Appendix B - Pollutant Information

Lead, Pb

Description of Pollutant
Lead is a bluish-gray metal that occurs naturally in the earth's crust. It has been used by humans for hundreds of years to produce pipes, and was widely used as a gasoline additive until the 1980's, when a worldwide movement began to ban its usage in fuel.

Common Sources
- Mining and smelting operations;
- Fossil fuel combustion from industries and vehicles;
- Industrial sources like battery production and recycling facilities, gun and ammunition factories, metal disposal and recycling facilities and electrical components manufacture;
- Domestic sources like flaking lead-based paint and water supply pipes;

Human Exposure Pathways
- Exposure to lead occurs mainly via inhalation or ingestion of lead dust. Lead can also be absorbed through the skin if present in dust or soil to which people come into routine contact.
- In areas near lead contamination sources, ingestion of contaminated dust or soil is often the pathway of most concern. Food on the ground or exposed to lead dust may become contaminated and then eaten, children may eat with contaminated hands after playing in contaminated areas, and dust may be caught in nose, throat and lung tissue and subsequently be coughed up and swallowed. In general, if adults and children swallow the same amount of lead, a bigger proportion of the amount swallowed will enter the blood in children than in adults. Children absorb about 50% of ingested lead.
- Humans can be exposed to lead through drinking water where contamination has occurred by the corrosion of old lead pipes.
- Drinking water may be of concern where soluble forms of lead are present in surface or groundwater used as a water supply. Note that lead solubility varies depending on the chemical form, with lead oxide and lead sulfate being highly insoluble (and therefore less of a risk from drinking water) while organic lead compounds are often quite soluble.

Human Health Effects

- Neurological disorders such as lead encephalopathy.
- According to WHO, children with blood lead concentrations of between 12 micrograms per deciliter (µg/dl) and 120µg/dl can suffer from lower IQ, shorter attention span, reading or learning disabilities, hyperactivity, impaired physical growth, hearing and visual problems or impaired motor skills.
- At blood concentrations above 70µg/dl, risk of encephalopathy is high and treatment is required.
- Acute symptoms from high levels of exposure include stomachache, irritation of the colon, kidney malfunction, blood anemia and eventually brain damage.
- Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in children.
- At blood concentrations of 70µg/dl in adults, symptoms are difficult to detect, but may include increased fatigue, short term memory loss or lack of coordination. At levels of 150 µg/dl acute poisoning, which can cause adult encephalopathy can occur and can ultimately lead to brain damage.
- In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production.

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Mercury, Hg

Description of Pollutant

Mercury occurs naturally in the environment and exists in several forms that can be broadly categorized into metallic mercury (elemental mercury), organic (bound with carbon), and inorganic mercury (not bound with carbon). Inorganic mercury compounds occur when mercury combines with elements such as chlorine, sulfur, or oxygen.It is a dense, silvery white, shiny metal, which is liquid at room temperature in its elemental form. The most common organic form of mercury, methyl mercury, is of particular concern as it can accumulate in fish and thus get transferred through the food chain. Mercury is widespread and persistent in the environment.

Common Sources

- Burning of fossil fuels (particularly coal-fired utilities) is the major source of mercury emissions to the atmosphere.
- Any facility using mercury in its process is a potential source of mercury emission.
- Smelting processes may contribute to a large percentage of mercury releases.
- Some inorganic mercury compounds are used as fungicides.
- It is used in measuring and control equipment (thermometers, medical equipment).
- Also used in copper and silver amalgams in tooth filling materials.
- Mercury-containing products such as batteries and electric lamps contribute to mercury emissions at municipal and hazardous waste dumps, and medical waste incinerators, and may leach out from landfills.
- Chlor-alkali plants, metal processing, and mining of gold and mercury contribute greatly to mercury concentrations in some areas, but atmospheric deposition is the dominant source of mercury over most of the landscape.
- Natural sources of atmospheric mercury include volcanoes, geologic deposits of mercury, and volatilization from the ocean.
- Some local mineral occurrences and thermal springs naturally high in mercury have also been documented.
- Bioaccumulation occurs in fish, which can expose individuals with a high fish diet to high levels of mercury.

Human Exposure Pathways

- The general population is commonly exposed to mercury primarily by consuming mercury-contaminated fish. There is about 95% absorption in the gastrointestinal tract of methylmercury and generally less than 10% absorption

in the case of inorganic mercury.
- Common exposure also occurs via the release of elemental mercury from dental amalgams used in fillings.
- Humans can be exposed to metallic mercury vapor in the atmosphere, which can be very dangerous when inhaled.
- Additional exposure may occur occupationally and in heavily polluted areas or in areas where mercury-containing fungicides are used extensively.
- Elemental mercury can also be absorbed through the skin.

Human Health Effects

In general, mercury affects the immune system, alters genetic and enzyme systems, and damages the nervous system, including coordination and the senses of touch, taste, and sight. But the specific health effects of mercury and its compounds depend on its chemical form owing to differences in toxicokinetics.

Methyl Mercury
- Exposure to very small amounts of methyl mercury can result in devastating neurological damage or death.
- Can also cause permanent damage to the brain and kidneys.
- Symptoms of acute mercury poisoning include cough, chest tightness, trouble with breathing, and an upset stomach. Pneumonia can develop, which can be fatal.
- Mental retardation, blindness, and cerebral palsy have been observed in children born to women having high levels of methyl mercury exposure. Exposure could have a negative impact on their neurological development resulting in psychological abnormalities like deficits in short-term memory, irritability, and social withdrawal.

Inorganic Mercury
- Ingestion of inorganic mercury compounds can cause renal and gastrointestinal toxicity.
- Swallowing inorganic mercury compounds results in nausea, vomiting, diarrhea, and severe kidney damage.

Elemental Mercury
- Elemental mercury, the form released from broken thermometers, causes tremors, gingivitis, and excitability when vapors are inhaled over a long period of time.

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Chromium, Cr

Description of Pollutant
Chromium is a steel-gray, naturally occurring element found as ore in natural deposits. It is commonly used in metal alloys like stainless steel, plumbing coatings, magnetic tapes, and pigments for paints, cement, paper, and rubber. It also finds application in wood preservatives. Although it is found widely in plants and soils, it is rare in natural waters. The most hazardous form of chromium is hexavalent chromium (Cr VI). Trivalent chromium (Cr III) is non-toxic, however in certain circumstances trivalent chromium can covert to hexavalent chromium.

Common Sources
- Tanneries
- Dye manufacturers
- Chemical manufacturing industry or hazardous waste facility;
- Combustion of natural gas, coal, and oil;
- Metallurgical facilities, electroplating;
- Small amounts of chromium are found in fruits, nuts, vegetables, grains, and cereals;
- Implants like cobalt-chromium knee and hip arthroplasts;
- Contaminated landfills
- Cement dust.

Human Exposure Pathways
- People can be exposed to chromium by eating food, drinking water, or breathing air that is contaminated;
- In air, chromium compounds are present mostly as fine dust particles that eventually settle over land and water;
- Cigarettes contain 0.24 to 14.6 milligrams (mg) chromium per kilogram (kg). Thus cigarette smoking might constitute a significant source of chromium intake;
- Skin contact with chromium-contaminated dust, dirt, and puddles.

Human Health Effects
- Hexavalent chromium, the most hazardous form, can cause cancer. It has been shown to cause tumors in the stomach, intestinal tract, and lungs.
- Hexavalent chromium can also cause damage to the male reproductive system
- Chromic acid or chromate dusts can cause permanent eye damage.
- Short-term exposure causes skin irritation and ulceration.
- Chronic health effects include damage to liver, kidney, circulatory and nerve

tissues, and skin irritation.

- It can cause allergic reactions, such as skin rash. Breathing it can cause nose irritations and nosebleeds.
- Inhalation of hexavalent chromium compounds can result in ulceration, asthmatic bronchitis, edema, cough, shortness of breath, and wheezing.
- Other health effects include upset stomach and ulcers, respiratory problems, weakened immune systems, and alteration of genetic material.

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Cadmium, Cd

Description of Pollutant
Cadmium is a soft, silver-white metal that occurs naturally in the environment. It is usually found as a mineral combined with other elements and is extracted during the production of metals like zinc, lead, and copper. It finds application in the manufacture of batteries, pigments, metal coatings, and plastics, as it does not corrode easily.

Common Sources
- Cadmium compounds are primarily released into the environment by copper, lead, and zinc smelters and municipal incinerators.
- A very large amount of cadmium is released naturally into the environment, about 25,000 tons a year.
- It is also released by the application of phosphate fertilizers or sewage sludge to soils.
- Tobacco leaves can accumulate high levels of cadmium from the soil.
- Smelting and electroplating are also two common sources of cadmium.

Human Exposure Pathways
- Human uptake of cadmium takes place mainly through food. Liver, mushrooms, shellfish, mussels, cocoa powder, dried seaweed, oysters, shrimp, lobster, and fish are potential sources. Cadmium also tends to bio-accumulate in aquatic life. Additionally, leafy vegetables such as lettuce and spinach can contain high levels of cadmium
- Smoking exposes people to significant amounts of cadmium. Tobacco smoke transports cadmium into the lungs.
- People who live near hazardous waste sites or factories that release cadmium into the air and people who work in the metal refinery industry are significantly exposed to cadmium via inhalation of dust or fumes.

Human Health Effects
- Damage to kidneys and lungs;
- Diarrhea, stomach pains and severe vomiting;
- Debilitating effects on bones and the skeletal structure;
- Reproductive failure and possibly even infertility;
- Damage to the central nervous system;
- Damage to the immune system;
- Psychological disorders;
- Possibly DNA damage or cancer development;
- Lung cancer is one potential result of chronic inhalation of fine-particle cadmium compounds, particularly cadmium oxide, which readily dissolves in the body.

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Arsenic, As

Description of Pollutant
Arsenic is a naturally occurring, brittle, steel gray semi-metallic solid. Arsenic and its compounds are highly toxic. It finds application in the manufacture of insecticides, pesticides and various alloys. It is also used for bronzing and as a wood preservative.

Common Sources
- Human activities like mining, smelting and agricultural applications.
- Arsenic can be released from pesticides and wood preservatives.
- Natural sources include volcanic activity, the erosion of rocks and minerals, and forest fires.

Human Exposure Pathways
- Arsenic exposure occurs by ingestion, inhalation of dust, and, to a much lesser degree, by absorption through the skin.
- Accidental poisoning has been reported to occur from wearing inadequate clothing when applying arsenic-based products.
- Arsenic exposure in the workplace occurs through inhalation, ingestion, or dermal or eye contact.
- Most arsenic compounds are white or colorless powders that do not evaporate. They have no smell, and most have no special taste. Thus, you usually cannot tell if arsenic is present in your food, water, or air.

Human Health Effects
- Arsenic in drinking water causes bladder, lung and skin cancer, and may cause kidney and liver cancer. Studies have also found that arsenic harms the central and peripheral nervous systems, as well as heart and blood vessels, and causes serious skin problems. It also may cause birth defects and reproductive problems.
- Arsenic can be carcinogenic at very low levels and one-tenth of a gram accumulated over a two-month period can be fatal.
- Symptoms of mild poisoning include loss of appetite, nausea, diarrhea, stomachache, and vomiting.
- Severe exposure causes cramps, vomiting, neurological effects like restlessness, chronic headache, fainting, dizziness, convulsions or coma.
- Acute exposures can cause lung distress and death.
- Chronic exposure to arsenic (known as arsenicosis) can lead to dermatitis, pigmentation of the skin, wart formation, hard patches on ones palms or soles of their feet, decreased nerve conduction velocity, and lung cancer.

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Radiation

Description of Pollutant
Radiation refers to the ionizing energy released from naturally occurring radioactive compounds in the environment. These compounds are usually referred to as radionuclides. Over 2,000 radionuclides exist on the earth, most of them naturally occurring (USEPA). The most common pollutants among radionuclides are Cs-137, Ss-90, U-238, Ra-226, Th-230, and Pb-210. They are unstable in the environment and are constantly decaying - a process that causes them to release radiation. Since each compound releases different types (alpha, beta and gamma radiation) and intensities of radiation, using mass per unit weight (ppm) does not allow for comparisons on toxicity. Therefore we use radiation instead of parts per million. The type of radiation that is emitted (alpha, beta or gamma) is what determines whether or not the radionuclide poses a risk. Beta and gamma can penetrate the body and cause damage to the cells, whereas alpha is harmful when released from inside the body after being inhaled or ingested.

You cannot see or feel radiation. You will need an instrument that measures energy, namely a radiation dosimeter when exploring a radionuclide site. The normal level of radiation usually doesn't exceed 0.50 microsieverts per hour. Pay attention to the site if you find places where radiation exceeds the normal value by 2-3 times. If you see high levels of radiation, record the levels and move away from the area. Do not spend extended periods of time near radiation hotspots.

Common Sources
- Mining of uranium;
- Nuclear power production;
- Nuclear weapons manufacturing and test sites;
- Spent nuclear fuel;
- Erosion of natural deposits of certain minerals that are radioactive;
- Decay of natural and man-made deposits of radioactive minerals.

Human Exposure Pathways
- Airborne dust can be inhaled.
- Once in soil, it can be absorbed into water used for drinking.
- Walking on contaminated soil directly exposes humans to radiation.
- Medical tests and treatments.
- Another pathway can be through food that has been contaminated with radiation like milk (if cow feeds on contaminated vegetation) and fish (found in

contaminated waters).

Human Health Effects

- Cancer is the major effect of concern from the long-term exposure to radiation.
- Short-term exposure to high levels of radiation can cause acute radiation poisoning, symptoms of which include radiation burns, nausea, fatigue, vomiting and hair loss. Other effects include diarrhea, hemorrhage, internal bleeding, and death in cases of severe exposure.
- Internal exposure to plutonium may cause damage to the kidneys.
- Chronic (long-term) inhalation exposure to uranium and radon in humans has been linked to respiratory effects, such as chronic lung disease, while radium exposure has resulted in acute leukopenia, anemia, and necrosis of the jaw.
- Radium, via oral exposure, is known to cause bone, head, and nasal passage tumors in humans. Radon, via inhalation exposure, causes lung cancer in humans. Uranium may cause lung cancer and tumors of the lymphatic and hematopoietic tissues. http://www.epa.gov/ttnatw01/hlthef/radionuc.html
- Internal exposure to strontium-90 is linked to bone cancer, cancer of the soft tissue near the bone, and leukemia.

Asbestos

Description of Pollutant
Asbestos is a mineral fiber resistant to heat and corrosive chemicals, that was commonly used for insulation and as a fire retardant. It found wide application in the construction industry prior to the 1970s, and was widely used up through the 1980s or later in many parts of the world. Typically, asbestos appears as a whitish, fibrous material that may release fibers that can be dangerous if inhaled.

Sources
- Indoors, deteriorating, damaged, or disturbed insulation, fireproofing, acoustical materials, and ceiling and floor tiles may be sources of asbestos.
- Asbestos is released into the air from erosion of asbestos-bearing rocks, asbestos-related industries, or from clutches and brakes on vehicles.
- Asbestos may be released to water from the erosion of natural deposits and corrosion from asbestos-cement pipes.

Human Exposure Pathways
- We are all exposed to low levels of asbestos in the air we breathe. People working in industries that make or use asbestos products (shipbuilding, mining, milling, and fabricating) are exposed to high levels of asbestos. People living near these industries may also be exposed to high levels of asbestos in air. Most fibers are removed from your lungs by being carried away or coughed up in a layer of mucus to the throat, where they are swallowed into the stomach. This usually takes place within a few hours. Fibers that are deposited in the deepest parts of the lung are removed more slowly.
- Drinking water may contain asbestos from natural sources or from asbestos containing cement pipes.

Human Health Effects
- Lung cancer;
- Mesothelioma (cancer of chest and abdominal lining);
- Asbestosis (irreversible lung scarring that can be fatal);
- Asbestos exposure via inhalation causes pulmonary hypertension and immunological effects.

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Cyanide

Description of Pollutant
Cyanide is a carbon-nitrogen chemical unit that is a rapidly acting, potentially deadly chemical that can exist in various forms. Cyanide is manmade but also occurs naturally in the environment. Very small amounts of cyanide are essential in the human diet in the form of Vitamin B12. The most common cyanide compounds are hydrogen cyanide, sodium cyanide, and potassium cyanide.

Common Sources
- Smoke inhalation from residential or industrial fires.
- Vehicle exhaust.
- Emissions from chemical processing industries, metallurgical industries, metal plating and finishing industries, and petroleum refineries.
- Waste incinerators and during the use of cyanide-containing pesticides.
- Burning of certain types of plastics, silk, wool, and paper
- Common sources to water are discharges from publicly owned wastewater treatment works, iron and steel production plants, and organic chemical industries.
- Releases to soil include cyanide wastes in landfills and the use of cyanide-containing road salts.
- Cyanide gas is used to exterminate pests and vermin in ships and buildings.

Human Exposure Pathways
- Cyanides are readily absorbed by the inhalation, oral, and dermal routes of exposure. Cyanide in water, however, does not build up in fish tissue.

Human Health Effects
- Skin contact with dust from certain cyanide compounds can cause skin irritation and ulcerations.
- Inhalation exposure to cyanide causes rapid effects. Exposure of humans at a level of 110 ppm can cause death within 30 minutes to 1 hour.
- Occupational exposure to lower concentrations causes breathing difficulties, nervousness, vertigo, headache, nausea, vomiting, precordial pain, and electrocardiogram (EKG) abnormalities.
- Exposure to higher concentrations results in convulsions, low blood pressure, slow heart rate, loss of consciousness, lung injury and respiratory failure leading to death.
- Neurotoxicity has been observed following ingestion and inhalation of cyanides.
- Effects on the nervous system believed to be from long-term exposure to cyanide include deafness, vision problems, and loss of muscle coordination.

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Effects on the thyroid gland can cause cretinism (retarded physical and mental growth in children), or enlargement and over activity of the gland.

- Survivors of serious cyanide poisoning may develop heart and brain damage.

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Dioxin (2,3,7,8-TCDD)

Description of Pollutant

(Note: we have decided to use 2,3,7,8-TCDD in particular because it is not only the most prevalent dioxin but also the most toxic). 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) is formed as an unintentional by-product of incomplete combustion. It is typically released into the environment during the combustion of fossil fuels and wood, and during the incineration of municipal and industrial wastes. The most common health effect associated with 2,3,7,8-TCDD in humans is chloracne, a severe acne-like condition. It is known to be a developmental toxicant in animals, causing skeletal deformities, kidney defects, and weakened immune responses in the offspring of animals. Human studies have shown an association between 2,3,7,8-TCDD and soft-tissue sarcomas, lymphomas, and stomach carcinomas. EPA has classified 2,3,7,8- TCDD as a probable human carcinogen (Group B2).

Sources

- 2,3,7,8-TCDD may be formed during the chlorine bleaching process used by pulp and paper mills, and as a by-product from the manufacture of certain chlorinated organic chemicals, such as chlorinated phenols.
- Natural processes such as forest fires and volcanoes.
- Byproducts of smelting, chlorine bleaching of paper pulp

Human Exposure Pathways

- Over 95% of the human intake of dioxins is through food, mainly from meat, dairy products, and fish.
- Very low levels of 2,3,7,8-TCDD are found throughout the environment, including air, food, and soil.

Human Health Effects

- Short-term exposure of humans to high levels of 2,3,7,8-TCDD may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. (Chloracne is also the major effect seen from chronic exposure.
- Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions.

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- Human studies, primarily of workers occupationally exposed to 2,3,7,8-TCDD by inhalation, have found an association between 2,3,7,8-TCDD and lung cancer, soft-tissue sarcomas, lymphomas, and stomach carcinomas, although for malignant lymphomas, the increase in risk is not consistent.
- http://www.epa.gov/ttnatw01/hlthef/dioxin.html

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Fluorides

Description of Pollutant
Fluorides are chemical compounds that occur naturally in air, water, soil and most foods.
Fluorides are properly defined as binary compounds, or salts of fluorine and another element. Examples of fluorides include sodium fluoride and calcium fluoride.

Sources
- Coal combustion;
- Waste from steel manufacture, primary aluminum, copper and nickel production, phosphate ore processing, phosphate fertilizer production and use, glass, brick and ceramic manufacturing, and glue and adhesive production;
- Pesticides and controlled fluoridation of drinking-water supplies;
- Phosphate ore production and aluminum manufacture are the major industrial sources of fluoride release into the environment;
- Natural sources include the weathering and dissolution of minerals, volcanic emissions and marine aerosols.

Human Exposure Pathways
- For adults, the consumption of foodstuffs and drinking water is the principal route for the intake of fluoride.
- In areas of the world in which coal rich in fluoride is used for heating and food preparation, the inhalation of indoor air and consumption of foodstuffs containing increased levels of fluoride also contribute to elevated intakes.
- Infants fed formula receive 50–100 times more fluoride than exclusively breast-fed infants.
- Swallowing toothpaste and other dental products can account for a large percentage of the fluoride to which a small child might be exposed.
- Occupational exposure to fluoride via inhalation or dermal contact likely occurs in individuals involved in the operation of welding equipment or in the processing of aluminum, iron ore or phosphate ore.

Human Health Effects
- An increased incidence of lung and bladder cancer and increased mortality due to cancer.
- Skeletal fluorosis.
- If you eat large amounts of sodium fluoride at one time, it can cause stomachaches, vomiting, and diarrhea. Extremely large amounts can cause death by affecting your heart.
- Dental fluorosis develops only while the teeth are forming in the jaw and before

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they erupt into the mouth (age <8 years).

- Several human studies found an increase in birth defects or lower IQ scores in children living in areas with very high levels of fluoride in the drinking water.
- Fluorine and hydrogen fluoride are very irritating to the skin, eyes, and respiratory tract.

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PAHs (Polycyclic Aromatic Hydrocarbons)

Description of Pollutant
Polycyclic aromatic hydrocarbons (PAHs) are hydrocarbon compounds with multiple benzene rings. PAHs are typical components of asphalts, fuels, oils, and greases and a few are used in medicines or to make dyes, plastics, and pesticides. They are also called Polynuclear Aromatic Hydrocarbons. Although hundreds of PAHs exist, two of the more common ones are benzo(a)pyrene and naphthalene

Sources
- PAHs are released during the incomplete burning of coal, oil and gas, and garbage.
- Forest fires and volcanoes can produce PAHs naturally.
- In the home, PAHs are present in tobacco smoke, smoke from wood burning stoves and fireplaces, creosote-treated wood products and some food.
- Barbecuing, smoking or charring food over a fire greatly increases the amount of PAHs in food.
- Roasted coffee, roasted peanuts, refined vegetable oil, grains vegetables and fruits may contain low levels of PAHs.
- A variety of cosmetics and shampoos are made with coal tar and therefore may contain PAHs.
- The PAH compound naphthalene is present in some mothballs.
- Discharges from industrial and wastewater treatment plants.

Human Exposure Pathways
- Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar.
- PAHs are more likely to be concentrated in plants and animals thank in soil or water, mainly because PAHs do not dissolve in water.
- Exposure to soils contaminated with PAHs may occur as well as PAHs tend to slightly stick to particles.
- Eating foods that have been grilled.
- PAH can be absorbed through the skin. Exposure can come from handling contaminated soil or bathing in contaminated water. Low levels of these chemicals may be absorbed when a person uses medicated skin cream or shampoo containing PAHs.

Human Health Effects
- Short-term exposure may cause red blood cell damage leading to anemia and consequently a suppressed immune system.
- Long-term exposure is believed to cause developmental and reproductive

effects and cancer.

- Other long-term health effects caused by exposure to PAHs may include cataracts, kidney and liver damage and jaundice.
- Dermal contact can result in skin redness and irritation.
- The Department of Health and Human Services in the USA has determined that some PAHs may reasonably be expected to be carcinogens.
- Some people who have breathed or touched mixtures of PAHs for long periods of time have developed cancer.

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Pesticides

Description of Pollutant
Pesticides are used in the agricultural industry to protect food from pests, such as insects, rodents, weeds, mold, and bacteria. The term pesticide also applies to herbicides, fungicides and so forth. Pesticides are often referred to according to the type of pest they control or grouped by chemical types of pesticides. These include organophosphate, carbamate, organochlorine and pyrethroid pesticides. Pesticide contamination typically results from pesticide projection facilities, pesticide application on agricultural fields, and abandoned storage facilities or dumpsites for obsolete pesticides. Because pesticides are widely used in agricultural practices, most people are exposed to low levels of pesticide residues through their diets.

Sources

- Runoff from agricultural fields
- Illegal dumping or inadequate storage
- Waste from pesticide production facilities

Human Exposure Pathways

- People can be exposed to pesticides and insecticides by eating food on which it has been applied or by drinking water from sources contaminated by pesticides.
- Children maybe exposed to pesticide residues from their agriculture-worker parents through dust and soil.

Human Health Effects

- Children, infants, and fetuses may be especially vulnerable to the health effects of pesticides. Children may be more susceptible to loss of brain function if exposed to neurotoxins, and may be more susceptible to damage to their reproductive systems. Increased odds of childhood leukemia, brain cancer and soft tissue sarcoma have been associated with children living in households where pesticides are used. Other childhood malignancies associated with pesticide exposures include neuroblastoma, Wilms' tumor, Ewing's sarcoma, non-Hodgkin's lymphoma, and cancers of the brain, colorectum, and testes.
- Pesticides are intentionally toxic substances. Some chemicals commonly used on lawns and gardens have been associated with birth defects, mutations, adverse reproductive effects, and cancer in laboratory animals.
- Toxicology and Industrial Health published a study showing that the natural mix of chemical pesticides and fertilizers – in concentrations mirroring levels found in groundwater – can significantly affect immune and endocrine systems as well as neurological health

- The Canadian Institute for Child Health has found that children are increasingly at risk of serious diseases from pesticides. The study said cancer rates in children grew 25 percent since 1975. http://www.ecochem.com/pesticides.html
- Many herbicides are known or suspected carcinogens
- Results from Agicultural Health Study showed that farm families with ongoing exposure to pesticides have increased headaches, fatigue, insomnia, dizziness, hand tremors, and other neurological symptoms.

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PCB's (Polychlorinated biphenyls)

Description of Pollutant
PCB's or polychlorinated biphenyls are manmade industrial chemicals. They were used in many different types of products including hydraulic fluid, casting wax, pigments, carbonless copy paper, vacuum pumps, compressors, heat transfer systems, and electrical equipment. Because of their fire resistance and insulating properties they were the fluid of choice for transformers and capacitors. PCB's are resistant to degradation and therefore persist for many years in the environment. They bioaccumulate in the food chain and are stored in the body fat of animals and humans. PCB's were banned from use in the U.S. in the early 70's, however they are still found in the environment due to their widespread use and resistance to degradation.

Sources
- PCB's may be released into the environment during manufacture, use, or by the careless disposal of materials and obsolete equipment.
- Accidental leakage and spills during transport or from fires and leaks in products containing PCBs.
- PCBs may leach out from hazardous waste disposal sites and landfills. Additionally it may be released from illegally dumped industrial wastes.
- PCB's are highly persistent in the environment and bind strongly to soils, organic particles, and bottom sediments. PCB's accumulate in fish and marine mammals and can be magnified several thousand times above background levels.

Human Exposure Pathways
- A major route of human PCB exposure is through eating PCB-contaminated fish.
- Inhalation is a more direct exposure route to certain sensitive tissues (such as the nasal passages) and the blood stream.
- Several occupational health studies have detected PCB health effects primarily through inhalation of PCB vapors.
- PCBs can be rapidly absorbed through the skin. Experts with the National Institute of Health speculate that, due to the transport of PCBs on dust particles, the current primary route of exposure of most people (non-fish-eaters) to PCBs is through skin exposure.
- Occupational studies show that skin absorption of PCBs is generally the route of entry into the bodies of exposed workers.
- PCB's are known to be passed from the mother to the fetus through placental blood, and to the baby via breast milk.

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Health Effects

PCB exposure of the smallest amount poses serious health risks, including:

- Skin ailments called chloracne;
- Reproductive disorders;
- PCB's are a known animal carcinogen. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.
- Health risks include nervous system damage. (Parkinson's, mood disorders, memory problems, etc.).
- Liver damage - jaundice, nausea, weight loss, edema, abdominal pain from internal poisoning.
- Rice Oil Disease in Japan - 2000 ppm caused eye discharge, acne, uterine ulcer, excess pigmentation, miscarriage, stillbirth, abnormal pigmentation on infants.
- Chronic PCB toxicities can result in liver damage in mammals, damaged pericardia, kidneys, spleen and liver and shell thinning in birds.
- Other effects include progressive weight loss, bone marrow depression, abdominal pain, numbness of limbs, swelling of joints, chronic cough, menstrual irregularity, abnormal tooth development, low birth weight, hyperpigmentation, fatigue and headache.
- Elevations in blood pressure, serum triglyceride, and serum cholesterol have also been reported with increasing serum levels of PCBs in humans.
- Women who are exposed to relatively high levels of PCBs through the workplace or through ingestion tend to have babies weighing slightly less than women who were not exposed.
- Newborns exposed to PCBs in-utero have shown behavior problems such as slow motor skills and decrease in short-term memory lasting several years.

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VOCs (Volatile Organic Compounds)

Description of Pollutant
VOCs are carbon-based compounds that easily evaporate into the atmosphere. VOCs typically are industrial solvents, such as trichloroethylene; fuel oxygenates, such as Methyl Tertiary Butyl Ether (MTBE); or by-products of chlorination in water treatment, such as chloroform. VOCs are often components of petroleum fuels, hydraulic fluids, paint thinners, and dry cleaning agents and are common ground-water contaminants. Concentrations of VOCs are generally higher indoors than outdoors and emitted from a wide array of products including paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials, office equipment and so forth.

Sources
- Emission sources include paints, varnishes, moth balls, solvents, gasoline and newspapers.
- They are present in exhaust fumes, cigarette smoke, synthetic materials and household chemicals.
- Point sources of VOCs include chemical plants, cement manufacturers, steel mills, power plants, surface coating operations, and printing operations.
- Construction and industrial machinery, farm equipment, railroads, lawn and garden equipment, boats, and aircrafts are other sources of VOCs.

Human Exposure Pathways
- Inhalation of VOCs from new carpeting, adhesives, draperies; wood products that use certain glues, finishes, and waxes in the manufacturing process; and vinyl type flooring and wall coverings.
- VOCs may enter the water supply through agricultural or industrial run-off.
- Dermal contact is another exposure pathway.

Human Health Effects
- Acute health effects are eye, nose and throat irritation, headaches, nausea, vomiting, dizziness and asthma exacerbation;
- Chronic effects are cancer, liver, kidney and central nervous system damage;
- It could be irritating to the skin upon contact.
- Some VOCs are suspected or known to cause cancer in humans.

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