Clean Rivers Spring from Their Source:
The Importance & Management of Headwater Streams

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Introduction
Headwater streams are the very small swales, creeks and streams that are the origin of most rivers. These small streams join together to form larger streams and rivers or run directly into larger streams and lakes. Ohio EPA defines headwater streams as a stream with a watershed less than or equal to 20 square miles. However, there are many streams that fall below this figure. In fact, there are many streams and drainage ways with a watershed of less than one square mile. We refer to these as "primary headwater" streams.

The quality of water in the larger streams and lakes have a close connection to the quality of the water coming from their source -- primary headwater streams. If there is poor water quality at the source of the larger streams and lakes, then it is likely that there will be poor water quality in the larger streams and lakes. Conversely, if there is high water quality at their source, then it is likely that there will be high water quality in the larger streams and lakes. The task of protecting water quality in larger streams and lakes begins with protecting their source -- primary headwater streams.

Purpose of Fact Sheet
Ohio EPA has prepared this fact sheet as an education piece for business and trade associations, environmental groups, local watershed groups and the public. In the future the Agency will seek well informed advice from all interested parties regarding the regulatory and other steps necessary to maintain and restore water quality in primary headwater streams. Activities currently underway are described at the end of this fact sheet.

What has been the past treatment of headwater streams?
Because of their small size, headwater streams in some locations have been treated as mere water "conveyances" and have been ditched, channelized, moved or even buried in pipes. Historically they have not been appreciated for their contribution to water quality. By their sheer numbers, however, they have important ecological and economic functions. They affect the ecological and economic viability of downstream rivers through the regulation of flood waters, the maintenance of safe and high quality drinking water, pollution prevention, and numerous other ecosystem services.

What is the connection between headwater streams and Ohio's historical water quality problems?
By the late 1960s and early 1970s gross water pollution in Ohio's lakes and streams were well publicized (e.g., burning of the Cuyahoga River, reported "death" of Lake Erie). Since then, there has been substantial, documented progress in restoring Ohio's larger streams to acceptable levels of water quality and aquatic life. The majority of improvement has been due to the abatement of direct pollution discharges (point sources) and the application of standard wastewater treatment technology.

Smaller streams, such as primary headwaters, have had less improvement than larger streams. A primary reason is that a large proportion of the impacts to smaller streams are due to nonpoint source impacts (e.g., agricultural runoff) and pollution that cannot easily be traced to a single source (e.g., habitat loss, sedimentation, nutrient enrichment). It is clear that efforts need to focus more on nonpoint sources of pollution.

The 2000 Ohio Water Resource Inventory indicates that 55% of streams and rivers in Ohio are fully supporting the applicable aquatic life "uses" with a restoration trend of a little over two percent a year. Clearly methods to improve the water quality of Ohio's streams and lakes while maintaining a vibrant economy are needed.

Previous efforts to improve water quality - those connected with point source abatement - will not address today's need. In order to improve water quality for Ohio's

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streams and lakes and protect progress already made, it will be important to practice proper management for primary headwater streams.

What kind of impacts are there to primary headwater streams?
Impacts to individual small streams may not be as noticeable as impacts to larger streams. However, the cumulative effects of such impacts over a relatively large area and over time can be quite substantial. The decline in quality of Ohio's primary headwater streams may not be obvious for two major reasons. First, as mentioned above, the quality of Ohio's rivers is improving due to massive expenditures to reduce point source impacts from wastewater treatment plants and industry. Second, the loss of primary headwater streams is a slow, cumulative process. The loss of one or two primary headwater streams does not raise much alarm about the overall health of large ecosystems. As such, stream deterioration only becomes evident over a relatively long period of time--after a substantial percentage of small streams are impaired.

There is a wide range of activities that can result in the degradation of primary headwater streams (with potential deterioration to the streams or lakes into which they flow). Point sources have been reduced but not eliminated as a source of impairment. On the other hand, nonpoint sources of pollution cause significant primary headwater stream degradation. Smaller streams tend to be more susceptible to the direct effects of nonpoint sources than larger streams. This may be partly because primary headwater streams form the principal boundary between land and water resources. They collect water, sediment, energy, chemicals and other inputs from the surrounding land which then flow into larger streams.

Hydro-modification (activities that result in habitat degradation such as channelization and riparian removal) can originate from agricultural activities (e.g., drainage) and urban/suburban development (e.g., flood control, construction). Hydro-modification is the leading source of impairment and is the origin of habitat degradation, nutrients, and silt found in smaller streams and the larger streams into which they flow.

Excess nutrients and increased sunlight from reduced riparian cover can result in a wide range of problems primarily associated with increased algal growth.

Changes in water flow can result from increased urbanization resulting in increased impervious surfaces surrounding primary headwater streams. This can result in the increase of high/low flow extremes in small streams.

Other activities affecting the function of primary headwater streams include those that change runoff patterns and reduce the inputs from small streams. Directing roof runoff directly into storm sewers, concentrating runoff, or piping small streams change the velocity, volume and delivery patterns of runoff, disturbing the stream's natural balance.

These and other impacts to primary headwater streams result in degradation of water quality that is then exported downstream as the water from the impacted areas flows into larger rivers, streams and lakes.

What conditions are found in primary headwater streams?
Streams that flow throughout the year usually have cool water, because their flow usually derives at least partly from ground water. They harbor species of macroinvertebrates that are well adapted to such conditions (macroinvertebrates are small animals without bones; examples include aquatic insect larvae such as dragonflies, mayflies and stoneflies as well as other animals such as aquatic worms & snails). Streams that flow most of the year may also be home to species of vertebrates (animals with bones). These include amphibians (especially salamanders) and/or small fish that have adapted to living in these cool, small streams. Here the presence of amphibians is related to a permanent flow of water where they may complete their life cycle, and the relative absence of predators, such as fish. This permanent flow may not be visible, as some water flows through crevices or pores below the actual surface.

In other primary headwater streams, with intermittent flow conditions or physical limitations (e.g., lack of suitable stream bottom, too steep of a gradient, or lack of deep pools), there may be macroinvertebrate populations and possibly some reproducing populations of fish or amphibians. The main difference between these streams and the type of primary headwater streams mentioned previously appears to be the absence of "cool" water during summer months, along with intermittent flow conditions

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(i.e., they tend to stop flowing in the summer time). Although they may have species of amphibians and/or fish adapted to these conditions, these are usually not the same species adapted to primary headwater streams with cooler water and permanent flow.

Other primary headwater streams have little or no potential to support significant reproducing animal populations. Usually these are precluded by natural background conditions (e.g., lack of seasonal flow) or irretrievable human induced conditions (e.g., flood control, drainage practices and other channel modifications). However, such streams still have an important role in maintaining high water quality in the larger streams into which they flow.

What are some of the ecological and economic functions of primary headwater streams and their riparian areas?
The following are examples of the important ecological and economic functions of primary headwater streams. Riparian areas include the woody, shrubby and wetland areas adjacent to natural streams and are an integral part of the streams. They are included when discussing stream functions below.

✓ Sediment reduction
Riparian areas assist in reducing the amount of sediment reaching the stream produced by human activities (construction, agriculture, etc.) that otherwise would choke and smother stream habitats. This can reduce dredging costs, reduce flood frequency, and reduce water treatment costs.

✓ Nutrient reduction
Primary headwater streams and riparian areas can efficiently capture many forms of nutrients, especially phosphorus, before they reach the stream. They can also be effective in removing other pollutants such as pesticides and herbicides. Nutrient reduction can improve recreation opportunities, reduce water treatment costs and human health risks, and reduce degradation of downstream waters.

✓ Water and organic matter retention
Natural primary headwater stream systems retain water and organic material (e.g., branches, leaves) in the flood plain. This helps to reduce local and downstream flooding and excess erosion and provides habitat for wildlife, fish and other small animals that live in the streams.

✓ Natural corridors
Headwater stream systems and their adjacent riparian vegetation provide natural corridors within otherwise barren areas. This provides a migration pathway for wildlife (e.g., birds, mammals, amphibians) and plants as well as wooded riparian buffers for aquatic life protection and wildlife habitat. Benefits may include: increased property values and reduced flooding and bank erosion.

What are some of the consequences of continued degradation of primary headwater streams?
✓ Increased degradation of larger streams
Primary headwater streams are part of a larger stream network. They flow into larger streams which in turn flow into still larger streams, etc. If the water quality of the smallest streams is poor (e.g., full of sediment and nutrients, high water temperatures), this will negatively impact the water quality of the streams into which they flow. Although degradation of one small stream may not seem significant, cumulative impacts to smaller streams on a larger spatial scale (e.g., rapidly developing areas) affect the water quality in the small streams themselves and in the larger streams, rivers and lakes into which they flow.

✓ Increased maintenance costs
Protection of floodways, riparian areas, wetlands and instream habitat results in a greenway that needs very little (if any) maintenance. In contrast, waters that have been channelized, entrenched for flood control, or encroached upon by development typically require continued maintenance to keep the stream in an altered state. These are generally either supported by extensive tax expenditures or the costs are externalized to others (e.g., downstream communities).

✓ Decreased wildlife habitat
Headwater streams are associated with vegetation that provides habitat for wildlife. Destruction of these areas often eliminates a significant source of habitat.

✓ Other consequences
Other consequences of continued degradation of small streams include: decreased aesthetics, increased flooding, increased erosion, and decreased property values.

How can the problem of degradation of primary headwater streams be addressed?
Ohio EPA does not have all the answers on stopping degradation to primary headwater streams.

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Indeed, as part of developing strategies to protect primary headwater streams in the future, it will be necessary to consider the role played by different levels of government as well as other major stakeholders affected by such strategies (e.g., agriculture, the building industry, development interests, and environmental groups).

There are numerous potential strategies that could be employed as part of the solution. Potential solutions and strategies could involve a mix of: identifying and establishing incentives and voluntary programs; identifying ways to help local government and organizations protect primary headwater streams; and evaluating existing regulatory programs for changes and improvements. Some strategies would be more appropriate at the local level whereas others would be more appropriate at the state level. In many of them, there would probably need to be some level of cooperation between the local and state level. Strategies need to build on the strengths, foresight and cooperation of major stakeholders affected by such strategies. Whatever mix of strategies is chosen, it will be important to clearly define what level of protection is warranted. Clearly, high quality primary headwater streams will need a higher level of protection than would sites with a low potential for developing into a higher quality waterway.

What is Ohio EPA considering?
Ohio EPA is considering a new use designation for primary headwater streams. Many primary headwater streams are not presently defined or assigned beneficial uses in Ohio's water quality standard regulations. However, as explained above, controlling the degradation of these streams is important to Ohio EPA's mission of restoring and maintaining the quality of our waters.

Why don't the existing regulations work for primary headwater streams?
Ohio EPA has developed biological criteria to work in concert with chemical and physical criteria for identifying and protecting various aquatic life uses of water bodies in the state. These criteria rely upon the assessment of fish, aquatic insects and other invertebrates. This is an excellent way to assess the majority of streams in the state with year-around flows and with the physical habitat to support fish. However, it has been found that in smaller headwater streams, generally those with drainage areas less than one square mile, the shallowness of the water and other factors may limit the stream's ability to support large-scale fish communities. In these situations the current regulations do not define appropriate aquatic life use designations, even for un-impacted natural streams.

What is Ohio EPA doing in regard to primary headwater streams?
Ohio EPA is in the process of conducting a primary headwater habitat study. It is a two-year study designed to document the biological and physical features associated with the various types of primary headwater habitats found in the state. The study will approximate the extent of primary headwater streams in Ohio and will provide the scientific basis for the establishment of a potential use designation for primary headwater streams and aquatic life criteria for these streams in Ohio.

The study is now in its second year. The goals for the continuing study are: to provide additional information and fill in data gaps regarding the nature of different types of primary headwater streams; to test and refine a rapid assessment tool for these streams; and to quantify the types of primary headwater streams found in selected areas throughout the state.

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