Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-5949: Bioretention for Highway Stormwater Quality Improvement in Texas

Background

Bioretention was developed in the late 1980s in Prince George's County, Maryland. This technique utilizes soil, sand, organic matter, and vegetation-based storage and infiltration facilities for treating runoff from paved surfaces such as parking lots, streets, and highways. To date, most bioretention results have been created by experiments conducted in different regions where climates and plants are very different from Texas. Moreover, few studies were conducted on highway environments. This project investigated the applicability and identified benefits and drawbacks of bioretention best management practices (BMPs) in Texas, specifically for highway-related applications. Large-scale and field experiments were conducted to evaluate the performance in hydraulic and water quality improvement.

What the Researchers Did

This project began with a literature review and case study, and identified applicable situations for the Texas Department of Transportation, followed by pilot testing and field demonstrations. The pilot testing focused on evaluating the bioretention cell's water quality performance and hydrologic responses (Figure 1). Tested vegetation types include:

- Shrubs.
- Grass species specified for highways in Texas.
- Native grasses.
- Bermuda grass (*Cynodon dactylon*).
- No vegetation (as the control).

The full-scale, field demonstration cell was constructed near the intersection of SH 21 and SH 6 in Bryan, Texas (Figure 2).

Figure 1. Large-Scale Pilot Testing.

Figure 2. Field Bioretention Cell during Testing.

Research Performed by:
Texas A&M Transportation Institute

Research Supervisor:
Ming-Han Li, TAMU/TTI

Researchers:
Kung-Hui Chu, TAMU
Jett McFalls, TTI

Project Completed:
8-31-12

The cell was first constructed to be able to fully drain. Synthetic and natural runoff tests followed the construction. After completing the experiments, the researchers modified the design to create an internal water storage (IWS) layer inside the cell, followed by natural rainfall sampling and monitoring. Hydraulic performance of peak flow reduction and runoff detention time was estimated. Pollutants of total suspended solids, nitrogen, phosphorus, copper, zinc, lead, etc. were analyzed.

What They Found

Bioretention BMPs can reduce peak flow and increase detention time. The non-IWS design moderately removed suspended solids, less effectively removed copper and zinc, less effectively removed total nitrogen, and moderately removed total phosphorus. The IWS layer significantly improved all performances, including hydraulic and water quality. Other findings include that IWS design may alleviate drought stress on plants in a bioretention cell and suppress a common fire ant colonization problem typically seen on roadsides.

What This Means

The significance of this research project is that bioretention BMPs are a promising method for highway application in hot, semi-arid areas. Furthermore, the IWS layer is a viable application to improve bioretention performance in both hydraulic and water quality improvement. An IWS layer could also be installed to modify (or retrofit) existing sand filter basins to enhance the water quality performance.

For More Information

Project Manager:
Wade Odell, TxDOT, (512) 416-4737

Research Supervisor:
Ming-Han Li, TAMU/TTI, (979) 845-6211

Technical reports when published are available at **http://library.ctr.utexas.edu.**

Research and Technology Implementation Office
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
Keyword: Research