Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans and ground waters). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities.
The coast of the Philippines depicts water pollution, a problem affecting most of the world in one form or another.

Raw sewage and industrial waste flows across international borders – New River passes from Mexico to California, USA.

Millions depend on the polluted Ganges river.
Water pollution

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels (international level down to individual aquifers and wells).

It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily.

An estimated 700 million Indians have no access to a proper toilet, and 1,000 Indian children die of diarrheal sickness every day.

Some 90% of China’s cities suffer from some degree of water pollution, and nearly 500 million people lack access to safe drinking water.

In addition to the acute problems of water pollution in developing countries, industrialized countries, continue to struggle with pollution problems as well.

In the most recent national report on water quality in the USA, 45% of assessed stream km, 47% of assessed lake ha, and 32% of assessed bay and estuarine square km were classified as polluted.

Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water.

Natural phenomena such as volcanoes, algae blooms, storms and earthquakes also cause major changes in water quality and the ecological status of water.
This EU directive commits EU member states to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015.

The directive defines “surface water status” as the general expression of the status of a body of surface water, determined by the poorer of its ecological status and its chemical status.

Thus, to achieve “good surface water status” both the ecological status and the chemical status of a surface water body need to be at least “good”.

Ecological status refers to the quality of the structure and functioning of aquatic ecosystems of the surface waters. Water is an important facet of all life and the water framework directive sets standards which ensure the safe access of this resource.

The Directive requires the production of a number of key documents over six year planning cycles. Most important among these is the River Basin Management Plans, to be published in 2009, 2015 and 2021. Draft River Basin Management Plans are published for consultation at least one year prior.

Good ecological status is defined locally as being lower than a theoretical reference point of pristine conditions, i.e. in the absence of anthropogenic influence.

Article 14 of the directive requires member states "to encourage the active involvement of interested parties" in the implementation of the directive.
WATER POLLUTION AND MORBIDITY

Link between water pollution and morbidity (saslimstība) has been equipollent stated due to cholera epidemic in London, 1854.

Transmission is primarily due to the faeces contamination of food and water due to poor sanitation. This bacterium can, however, live naturally in any environment.

2008–2009

CHOLERA EPIDEMICS IN AFRICA

Declared in June 2014, the West and Central African cholera outbreak as of January 25, 2015 claimed 1,683 registered deaths and over 91,361 reported cases with a reported case fatality rate of 2% in 11 countries, which is 3 times more than in 2013. The case fatality ratio is high in the Sahelian area, equal or greater than 2%, especially in Nigeria, Chad, Cameroon, and Niger, Nigeria, Ghana and Democratic Republic of the Congo being the most affected countries with Ghana reporting its worst outbreak since 1982. In January 2015 the Greater Accra region and Volta region still reported cases of Cholera while in the rest of Ghana the outbreak was declared over. As of January 11 the Democratic Republic of the Congo, Ghana and Nigeria are the countries with highest number of new cases of the disease in 2015.

Map of the 2008–2009 cholera outbreak in sub-Saharan Africa showing the statistics as of 12 February 2009.
HAITI CHOLERA OUTBREAK

The Haiti cholera outbreak began in late October 2010 in the rural area of Haiti about 100 kilometres north of the capital, Port-au-Prince, killing 4,672 people by March 2011 and hospitalising thousands more. The outbreak followed a powerful earthquake which devastated the country on 12 January 2010. By March 2011, 252,640 cases had been reported. By the first 10 weeks of the epidemic, cholera spread to all of Haiti’s 10 departments or provinces.

In November 2010, the first cases of cholera were reported in the Dominican Republic and a single case in Florida, US. As of late September, 2011, some 6,435 deaths have been reported and is expected to continue rising.
Health protection is primary reason for environmental control in the whole world.

Other reasons:

- Protection of water resources
- Conservation of fishing zones
- Development of recreational areas
Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated.

Surface water seeps through the soil and becomes groundwater. Conversely, groundwater can also feed surface water sources.

Sources of surface water pollution are generally grouped into two categories based on their origin. Point source water pollution refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch.

Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain.

Non-point source (NPS) pollution refers to diffuse contamination that does not originate from a single discrete source. NPS pollution is often the cumulative effect of small amounts of contaminants gathered from a large area.

A common example is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff in storm water from "sheet flow" over an agricultural or a forest are also cited as examples of NPS pollution.

Contaminated storm water washed off of parking lots, roads and highways, called urban runoff, is sometimes included under the category of NPS pollution. However, this runoff is typically channelled into storm drain systems and discharged through pipes to local surface waters, and is a point source.

However where such water is not channelled and drains directly to ground it is a non-point source.
CONTAMINANTS OF WATER

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water, and what is a contaminant.

High concentrations of naturally-occurring substances can have negative impacts on aquatic flora and fauna.

Oxygen-depleting substances may be natural materials, such as plant matter (e.g. leaves and grass) as well as man-made chemicals. Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills (žaunas) of some fish species.

Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts. Alteration of water's physical chemistry includes acidity (change in pH), electric conductivity, temperature, and eutrophication.

Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases in the primary productivity of the ecosystem. Depending on the degree of eutrophication, subsequent negative environmental effects such as anoxia (oxygen depletion) and severe reductions in water quality may occur, affecting fish and other animal populations.
1. Oxygen-depleting substances: organic waste, used by aerobic microorganisms in presence of oxygen.

If concentration of oxygen in water is insufficient, oxygen consumed living creations can go out. Very important is to know what is the biochemical oxygen demand (BOD).

The BOD₅ value is most commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a robust surrogate of the degree of organic pollution of water.
2. **Water soluble inorganic substances**: salts, acids, compounds of heavy metals. Acidity caused by industrial discharges (especially sulphur dioxide from power plants). Presence in soil (via polluted water) of these substances reduce agricultural harvest, as well as to arouse corrosion of the metals.

3. **Inorganic nutrients for plants**: water soluble nitrates, phosphates, which are promoters of eutrophication. Ammonia from food processing waste.

4. **Organic substances**: oil products, petrol, plastic, pesticides, solvents, detergents, etc.

In surface and ground waters of developed countries are find at least **700 synthetic organic substances** – many of them might to bring on an kidney illness, hereditary defects, a number of cancer varieties.
5. **Suspended substances**: water non-soluble soil or mineral particiles, other organic and inorganic substances.

   **These substances**:
   - cause turbidity,
   - reduce water plants ability for photosynthesis,
   - affect trophical chains,
   - make difficulties for some species to find food,
   - through sediments destroy feeding and spawn territories, as well as, fill bottom of rivers and lakes, change flow of rivers,
   - absorb and transport bacteria, pesticides or other hazardous substances on the surface of solid particiles.

6. **Radioactive substances**: water soluble radioisotopes can accumulate and move from one to another species in the trophical chains.

   **Ionized radiation of radioactive substances can induce hereditary defects, to bring on cancer illness and to damage genetic information.**
7. **Heat**: wormed water, as result of the cooling processes (thermo-electro plants) are flown into river or lake.

   Temperature rising lowers solubility of oxygen in water and reduce concentration of oxygen in water. Wherewith water living species feel deficit of oxygen and become more sensitive against diseases, parasitic species and toxic chemicals.

8. **Pathogenic organisms**: microorganisms, parasitic worms.

   Majority of microorganisms are not dangerous, but take part in processes of destruction of the organic substances. Unfortunately in waters, especially in wastewaters, can be pathogenic microorganisms, which induce infection diseases.

   - *Ascaris lumbricoides* (human worm) and its egg.
Microorganisms and parasitic warms to get in water mainly from household wastewater.

Under constant wet and temperature conditions microorganisms fast multiply – accordingly household wastewater is ideal environment for microbes, primary bacteria, some viruses and protozoa existence.

*Escherichia coli* bacteria under different magnification

Analyses for detection of the pathogenic microorganisms are very complicated, therefore are used method don’t search for individual pathogen species, but to carry out integral analyses, for example, to fix coli titre.

World Health Organisation recommend that in 100 ml drinking water don’t be any *Escherichia coli* bacteria.
**Burkholderia pseudomallei** (also known as *Pseudomonas pseudomallei*) is a Gramm-negative, bipolar, aerobic, motile rod-shaped bacterium. It infects humans and animals and causes the disease melioidosis.

It is also capable of infecting plants. *B. pseudomallei* measures 2-5 µm in length and 0.4-0.8 µm in diameter and are capable of self-propulsion using flagellae. The bacteria can grow in a number of artificial nutrient environments. Bacteria produce both exo- and endo-toxins. The role of the toxins identified in the process of melioidosis symptom development has not been fully elucidated.

**Salmonella** is a genus of rod-shaped, Gram-negative, non-spore-forming, predominantly motile enterobacteria with diameters around 0.7 to 1.5 µm, lengths from 2 to 5 µm, and flagella which grade in all directions. They obtaining their energy from oxidation and reduction reactions using organic sources, and are facultative anaerobes. *Salmonella* is closely related to the *Escherichia* genus and are found worldwide in cold- and warm-blooded animals (including humans), and in the environment. They cause illnesses like typhoid fever and food-borne illness.

**Giardia lamblia** is a flagellated protozoan parasite that colonizes and reproduces in the small intestine, causing giardiasis. The giardia parasite attaches to the epithelium by a ventral adhesive disc, and reproduces via binary fission. Giardiasis does not spread via the bloodstream, nor does it spread to other parts of the gastro-intestinal tract, but remains confined to the lumen of the small intestine. Chief pathways of human infection include ingestion of untreated sewage, a phenomenon particularly common in many developing countries; contamination of natural waters also occurs in watersheds where intensive grazing occurs.
WASTEWATER

Wastewater is human changed waters with other physical, chemical and biological properties as natural waters.

Classification of wastewaters by origin:

- household wastewater
- municipal wastewater
- precipitation (rain) wastewater
- Industrial (production) wastewater
DOMESTIC SEWAGE

Quantity of wastewater per capita in day:
- in small towns are 250 – 300 l,
- in big industrial cities up to 900 l.

Deer Island Wastewater Treatment Plant serving Boston, Massachusetts.

Domestic sewage is 99.9 percent pure water, while the other 0.1 percent are pollutants. Although found in low concentrations, these pollutants pose risk on a large scale. In urban areas, domestic sewage is typically treated by centralized sewage treatment plants. In the EU and US, most of these plants are operated by local government agencies, frequently referred to as publicly owned treatment works. Municipal treatment plants are designed to control conventional pollutants: BOD and suspended solids. Well-designed and operated systems (i.e., secondary treatment or better) can remove 90 percent or more of these pollutants. Some plants have additional sub-systems to treat nutrients and pathogens. Most municipal plants are not designed to treat toxic pollutants found in industrial wastewater.

Households wastewater characteristics:
- temperature is 8-12°C,
- transparency 4-10 cm, grey colour,
- medium bog odour, neutral pH reaction

Content of households wastewater:
- 60-80% organic substances (meat and plants fibres, oils, human excrements and urine),
- inorganic impurities (sand, mineral salts, acids, detergents),
- living organisms: microorganisms, protea, warms, alkali
Effective control of urban runoff involves **reducing the velocity and flow of storm water**, as well as reducing pollutant discharges. Local governments use a variety of storm water management techniques to reduce the effects of urban runoff.

These techniques, called best management practices, may focus on water **quantity control**, while others focus on improving water quality.

Pollution prevention practices include **low impact development techniques** (grass lawn), and **improved chemical handling** (e.g. management of motor fuels and oil, fertilizers and pesticides).

Runoff mitigation (atviegløjuma) systems include infiltration basins, bio-retention systems, **constructed wetlands**, retention basins and similar devices.

Thermal pollution from runoff can be controlled by storm water management facilities that absorb the runoff or direct it into groundwater, such as bio-retention systems and infiltration basins.

Retention (uzkrāšanas) basins tend to be less effective at reducing temperature, as the water may be heated by the sun before being discharged to a receiving stream.

Runoff quantity varies in wide scale depending on season, geographical location and intensity of the precipitation.

In Latvia average precipitation is ~700 mm/y. There are estimation, that runoff quantity is around 1/4 of the municipal wastewater quantity, but in storm rain water quantity might be considerably higher.
Some industrial facilities generate ordinary domestic sewage that can be treated by municipal facilities. Industries that generate wastewater with high concentrations of conventional pollutants (e.g. oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or other unconventional pollutants such as ammonia, need specialized treatment systems. Some of these facilities can install a pre-treatment system to remove the toxic components, and then send the partially-treated wastewater to the municipal system. Industries generating large volumes of wastewater typically operate their own complete on-site treatment systems.

Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants, through a process called pollution prevention.

Heated water generated by power plants or manufacturing plants may be controlled with:

- cooling ponds, man-made bodies of water designed for cooling by evaporation, convection and radiation,
- cooling towers, which transfer waste heat to the atmosphere through evaporation and heat transfer,
- cogeneration, a process where waste heat is recycled for domestic and/or industrial heating purposes.
INDUSTRIAL WASTEWATER

**Relatively polluted** – used for heat exchangers (cooling needed)

**Polluted** – contain different chemicals (treatment needed before to feed in municipal sewage system)

**Very polluted** – if on the site isn’t possibility for treatment, necessary to fill in containers and send to especial treatment plant

Discharge from a Chinese fertilizer factory toward the Yellow River
INDUSTRIAL WASTEWATER QUANTITY

Wastewater amount by processing of the one unit (kg or l) of the product:

- Milk: 0.5-4 l
- Meat: 1-3 l
- Canned fish: 17-45 l
- Beer: 2.5-15 l
- Paper: 10-20 l
- Liquor: 15-20 l
- Sugar: 100 l
- Margarine: 40-60 l
- Wool: 100 l
- Coal: 20-30 l
- Cellulose: 80-150 l
Nonpoint source controls
Sediment (loose soil) washed off fields is the largest source of agricultural pollution. Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour ploughing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers.

Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer; animal manure; or spraying of municipal or industrial wastewater (effluent) or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients.

Point source wastewater treatment
Farms with large livestock and poultry operations, such as factory farms, are called concentrated animal feeding operations or confined animal feeding operations in the US and are being subject to increasing government regulation.

Animal slurries are usually treated by containment in lagoons before disposal by spray or trickle application to grassland.

Constructed wetlands are sometimes used to facilitate treatment of animal wastes, as are anaerobic lagoons. Some animal slurries are treated by mixing with straw and composted at high temperature to produce a bacteriologic ally sterile and friable manure for soil improvement.
AGRICULTURAL WASTEWATER

Riparian buffer lining a creek in Iowa.

Confined Animal Feeding Operation in the US.

Silt fence installed on a construction site.
MUNICIPAL WASTEWATER

Municipal wastewater is mixture of the household and industrial wastewaters with or without precipitation water.

Content of the municipal wastewater:
- Different solid particiles
- N and P compounds
- Stable organic substances
- Ions of the metals
- Microorganisms
- Other compounds

- Biochemical oxygen demand (BOD) - 250 mg/l
- Chemical oxygen demand (COD) - 500 mg/l
- Ammonia (NH₄-N) - 40 mg/l
- Total nitrogen, including ammonia (NH₄-N) - (₇₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉₉ninetyseven
DOMESTIC SEWAGE

Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage, including:
- utilizing a green infrastructure approach to improve stormwater management capacity throughout the system, and reduce the hydraulic overloading of the treatment plant;
- repair and replacement of leaking and malfunctioning equipment;
- increasing overall hydraulic capacity of the sewage collection system (often a very expensive option).

A household or business not served by a municipal treatment plant may have an individual septic tank, which treats the wastewater on site and discharges into the soil. Alternatively, domestic wastewater may be sent to a nearby privately owned treatment system (e.g. in a rural community).

The septic tank partially installed in the ground

Septic drain field
Evaporation and transpiration

Water treatment plant

Water use

Groundwater flows

Replenishment of groundwater

Irrigation of fields

Filtration through soil

Runoff

Water extraction
LITHOSPHERE POLLUTION

Aerial view of Barringer Crater in Arizona.
The hard and rigid outer layer of the Earth – the lithosphere – is up to 200 km deep, and it comprises the Earth’s crust and the outer part of the upper mantle.

Earth’s crust – planet’s hard cover in average is 35-40 km thick

Lithosphere by formation is heterogeneous and complicated
CHEMICAL COMPOSITION OF THE LITHOSPHERE

- Oxygen (47%)
- Silicon (29,5%)
- Aluminium (8,05%)
- Iron (4,65%)
- Calcium (2,96%)
- Sodium (2,5%)
- Potassium (2,5%)
- Magnesium (1,87%)
- Titan (0,45%)

84,55% total

14,93% total

- Rare elements → 0,01-
- Microelements → % less as 0,001%

Diagram showing the percentage distribution of elements in the lithosphere.
LITHOSPHERE POLLUTION

Chemical elements in the form of mineral resources are taken out lithosphere. Under processing, burning, etc., processes pollution comes back to lithosphere.

Man-made goods as a garbage returns to lithosphere.

The litter problem on the coast of Guyana.
If pollutants are on surface of soil, there are three possibilities:

1) Polluting substance are distributed or wash away, for example, with rain water, therefore damage for soil is minimal.

2) Polluting substance (if evaporable) can evaporate, without polluting soil surface and deeper layers, but polluting the air.

3) Polluting substance can infiltrate into soil, similarly, as water infiltrates into soil, therefore soil will be polluted.
Polluted place – soil, entrails of the Earth, water, sludge, buildings and activities indoor, production units or other objects, where are used polluting substances.

Categories of the polluted places:

- Place isn’t polluted
- Potentially polluted place
- Polluted place

Ministry of Environment and Regional development from 2004 has database with information about approximately 3500 potentially polluted places and polluted places in Latvia.
In Latvia more polluted places are in Riga, but majority of potentially polluted places are in Vidzeme region.

We know 241 polluted places and 2622 potentially polluted places in Latvia.
Polluted volume of underground waters is $108,000 \text{ m}^3$, but total pollution distribution areal is more as $280 \text{ ha}$.

Pollution of the goudron ponds by infiltration is reach 70-90 m deep layers, where are reserves of ground and artesian water. Pollution moves in direction of river Gauja with speed 25-35 m/y.

Without recovery polluted water reach river Gauja in 65 years.

Calculations demonstrate, that recovery expenses will be approximately $20,378,000 \text{ Ls.}$

Goudron (flux oil; oil tar) ponds are situated in area, used for extraction of artesian drinking water, therefore threat supplement Riga city with high quality of drinking water.
Chemical pollution from goudron ponds migrate in direction of river Gauja, to arouse threats of ecological catastrophe.
Toxic liquid waste landfill is situated approximately 4 km from Olaine. That site seriously threat towns Jaunolaine and Olaine by groundwater polluting.

On 1973-1980 there has been deposited liquid, pseudo-solid and solid waste from factory “Latbiofarm” and “Biolar” in amount as far as 16 000 t/y. Toxic substances: ammonia chloride, pyridine, butanol, isopropanol, sodium acetate and other toxic substances.
Aerodrome “Rumbula” – hardly polluted site in Riga

Aerodrome “Rumbula” in Soviet time has been used for military and public needs. There was huge reservoirs of fuel and lubricants. Unfortunately all territory management was quite bad.

Pollution is located in three phases:
- in soil (absorbed),
- on groundwater surface (floating),
- dissolved (in water)

Risk is very high, as pollution via groundwater can reach river Daugava, but later – Baltic sea.

Oil products, infiltrate through sand and reach groundwater level, where formed thick floating oil layer.
Pollution, which is quite high, is localized in five areas.

Pollution is located in three phases:
- in soil (absorbed),
- on groundwater surface (floating),
- dissolved (in water)

Risk is very high, as pollution via groundwater can reach river Daugava, but later – Baltic sea.
Chernobil, Ukraine
Radioactive pollution after incident on Nuclear Power plant

Sumgait, Azerbaijan
Pollution from chemical industry

Oroja, Peru
Pollution from mining

Kabve, Zambia
Pollution from Pb and Zn processing

Vapi, India
Industrial pollution

Sukinda, India
Pollution from Cr mines

Tjaning, China
Pollution from Pb processing

Norilsk, Russia
Pollution from heavy metals processing

Linphen, China
Pollution from coal mines

5 million people are poisoned everyday in the developing world

25% of all deaths in the developing world are attributable to environmental factors

Water pollution causes 14,000 deaths a day

Source: WorstPolluted.org, MSN News
Soil pollution

Soil contamination or soil pollution is caused by the presence of human-made chemicals or other alteration in the natural soil environment.

This type of contamination typically arises from the failure caused by corrosion of underground storage tanks (including piping used to transmit the contents), application of pesticides, oil and fuel dumping, disposal of coal ash, leaching of wastes from landfills or direct discharge of industrial wastes to the soil.

The most common chemicals involved are petroleum hydrocarbons, lead, polynuclear aromatic hydrocarbons (such as naphthalene and benzo(a)pyrene), solvents, pesticides, and other heavy metals. This occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage.

According to a scientific sampling 100,000 square kilometers of China’s cultivated land have been polluted, with contaminated water being used to irrigate a further 21,670 square kilometers and another 1,300 square kilometers covered or destroyed by solid waste. In total, the area accounts for one-tenth of China’s cultivatable land, and is mostly in economically developed areas.

An estimated 12 million tonnes of grain are contaminated by heavy metals every year, causing direct losses of 20 billion yuan (US$ 2.57 billion).
Oil pollution

Oil – complex hydrocarbons mixture (carbon 84-87 %; hydrogen 12-14 %)

Not burn the oil because this method causes air pollution.
Oil and oil products can be in different state of aggregation in the lithosphere:

- Gaseous phase among soil and ground participle
- Liquid phase among soil and ground participle
- As solution in the soil and ground pores
- Adsorption layer on the soil and ground participle
- Diffused in the deeper layer of soil and ground
INDUSTRIAL POLLUTION

Chimneys throw out in air industrial pollution, which are transported by wind in long distances, but at the end precipitate on the earth’s surface.

Main industrial pollution sources:
- Chemical factories
- Metallurgy complexes
- Integrated plants for building materials
- Thermo-electro plants

Untreated effluent flows from the Assalaya sugar factory to the White Nile.
Definitions of the heavy metals are different:

**Chemistry** – metals with density more as 3,5 g/cm$^3$

**Environmental** – metals with density more as 5 g/cm$^3$

**Dangerous elements:**
- Arsenic (As)
- Mercury (Hg)
- Copper (Cu)
- Zinc (Zn)
- Chromium (Cr)
- Selenium (Se)
- Cadmium (Cd)
- Nickel (Ni)
- Lead (Pb)
- Tin (Sn)
- Antimony (Sb)
- Bismuth (Bi)
- Cobalt (Co)
Main sources:

- Industry
- Agriculture (fertilizers, applying lime, irrigation)
- Household and industrial solid waste storage
- Burning of the fossil fuel
- Use of mobile vehicles
Pesticides

Food and Agriculture Organization (FAO) has defined the term of pesticide as:
any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

<table>
<thead>
<tr>
<th>Type of Pesticide</th>
<th>Target Pest Group</th>
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<tbody>
<tr>
<td>Algicides</td>
<td>Algae</td>
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<tr>
<td>Avicides</td>
<td>Birds</td>
</tr>
<tr>
<td>Bactericides</td>
<td>Bacteria</td>
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<tr>
<td>Fungicides</td>
<td>Fungi</td>
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<tr>
<td>Insecticides</td>
<td>Insects</td>
</tr>
<tr>
<td>Miticides or acaricides</td>
<td>Mites</td>
</tr>
<tr>
<td>Molluscicides</td>
<td>Snails</td>
</tr>
<tr>
<td>Nematicides</td>
<td>Nematodes</td>
</tr>
<tr>
<td>Rodenticides</td>
<td>Rodents</td>
</tr>
<tr>
<td>Virucides</td>
<td>Viruses</td>
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</tbody>
</table>
Environmental and economical effect by pesticides use

Environmental effect
Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas, potentially contaminating them. Pesticides are one of the causes of water pollution, and some pesticides are persistent organic pollutants and contribute to soil contamination. In addition, pesticide use reduces biodiversity, reduces nitrogen fixation, contributes to pollinator decline, destroys habitat (especially for birds), and threatens endangered species. Pests can develop a resistance to the pesticide (pesticide resistance), necessitating a new pesticide. Alternatively a greater dose of the pesticide can be used to counteract the resistance, although this will cause a worsening of the ambient pollution problem.

Economics
Harm Annual US Cost
Public Health $1.1 billion
Pesticide Resistance in Pest $1.5 billion
Crop Losses Caused by Pesticides $1.4 billion
Bird Losses due to Pesticides $2.2 billion
Groundwater Contamination $2.0 billion
Other Costs $1.4 billion
Total Costs $9.6 billion

Human health and environmental cost from pesticides in the United States is a total of $9.6 billion. Additional cost includes the registration process and the cost of purchase pesticides. The registration process can take several years to complete the 70 different types of field test and can cost between $50–70 million for a single pesticide. Annually the United States spends $10 billion on pesticides.
Many of pesticides are very stable, therefore can accumulate in the trophical chains:

Pesticides kill innocent species too!
Have negative impact on different elements of the ecosystem!
Radioactive pollution of lithosphere with radioactive elements can arouse:

- Tests of nuclear weapon
- Incidents in the Nuclear Power Plants
- Extraction, enrichment and processing minerals of the radioactive elements
- Incorrect storing of the radioactive waste

104 kT nuclear bomb test in USA.
At the Chernobyl NPP catastrophe (April 26, 1986) in atmosphere come in radioactive substances with total radioactivity $10^{18}$ Bq, what is equal approximately 30-40 nuclear bombs explosion.

Movement of radioactive clouds in atmosphere after Chernobyl NPP catastrophe:
1) April 26, 1986
2) April 27, 1986
3) April 29, 1986
4) May 2, 1986
After Chernobyl NPP catastrophe majority of the radioactive pollution with air came and fall down in Russia, Ukraine and Belarus.

\[137\text{Cs} \text{ More polluted territories with } 137\text{Cs after Chernobyl NPP catastrophe.}\]
Content of $^{137}\text{Cs}$ in moss *Sphagnum magellanicum* did help to measure concentration of the radioactive isotopes after falling down in Latvia after Chernobil NPP catastrophe.