TECHNICAL NOTES

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WETLAND REVEGETATION – DESCRIPTIONS of SELECTED SPECIES, and TECHNOLOGY

This Technical Note is subdivided into the following Sections:

SECTION 12.1 Harvesting, Propagating, and Planting Wetland Plants

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INTRODUCTION

Sedges (*Carex spp.*), spikerushes (*Eleocharis spp.*), bulrushes (*Scirpus spp.*) and rushes (*Juncus spp.*) are used extensively in riparian and wetland revegetation because of their aggressive root systems. They also provide wildlife habitat for a variety of terrestrial and aquatic species. They form buffer zones that remove pollutants from surface runoff. The above ground biomass provides roughness that causes stream velocity to decrease and sedimentation to occur. The thick humus developing in those areas breaks down organic compounds and captures nutrients (Carlson 1993).

Wetland plant root systems are important means of stabilizing degraded sites. Manning et al. (1989) found that Nebraska Sedge (*Carex nebrascensis* Dewey) produced 212 ft/in^3 (382.3 cm/cm^3) of roots in the top 16 in (41 cm) of the soil profile and Baltic Rush (*Juncus balticus* Willd) had 72 ft/in^3 (134.6 cm/cm^3) of roots. An upland grass like Nevada bluegrass only has 19 ft/in^3 (35.3 cm/cm^3) of roots. The root system is the basis for soil bioengineering. Soil bioengineering increases the strength and structure of the soil and thereby reduces streambank erosion. Most soil bioengineering applications emphasize the use of woody riparian plants. However, herbaceous wetland plants provide more fibrous root systems that in combination with the larger woody plant roots do a better job of tying the soil together (Bentrup and Hoag 1999).

Wetland plants are also used for constructed wetland systems (CWS). A CWS is a wetland that is constructed in an area that has no previous history of wetland hydrology for the purpose of improving water quality. Water purification is a natural function of wetlands. The wetland plants provide suitable sites for colonizing microbial populations to establish on. The microbial populations live on the plant roots and breakdown various nutrients found in the water. The above-ground biomass serve as nursery sites for periphyton that also break down various nutrients.

DIRECT SEEDING OF WETLAND PLANTS

Many wetland plants are very difficult to seed in the wild. Wetland plant seeds usually need three things to germinate: 1) heat, 2) water, and 3) light. The need for light means that wetland plant seeds need to be seeded on the surface and they can not be covered with soil (Grelsson and Nilsson 1991, Leck 1989, Salisbury 1970). Drilling the seed with a drill will cover the seed especially if packer wheels or drag chains are used.

Many species have a very hard seed coat that takes up to one year or longer to break down enough for the embryo to germinate. Many species require special stratification treatments to prepare the seed for planting. These treatments include everything from acid wash to mechanical scarification, from pre-chilling to extremely high temperature soil conditions. Occasionally, dormant seeding (seeding during the late fall or winter after the plants have gone dormant) can be successful, but it depends on the species.

Not having absolute control of the water going into the wetland or riparian area is the most common mistake that occurs when seeding wetland plants. Without good water control, when water enters the system the newly planted seeds will float to the water surface and move to the water's edge where wave action will deposit the seed in a very narrow zone. The seed will germinate here and the stand will generally be quite successful as long as the hydrologic conditions are maintained for the various species deposited there (Hoag and Sellers 1995). With good water control, the seeds, for the most part, will stay in place and the stand will cover the wetland bottom instead of just around the fringe.

Some species when seeded in a greenhouse setting need a cold-hot stratification environment for successful germination. This means that the seeds are placed in cold storage at 32-36º F for 30-60 days and then they are planted in moist soil containers at about 100º F. Heat is one of the essential requirements for germination and growth. (Hoag et al. 1995)

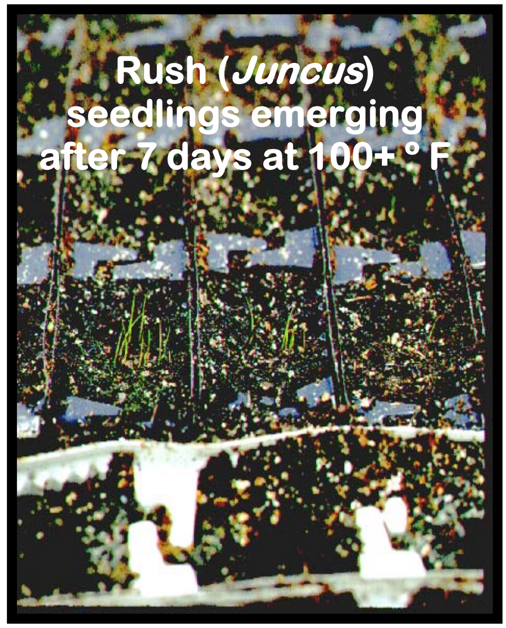
Based on these difficulties, using direct seeding of herbaceous plants as the primary means of revegetating a site will require more attention to planning and control of site hydrology during the establishment period to be successful. It also means that you will need to know what specific germination/stratification requirements (if any) that the targeted species require. Successful establishment of herbaceous vegetation by direct seeding is possible and examples of these successes range from the establishment of Tufted Hairgrass (*Deschampsia caespetosa*) wetlands in Oregon to multiple species herbaceous depression wetlands in Delaware. Typically; however, direct seeding of herbaceous species is not used as the primary means of active revegetation, but it is a method to increase the overall species diversity in a wetland, especially around the perimeter, and to establish populations of specific target species.

Revegetating a site with herbaceous species plugs of greenhouse grown material has shown a much higher establishment rate than with seeding or collections of wildlings (plugs collected from wild populations) (Hoag and Sellers 1995). The remainder of this paper discusses the use of seedlings of wetland plants as a means of actively revegetating herbaceous vegetation on restored and enhanced wetlands.

COLLECTION AND PROPAGATION OF WETLAND PLANTS

Woody shrubs, grasses and wetland plants are often grown in small containers or plugs [volumes less than 22 in^3 (361 cm^3)]. Plugs are used in bioengineering designs when the water is too deep or persistent to get woody plants established in other ways. Transplanting wild plants (“wildlings”) is sometimes used but small volume containers have been shown to have higher establishment rates and to spread faster and further (Hoag 1994). There are two basic procedures for obtaining wetland plant plugs: growing them or harvesting wildlings from a donor site.

Greenhouse Propagation: As previously stated, when growing wetland plants from seed, three things are required: 1) water, 2) heat, and 3) light. The need for water is fairly straightforward especially when one thinks about conditions in a natural wetland. Light, however, is not as obvious. Covering wetland plant seeds with even a thin covering of soil will significantly decrease germination of some species. Heat is also less obvious. Natural wetlands are generally very hot and humid. Our research has found that greenhouse temperatures in the range of 100ºF or higher will increase germination and growth.



Seeds of most of the wetland plants except rushes need to be stratified. Stratification is essentially "fooling" the seeds into germination mode by mimicking the environmental conditions that they would be subject to had they remained outside during the winter. The seeds are stratified in small plastic containers that are filled with distilled water. We add about 0.3 oz (8 g) of loose sphagnum moss to the water in the bottom of the cup. The seeds are put into a coffee filter and the filter is nestled down into the moss. The containers are placed in a dark cooler for 30 days at 32-36ºF. At the end of 30 days, the seeds are removed from the stratification medium.

When planting wetland plant seeds in the greenhouse, we use special propagation tanks and Rootrainers$_{tm}$ with a 1:1:1 soil mix of sand, vermiculite, and peat. Rootrainers$_{tm}$ have a large hole in the bottom that needs to be covered so the soil does not wash out when water is added to the tanks. A single sheet of paper towel crumpled up and shoved into the mouth of each cell will prevent this. The seeds are placed on the soil surface of the cells in each Rootrainer $_{tm}$ after the surface has been firmly packed. A 2 x 2 in (5 x 5 cm) wooden tamp works well and can pack the soil to a sufficient density that a finger will barely make an impression in the soil surface. About 5 to 10 seeds are put on a finger and pushed on to the soil surface. The seeds need to be in good contact with the soil surface.

After the stratified seeds are planted on the soil surface, the tanks are filled with water to within about one inch of the soil surface. The seeds should be illuminated for 24 hours a day with 400-watt metal halide lamps for the first month. After one month the lights can be turned off. Covering the propagation tanks with clear plastic while the seeds are germinating helps keep the environment warm and humid. If you find that you have a problem with damping off of the seedlings, try flooding the soil. Leave the soil completely submerged under about 1/4 to 1/2 in (6.4 to 12.7 mm) of water for about two weeks. After this period lower the water level. This procedure will subdue the fungus and may also stimulate more stubborn seeds to germinate. Do not flood the soil if the seeds have not germinated or they will float and move out of the cells.

With this method, 22 in^3 (361 cm^3) plants can be grown from collection to full size in less than 100 days. Plugs can be held in the greenhouse if necessary for extended periods of time with minimal maintenance. Several crops can be raised throughout the year because of the short turn around time.

If growing the plants is not an option and they must be purchased, several things need to be considered. It is important to find a grower who is willing and able to grow wetland plants that can be difficult to propagate. The grower must understand the special propagation requirements and be able to accomplish them. Make sure the grower understands the project plant requirements in terms of height and size at the time that the contract is signed. When determining whether to accept the plant materials, look at the roots in addition to the tops. The tops and roots should be about the same in terms of density. Always remove several plants from their containers to look at the roots. The roots should extend to the bottom of the container, but they should not be root bound (wound around the inside of the container). If they are root-bound, the grower did not transplant them to larger containers in a timely manner. The roots should have several well-developed rhizomes in addition to hair roots. The tops should be vigorous and as tall as the contract called for. Remember if the tops are too short, the plants will be in danger of drowning if planted in water that is too deep. The aerenchyma should be well started in the bottom third of the above ground biomass. Determine the planting date before going to the grower so that he knows when the plants need to be ready. Check in with the grower occasionally especially early to make sure that he has been able to get beyond the germination stage. If problems occur, there might still be time to go to another grower or to adjust your planting date.

Wildlings or (Wild Transplant Collection): Wetland plants because of their tremendous root systems are readily transplanted and the remaining plants will fill in the harvest hole rapidly. One rule of thumb is to dig no more than 1 ft^2 (0.09 m^2) of plant material from a 4 ft^2 (0.4 m^2) area. It is not necessary to go deeper than about 5 to 6 in (13 to 15 cm). This will get enough of the root mass to ensure good establishment at the project site. It will also retain enough of the transplants' root system below the harvest point to allow the plants to grow back into the harvest hole in one growing season assuming good hydrology and some sediment input (Bentrup and Hoag 1999). Transplants can be taken at almost any time of the year. Collections in Idaho have been taken from March to October with little or no difference in transplant establishment success. If plugs are taken during the summer months, cut the tops down to about 4 to 5 in (10 to 13 cm) above the potential standing water height or 10 in (26 cm) which ever is taller. Research at the Aberdeen Plant Materials Center has shown that covering the cut ends with water will not necessarily kill the plant, but will significantly slow its establishment rate (except if left for longer periods of time) (Hoag et al. 1992). Cutting the tops will also increase the survival rate of transplants that are

transported long distances.

Generally, leaving the soil on the plug will increase the establishment success by about 30%. Beneficial organisms that are typically found on the roots of the wetland plants that are important in the nitrogen and phosphorous cycles can be moved to the new site which often will not have the organisms. However, there will be an increase in the volume of material that needs to be transported. In addition, if collections are made from a weed infested area, there is a good chance that weed seeds could be transported in the soil. Washed plugs can be inoculated with mycorrhizae purchased from dealers if the project objectives call for it. The collection location will also help determine whether the soil should be left on the plugs or washed off.

If a total of 1 ft^2 (0.09 m^2) of plant material is harvested, it is possible to get 4 to 5 individual plants plugs from the larger plug. The plugs can either be chopped with a shovel very rapidly or the plugs can be cut relatively accurately with a small saw so they can easily fit into a predrilled, set diameter hole. To get the right length of plug, lay the large plug on its side on a sheet of plywood and use the saw to cut the bottom off level and to the desired length. After this, stand it up and cut smaller plugs off like a cake.

Make sure the length of the plug is related to the saturation zone at the planting site. The bottom of the plug needs to be in contact with the saturation zone. Match the amount of water with the wetland plant species. Ogle and Hoag (2000) display a hydrologic planting zone diagram that outlines the various hydrologic regimes. They also include a series of tables that specify which zones various species will tolerate.

Wetland Transplant Planting

Natural wetland systems have high species diversity. When selecting plant species for the project wetland, try to copy a nearby natural wetland. Identify the particular hydrology in areas where the individual plant species are growing. Make note of how deep the water is. Try and imagine how long the plants will be inundated. Determine if the plants are in flowing or relatively stagnant water. Rarely will a natural wetland be totally stagnant through time. Generally, there is water flowing into the wetland from somewhere either above ground or from groundwater. Spring and fall overturn, as well as wind mixing, also help to circulate the water.

Next, prepare the planting area. The easiest way to plant the plugs is by flooding your planting site. Standing water is much easier to plant in than dry soil (this also ensures that your watering system, what ever it may be, works before you plant). Make sure the soil is super saturated so that you can dig a hole with your hand. This is more successful with fine soils than with coarse soils. Take the plug trays and place them in a Styrofoam cooler (you will not need the lid). Try to cover most of the roots with water while in transit. At the planting site, drain off most of the water so the cooler will float. Use the cooler to move the plugs around the wetland as you plant. Select a spot in your wetland to put a plug, reach into the water with your hand and dig out a hole deep enough for the plug to fit all the way into. Push the plug into the hole and pack around it with your hand. Make sure all of the roots are covered with soil. Be careful to not dislodge the plug and expose the roots when moving around. Start at one end of the planting site and work toward the opposite end.

Spacing of the plugs is a common question. Our research has indicated that many wetland plants will typically spread about 9 to 12 in (23 to 30 cm) in a full growing season. We plant on 18 in (46 cm) centers. Even though it takes fewer plants to plant an area at a wider spacing, we have found that plantings at wider spacing have less overall success than those planted at closer spacing. The exact reason for this is unknown, but it could be a sympathetic response to plants of the same species. If the project budget does not allow for the purchase of enough plants to cover the wetland bottom, plant the plugs on 18 in (46 cm) centers but plant them in copses or patches that are about 10 ft (3 m) square. Space the copses about 10 ft (3 m) apart. The copses can be planted to different species according to the hydrology. Over time, the plants will spread out into the unplanted areas.

The planting window for wetland plants is quite long. At the Aberdeen Plant Materials Center, Idaho we have planted plugs from April through late October. Planting plugs in the fall and winter has resulted in frost heaving of the plugs so that only about 1/3 of the plug remained in the ground. The availability of water is critical. Remember wetland plants like it hot and wet. They tend to spread faster with warmer temperatures. If you plant in the spring, it will take the plants a while to get going, but they will have a longer establishment period. Fall planting will generally result in lower establishment success because of the shorter growing season and frost heaving damage.

The plants can be successfully established in a wide variety of soil textures. We have successfully established wetland plants in areas that are clay with no organic matter all the way up to gravels. The biggest problem is digging the holes. The soil texture will often limit the equipment available to dig the holes. In clay bottoms, we have used a small bulldozer or tractor with a ripper tooth to dig lines across the bottom about 8 in (20 cm) deep.

In general, fertilizer is not necessary. However, it really depends on the site and the soils. If during construction, the bottoms have been cut down to the subsoil and all of the naturally present nutrients have been removed, fertilization will probably be necessary unless the water coming into the wetland has a high nutrient load.

After planting, release the water into the site slowly. Remember that the young plants have not fully developed the aerenchymous material necessary for them to survive in anaerobic soils and standing water. After the initial planting, be careful not to raise the water level to more than about 1 in (2 to 3 cm) above the substrate. Too much water at this time may stress the new plants. Maintain the water at about 1 in (2 to 3 cm) for about one week, this will inhibit the germination and growth of any terrestrial species that may be present in the restored wetland. The water level can then be lowered to the substrate surface for 15 to 20 days. This will expose the mud surface, stimulating any wetland seeds that were brought in with your transplants to germinate as well as increase the rate of spread of the transplants. You can then raise the water level 1 to 2 in (3 to 5 cm). for another week. Then lower the water to the substrate surface for another 15 to 20 days. After this period, slowly raise the water level to 4 to 6 in (10 to 15 cm). for 3 to 5 days. Continue to gradually increase the water depth to 6 to 8 in (15 to 20 cm). Remember that the aerenchymous tissues in the plant shoots are what supply the roots with oxygen so be careful not to raise the water over the tops of the emergent vegetation. If the plants are not showing any stress, continue to carefully raise the water level to 12 to 20 in (30 to 50 cm) if possible. These suggested water level depths must be modified based upon the species used. Some species will not tolerate inundation at these suggested depths or durations. When in doubt, defer to the hydrology conditions on natural reference sites where the species occurs. The goal here is to inundate the transition zone between wetland and upland as much as possible to control any invading terrestrial species. After about 20 days lower the water level to about 2 to 3 in (5 to 7 cm)(Hammer 1992). For the rest of the growing season, adjust the water level to maximize the desired community type. The key to determining the appropriate water level is to monitor the emergent wetland plant community. Raise the water level if weed problems surface. Lower the water level to encourage emergent wetland plant growth and spread. The key thought here is to fluctuate the water level. Natural wetlands rarely have a constant water level. Many species cannot tolerate a constant water level and will begin to die out. Species more tolerant to standing water will increase. The plant diversity that was so carefully planned for will be lost

Management during the establishment year is important to ensure that the plants do not get too much water or too little. Weed control is important especially during the establishment year because of the low water levels and exposed, unvegetated areas. A good weed control plan needs to be in place before planting. Monitoring the planting for 3-5 years after the establishment year will help maintain the planting and it will provide useful information for future plantings.

Recommendations:

- Always match the plant species to the hydrology associated with that species.
- In general, purchase the largest plugs you can afford. Planting technique will often determine the size of the plugs and the ease of planting.
- Plant the plugs on 18 to 24 in (46 to 61 cm) centers.

- Plant in patches rather than wider spacing.
- Fertilizer is generally not necessary unless the water coming into the site is relatively clean or the construction has cut into the subsoil.
- The plants tend to spread faster under saturated soil conditions rather than standing water. However, terrestrial weeds will move in to saturated soils much faster than flooded soils. Fluctuating the water level will help the plants spread and decrease terrestrial weed establishment.
- Water control is extremely important during the establishment year.
- Weed control needs to be planned and budgeted for at the beginning of the project.
- Monitoring is essential for the success of the project. Monitoring needs to have time and money allocated in the budget and it needs to have a specific person identified to carry it out.
- Successful wetland plantings take significant planning and a good understanding of the hydrology at each site.

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Section 12.2 Wetland Revegetation Planning

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GETTING "BANG FOR YOUR BUCK" ON YOUR NEXT WETLAND PROJECT

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What is the one thing that all consumers expect when they purchase a product? Value! In consumer terms, value is often referred to as "Bang for the Buck". One way to get this is by purchasing the most "function", and quality one can for the lowest price. As with any other major purchase, when designing a constructed or created wetland, whether it be for improving water quality, stormwater retention, or wildlife habitat, one should demand the most value for their investment.

What is the difference between wetland functions and values? Functions are those processes or qualities that are inherent in a given wetland system, and may include: wildlife habitat, nutrient sinks or sources, biogeochemical cycles, aquifer recharge or discharge, etc. Values, while derived from functions, are those qualities or process which society perceives as being important or valuable. For example, one function of a given wetland may be to intercept and store stormwater runoff, discharging it slowly over time into a given stream thus reducing peak flows and maintaining more stable flows during periods of low precipitation (streams are less "flashy"). Society derives value from this function since large peak flows cause the most flood damage to manmade structures.

It is important to remember that wetland functions and values can and do change over time. A wetland that functions as a nutrient sink in the summer may function as a source in the spring. A wetland that provides a critical nesting habitat for an endangered species one year, may not provide that same habitat in following years because of plant community succession or drought. Likewise, due to changing attitudes, increasing population densities, losses of wetlands and open space, etc., a quality that society perceives as being valuable today may be viewed as more or less valuable in the future.

When designing a wetland, people should incorporate as many compatible functions and values as they can into the finished product. Be careful not to go overboard, however. If the design of the wetland is too complex, the actual usefulness and value of the wetland could be diminished.

To achieve a wetland design with function and value, always opt for a multi-disciplinary approach. As a minimum, the design team on any wetland planning project should have a wetland ecologist, hydrologist, engineer, and the landowner.

One of the most important people you can have involved with the design of any wetland project is a wetland ecologist. Wetlands, no matter what functions and values they provide, are all complex biological systems. To design a wetland without the expertise of someone with extensive biological or ecological training and experience in wetland plants and their propagation, is asking for trouble.

Engineers are also essential. Projects that are designed by engineers alone commonly do not take into account the biological system requirements. After the system is constructed, the engineers then consult a biologist to find out what types of plants would work in the system they designed. This rarely works out very well and the objectives of the system will not be met. Engineers are very good at what they do, but very few have much biological or ecological expertise.

Another critical person to have involved from the beginning is a hydrologist. As one might guess, the wet in wetland refers to water, so it makes good sense to have a person on the team whose expertise is with water dynamics, such as flow, drainage, sedimentation patterns, etc. and can help determine the total water budget for the project.

A landscape architect can add a lot to the value of the project. Their expertise is in blending cultural, biological, and engineering designs aesthetically into the surrounding landscape. By making the project pleasing to the eye, it will be much more valuable to the community.

The landowner is perhaps the most important member of the team. They must have a feeling of ownership in the project and that their concerns are being addressed. Also consider inviting neighboring landowners to participate. This will help in the long run to ensure that the project is a success. In many cases, the landowner and the neighbors will work many extra hours making sure that the plantings are successful by watering, weeding, watching for vandals, and generally keeping the site clean.

Local school teachers can be consulted to find out how the wetland can be used as an educational tool for the community. All grades and classes can benefit, and not only biology and ecology classes, but physics, chemistry, earth science, geography, math, English/composition (students can write about what they see in the wetland), art (draw what they see), and shop classes (help construct informative signs, benches, walkways, overlooks etc.). Kids also tend to feel an ownership of the site if they are involved. Don't forget, they are an excellent source of labor for the planting of the wetland and they enjoy getting out of the classroom for a day.

Discuss your project with public officials and other community leaders. Be pro-active, get them involved from the onset. Discuss with them what you are doing and how it can benefit the community. A CWS, if properly designed, is a community asset that everyone can rally behind and be proud of.

A word of caution: when working with a diverse group, it is extremely easy to get off track and waste a lot of time arguing about insignificant topics. People eventually lose interest and the whole project dies. It is extremely important to stay on task at the meetings and to set time limits. A good facilitator (whether it is someone from outside the project or one of the members) can improve the chances of success of any project.

Once you have decided to develop a wetland project and have formed your planning team, get together for a brainstorming session. Produce a list of possible functions and values that you would like to see. Don't worry about whether these functions are compatible at this stage, it's only a brainstorming session. Once you have formed this wish list, take a look at the biotic and abiotic factors that exist or affect your project.

What is the quality and quantity of water, what is its chemistry, what seasons will you have water and how much, will there be effluent discharged from the wetland into another body of water or will it be kept on site, how much land do you have for the project, do you have any political or legal constraints as to the location or function of the wetland?

Now produce a list of compatible functions and values that can be managed together without causing too many problems. For example, there is a wetland in Wisconsin that was managed for waterfowl and as a warm water fishery. Most of the time, the fisherman and the duck hunters got along. The fish grew and the wetland complex began to produce some nice sized bluegills. As part of the management for waterfowl, the wetland was drained to oxidize the tied up nutrients in order to increase the primary production of the system. Since this system was fairly shallow with no deep water refuge for the fish, the fishery was decimated each time it was drained. This created animosity between the duck hunters and the fisherman. As this system was designed, the fishery value was not well thought out. There was no way to keep everyone happy in this case with the given system design. Better planning in the beginning might have prevented this problem.

If your design team runs into problems like the one just described, think of ways to keep both functions working. For example, if a deep water refuge had been built into the Wisconsin wetland, the fish would have been able to use it during drawdown. Bigger fish could have survived and the value for both the fisherman and hunter would have been maintained. If that "deep water refuge" can not be provided for, consider developing the system for only one function. Each situation is unique. Try to calculate the value return for each function and change the design accordingly.

When it comes to budgeting for CWS projects, there is a tendency to spend all the money on the engineering components and then make do when it comes to purchasing or obtaining plant materials. It's hard to put together a biological system when you ignore the biological component. If you are on a tight budget, there are many creative ways of obtaining plant materials (see the Interagency Riparian/Wetland Plant Development Project newsletter *View from a Wetland*, No. 1 and 2). However, don't lose sight of the fact that the plants are critical in getting your wetland system functioning.

Many people feel that planting a constructed wetland is not necessary. If the system is left alone, the plants will eventually colonize it. This is true, but what type of vegetation will come in? Will it be a monotypic stand of cattails? How long will it take to get your desired community? What about the potential for weed invasion (purple loosestrife, foxtail barley, etc.). If the entire team is willing to accept these problems, planting may not be necessary. However, by planting a diverse community composed of the species you want, you can accelerate the development of a functioning ecosystem.

To get a better idea of what the vegetative community should be, visit healthy wetland communities in your area which have similar hydrological patterns and chemistry. Make some notes on species present in these wetlands as well as where they are growing. How deep is the water? What are the associated species? The information you gather on these trips can prove very valuable when planning the species composition for the project wetland. The information will also give you ideas about what water depths each species will tolerate (see **Wetland Planting Tips**, *View from a Wetland*, No. 1).

Before you begin planting, run water through the wetland. Control of the water coming in as well as the water going out is essential. With water control, four things can be accomplished. First, it is much easier to successfully establish the plants. Second, planting with a large crew is easier when the substrate is saturated and has standing water. Third, weed control will be much more efficient. Fourth, manipulating the plant community will be much easier.

Establishment of young wetland plants in a constructed wetland is often difficult because of too much water. This is because the young wetland plants have not developed the aerenchymous material in the stems that allows them to survive in anaerobic conditions associated with waterlogged soils. During the establishment year, water depths must be slowly increased as the plants continue to grow.

Plants are much easier to plant if the site is flooded with a couple of inches of water for several days prior to planting and during planting. Generally, the planter can scoop a hole out with his hand and stick the plug into the resulting hole. This eliminates having to use shovels, augers, tree planters, etc. In addition, when water is actually being brought into the wetland site, you are sure that the system actually works before the plants are planted. This saves time, effort, expense, and, of course, the plants.

Weedy species that often invade wet sites can be a real problem when trying to establish a plant community. By having control of the water both coming in and going out of the wetland site, many of these weedy species can be controlled just by using the water level and length of time the water is in the system.

Once planting is completed, use the hydrological design (worked out before hand between the members of the interdisciplinary team) to manipulate the community in the direction you want it to go, working with natural processes in a pro-active mode rather than an attempt at crisis management. The hydrology of the site will be the main driving force behind the plant community that establishes in the constructed wetland site. By manipulating the water levels and duration, different wetland plant communities will spread or decrease in size. Research has indicated that the main controlling factor will move the vegetative community one way or another is a fluctuating water table. Keeping the water at one level throughout the growing season will decrease the spread of the plants and reduce their vigor.

With some basic information, a little knowledge of plants, and the help of a team with a variety of backgrounds, a wetland project can be extremely successful. Remember that maintenance of the system will be as important as the care that was taken in the construction and planting.

Section 12.3 Wetland Plant Descriptions

Use the web site below for a list of species that inhabit Washington Wetlands.

http://www.npwrc.usgs.gov/resource/plants/florawe/florawe.htm.