Geospatial Analysis of the Occurrence and Transport of Phosphorus in the Poudre River Basin in Northern Colorado

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Abstract. This study examines the effect of different hydrologic conditions, source locations, and transport mechanisms on phosphorus concentrations throughout the Poudre River watershed in Northern Colorado. A total of 48 sampling locations was used to characterize total phosphorus concentrations in the watershed from May to September 2010, a timeframe that focused on five unique hydrologic conditions. To assess the spatial distribution of phosphorus within the watershed, GIS was used to locate major phosphorus sources (e.g. wastewater treatment plants and confined animal feeding operations) and determine the overland, canal, and river distances from the sources to the sampling location. Non-linear regression and multiple linear regression models were used to explore relationships between the measured phosphorus and the distance from the source. The nonlinear tree regression analysis was used to determine which anthropogenic sources and transport mechanisms have the greatest impact on phosphorus concentrations in the watershed for each hydrologic condition. The multiple linear regression was used with the entire data set to determine how well the most influential variables could estimate phosphorus concentrations. Results seemed to indicate that the primary source and transport mechanism for each sampling event was dependent on the hydrologic condition. For example, CAFO capacity and the irrigation canal distance from CAFOs to the sample location were the most important factors for determining phosphorus concentrations during a precipitation event. This illustrates the importance of irrigation canals as transport mechanisms for phosphorus from nonpoint sources, such as CAFOs, in semi-arid environments. As new phosphorus standards are being established, it is important to consider the location and timing of phosphorus monitoring. More effective pollution control strategies can be implemented with a better understanding of the geospatial and hydrologic conditions that affect phosphorus concentrations.
Keywords: Phosphorus, Poudre River, Water Quality, Irrigation Canals, Environmental Monitoring