Constructed Wetlands

for On-Site Septic Treatment

A Guide to Selecting Aquatic Plants for Low-Maintenance Micro-Wetlands

Developed jointly by:
East Texas Plant Materials Center
Pineywoods Resource Conservation & Development
The Forest Resources Institute
Arthur Temple College of Forestry, SFASU

The use of constructed wetlands to treat domestic wastewater from single family residences is a rapidly emerging biotechnology. Such treatment systems are called micro-wetlands or rock/reed filters because they have a media filter in which special plants grow to enhance treatment and create a pleasant landscape. Micro-wetlands allow both safe treatment of household wastewater and the use of treated water to sustain a low-maintenance landscape.

Micro-wetlands require a permit in Texas from the local permit authority. They are relatively inexpensive and easy to maintain if installed correctly. This brochure provides the basic guidelines for plant selection and installation to create a low maintenance treatment system.

How Micro-Wetlands Work

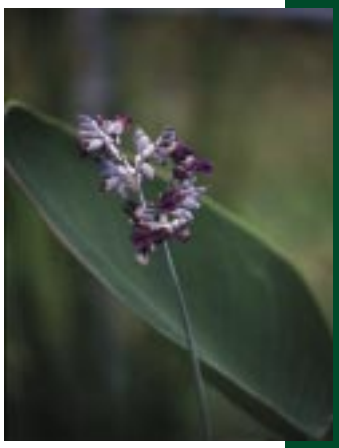
Micro-wetlands are an alternative treatment where standard septic systems are not suitable. They are constructed by excavating shallow earthen ponds which may be lined and filled with media such as river rock or chipped rubber tires. A typical micro-wetlands is designed to contain two cells or zones. A perforated pipe at the front of the first cell allows strong water from the septic tank to enter and spread across the entire media bed. As it passes through the media and plant roots, bacteria, enzymes, fungi and protozoa break down pollutants. The special plants used in the front section of wetlands pump oxygen to their root zones and create aerobic conditions that speed treatment.

Construction of the ETPMC's wetlands included two lined cells.

At the back, or outfall, of the cell is another perforated pipe that collects the treated water and sends it out for disposal. The quality of effluent is determined by how long the water takes to pass through the media. Selecting the correct plants reduces maintenance and increases the life of the filter. Guidelines for selection and placement of plants follow.

Selecting Plants

Plant selection and placement are determined by the system design. The ideal design has two sections or zones of treatment. The first zone receives and mixes strong wastewater. Since this section is likely to be anaerobic, or lacking oxygen, plants that pump oxygen to their roots and are nutrient-loving should be placed here. These plants are usually hard-stemmed marsh plants that have tiny tubes for transporting oxygen to their roots. Most of these do not flower, but many stay green during the winter. Some hard-stemmed plants are very aggressive and will crowd out other varieties if not contained in the first zone.



The hard-stemmed Thalia, has a beautiful purple flower that blooms in the spring.

In the second zone or the back of the wetlands, nutrient are reduced. Flowering, soft-stemmed, nutrient-tolerant plants work best in this section. These plants transport water out of the system by evapo-transpiration. However, the primary benefit of these plants is that they beautify the garden and provide color. Using plants that flower in different seasons will keep the wetlands beautiful all year long.

A wetlands soon becomes a complete ecosystem with insects, frogs and butterflies.

As a rule, the right plant placed in the wrong zone will quickly display signs of stress, such as wilting, refusal to flower and other indications that it is not suited to the site. Such plants are easily removed and replaced with other species.

Many of the hard-stemmed plants, such as cattails and woolgrass, can be found growing wild in nearby drains and ponds. Other plants like dwarf cattails, dwarf palms and papyrus will have to be purchased from a water garden source.

Hard-Stemmed Plants

These marsh plants are examples of plants that work well in the front zone of a micro-wetlands and reduce the amount of annual pruning needed. Their characteristics are noted beside each picture.

Blue Flag Iris
Iris versicolor
- Front or back section
- Nutrient tolerant
- Full or partial sun
- Shallow roots
- Slow growth
- Mildly invasive
- Dormant in summer
- Blooms in spring

Horsetail
Equisetum hyemale
- Front section
- Nutrient tolerant
- Full sun
- Deep roots
- Fast growth
- Highly invasive
- Dormant in winter
- Seeds in late spring

Dwarf Palm
Cyperus alternifolius
- Front or back section
- Nutrient tolerant
- Full or partial sun
- Deep roots
- Fast growth
- Mildly invasive
- Dormant in winter
- Seeds in late spring

Soft Rush
Juncus effusus
- Front section
- Nutrient tolerant
- Full sun
- Shallow roots
- Slow growth
- Mildly invasive
- Dormant in summer
- Green in winter

Dwarf Papyrus
Cyperus papyrus
- Front or back section
- Nutrient tolerant
- Full or partial sun
- Deep roots
- Fast growth
- Mildly invasive
- Seeds in late spring

Thalia
Thalia dealbata
- Front section
- Nutrient tolerant
- Full sun
- Shallow roots
- Slow growth
- Mildly invasive
- Dormant in winter
- Seeds in late spring
- Purple flower in spring

Graceful Cattail
Typha laxmanii
- Front section
- Nutrient loving
- Full sun
- Deep roots
- Slow growth
- Mildly invasive
- Dormant in winter
- Seeds in late spring

Yellow Flag Iris
Iris pseudocorus
- Front or back section
- Nutrient tolerant
- Full or partial sun
- Shallow roots
- Slow growth
- Mildly invasive
- Dormant in summer
- Blooms in spring

Soft-Stemmed Plants

The following plants are examples of the many varieties of soft-stemmed plants that have proven to grow well in the second zone. Their characteristics are noted beside each picture.

Arrow arrum
Peltandra virginica
- Front or back section
- Nutrient tolerant
- Full or partial sun
- Shallow roots
- Moderate growth
- Non- invasive
- Dormant in winter
- Seeds in late in spring

Elephant Ear/Taro
Colocasia esculenta
- Front or back section
- Nutrient tolerant
- Partial shade
- Deep roots
- Slow growth
- Highly invasive
- Dormant in winter
- Seeds in late fall

Canna Lily
Canna spp.
- Back section
- Nutrient loving
- Full or partial sun
- Deep roots
- Fast growth
- Highly invasive
- Dormant in winter
- Flowers in spring/ summer

Pickerel Rush
Pondetaria cordata
- Back section
- Nutrient loving
- Full or partial sun
- Deep roots
- Fast growth
- Invasive
- Dormant in winter
- Flowers in spring/ summer

Duck Potato
Sagittaria spp.
- Back section
- Nutrient loving
- Full or partial sun
- Deep roots
- Fast growth
- Invasive
- Dormant in winter
- Flowers in spring/ summer

Sweet Flag
Acorus calamus
- Back section
- Nutrient tolerant
- Full or partial sun
- Shallow roots
- Moderate growth
- Non-invasive
- Dormant in winter
- Seeds in late spring

Dwarf Canna Lily
Canna variegata
- Back section
- Nutrient loving
- Full or partial sun
- Deep roots
- Fast growth
- Mildly invasive
- Dormant in winter
- Flowers in spring/ summer

Woolgrass
Scirpus cyperinus
- Front section
- Nutrient tolerant
- Full sun
- Shallow roots
- Slow growth
- Mildly invasive
- Dormant in winter
- Seeds in late fall

Installing Plants

A newly constructed wetlands system should be filled with water prior to installing plants. During the first few months after planting, the water level should be maintained at its highest level--about two to three inches below the media surface.

To get the optimum plant design, first place colored flags in the media for each plant according to a desired pattern. Plants should be spaced from two to three feet apart in all directions. Begin one foot from the front edge and one foot from the side. To determine how many plants should be in the first row, divide the width of the system by the selected plant spacing. In the second row, subtract one plant and offset them between those in the first row. Repeat this pattern down the length of the system.

Plants must be installed at the depth they were originally planted, which is determined by a change in color on the stalk.

Freshly dug plants must be kept wet and covered until ready for installation. Wash all loose dirt from the roots before planting. The new stalk must be planted at the same depth that it was originally growing. This depth can be determined by the change of color from dark green to pale green or white on the stalk just above the root or corm. Place the plant deep enough in the media so that the roots are in the water and the pale area on the stalk is covered. Hold the green stalk upright and cut it off between 6 to 12 inches above the media. Stalks may die back before the new roots are established and new shoots push out of the media.

Rake the media level around the plants and fill in any foot prints so the water will not surface in them and create an odor. Place good mulch around new stalks to a depth of 2 to 4 inches.

Place slow release fertilizer around the new plants as the system will not make many nutrients available to them until normal bacteria grow and spread. Fertilizer and water can be added at anytime if the plants yellow or wilt. Complete vegetative cover may take up to three years.

System Maintenance

The State of Texas regulates the design and construction, as well as the maintenance of micro-wetlands. A maintenance agreement with a registered installer may be required if the effluent from the wetlands is not disposed of in a standard drainfield.

Cannas are soft-stemmed high-maintenance plants that may need to be pruned each spring.

Besides state regulatory maintenance requirements, a homeowner can expect to spend some time weeding and trimming plants to maintain the desired beauty of the wetlands. The amount of maintenance required is largely determined by the type of plants installed in the wetlands. As a rule, hard-stemmed plants require less maintenance than soft-stemmed plants. Attention should also be given to a plant's time of flowering and dormancy, along with response to sunlight exposure. For example, cannas, which are soft-stemmed plants, are highly invasive and dormant in the winter. Their dried brown leaves may need to be removed in the spring. To make pruning easier, keep soft-stemmed, broad-leafed plants like cannas near the edges so that they can be reached easily.

A bed of mulch should be placed around plants to reduce weeds in the system.

In the early stages of plant growth, keeping weeds out of the media is vital. A good bed of mulch will minimize weeds.

In time, all plants will spread and may require thinning for aesthetic purposes. If bare spots or unhealthy plants appear, the most desirable plants can be divided and replanted. Follow initial planting steps for the best results.

A well-maintained system can be expected to function properly for up to thirty years.

Pineywoods Resource Conservation and Development, Inc.

The Pineywoods RC&D is a local, nonprofit, agency affiliated with the USDA Natural Resources Conservation Service program. They are committed to working with local groups to improve their economy and the environment through the conservation, development and better utilization of natural resources.

East Texas Plant Materials Center (ETPMC)

The ETPMC evaluates and releases new or improved plants and develops cultural and management techniques for plants that are used to address soil and water conservation problems. The ETPMC has studied aquatic plants suitable for constructed wetlands and has operated an on-site constructed wetlands for more than five years.

The Forest Resources Institute (FRI)

FRI's mission is to serve as a "friend of the forest;" meaning the Institute provides unbiased, scientific information concerning various forest resource management issues. FRI was established in 1997 and was funded by a grant from the T.L.L. Temple Foundation. Housed on a 40 acre estate in the heart of Nacogdoches, TX, FRI provides a "think tank" atmosphere for resident and visiting scientists. The facility also houses the Forest Resources Information System (FRIS), which provides up-to-date information on southern forestry issues via the World Wide Web.

For brochures and wetlands design information,
call the Pineywoods RC&D at (936) 568-0414.

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