3. Slope Treatment - Retaining Walls

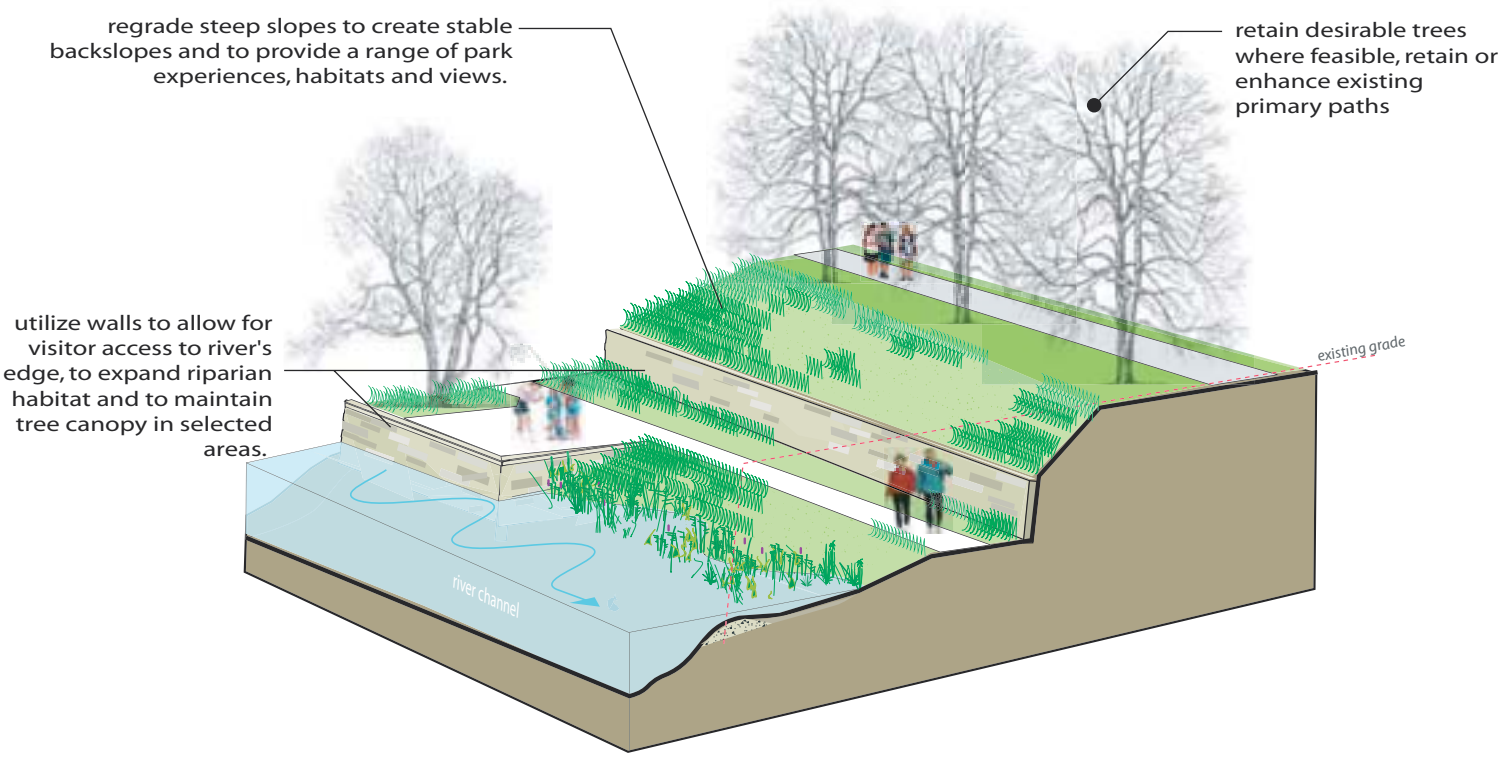
Retaining walls stabilize the slopes by retaining the soil behind them. The wall can be made from a variety of durable materials such as sheetpile, timbers, stacked rock, poured concrete, stone or gabions. Retaining walls can be located at the river edge where they can be an extension of a wall or can be placed back from the river edge to allow for a trail or other uses between the edge and the back slope. Also, the materials selected can impact the the aesthetic of the wall.

This treatment type does not provide any habitat benefits.

Advantages:
- Can be placed at shoreline or further landward to accommodate trails and amenities.
- Provides access to water's edge.
- Presents opportunity to integrate overlooks, steps to the river, and other amenities in an artful way.

Disadvantages:
- There may be significant floodway permitting issues where the retaining wall is used to reduce the cross-section of the channel.
- Retaining walls are generally the most expensive means of slope stabilization
- Retaining walls tend to isolate the river from its corridor and associated habitat.

Maintenance:
- Periodic inspection for tipping and buldging.
- Possible vandalism where the wall is constructed of movable material (stacked stone, gabions, etc).



Note: The "retaining wall" slope treatment is shown with "retaining wall and wetland fringe" toe of slope treatments.

4. Slope Treatment - Compacted Soil Lifts

Soils lifts are typically used to reconstruct failed slopes and allows for the creation of steeper slopes than would normally be feasible with regrading alone. This slope treatment consists of fabric reinforced soil lifts (compacted layers) seeded and planted with native vegetation. Compacted soils lifts are generally installed with a stone toe or A-jacks to provide a foundation and toe protection. The stone provides a drainage layer to reduce the duration of saturated bank conditions that can lead to bank slumping. The fabric provides temporary stability and protection from erosive forces before the native vegetation can become established and provide long-term stability.

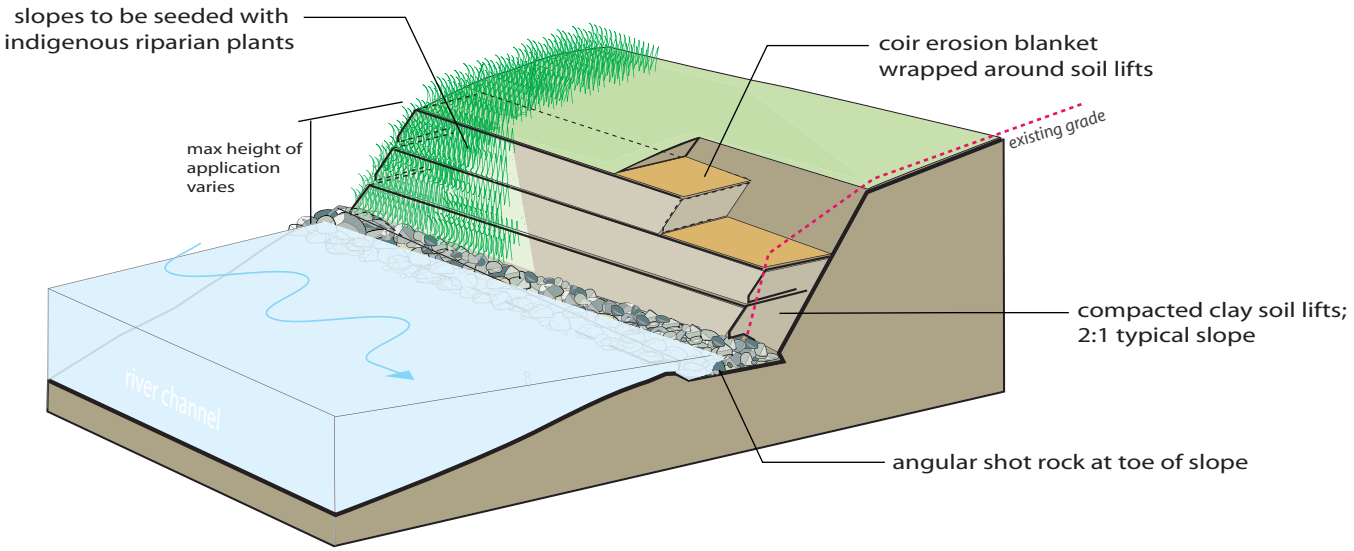
In many applications, the soil lifts are constructed in the location of a former slump to replace lost bank material and reestablish a continuous slope along the reach. In other applications, compacted soil lifts may be used where bank regrading is not an option due to space constraints.

This treatment would provide some potential cover and foraging habitat opportunities similar to the "no grading" alternative. However, due to the steeper gradient of this treatment, it would be more limiting for wildlife usage. This method of stabilization would most likely be used in limited scenarios such as a bank "blowout" due to lateral runoff, and the application of the treatment would not be widespread.

Advantages:
- Can be used on steeper and higher banks than the regrading option.
- Can be used to rebuild bank slope where soil has slumped away.
- Creates environment for native plant growth and wildlife habitat.

Disadvantages:
- More expensive than regrading.
- May require importing of suitable soils if existing material is unsuitable for bank stability.
- For successful treatment, this technique must be combined with the stone toe or other hardened shoreline treatment.
- System must be built during low flow conditions.
- Erosion blanket biodegrades in 5-7 years.

Maintenance:
- Vegetative management during the vegetation establishment period.
- Periodic inspection to identify and address evidence of slope failure.



Note: The "compacted soil lifts" slope treatment is shown with "stone toe" toe stabilization.

5. Slope Treatment - Rip rap

This treatment involves layered angular stone that protects and stabilizes banks that are subject to erosion within areas of poor soil structure. The stone should be underlain by a filter blanket of gravel or synthetic material to prevent migration of soil through the rip rap.

The voids in the rip rap may be filled with soil and interplanted with vegetation to soften the appearance and improve habitat and water quality benefits. Although a portion of the soil may erode away over time, the rip rap prevents the bank from receding further and the vegetation will tend to mask the rock. This variation rip rap is similar to vegetated gabions.

Advantages:

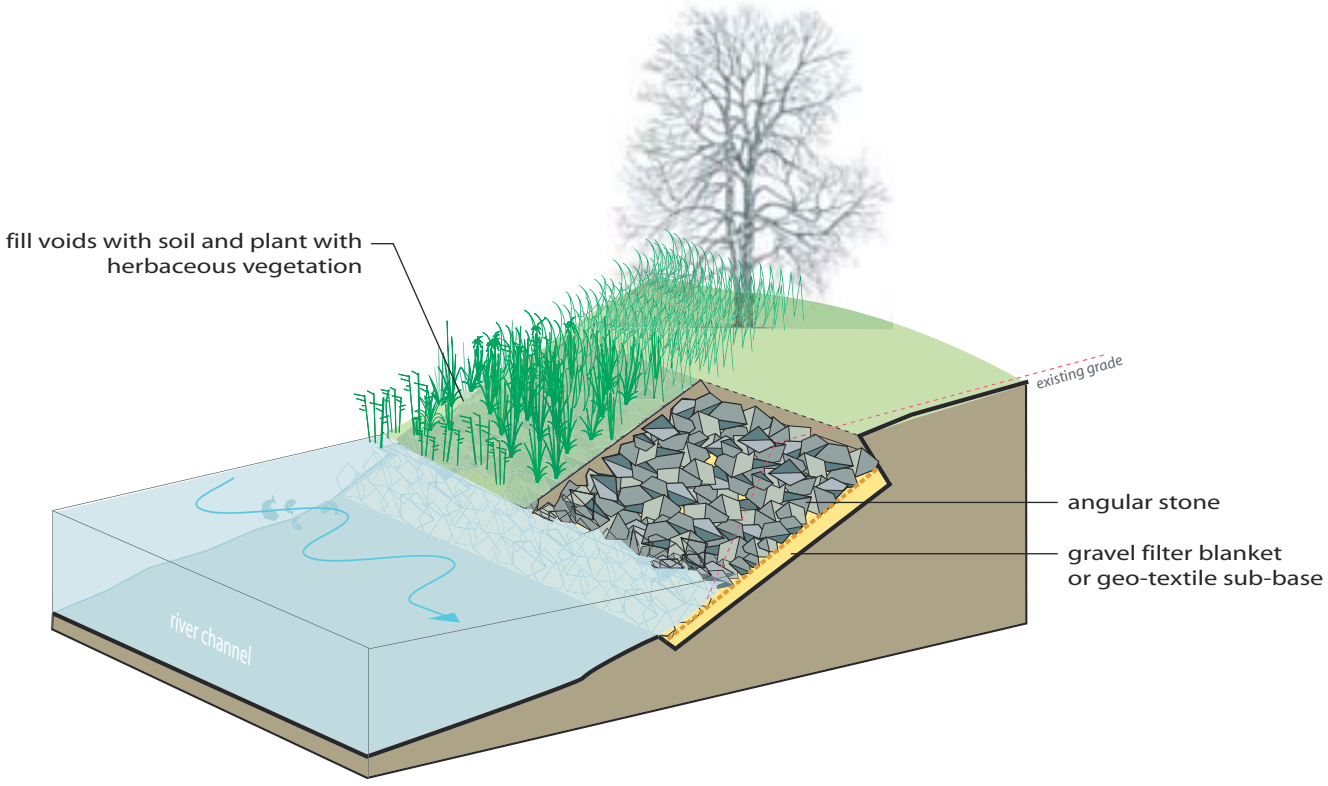
- Well suited for locations of high flow or wave energy that impinges higher on the slope than toe protection measures. Examples include locations of large waves and large water level fluctuations.
- Can be used to protect steeper slopes where regrading to relieve flow or wave energy is not feasible.
- Can appear quite natural when layered with soil and vegetation.

Disadvantages:

- May be considered unaesthetic in some locations, especially if unable to be interplanted with native vegetation.
- Limited wildlife habitat opportunities when not layered with soil and vegetation.
- Moderately expensive although less than retaining walls.
- Potential for vandalism. Stone can be thrown into river.

Maintenance:

- Low maintenance required; periodic inspections to assess if rocks have subsided.



Treatment Summary Matrix

		Application				Environmental Benefits						Cost Considerations		
	Treatment	Tolerate large water level fluctuation	Tolerate high flow velocity	Tolerate high wave action	Ability to accommodate amenities (trails, etc)	Fish habitat	Small fry fish habitat	Macro-invertebrate habitat	Soil Stabilization	Improve Water Quality*	Dissipates flow/wave energy	Installation Cost	Longevity**	Maintenance
Shoreline	Stacked Flat Rock	X	X	X	X		X	X	X			M-H	H	L
	Stone Toe Protection	X	X	X	X		X	X	X			L	H	M
	Gabion Basket or Mattress	X	X	X	X		X	X	X			M	M	M-H
	Sheetpile	X	X	X	X				X			H	H	L
	Fiber Roll				X		X	X	X	X	X	L	L	H
	Floodplain Wetland /Aquatic Shelf		X	X	X	X	X	X	X	X	X	L-H	H	M
	Lunkers	X	X	X	X	X	X		X		X	M	M	M
Slope	No Grading	X				-	-	-	1	1		L	L-H	M-H
	Regrading	X			X	-	-	-	X	X	X	M-H	M-H	M-H
	Retaining Wall	X	X	X	X	-	-	-	X			H	H	L
	Compacted Soil Lift	X	X			-	-	-	X	X	X	M	M	M
	Rip rap	X	X	X		-	-	-	X		X	M-H	H	L-M

* Improvement in water quality due to filtering of runoff from adjacent areas and/or flow river water. Improvement due to reduction in soil erosion of slope or toe addressed under "soil stabilization."

** Certain techniques longevity such as fiber roll, aquatic shelf and compacted soil lift depend on continual maintenance.

1. No grading treatment will only provide soil stabilization and water quality benefits if the existing slope is stable and vegetation is managed to achieve good herbaceous cover.

L = Low
M = Medium
H = High

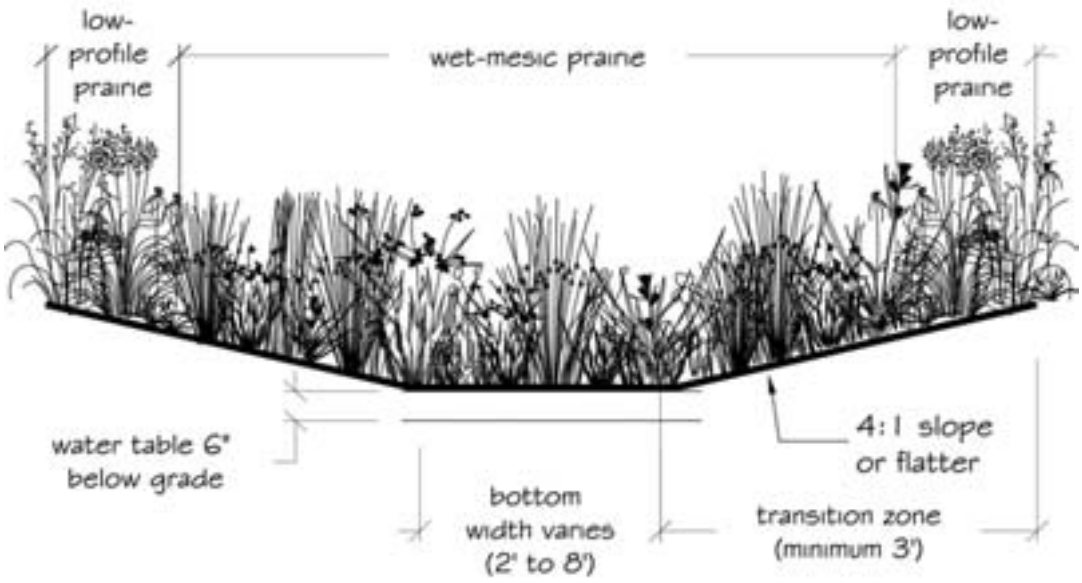
Appendix L: Stormwater Best Management Practices

The following are stormwater best management practice stormwater systems and maintenance protocols that can be utilized on the river setback area (source: City of Chicago Calumet Design Guidelines 2004).

Stormwater Systems - Best Management Practices

Vegetated Swales

A vegetated swale is an open system that is used to slow runoff and filter sediments and pollutants. It is used instead of conventional piping to contain and convey stormwater. Depending on the depth of the water table, the swale may be wet, wet-mesic or well-drained. On-line detention can be augmented by using check dams. Maximum efficiency for water quality enhancement can be achieved by lengthening the channel and/or minimizing its gradient.



Design Objectives:

- Slow conveyance of stormwater runoff.
- Facilitate the removal of pollutants and the assimilation of organic nutrients by vegetation.
- Encourage surface water infiltration (where soils permit).
- Provide an aesthetically pleasing landscape feature.

Considerations:

- Vegetated swales should be at least 20 feet wide, and designed with slopes that do not exceed 4:1 **(**see Figure V-11).
- The design of the landscape within a vegetated swale will depend upon:
  - Its location and function.
  - Soil permeability.
  - The depth to water table.

- An erosion control blanket will be required for slopes that are steeper than 5:1. Slopes that are 5:1 or less can be stabilized by vegetation and mulch (see Section VI, Specifications).

- The water level in the swale will fluctuate. Plant mixes presented below have been developed to tolerate the two-year and ten-year storm events.

Design Standards:

- Develop swales with slopes that are 4:1 or flatter.
- Install mixes in appropriate zones (see Figure V-11).

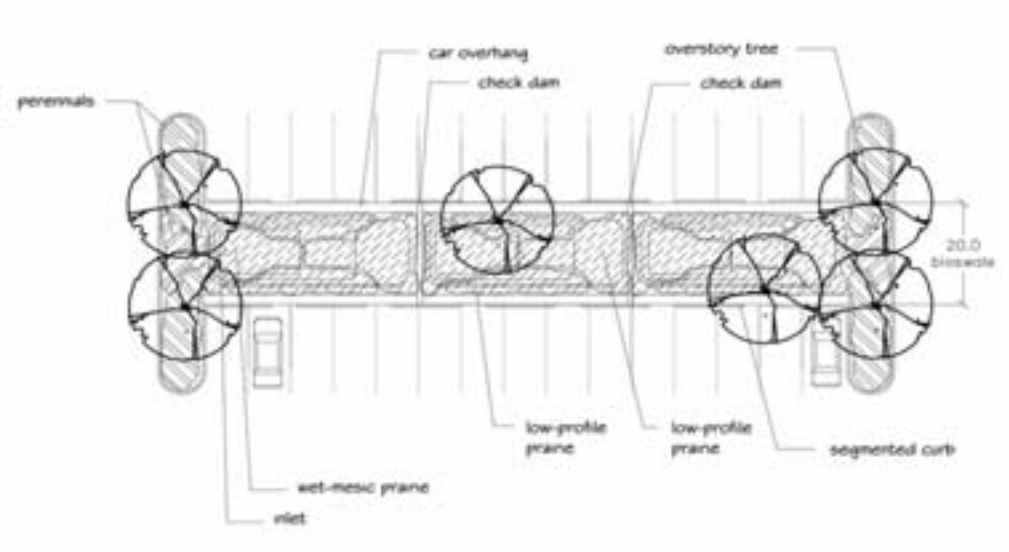
Planting Recommendations:

Components	Plant Community	Design Standards
Well-Drained Swale	Low-Profile Prairie, Mix #3	Seed: 47.7 lbs. per acre Plugs: 50.0 per acre, 18" o.c. (avg.)
Wet-Mesic Swale		
Slopes above 2-year event	Low-Profile Prairie, Mix #3	Seed: 47.7 lbs. per acre Plugs: 50.0 per acre, 18" o.c. (avg.)
Bottom	Wet-Mesic Prairie, Mix #2	Seed: 39.7 lbs. per acre Plugs: 4850 per acre, 18" o.c. (avg.)
Wet Swale:		
Slopes above 2-year event	Low-Profile Prairie, Mix #3	Seed: 47.7 lbs. per acre Plugs: 50.0 per acre, 18" o.c. (avg.)
Waterline (NWL to 2-year event)	Wet-Mesic Prairie, Mix #2	Seed: 39.7 lbs. per acre Plugs 4850 per acre, 18" o.c. (avg.)
Bottom (NWL to 6" below NWL)	Emergent Marsh, Mix #3	Seed: 8.8 lbs. per acre Plugs: 4825 per acre, 18" o.c. (avg.)

Bioswales

Bioswales are recommended for use in parking lots as a way to replace curbed, landscaped medians with an option that assists in stormwater management. A bioswale is a lightly excavated swale where the grade is a foot lower than surrounding pavement. Surface water enters the swale via openings in the curb, and then flows through a series of short pools created by low check dams. Water drains into a stormwater inlet and then flows though underground pipe to the next segment of the stormwater system. Bioswales can improve water quality through the removal of sediments and the assimilation of nutrients.

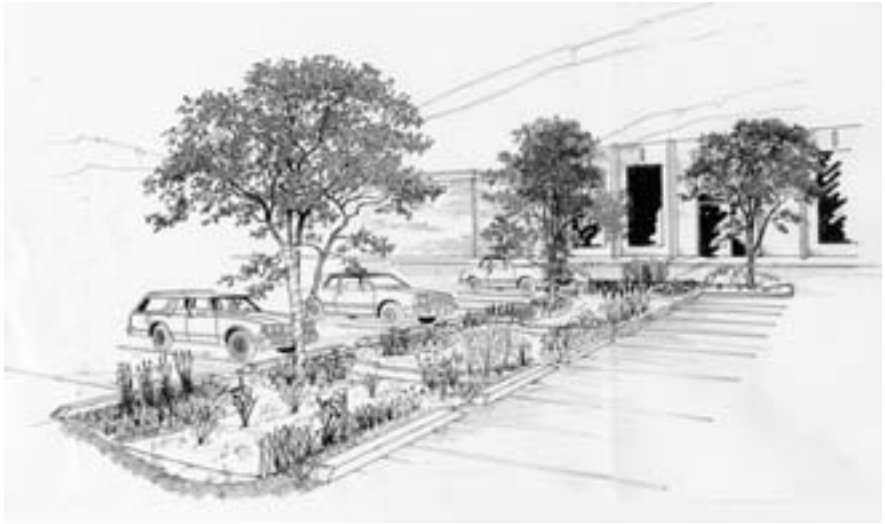
A bioswale can be planted with trees for shade, and with low-growing prairie plants that tolerate road salt. Plant choices may include decorative native grasses such as little bluestem and prairie dropseed, as well as flowers such as brilliantly orange butterflyweed or purple spiderwort. This creates an attractive first-impression for a business facility, as well as being a component of a stormwater management system.



Plants selected need to be adaptable to varying soil moisture regimens, depending on their location in the system. The success of a bioswale can be enhanced by seasonal flushing of salts and de-icing chemicals. This reduces the effects of accumulated salts or de-icing chemicals on plants in the spring that could stunt growth, or otherwise damage or destroy the landscape.

Design Objectives:

- Encourage the settling of particulates and associated pollutants from parking lots.
- Offer the opportunity for infiltration and the assimilation of nutrients by native plants.
- Help store and modulate conveyance of stormwater.
- Provide an aesthetically pleasing amenity in open parking lots that introduces seasonal color and interest through the planting of native flowering plants and perennials on the ends of islands.



Considerations:

- Snow should not be piled within these swales, but placed in other areas of the parking lots to minimize the leaching of salt or other chemicals into the bioswales.
- Sand or de-icing chemicals, such as calcium chloride, should be used instead of salt to maximize the success of the landscaping in these swales.
- A bioswale needs to have access to a water hookup or have an irrigation system installed to flush out chemical de-icing agents or salts in early spring.

Design Standards:

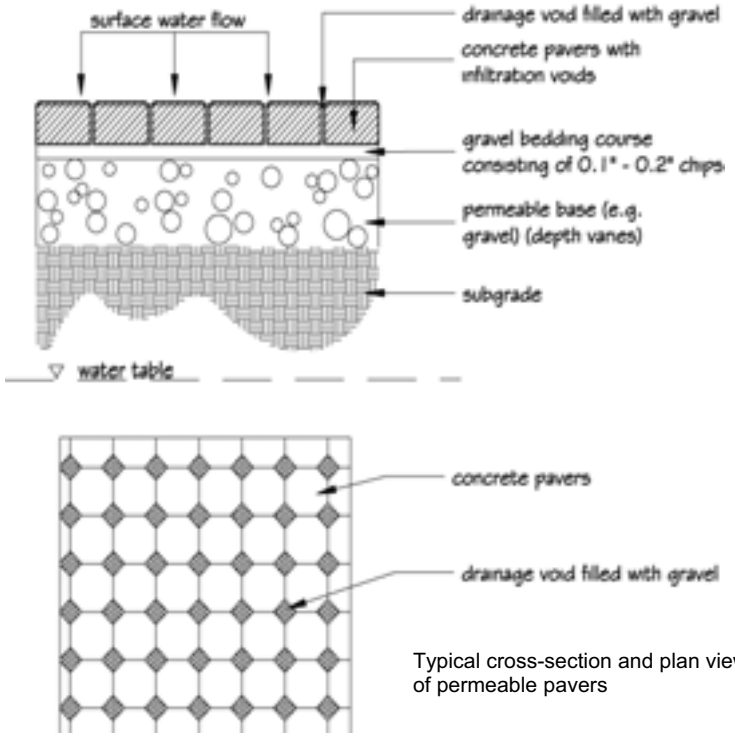
- Provide 20-foot wide bioswales within alternating parking modules (one bioswale every three rows.)
- Construct the bioswale with side slopes that are 3:1 or flatter.
- Create check dams with soil or other material (i.e., concrete, boulders, or masonry interlocking retaining wall system) every 50 feet.
- Construct a series of 9' long, 6" segmented barrier curb with 24" openings, along the length of the bioswale, between each segment.
- Install 24" of low-mow turf or other material acceptable to the City on the inside edge of the curbs to accommodate car overhang.
- Select plantings for conditions typical for each zone (i.e., dry, wet and fluctuating between dry and wet) from the plant lists identified below. Use native plants in the swale and, where possible, on the ends of each island.
- Use horticultural varieties of native plants on islands for longer-bloom times and more intense color. However, the designer is limited to the perennials list included in Appendix B for end islands of bioswales, to ensure landscapes are blended (native and ornamental).
- Install an erosion control blanket in the swale while vegetation is established.

Recommended Plantings:

Components	Plant Community	Design
Upper Slopes (next to pavement)	Low Profile Prairie #2	Plugs: 405/900 sq. ft., 18" o.c. (avg.)
	Overstory Trees, Woody Plant List #2	3" caliper, min. (6' branch ht.) 1 tree/45 lineal feet
Channel (below check-dam)	Low Profile Prairie #1	Plugs: 405/900 sq. ft., 18" o.c. (avg.)
Channel (above check-dam)	Wet- Mesic Prairie, Mix #5	Plugs: 405/900 sq. ft., 18" o.c. (avg.)
Island Termini	Perennials	1600/25 sq. ft., gal.containers 15" o.c. (avg.)
	Overstory Trees, Woody Plant List #2	3" caliper, min (6' branch ht.) 2 trees per island terminus

Permeable Pavers

Permeable pavers are interlocking concrete blocks set in a compacted sand or gravel base. The bed allows absorption of rainwater. When laid properly, with an appropriate depth of gravel, pavers can handle weight loads equal to or greater than those of asphalt or other conventional impermeable surfaces.



Typical cross-section and plan view of permeable pavers

They can be used in parking lots, loading areas, and outdoor storage areas where no chemicals or other materials hazardous to the environment are stored. Their use is appropriate where a hard, paved surface is required and reducing stormwater runoff is desirable.

Pavers form a tight surface with narrow joints separating the pavers, and structured openings that are filled with permeable material, such as gravel. Approximately 10 to 12 percent of the surface area remains permeable, allowing rainwater to drain through the paved surface and into the subgrade material below. Depending on the nature of the soil on the site, water may infiltrate and contribute to groundwater recharge, or it may be discharged into other stormwater management facilities via underground drains.

The use of permeable pavers reduces runoff, providing some storage, and it improves water quality. Water that is discharged into other swales, ponds or basins is cooler and microbial action within the aggregate subgrade helps enhance water quality. Permeable pavers are marketed under several different names, but should not be confused with permeable pavements, which require resurfacing.

Permeable pavers can be:

- Plowed without damage to the paver surface.
- Painted to differentiate parking spaces.
- Color-coordinated to identify pedestrian walkways, parking spaces, or drive aisles.
- Used instead of concrete for private walks.
- Installed along the edges of drive aisles or parking lots to allow runoff or rain water to infiltrate into the ground.

Design Objectives:

- Provide a solid paved surface with high permeability for surface water (see Figure V-16).

- Create an aesthetic amenity on parking, loading, and driving surfaces.
- Offer opportunities for attractively distinguishing between functional areas and pedestrian ways, drive aisles and parking lots.

Considerations:

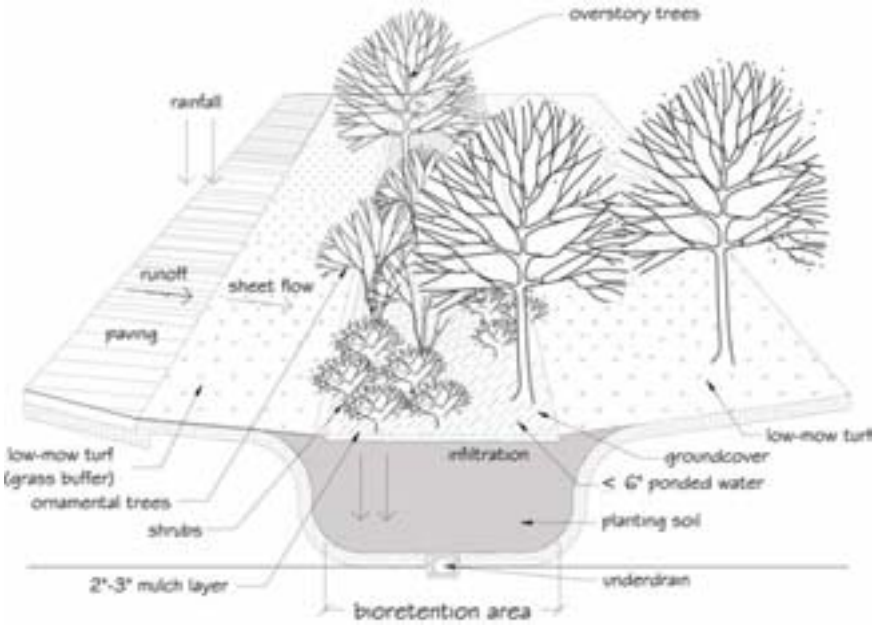
- Permeable pavers cost more to install than traditional asphalt pavements, though they last longer and do not require resurfacing.
- They require regular sweeping to remove debris from openings.
- They require periodic replacement or cleaning of the gravel filters to remove silt that can obstruct infiltration of water into the ground.

Design Standards:

- Consult paving manufacture for installation and maintenance specifications.
- Install pavers mechanically to achieve cost competitiveness with asphalt.

Bioretention Basin

A bioretention area is a depressional stormwater management facility that uses a conditioned soil, mulch and plant matrix to collect, and infiltrate stormwater (see Figure V-15**)**. It uses the substrate and its microbial action to filter and break down or assimilate pollutants. Stormwater is routed to or flows overland through a vegetated strip to the basin, then enters a shallow basin consisting of a prepared planting bed, organic mulch and woody and herbaceous plant species. Water is detained, passing slowly through the soil medium and allowing the physical and biological processes in the facility to enhance water quality before discharge.



Design Objectives:

- Establish a grass strip to intercept surface runoff entering the basin, reducing flow velocities, and filtering out sediments.
- Construct a deep, planting soil mixture that supports desirable vegetation and permits infiltration to subgrade or underdrain.
- Create a terrestrial forest ecosystem consisting of canopy and understory trees, shrubs and ground cover, planted in a shallow, mulch layer.

Considerations:

- The use of this type of facility is not recommended on slopes greater than 5:1.
- Special attention to erosion and sediment control is critical for those areas tributary to the basin in order to prevent silt loads from clogging the basin.
- A bioretention basin can be established either on-line or off-line of the stormwater system. To prevent clogging, pre-treatment (vegetated filter strips, bioswales, etc.) may be required of the first flush.
- Basin size is determined by drainage area and runoff characteristics.
- Multiple bioretention basins may be required for larger drainage areas.

Design Standards:

- Design the basin so that:
  - A grassed buffer strip intercepts overland flow from paved surfaces.
  - Its maximum ponding depth is six inches.
  - Standing water at or near the surface should be eliminated within 72 hours to avoid mosquito proliferation.
- Use the following specifications for planting soil:
  - Soil should be two to three feet deep and four inches deeper than the largest root ball.
  - It should be sandy loam, loamy sand or loam texture with clay content ranging from 10 to 25 percent and a sand content of approximately 50 percent.
  - Planting soil should have infiltration rates of 0.5 inches per hour or greater.
  - The soil pH should be between 5.5 and 6.5, with approximately 1.3 to 3 percent organic content.
- Add a 2 to 3 inch layer of fine shredded mulch as a top layer in the basin.
- Vegetate the bioretention facility to create a terrestrial forest community, with a minimum of three species of trees and a shrub to tree ratio of 2:1 to 3:1.
- Install perforated pipe underdrains in the facility, unless it is constructed in sandy soils.

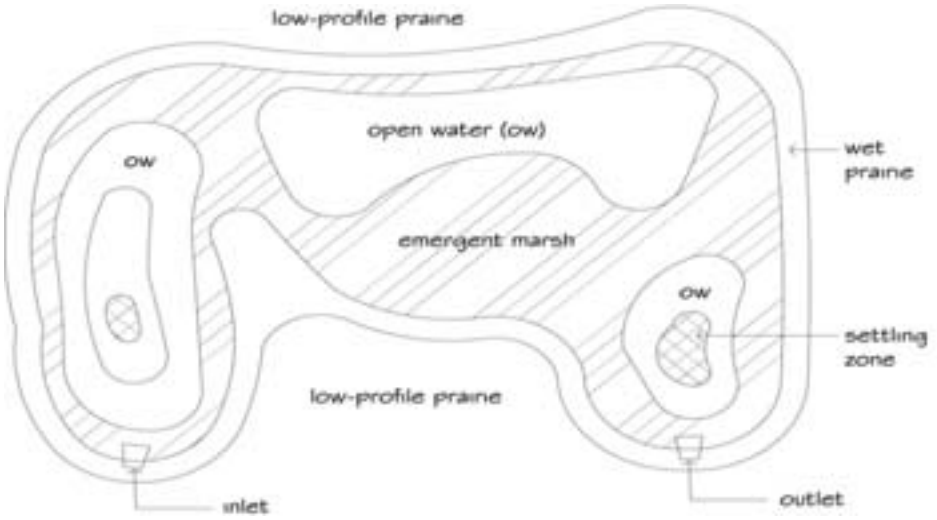
- The shape of the basin should be a curved configuration following natural contours.
- Final design specifications to be determined by the Department of Water Management.

Planting Recommendations:

Components	Plant Community	Design Standards
Vegetated Buffer Strip	Low-Mow Turf ***OR***	Seed: 5 lbs. per 1000 s.f.
	Low-Profile Prairie Mix # 7	Plugs: 50 per acre in 2.5 " containers @ 24" o.c. (avg.)
Basin	Overstory Trees, Woody Plant List #2 or #3	3" caliper, 1 tree per 1000 s.f.
	Intermediate Trees, Woody Plant List #1 or #4	6' ft. B&B; 3 trees per 1000 s.f.
	Deciduous Shrubs, Woody Plant List #1 or #4	30" ht,, 10 per 1000 s.f.
Groundcover		Seeds: 44.57 lbs. per acre
Basin Slopes	Low-Profile Prairie # 2	Seed: 41.38 lbs. per acre
		Plugs: 50 per acre in 2.5" containers @ 24" o.c. (avg.)
Basin Bottom	Wet-Mesic Prairie Mix # 5	Plugs: 225 per acre in 2.5" containers @ 24" o.c. (avg.)

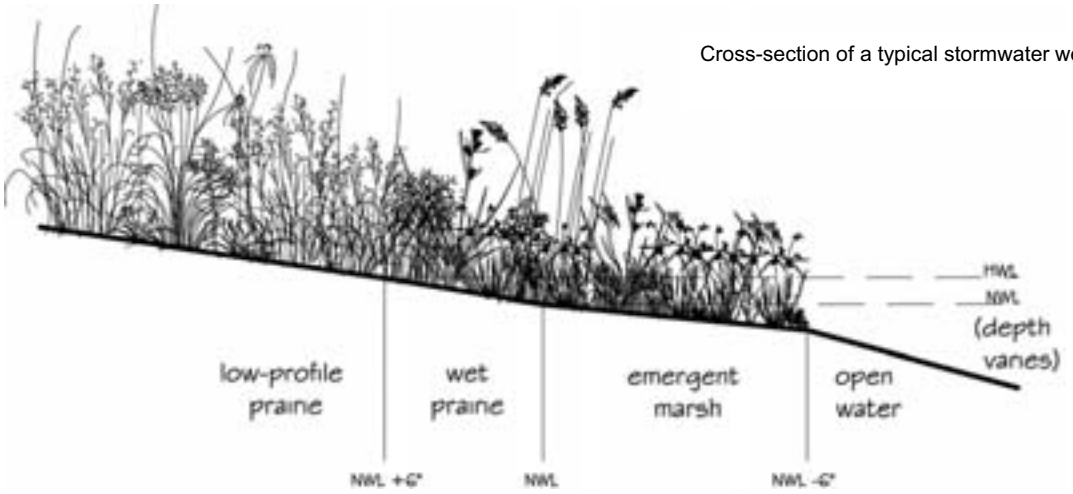
Stormwater Wetland

Of the wetland basin types listed in Table 2, Stormwater wetlands are the preferred option in the Calumet area as they are designed specifically to receive and treat stormwater runoff (see Figures V-16 and V-17). Water quality improvement is achieved through a combination of settling, microbial action and pollutant assimilation by wetland plants. Stormwater wetlands are designed to accommodate lower water quality and frequent fluctuations in water level. They can be an aesthetic feature, offering wildlife habitat as well as functioning as part of the stormwater management system.



Design Objectives:

- Construct a wetland system that is capable of detaining the design storm.
- Design stormwater wetlands with natural, curvilinear configurations and contours, and avoid steep slopes and angular geometric shapes.
- Provide water quality enhancement to stormwater entering the wetland basin through a design that encourages the settling of particulates and biological assimilation of nutrients.
- Provide both upland and wetland habitat for wildlife.
- Create an aesthetic feature as part of the stormwater management system.
- Install native landscaping to minimize maintenance costs.



Cross-section of a typical stormwater wetland

Considerations:

- Wetlands receiving high levels of pollutants should be separated from groundwater to avoid contamination.
- Maintaining appropriate normal water levels is most easily accomplished by using a controlled outlet, allowing excess water entering the basin to discharge downstream.
- Plant materials will need to be selected based on the anticipated hydrologic regimen of the specific basin and its associated moisture gradient.
- Shallow marsh communities may need to be protected from waterfowl through the use of net or wire mesh planting enclosures until such time as the plants become well established.

Design Standards:

- Route enough stormwater to the wetland basin to maintain a permanent pool.

- Design the wetland basin and discharge to permit water levels under the 10-year, 24-hour duration storm event to rise and return to near normal water level (NWL) within a 24-hour period.
- Establish a pretreatment forebay at the basin's inlet, sized to hold approximately ten percent of the permanent pool volume.
- Provide access for periodic maintenance and silt removal as necessary from the forebay.
- Maintain a minimum length to width ratio of 1.5:1 for the main body of the wetland.
- Provide a wetland surface area that is at least one percent of drainage area.
- Maximize the distance between inlet and outlet to avoid short-circuiting of flows.
- Create variable planting depths throughout body of basin ranging from + 6 inches to - 6 inches from normal water level.
- Create deeper zone near outlet to permit additional settling of particulates.

Planting Recommendations:

Components	Plant Community	Design Standards
Top of Slope to 6" above NWL	Low-Profile Prairie, Mix # 2	Seed: 41.4 lbs. per acre Plugs: 50 per acre in 2.5" containers @ 24" o.c. (avg.)
6" above NWL to NWL	Wet-Prairie, Mix # 2	Seed: 43.4 lbs. per acre
NWL to 6" below NWL	Emergent Marsh, Mix # 2	Seed: 5.6 lbs. per acre Plugs: 4000 per acre in 2.5" containers @ 24" o.c. (avg.)

Vegetated Filter Strip

A vegetated filter strip is a linear vegetated area separating an up-gradient pollution source or development from any adjacent water resources such as a waterway or perhaps a wetland on the Calumet Open Space Reserve (see Figure V-18**)**. Vegetated filter strips intercept surface flow, filtering out a portion of the sediment load and increasing opportunities for infiltration.

Design Objectives:

- Filter out pollutants between developed areas of the site and wetland or surface water body.
- Ensure filter strip is fully vegetated (not spotty) to meet design objectives.

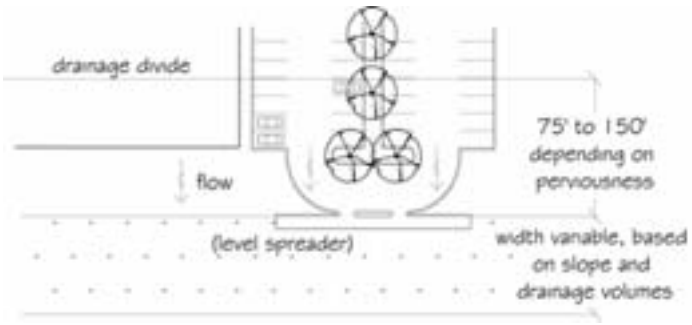


Figure V-18: Use a vegetated filter strip to filter out pollutants between a developed area and adjacent water body

Considerations:

- To operate effectively, only sheet flow should pass through the filter strip.

- This feature is not appropriate where high velocities of surface runoff will occur.
- The use of a level spreader at the upper edge of the strip is recommended, because it can help maintain sheet flow (see Figures V-18 and V-19, next page).
- The water-quality enhancement functions of a vegetated filter strip are appreciably reduced on slopes of greater than ten percent.

Design Standards:

- Ensure that the drainage area is five acres or less.
- Use a level spreader at the upper edge of the strip to help maintain sheet flow.
- Design the filter strip so that the:
  - Length of the vegetated strip (perpendicular to flow) extends the entire length of the impervious surface from which stormwater originates.
  - Flow length (parallel to flow) of areas draining to a filter strip is no more than 75 feet for impervious areas and no more than 150 feet for pervious areas.
  - Optimum width is based on the water quality design storm (up to a 2-year storm event) and a hydraulic radius equal to a design flow depth of less than or equal to 0.5 inches.
  - Minimum width is 25 feet.
  - Slope is greater than one percent, but less than five percent.

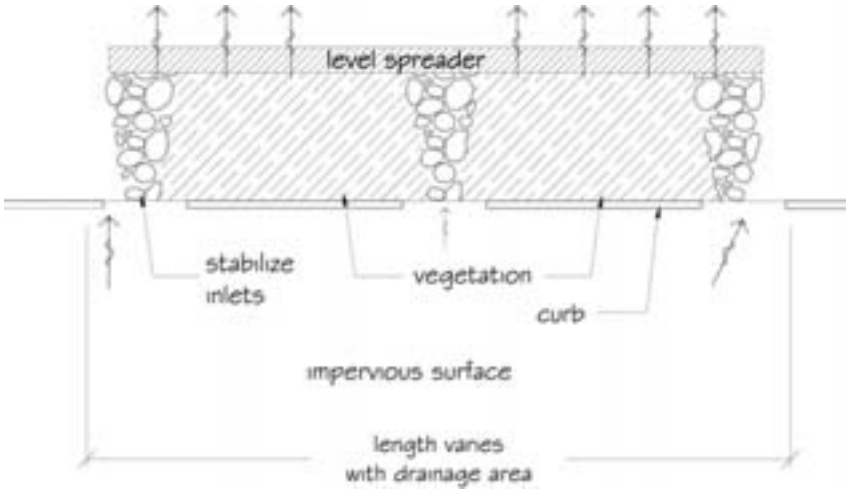
Planting Recommendations:

Use one or more components as appropriate to site conditions:

Components	**Plant Community**	**Design Standards**
Groundcover	Low-Profile Prairie Mix # 4 ***OR***	Seed: 47.7 lbs. per acre Plugs: 50 per acre in 2.5" containers @ 24" o.c. (avg.)
	Mesic Prairie Mix # 1 ***OR***	Seed: 47.95 lbs. per acre Plugs: 50 per acre in 2.5" containers @ 24" o.c. (avg.)
	Mesic Prairie Mix # 2 ***OR***	Seed: 47.95 lbs. per acre Plugs: 50 per acre in 2.5" containers @ 24" o.c. (avg.)
	Wet-Mesic Prairie Mix # 3 ***OR***	Seed: 44.59 lbs. per acre Plugs: 50 per acre in 2.5" containers @ 24" o.c. (avg.)
	Wet-Mesic Prairie Mix # 4	Seed: 49.93 lbs. per acre Plugs: 100 per acre in 2.5" containers @ 24" o.c. (avg.)

Level Spreader

A level spreader is a water management feature that assists in the interception and collection of moderately concentrated flows of surface runoff and disperses the runoff in a uniform manner to the adjoining landscape **(**see Figure V-19). Although not water quality enhancement features themselves, level spreaders improve the effectiveness of other BMPs that depend on sheet flow to operate (e.g., vegetated filter strips). Level spreaders may be used at the edges of parking lots, loading areas, driveways or other discharge points where it is desirable for a point source discharge to be spread over a larger horizontal area. This feature consists of a deep, gravel-filled trench, running perpendicular to the direction of concentrated flow. Water entering the trench spreads evenly along its axis before it infiltrates into surrounding soils.

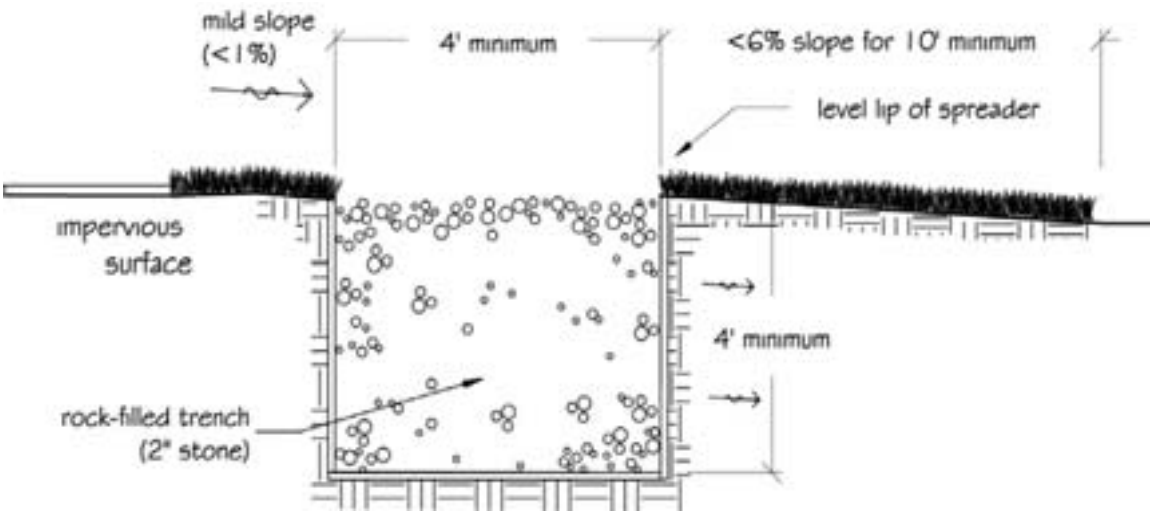


Design Objectives:

- Establish a linear trench with the capacity and porosity to capture, disperse and discharge surface runoff.
- Maximize design compatibility with surrounding landscape by planting trees and shrubs to soften exposure of linear aggregate.

Considerations:

- The level spreader must be absolutely level to avoid ponding and reconcentration of flows.
- Areas tributary to level spreaders should be stabilized to avoid erosion.
- Flows to the level spreader should be free of sediments.
- Level spreaders must be maintained at a level elevation to avoid the re-concentration of flows and the creation of gullies. If gullies start to develop, they must be repaired immediately.



Cross-section of a typical level spreader

Design Standards:

- Base the length of a level spreader on a 10-year design flow, adjusting for the drainage area as follows:

Drainage Area (acres)	Minimum Length (feet)
1	10
2	10
3	15
4	18
5	20

- Design the slopes that lead to the level spreader as follows:
  - The slope upgradient from the level spreader should be less than 1 percent for at least 20 feet; and
  - The slope downgradient should be 6 percent or less.

Management And Maintenance

Trees and Shrubs

Naturalized plantings of trees and shrubs require less intensive maintenance. After establishment of new plantings, the following general maintenance operations should be incorporated into the overall facility maintenance program.

Watering – After the establishment period has concluded supplemental watering during the first growing season is recommended. This will be especially important during hot dry periods of the year. Watering weekly for the first growing season when a one-inch rain is not received is recommended.

Pruning/Trimming – Woody plants will require a yearly program to remove dead wood and excess growth to maintain a open healthy canopy. This program should be performed primarily in the late fall and winter. Supplemental spot pruning/trimming may need to be done to remove dead branches that may present a safety concern. Pruning/trimming should be done to maintain the natural character of the plant.

Supplemental Planting – In order to maintain the character of the landscape periodic planting of additional trees and shrubs will need to be done. Budgeting of annual supplemental planting for the first five years should be anticipated. Once the canopy's of the trees grow and provide a more dense cover additional shade tolerant species of shrubs and groundcover may need to be planted.

Low-Mow Turf

Establishment – Low mow turf should be seeded between late August and late September for best results. March through mid May is also a good planting timeframe, however may require additional establishment activities since most weeds also germinate at this time.

Watering – New seed installations should be watered daily for the first six weeks. Water application rates should consist of fifteen to thirty minutes unless the soil is damp and watering rates should be adjusted. After the first six weeks watering may be cut back to every two to five days until establishment based on weather conditions.

Fertilizer & Weed Control – Fertilizer is not recommended and weed control should be applied on an as needed basis only for specific problems.

Mowing – Mowing operations should never remove more than one third of the top growth. Mowing is generally required once per growing season for general clean-up.

Integrated Pest Management (IPM) – The use of chemical applications should be considered as the last resort for spot treatment of infestation. Biological and non-toxic chemicals should be the first choice in pest management. Careful and regular monitoring of the landscape will assist in the early detection of problems.

Natural Areas

Natural landscape maintenance is different from traditional landscape maintenance. Natural landscape can reduce maintenance costs associated with traditional landscaping; however, just like any other

plantings natural landscapes require management and maintenance. Long-term, the maintenance requirements of natural communities are generally much less than those of more ornamental landscaping. During the first few years, more weeds will be evident than prairie plants and more intensive maintenance will be required. Maintenance efforts will likely decrease beginning around Year Three following installation. To promote successful establishment, the services of a qualified native restoration professional will be invaluable as the installed native community evolves. With respect to management, the initial priority should be to establish a matrix of grasses; supplemental wildflowers can be added later if desired.

The type of maintenance required depends on the system. A typical outline of management following native seed installation is presented below. As with installation guidelines, no "recipe" can be provided for natural area management and maintenance. However, the basic rule of thumb is that weeds must be controlled or the native community will not establish. Once established, native plants can out-compete most weeds that remain.

An EPA publication (http://www.epa.gov/glnpo/greenacres/toolkit) provides valuable information on selecting assistance for your natural landscaping project; sources of information and assistance; sources of native seeds, plants, and garden catalogs; and a selected biography.

Typical Maintenance Requirements:

Year 1

1) Mow (4-6 inches, late April-mid May) (following a fall seeding only).

2) Mow (8-10 inches), when cover crop and weeds are 1 to 2 feet high, usually once in mid- to late June and again between 15 July and 15 August (depending on how weather affects plant growth).

3) Mow – September (optional).

4) Weed control (mowing should keep down annual weeds; spot wick thistles, etc., spray application may be more efficient for larger areas but must be done in a manner that does not adversely affect desirable plants).

5) Watering (may be necessary during first two months of spring or summer planting when seed has germinated or plugs have been installed but are in early growth and a drought or heat wave begins).

Weeds should not be allowed to grow higher than 12 to 14 inches (even if this means sacrificing some of the short-term wildflowers), or they will deprive the prairie of light and water. A qualified, native landscape maintenance company should be contracted to perform weed control, as it is critical that the maintenance company have experience in recognizing prairie plants from weeds. A flail (preferred) or rotary mower should be used rather than a sickle-type mower, which leaves "hay" that will smother prairie plant seedlings. Cover crop should develop within two weeks of planting (except in dormant seedings). Seedlings should be spaced 1-6 inches apart in drill rows. Native grass seedings may be only 4 to 6 inches tall. Most prairie plants are warm season plants and do not begin growth until warm weather arrives. If there is a flush of growth from foxtail, etc., mowing should occur more often. Cuttings should not be left if they will smother the small prairie seedlings. Watering should only be performed during the morning, never at night. Once prairie plants develop their root systems, they will not need watering. In fact, excessive water can produce unappealingly tall, lanky plants.

Year 2:

1. Conduct a spring prescribed burn if sufficient fuel exists. If not, mow (3-4 inches in late March or early April).
2. Mow 4-6 inches in late April-mid May, if needed).
3. Mow (6-10 inches), June 15-August 15 if weeds are thick.
4. Mow – September (optional).
5. Weed control (mowing should keep down annual weeds; spot wick thistles, etc.).
6. Some sites may not require much maintenance the second year.

The cover crop will be gone. Grasses should form clumps 1 to 6 inches apart in drill rows but still short. Some flowers should bloom (e.g., black-eyed Susan, sand coreopsis, bergamot, etc.). If there is a flush of foxtail growth, mow the site.

Years 3-5

1. Mow only if and where necessary (spot treatments).
2. Weed control (spot treatment of thistles, etc.).
3. Conduct prescribed burn in spring or fall.
4. Maintenance efforts should begin to decrease.

At this stage, planting should begin to look like a prairie (i.e., tall grasses, flowers, etc.). During this "establishment phase" the prairie should be burned annually for five to six years. Burning should be performed by qualified personnel incorporating all appropriate safety precautions. Unless the site manager is trained in managing controlled burns by the U.S.D.A. Forest Service or other qualified agency, the site manager should contract with a qualified native landscape maintenance company. A prescribed burn permit must be obtained from the Illinois Environmental Protection Agency, and permits will likely be required from the fire and police departments.

Most existing woodlands are best initially managed by regular burning, understory re-seeding (as needed), and weed control. Created woodland areas will need reseeding and/or supplying woodland plugs approximately 10 or so years down the road because shading will make prairie elements disappear/decrease.

Long-Term Maintenance

1. Mow prairies only occasionally (spot treatments may be necessary).
2. Weed control (spot treatment of thistles, woody invasives, etc.).
3. For prairies, conduct prescribed burn in spring or fall (annual burn preferred, but at minimum every three years, alternating spring and fall burns); early fall haying may substitute for burning on occasion. Burning a prairie two years in a row will "clean up" rough-looking sites.
4. Wetlands may be burned in spring or fall. A fall burn may be more successful as water levels are typically lower.

5. Mature woodlands should be burned only in the fall, with the leaves used for fuel. Immature or created woodland and riparian areas should be managed as prairies until the canopy develops and the plant community shifts.

Once a prairie is well established (typically after five years), maintenance involves occasional mowing or controlled burning to maintain native plant diversity and control weeds. Certain noxious weeds may need focused control such as selective use of an appropriate herbicide. Fertilization is not needed for areas with native plantings, and should not be performed except as directed by an ecologist. Burning should be "prescriptive" (i.e., conducted to achieve specific goals such as targeting particular weed species, encouraging development of grasses or wildflowers, etc.). Prairie plants are generally free of pests and diseases, so insect control is not appropriate and may harm desirable insects.

Mechanical Control – Mechanical control of nuisance plant species typically includes mowing and/or the digging up individual plants by hand. In many cases, mowing a plant before its seeds mature will minimize further spread. Mowing at or very close to the ground surface with a weed-eater or hand-scythe can be an effective means of control for species such as sweet clovers, various thistles, and ragweeds. For general mowing of swaths of vegetation, mowers should be set to a height of 12+ inches above the ground surface or to a height that treats weedy species yet minimizes impacts on desirable plants.

For species such as common reed, purple loosestrife, Canada thistle, and reed canarygrass, mowing actually encourages the spread of underground stems. Hand pulling or digging out these species and woody undesirables such as multiflora rose can be used as an effective means of control if there are fewer than 100 plants throughout the entire site. Where more than 100 individuals of such plants are present, chemical control should be the primary method of control.

Chemical Control – Because of the potential for damage to native plant communities, the use of preventative herbicides should be limited to problem areas and problem species where manual measures are ineffective. Manual weed removal and prescribed burning are preferred means of vegetation management. Aquatic herbicides should not be used to treat algal blooms.

Employed in conjunction with prescribed burning and mechanical control, the judicious use of herbicides can be an important component of management programs for controlling invasive species. Some species, such as purple loosestrife, buckthorn *(Rhamnus* spp.) and honeysuckle (*Lonicera* spp.), reed canarygrass, common reed, sandbar willow, and cattails are controlled more effectively by chemical treatment than by mechanical control measures.

Glyphosate herbicide (trade names Rodeo or Roundup) is often recommended for use in native areas. Other herbicides such as Transline, Plateau, and Garlon also have been used in natural areas. The application of herbicides should be performed only by a licensed professional applicator according to approved rates and procedures. Herbicide application should be conducted in strict compliance with all warning labels and applicable codes, standards and best management practices.

Generally, wick application is more selective than spray application. Wicking applies herbicide only to individual plants, using a canvas-covered, perforated, chemical filled PVC pipe. Trained personnel walk the area, swinging the eight-foot pipe from side to side above the native plants but deliberately striking invasive species. The pipe strikes and bends the weeds, smearing them with the chemical and destroying them within a few days. Spray applications, if used, should not be conducted on windy days because non-target species could be affected.

Biological Control – An alternative to chemical treatment, use of biological controls for purple loosestrife should be considered provided site conditions are appropriate to support and maintain the insect population. Through this method, host-specific insects (one a root infesting weevil; others are leaf-eating chrysomelid beetles) are released to feed on the roots or leaves of purple loosestrife. If purple loosestrife becomes abundant, biological control can prove a cost-effective means of management.

Stormwater Best Management Practices

The landscape treatments and systems recommended within this document will require certain management and maintenance activities in order to assure their long-term performance. By making a commitment to regular management and maintenance, individual property owners will be able to:

1. Achieve the desired design results.
2. Prolong the optimal function of landscape designs and treatments.
3. Avoid significant repair and restoration costs.
4. Maintain the aesthetic qualities of the overall landscape.

The following regular activities should be considered as part of the standard management protocols for recommended landscape features:

Vegetated Swales:

Annually:

- Burn or mow.
- Replant sparsely growing areas.
- Repair eroded slopes or bottom.
- Disk or aerate of swale bottom.

Five Year Cycle or As Needed:

- Re-grade and remove sediment to establish original cross-section.
- Replant to restore groundcover.

Bioretention:

Annually or as Needed:

- Repair eroded areas.
- Check mulch and add as needed to maintain 2 to 3 inches of depth.
- Remove and replace all dead or diseased plants.

Permeable Pavers:

Weekly – Sweep or clean surface to remove accumulated dirt or debris.

Monthly – Mechanically remove any vegetation establishing in gravel spaces.
Five to Ten Year Cycle or as Needed – Remove, clean and replace aggregate between pavers.

Stormwater Wetland:

Annually:

- Burn sideslopes initially on an annual basis, then every other year once established.
- Monitor the establishment of native wetland and prairie vegetation until prescribed levels of growth are achieved; replant as necessary for long-term viability and sustainability.
- Treat or remove invasive vegetation.
- Monitor and repair under cut or eroded slopes and damaged embankments.
- Inspect and repair water level control structures.
- Clean out inlet and outlet devices.

Five Year Cycle or As Needed – Remove sediment accumulated in forebays and settling areas every five years or as needed.

Vegetated Filter Strips:

Annually:

- Burn or mow.
- Remove litter or debris.
- Aerate soil biannually.
- Repair eroded areas.
- Replant sparsely vegetated areas.