



## Damage cost of the Dan River coal ash spill



A. Dennis Lemly

215 Sapona Road, Lexington, NC 27295, USA

### ARTICLE INFO

#### Article history:

Received 24 August 2014

Received in revised form

19 November 2014

Accepted 30 November 2014

Available online

#### Keywords:

Coal ash  
Dan River  
Duke Energy  
Fish  
Wildlife  
Selenium  
Copper

### ABSTRACT

The recent coal ash spill on the Dan River in North Carolina, USA has caused several negative effects on the environment and the public. In this analysis, I report a monetized value for these effects after the first 6 months following the spill. The combined cost of ecological damage, recreational impacts, effects on human health and consumptive use, and esthetic value losses totals \$295,485,000. Because the environmental impact and associated economic costs of riverine coal ash spills can be long-term, on the order of years or even decades, this 6-month assessment should be viewed as a short-term preview. The total cumulative damage cost from the Dan River coal ash spill could go much higher.

Published by Elsevier Ltd.

### 1. Introduction

On February 2, 2014 two large stormwater drainpipes (36" and 48" diameter) underlying a coal ash disposal impoundment at Duke Energy's Dan River Plant collapsed, spilling approximately 39,000 tons of coal ash (Duke Energy revised figure, originally estimated at 82,000 tons) and about 27 million gallons of untreated ash wastewater into the Dan River at Eden, North Carolina (Duke Energy, 2014; NCDENR, 2014, Fig. 1). This event was the third largest coal ash spill ever recorded in the USA (Waterkeeper Alliance, 2014).

The volume of ash and wastewater, and its rapid release, overwhelmed the river's natural flow. The spill coated the river banks and left ash deposits on the river bottom several feet thick in some places, and changed the chemistry of the entire flow of the river due to poisonous metals and trace elements such as selenium, arsenic, and copper. Within days, the US Fish and Wildlife Service detected floating ash and benthic ash deposits at the mouth of Kerr Reservoir in Virginia, some 70 miles downstream (USFWS, 2014). The North Carolina Department of Environment and Natural Resources called the spill "an environmental disaster" (Zucchino, 2014).

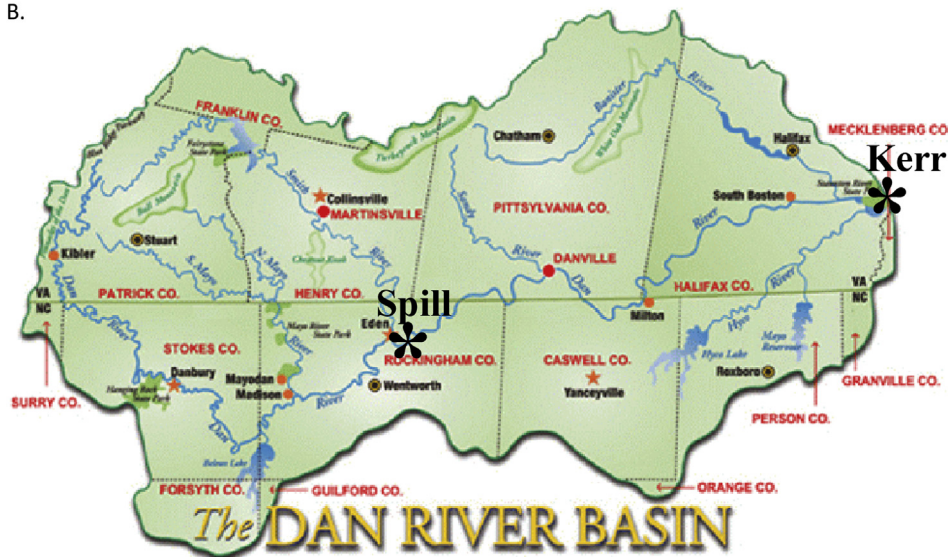
In addition to chemical hazards from waterborne toxins, the physical habitat degradation (blanketing and smothering) caused by coal ash deposited after a spill is extremely damaging to benthic animals like mussels, clams, insects, snails, worms, crayfish, frogs, toads, salamanders, turtles, etc. A portion of the more mobile species such as fish may be able to escape the initial "ash tsunami" by moving long distances up or downstream (in the Dan River, only downstream movement is possible due to a large weir dam just upstream of the spill site), but this doesn't really prevent damage to the greater animal community. Some fish will stay and ingest toxic ash and be chemically poisoned (Tuberty, 2009). Many will leave, which causes mass exodus of populations and severe disruption of the natural ecosystem balance (Arcadis, 2012). The ash deposits will persist and some of their contaminants will move up the benthic food chain into fish and wildlife (Ruhl et al., 2010; Arcadis, 2012). In addition to direct impacts on animals and their habitat, there is a cascade effect of the ecological damage that influences human-related factors such as recreation, public health, consumptive uses, and property values. The environmental damage from coal ash spills into rivers can be catastrophic and the effects can be long-lasting. Research shows that when a riverine aquatic ecosystem is severely damaged from coal ash pollution, it may never fully recover to its "pre-pollution" biological condition and ecological balance. For example, a spill of smaller size in 1967 on the Clinch River in VA resulted in destruction of benthic communities and displacement of resident fish populations for over 70 miles (Lemly

E-mail address: [lemlyad@wfu.edu](mailto:lemlyad@wfu.edu).

A.



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**Fig. 1.** A. Location of the Dan River coal ash spill zone, which spans the North Carolina–Virginia border and extends from Edén, NC to Kerr Reservoir, VA. About 10 miles of the spill zone are in NC and about 60 miles are in VA. B. Watershed of the Dan River basin showing spill site near Edén, NC and mouth of Kerr Reservoir in VA.

and Skorupa, 2012a, 2012b). Natural recovery coupled with extensive restoration efforts (stocking) for endangered and threatened mussels carried out by the US Fish and Wildlife Service have not been able to restore the native river fauna to its pre-pollution condition after more than 30 years (Jones et al., 2000). Other examples of extensive, long-term damage of coal ash spills on water quality and river fauna include the Delaware River, PA and the Emory River, TN (Arcadis, 2012; Carriker et al., 2013; Lemly and Skorupa, 2012a, 2012b; Ruhl et al., 2010).

The type of pollution and associated fish and wildlife impacts that have taken place in the Dan River due to coal ash results in diminished natural resource values that have both short-term and long-term negative economic effects at the local, state, and regional levels (Kopp and Smith, 1993; King, 1998). These values include (1) ecological costs (poisoning and blanketing/smothering of animals, displacement of animals, destruction of aquatic habitat and ecosystem function, associated animal replacement and aquatic habitat restoration costs), (2) sport/recreational costs (impacts to

fishing, camping, hiking, boating, swimming, and associated costs including outfitters, guides, licenses, food, clothing, tackle/gear, bait, gasoline, vehicles, and other provisions), (3) human health and consumptive use costs (food value of poisoned or displaced edible fish, human health risks from elevated pollutants in edible fish, physical stress and anxiety), (4) property damage costs (lost/depreciated real estate values of waterfront property due to pollution), and (5) esthetic costs (inherent value of a clean and healthy ecosystem to non-users/recreators). Spatial extent of the damage and duration in time both add substantially to these costs.

## 2. Damage cost of the Dan River spill after 6 months

The cost calculations presented here were derived based on valuation parameters established by NC State Statute for fish and wildlife replacement, US Fish and Wildlife Service Natural Resource Damage Assessment principles and procedures, and case examples taken from the scientific and technical literature (Lemly and

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