



- Surface runoff is a very important part of the hydrologic cycle.
- Stormwater is a term used to describe water that originates during precipitation events.



#### **Detention Ponds**

Stormwater that does not soak into the ground becomes surface runoff, which either flows directly into surface waterways or is channeled into storm sewers, which eventually discharge to surface waters.



## **Detention Ponds**

- Since humans began living in concentrated village or urban settings, stormwater runoff has presented itself as an issue.
- Evidence of the early incorporation of stormwater engineering has been uncovered in ancient Greece.
- During this time considerable amounts of impervious surfaces emerged as a factor in the design of early human settlements.

## **Detention Ponds**

An early specific example of stormwater runoff system design is found in the archaeological recovery at Phaistos a place and BronzeAge settlement on southern Crete



A **detention basin** is an artificial flow control structure that is used to contain flood water for a limited period of a time.



#### **Detention Ponds**

**Detention basins** are used to mitigate the effects of storm water runoff by providing temporary storage and control release to downstream areas.



#### **Detention Ponds**

- Detention basins are for short-term storage of storm water.
- The objective of a detention facility is to regulate the runoff from a given rainfall event and to control discharge rates to reduce the impact on downstream stormwater systems.
- Retention basins are permanent storing of water indefinitely.



## **Detention Ponds**

- It is generally acknowledged by the stormwater management profession that urbanization increases runoff from rainstorms and snow melt
- For example, studies in Denver show that during a routine summer afternoon rainshower, an acre of pavement will produce the same amount of runoff as would occur from several square miles of native rangeland.

## **Detention Ponds**

What is a Stormwater Retention/Detention Facility?





A retention/detention (R/D) facility can be either a pond, an underground tank or vault, or an infiltration system specifically designed to capture, store and then slowly release stormwater runoff downstream or into the surrounding ground.



How do R/D Facilities Work?

- > A detention pond stores accumulated stormwater runoff and slowly releases it downstream.
- A flow control structure regulates the release rate of the stored water.
- Some detention ponds are combined with water quality treatment ponds (i.e., wetponds) which are intended to have some water in them on a permanent basis.



## **Detention Ponds**

Why is stormwater runoff a problem?

- As we cut woodlands, clear land, pave roads and parking lots, and construct houses and buildings, we change the permeability of the ground.
- Falling rain has fewer places to soak in gradually. Runoff on hard surfaces occurs faster and in greater volumes.
- Increased stormwater runoff can worsen flooding, erosion, and water pollution and destroy stream habitat.







#### True or False?

Urban stormwater discharges cause no significant harm to our lakes, rivers and oceans





Urban stormwater is one of the most significant sources of pollution in our nation's rivers, lakes and estuaries. According to the U.S. Environmental Protection Agency, urban stormwater is the second largest source of water quality damage in estuaries and a significant contributor to the damage to lakes, rivers, and bays.



The detention aspect is often considered secondary by the residents in the area. Planning for detention needs also to consider the social, environmental, and recreational needs of each community.



### **Detention Ponds**

#### Planning for Detention Ponds

- > Effects on the Landscape: Aesthetics
- Pond Environment
- Recreational Opportunities
- Removal of Pollutants
- > Detention in Natural Lakes
- Safety
- > Layout of Detention Ponds

## **Detention Ponds**

#### Effects on the Landscape: Aesthetics

- As an integral part of the community it serves, a detention pond needs to blend into the landscape and into the community.
- Too often, detention ponds are installed merely as a hole in the ground (sometimes referred to as an HIG) without any redeeming landscape features.
- Simple yet inexpensive measures, such as gentle side slopes, planting of trees and shrubs, and other landscaping features can transform an HIG into an attractive amenity for the neighborhood.

## **Detention Ponds**

Effects on the Landscape: Aesthetics



Detention Ponds
Pond Environment
Ponds that have a permanent pool of water offer many attractive environmental possibilities.
As urbanization occurs, there is a loss of wildlife and bird life habitat. Such habitat is replaced by manicured lawns, shrubs, and trees that offer habitat for select small birds and animals such as squirrels.
These "natural" environmental pockets are considered by many city dwellers to be a treasure in an otherwise densely urbanized community.

## <section-header>Detention Ponds Recreational Opportunities • Detention basins and ponds, with or without permanent pools of water, offer many recreational opportunities in an urban setting. • Offer many recreational opportunities in an urban setting. • Since the periods between storms generally far exceed the periods of rainfall, these facilities are available for recreational uses most of the time.









#### **Bioretention area**

- Bioretention areas (also referred to as bioretention filters or rain gardens) are structural stormwater controls that capture and temporarily store the water quality volume using soils and vegetation in shallow basins or landscaped areas to remove pollutants from stormwater runoff.
- The following is a list of some of the benefits of Bioretention areas and rain gardens:
  - > Applicable to small drainage areas.
  - Good for highly impervious areas such as parking lots.
  - > Relatively low maintenance requirements.
  - > Can be planned as an aesthetic feature.

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- The following is a list of some of the limitations of bioretention areas and rain gardens:
  - > Cannot be used to treat large drainage areas.
  - > Susceptible to clogging by sediment.
  - > Tend to consume space (about 5% of the drainage area).
  - When compared to other detention options, the construction cost can be kink
  - be high.



**Removal of Pollutants** 

- Detention basins and ponds will cause suspended solids to settle.
- Since many of the pollutants are attached to suspended solids, ponds will remove some of them.
- How much is removed will depend on pond volume, inlet and outlet configuration, pond depth and shape, and the time the stormwater resides in the pond.

### **Detention Ponds**

Detention in Natural Lakes

- When the downstream recipient of urban storm runoff is a natural lake, a water supply reservoir, or a recreational reservoir, each of them can provide peak flow attenuation.
- The flow routing advantages of these water bodies, however, can extract a price in the form of water quality deterioration and adverse impacts on their natural or designated uses.

#### **Detention Ponds**

Detention in Natural Lakes

- Nutrient enrichment and excessive algae levels can deplete oxygen and cause fish kill
- Deposits of sediments containing heavy metals and attached petroleum product will occur in the bottom.



# Detention Ponds

- If salt is used to control street icing, increases in take salinity can occur.
- If acid rain is of concern, the increased surface runoff from urbanization may increase the acidity of the



### Detention Ponds

Safety

- Safety issues include: the structural integrity of the confining embankment, the outlet works, people using the facility for recreation.
- The latter includes the need to protect people when the pond is storing runoff (i.e., operating) and during the periods between storms.

## **Detention Ponds**

#### Layout of Detention Ponds

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- When planning a detention basin, try to lay it out so that it fits the surrounding landscape and the community.
- Detention ponds should be laid out to insure that the flow entering the pond is evenly distributed across the pond so that stagnant zones do not develop in the pond.



#### **Technical Configuration**

- Inflow Structure
- Configuration of Pond Bottom
- Slope Protection
- Outlet Structure
- Trash Racks
- > Spillway vs. Embankment Overtopping
- Embankment Loss Analysis

#### **Detention Ponds**

Inflow Structure

- Erosion and sediment deposition problems can develop at the inflow to the detention basin.
- Although it is possible to design inflow structures to minimize erosion, deposition cannot be prevented.
- To minimize maintenance costs, however, it is a good idea to localize much of the deposition where it can be easily removed.

### **Detention Ponds**

Inflow structures should have the following features:

- Dissipate flow energy at the inflow.
- Provide protection against erosion.
- Provide maintenance access for the repairs to the inlet and for the removal of sediments.
- Incorporate safety features to protect the public (i.e., gentle slopes, fencing or railing at vertical faces of the structure).
- Be unobtrusive to the public eye by blending the inlet into the surrounding terrain.











Configuration of Pond Bottom

- A detention basin that stores water only during storms should have a trickle flow ditch between the inlet and the outlet.
- Low flow ditches are sized to carry the frequently occurring runoff and trickle flows.
- When large rainstorms occur, the capacity of these ditches is exceeded and the water floods the adjacent pond bottom.



## **Detention Ponds**

#### Configuration of Pond Bottom

- The most successful installations of low flow and trickle flow channels have a concrete bottom.
- Concrete lining facilitates self-cleansing of the ditch and its maintenance.
- Drainage of the pond bottom between storms has to occur efficiently if it is going to be used for recreation.
- To achieve this, the bottom has to be cross-sloped at no less than 2% toward the trickle channel(s).

**Slope Protection** 

- Side slopes of the pond will tend to erode whenever the detained water surface fluctuates frequently or when there is wave action.
- Good vegetation will help to protect the side slopes against erosion.
- In areas of high velocities and wave attack, structural measures are needed to supplement vegetation.











**Outlet Structure** 

- The configuration of a pond outlet determines the type of pond (wet or dry), the storage volume, and the control the pond provides the storm runoff.
- Many detention ponds are designed to control runoff for different rainstorms.

### **Detention Ponds**

#### **Outlet Structure**

- Design for the control of two or three levels of flow (for example, 2and 10-year)
- Provide maintenance access to the outlet.
- If possible, use no moving parts or pumps in an outlet. Use massive components to reduce damage from vandalism.
- Provide erosion protection at the inlet and outlet ends of the outlet pipe.
- Provide coarse gravel packing to screen out debris.
- > Always design with maintenance and aesthetics in mind.





## **Detention Ponds**

#### Water Harvesting

- Every year tremendous amounts of stormwater runoff is flushed down traditional systems, which end up contaminating natural waterways with gross and dissolved pollutants.
- There are viable alternatives that completely replace antiquated systems, providing a sustainable solution with the added benefit of immediate reuse of clean water.
- This is a major advantage for communities experiencing low rainfall or water restrictions.









