WATER POLLUTION

Water has the remarkable ability to renew and cleanse itself. When waste materials are deposited into a receiving stream, they often settle out, break down, or become diluted in the stream. However, pollution can occur if too much of a substance or too many substances are discharged so that it overwhelms the capacity of the stream to assimilate the substance(s) or cleanse itself. Water pollution may also occur if even just a little of a highly toxic substance is discharged into a receiving stream (e.g., dioxin).

Water pollution can be classified into two main categories: **point source** pollution and **nonpoint source** pollution. The difference between the two categories is simple. Point source pollution is any type of pollution that can be identified as coming from a clearly established source. This may be a factory, a previously polluted stream, or other source that is obviously causing pollution. Point source pollution problems are often simpler to control because it=s easier to see the cause of the pollution and to do something about it.

Nonpoint source pollution problems are more difficult to resolve because they often cannot be traced to one specific location. Nonpoint source pollution includes sediment from rainwater runoff or fertilizer pollution as storms wash nutrients from fields. Nonpoint source pollution can be runoff from animal wastes, construction sites or mines, and leachate from landfills. Nonpoint source pollution could even be acid rain from atmospheric pollutants that falls to earth in polluted rain or snow and contaminates waterbodies.

There are six major types of water pollutants:

*Biodegradable wastes

*Plant nutrients

*Heat

*Sediments

*Hazardous and toxic chemicals

*Radioactive wastes

Biodegradable wastes include human and animal wastes, food scraps, and other types of organic materials. Biodegradable wastes can cause water pollution by providing nutrients for bacteria. If there are excessive nutrients, aerobic (oxygen-consuming) bacteria multiply too rapidly, consuming the oxygen in a stream and making it uninhabitable for some species of fish and other aquatic life. In fact, if the bacteria grow too fast, they consume enough oxygen so that virtually everything in the water dies, leaving only anaerobic bacteria (bacteria that do not require oxygen to live) that create foul smelling gases.

Biodegradable wastes can also cause water pollution by spreading disease-causing bacteria. This type of pollution was the cause of typhoid fever and cholera epidemics that led to the development of public water treatment systems.

Many of the **nutrients** used to bring the earth to life can Aoverfeed@ a waterway to death. Sources of

nutrient pollution are sewage and septic runoff, livestock waste, fertilizer runoff, detergents, and industrial wastes. Some of these are point source causes, while others are nonpoint source.

Nutrients like phosphates and nitrates stimulate plant growth, and are primary ingredients in fertilizers. These compounds occur naturally, but in excess quantities they can cause great damage. Approximately 80 percent of nitrates and 75 percent of phosphates added to lakes and streams in the U.S. are the result of human activities.

Natural nitrates and phosphates usually are **limiting factors** in the growth of plant life. In other words, they occur in limited amounts that help govern the growth of different organisms and keep nature in balance. But when excess amounts of these nutrients are introduced into a waterway, some plant species can experience explosive growth, literally choking off other life forms.

When soluble inorganic nitrogen concentrations in water reach just 0.3 parts per million and inorganic phosphorus concentrations reach 0.01 parts per million, algae Ablooms,@ or multiplies rapidly. The algal blooms can become so severe that an entire lake can be fouled with a green, foul-smelling slime. Clear water can become so cloudy that visibility is restricted to a depth of a foot or less, destroying the aesthetics of the lake.

Once a bloom occurs, its negative effects can multiply rapidly. The green slime can foul up boat propellers and make swimming unpleasant. Nutrients can also cause weeds and other undesirable plants to flourish, increasing the problem. The algal bloom impairs water quality, and if the waterway is a source for municipal water supplies, it can be expensive to remove impurities and odors. Masses of algae can wash up on shore, decaying and producing hydrogen sulfide gas, which smells like rotten eggs. Certain marine algae can also release toxics that concentrate in fish and shellfish which cause human digestive problems. In fact, in some areas it is dangerous to eat foods like oysters at certain times of the year because of "red tide," a phenomenon caused by a marine algal bloom.

When an algal bloom clouds water, it can block sunlight from other plants and aquatic life, killing them or limiting their growth. And as the algae die, the bacteria which feed on them can deplete oxygen levels in the water to the point where it cannot support other life forms. This condition leads to **eutrophication.** Eutrophication is a naturally-occurring process of changes that take place after a waterbody receives inputs of nutrients, mostly nitrates and phosphates from erosion and runoff of surrounding lands. Usually this process occurs slowly over millions of years. Human activities can accelerate this process and the results can be very serious. Eutrophication caused Lake Erie to Aage@ nearly 15,000 years between 1950 and 1975.

Heat, or **thermal pollution**, can be a deadly water pollutant. An important relationship exists between the amount of dissolved oxygen in water and its temperature. The warmer the water, the less dissolved oxygen. Thermal pollution can be natural, such as in hot springs or shallow ponds during summer months, or it can be human-made, when water used to cool power plants or other industrial equipment is discharged back into streams. The amount of oxygen in water affects the life it can support. Some sport fish, such as trout, need cold water with high levels of dissolved oxygen and cannot live in warm water. Other nongame fish like carp and suckers thrive in warm water and can take over habitats from other fish if waters become too warm. This can result in greatly reduced diversity of fish species important for the environmental health of the stream.

Thermal pollution has been such a problem that most states have passed laws requiring power plants and industries to cool water before releasing it back into streams.

Sediment is one of our most destructive water pollutants. America=s water is polluted by more than one **billion** tons of sediment annually. Every day, Americans lose about one million dollars because of sediment pollution.
Sediment is mineral or organic solid matter that is washed or blown from land into lakes, rivers, or

streams. It can be point source or nonpoint source pollution. Typically, it comes from nonpoint source causes. Sources of sediment pollution include construction, row cropping, livestock operations, logging, flooding, and runoff from city streets, parking lots, and buildings. Sediment by itself can be a dangerous pollutant, but it is also considered serious because other contaminants such as heavy metals and toxic chemicals can be transported with it.

The effects of sediment pollution can be devastating. It can clog municipal water systems. Lakes or reservoirs can receive so much sediment that they actually fill in. Sediment can turn a deep lake into a shallow wetland area over time. Fine sediment can blanket the bottoms of lakes and rivers, smothering aquatic life such as fish eggs and insects and damaging fish gills. This can disrupt the entire food chain, and cause great damage to an ecosystem. Sediment can also be detrimental before it settles, while it is still suspended in water. It can make water cloudy, or turbid. High turbidity makes water aesthetically unpleasant and can destroy recreational opportunities. Some species of fish, such as smallmouth bass, will not thrive in a highly turbid aquatic environment, and studies indicate that high turbidity decreases fishing success.

Sediment in water can also create thermal pollution problems. Sediment darkens water, and allows it to absorb more solar radiation. This raises water temperatures to the point where it may not support some forms of life. At the same time, sediment blocks light from reaching aquatic plant life, slowing or stopping plant growth. And since plants add oxygen to water, oxygen levels can be reduced to the point that fish kills can occur.

This type of damage to the ecosystem is cumulative. As plants and fish die, the waterway loses its ability to break down wastes and materials that are naturally washed into it. These materials begin to accumulate and form another source of pollution.

Chemical pollution is usually human-made. Modern nations rely on thousands of organic and inorganic chemicals in industry, agriculture, and the home. These materials provide many benefits, and new chemical compounds are constantly being developed to improve existing processes.

But with modern chemicals come modern pollution problems. Improperly used or disposed of, reasonably safe chemical compounds cause toxic reactions. The effects of such toxics can be short term or long term and are regarded as a major national and international health concern.

Toxic water pollution is most often linked to point source causes, such as improperly treated industrial discharges or accidents in transportation (such as oil spills). But it can also come from nonpoint source causes. These include runoff from both urban and rural areas, and atmospheric transport.

Hard-surfaced roads and parking lots and urban areas collect toxics such as lead, oil, cadmium (from tires) and other pollutants, which can be washed into streams through storm drains. These materials can cause immediate toxic effects as well as long-term effects by accumulating in sediment or in living organisms. In the 1970s, many people suffered severe health problems from eating swordfish and tuna containing high levels of mercury, which accumulated in the fish over a long period of time. In agricultural areas, pesticides containing toxic compounds are applied to crops to improve crop quality and increase yields. Their proper use has helped eliminate hunger in many parts of the world. But improper application of pesticides can create serious water pollution problems, because runoff from fields can introduce large amounts of toxics into waterways. Pesticides can also cause groundwater contamination. Techniques of integrated pest management that involve a combination of biological control (natural predators) and reduced application of pesticides can help eliminate some of the potential problems of excessive pesticide application.

The cost of disposing of toxic chemicals created by industry is high. Federal and state laws require careful monitoring of industrial processes and specific storage and disposal procedures of these materials. This cost has caused some unscrupulous people to illegally dispose of toxic chemicals, a

process called Amidnight dumping.@ Pollution from this source may go undetected for years, and when discovered, it can be very difficult to determine the source. Legislation adopted since the late 1970s has imposed large fines and jail sentences for people caught illegally dumping toxic wastes.

Another, perhaps surprising, source of toxic water pollution comes from individuals. Household chemicals such as cleaners, dyes, paints, pesticides, and solvents are a large source of toxic water pollution, particularly in urban areas. Many of these materials are simply poured down drains or flushed down toilets with no regard to their consequences. And while the toxic chemicals from one household may not seem like much, they can cause problems. In fact, a single quart of used motor oil can pollute a quarter of a million gallons of water. And homeowners may use ten times the amount of pesticides per acre as farmers do. The amount of toxics released by an entire cityCone person at a timeCcan be staggering. EPA and other agencies have published educational materials to explain ways to properly apply and dispose of pesticides. (See AA Citizen=s Guide to Pesticides,@ U.S. EPA, Office of Pesticides and Toxic Substances, 3rd Edition, OPA 008-89, Washington, D.C., 1989.)

Radioactive pollution can be human-made or natural. It can come from wastewater discharges from factories, hospitals or uranium mines, or it can come from naturally-occurring radioactive isotopes in water like radon. Radiation accumulates in the body, and children are more sensitive to the effects of radiation than adults. Radiation can cause cancer, and in high concentrations, death.

Facilities that use radioactive materials are highly regulated and carefully monitored to prevent pollution. However, one of the potential problems of radiation pollution is stored radioactive wastes. Tons of waste have accumulated over the years, and the waste will remain dangerous for centuries. Unless suitable storage methods are found, these wastes could pollute groundwater or streams through improper storage. Work continues to create ways to safely dispose of radioactive wastes.

WATER CONTAMINATION (NATURAL DISASTERS)

Water pollution can also come from natural occurrences. Storms can create large amounts of runoff that carry pollutants into water supplies. Fires destroy ground cover and cause sediment pollution. Earthquakes can break sewer lines and cause pollution from human-made sources, or they can even change river courses, destroying some aquatic habitats while creating others. Naturally occurring elements in soils can cause water pollution when they leach into water in concentrations that exceed water quality standards or criteria. For example, desert soils are naturally high in concentrations of salt, boron, and other trace elements. Irrigation can cause these elements to wind up in high concentrations in the water supply, causing pollution that is a danger to crops and wildlife.