Arboretum Leaflets

LEAFLET 12
December 2006

Turning stormwater facilities into amenities for learning

Our mission is to conserve and restore Arboretum lands, advance restoration ecology and foster the land ethic. Yet, the Arboretum's position makes it a "sink" for runoff from urban neighbors higher in the landscape. Once on our land, urban runoff becomes our responsibility, and we must manage it and prevent it from eroding natural areas and from polluting Arb wetlands and aquatic resources downstream (Lake Wingra, Lake Monona, and Madison's E-Way).

Our first project to improve stormwater management (completed in 2005) concerned Marion Dunn Pond. Contractors dredged out the sediments that had accumulated from the upstream urban watershed. They added large rocks to stabilize banks and built new weirs to direct flows. But this project preceded our stormwater planning activities, thus our ideals for stormwater treatment (Box 1) were unfulfilled, and few of our principles were followed.

Because the Arboretum is required to upgrade its stormwater treatment facilities, and because many standard designs are at odds with Arboretum principles (Box 1), the Arboretum Storm Water Committee (hereafter, "the Committee") has reviewed and rejected subsequent designs that were inconsistent with the principles. First, we rejected a 20-acre stormwater detention facility at Manitou Way, opting instead to implement the minimum requirement of grading and stabilizing the banks of the existing 500-foot channel and removing sediment from Secret Pond. Next, we rejected an 18-acre system involving a buried pipe, flume, forebay and infiltration basin, which was designed to bypass Pond 1 in Curtis Prairie, and re-direct flows to Pond 2 (Johannsen Pond, southeast of Curtis Prairie).

But rejecting all options for managing stormwater would allow runoff to continue to erode natural areas, and contaminated waters to move into Arboretum wetlands as well as downstream aquatic habitats. Common ground was needed—an approach that would improve stormwater treatment while adhering to principles and fulfilling the Arboretum mission.

The Committee went back to work, asking how the need to treat stormwater could become a research effort that would test innovative methods using native vegetation, while enhancing infiltration and removing phosphorus, nitrogen and other contaminants from stormwater. We began by identifying the most critical "unknowns" (Box 2).

The Committee modified two project designs to incorporate research. First, we agreed that the channel leading to Secret Pond (Fig. 1–3) could be planted as a large experiment that would test the ability of native shrubs and non-woody plants to stabilize channel banks while reducing erosion. That approach fulfills the Arboretum's mission to "advance restoration ecology" without compromising the need to convey stormwater to Secret Pond, where slower velocities will allow sediments to accumulate. Students in Botany 670 ("Adaptive Restoration Lab") designed alternative plantings to help answer questions 1–3.

Box 1: Ideals and principles for managing stormwater

(abridged from: UW-Madison, Arboretum – facility Storm Water Management Plan, July 2006)).

Ideals

- Transport and infiltrate stormwater to serve restoration objectives and protect the environment.
- Limit inflows to pre-settlement quantities to the extent possible.
- Accept only inflows of pre-settlement quality (e.g. nutrients, solids, temperature).
- Allow only infrastructures (e.g. detention ponds, dikes) that serve the Arboretum mission.
- Encourage proper storm water management by example and through education.

Principles

- Manage stormwater where the rain falls, before runoff accumulates.
- Prevent further degradation of groundwater, downstream ecosystems and surface waters.
- Within 10 years, reduce the volume of inflowing runoff by 25% and total suspended solids, nutrients and contaminants by 40%.
- Measure progress in stormwater management and support of research and education (assessing physical, chemical, and biological responses).
- Configure infrastructure to support research, restoration and educational purposes.
- Convey inflows not treated by infrastructure to minimize impacts on Arboretum ecosystems.
- Ensure that adjoining businesses and municipalities have spill control/ response plans in place.
- Infiltrate runoff wherever feasible.
- Minimize inflowing chlorides, and disperse outflows to prevent down-gradient scouring and erosion.
- Design infrastructure to accommodate long-term maintenance.

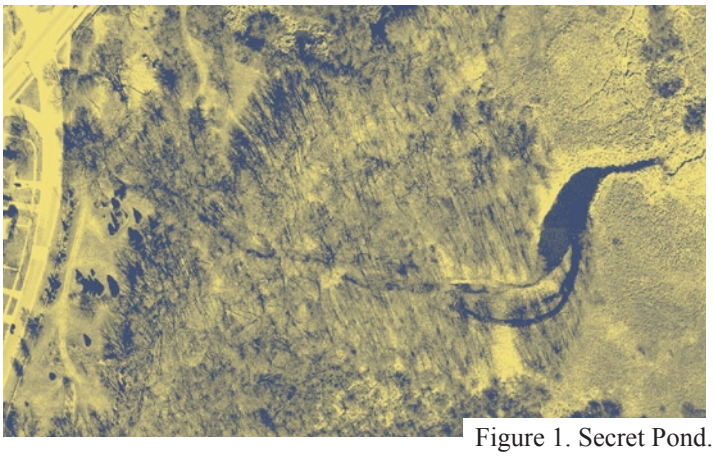

Figure 1. Secret Pond.

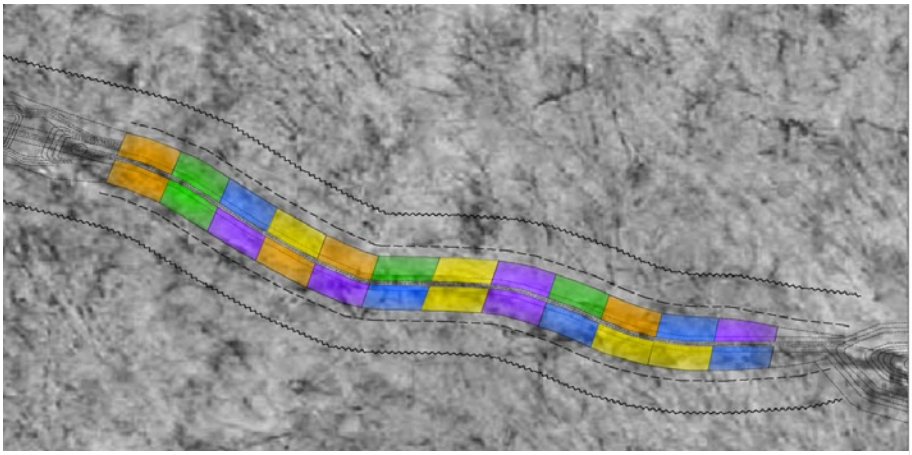

Figure 2. Test plot placements for various planting treatments (drawn by Erin Lewis).

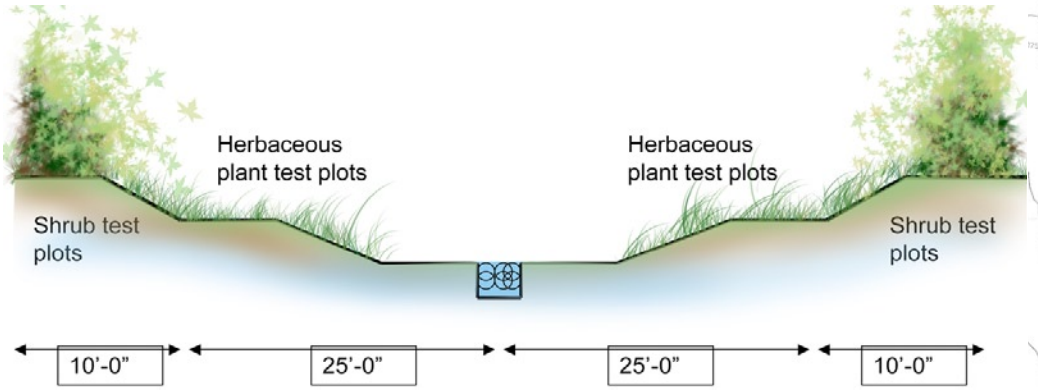

Figure 3. Secret Pond channel and proposed test plantings for stormflow retention (drawn by Erin Lewis).

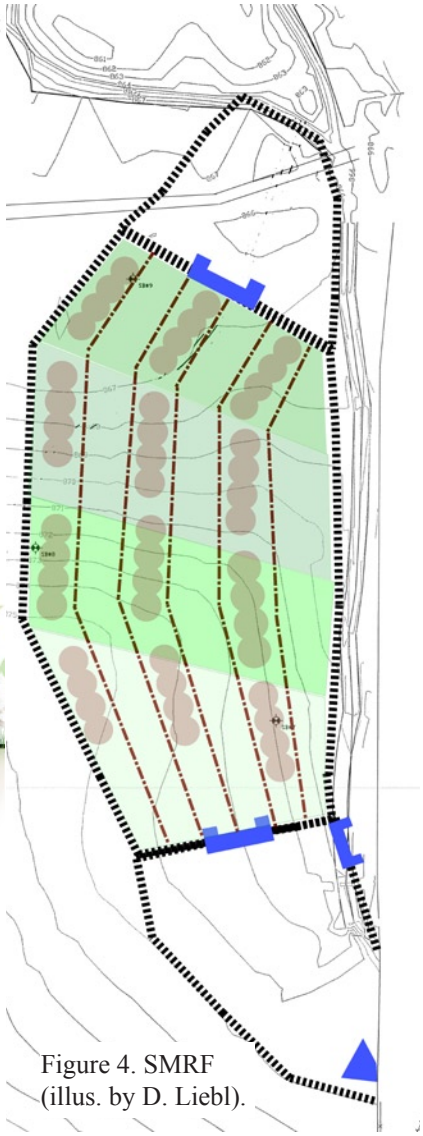

Figure 4. SMRF (illus. by D. Liebl).

Next, the Committee addressed Pond 2, where the challenge was to reduce surface water inflows via infiltration beds while simultaneously improving water quality. Treatment and experimentation needed to occur at a large scale, and multiple factors needed to be tested for their ability to enhance infiltration. Either substrate properties or rooting characteristics of various plants (or both) might accelerate infiltration and/or water quality improvement. Engineers, ecologists and Botany 670 students addressed questions 4–8. The collective result was a plan to construct a Stormwater Management Research Facility (SMRF, nicknamed "smurf"; Fig. 4) that is consistent with the Arboretum research mission and likely to reduce the quantity and quality of surface water that flows downstream to Teal Pond, and increase infiltration to groundwater. Improving and reducing stormwater that overflows Pond 1 is next on our list, followed by Pond 4 (to be tackled by the Water Resources Management practicum in summer 2007). Innovative suggestions are welcomed by the Committee.

The need to improve stormwater facilities in the Arboretum has now established a precedent for future projects: The Arboretum is not just a place to dump stormwater. Our mission is to conserve and restore land, not convert it to stormwater detention and infiltration basins. Where we cannot avoid stormwater infrastructures, we can turn them into opportunities to learn how best to reduce the quantity and improve the quality of water that we discharge. At the same time, we will advance restoration ecology by experimenting with native vegetation and we will foster the land ethic by developing "green" alternatives that others can view and adopt.

Box 2: Questions to answer through research efforts.

1. Which native species can tolerate the flashy hydroperiods of stormwater inflows (i.e., highly pulsed flows interspersed with drying)?
2. Which shrubs and non-woody plants can anchor channel banks and reduce surface erosion?
3. Which plantings can resist invasion of buckthorn, reed canary grass and other pest plants or at least tolerate management tools (control burning of invasive shrubs, grass-specific herbicides)?
4. Which plants create root channels that convey water deep into the soil, enhancing infiltration?
5. Can infiltration and/or water quality be improved by creating soil surfaces that are topographically heterogeneous (relative to smooth surfaces)?
6. Will topographically heterogeneous surfaces support more native plant species?
7. What type of facility would foster research of faculty, students, and classes?
8. How can planners, engineers, regulators, and the broader range of visitors best learn from the Arboretum's innovations in stormwater management?

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This leaflet was compiled by J. Zedler and D. Liebl. Layout by Kandis Elliot.

This and other leaflets can be found at www.botany.wisc.edu/zedler/leaflets.html and the Arboretum website: www.uwarboretum.org.