MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 22-454 (project 568) | May 2022

Assessing the Use of Dual-drainage Modeling to Determine the Effects of Green Stormwater Infrastructure on Roadway Flooding and Traffic Performance

the **ISSUE**

The increase in impervious surfaces in urban areas leads to higher peak runoff and total runoff volume in receiving water bodies during rains. These effects of urbanization indicate a loss of the watershed's ability to naturally mitigate flooding and must be compensated for by the implementation of stormwater management practices. Urban flooding results in repeated damage to property and infrastructure, economic disruption, and increased risk to human health and safety. Roadway flooding leads to the disruption of transportation systems even when flood depths are still passable by causing hazardous driving conditions that require a reduced safe driving speed. Because of traffic networks' connectivity, localized roadway flooding can cause traffic disruptions that reach far beyond the extent of the flooding. These disruptions can cause significant economic loss and pose a risk to the function of transportation networks during emergency events.

the **RESEARCH**

Green stormwater infrastructure (GSI) is a range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters. This work investigated how GSI interacts with surface runoff and stormwater structures to affect the spatial extent and distribution of roadway flooding and subsequent effects on the performance of the traffic system using a dual-drainage model.

The model simulated roadway flooding using PCSWMM (Personal Computer Stormwater Management Model) in Harvard Gulch, Denver, CO, and was then used in a microscopic traffic simulation using the

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Project Title

Mitigation of Flooding-Related Traffic Disruptions with Green Infrastructure Stormwater Management

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the RESEARCH (cont.)

Simulation of Urban Mobility Model (SUMO). We examined the effect of converting between 1% and 5% of directly connected impervious area (DCIA) to bioretention GSI on roadway flooding. The results showed that even for 1% of DCIA converted to GSI, the extent and mean depth of roadway flooding was reduced. Increasing GSI conversion further reduced roadway flooding depth and extent, although with diminishing returns per additional percentage of DCIA converted to GSI. Reduced roadway flooding led to increased average vehicle speeds and decreased percentage of roads impacted by flooding and total travel time.

the FINDINGS

The results of this project demonstrate the measurable yet small effect of GSI on roadway flooding in Harvard Gulch in Denver. Green stormwater infrastructure is usually thought of as providing co-benefits, such as water quality benefits, reduced stormwater volume going to a stream, and reduced peak flow to urban streams, but has not been investigated for the effects on the primary purpose of stormwater infrastructure, maintaining low flood depths, and velocities on roads.

the IMPACT

This work can be used to better manage stormwater on roadways and the resulting traffic effects. Current practices mostly implement gray stormwater infrastructure for reducing roadway flooding. This work shows that the emerging and increasingly implemented green stormwater infrastructure (bioretention was used as an example type of green stormwater infrastructure in this project) can also have a benefit in reducing roadway flooding. Roadway flooding for frequent, smaller storm events can lead to common traffic delays with large cumulative effects annually. Green stormwater infrastructure implemented for other purposes should also be considered for the benefits on roadway flooding and traffic impacts.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1075

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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