Design, Construction and Performance of Low Impact Development in North Texas

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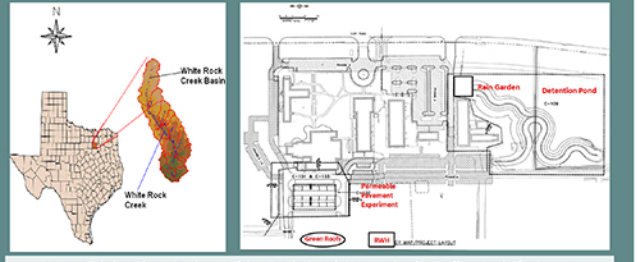
Introduction: Urbanization is altering the composition of landscapes nationwide, with urban areas characterized by a high proportion of impervious surfaces that adversely impact the water cycle of the region. The loss of infiltration of runoff into soil reduces ground water recharge. Increased surface runoff, velocity and pollution are all byproducts of rainfall on impervious surfaces. Increase in volume of runoff can lead to flooding, with receiving water bodies exhibiting stream bank erosion and channelization. Low impact development (LID) is considered to be a way to mitigate the adverse effects of increasing impervious cover, using decentralized measures to retain stormwater runoff on-site, and thereby seeking to mimic the natural pre-development hydrology of a site. Effectiveness of LID practices in various regions in the United States have been evaluated. However, modeling studies have suggested that the adaptability of LID designs to other regions is problematic, requiring modified solutions to be field tested in every location to confirm how they will perform. Therefore, there is still a great need to evaluate these practices in the field and to collect quantitative data on LID practices performance, especially in clay soils characterized by low infiltration.



Upper Trinity River Basin – White Rock Creek Watershed – Dallas AgriLife Center

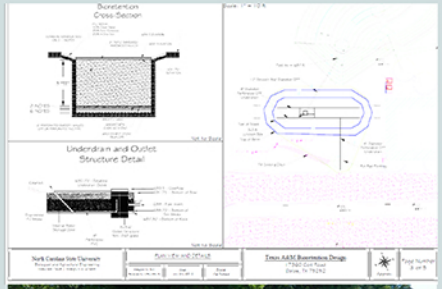
Study Area: The Dallas-Fort Worth (DFW) metropolitan area is one of the 20 fastest growing metropolitan areas in the country and is mostly urbanized, with an estimated 47% of the metroplex classified as impervious surfaces.

-The area is characterized by Houston Black soil series (Blackland Prairie) that has a very high amount of clay content and underlying calcareous layer and has low permeability.

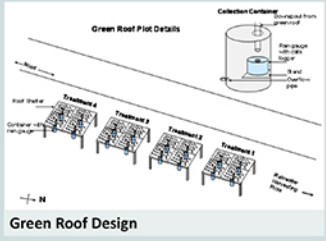
-The Upper Trinity River has been designated impaired for chlordane and bacteria. In addition, total phosphorus, Nitrate, Chlorophyll-a, and Orthophosphorus are considered parameters of concern. These issues underscore the need to evaluate LID practices in a region specific manner.

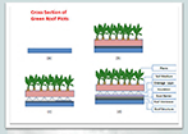
Objectives: This project evaluates five urban stormwater best management practices in a typical urban watershed in the Dallas Fort Worth area. The three discussed in this poster are permeable pavements, bio-retention area, and green roofs.

Methodology:

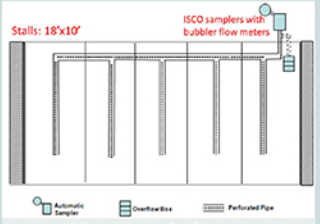


Bioretention Design





Green Roof Design



Permeable Pavement/Parking Lot Design

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Results: Reduction in water volumes and water quality contaminant loads were recorded for all BMPS on site. Volume and Load Reduction are shown for the bioretention area, Green Roofs (GR), and three Parking Lot stations (P.).

Volume Reduction

Total Volume Reductions	Rainfall (in)	Inflow/ Control (gallons)	Outflow (gallons)	% Reduction
Bioretention	8.84	97399	47468	51.3%
GR Hydrotech	18.35	141.84	60.7	57.2%
GR Soil	18.35	141.84	56	61%
GR Soil + Drainage	18.35	141.84	59	58.2%
P. Grass Pavers	11.57	1292	412	66%
P. Interlocking Concrete Pavers	11.57	1292	429	65%

Bioretention Load Reduction

Contaminant	Inflow (lbs)	Outflow (lbs)	% Reduction
NO3	94070	20268	78%
NH4	15102	5192	66%
TKN	177932	63353	64%
Ortho-phosphate	3190	2056	36%
Total Phosphorus	9082	5320	41%
TSS	2020645	341401	83%

Parking Lot Load Reduction

Contaminant	Control	Grass Pavers	% Reduction	ICP	% Reduction
NO3	222	858	-286%	654	-195%
NH4	272	173	36%	61	78%
TKN	2328	1761	24%	1023	56%
Ortho-phosphate	2.46	12	-391%	21	-747%
Total Phosphorus	54	85	-59%	108	-101%
TSS	59833	9649	84%	53307	11%

Green Roof Load Reduction

Contaminant	C	H	% Reduction	S	% Reduction	SD	% Reduction
NO3	76	64	16%	56	26%	44	42%
NH4	25	36	-41%	34	-34%	32	-27%
TKN	131	169	-30%	282	-116%	297	-128%
Ortho-phosphate	5	4	27%	2	69%	4	23%
Total Phosphorus	38	28	26%	20.5	45%	26	31%
TSS	1059	807	24%	605	43%	766	28%

Summary: These Low Impact Development Best Management Practices were constructed to collect runoff from paved areas receiving a minimum amount of soluble chemicals and a 1.5" rainfall event. Modifications now need to be made in the experiments for the local soil type to increase water retention times, especially in the bioretention area.

-TSS (total suspended solids) are the major target pollutant because of the chemical bonding properties Chlordane and other pollutants have with soil. TSS showed close to 90% reduction repeatedly in the BMPs, especially the bioretention area.

-All LID BMPs reduced flow volumes and lagged peak flow times. This greatly decreases flooding and degradation in urban stream systems.

-Overall, these LID practices increased groundwater recharge in North Texas clay soils while simultaneously decreasing runoff, contaminant loads, velocity and flooding in their systems.

-Also, these sites have been used in many educational and outreach trainings to inform companies and individuals about the growing ecosystem services and energy savings utilized by LID.