This Lecture has been divided into two parts:
This file is Part 2 of 2

ARCH 1250
APPLIED ENVIRONMENTAL STUDIES

CLASS FIVE
HYDROLOGY

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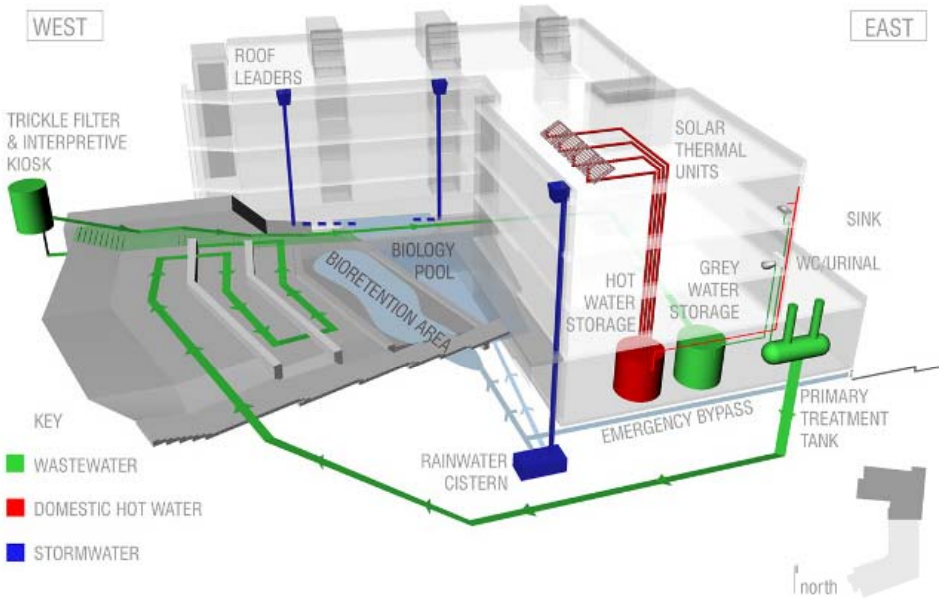
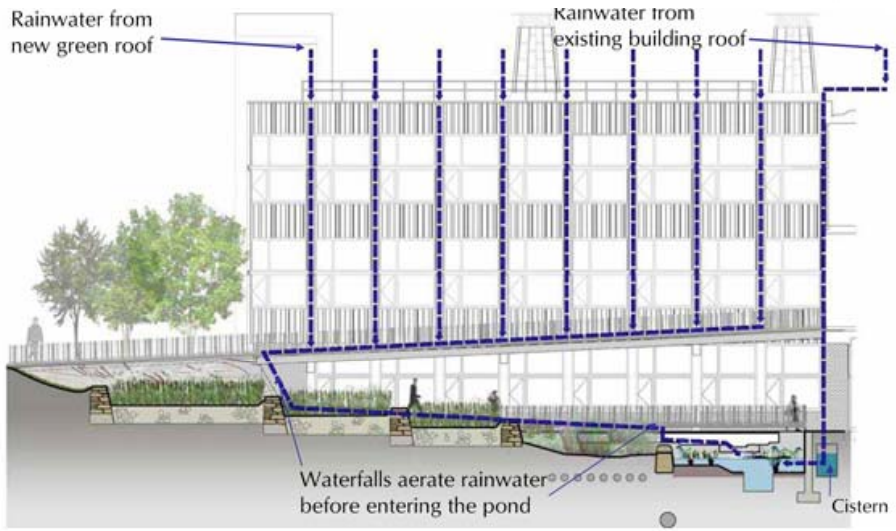
A green roof and constructed wetland reduce stormwater runoff, improve the quality of infiltrated runoff, and reduce municipal water use. The green roof slows the flow of rainwater and diverts it through a series of scuppers, downspouts, and flowforms to the biology pond and rain garden in the courtyard. The naturally treated water is eventually reused in the toilets and cooling towers.

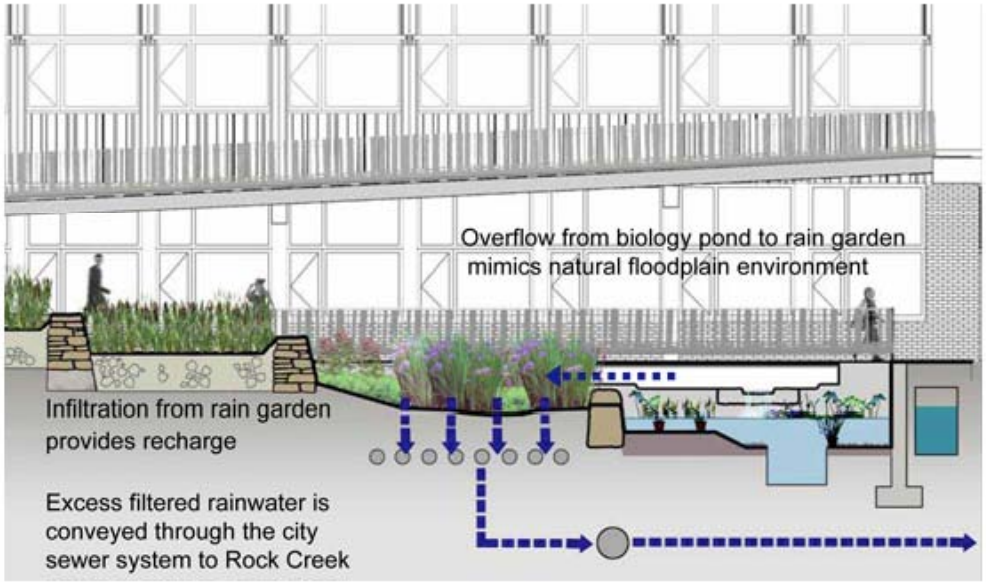




LECTURE FIVE

HYDROLOGY

Sidwell Friends School, DC



APPLIED ENVIRONMENTAL STUDIES

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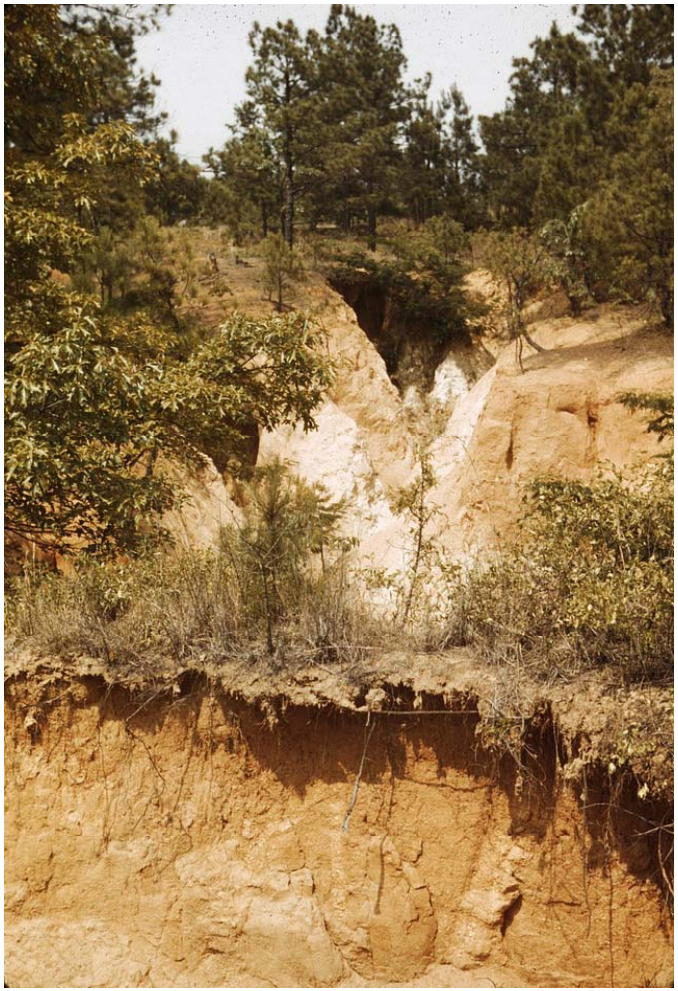
Site Hydrology - Erosion Control

Erosion is the process by which the surface of the earth is worn away by the action of natural elements, such as water and wind.

It is strongly influenced by the

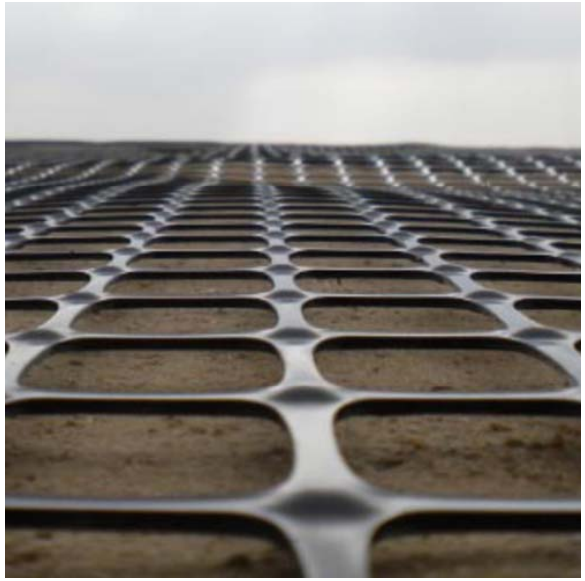
- Type of soil
- Steepness of slope
- Speed of water or wind



Erosion Control

Site strategies to reduce erosion must address both construction activities and the completed project.

They may include regrading, retaining walls, geotextiles, plantings, riprap



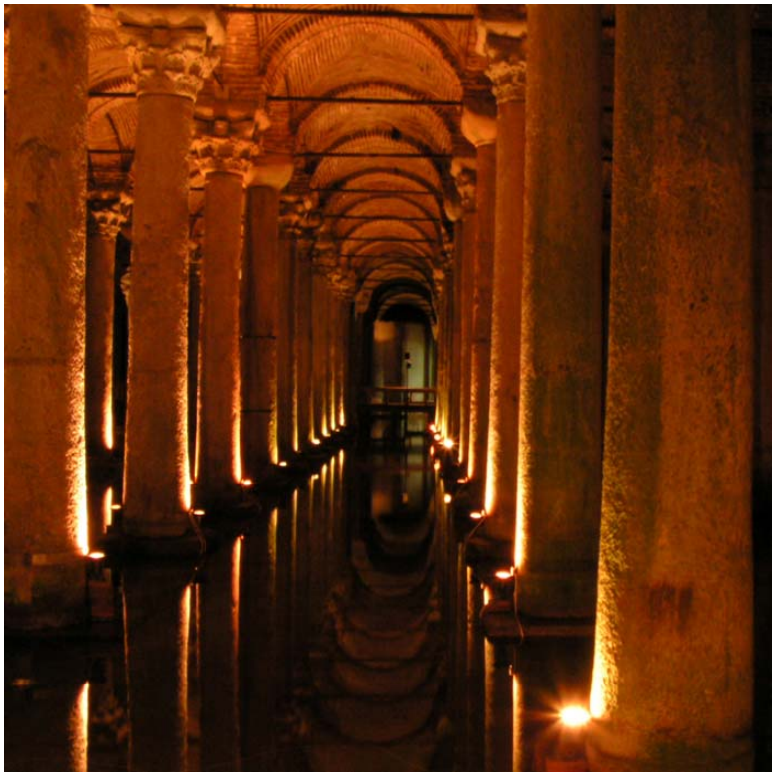
Above Geotextile
Below riprap

Sustainable irrigation strategies

include drip irrigation, rain controllers and appropriate plantings

Catchment systems

Rainwater capture and cisterns have long been a part of indigenous building, particularly in dry climates. Water can be easily stored in closed below ground cisterns.



Basilica Cistern, Istanbul

LECTURE FIVE

HYDROLOGY

- THE HYDROLOGIC CYCLE
- WATER in CULTURE
- WATER in ECOSYSTEMS
- **SITE HYDROLOGY**
  - GROUNDWATER
  - STORMWATER
  - EROSION CONTROL
  - IRRIGATION SYSTEMS
  - **CATCHMENT SYSTEMS**
  - TREATMENT SYSTEMS
  - THE WATER BALANCE

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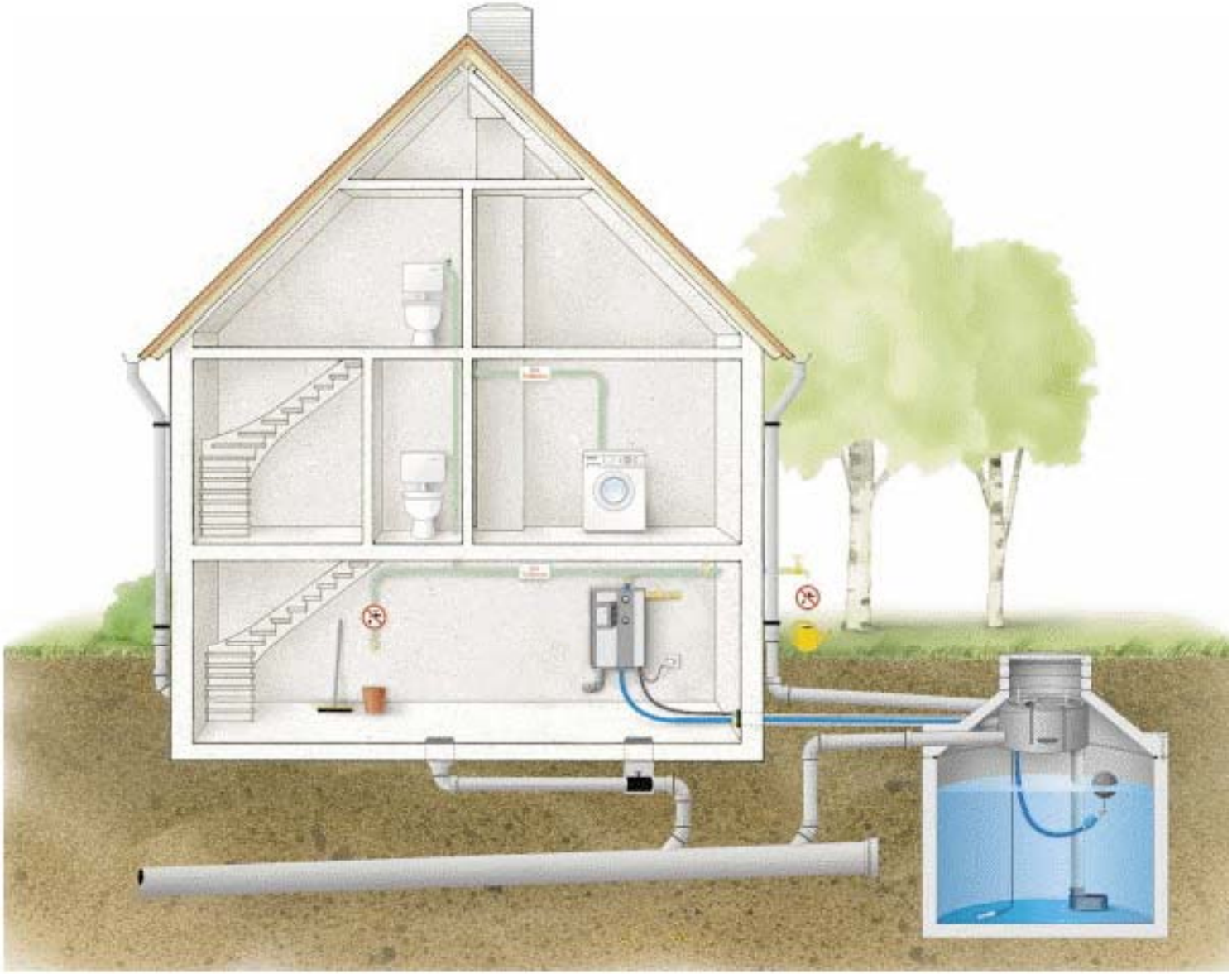

LECTURE FIVE

HYDROLOGY

Magney House, Australia by Glenn Murcutt

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LECTURE FIVE

HYDROLOGY

Making the story of water more visible

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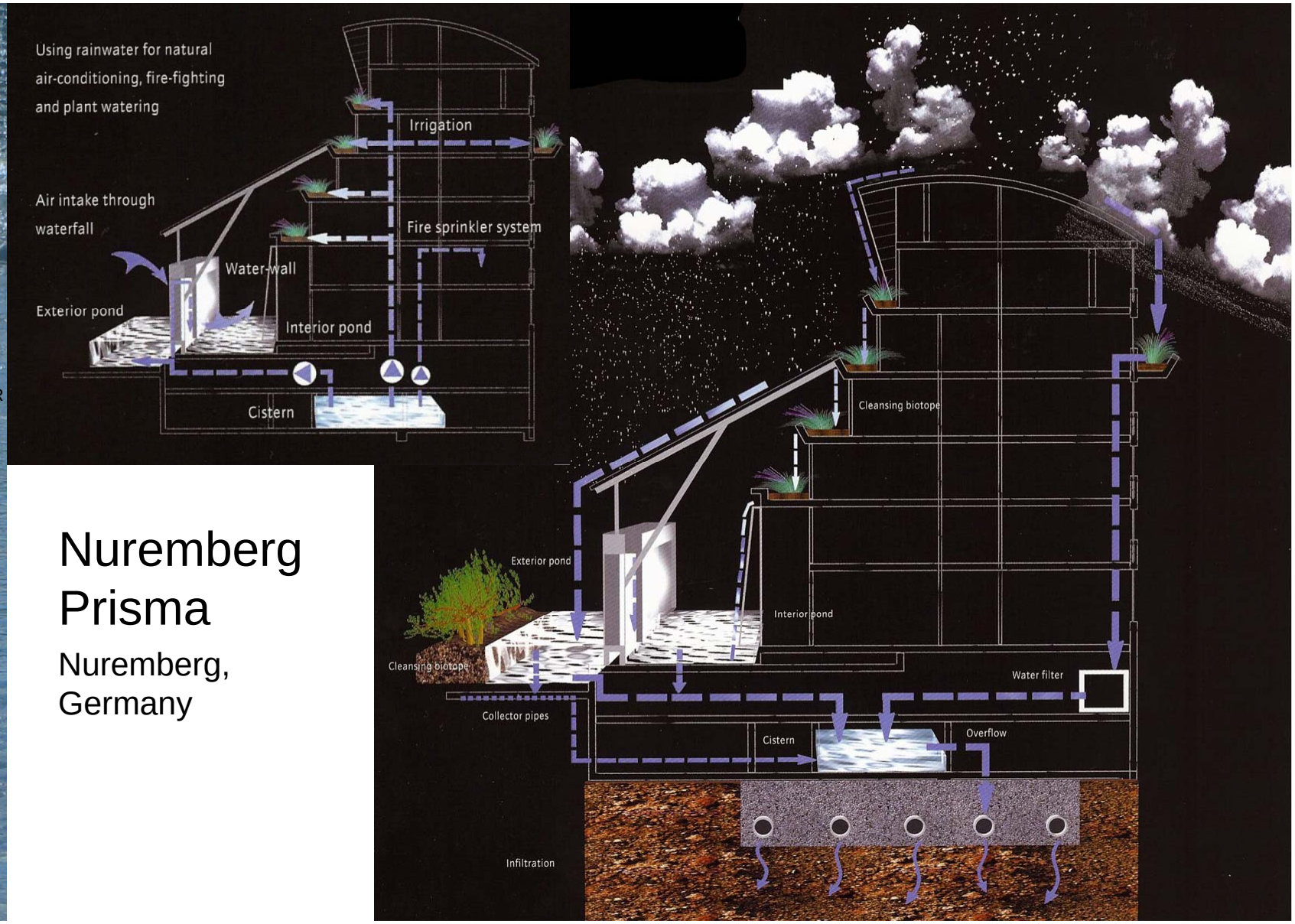


Nuremberg Prisma

Nuremberg, Germany

Nuremberg Prisma

Atrium view

Site Hydrology - Treatment Systems

Reuse (treatment) strategies:

Municipalities generally recognize two categories of wastewater and treatment requirements will vary.

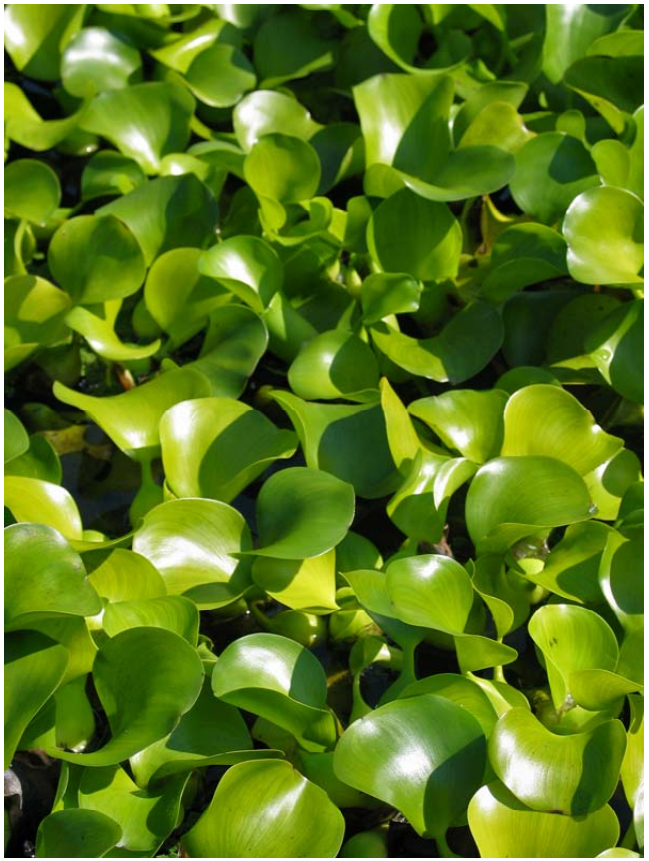
Greywater -is generated from domestic activities such as laundry, dishwashing, and bathing. This water can generally be applied to toilet flushing and irrigation with a minimum of treatment.

Blackwater - is wastewater from toilets and requires signficant treatment before reuse is allowed.

Ecological wastewater treatment

In 1976 NASA developed the first operational wastewater treatment system for both domestic sewerage and industrial wastewater. This first system relied upon the Water Hyacinth.

Further development and research revealed that a mixture of water plants in combination with a rock filter provided the optimum combination. The rock added to the available surface area, allowing larger colonies of bacteria and microorganisms to thrive. As the water moves through the system the oxygen content improves and allows larger organisms and protozoa to feed on the bacteria.



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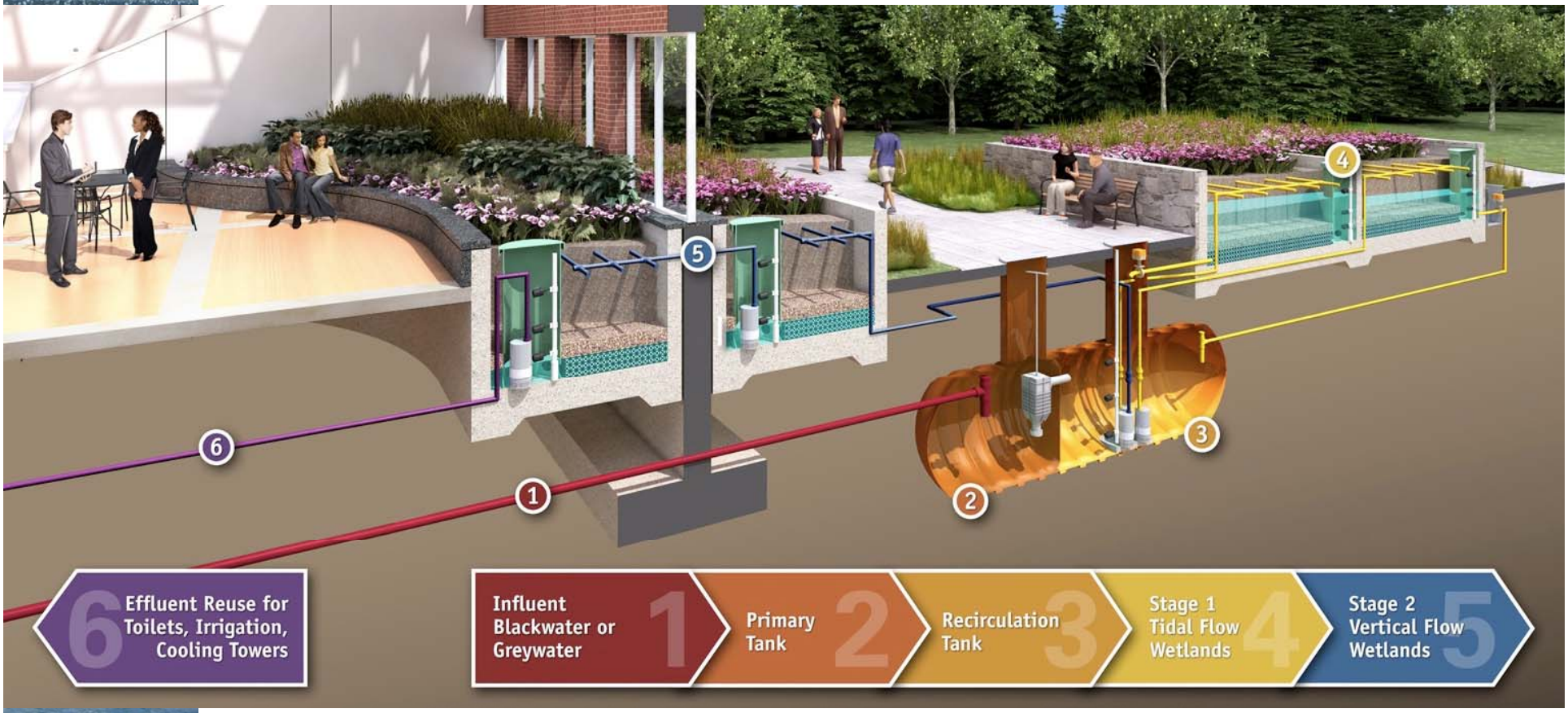
Living machine diagram



Noorder Zoo, Emmen, Netherlands (treats 220,000 gals daily)

Additional water plants used with success include ……

Duckweed

Arrowhead

Pickerelweed

Bulrush

Cattails

Calla Lily

Designed wetlands - Living Machines

The living machine designed for El Monte Sagrado, a New Mexico resort forms the centerpiece of the design and treats more than 4,000 gallons of water daily

A trademarked form of biological wastewater treatment designed to mimic the cleansing functions of a wetland.

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Designed wetlands

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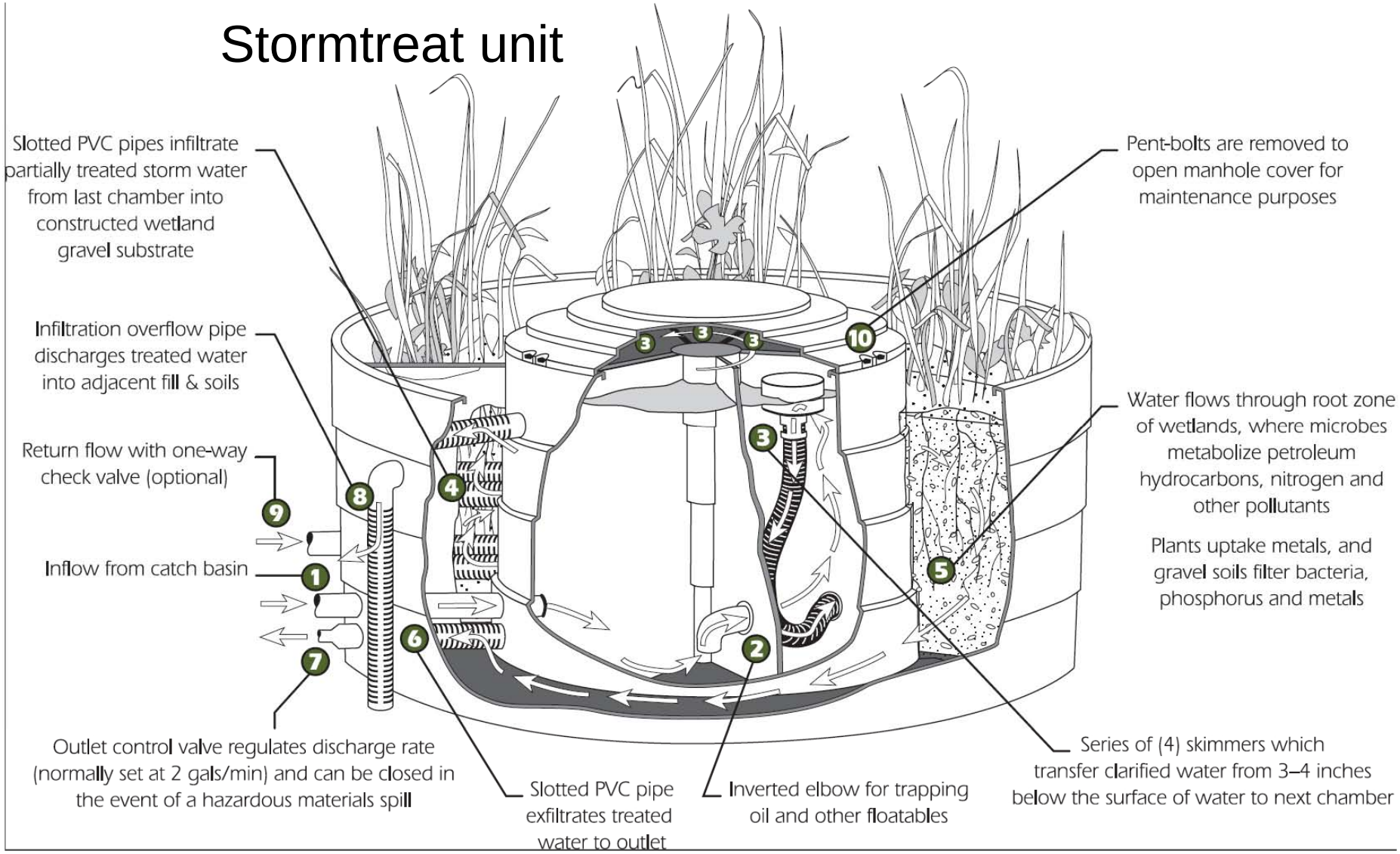
The living machine at Old Trail School, Bath Ohio is indoors to allow it to function year round. It processes more than 5,000 gallons of wastewater daily

Stormtreat unit



Potsdamer Platz, Berlin

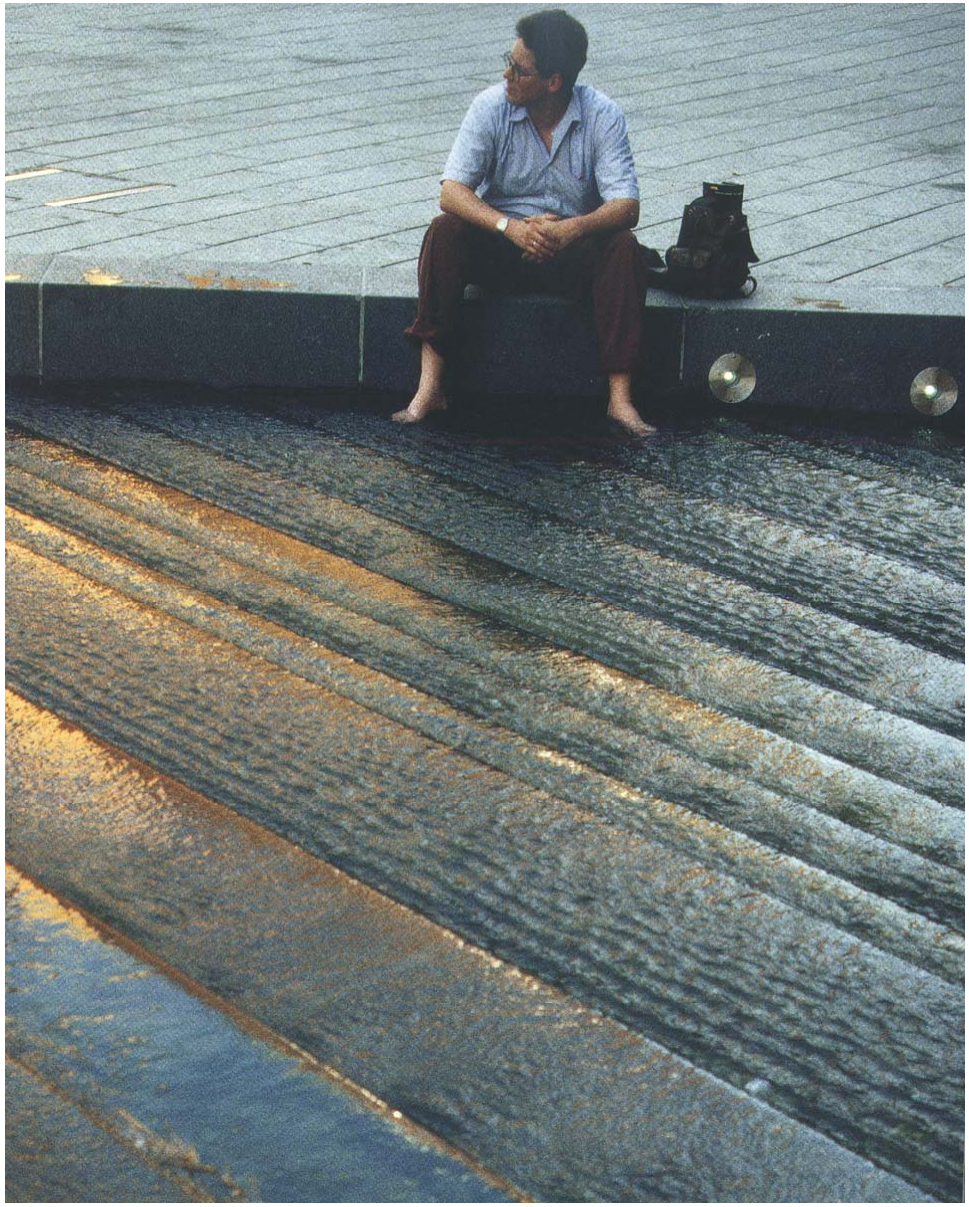
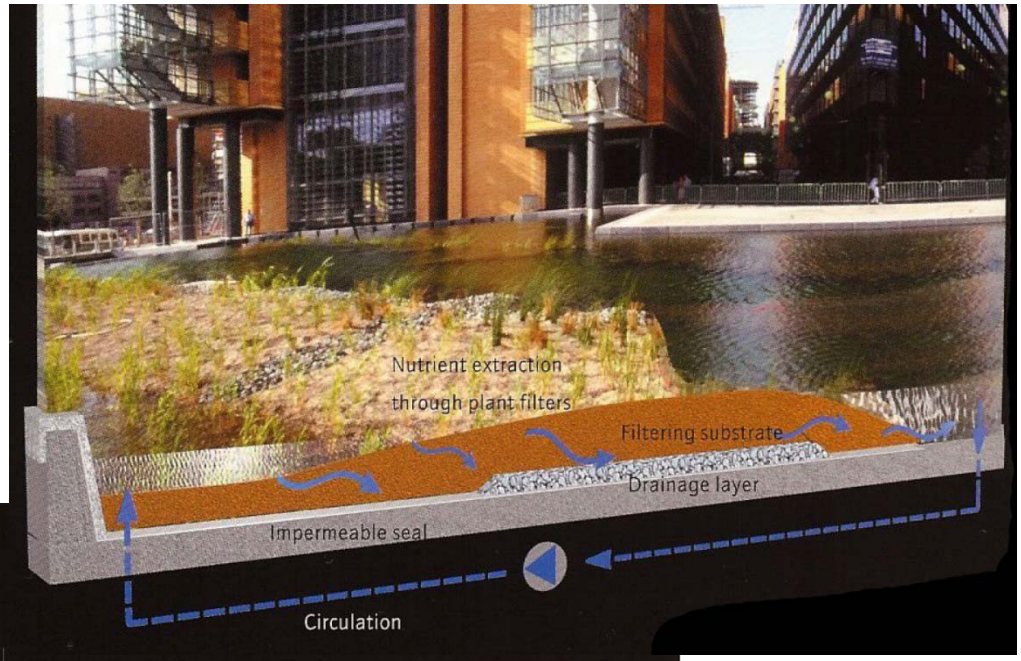
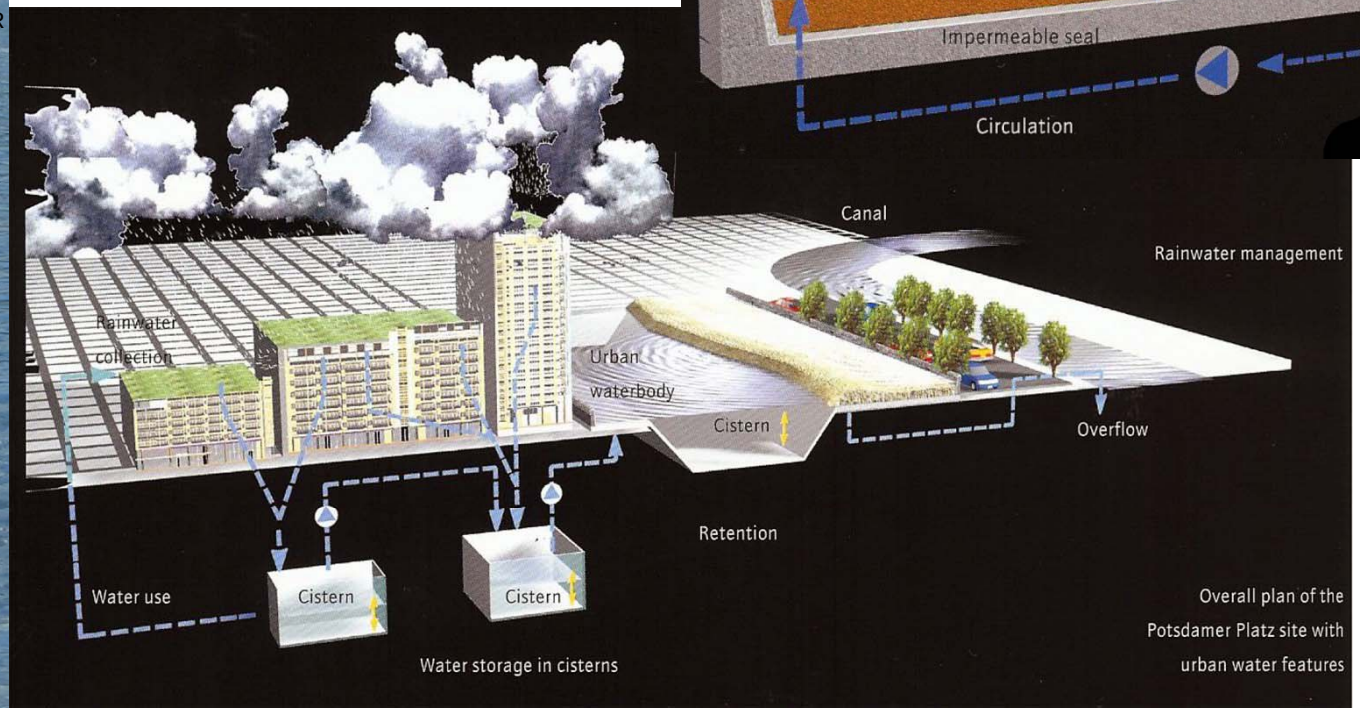


Illustration of cleansing biotype and cistern system





Solaire, Battery Park City

Wastewater treatment system treats 25,000 gallons of wastewater daily. Cleaned water is used for toilet flushing, refilling the cooling tower and irrigation.

Reclaimed water is often in purple pipes

Site Hydrology - The Water Balance

It has become the task of every building professional to match site water needs with site resources. We do this through a combination of

Water conservation

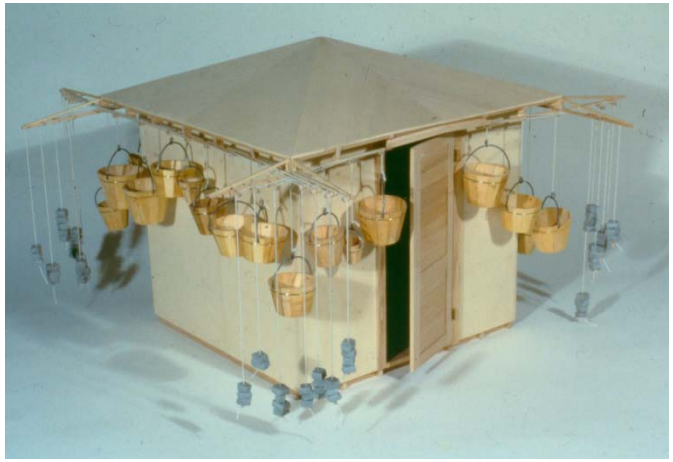
Rainwater capture and use

Used water recycling

LECTURE FIVE

HYDROLOGY

We can harvest more than half of our water requirements from rainfall



Rainfall in NYC averages 48” per year. This amounts to …..

4 feet x 27,878 400 (Sq feet in Sq mile) x 350 (area in sq miles of NYC) = 39,029,760,000 cubic feet

39,029,760,000 cubic feet x 6.429 (gallons in a cubic foot) = 250,922,327,000 gallons of water that fall on city annually

250,922,327,000 / 365 (days in year) = 687,458,430 gallons daily


WATER COLLECTED = 70,717 GAL/YEAR
WATER USAGE = 79,760 GAL/YEAR
NET = - 9,043 GAL/YEAR
STRATEGIES:
GREY WATER = 9,043 GAL/YEAR
10.0K
7.0K
4.4K
4.0K
2.8K
1.3K
5.0K
6.5K
6.5K
10.3K
11.6K
6.8K
6.1K
6.2K
6.8K
6.5K
6.8K
6.5K
6.7K
6.8K
6.8K
6.8K
6.5K
6.8K
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

LEED and LBC criteria

LEED awards points as follows

WEprereq Requirement to reduce water use by 20% below a standard practice baseline.

WEc1 Reduce irrigation requirements by 50% (2pts)

Or completely (4pts)

WEc2 Utilize an innovative wastewater system or reduce potable water by 50% (2pts)

WEc3 Further reduce water use by up to 40% (2-4pts)

Living Building Challenge has the following imperative

05 One hundred percent of occupants' water use must come from captured precipitation or closed loop water systems (that are purified without the use of chemicals).