

The use of salt as a deicing agent in cold climates has been a common practice since the mid-1900s and there has been an increase in the use of salt since the 1990s (Kelly et al., 2008). The municipalities in the US apply 8-12 million tons of road salt to impervious surfaces annually (Cunningham et al., 2008). This increase in salt loading corresponds to a general increase in impervious surfaces within urban and suburban watersheds (Kaushal et al., 2005). Once applied to road surfaces, there are several pathways for the salt ions to enter surface water and ground waters. The most direct pathway is through sheet flow or storm drain discharge to streams from impervious surfaces. In watersheds where modern storm water best management practices (BMPs) have been implemented, winter runoff from roadways is directed into infiltration structures (e.g. swales, storm water ponds basins and bioretention cells) designed to reduce the impact of high discharge from impervious surfaces on streams. In these systems, salt ions will infiltrate through soils to groundwater and discharge to surface waters. There is recent evidence to suggest that chloride is accumulating in surface water systems to levels that can impact aquatic ecosystems (Marsalek, 1997; Novotny et al., 1999, Kaushal et al., 2005, Casey et al., 2007 and Flora et al., 2009). Despite this evidence, there has been limited study of the fate of the cationic species associated with road salts. The most commonly applied road salts are in the form NaCl, CaCl₂ and MgCl₂ with the Na⁺ variety being most commonly associated with State Highway applications in the state of Maryland (MD State Highway Administration).

Chloride will tend to behave conservatively in these systems while the salt derived cations will be involved in cation exchange reactions with shallow aquifer soils. At high concentrations these road salt derived ions can displace nutrients, displace and mobilize trace metals and reduce soil permeability as Na⁺ is known to disperse soil colloids (Cunningham et al., 2008). A pilot study of soils from the Red Run watershed in Baltimore County, MD has revealed salt impacted soil chemistry in soils associated with modern storm water retention basins. The extent of these impacted soils has not been well characterized and the distribution and accumulation of road salt related ions at the watershed level is not known. The Red Run watershed is a designated development zone for Baltimore County and has experienced a steady transition from a rural/forested watershed to one dominated by urban land use with modern storm water BMPs in place across much of the watershed. Public roadways and paved surfaces in the watershed are maintained by the county and state highway administration where NaCl is the primary road salt applied to these surfaces. In privately owned portions of the watershed, it is more likely that MgCl₂ will be the dominant road salt applied to paved surfaces (unpublished data, Lev and Snodgrass). Therefore the composition of winter runoff will be directly influenced by land use and ownership decisions. Superimposed on these parameters is the presence of storm water BMPs in the landscape which will influence how winter runoff associated cations and anions enter the subsurface and interact with soils.

We propose to investigate two questions concerning the effects of road salt application on soil ion chemistry. First, we will investigate the accumulation of road salt derived ions (Na⁺, Mg²⁺, Ca²⁺) in soils receiving direct runoff from paved surfaces (BMP soils) to test the hypothesis that these ions will accumulate in these systems and alter the chemistry of local soils. We will conduct an extensive survey collecting soils from 68 stormwater BMP structures

and then select three sites that represent the range of conditions in the watershed and conduct an intensive survey (high resolution sampling of soils across the BMP structure) of soil chemistry within the associate BMP structure. Second, we will characterize the cation storage capacity of BMP soils using a series of salt loading experiments in the laboratory. These experiments will establish the point at which BMP soils will become saturated with respect to road salt storage.