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Holding the Stormwaters

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Not so very long ago, city drainage systems had one purpose only--to remove stormwater from an area as quickly as possible.

This traditional concept of drainage backfired on the Houston area in the late 1970s. Many developed areas which had never flooded before were inundated with stormwater from new subdivisions and shopping centers upstream.

Drainage systems originally designed to carry 15 inches of rainfall in the 1950s now flood when the area receives only 6 inches of rain. Houston's extremely flat terrain and its intense rainfall patterns contribute, of course, to the flood problem. But the major factor--the one most responsible for increased flooding--is the fast-paced development around the burgeoning city.

Because traditional stormwater systems increase the quantity and the rate of flow as development of an area takes place, other types of stormwater control have become quite popular in the Houston area. The present concept of stormwater design involves holding water in an area and releasing it slowly to decrease the impact of development on stormwater leaving an area. The county flood control district, as a matter of fact, now requires new developments in Harris County to design their drainage system so as not to change the rate or timing of the flow into receiving channels or streams.

Some of the more popular methods used to control stormwater include natural drainage channels and detention ponds. Natural drainage is a fancy name for old-fashioned roadside ditches and grassy drainage channels. Detention systems or ponds hold stormwater and release it slowly to reduce impact downstream. Detention ponds can be designed as (1) permanent pools of water designed with additional capacity for stormwater (2) low-lying areas with dikes to temporarily hold runoff after a storm or (3) paved areas specifically built for holding stormwater. Ponds to complement golf courses

and parks, for instance, now often serve also as areas where stormwater runoff can be held and released slowly. Park areas as well as parking lots can also hold stormwater temporarily.

RESEARCH NEEDED

Because the use of detention systems is a relatively new concept in subdivision design, very little research has been completed on their overall impact in a watershed.

Rice University environmental engineer, Philip Bedient, led a team of researchers in 1980 and 1981 to study detention systems in the Houston area. Bedient's multidisciplinary team included Rice professors James Blackburn, Peter Rowe, and John Anderson; University of Texas civil engineer Larry Mays, and City of Houston public health engineer Enrique Quevedo. Project funding came from a matching grant from the Office of Water Research and Technology through the Texas Water Resources Institute and from the City of Houston Health Department.

Three of Bedient's research objectives were to study the impact of detention ponds on stormwater quality, to develop methods to design and locate detention ponds, and to compare the economics and implementation of detention ponds with traditional stormwater drainage systems.

Bedient initiated the study partially because of his concern with the worsening water quality in Lake Houston. After monitoring the water quality in Lake Houston for three years, Bedient feels that it is one of the most threatened sources of drinking water in Texas. He sees detention ponds in new developments in the Lake Houston watershed as one way to lessen the impact of new developments on the water quality of the lake.

WATER QUALITY

The research team monitored the quality of water entering and leaving a detention pond built in The Woodlands, a large development in the Lake Houston watershed. Researchers installed an automatic sampling station just upstream from the pond and one in the pond at the downstream outlet. After monitoring inflow and outflow during rain storms for one full year, he concluded that the detention pond was quite effective in removing suspended solids from the stormwater.

He found that up to 90 percent of the suspended solids in the entering stormwater settled to the bottom of the pond. The researchers took core samples from the pond bottom and found 6 to 8 inches of accumulated sediment there. A much better place for them, says Bedient, than in the drinking water supply of Lake Houston. Even if detention ponds must be dredged every 10 or so years, he feels the cost compares favorably to the maintenance costs required of other types of drainage considering the impact of the ponds on downstream water quality.

In addition to suspended solids, Bedient also measured the entering and exiting stormwater for chemical and biological oxygen demand and for nutrients such as nitrogen and phosphorus. He points out that if detention pond systems can keep a certain amount

of pollutants out of receiving waters, cities can reduce money and energy costs for water treatment.

LOCATING DETENTION PONDS

Another important part of the study of stormwater detention systems had to do with determining the most advantageous sites for detention ponds. The researchers working with Bedient developed a computer model which can be used by flood control districts, counties, or even a single developer in planning detention storage systems.

"It's a very sophisticated model," he says, "but it is designed so that the input data is easily obtained. A developer would only need to know such things as the size and topography of an area, the past rainfall records, and the economic value of the land in order to make good use of this model we have designed." The model can be used to site one pond or to put together a complicated network of ponds and channels.

ECONOMIC CONSIDERATIONS

Bedient's team of researchers evaluated some of the economic and political issues concerning stormwater detention systems compared to traditional storm drainage systems and concluded that:

- 1. On-site stormwater detention in Harris County clearly increases the costs of development.
- 2. Current financial procedures initiated by the state provide some relief for developers. An example of this is a decision by the Texas Department of Water Resources to allow developers to include raw land costs involved in detention ponds as part of development costs.
- 3. Detention systems can mean losses in potential land and revenue, but increased value and increased residential densities can make up some of the loss.

The general acceptance of stormwater detention as a preferred practice over traditional drainage has not been without conflict. Upstream developers argue, for instance, that a new requirement by the Harris County Flood Control District forces them to pay for flood protection downstream. Recent action by the district requires developers to install detention systems for new developments in Harris County draining into water courses having less than a 100-year flood capacity.

Few would argue with Bedient who feels that the benefits of stormwater detention more than make up for the increased cost of developing upstream areas around Houston. Bedient's research is just a beginning, though, in understanding and solving the flood problems which plague Houston and other Texas cities.

TEXAS LAW OF DRAINAGE

The owner of upstream property has the right to drain surface waters naturally from his land onto the adjacent land downstream.

The owner of adjacent property downstream has no right to obstruct the natural flow of waters and cause water to back up on the land above.

The downstream property owner is not required to receive artificial flow--that flow which has been changed by channelization, paving, or other land modifications which accelerate or concentrate the flow.

The owner of the downstream land may, even if other property intervenes, construct reasonable barriers to protect his property from artificial flow.

If a new development increases the flow and causes a downstream area to flood, the downstream landowner may sue the developer for flood damages. Often, however, it is impossible to prove exactly which development has caused the increased flooding downstream.

Downstream landowners cannot hold municipal utility districts (MUDs), water control and improvement districts (WCIDs) or other governmental units liable for flood damage caused by upstream development.

BACKTRACKING

The last issue of Texas Water Resources incorrectly stated that no Texas groundwater district regulates the quantity of water pumped. Richard Bowers, the manager of the Panhandle Ground Water Conservation District, says that his district does indeed enforce rules regarding the quantity a well can pump as well as the spacing between wells.