



Toxicity Of Storm Water Aluminum From The Pajarito Plateau

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ABSTRACT

The New Mexico Administrative Code (20.6.4 NMAC) allows that high turbidity surface waters may be filtered to reduce mineral phases that are thought to be non-toxic to aquatic life. Almost all ambient and storm water samples from the Pajarito Plateau are high in turbidity and aluminum (Al), but even after filtration, the Al that passes a 10.0 µm filter often exceeds state water quality standards. Here, we demonstrate through toxicological analyses that even unfiltered stormwater samples from several background sites (limited anthropogenic impact sites identified by Los Alamos National Lab and the New Mexico Environment Department) with known high Al concentrations, that no toxicity was observed with an Al-sensitive test organism.

INTRODUCTION

Aluminum is the most abundant metal in the earth’s crust and concentrations in Pajarito plateau soils and canyon sediments are roughly 3%. When this aluminum is mobilized by snow melt and storm water, the Al concentration regularly exceeds acute water quality standard criteria for the State of New Mexico.

However, little of the Al present in the parent material (Bandelier tuff and other volcanic rock) are in forms known to have toxic properties. Potentially toxic aluminum oxides, for instance, make up less than 1% of the Bandelier tuff. Using an aquatic test organism sensitive to Al (Ceriodaphnia dubia) we carried out acute toxicity tests on storm waters collected from various locations in the Los Alamos vicinity.

METHODS

The water flea (Ceriodaphnia dubia), was exposed to unfiltered storm water from three locations; E240 (Upper Pajarito canyon), Burnt Mesa, and Ponderosa mesa (all undeveloped sites in the vicinity of Los Alamos). These three sites have been identified as locations representing background conditions or least impacted by human disturbance. Test organisms were exposed to storm waters for 48 hours, with a 100% renewal of well mixed stormwater at 24 h. Based on the Genus Mean Acute Toxicity value, the toxicity test organism C. dubia is ranked most sensitive to aluminum in EPA’s Ambient Water Quality Criteria (EPA, 1988). The toxicity test protocol used was EPA-821-R-02-012 (EPA 2002).

Additionally, replicate exposures of C. dubia with these three same sources of storm water, and were spiked with additional fine silty matter collected from sediments in each of these water courses. This was done in an attempt to increase the Al exposure as the sediment load of the storm was moderate at the time of collection. Mortality of the test organisms was compared to appropriate controls. Subsamples of exposure stormwater were taken at the initiation of exposure (t=0) and at the end of the exposure (t=48h), and these were submitted to a lab for total aluminum determination, and thus exposure concentrations. The hardness-dependent acute criteria for the E240 site was calculated to be 844 µg/L; Burnt Mesa, 718 µg/L; and Ponderosa, 278 µg/L based on dissolved hardness measurements made on the exposure waters.

CONCLUSIONS

Addition of sediment materials increased Total Suspended Solids but did not necessarily increase Al.

Exposure of C. dubia to storm waters generated on the Pajarito plateau and in Bandelier National Monument yielded no acute toxic responses despite exceedances of New Mexico Water Quality Standards.

Given the non-toxic nature of aluminum in storm water on the plateau, the current state water quality standards criterion is unnecessarily stringent and a site-specific standard, or other remedy may be warranted.

Analyte	Sample time (hr.)	E240	E240+500 mg/L SS*	Burnt Mesa	Burnt Mesa+ 500 mg/L SS	Ponderosa	Ponderosa+ 500 mg/L SS
TSS (mg/L)	0 hr.	32	532	12	512	4	504
Total Al (µg/L)	0 hr.	16,838	16,660	3,183	4,442	1,487	2,239
	48 hr.	15,132	15,849	4,558	3,616	1,509	3,671
Dissolved Al (µg/L)	0 hr.	16	13	1,232	1,384	376	716
	48 hr.	22	31	1,823	1,794	859	611
*Total Suspended Solids							
Aluminum concentrations in RED exceed the State of New Mexico Hardness-Dependent Acute Water Quality Criteria							

Stormwater Source	Exposure	48 hour survival (%)
E240	Control	100
	E240 Raw Water	100
	E240+500 mg/L TSS	100
Burnt Mesa	Control	100
	BM Raw Water	100
	BM+500 mg/L TSS	100
Ponderosa	Control	100
	P Raw Water	100
	P+500 mg/L TSS	100

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