PURDUE EXTENSION
LAND USE teamWORK

Land Use & Water Quality

All land uses have an effect on water quality, whether positive or negative. In fact, "Land use and practices are probably the most important factor in determining water quality in most Indiana landscapes," says Jane Frankenberger, Purdue Extension Water Quality Specialist. Indiana's growing population, expanding economy, and the resulting land use changes have significant and usually negative impacts on water resources. "Although growth and land use change are inevitable, the way in which growth takes place affects its impact on water quality," she says.

Rainfall, Runoff, & Land Use

The fate of rain that falls on the land is strongly affected by land use. In a forest or grassed area, most rain soaks into the soil (infiltrates), where it's eventually used by growing plants or percolates to ground water. Ground water then flows slowly into streams, usually over a period of months.

By contrast, most rain that falls on a parking lot runs off immediately, often draining into storm sewers that transport it to a stream or ditch. Frankenberger says, "The most common land use in Indiana is agriculture, which lies somewhere between these two extremes."

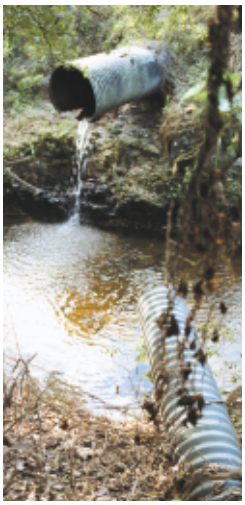
Frankenberger says, "Most people are surprised to find that the runoff predicted in residential areas is about the same as the runoff from the cropped field." The industrial and commercial land uses represent higher percentages of impervious surfaces and do result in higher runoff.

Increased runoff has impacts on both our streams and ground water. First, there is an increased frequency and severity of flooding. Increased runoff also reduces ground water recharge. "This could be cause for concern because 60% of drinking water in Indiana is provided from ground water, and ground water provides base flow to streams throughout the year," says Frankenberger.

Continuous base flow in streams is vital to the health of fish and aquatic life in the stream. Increased runoff causes greater stream channel erosion, producing sediment that harms aquatic life. Frankenberger says, "Doubling the flow may cause the streambank erosion to increase by a factor of 4 or more."

Another effect is the reduced natural filtration of the water. "The process of passing through the soil is one of the most important purifiers of water because many pollutants are filtered as water passes through the soil," she says.

Pollution & Land Use



Besides the effect on flow, land use directly affects pollution and the resulting water quality. Point source pollution is contamination that enters the water directly, usually through a pipe. Some sources are sewage treatment plants and industrial sources.

The exact location where nonpoint source pollution, or "polluted runoff," enters a stream cannot be identified,

because it comes from entire landscape areas, anywhere that rain falls and carries pollutants as it runs off. "Nonpoint source pollution is currently the major water quality problem in the U.S.," says Frankenberger, "and nonpoint source pollution is directly related to land use."

Nonpoint source pollutants include:

- Sediment;
- Pathogens such as *E. coli*, viruses, bacteria, and protozoa;
- Nutrients like nitrogen and phosphorus;
- Pesticides;
- Oxygen-demanding substances that consist of organic matter such as leaves and grass clippings;
- Metals, including lead, copper, cadmium, zinc, mercury, and chromium;
- Oil and other petroleum products; and
- Road salt.

Imperviousness, Development, & Water Quality

The nonpoint source pollutants in urban areas are usually deposited on impervious surfaces such as parking lots and roads. Frankenberger says, "Impervious surfaces that are connected to streams through a pipe (storm sewer) more directly affect water quality than do pervious areas, even if equivalent amounts of pollutant are present." This is because filtration through the soil is completely absent in sewered areas.

"The most important factor in determining the negative impact of urban development on water quality appears to be the number and extent of impervious areas directly connected to the drainage network by storm sewers or other piping systems," says Frankenberger. Removing water as quickly as possible is the goal in many developments. "We now realize that removing water quickly can have significant negative impacts," she says. In fact, studies in many areas of the country have found that concentrations of various contaminants increase with increasing impervious cover, while stream biodiversity decreases.

Stormwater runoff is one of the leading remaining causes of water quality problems in the United States. There is no doubt that it is easier to plan for good stormwater management before development takes place rather than retrofit existing development to reduce stormwater impacts.

Balancing the needs of growth and protection of the environment requires planning and commitment, but it is well worth the effort, says Frankenberger. All citizens benefit when clean streams with healthy aquatic life flow in and around their communities.

Runoff Expected from Four Types of Land Use

Land Uses	Runoff from a 4-inch Rainfall (inches)	Runoff Volume from 4-inch Rainfall on 1 Acre (gallons)
Forest	0.5 inch	13,600
Grass (meadow, lawns, parks)	0.8 inch	21,700
Residential (1-acre lots)	1.2 inches	32,600
Corn or Soybeans	1.7 inches	46,200
Residential (1/4-acre lots)	1.7 inches	46,200
Industrial	2.7 inches	73,350
Commercial	3.7 inches	100,520