

The Advantages of Naturalized Detention Basins: A Cost-Benefit Analysis



Image 1: A conventional detention basin lined with riprap and turfgrass.

Editor's Note: This previously published examination of naturalized versus conventional detention basins appears with permission of V3 Consultants, Ltd.

Management of stormwater is essential for successful development to minimize flooding and maintain water quality. Stormwater management is typically accomplished by construction of a detention basin to accommodate onsite surface runoff following storm events. However, significant benefits and long-term cost savings can be realized through the utilization of a "naturalized" detention basin. This article provides an environmental and economic cost/benefit analysis of a conventional basin versus a basin naturalized with native vegetation.

The conventional detention basin design (Image 1) consists of a riprap-lined deep-water basin surrounded by turfgrass side slopes. The conventional basin is generally void of wetland vegetation due to the deep-bottom construction. Although the conventional basin provides stormwater storage and some water-quality benefits, additional benefits are lost due to the lack of native vegetation.



Image 2: In naturalized basins, native plants provide shoreline and side-slope stabilization.

The distinction between a conventional basin and a naturalized basin is the utilization of native plants to provide shoreline and side-slope stabilization (Image 2). Wetland vegetation is used instead of riprap to stabilize the shoreline and prairie vegetation replaces turfgrass on the side slopes. Not only are native wetland and prairie vegetation more reliable soil stabilizers than riprap and turf, additional environmental benefits such as improved water quality, creation of wildlife habitat, and beautification are provided.

The environmental benefits of using prairie vegetation instead of turfgrass have been well-documented. Turfgrass provides minimal water-quality benefits due to its shallow roots. As a result of the deep roots that prairie species possess, significant water-quality benefits are provided through increased infiltration and attenuation of runoff, and increased soil stabilization.

Interception of pollutants occurs above ground within the dense prairie vegetation as well as subsurface as a result of the increased soil permeability

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that the network of roots provides. Not only is water quality improved as a result of increased soil permeability, a reduction in flooding can result due to the subsurface infiltration of stormwater. As a result of the prairie-vegetated side slopes, the functions of the detention basin are improved, and the viability of the wet-bottom portion is increased as a result of this primary treatment that the prairie vegetation provides.

There are many additional benefits from using prairie vegetation instead of turf, and these benefits have also been well-documented. However, the use of wetland vegetation in a detention basin has only been briefly discussed in the literature. Wetland vegetation plays a key role in the function of a naturalized basin in the treatment of water and completes the stormwater management "prairie-wetland complex."

Installation of wetland vegetation around the perimeter of a basin minimizes the erosive pressures of



Image 3: One advantage of naturalized basins: they are more aesthetically pleasing.

wave action and water-level fluctuation that can destabilize the shoreline. Riprap also protects the shoreline, but riprap does not offer the environmental benefits provided by wetland

vegetation. One environmental benefit of using wetland vegetation is its ability to improve water quality. The microorganisms that live on emergent and submerged wetland vegetation

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break down many pollutants, thereby cleaning water. Some studies show that submerged aquatic vegetation can retain as much as 80% of phosphorus that enters a basin. This natural water cleansing reduces nutrients, which is a significant water-quality benefit not provided by riprap.

The use of chemicals, such as copper sulfate or Aquashade—which are commonly used to control algae in a conventional basin—is not normally required in a naturalized basin. Algal blooms are caused by high phosphorus concentrations in the water. As previously discussed, wetland vegetation retains high amounts of phosphorus, which reduces its availability for algae and minimizes the need for chemical control. Less use of chemicals also results from installation of prairie instead of turf on the side slopes. Thus, the use of wetland and prairie vegetation not only provides additional water-quality benefits but also eliminates the usage of the chemical pollutants that degrade water quality. As a result, the water-quality benefits from native vegetation are two-fold.

An additional benefit associated with a naturalized basin is creation of wildlife habitat. Many species of birds, reptiles, amphibians and fish are attracted to wetland vegetation, whereas only a few species utilize unvegetated, conventional basins. Installation of wetland vegetation in detention basins can replace wildlife habitat lost as a result of the extensive development in the Chicago region. Many wildlife species, including the state-endangered black-crowned night heron, great egret, green heron and great blue heron are attracted to these types of naturalized areas. The wetland vegetation in naturalized basins can provide attractive nesting and feeding grounds for a variety of wildlife species, and these are lacking in conventional basins.

Additionally, naturalized basins are not as attractive to Canada geese, which have become a nuisance species in the Chicago region. Canada geese prefer unvegetated shorelines and mowed turf side slopes, which allow quick access to the water's edge and provide an unlimited food source.

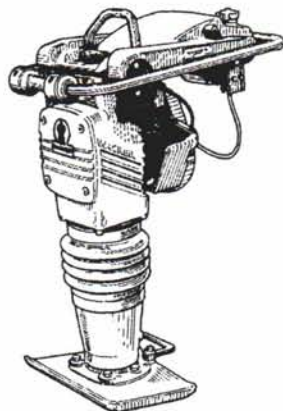
Many species of birds, reptiles, amphibians and fish are attracted to wetland vegetation, whereas only a few species utilize unvegetated, conventional basins.

This unlimited food source results in generation of large amounts of droppings that degrade water quality and present a potential health risk. Installation of wetland vegetation on the shoreline creates a permanent, effective

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tive barrier, which makes it difficult for geese to move from water to land. Also, installation of prairie vegetation on the slopes eliminates the unlimited food source provided by turf and provides cover for potential predators, which discourages Canada geese.


Other benefits of a naturalized basin are the attractive features that provide an aesthetic amenity to the landscape (Image 3). A conventional basin has minimal attractive features and often the riprap becomes overgrown with weeds (Image 4) or the slopes erode (Image 5), which further degrades the appearance and can add significant future remediation costs. Native vegetation provides an abundance of colors and textures throughout the growing season. Prairie plants offer a variety of flower colors throughout the season that attract interesting birds and butterflies, which enhances the aesthetics of the area. Various species of wetland plants provide many shades of green, an assortment of plant heights and a mixture of leaf shapes that contrast well




Images 4 & 5: Weed growth and/or slope erosion can degrade the appearance of conventional detention basins.

together amidst the water. Additionally, native vegetation can reduce algal blooms, which is probably the number-one complaint residents have concerning detention basins. With the

use of native vegetation, beautification of the landscape occurs through the additional water-quality benefits and the unique features of native plants.



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Using native vegetation instead of turf and stone provides other environmental benefits, such as reduced air and noise pollution, and a reduction in the greenhouse effect. Prairie results in the reduction of standard lawn-care equipment usage, which reduces air and noise pollution. The lawnmower emits 11 times the air pollution of a new car for each hour of operation. Natural vegetation can reduce the need for the lawnmower and other fossil-fueled equipment, thereby improving air quality. Additionally, plants remove carbon dioxide from the atmosphere, which can reduce the greenhouse effect.

Naturalized basins provide significantly more benefits to the environment than conventional ones. These environmental benefits include improved water quality, flood reduction, wildlife habitat creation and aesthetic amenities. The remainder of this article analyzes the economic benefits of a naturalized basin versus a conventional basin. Factors analyzed include costs of implementing the different slope treatments and maintenance for a 10-year period.

In order to conduct an adequate cost comparison of the two types of basins, the design of the basins will be

almost identical with only minor differences in the proposed contours to accommodate wetland planting. Based on these design similarities, differences in excavating and grading costs are negligible, and thus, should not affect the cost comparison. The specifications for the basins are provided below.

- The size of both basins at normal water level (NWL) is one (1) acre with 800 linear feet of shoreline.
- The side slopes of both basins are 4:1 and are 27 feet wide, which results in 0.5 acres, or 2,400 square yards of side-slope area.

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Table 1: Cost Estimate for a 1.5-acre Conventional Detention Basin

1.0 Slope Treatment	QUANTITY	UNITS	PRICE	COST
1.01 Stone Rip Rap & Geo Fabric - IDOT Gradation 3	533	sq. yd.	\$15.00	\$7,995.00
1.02 Turf Grass Sod	1,866	sq. yd.	\$2.50	\$4,665.00
TOTAL SLOPE TREATMENT				\$12,660.00
2.0 Maintenance (Year 1 - 5)	QUANTITY	UNITS	PRICE	COST
2.01 *Mowing	130	each	\$100.00	\$13,000.00
2.02 Fertilization	10	each	\$100.00	\$1,000.00
2.03 Herbicide Application	5	each	\$50.00	\$250.00
2.04 **Irrigation	8	each	\$200.00	\$1,600.00
2.05 ***Algae Treatment (Aquashade)	10	each	\$250.00	\$2,500.00
SUBTOTAL MAINTENANCE YEAR 1 - 5				\$18,350.00
3.0 Maintenance (Year 6 - 10)	QUANTITY	UNITS	PRICE	COST
3.01 *Mowing	130	each	\$100.00	\$13,000.00
3.02 Fertilization	10	each	\$100.00	\$1,000.00
3.03 Herbicide Application	5	each	\$50.00	\$250.00
3.04 ***Algae Treatment (Aquashade)	10	each	\$250.00	\$2,500.00
SUBTOTAL MAINTENANCE YEAR 6 - 10				\$16,750.00
TOTAL MAINTENANCE				\$35,100.00
GRAND TOTAL				\$47,760.00

- * Mowing occurs weekly from mid-April to the end of October
- **Estimate 8 events during establishment period during first growing season
- ***Aquashade applied twice annually

Table 2: Cost Estimate for a 1.5 acre Naturalized Detention Basin

1.0 Slope Treatment	QUANTITY	UNITS	PRICE	COST
1.01 *Emergent Planting (0.18 acres)	900	plugs	\$3.50	\$3,150.00
1.02 Floating & Submerged Planting (0.1 acres)	0.1	acre	\$1,500.00	\$150.00
1.03 Wetland Seeding	0.18	acre	\$2,000.00	\$360.00
1.04 Prairie Seeding & Erosion Blanket	0.50	acre	\$7,000.00	\$3,500.00
TOTAL SLOPE TREATMENT				\$7,160.00
2.0 Maintenance (Year 1 - 5)	QUANTITY	UNITS	PRICE	COST
2.01 First Year Buffer Mowing	2	each	\$100.00	\$200.00
2.02 Prescribed Burning	4	each	\$3,500.00	\$14,000.00
2.03 Chemical & Mechanical Weed Control	5	year	\$1,500.00	\$7,500.00
SUBTOTAL MAINTENANCE YEAR 1 - 5				\$21,700.00
3.0 Maintenance (Year 6 - 10)	QUANTITY	UNITS	PRICE	COST
3.01 Prescribed Burning	2	each	\$3,500.00	\$7,000.00
3.02 Chemical & Mechanical Weed Control	5	year	\$1,000.00	\$5,000.00
SUBTOTAL MAINTENANCE YEAR 6 - 10				\$12,000.00
TOTAL MAINTENANCE				\$33,700.00
GRAND TOTAL				\$40,860.00

*5,000 plants per acre planting rate

- The conventional basin has a 6-foot-wide band of grade 3 riprap along the bottom of the side slope, which totals 533 square yards. The remainder of the conventional basin's side slopes, or 1,866 square yards, is turfgrass.
- The naturalized basin has a 15-foot-wide perimeter planting shelf between 0.25 to 2 feet below NWL for emergent, floating and submerged aquatic vegetation. The remainder of the naturalized basin bottom is up to 10 feet deep, which will match the conventional basin.
- The entire side slope of the naturalized basin is prairie (0.5 acres).
- The entire bottom of the conventional basin is 10 feet deep.
- Maintenance of both basins includes management activities for a 10-year period to promote successful results.

Tables 1 and 2 provide costs for a conventional basin and a naturalized basin according to the specifications given above. Costs were provided by qualified engineering, ecological and landscape firms in the Chicago area.

As illustrated by Tables 1 and 2, conventional slope treatment costs a great deal more (\$5,500) to install than native vegetation, which is primarily the result of the high riprap expense. The cost of the riprap alone exceeds the total cost of the entire slope treatment for the naturalized basin. Additionally, the cost to install turfgrass was slightly more than the cost for prairie vegetation, which is the result of lower costs associated with seeding versus planting. Section 1.0 of the tables

shows that a considerable amount of cost savings can result from installation of wetland and prairie vegetation instead of riprap. The installation cost savings of a natural slope treatment are magnified as a result of the additional environmental benefits provided.

The other factor illustrated by the tables is maintenance cost for a 10-year period. According to the tables, the five-year maintenance costs of the naturalized slope treatment were \$3,350 more than for the conventional basin, but \$1,400 less at the end of Year 10. These results show that a long-term maintenance-cost savings results from installation of native vegetation. This maintenance-cost savings is due to the adaptations native vegetation have to the extreme weather conditions of our region. Maintenance of native vegetation decreases as the community establishes and only minimal maintenance is required upon maturity. On the contrary, turfgrass requires continuous management using chemicals and fertilizers for it to remain healthy, because it is not adapted to the local conditions. Furthermore, additional maintenance costs may be required in a conventional basin due to failure of the riprap and turf to provide long-term stabilization. Activities including riprap replacement and slope regrading and planting are frequent activities conducted to improve failing detention basins.

Summary

This article demonstrates that a naturalized basin provides significant environmental and economic benefits in comparison to the conventional basin. Installation of native vegetation instead of riprap and turf

Maintenance of native vegetation decreases as the community establishes and only minimal maintenance is required upon maturity. On the contrary, turfgrass requires continuous management using chemicals and fertilizers for it to remain healthy . . .

provides water-quality benefits, valuable wildlife habitat and beautifies the landscape. Furthermore, installation costs are less and savings are realized in long-term maintenance cost. Additionally, construction of a naturalized basin also eliminates the potential future remedial activities typically required for a conventional basin. Utilization of native vegetation in a detention basin can significantly improve stormwater management.



Questions or comments regarding this article? Please contact George Milner at 630-724-9200 or e-mail gmlner@v3consultants.com.

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