BMP 6.7.2: Landscape Restoration

Landscape Restoration is the general term used for actively sustainable landscaping practices that are implemented outside of riparian (or other specially protected) buffer areas. Landscape Restoration includes the restoration of forest (i.e. reforestation) and/or meadow and the conversion of turf to meadow. In a truly sustainable site design process, this BMP should be considered only after the areas of development that require landscaping and/or revegetation are minimized. The remaining areas that do require landscaping and/or revegetation should be driven by the selection and use of vegetation (i.e., native species) that does not require significant chemical maintenance by fertilizers, herbicides, and pesticides..

- Minimize traditional turf lawn area
- Maximize landscape restoration area planted with native vegetation
- Protect landscape restoration area during construction
- Prevent post-construction erosion through adequate stabilization
- Minimize fertilizer and chemical-based pest control programs
- Creates and maintains porous surface and healthy soil.
- Minimize mowing (two times per year)
- Reduced maintenance cost compared to lawn

Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

Stormwater Functions

Volume Reduction: Low/Med.
Recharge: Low/Med.
Peak Rate Control: Low/Med.
Water Quality: Very High

Water Quality Functions

TSS: 85%
TP: 85%
NO3: 50%

Other Considerations

- Soil investigation recommended
- Soil restoration may be necessary

Description

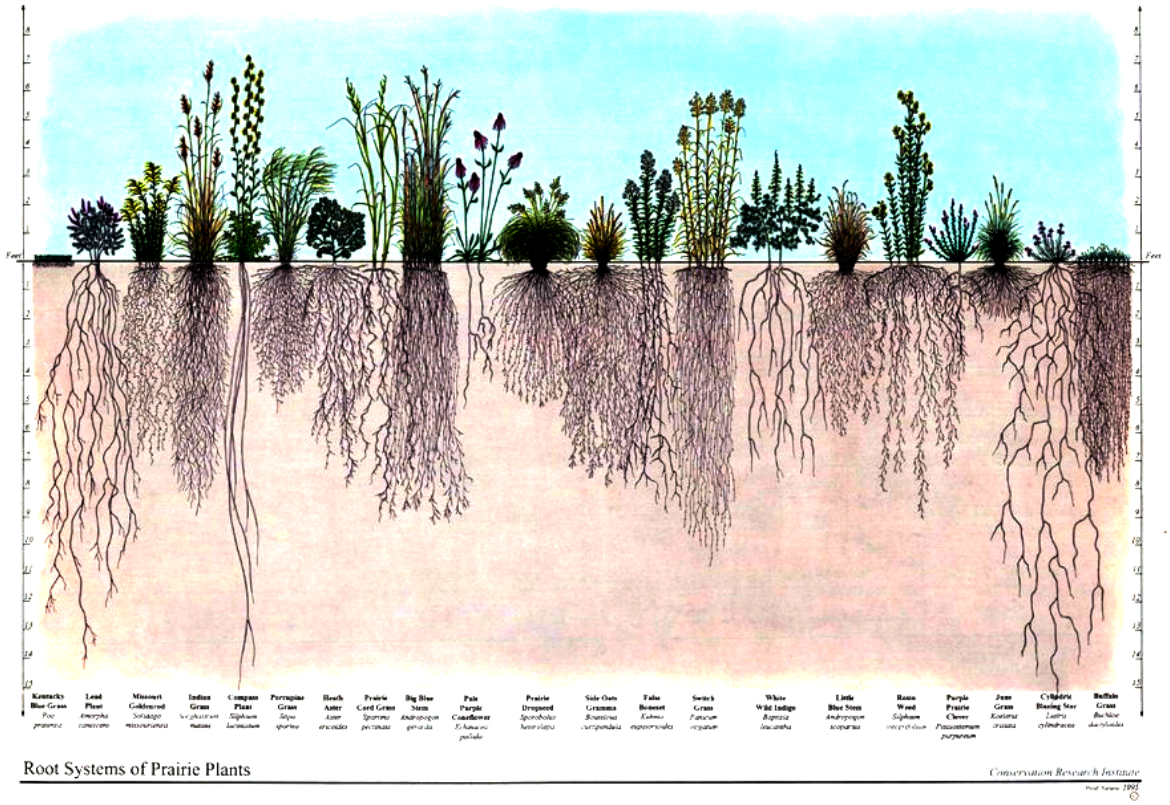
In an integrated stormwater management plan, the landscape is a vital factor, not only in sustaining the aesthetic and functional resources of a site, but also in mitigating the volume and rate of stormwater runoff. Sustainable landscaping, or Landscape Restoration, is an effective method of improving the quality of site runoff. This often overlooked BMP includes the restoration of forest and/or meadow or the conversion of turf to meadow.

Landscape Restoration involves the careful selection and use of vegetation that does not require significant chemical maintenance by fertilizers, herbicides and pesticides. Implicit in this BMP is the assumption that native species have the greatest tolerance and resistance to pests and require less fertilization and chemical application than do nonnative species. Furthermore, since native grasses and other herbaceous materials often require less intensive maintenance efforts (i.e. mowing or trimming), their implementation on a site results in less biomass produced.

Native species are customarily strong growers with stronger and denser root and stem systems, thereby generating less runoff. If the objective is revegetation with woodland species, the longer-term effect is a significant reduction in runoff volumes, with increases in infiltration, evapotranspiration, and recharge, when contrasted with a conventional lawn planting. Peak rate reduction also is achieved. Similarly, meadow reestablishment is also more beneficial than a conventional lawn planting, although not so much as the woodland landscape. Again, these benefits are long term in nature and will not be forthcoming until the species have had an opportunity to grow and mature (one advantage of the meadow is that this maturation process requires considerably less time than a woodland area). Native grasses also tend to have substantially deeper roots and more root mass than turf grasses, which results in:

- A greater volume of water uptake (evapotranspiration)
- Improved soil conditions through organic material and macropore formation
- Provide for greater infiltration

Landscape architects specializing in the local plant community are usually able to identify a variety of species that meet these criteria. Other sources of advice may be county conservation districts, watershed associations and other conservation groups. As the selection of such materials begins at the conceptual design stage, where lawns are eliminated or avoided altogether and landscaping species selected, Landscape Restoration can generally result in a site with reduced runoff volume and rate, as well as significant nonpoint source load reduction/prevention.



Landscape Restoration can improve water quality by minimizing application of fertilizers and pesticides/herbicides. Given the high rates of chemical application which have been documented at newly created lawns for both residential and nonresidential land uses, eliminating the need for chemical application is important for water quality. Of special importance here is the reduction in fertilization and nitrate loadings. For example, Delaware's *Conservation Design for Stormwater Management* lists multiple studies that document high fertilizer application rates, including both nitrogen and phosphorus, in newly created landscapes in residential and nonresidential land developments. Expansive lawn areas in low density single-family residential subdivisions as well as large office parks typically receives intensive chemical application, both fertilization and pest control, which can exceed application rates being applied to agricultural fields. Avoidance of this nonpoint pollutant source is an important water quality objective.

Variations

- Meadow
- No-mow lawn area
- Woodland restoration
- Removal of existing lawn to reduce runoff volume
- Buffers between lawn areas and wetlands or stream corridors
- Replacement of "wet" lawn areas difficult to mow
- Replacement of hard to maintain lawns under mature trees

Applications

- Forested Landscape/Restoration
- Suburban / Developing Landscape
- Urban Landscape
- Meadow Restoration
- Conversion of Turf to Meadow

Design Considerations

1. The recommended guidelines for Landscape Restoration are very closely related to those of Riparian Buffer Restoration (RBR) (BMP 6.7.1). Specifically, Landscape Restoration overlaps with the guidelines for Zones 2 and 3 in typical RBR. As with RBR, it is essential for successful Landscape Restoration that site conditions be well understood, objectives of the landowner considered, and the appropriate plants chosen for the site. These are all tasks that should be completed in the early planning stages of a project. For a summary of the nine steps recommended for the planning stages of a restoration project, see BMP 6.7.1- Riparian Buffer Restoration. Included in this nine-step process are: analysis of site soils/natural vegetative features/habitat significance/topography/etc., determination of restoration suitability, and site preparation.

2. In those sites where soils have been disturbed or determined inadequate for restoration (based on analysis), soil amendments are needed. Soil amendment and restoration is the process of restoring compromised soils by subsoiling and/or adding a soil amendment, such as compost, for the purpose of reestablishing its long-term capacity for infiltration and pollution removal. For more information on restoring soils, see BMP 6.7.3 Soil Amendments and Restoration.

3. “Native species” is a broad term. Different types of native species landscapes may be created, from meadow to woodland areas, obviously requiring different approaches to planting. A native landscape may take several forms in Pennsylvania, ranging from reestablishment of woodlands with understory plantings to reestablishment of meadow. It should be noted that as native landscapes grow and mature, the positive stormwater benefits relating to volume control and peak rate control increase. So, unlike highly maintained turf lawns, these landscapes become much more effective in reducing runoff volumes and nonpoint source pollutants over time.

4. Minimizing the extent of lawn is one of the easiest and most effective ways of improving water quality. Typical (i.e. compacted) lawns on gentle slopes can produce almost as much runoff as pavement. In contrast to turf, “natural forest soils with similar overall slopes can store up to 50 times more precipitation than neatly graded turf.” (Arendt, Growing Greener, pg. 81)
   The first step in sustainable site design is to limit the development footprint as much as possible, preserving natural site features, such as vegetation and topography. If lawn areas are desired in certain areas of a site, they should be confined to those areas with slopes less than 6%.

5. Meadow restoration may be used alone or in combination with a forest restoration. The native meadow landscape provides a land management alternative that benefits stormwater management by reducing runoff volume and nonpoint source pollutant transport. Furthermore, meadow landscapes vastly reduce the need for maintenance, as they do not require frequent mowing during the growing season. Because native grasses and flowers are almost exclusively perennials, properly installed meadows are a self-sustaining plant community that will return year after year.

   Meadows can be constructed as a substitute to turf on the landscape, or they can be created as a buffer between turf and forest. In either situation, the meadow restoration acts to reduce runoff as well as reduce erosion and sedimentation. Meadow buffers along forests also help reduce off-trail pedestrian traffic in order to avoid creating paths which can further concentrate stormwater.

   The challenge in restoring meadow landscapes is a lack of effective establishment and maintenance methods. Native grasses and flowers establish more slowly than weeds and turf grass. Therefore, care must be taken when creating meadow on sites where weed or other vegetative communities are well established. It may take a year or more to prepare the site and to get weeds under control before planting. Erosion prone sites should be planted with a nurse crop (such as annual rye) for quick vegetation establishment to prevent seed and soil loss. Steep slopes and intermittent water courses should be stabilized with erosion blankets, selected to mitigate expected runoff volumes and velocities. Additionally, seed quality is extremely important to successful establishment. There is tremendous variation among seed suppliers, seeds should be chosen with a minimum percent of non-seed plant parts.

6. Conversion of turf grass areas to meadow is relatively simple and has enormous benefits for stormwater management. Though turf is inexpensive to install, the cost of maintenance to promote an attractive healthy lawn is high (requiring mowing, irrigation, fertilizer, lime and

herbicides) and its effects are detrimental to water quality. Turf areas are good candidates for conversion to meadow as they typically have lower density of weed species. The conversion of turf to meadow requires that all turf be eliminated before planting, and care must be taken to control weed establishment prior to planting.

7. Forest restoration includes planting of appropriate tree species (small saplings) with quick establishment of an appropriate ground cover around the trees in order to stabilize the soil and prevent colonization of invasive species. Reforestation can be combined with other volume control BMPs such as retentive berming, vegetated filter strips and swales.

   Plant selection should mimic the surrounding native vegetation and expand on the native species composition already found on the site. A mixture of native trees and shrubs is recommended and should be planted once a ground cover is established.

8. In terms of woodland areas, DCNR's *Conservation Design for Stormwater Management* states, "…a mixture of young trees and shrubs is recommended…. Tree seedlings from 12 to 18 inches in height can be used, with shrubs at 18 to 24 inches. Once a ground cover crop is established (to offset the need for mowing), trees and shrubs should be planted on 8-foot centers, with a total of approximately 430 trees per acre. Trees should be planted with tree shelters to avoid browse damage in areas with high deer populations, and to encourage more rapid growth." (p.3-50). Initial watering and weekly watering during dry periods may be necessary during the first growing season. As tree species grow larger, both shrubs and ground covers recede and yield to the more dominant tree species. The native tree species mix of small inexpensive saplings should be picked for variety and should reflect the local forest communities. Annual mowing to control invasives may be necessary, although the quick establishment of a strong-growing ground cover can be effective in providing invasive control. Native meadow planting mixes also are available. A variety of site design factors may influence the type of vegetative community that is to be planned and implemented. In so many cases, the "natural" vegetation of Pennsylvania's communities is, of course, woodland.

9. Ensure adequate stabilization. Adequate stabilization is extremely important as native grasses, meadow flowers, and woodlands establish more slowly than turf. Stabilization can be achieved for forest restoration by establishing a ground cover before planting of trees and shrubs. When creating meadows, it may be necessary to plant a fast growing nurse crop with meadow seeds for quick stabilization. Annual rye can be planted in the fall or spring with meadow seeds and will establish quickly and usually will not present a competitive problem. Erosion prone sites should be planted with a nurse crop and covered with weed-free straw mulch, while steep slopes and areas subject to runoff should be stabilized with erosion control blankets suitable for the expected volume and velocity of runoff.

Volume Reduction Calculations and Peak Rate Mitigation
Areas designated for landscape restoration should be considered as “Meadow, good condition” in stormwater calculations.

Water Quality Improvement
See Section 8 for Water Quality Improvement methodology, which addresses pollutant removal effectiveness of this BMP.

Construction Sequence

Forest restoration installation follows closely the procedure outlined in BMP 6.7.1- Riparian Buffer Restoration. Refer to BMP 6.7.1 for detailed information, with the understanding that species selection for upland forest restoration will differ from that for riparian restoration.

Meadow installation should proceed as follows:

1. SELECT SITE
- Confirm site is suitable for restoration, should be sunny, open and well-ventilated. Meadow plants require at least a half a day of full sun.
- Obtain landowner permission

2. ANALYZE SITE
- Evaluate site’s physical conditions (soil attributes, geology, terrain)
- Evaluate site’s vegetative features (desirable and undesirable species, native species, sensitive habitats). Good candidates for meadow plantings include areas presently in turf, cornfields, soybean fields, alfalfa fields and bare soils from new construction.
- Areas with a history of heavy weed growth may require a full year or longer to prepare for planting.
- Beware of residual herbicides that may have been applied to agricultural fields. Always check the herbicide history of the past 2-3 years and test the soils if in doubt.

3. PLANT SELECTION
- Select plants that are well adapted to the specific site conditions. Meadow plants must be able to out compete weed species in the first few years as they become established.

4. PREPARE SITE
- All weeds or existing vegetation must be eliminated prior to seeding.
- Perennial weeds may require year long smothering, repeated sprayings with herbicides, or repeated tillage with equipment that can uproot and kill perennial weeds.

5. PLANTING DAY
- Planting can take place from Spring thaw through June 30 or from September 1 through soil freeze-up (“dormant seeding”)
- Planting in July and August is generally not recommend due to the frequency of drought during this time.
- Seeding can be accomplished by a variety of methods: no-till seeder for multi-acre planting; broadcast seeder; hand broadcast for small areas of one acre or less.
- Seed quality is critical and a seed mix should be used with a minimum percentage of non-seed plant parts.

6. SITE MAINTENANCE (additional information below)

- Assign responsibilities for watering, weeding, mowing, and maintenance
- Monitor site regularly for growth and potential problems

Maintenance Issues

Meadows and Forests are low maintenance but not “no maintenance”. They usually require more frequent maintenance in the first few years immediately following installation.

Forest restoration areas planted with a proper cover crop can be expected to require annual mowing in order to control invasives. Application of a carefully selected herbicide (Roundup or similar glyphosate herbicide) around the protective tree shelters/tubes may be necessary, reinforced by selective cutting/manual removal, if necessary. This initial maintenance routine is necessary for the initial 2 to 3 years of growth and may be necessary for up to 5 years until tree growth and tree canopy begins to form, naturally inhibiting weed growth (once shading is adequate, growth of invasives and other weeds will be naturally prevented, and the woodland becomes self-maintaining). Review of the new woodland should be undertaken intermittently to determine if replacement trees should be provided (some modest rate of planting failure is usual).

Meadow management is somewhat more straightforward; a seasonal mowing or burning may be required, although care must be taken to make sure that any management is coordinated with essential reseeding and other important aspects of meadow reestablishment. In the first year weeds must be carefully controlled and consistently mowed back to 4-6 inches tall when they reach 12 inches in height. In the second year, weeds should continue to monitored and mowed and rhizomatous weeds should be hand treated with herbicide. Weeds should not be sprayed with herbicide as the drift from the spray may kill large patches of desirable plants, allowing weeds to move in to these new open areas. In the beginning of the third season, the young meadow should be burned off in mid-spring. If burning is not possible, the meadow should be mowed very closely to the ground instead. The mowed material should be removed from the site to expose the soil to the sun. This helps encourage rapid soil warming which favors the establishment of “warm season” plants over “cool season” weeds.

Cost Issues

Landscape restoration cost implications are minimal during construction. Seeding for installation of a conventional lawn is likely to be less expensive than planting of a “cover” of native species, although when contrasted with a non-lawn landscape, “natives” often are not more costly than other nonnative landscape species. In terms of woodland creation, somewhat dated (1997) costs have been provided by the *Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers*:

$860/acre trees with installation
$1,600/acre tree shelters/tubes and stakes
$300/acre for four waterings on average

In current dollars, these values would be considerably higher, well over $3,000/acre for installation costs. Costs for meadow reestablishment are lower than those for woodland, in part due to the

elimination of the need for shelters/tubes. Again, such costs can be expected to be greater than installation of conventional lawn (seeding and mulching), although the installation cost differences diminish when conventional lawn seeding is redefined in terms of conventional planting beds.

Cost differentials grow greater when longer term operating and maintenance costs are taken into consideration. If lawn mowing can be eliminated, or even reduced significantly to a once per year requirement, substantial maintenance cost savings result, often in excess of $1,500 per acre per year. If chemical application (fertilization, pesticides, etc.) can be eliminated, substantial additional savings result with use of native species. These reductions in annual maintenance costs resulting from a native landscape reestablishment very quickly outweigh any increased installation costs that are required at project initiation. Unfortunately, because developers pay for the installation costs and longer term reduced maintenance costs are enjoyed by future owners, there is reluctance to embrace native landscaping concepts.

Specifications

The following specifications are provided for information purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

Vegetation – See Appendix B

References

Bowman's Hill Wildflower Preserve, Washington Crossing Historic Park, PO Box 685, New Hope, PA 18938-0685, Tel (215) 862-2924, Fax (215) 862-1846, Native plant reserve, plant sales, native seed, educational programs, www.bhwp.org

Morris Arboretum of the University of Pennsylvania; 9414 Meadowbrook Avenue, Philadelphia, PA 19118, Tel (215) 247-5777, www.upenn.edu/morris, PA Flora Project Website: Arboretum and gardens (some natives), educational programs, PA Flora Project, www.upenn.edu/paflora

Pennsylvania Department of Conservation and Natural Resources; Bureau of Forestry; PO Box 8552, Harrisburg, PA 17105-8552, Tel (717)787-3444, Fax (717)783-5109, Invasive plant brochure; list of native plant and seed suppliers in PA; list of rare, endangered, threatened species.

Pennsylvania Native Plant Society, 1001 East College Avenue, State College, PA 16801 www.pawildflower.org

Western Pennsylvania Conservancy; 209 Fourth Avenue, Pittsburgh, PA 15222, Tel (412) 288-2777, Fax (412) 281-1792, www.paconserve.org

Conservation Design for Stormwater Management (DNREC and EMC)

Stream ReLeaf Plan and Toolkits

The Once and Future Forest – Leslie Sauer

Forestry Best Management Practices for Water Quality – Virginia Department of Forestry

Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers (1997)

Arendt, R. *Growing Greener.* Island Press, November 1999.

Diboll, Neil. Five Steps to Successful Prairie Meadow Establishment. Windstar Wildlife Institute.

Penn State College of Agricultural Sciences, Agricultural Research and Cooperation Extension. " Pennsylvania Wildlife No. 12: Warm-season Grasses and Wildlife" and "Pennsylvania Wildlife No. 5: Meadows and Prairies: Wildlife-friendly Alternatives to Lawn"