



## **Design Methodology for the Identification of Critical Stream Sampling Points in Upland Watersheds**

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From a world-wide perspective, the degradation of water resources continues to be a critical environmental problem. To reduce, control, and manage the pollution disrupting the natural equilibrium of water bodies, there is a need to qualitatively and quantitatively determine the existing conditions and changes in water quality. The principal instrument to temporally and spatially manage water resources is the establishment of a water quality monitoring network. However, to date there is a definite absence of a concise strategy or methodology for designing monitoring networks. Limited resources, especially in developing countries, require a well-configured, effective, and practical water quality monitoring network that generates information and data to guide water quality control operations. A methodology for identifying the critical sampling locations within a watershed has been developed and embodies the spatial component in the design of a water quality monitoring network by designating the critical stream locations that should ideally be sampled. For development purposes, the methodology focuses on a single contaminant, namely total phosphorus, and is applicable to small, upland, predominantly agricultural-forested watersheds. It takes a number of hydrologic, topographic, soils, vegetative, and land use factors into account. In addition, it includes an economic as well as logistical component. The methodology

incorporates a geographic information system (GIS) for spatial analysis and data manipulation purposes, a hydrologic simulation model for estimating the total loads, and an artificial intelligence technology, known as fuzzy logic, for improved input data representation. Three watershed case studies in Pennsylvania, Amazonian Ecuador, and central Chile were examined. For comparative purposes, each case study offered a different degree of data availability, reflecting typical conditions found in developing and developed countries. It was demonstrated that the developed methodology could be successfully used in all three case studies. The case studies suggest that the methodology has potential in applications world-wide.