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ONE-DIMENSIONAL MODELING OF THE POTENTIAL IMPACTS OF A HYPOTHETICAL URANIUM TAILINGS DAM FAILURE ON BANISTER RIVER AND KERR RESERVOIR IN VIRGINIA

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Interest in mining and milling of a large uranium ore reserve in southern Virginia raises concern regarding the potential impact of the failure of a future tailings dam on the surface waters. Born in Pittsylvania County, VA, Banister River follows northeasterly course, which runs parallel to the uranium reserves for about 12km. In this upper reach, Banister River receives Whitehorn Creek and Stinking River, which receive drainage from the area where uranium mining may be initiated. Southeast of Hermosa, VA, Banister River changes direction to follow a southeasterly course that passes through the town of Halifax, VA, to join Dan River. Upstream of the Town of Halifax, it is impounded by Banister Dam to form a narrow reservoir. A few kilometers downstream of the confluence with Banister River, Dan River flows into Kerr Reservoir impounded by John H. Kerr Dam, operated by U.S. Army Corps of Engineers for flood control and hydropower. The discharges released from Kerr Reservoir flow into Lake Gaston impounded by the Gaston Dam. Four drinking water intakes, serving a large population, are located along this system.

The City of Virginia Beach commissioned a preliminary study (Baker 2011 and 2012) to assess the impacts of tailings discharge on the quality of drinking water in Banister River and Kerr Reservoir as a result of failure of a tailings dam if one were to be built. The study was carried out using the CCHE1D model, developed by the National Center for Computational Hydroscience and Engineering, the University of Mississippi, which simulates one dimensional unsteady flow, non-uniform and non-equilibrium sediment transport, morphodynamic changes, and transport and fate of contaminants in dendritic channel systems. One-dimensional model extended from the confluence with Whitehorn Creek, located upstream of the uranium deposits, down to the John H. Kerr Dam. The main channel of Kerr Reservoir was modeled without taking into account the side branches. The volume of tailings to be released into the reservoir was estimated using an empirical equation established based on the past failures. The characteristics of the tailings, the radioactivity content due to radium and thorium, and the uranium content were estimated based on the site-specific reports published for the uranium reserves in Virginia and the values available in the literature. The simulations were performed for two different hydrologic scenarios representing a two-year long wet period and a two-year long dry period. The simulations considered adsorption and desorption of uranium and radionuclides to suspended sediments using a linear partition

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coefficient. For each hydrologic scenario two different sets of partition coefficients were simulated. This paper discusses the modeling of the river-reservoir system, presents the simulated flow discharge, sediment transport, and concentrations of radionuclides and uranium in water and in the bed, and draws conclusions regarding the potential impact of a tailings dam failure on the water quality.

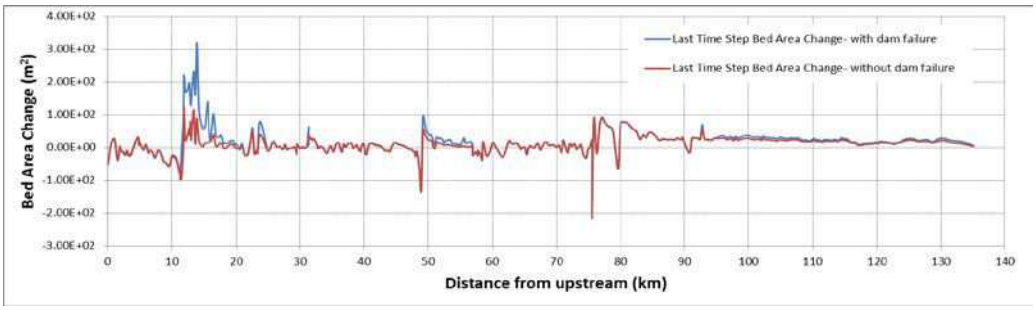

Figure 1 Bed area change in Banister River at the end of wet-period simulations with and without the hypothetical failure of the uranium mine tailings dam.

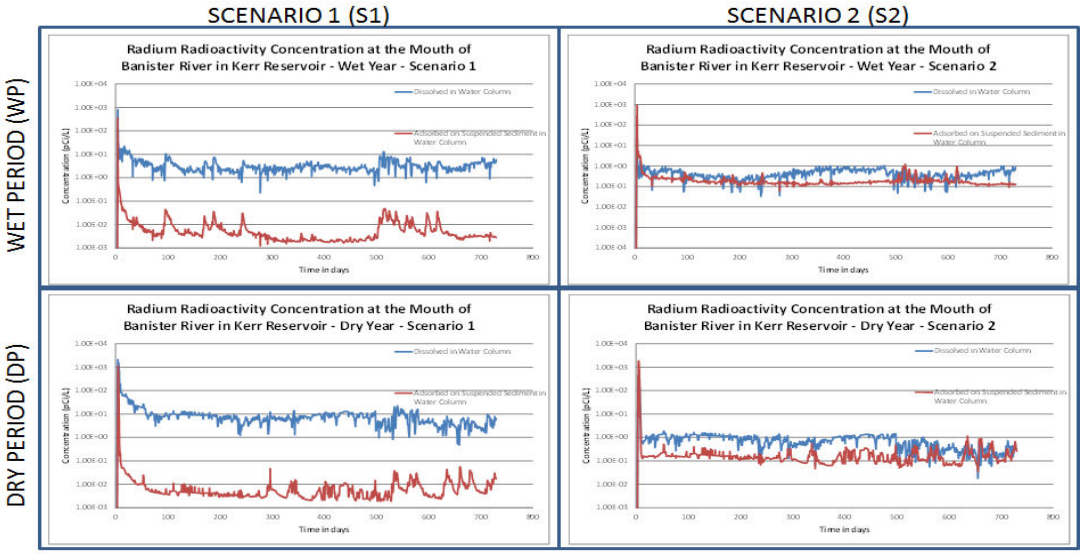

Figure 2 Dissolved and particulate radium radioactivity concentration at the mouth of Banister River in Kerr Reservoir simulated using wet and dry period hydrographs and two different partition coefficient sets (Scenarios S1 and S2).

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