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Project Summary

Water Quality of the Three Major Tributaries to the Chesapeake Bay, the Susquehanna, Potomac, and James Rivers, January 1979 - April 1981

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This project characterizes the inputs from the Susquehanna, Potomac, and James Rivers — the major sources of fresh water to Chesapeake Bay. The rivers were monitored for inorganic and organic chemical and physical components.

The Susquehanna was monitored at Conowingo, Maryland; the Potomac was monitored at the Chain Bridge in Washington, D.C.; and the James was monitored at Cartersville, Virginia. Measurements were made for suspended sediment, nutrients, carbon, trace metals, pesticides, major ions, chlorophyll *a*, total solids, and discharge. Scheduled frequencies of measurement vary from daily to monthly depending upon the type of measurement. Supplemental sampling was used to assess the impact of extreme events (e.g., storms).

Study results provide estimates of pollutant loadings for use in evaluating the effects of existing and future land use, water use, and regional economic developments in the freshwater portions of the Susquehanna, Potomac, and James River Basins.

This Project Summary was developed by EPA's Chesapeake Bay Program, Annapolis, MD, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The ultimate objectives of this project are to provide four categories of water information:

1) Estimated loadings of major ions, suspended sediment, selected nutrient species, and major trace metals for the two-year data collection period.

2) An assessment of accuracy and limitations inherent in these estimates.

3) Seasonal characteristics of nutrients, pesticides, and chlorophyll *a* collected during the study.

4) Relationships, comparisons, correlations, and trends detected in selected water quality constituents.

Procedure

Water quality data were collected from the three sites at intervals during base flow, and at more frequent intervals during high flow. The other parameters collected were daily or continuous discharge, suspended sediment, specific conductance, and water temperature. Water quality, suspended sediment, and chlorine samples were collected, preserved, and analyzed according to scientifically accepted procedures.

Bivariate linear regression equations were used to estimate all loads in this study. Logarithmic transformations of constituent loads (computed from instantaneous concentrations, discharges, and a factor to yield loads in pounds per day) were regressed against logarithmic transformations of concurrent measurements of discharge, suspended sediment, and specific conductance. The regression lines were fitted analytically by the method of least squares.

Results

Month-by-month comparisons of loads do not compare as well as annual total loads. This is because the regression technique does not allow for seasonal and antecedent-flow variations. The regression load estimations technique is most accurate in wetter years having a wide range of flow.

Two pesticides were consistently detected at the Conowingo and Chain Bridge stations — 2,4-dichlorophenoxyacetic acid (2,4D) and atrazine, primarily in late spring and summer.

Maximum chlorophyll *a* concentrations at all three sites occur during the high spring runoff. Concentration peaks of lesser magnitude occur during the late spring and summer and are possibly related to high velocity runoff in the spring and warmer temperatures in the summer.

All samples had total residual chlorine concentrations of less than or equal to the lower limit of detection for the technique, 0.01 mg L^{-1}.

Aluminum, iron, and manganese concentrations correlate more closely with suspended sediment totals than with discharge totals at the Potomac and Susquehanna Rivers. Correlations for the James River station are not as high.

According to discharge-weighted concentrations of sulfate concentrations, the Susquehanna and Potomac Rivers carry greater sulfate loadings than the James River, possibly due to coal mining activities within their drainage basins.

All the nutrient parameters at the Susquehanna River station correlate more closely with discharge; for the Potomac River site, however, some parameters correlate better with suspended sediment while others correlate better with discharge. In general, nutrient parameters associated with suspended material relate better to suspended sediment, while constituents with large solubilities relate better to discharge.

The Potomac River at Chain Bridge has the highest discharge-weighted average concentration of total nitrogen (2.20 mg L^{-1}), primarily in the form of nitrite-nitrate. The James River at Cartersville has the highest discharge-weighted concentration of both total phosphorus (.42 mg L^{-1}) and orthophosphate (.13 mg L^{-1}).

The data in this report do not support suggestions from some previous investigations which state that certain nutrient species are inversely proportional to streamflow.

Comparisons of data for the Susquehanna River at Harrisburg and Conowingo indicate that loads of those parameters more associated with the water phase (dissolved), such as orthophosphate and nitrite plus nitrate, increase in the downstream direction. However, for total phosphorus, organic and Kjeldahl nitrogen, organic carbon, aluminum, iron, and manganese (those parameters more closely associated with the suspended sediments), loads near the mouth of the Susquehanna River are less than those at Harrisburg, presumably because of the effects of the intervening hydroelectric dams.

High-flow sediment transport for the Potomac River at Chain Bridge is heavily influenced by seasonal variations, form of precipitation, and antecedent conditions.

Conclusions

Water quality loadings can be estimated reasonably by regression techniques, especially for wetter periods of one year or more.

Net transport of nutrient species and adsorbed constituents is dominated by a relatively few spring and storm-related high flow events.

Atrazine and 2,4D are the two most consistently detected pesticides at the Susquehanna and Potomac sites.

The sparsity of coal mining activity in the James River may be responsible for the River's lower sulfate concentrations. Phosphorus loads are increasing in the James and concentrations for both total phosphorus and orthophosphate are higher than in the other two tributaries.

Peak discharges above 400,000 ft^3 sec^{-1} at the Susquehanna River at Conowingo resuspend sediments and related water quality constituents which had been deposited behind the three hydroelectric dams and transport constituents to the Bay in excess of those transported 40 miles upstream at Harrisburg.

Sediment transport at the Potomac River site is heavily influenced by antecedent and seasonal conditions in addition to precipitation quality and quantity.

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The complete report, entitled "Water Quality of the Three Major Tributaries to the Chesapeake Bay, the Susquehanna, Potomac, and James Rivers, January 1979-April 1981," (Order No. PB 82-238 593; Cost: $9.00, subject to change) will be available only from:
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