California State University, Sacramento (CSUS)

University of California, Davis (UCD)

California Department of Transportation (Caltrans)

Storm Water Filtration Pilot Studies at Lake Tahoe

ABSTRACT

Presented at:

American Water Resources Association, 2003 Annual Water Resources Conference, Nov. 3, 2003, San Diego

Authors:

Dipen Patel, Caltrans/CSUS Office of Water Programs
Jeffrey Hauser, Eco Logic, Sacramento
John Johnston, Caltrans/CSUS Office of Water Programs

Disclaimer:

This work reflects the author's opinions and does not represent official policy or endorsement by the California Department of Transportation, the California State University, or the University of California.

AWRA's 2003 ANNUAL WATER RESOURCES CONFERENCE
Nov. 3, 2003 American Water Resources Association San Diego, CA

STORM WATER FILTRATION PILOT STUDIES AT LAKE TAHOE

Dipen Patel, Jeffrey Hauser, and John Johnston*

ABSTRACT: At Lake Tahoe storm water runoff will be subject to strict numeric effluent limits for infiltration and surface water discharge starting in 2008. The primary constituents of concern are turbidity, nitrogen, and phosphorus. As part of its program to meet these requirements, the California Department of Transportation (Caltrans), which is responsible for more than 500 storm water discharge points in the Tahoe Basin, has constructed a small-scale test facility for developing treatment technologies. Of particular interest are combinations of settling and gravity filtration units because of their potential for deployment within the Caltrans right-of-way.

Particular attention is also being given to media with potential to remove dissolved phosphorus. At Tahoe, the dissolved phosphorus fraction is sometimes large enough to violate the effluent limit by itself. In general, phosphorus removal by solid media is controlled by adsorption onto surface sites, which depends on surface area, pore size and polarity, and precipitation of inorganic phosphorus minerals from solution. Precipitation reactions depend on pH, temperature, and the presence of aluminum, calcium and iron cations. Based on a literature review of over twenty materials, the four most promising media for this application appear to be activated alumina, expanded shale, limestone and wollastonite (calcium metasilicate) tailings. Both activated alumina and expanded shale have relatively large specific surface areas and remove phosphate ions primarily by adsorption onto surface sites. Wollastonite tailings and limestone remove phosphate ions by adsorption and precipitation with calcium. Laboratory batch and column studies using phosphate solutions or wastewater reported in the literature showed that all four media have relatively high phosphate adsorption capacities.

To test these media with storm water, pilot testing is being conducted using 30-inch diameter filters filled with 24 inches of media and dosed with storm water collected from local detention devices. Three grades of sand, activated alumina, and aluminum oxide were tested during the 01/02 wet season. Fine sand, activated alumina, expanded shale, and limestone are being tested during the 02/03 wet season. During the 01/02 season, none of the media filters were able to meet the turbidity limits for either infiltration (200 NTU) or surface discharge (20 NTU). Some of the filters could meet the phosphorus limits for infiltration (1 mg/L) but only rarely could they meet the surface discharge limit (0.1 mg/L). Nitrogen removal was highly variable. Hydraulic application rates were reduced in the 02/03 season. In some filters, dosing is controlled at the inlet; in others, dosing is controlled at the outlet, leading to submerged conditions. In results to date, all the media tested could meet the turbidity limit for infiltration and several could meet the turbidity surface discharge limit. Nitrogen, phosphorus, and turbidity data will be presented.

* Respectively, Office of Water Programs, California State University-Sacramento, 7801 Folsom Boulevard, Suite 102, Sacramento, CA 95826 USA, (Phone: 916-278-8119, Fax: 916-278-8140, E-mail: dipen.patel@owp.csus.edu); Eco:Logic Consulting Engineers 3875 Atherton Rd., Suite 1, Rocklin, CA 95765 USA (Phone: 916-773-8100, Fax: 916-773-8448, E-mail: hauser@ecologic-eng.com); Department of Civil Engineering, California State University-Sacramento, 6000 J St., Sacramento, CA 95819 USA, (Phone: 916-278-8113, Fax: 916-278-8140, E-mail: johnston@ecs.csus.edu).