

Constructed Wetlands

There are three types of constructed wetlands:

1. Restored wetlands - those under rehabilitation. Fixed hydrology of wetland either by dredging or by taking out a dike (common in small areas).
2. Constructed wetlands - built where none existed before (usually for water treatment).
3. Created wetlands - built where none existed before (usually for wildlife habitat).

1. Waste Treatment:

- Municipal waste (like at Roger Road): secondary/tertiary treatment of wastewaters. Trying to reduce the nitrogen, phosphorus, TSS (Total Suspended Solid), BOD (Biological Oxygen Demand), TFC (Total Fecal Coliforms).

Note: BOD is the measurement of total oxygen depleted from the water column by bacteria decomposing decaying organic matter.

- Acid Mine Drainage: This drainage would kill everything but *Typha*. *Typha* grew steadily and made the water better by picking up the excess iron and increasing the pH of the water to 4 to 5 from a pH of 2. After this, the other plants would start filling back in. *Typha* effective at reducing sulfates in the water.

- Highway Runoffs: Effective at cleaning up the water that runs off carrying oil, gas, dirt, etc.

- Specific Pollutants: Wetlands put in to handle specific pollutants such as heavy metals and organics. A lot of times, the plant will hold all of the chemicals inside of it (concentrating the pollutants). The plant can then be disposed off.

- Storm Water: handle storm waters in developed areas where runoff is a problem. cleans up runoff as well.

2. Hydraulic modification - for flood control, water storage(like a reservoir), or groundwater recharge(like at Roger Rd.).

3. Water quality changes - for the removal of sediment from water, change of pH(acts like a buffer-alone pH is at 6, this is slightly acidic because of the organic matter), or to add or remove organics (remove in the case of paper mills, add in acid mine drainage).

4. Erosion protection - bank or shoreline stabilization, dissipation of wave energy, or to alter flow patterns(like at Pantano wash).

5. Open spaces and aesthetics - used by resorts or new developments to increase land value.

6. Mitigation - intended to replace the function of lost wetlands. When developers take out wetlands they must replace them by a 5 to 10 or 5 to 15 ratio. Usually replaced wetlands do not function as well. The developer is not only responsible for replacement, but the function as well. Lots of problems occur with how to build and maintain them.

7. Life support as a habitat - a place for threatened and endangered species, but also for other wildlife.

8. CAFO treatments (Concentrated Animal Feeding Operations): clean up dairies, feedlots, hog sheds, chicken ranches, and fish farms, rid of excess manure build up.

For information and data concerning wetland systems in use, search the EPA Wetlands Treatment Database.

Building a constructed wetland:

I. Design

A. Free water systems(FWS): like the one at Roger Rd., lots of open spaces, some plants but mostly water.

B. Subsurface systems (SF): like the one at CERF, water below gravel level.

Concerns include:

1. The Input Water Quality
2. Pretreatment: primary sewage treatment 1st?, pick out big solid by hand?
3. Groundwater Protection: protect groundwater from pollution, what kind of liner to use?
4. Size Requirements: determined by several factors: volume of water treated, retention time, suggested 150 m² / kg BOD (0.1 ha/kg Total N (1000 m²), regulations, and the use of parallel cells in case of problems (input output points, separate valves, etc.).

II. Soils

Critical importance: Check:

1. permeability, bulk density measures pore spaces and liquid limit. (How fast will the water percolate? What will be retained?)
2. Depth to the water table: if wetland water reaches water table a dome will build up in the water table.

3. Seep control layer: liners, clay, compacted soils; reduce water table done build up.
4. The top soil is removed and then replaced after construction for use as a growing medium.
5. Loam soil is often the soil of choice because it provides a better support than sand and has more room for root growth than regular soil. Most soils used have a pH between CEC (Cation Exchange Capacity) > 15 meq/100g. Electrical conductivity (EC) great than 4mmhos/cm.
6. The soil used may be cultivated for direct seeding.

III. Construction

1. Have drawings checked (NRCS or county ag. agent).
2. Clear, stake, and take care of grading.
3. Place seepage control layer (clay or plastic liner).
4. Select and place soil.
5. Water level control and conveyance (plumbing).
6. Cultivate and presoak, then plant.

IV. Water Management: It is important to simulate natural processes (periodic drying out, oxidation at the bottom), control flow levels, and control residence time.

V. Vegetation The roots and stems are the most important plant parts. In selecting plants it may be necessary to purchase, rear yourself, or collect and transplant. Most sites use indigenous plants. Handbooks list plant suggestions for different regions and types of waste. The Texas and Florida Aquatic Plants Guides are good databases. Handbooks also suggest when and how to plant.

VI. Operation and Maintenance

1. Start up as soon as possible after planting to avoid losses.
2. Determine seepage and evaporation to control water level.
3. Check vegetation for any diseases or pests.

4. Adjust water level to control pests and aerate shallow areas.

VII. Monitoring

1. Watch the flow rates.

2. Check on water quality (BOD, TSS, nitrate and phosphate levels, fecal coliforms, heavy metals).

3. Check for any groundwater leakage by sampling in nearby wells or use of a neutron probe.

VIII. Regulations

1. For discharge to waters of the state you need to follow NPDES (National Pollution Discharge Elimination System) or BMP (Best Management Practices).

2. For construction you must check with the Army Corps of Engineers.

3. For groundwater protection check with ADEQ for an aquifer protection permit.

4. For reuse also check with ADEQ for a reuse permit.

5. For the collection of plants for transplantation check with Az. Game and Fish or the Dept. of Ag. for plant material acquisition permits.