Project Summary

Texas Department of Transportation

0-4543: Bridge Runoff Characterization

Background

Non-point source water pollution is an environmental issue currently facing water quality professionals. Although some highway runoff is treated by best management practices (BMPs) (structural or non-structural systems), or is diverted to municipal treatment systems, a fraction of water pollution caused by highway runoff is often conveyed to receiving waters without treatment. Highway runoff may contain suspended solids, metals, oil and grease, fecal coliform, and oxygen-demanding organic material. Runoff from highways has been studied and characterized in some detail; however, limited data is available on the quality of runoff from bridge decks. The objectives of this study were: 1) to characterize and compare the quality of runoff from bridge decks and approach highways using three different geographical regions of Texas, and 2) to assess the impacts of the runoff on the quality of the receiving water at each site.

What the Researchers Did

Flow-weighted composite and grab samples of runoff were collected from a bridge and an approach highway in each of three regions of Texas: Austin (Central), Lubbock (High Plains), and Houston (Coastal Zone).

Barton Creek in Austin is an ephemeral stream with peak flows exceeding 30,000 ft^3/s. The average daily traffic (ADT) count during this project was 58,000 vehicles per day (VPD) at the Loop 360 bridge crossing. The North Fork of the Double Mountain Fork of the Brazos River in Lubbock is also an ephemeral stream with peak flows approaching 148 ft^3/s; the ADT was approximately 10,000 VPD at the Loop 289 bridge crossing during this research. Clear Creek, in the Houston area, is a tidally influenced bayou that is approximately 45 miles long with about 15,000 VPD at the bridge crossing on FM 528. Clear Creek is one of the largest un-channelized bayous in the city of Houston, supporting a variety of river aquatic biota through feeding grounds and nurseries. Peak flows during the course of this study approached 4000 ft^3/s.

Automatic flow monitoring and sampling equipment was installed to record runoff flow and collect samples from the bridge surface and the approach highway at each site. Runoff was analyzed for:

- total and volatile suspended solids,
- total and dissolved metals,
- phosphorus,
- nitrogen species, and
- chemical oxygen demand.

Research Performed by:

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Center for Multidisciplinary Research in Transportation (TechMRT),
Texas Tech University

Texas Transportation Institute (TTI),
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Grab samples were collected and analyzed for:

- oil,
- grease, and
- fecal coliform organisms.

The constituents were compared to establish any significant differences in the concentrations observed for the bridge deck and highway.

What They Found

The average concentrations of constituents monitored reflected the unique meteorological characteristics of the area in which the sampling sites were located. The mass loadings (lb/d) of any constituent contributed by the runoff from the bridge decks were minimal compared to the mass loads of the same constituent carried by the respective receiving stream. The mass load contributed by the bridge deck runoff was less than 0.01% of the mass load in the receiving stream.

The concentrations of all constituents monitored in the bridge deck runoff were lower than or equal to the concentrations measured in the runoff of the approach highway on Loop 360 at Barton Creek in Austin, and in no instance was the concentration of a constituent in the bridge runoff significantly different from that of the approach highway at Loop 289 in Lubbock. At the site on FM 528 at Clear Creek, only phosphorus concentrations in the bridge deck runoff were lower than in the runoff from the approach highway, and there was no difference in the concentrations of dissolved lead, total Kjeldhal nitrogen, total suspended solids, and volatile suspended solids in the runoff from the bridge deck and the runoff from the approach highway. However, the concentrations of copper, lead, zinc, and nitrate nitrogen were higher in the runoff from the bridge deck than in the runoff from the approach highway.

What This Means

The average annual loads (lb/yr) of each constituent in the bridge deck runoff were much lower than the average annual loads of the respective constituent in the receiving stream. The difference was several orders of magnitude in most cases. Therefore, the runoff from each of the bridges had very little impact on the water quality of its respective receiving stream. The constituents observed in this study for runoff from an approach highway could be used as a conservative proxy for the constituents bridge deck runoff, if site-specific bridge deck runoff quality data were not available.

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