Low Impact Development (LID) Structures for Groundwater Management and Watershed Protection in the AMRC10 Watershed, El Paso Texas

Focus Category: Conservation, Hydrology, Models

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Abstract: The Ivey Property is subject to excess peak runoff as a result of improperly designed upstream developments. A conservation orientated design will be developed for the property that will a) allow for increases in peak flow resulting from upstream development, b) increase recharge of groundwater, and c) incorporate rainwater harvesting to reduce water use and decrease stormwater runoff. Experimentation will be executed, and computer models will be constructed to predict the response of the AMRC10 watershed to the development of the Ivey property located in the lower, undeveloped portion of the watershed. This will center on the construction of the passive rainwater capture and energy dissipation structures in the existing drainage pathways (arroyos) to accommodate the structures in an aesthetically pleasing design. The desired outcome is to determine the effects of this development on recharge of the underlying aquifer, and what methods can be used to maintain that recharge.

Statement of Critical Regional Water Problems: The subject property is located on the bench or mesa above the Rio Grande Valley. The sandy soils make the area subject to erosion and this natural tendency is exacerbated by increases in peak runoff discharge caused by upstream development. Overall El Paso has a desert climate making water supply a constant problem. Water conservation and groundwater mining have also become important issues in the southwest, as recent studies have shown that groundwater is a tenuous resource that is highly susceptible to overuse. The city of El Paso in particular relies heavily on its groundwater sources for municipal distribution, and has

only recently sought for ways to address the problem of groundwater mining. (Hutchison, 2006; Sheng and Devere 2005) Since 2006, after a major unexpected storm hit and flooded the city, El Paso has been addressing the concepts of artificial recharge through the management of storm water effluent, thus potentially solving two problems at once. However, the development of virgin land is gradually causing what was once open soil to be covered with impermeable surfaces that send storm water effluents along lined impermeable conduits to detention ponds. This necessitates detention ponds in most new developments, and poses the potential effect on the underlying aquifers, which will alter the cities' overall water budget. The resulting increase in stormwater runoff needs to be managed, and it is preferred that it be directed into areas of artificial groundwater recharge, so as to preserve that water resource. The Ivey property which sits within the lower portion of the AMRC10 watershed is one such area, which is intended for future development.

Nature Scope and Objectives of Research: New forms of stormwater transport and storage have been explored and implemented in El Paso. Other methods used in other parts of the nation are also being considered for new developments. Some of these have benefits such as in creasing infiltration, and thus groundwater recharge, slowing effluent flow rates, and decreasing storage needs. We have a unique opportunity in the form of a land owner that desires to develop a property while using as much natural landscape in the drainage structures as possible and are afforded the chance to research the applicability of such structures, and their effect on the underlying aquifer, in comparison to standard concrete structures and the resulting increases in effluent. The principle objectives of this exploration are as follows: Characterize the Americas 10 watershed; Develop HEC-HMS model to simulate storm runoff within the Americas 10 watershed; Simulate the current hydrologic conditions; Simulate future hydrologic conditions with proposed development; Assess impacts of future development; and Evaluate alternative strategies for storm water runoff management. The specific intentions of modeling the basin are to estimate overland flow volumes and speeds, as well as to use a water balance to estimate the volume, and difference of volume of water captured in storage under each of the existing, and proposed conditions, or be consumed through transpiration in local vegitatative lining.

Overview and Approach of Study Area: The study area is approximately 442 acres of the Ivey property on the far east side of El Paso, Texas. The area is bounded by I-10 to the northeast, Texas highway 375 to the northwest, the Mesa drain to the southwest and the Socorro Grant to the southeast. The contributing drainage basin of the study is the area of suburban and commercial development to the north of the site. It extends to the Socorro sports center, and includes all the commercial and residential development directly east and west of the sports center. A total of over 1,900 acres of land feed runoff out of the drainage basin. After the proposed development, the site will be comprised mostly of residential and some commercial areas. The majority of the area is bluepoint classified soil and almost all of the area has been previously graded, though there are some larger tracts that remain mildly rolling. Natural arroyos provide a great deal of drainage to the area, thought there are existing concrete lined channels for drainage through the previously developed areas. The drainage from above the site is all funneled

into two unlined arroyos which then feed the Americas 10 Detention Pond. The two arroyos are the Research Drive arroyo and the AMRC10 arroyo. They are ephemeral waterways which are dry for the majority of the year. (Moreno, 2006)

Tasks to be Completed

Task 1: Characterization and development of numerical model for the watershed. Characterization of the watershed and the development of conceptual models based on previous studies were carried out. Additional data has been collected and will be used for refining the conceptual model of the watershed. The numerical model for the AMRC10 watershed are to be constructed using HEC-HMS, for present conditions and proposed development conditions. Models will also be used to assess the traditional stormwater management structures and low environmental impact stormwater management structures. Time frame: ongoing.

Task 2: Determine permeability of the study area. Infiltration and permeability tests are to be performed at various locations of the study area. This is for estimation of the infiltration volumes during precipitation events, and calibration of the models. Methods will be done using double ring infiltration test in the field, and constant head permeability test in the lab. Time frame: present to May 2010.

Task 3: Visit existing grass lined channels using energy dissipation structures. It will be necessary to asses the performance and effects of such LID structures. In order to do so, existing installations will be visited and observed and the resulting information will be used to calibrate the appropriate model. Time frame: March 2010 to October 2010.

Task 4: Interpret and analyze modeling results. Using model runs under various precipitation conditions, the performance of the drainage structures will be evaluated. Additional model simulations will be done to confirm the functionality and implementation of low environmental impact drainage structures. Secondarily, a water balance and watering requirements for indigenous plants, the effect of the structures on the local water budget is to be estimated. The results will be summarized in a technical report. Time frame: August 2010 to February 2010.

Overlap in time frames is intentional, due to cross reliance of tasks and results.

Expected Results:

Report: Model data and simulation results will be compiled and to be published as a technical report by Texas Water Resources Institute as well Master thesis by the University of Texas at El Paso. The results will be shared with engineers and developers as well as stakeholders at meetings and conferences.

The potential **benefits** of the project include promotion of implementation of LID design for commercial and residential developments. A) reduce environmental impacts by urban development B) enhance recharge into the aquifer using runoffs and C) maintain or enhance green belts or riparian zones using collected storm runoffs This could help facilitate future developments, which will help to manage and maintain the underlying aquifer. With such future developments, El Paso will experience less impact of urban development on its water budget from the spread of development. Also, the quantification of a water balance using the computer models will help us to better understand the impact that development has on underlying water storage.

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