants as a major contributor to water quality and safety, as was PennFuture. Many local watershed associations were reported as being active in southwestern Pennsylvania, including the Mountain Watershed Association, Slippery Rock and Nine Mile Run Watershed Associations, as well as Yough River Keepers and other similar River Keeper community organizations. The Center for Coalfield Justice was mentioned as an advocate for clean water, especially relating to acidified mine water drainage, flyash waste storage pools, and other water issues based around coal mining and use.

[6] Roxarsone is an antibiotic made with arsenic that is used for poultry, particularly in large quantities in large animal production facilities, where animals are kept in close contact and are more likely to contract and transmit diseases.

Additionally, the Allegheny Land Trust was mentioned for working with Pennsylvania Environmental Council to set up passive remediation areas for acid mine drainage.

Even private companies were discussed concerning the protection of clean water supplies. A for-profit water company, Pennsylvania American, was cited as one of many water provision companies located across the Marcellus shale region that is quite concerned about the loss of any significant quantities or quality of their product – fresh drinking water. Experts noted that resistance to natural gas drilling from within the private sector may be quite beneficial for controlling water problems that hydraulic fracturing may cause, as they create market competition for resources.

### 4.4.3 Gaps and Challenges

As revealed above within the quote about MTBE found in local drinking water wells, even those who are in the business of knowing about environmental issues feel a serious lack of information concerning legacy chemicals that have been left by previous users, often without any record. According to the five experts who discussed safety of well water drinking sources, these unknown chemical contaminants pose a meaningful threat to the safety of the public in the southwestern Pennsylvania region. Further, the primary gap in addressing this environmental hazard was reported to be a lack of information about what, where, how much, and the effects of so many possible chemical contaminants on water sources. Experts continuously expressed disdain at a lack of knowledge within the scientific community about the threats, including ecological and human health effects related to the presence of pharmaceuticals and personal care products in water sources, as well as proprietary chemical mixtures used to drill for natural gas, among others. In many cases, informants felt that a lack of research to support a contaminant's

relationship with human and ecological health made situations even more difficult to change; most recommended further research on nearly every mentioned threat and its association to health.

As the possible array of threatening substances is not well known, they cannot be well regulated, and without strong scientific evidence, few governmental regulatory bodies are willing to create and enforce potentially unpopular regulations. These are the major gaps to creating strong policies to prevent degradation of water quality.

### 4.4.4 Best Practices and Recommendations

The suggested best practice in dealing with unknown chemicals was a recommendation for prudent choices and prevention. One interviewee commented, "…that's kind of a core principle, that applies to the whole…hazardous consumer products issue, …you want to prevent these products from existing, rather than manage them after they're already out on the market." [10] This quote provides a good synopsis of the sentiment expressed by all experts concerning unknown water contaminants.

Several types of technology were mentioned for the purification of contaminated water. Granulated activated carbon (GAC) filtration was discussed by two informants, and noted as "the best management practice for many years." It provides a very practical solution for improving drinking water, in that it is fairly inexpensive for home use and very effective at removing unsafe materials in the water. Newer technologies for air stripping were also suggested as a fairly inexpensive model for municipal water treatment. In this process, a large silo-like tube is filled with little diffusing plastic balls that break up water droplets as the water is poured down over them. Simultaneously, air is forced up through the tube, stripping away the most volatile organic

chemicals and releasing them into the air. This produces safer water, and the chemicals released into the air are at concentrations much lower than even those created by an automobile.

Reverse osmosis, which is used for seawater desalination, was even suggested as the best technology to purify water with a heavy load of total dissolved solids, like that draining from abandoned coal mines. However, this process, while very effective, is also quite expensive, and therefore is not often a first choice.

## 4.5 ADDITIONAL ENVIRONMENTAL THREATS

While the four groups of threats above were those most frequently discussed by expert informants, other ecological and public health issues of merit arose during the interviews. Indoor air quality was a threat discussed by two informants, including risks associated with chemical, allergen, or other airborne, indoor hazardous exposures, especially concerning impacts on children's health and rising asthma rates. Six total informants attributed air, water, and soil quality threats to automobile traffic, with an emphasis on diesel engines. They noted that gasoline and diesel engines frequently used for transportation deposit chemicals from combustion processes into all of these natural media.

Generally, experts alluded to the impending causes and problems that may arise due to global climate change. One spoke about increases or changes in regional disease susceptibility, referencing diseases currently not suited for the southwest Pennsylvania region, that may be able to survive here with a change in climate. One informant talked about invasive species, including insects, plants, and animals, as a threat to current regional ecology and public health. He alluded to risks of vector-borne diseases, carried by insects that may soon be able to survive in the

Pittsburgh region, again due to climate changes. Water quantity and quality was the largest concern associated with climate change. Experts acknowledged that the focus region is unlikely to suffer from massive drought, as other areas in the United States might, if climatic conditions change in upcoming years. However, they referenced the many other examples of degradation to water quality, already discussed, as ways in which the local supply of water could become too damaged to provide a good source of drinking water and habitat for aquatic species. At least one informant expressed a concern over a price increase on water, if a potential shortage of clean water were to occur - further limiting the availability of clean, fresh water sources on which everyone relies.

The current food system in the United States also came under some scrutiny by experts, who noted a number of threats inherent in the system. One informant spoke about the ever-present threat of food-borne illness and the importance of education regarding home food preparation and sanitation, as well as commercial. Three experts mentioned threats of food safety related to production, including human exposure risks to hazardous chemicals used in agriculture and environmentally degrading food production methods (e.g. CAFOs). Additionally, they spoke about related food production threats, and particularly availability of quality food sources for everyone, which is inextricably tied also to climate change and water availability.

One informant talked about the emotional and mental stress related to noise pollution and discussed studies in which exposure to excess noise pollution was associated with increased blood pressure and other measures of stress.

An informant with a personal interest in urban planning commented: “What I also think is a quiet threat is a lack of walkability and a lack of accessibility and a lack of accommodating

outdoor spaces, as well as public transit, which I think translates into human health issues around everything from heart and diabetes, to psychological impacts." [6]

Finally, many informants addressed the importance of a good quality of life as a central goal for all environmental protection and conservation work. Serious threats to a high quality of life arose in discussion of environmental injustices, but also in relation to issues regarding a changing economic framework, and its impacts on socio-cultural factors. One informant shared this view:

> I've been doing a lot of work on how the natural gas industry has been developing here, and one thing that seems really clear from people living in communities that are impacted by this, is that they feel like, what are essentially rural, agriculturally-based communities are being changed into essentially little industrial communities. And that, you know, that's a very big shift for them, in terms of how they view where they're living. In a lot of ways, that's what upsets people the most. Like, people, you know, are living in a particular place for a particular reason… And you know, all of a sudden, someone else is changing that. And they feel very frustrated that they don't have control over how their community is changing. [10]

# 5.0 DISCUSSION

The goal of this study was to understand the major threats to the southwest Pennsylvania region, as viewed by educated experts who deal with these issues regularly and are personally and professionally invested in environmental improvement. A wealth of rich information was gathered through the ten informant interviews, elucidating far more ideas than could be discussed in this thesis. The four topic areas examined were chosen because they seemed to best reflect the major ecological and environmental health threats brought to light during the expert interviews.

Clearly, concern for quality and quantity of water is a major issue to environmental experts in Pittsburgh and the surrounding region; members of this community identify with their local river system and feel tied to the importance of water, which was evidenced by the large number of citizens' watershed and River Keeper organizations that came out in the discussion of environmental advocates. Water is also central to the vitality of the region for transportation, recreation, and visual appeal, a key in attracting new businesses and residents, and economic development that does not abuse the natural environment.

Today, southwestern Pennsylvania is saddled with the political, economic, and environmental history of strong favoritism toward extractive and ecologically exploitive industries. The consequences of these past and current uses threaten air, water, and soil to the present. As one informant noted,

> It's all interrelated: politics, the historical political persuasion here favors the extractive industries. The laws were written either by the extractive industries, or

> by legislators who were beholden to extractive industries – certainly ones that get political donations from them. So, it's an uphill battle to regulate them given the set of laws that existed in the state. It's gotten a little bit better, but not really. It still takes a lot of effort from community groups and environmental groups to call attention to a lot of these issues. [1]

Companies and policy makers saw, and perhaps still see, the land only as a potential resource, available for people to make money or build upon or use in whatever way they see fit, rather than appreciating the natural environment as its own functional, thriving system. This leads into one of the crucial recommendations voiced by experts – to increase public education about environmental issues. An appreciation for the rich and complex natural system may create stronger sentiments of responsibility for citizens and entrepreneurs, promoting preservation rather than extraction.

Public engagement around environmental concerns is fundamental to building the necessary momentum or political force to make major changes and support resource conservation and responsibility, over consumption. Additionally, it is very important to connect reports of environmental threats to everyday reality for people who have not spent their time studying these types of issues. It is crucial to communicate messages emphasizing the reality of current environmental threats; that they can affect the lives of everyone, including people who are rich, poor, more or less educated, without racial or national borders. It is most important to convey that public participation and interaction can alleviate and change these threats. They are not hopeless cases that cannot be altered, but rather circumstances ripe for a motivated citizenship to take action.

The most important and insightful recommendation for public education came from one of the interviewees who was engrossed by this task. He emphasized the necessity for people to understand the relationship between humans and the natural world; particularly, the way the

world would exist without human beings in it. Upon reflection on the damages inflicted on natural resources and other species by people, it could be argued that the natural world would be better off without humans. Clearly, this is a hypothetical position, but it can be effective in making points about the behavior of mankind, and how it plays out for the natural world. Another insightful comment by this expert:

> I think that one of the problems we have today is that most people are going to count on technology to solve the world's problems. And I think there's a real disconnect between understanding how much can technology do, and how much will technology never be able to do – when you've got more than six billion people on the world. No matter how good your technology is, you still have the needs and the health of almost 7 billion people, now. So, I think it would be helpful for people everywhere to have an understanding of the limits of technology, the limits of the natural world. …how that reflects on the limits of their actions, and what their actions should be. [8]

Unfortunately, it does not seem that everyone is considering the full ramifications of their actions or working for the betterment of all, but rather the advancement of few, which returns to the issue of environmental justice. A number of experts addressed justice and fair distribution of the threats and benefits incurred by environmental degradation or preservation. The inherent unfairness is obvious when people with fewer resources are unable to move away from a threatened or more risk prone community (e.g. greater pollution sources, flood-prone areas).

Through these expert interviews, serious policy and regulation deficiencies were seen, such as those allowing some populations to bear the brunt of environmental degradation while others are able to live relatively free from risk. Many examples show a system of people at the top of the socio-economic scale reaping financial or quality of life benefits, while those with less financial and political power are living near the waste sites or with contaminated water supplies, resultant from actions not within their control. In conversations with informants, several talked

about this type of unjust situation and unfair power dynamics, which understandably caused them feelings of unease.

As an example of environmental injustice, experts highlighted the persistence of lead as a threat to human health through its surprisingly numerous mentions during interviews. Proximity of homes and neighborhoods to coal-fired power plants, coke-processing facilities, landfills, high traffic roadways, and other hazards were also discussed as issues related to injustice. Early life exposure to lead was so concerning to informants because of the lifelong implications that it may have on the exposed person and his/her family and community. Children exposed to lead can suffer physical, mental, and behavioral health problems, leading to poor performance academically, socially, and more. The great injustice here is that a child exposed to this toxic chemical may be debilitated in essentially all his/her capacities for his/her entire life. This type of permanent damage is truly a public health problem that needs to be immediately addressed. Perhaps more frightening, lead is one of the more well understood exposures, many other chemicals and products used and disposed of in southwest Pennsylvania and globally are not as clear, and may produce similar or even worse consequences.

A different type of injustice may occur for people who are already suffering from an illness or some health problem. Often, those suffering from poor health conditions are also more susceptible to damage from decreased air and water quality. While current regulations uphold safe standards for the general public, people already dealing with poor health may not be adequately protected by these standards. An example of such a situation exists for many organ transplant patients with suppressed immune systems, who are cautioned by their physicians to avoid drinking Pittsburgh's city water for their own safety. This is because of the presence of opportunistic microorganisms, such as giardia and cryptosporidium, which could attack their

bodies much more easily than those of healthy people (personal communication with patients). This lack of basic protections for safe air and water for all citizens is a threat to equity and environmental justice.

Lack of knowledge regarding the ties between health and environmental threats was a major issue that arose in discussion with experts. They identify a deficit in information, especially in research-based scientific understanding of links between environmental hazards and human health effects that presently needs to be addressed. While some associations have been determined, a great deal more study is needed to understand which contaminants and chemicals pose the greatest danger to human health, the ecological health of the region, and the health of special populations.

Experts also discussed the unknown effects of cumulative exposures during interviews. They cautioned that exposure to many pollutants in combination may create unknown dangers: even exposures whose human health impacts are fairly well understood when alone, may pose a completely different condition when combined with other exposures and outside factors. The potential for damaging, synergistic impacts on both ecology and public health is largely unknown. It is especially notable that this type of information is lacking, considering that in reality few people are ever exposed to a single contaminant alone, without any interactions, as in a laboratory setting. This type of cumulative effect was discussed in relation to exposure to heavy metals, stress and noise pollution, air pollution and cardiovascular events, and other exposure combination possibilities.

The principle of prevention is stressed as a core tenet in planning for ecological and public health for the future and for current actions. Many of the threats discussed by these key informants are essentially preventable. One informant summarizes the situation, “I think the

best, some of the best practices are to not let things get into the system to begin with. We're working with a lot of old habits that we didn't know were destroying the environment, or weren't really aware of how much it really affected health." [5] Another similarly comments about the issue of lead exposure and the removal of lead from gasoline,

> We got lead out of the gasoline; we got lead out of blood. Beautiful to see those charts over thirty years. You notice there, it wasn't a matter of pollution control. It was a matter of utter prevention. In other words, you just don't do it. Prevention – source reduction, ultimately elimination. Wasn't about capturing at some point of discharge. It was about changing the system. [4]

So, the running challenge is to change the current system. We need to find ways to prevent contaminants from getting into water sources, air, soil, and consumer products, rather than building filtration systems or issuing recalls to remediate concerns once contaminants have already injured someone or harmed biological systems.

However, a conflict often arises when safety measures appear to contradict economic growth or meeting the needs of consumers, according to policy makers or the general public. A balance is needed between the consumption requirements of people and the natural amenities we hope to still have available in the future. The concept of balance is crucial in attempting to meet the needs of all parties. It might seem valuable to fight for a total end to some type of dangerous pollution, but as most of the experts noted, there is a need for the products being created; if no cleaner alternative exists, it will be very difficult to pass any type of ruling against the older product. One informant recognized the issue of balance in concerns over water quality and gas drilling in the Marcellus shale, versus the benefits of a cleaner source of electricity concerning air quality (i.e. coal versus natural gas):

> I think we're stuck right now without a really clear policy of how to handle the gas drilling and how to pay for that. So, I think the air policy has to come into play to bring the need for the gas into balance with the potential health effects of

> pollution from the water they use to fracture, and to get all the industries to pay for things along the lines, so we have good clean water, and good health. [5]

The challenge today is to strike an appropriate balance to make a good quality of life available for all people, allowing for technological and communication advancements, travel, housing, and other benefits, while still preserving and protecting the other creatures and resources on our planet.

Quality of life was a central goal for improvements being made and suggested by the informants, even in their own regular work. Experts stressed that a good quality of life required natural benefits such as open green space, clean flowing waterways for swimming and fishing, fresh air to breathe, and safe food to eat. One informant spoke about attaining high quality of life in local communities: "Well, you don't get quality of life with income only. You get quality of life with amenities – clean air, nice water, green space, trout in the stream, symphony orchestras, you know, football teams, whatever. It's not just the money; it's the cultural assets, the natural assets." [4]

Flooding has always been an issue in southwest Pennsylvania, due to the topography and natural conditions of the region. However, the frequency and intensity of damaging floods and contaminated runoff seen in recent decades have surpassed those of previous, historical events. Increased sprawl and extension of impermeable surfaces, especially in upper elevations, have removed the natural protections against these wet weather events, as well as augmented the source problems, by speeding the flow of water quickly from upper, paved areas toward the rivers and lower elevations, where flooding then hits hard and fast. One informant talked about the issues surrounding increases in impervious surfaces with growing developments:

> I think that there's this wide variety of threat to water quality form increasing impervious surfaces. So, some of it contributes to the sewage overflow problem, some of it just contributes to overall storm water runoff going into the storm

> sewers and going directly into our rivers. …while southwest Pennsylvania doesn't have as much sprawl as, you know, East coast cities…it's impressive that we can have as much sprawl as we have, given that our population has been steadily declining for a long time. So, Pittsburgh is down to, you know, half of its historical high in population; yet, we seem to…keep spreading people out. So, that's something which is definitely a major threat, because, I think, of the region having a difficult time economically; it's been harder to put in the proper controls on development, because every municipality sees development as being important. So, that keeps driving more and more building, even though, it might not be something that's gaining the region, economically, but because our system is all divided up into these little fiefdoms of municipalities…everybody competes with each other. And that also increases the amount of development that happens, although it doesn't necessarily increase the economic activity, because frankly, there's a limited number of people here… [10]

Informants frequently mentioned or alluded to the interplay of politics and government with environmental threats. They were often referring to noted gaps, such as a lack of unified governance over the wet weather and combined sewer overflow issue, or in recommendations made for cooperation and unified planning. Occasionally, political will was related to a certain level of misconduct, as in the 'good ol' boy' network of politicians, referred to by one informant. This informant spoke of politicians allowing historic, 'untouchable' polluting industries to continue in their own ways without proper regulation. These public servants were obviously not serving the people's best interests in regards to their health and environment.

Informants reported a key systemic problem leading to environmental threats. They realized that most agencies working to improve the function of systems (e.g. utilities, transportation, pollution regulation) were simply creating small 'patches' or treating the symptoms of a larger problem. A number of examples were given to illustrate this occurrence, including the local problem of an aged and barely functional sewer and water management system. As this problem has grown and become more evident to those governing its function, there have been temporary fixes: building bigger pipes or suggesting more or bigger water treatment facilities, instead of addressing the underlying and contributing issues: shunting natural

waterways underground as part of the rainwater runoff system and unscrupulous overbuilding in areas that should be more thoughtfully and sustainably managed. Another example was given on a national scale: this informant made a strong critique of current projects to expand and connect the electricity grid on a national level, as well as building many power generation units in close proximity to send power all over the country. This expert suggested that perhaps smaller scale power generation units, built to use local resources and create smaller amounts of pollution, could serve smaller regions, without shipping fuels across the country, concentrating the burden of pollution, or depending on an expensive and perhaps unreliable network of electrical distribution. As evidence of the current problems with the electrical system, this informant discussed both the Ohio valley concentration of air polluting coal-fired power plants and the number of massive blackouts along the East Coast in the last five to ten years. Installing marginally better stack scrubbers or making incremental improvements in local outdoor air regulations, was another frequently mentioned example related to coal-fired power plants intended to better protect air quality. A more functional solution might be to conserve electricity and focus development energies not on small changes but on alternative power solutions. Informants suggested it might be better to simply build a completely new and different form, rather than continue to try and make small updates to an outmoded way of energy production and dependence.

Following the same model as above, suggestions for promotion of smaller, local production was also applied to our current food system. Experts lamented that our current food system involves an incredible amount of air-polluting cross-country transportation, millions of gallons of dangerous chemicals and petroleum-based fertilizers spread onto soil and into food animals, contaminating local water quality, as well as the potential safety of the food itself. All

of this occurs in addition to harming local economies by keeping food production consolidated as big business. While these issues are not always seen as major environmental threats, informants spoke passionately about them in interviews, and provided a great deal of insight to the underlying causes of current problems.

Through the examples above, informants made clear they felt that a majority of agencies, including federal, state, and municipal governments are consistently addressing environmental threats on a reactive, case-by-case basis. According to informants, some bodies of government are unable to address, or unwilling to recognize, the inefficiency of putting a metaphorical 'patch' on the symptoms of every issue. They are encouraged to take the admittedly larger, more costly, more time consuming, and more difficult step of prevention.

These criticisms lead easily to expert recommendations for large-scale systemic overhaul. In obvious relation to reactive, 'patching' of larger problems, many of these situations may require revolutionary changes, some in unifying governance to find agreement on plans to act, and some to change the balance of power from large corporations back to the agencies regulating pollution and resource use for the benefit of the land and the people. Still another 'overhaul' was recommended to shift public opinion through education, to emphasize principles of conservation and sustainability as reachable goals and national values, replacing the push for constant consumption.

A major change is needed to protect ecological and public health, both regionally, and nationally, and this is mostly in the area of personal and corporate responsibility. Companies and individuals need to be made responsible for the resources and materials they consume, from start to finish. One informant advocates for a full lifecycle approach:

> So, if we do things in a more 'green' way of thinking 'cradle to cradle,' instead of 'cradle to grave.' And we think about, logically about how much cost is it going

> to be to actually use a product and get rid of the product, rather than just how much does it cost to make the product itself. As you think more about that, I think that we can do more for efficient costs, more efficiency in the system and less pollution. And so, it's improving the awareness that you have problems with some of your practices, then helps you start remediating. So the best practice is, again, is thinking logically about the whole system, rather than just little parts of it – and then, winding up having to clean up fires... And I think economically, the more efficient you are with all your materials management and waste management, the more economically viable it's going to be. I don't think you have to lose money to have a great environment. [5]

Interestingly, experts did not seem to be limited by their own field of expertise in providing a broad spectrum of environmental threats and concerns. Most knew and spoke about a scope much wider than that of their current investigations, though one was particularly reticent in making confident statements outside of his field of research. This informant made several comments like, 'I think X [some threat] may be causing problems, and I know that Y [other researcher] and Z [organization] are working on it, so that must mean it's important'.

Many valuable insights were realized throughout this process of interviewing and data analysis. Expert informants provided specialized information and demonstrated their acute awareness of environmental issues. Individual threats and contaminants were brought to light, as were more intuitive personal perceptions of overall system functions. Through careful assessment, informants provided creative, applicable recommendations for solutions, as well as honest views of current situations regarding environmental threats. Their information was invaluable in understanding the ecological and public health threats present in the Pittsburgh region.

# 6.0 CONCLUSION

This thesis has presented the use of expert interviews and qualitative analysis to gather perceptions about ecological and environmental health threats in Pittsburgh and the surrounding southwestern Pennsylvania region. Informants shared their opinions and beliefs about pressing issues, and some of that information was reported here. The major issues discussed included threats: (1) to water quality by Combined Sewer Overflow (CSO) and wet weather events, (2) to air, water, and human safety from coal combustion and processing, (3) of a lack of equity, or lack of environmental justice, and finally, (4) of new and unknown chemicals and contaminants in the water supply, again posing risks to the quality of water resources. The four topic areas presented, as well as organizations involved and themes discussed, provide a basic summary of the wealth of information that was gathered through this interviewing process. Common issues arose, such as concern for the safety of local fresh water resources, a desire for further public education and engagement, and a strong goal of prevention of hazards rather than remediation after some damage. Finding a balance between economic goals and human growth with the often-opposing goals of ecological conservation and public health promotion was a major feature of the discourse with local experts.

This study posed some minor limitations, in that the expert respondent information was drawn from only nine complete interviews, due to time constraints on the larger PRETA project.

While the author cannot be sure that a saturation of ideas was reached through this set of interviews, main issues were repeated by expert informants.

Secondly, the main researcher of this study had limited experience with this type of work before beginning interview sessions. Thusly, interview techniques may have improved throughout the study, gathering more in depth material in later interviews. However, this inexperience may also have led to further questioning to understand concepts agreed upon by researchers in the environmental field, thus gleaning further information and explanation from experts.

It is recommended that the ten-county southwest Pennsylvania region adopt some regional policies, regarding water management and air quality, so that they can work cooperatively to solve or prevent problems that may arise in the future. Regional policies should adhere to principles of prevention, as strongly advocated by these environmental experts. Goals should be set to restrict use or release of some material until it has been proven to not harm ecology or public health, to provide the highest possible level of environmental protection for the general population, as well as at-risk subpopulations.

Clearly, further research is recommended in a number of areas: to better understand the human health and natural environmental impacts associated with extant and potential environmental threats, to seek better processes by which to manage current pollution sources, as well as create new systems that may circumvent these contamination problems. Finally, public awareness and engagement should be a focus for public health workers and other environmental advocates. Individuals need to understand their relationship to the natural world, and be willing and able to take responsibility for that relationship. Only with the cooperation of many can large systemic changes occur, for the benefit of humanity and the rest of the natural world.

# APPENDIX

## PRETA INTERVIEW INTRODUCTION & SCHEDULE

### Introduction

Good morning/afternoon. I am here to gather your perspectives regarding important environmental threats to the southwestern PA region or portions of it, both to human health and the ecosystem in general. This is the first step in performing a Pittsburgh Regional Environmental Threat Analysis (acronym PRETA), a project funded by the Heinz Endowments and conducted by the Center for Healthy Environments and Communities of the University of Pittsburgh Graduate School of Public Health.

PRETA will initially cover southwestern PA, a 10-county region as defined by the Southwestern Pennsylvania Commission. PRETA will consist of: scanning key informants' perspectives and knowledge, as well as organizational websites, newspapers, and government and academic reports, for environmental threats; surveying organizations throughout the region involved in threat reduction; researching best-practices available to reduce environmental and environmental public health threats; and distributing the results.

More specifically, your involvement will help us to: form an initial list of general environmental and environmental public health threats; understand the basis for choosing those

threats; find databases, literature or reports substantiating the threats; determine the programs or projects underway to address each threat; and assess the potential for those programs being effective at reducing or eliminating the threat. To ensure that your responses are as candid as possible, your participation will be acknowledged only if you wish, and individual responses will be kept confidential.

PRETA Key Informant Interview Questions

[Examples and emphasis added for guidance of interviewer.]

1. Can you tell me what you think are the major environmental threats to this region or portions of the region? And your reasons for choosing these?

   -- I am interested also in human health threats and threats to the general environment.

2. Could you share your perspectives on any particular environmental media (water, air, etc.) and related high concentrations of contaminants in southwestern, PA?
   - Do you have any data regarding this?

In terms of what you have just talked about…

3. **What are the contaminants of highest concern to you in this region, and why?**

   -- Examples: heavy metals, pathogens, carcinogenic substances

4. Can you tell me more, especially about sources of the contaminants you have mentioned?
   - Again, do you have any data to support this?

     -- Examples: Power plant emissions or natural gas drilling/frac water

   - Given that, do you think there are other, related media that actually affect the media you mentioned earlier?

     -- For example, do you see air deposition from coal-fired power plants affecting heavy metal concentrations in fish from nearby rivers/streams?

5. Tell me your view on the effects of the aforementioned environmental problems.

    -- Examples:

    - Do you feel that the environmental issues we discussed before are affecting public health and/or the region's economy?
    - Do geographical regions play a part in this?

6. You have spoken about source(s) of contamination…

   **What policies or programs are in place to address this threat or each one of these threats, if any?**

   - Please elaborate.

     -- Examples: implementing fish consumption advisories or rebuilding inadequate municipal sewer infrastructures

7. Can you tell me what you know about organizations working on these threats we are speaking of?
   - How are they successful and what challenges do they face?
   - Is there data to support this?

8. Do you know of any *best practices* for addressing this problem (or these problems) that have been established in other regions?
   - Could you please elaborate?

<u>Comments</u>

9. Is there anything else that has come to mind that we have not asked or you would like to add to this conversation regarding threats to our environment here in southwestern PA?

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