Salt Creek: A Resource Worth Preserving

Best Management Practices for Reducing Non-Point Source Pollution

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northeastern illinois planning commission

Salt Creek has a rich history and, with your help, a bright future as a healthy and valuable asset to our communities. Protecting and enhancing Salt Creek and its watershed can provide numerous benefits:

- Floodwater detention that reduces property damage.
- Business and tourism revenue from recreation.
- Increasing property values.
- Erosion control and water quality protection.
- Better fishing, canoeing, and enjoying the creek.
- Habitat for native plants and animals.

Municipalities, park districts, and other local governments can manage public property and guide development and land use to minimize impact to the creek. Stormwater, in particular, can be a problem because much of it eventually flows into the creek. Impervious (impenetrable) surfaces such as rooftops, parking lots, roads, and sidewalks do not allow stormwater to seep into the ground, which can lead to flooding. Rainwater flowing across these hard surfaces picks up pollutants such as oil and grease, dirt, fertilizers, pesticides, road salt, and bacteria. These pollutants from across the landscape are called non-point source pollution. These materials cause water contamination, toxicity, and algae growth making the creek unsuitable for fishing, swimming, and aquatic life, and reducing its value as a community amenity.

This manual provides local governments and other landowners with cost-effective techniques to improve the quality of Salt Creek. The Best Management Practices (BMPs) described here can effectively and naturally improve water quality and the natural environment, and reduce the volume of stormwater runoff.

These BMPs are important because a healthy Salt Creek is an asset to communities, a recreational amenity for residents, and an essential component of a healthy environment. BMPs can reduce development costs and long-term maintenance costs for stormwater management. They can also help communities meet the Salt Creek Total Maximum Daily Load (TMDL) standards that specify how much pollution the creek can carry, as well as National Pollution Discharge Elimination System (NPDES) Phase 2 permit requirements for eliminating significant sources of water pollution from municipal stormwater systems and construction activities.

This manual is a first step for increasing awareness of the need for better management of stormwater in the Salt Creek watershed, but it is not intended as an in-depth "how-to" technical resource. Many additional resources are provided in the back of this manual for those seeking technical information. The practices are arranged in order beginning with those easier and less costly to implement. If you have never tried any of these practices, consider one of the first few techniques and then move on to more complex projects, which may

A low-head dam on Salt Creek.

require additional time and resource investments and outside funding sources. However, the order of this manual is not an indicator of effectiveness. Simpler BMPs can be as effective as more complicated ones. The key is to use the right BMP for the job.

In many communities, outdated ordinances and other standards are barriers to the use of BMPs. For example, many community weed ordinances do not allow vegetation greater than a few inches in height, thereby outlawing the use of beneficial native plants that grow taller. Local regulations should be adopted or updated to encourage or at least allow the techniques covered in this manual.

BMPs covered in this manual:

- Public green space management.
- Natural landscaping, buffers, swales, and filter strips.
- Rain barrels, cisterns, and rain gardens.
- Reduced road salt impacts.
- Bioengineered streambank stabilization.
- Naturalized detention basins.
- Infiltration practices.
- Green roofs.

This manual is one part of a larger educational effort by the Salt Creek Watershed Network, the Illinois Environmental Protection Agency, and the Northeastern Illinois Planning Commission to work with local government entities, residents, businesses, and other landowners to improve water quality and environmental conditions in Salt Creek and its watershed.

Public Green Space Management – Be Kind to the Land

Why is this Important?

Turf grass covers a portion of the Salt Creek watershed's public green space, from parks and playing fields and golf courses to the lawns around municipal buildings and business campuses. When managed in a traditional fashion using fertilizers and pesticides, turf grass is a primary contributor to runoff pollution. Turf grass areas absorb much less runoff than might be expected; most rainfall runs off turf grass into storm sewers. Pesticides, fertilizers, and the bacteria found in pet waste flow easily off of turf during rainstorms and end up in lakes and streams. Proper land management and maintenance can minimize negative environmental impacts, particularly from stormwater runoff and non-point source pollution.

Ideas for Implementation

Though there are many ways to protect the creek from runoff and non-point source pollution, some of the easiest and most significant ways involve simply changing management practices on public land. Though costs are difficult to estimate, the majority of these practices present cost savings, some short term and others over the long term, over traditional management approaches.

Convert turf grass into native plants. Where possible, convert turf grass into native groundcover, shrubs, trees, or meadow plantings (also see section on natural landscaping). Replace grass under mature trees with shade-tolerant groundcover. Where turf grass is difficult to grow, native groundcover and shrubs can thrive. Use turf grass selectively for a particular function such as a children's play area or soccer field.

Check the soil. Test the soils to determine pH and fertility; lime or fertilizer may not be necessary. Also test for soil compaction. If the soil is compacted, aerate it.

Choose the right grass. If you must use turf, choose a grass that is adapted to northeastern Illinois' climate such as a fine fescue. Consider new species of slow-growing, low-input dwarf grass mixes that reduce the need for mowing and fertilizers. Check with your local nurseries for information on these new "no-mow" or "low-mow" mixes.

Allow grass to grow taller. Mowing height affects the depth of the root system; the longer the cut the deeper the roots and the stronger and healthier the turf. Set mowing height as high as possible, at least one setting higher than you normally do, and don't mow too often; this allows the grass to grow in thicker with deeper roots and will help crowd out weeds reducing the need for fertilizers and pesticides. Leave some of the grass clippings on the lawn (or better yet use a mulching mower) to provide nutrients and hold in moisture. Recycle or compost the rest of the grass clippings.

Use appropriate amounts of fertilizer. Heavy use of fertilizers, particularly those with high nitrogen and phosphorous content, is one of the leading causes of excessive algae growth in Salt Creek. Fertilizers not absorbed by plant roots often run directly into the water, where the nutrients intended to grow grass provide food for the algae. Not only are algae unsightly, when they die the decomposition process consumes oxygen in the water that is needed by other plants and animals. It also blocks light needed by aquatic plants growing in the bottom of the creek. To reduce the effects of fertilizers on the creek:

- Fertilize only if soil tests indicate that it is necessary; some soils are fertile enough.
- Apply low-nitrogen, encapsulated nitrogen, or zero phosphorous fertilizers or an organic product.
- Follow application instructions; more is not better.
- Maintain natural vegetative strips at least 25 feet wide along streamside property to filter out excess fertilizer (see section on buffers, swales, and filter strips.)
- Avoid placing lawn clippings directly along creek banks.
- Don't fertilize before a rain.
- Ensure grounds maintenance personnel follow these guidelines.

Accept some weeds. Healthy, full grass will crowd out most weeds. Get comfortable with the idea that some weeds are ok, as long as they don't dominate. Employ least toxic methods to reduce weeds such as herbicidal soap and rapidly biodegradable or biological pest controls.

Insects are a necessary part of the landscape.

Accept some pests. Bugs are a natural part of the environment, and they serve important functions in the food chain. Applying poisons designed to kill bugs will also kill birds, butterflies, fish, and other wildlife. If you have an overabundance of insects, try removing or trapping them, introducing biological control agents such as bugs that prey on your pests, or by applying low toxic chemical controls like insecticidal soaps. You can also try to attract natural predators such as birds that eat those pesky bugs.

Be smart with water. The turf grass most of us associate with an attractive lawn is not adapted to our hot summers and heavy watering to keep it green is highly wasteful and can also be expensive. Use landscaping techniques that don't require a lot of water, or, if you must irrigate, try watering the lawn well in the early morning or late in the evening.

Manage golf courses naturally. Golf courses can be a significant source of water pollution, but they also present great opportunities for good land management. Courses that have incorporated natural features are receiving increasing attention and acclaim from golfers and environmentalists alike, and some are certified as Audubon Cooperative Sanctuary courses by Audubon International and the United States Golf Association. (See resources section for a listing of Illinois golf courses that are Audubon certified.)

Golf courses, such as this one in Olympia Fields, provide good opportunities for natural landscaping.

Incorporating natural characteristics into course design can reduce the course's impact on natural resources. For example, small woods, wetlands, and stream buffers can be designated as unplayable rough while providing good habitat for wildlife. Long, broad fairways are significant sources of runoff pollution. Keep cart paths away from the streams and minimize stream crossings. Fertilizers and pesticides are also a serious concern. Swales, streamside buffers, and infiltration trenches can help remove fertilizers and pesticides from fairway runoff before it enters the stream.

Landscape golf courses naturally. Intensive irrigation of golf course turf grass, which is not adapted to northeastern Illinois' climate, can reduce the water level in streams and groundwater and cause serious problems for the stream. Native vegetation for course landscaping and drought and disease resistant turf for greens and fairways can reduce water consumption.

Manage animal waste. One deceptive contributor to water quality impairments, especially in heavily urbanized watersheds such as Salt Creek, is pet and animal waste. When allowed to enter the water via stormwater runoff, this waste causes high nutrient and bacterial levels, which can lead to excessive algae growth and damage to plants and animals. Leash and pick-up rules, appropriate signage, and the provision of pet waste bags at streamside parks have proven effective in mitigating pet waste's negative effects. Goose waste, found in abundance on turf areas around detention basins, is another significant source of pollution for streams.

Natural landscaping, covered in the next section, is helpful for reducing the number of geese, especially around detention basins, because tall plants make geese uncomfortable causing them to seek out other areas.

Success Stories

In 1998, the DuPage County Forest Preserve District purchased the erosion-plagued Oak Meadows Golf Course in Addison. In 2001, the county's Master Plan for Golf Course Reconfiguration called for shoreline and bank toe stabilization to curtail erosion along Salt Creek, as well as bridge modifications to make the creek more suitable for recreation. The project, begun in autumn of 2002, stabilized 6,619 linear feet of streambank. The Illinois Department of Natural Resources contributed approximately 75% of the project total cost of $2.2 million, with the DuPage County Forest Preserve District and Department of Environmental Services picking up the rest. Golf course administrators reduced the slope of the streambanks, replaced shallow-rooted vegetation with deep-rooted native grasses, shrubs, and trees, and removed the stonework stabilization measures previously installed in favor of more aesthetic, below-water A-Jacks to stabilize the streambank toe. The project, which cost approximately $124 per linear foot, is widely regarded as a success. (See section on bioengineered streambank stabilization for more on practices mentioned here.)

Native landscapes are beautiful and functional.

Natural Landscaping, Buffers, Swales, and Filter Strips – Filter, Infiltrate, and Stabilize

Why is this Important?

Using native plant materials in landscaped areas on a development site is a low-cost and environmentally beneficial alternative to traditional landscaping. Native plants are far superior to turf grass for stabilizing soil, reducing erosion, infiltrating stormwater, and filtering and absorbing pollutants. The root structures of native vegetation are 3 to 10 feet deep for prairie vegetation versus 4 to 6 inches for turf grass. Native plants require no mowing, fertilizers, or pesticides, thereby eliminating a source of pollution and saving money. Native plants also play a key role in the filtration capacities of many of the other best management practices discussed in this manual including swales, buffers, filter strips, and natural detention areas.

Ideas for Implementation

Natural landscaping is appropriate on nearly all sites, especially large common areas, stormwater facilities (e.g., detention basins), drainage ways, and buffers along sensitive natural areas. It is particularly well-suited to low density residential and multi-family residential developments, institutions, office and industrial campuses, government property, and public land. Existing natural features should be preserved whenever possible.

Natural landscaping costs significantly less than conventional landscaping to install and maintain. Though prairie and wetland planting costs are similar to turf grass seeding (approximately $2,000 to $4,000 per acre), turf irrigation systems can double its cost, and sod ($10,000 or more per acre) and ornamental trees and shrubs are even more costly. Only annual mowing or controlled burning and occasional spot spraying to control invasive weeds is typically needed.

Controlled burning is a specific management tool that requires some additional attention. Professionally trained burn crews must be used, all state and local permits must be secured prior to using controlled burning as a management tool, and the group undertaking the burn must coordinate with local fire districts and should also coordinate with other local governments to help avoid misunderstandings and conflicts.

Maintenance costs range from one half to one-fifth of the amount for conventional landscaping. However, it can take slightly longer to fully establish a diverse native plant community (2 – 4 years.)

Buffers, swales, and filter strips are areas of land comprised of deep-rooted native plants that help protect water by filtering pollutants from runoff. Buffers are typically used along waterways, and filters strips are used adjacent to impervious areas. They are recommended for use between developed areas and sensitive aquatic environments, especially along roads, parking lots, and construction sites. Swales are somewhat different from buffers and filter strips. They are vegetated channels used to transport and temporarily store runoff. Swales can be alternatives to storm sewers in some areas.

The longer water takes to move across these treatments, the better cleansing and infiltration will occur. Filter strips, swales, and buffers are particularly effective at reducing pollutants through settling and filtration. Road

Native plant buffer in Wood Dale.

salt, however, is not well removed by filters, buffers, or swales and can harm native plants, which are not adapted to salty conditions. These practices also can reduce surface runoff volumes by up to 40 percent for small storm events, and may reduce the need for storm sewers in less densely developed areas.

Installation of buffers and filter strips begins by removing existing plants and turf grass and then immediately planting with native species to minimize opportunities for erosion. Planting live plants in combination with seeds is preferred because it results in rapid establishment of vegetative cover. Live plants, however, are more expensive than seed. Where seeding is done on bare soil it is important to protect the seed and soil from washing away by raking the seed into the ground and covering the soil with an erosion blanket or hydro mulch.

Along streams, native vegetation should begin at or below normal water level with aquatic or wetland species and continue up the bank with water-tolerant and finally upland species. Any amount of native vegetation can be beneficial, but to be most effective, a buffer should be at least 25 feet wide on each side of the stream and should cover the entire bank to provide maximum soil stabilization.

Filter strips and buffers can cost approximately $2,000 to $3,000 per acre to seed, not including soil erosion prevention. Maintenance within the first two growing seasons, as with most natural landscaping, may require prescribed burns, removal of invasive species, and additional planting to control undesirable plants from invading and taking over newly planted areas. After

Managing natural landscapes with controlled burns.

establishment, mowing and/or prescribed burns every 2 – 3 years will provide most of the subsequent maintenance needs. Fertilizer and pesticides are typically not necessary. However, herbicide may be necessary if invasive species are allowed to colonize.

Swales, open, vegetated drainage channels, can be used as alternatives to enclosed storm sewers and concrete-lined channels where there is some undeveloped land between buildings or paved areas. However, in denser, more urbanized settings they usually must be used in conjunction with storm sewers. Like buffers and filter strips, swales function best on gentle slopes and when planted with abundant native vegetation. They should be shallow and wide, with gentle side slopes, and evenly graded to avoid ponding of water. Swales generally cost up to $13 per linear foot less to install than curb and gutter storm sewers, and can often be installed faster, though it may take some time for the natural vegetation to become fully established. Swales may require occasional mowing and debris and sediment removal, but cost much less to maintain than storm sewers which require periodic maintenance, repair, and replacement. One type of swale, a depressed median, can be used within paved areas such as parking lots to collect and infiltrate stormwater (see section on infiltration practices.)

Success Stories

Save the Prairie Society is using all plant materials to stabilize and restore approximately 1900 feet of streambank along Salt Creek. Invasive and non-native tree and plant species have been removed to allow sunlight to reach the streambanks where native grasses, forbs, and sedges create a dense, deeply rooted vegetative cover. Trees, while they do have deep root systems, do not protect the banks from erosion and can shade out ground cover leaving bare banks. The native vegetation will provide food and shelter for various types of wildlife including the Henslow's Sparrow, Kingfisher, and the Monarch Butterfly. Maintenance of the area includes prescribed burning and selective herbiciding and cutting of invasive species. The native planting along the stream also acts as a buffer to absorb pollutants before they reach the waterway.

Stabilized Salt Creek canoe launch in Elmhurst.

In 2002, the Elmhurst Park District completed the installation of a naturally vegetated streambank buffer near a canoe launch on Salt Creek. This buffer is helping to stabilize steep, eroding streambanks and provide a protective filter for water running off the adjacent landscape. A couple hundred feet of buffer area along the creek was regraded to a more gentle slope and replanted with prairie plants. The entire project, including the canoe launch, cost approximately $100,000. It was important to plant both upland species and wet prairie species on the site because during high water periods the canoe launch is under water. The water-tolerant prairie plants help maintain the integrity of the banks during high flow conditions, saving land from eroding and protecting the canoe launch.

Rain Barrels, Cisterns, and Rain Gardens – Using Rain as a Resource

Why is this Important?

In urban areas, impervious surfaces dominate the landscape and less rainwater is naturally absorbed into the ground. Most roof runoff is collected in gutters and discharged onto the ground or into storm sewers, picking up debris and pollutants and discharging them into nearby streams. Reducing the volume of stormwater by managing it onsite reduces the flow of pollutants to the stream.

Ideas for Implementation

Downspouts that normally transport rainwater from the roof to the ground or storm sewer can be disconnected and directed into rain barrels, cisterns, or rain gardens, where it can be stored for irrigation or slowly infiltrated into the ground. Sump pumps can also be redirected. Rain barrels and cisterns are most often positioned at building corners. A 1200-square-foot residential roof, for example, could use 55-gallon barrels to collect rainwater. Rain barrels and cisterns must be emptied regularly and cleaned to remove debris such as leaves or branches. Installing mesh screens on top of the barrels can prevent debris buildup. Barrels should be covered during summer months to prevent mosquito breeding and should be emptied before winter to avoid freezing. Normal costs

Rain barrels, such as this one in Chicago, capture roof runoff for other uses.

for pre-made rain barrels range from $20 to $150, but homeowners can reduce this cost by making their own.

Rain gardens collect runoff water, which the garden's soil and plants then slowly absorb. Plants can filter out many of the pollutants in runoff water and reduce runoff volume. Rain gardens are typically 6- to 18-inch deep depressions filled with attractive, native plants and wildflowers, which also serve as habitat for birds, butterflies, and dragonflies, which eat mosquitoes. Like rain barrels, rain gardens function best during small to moderate storms and should be constructed at least 10 feet away from building foundations. Weeding and planting needs are similar to that for typical gardens, and costs are similar to those for ordinary gardens ($3 – 4 per square foot per year).

Success Stories

Thanks to funding from the Illinois Environmental Protection Agency, the Brookfield Zoo was able to plant demonstration rain gardens at various locations around the park. At the Reptile House, water from the roof was eroding soil and washing it onto the pathway. With the roof's downspout now turned into a low area planted with native plants, the rain garden absorbs the excess rain. At the North Gate, a rain garden helps absorb excess water before it reaches the storm drain. At Hamill Family Play Zoo, a small garden is being converted to a wet garden using some rainwater from the roof downspout.

Brookfield Zoo's new rain garden after planting.

Homeowners with wet areas in yards also are learning to go with the flow and build rain gardens. This was the case in Brookfield where one resident suffering from flooding on a portion of his yard constructed a 20-foot by 25-foot rain garden planted with native plants and shrubs and a few boulders between his driveway and neighbor's yard. In its first growing season, the rain garden flowered and attracted a variety of birds and butterflies, and even hosted a bathing Coopers Hawk. Summer downpour storms generate a surge of water that is collected in the rain garden and absorbed into the soil within 12 hours. The project took approximately one day to design and four days to install, costing approximately $1,400 for materials.

Reduced Road Salt Impacts – Salt Creek Shouldn't be Salty

Why is this Important?

Here in the Midwest, salt is heavily depended upon to melt ice and snow from roadways, driveways, and parking lots. However, dissolved salt collects in puddles on paved surfaces where its corrosive effects damage roadways, bridges, and vehicles. It also runs off into road side ditches, sewers, and water bodies. As a result, soils, groundwater aquifers used for water supply, and fish and other aquatic organisms, plant communities, and wetland systems are all negatively impacted. Few species of plants and wildlife can tolerate salty water, but impacts are greatest in smaller water bodies and streams.

Ideas for Implementation

Rock salt is the most typical material used to clear ice and snow, primarily due to its low cost. However, a number of alternatives exist.

- Calcium chloride, typically used in combination with regular salt, is an effective alternative. Unfortunately, it is three to ten times more expensive than salt and because it is highly corrosive it is not the most feasible alternative.
- Calcium magnesium acetate and abrasives have both proven to be more benign alternatives to road salt. Calcium magnesium acetate costs $600 to $700 per ton versus about $25 per ton for road salt and is less corrosive.
- Abrasives such as sand or cinders can be used to improve traction in snowy conditions. They are significantly less costly but also less effective than salt, and they don't melt ice. Abrasives also may build up in water bodies and also may contribute to dust and associated air quality concerns.

Anti-icing, or preventative salting, involves the application of ice control chemicals before a storm to prevent ice from forming on roads. Approximately 70 percent less salt is needed to prevent icing than is needed to melt ice once it has formed. The material stays on pavement with little or no dispersion, and the anti-icing effects can last for a few days. The downside is that anti-icing measures may be taken in anticipation of a storm event that never materializes.

If road salt still proves to be the most feasible solution for snow and ice removal in your community, these practices can help reduce the environmental impacts:

- Provide adequate training for road work staff on minimizing the over-application of salt. The American Public Works Association provides training opportunities.
- Use correctly calibrated salt truck spreaders to apply only what is needed for expected temperature and precipitation conditions. Deicing agents should be applied at a rate that is governed by truck speed so that piles of salt do not accumulate at stop lights and signs.
- Prioritize heavily-traveled roads and intersections for salting. On less-traveled roads, switch to straight plowing and/or abrasives.
- Apply salt only to loosen snow and ice from the road, and follow with repeated plowing to remove it. Do not continue to apply salt without clearing the accumulated snow and ice first.
- Minimize salt and use alternative methods in especially sensitive areas such as near streams and wetlands, remnant prairies, and groundwater recharge zones. Even a small amount of salinity can seriously affect sensitive plant species.
- Store salt as far as possible from water bodies and other sensitive areas and recharge zones, outside of the floodplain, and on impermeable soils. Storage facilities should be built on an impervious surface to prevent infiltration. Salt piles should be placed on a concrete pad and covered, and any spillage during truck loading should be promptly cleaned up.

Success Stories

Elk Grove Village is replacing old salt trucks with new, computerized trucks that are calibrated to spread salt according to conditions and truck speed. This reduces the amount of salt used, the amount of salt being carried into Salt Creek during winter months, and the cost of salt to the Village.

Bioengineered Streambank Stabilization – Nature Does it Best

Why is this Important?

Salt Creek's banks experience unnaturally high erosion due to high water velocities and fluctuating water levels. Trees along streambanks shade out deep-rooted ground cover, weakening the bank and leading to erosion. Some invasive plant species such as reed canary grass have shallow root systems that do not stabilize stream banks. These impacts destroy natural habitats, impair water quality, damage property, and threaten infrastructure.

The conventional solution to bank erosion has been to armor channels with concrete, steel, or rock. While such techniques may reduce erosion locally, they destroy water habitat, and push water volume and velocity problems downstream. Natural stabilizing approaches reduce streambank erosion and failure through natural, vegetative and bioengineered methods, so-called because they incorporate living plant material rather than concrete or rip rap. Native plants have deep root systems that grow into soil and hold it in place. While conventional stabilization measures are strongest when installed and get weaker over time, bioengineered installations get stronger over time. Natural, vegetative bank stabilization is self-sustaining and self-repairing, since the plants are adapted to grow along streambanks. It also provides much needed stream habitat for wildlife, and is a more attractive alternative to concrete or rock. Bioengineered stabilization methods are also substantially less expensive than conventional methods, most often costing significantly less than the $100 or more per linear foot for conventional methods.

Streambank stabilization using bioengineering methods.

Ideas for Implementation

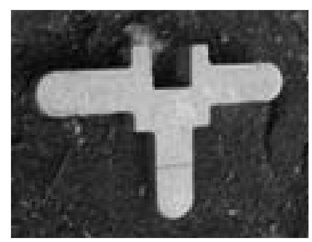
A variety of factors including severity of erosion, bank slope, water flow velocities, adjacent land uses, and aesthetic considerations will determine which methods to use. The following techniques can be used alone or in combination.

Vegetative stabilization involves planting appropriate native vegetation along streambanks and in shallow water. It is most effective on relatively flat slopes (less than 30 percent) where erosion problems are not severe. This practice may be used as a preventive measure to replace conventional turf grass before serious erosion occurs, and in conjunction with other structural bioengineering techniques for heavier erosion.

To be successful, the shade canopy along the stream bank must be reduced (to 50 percent or less) to allow more sunlight to penetrate and encourage plant growth. Plants can be introduced as plugs or seeds, though plugs are recommended for lower bank areas because they provide quicker stabilization and are less likely to wash away. Temporary soil stabilization measures such as erosion control matting should be used until the plants are fully established, particularly if seed is used. Vegetative stabilization can often be installed by volunteers and is relatively inexpensive, typically $10 to $20 per linear foot.

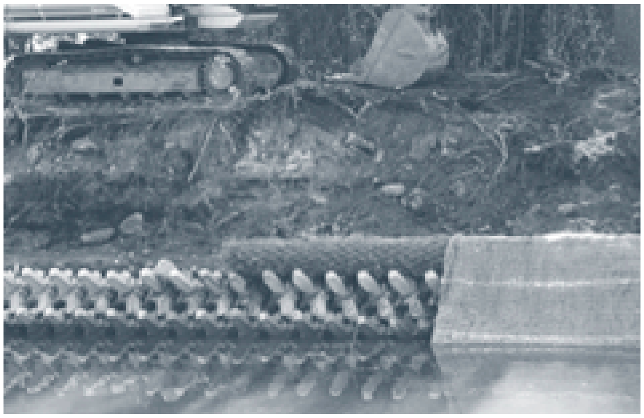
In stream corridors where water velocities are low, wetland plants can be useful in stabilizing bank toes and slopes to a depth of about one foot. Stream-adapted shrubs such as willow and dogwood can provide a substantial degree of streambank stabilization and erosion prevention. Their deep root systems bind soil and their thick vegetation deflects stream flows away from banks. They are often planted as dormant cuttings or live fascines stakes harvested and planted during winter months when the shrubs are dormant. Dormant cuttings are very cost-effective when compared to traditional techniques, costing only $10 to $20 per linear foot. Vegetative stabilization measures may need occassional maintenance over time so that sprouting stumps and shrub plantings do not grow into larger trees that overshadow the creek and banks.

In areas with heavier erosion potential and higher stream velocity, cuttings often function best when used in conjunction with structural bank stabilization techniques such as fiber rolls. Roughly the diameter of a basketball, **fiber rolls** are cylinders of compacted coconut husk fiber wrapped in coconut fiber mesh used to stabilize the toe of the bank. They are placed in shallow water at the base of the streambank, staked securely in place, and planted with water-tolerant shrubs and sedges. Fiber rolls trap eroding bank soils and keep larger sediment particles out of the stream, as well as provide a good medium for native plant growth. They are more effective at erosion control than vegetation alone, and can be used for areas with moderate erosion. The cost of fiber roll installations ranges from $25 to $35 per linear foot.



A single A-Jacks piece.

A-Jacks also provide bank toe stabilization and are appropriate for moderate- to high-velocity stream flow areas and steep slopes. A-Jacks are comprised of pre-cast concrete pieces that are fitted together and can be nested in a shallow trench along an eroding stream bank. After they are installed, spaces around them are filled with soil planted with water-tolerant shrubs and grasses. Over time, the roots of these plants wrap around the buried A-Jacks structures, creating a living erosion control system. Though A-Jacks installations are more expensive than fiber rolls, costing between $30 and $75 a linear foot, they are still significantly less expensive than traditional stabilization methods.



Stabilization using A-Jacks, fiber rolls, and erosion control matting.

Lunkers, used primarily for fish habitat and secondarily as a stabilizatioin measure, provide a significant degree of bank toe stabilization in moderate to heavy erosion areas. Lunkers are 4 to 8 foot long structures comprised of oak or Eco-wood (recycled plastic) planks stabilized by rebar stakes. They are installed in trenches at bank toes, which are then backfilled with soil, and they should always be under water, even during low flow conditions. Lunkers function best when used in conjunction with other bank stabilization practices, such as native vegetation, and benefit from relatively shallow grading (30 percent) on the streambanks above them. Due to their structure and placement at the bank toe, they also provide shelter and habitat for aquatic species. The material components of lunkers typically cost approximately $15 per linear foot, but excavation and installation makes their installation significantly more expensive.

Success Stories

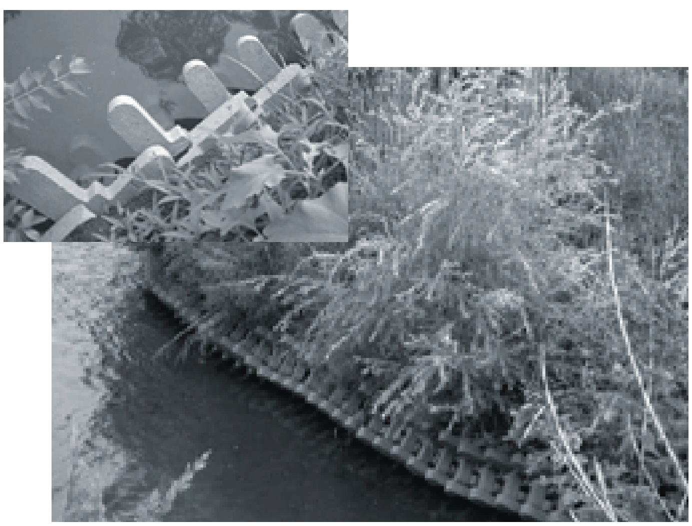
Numerous private backyards in Elk Grove Village were eroding into Salt Creek during flooding events. Water quality was diminishing due to increased sedimentation and fallen trees were creating snags that blocked water flow and required frequent removal by the Village. By the late 1990s, Village staff began looking into regulations and funding for remediation. An engineering study determined that a two-phase, $1.5 million program to use bioengineering to stabilize 14,700 linear feet of streambank was needed. Phase 1 of the project stabilized approximately 12,000 feet of streambank with A-Jacks, fiber rolls, lunkers, erosion control matting,

Elk Grove stabilization before new growth.

Elk Grove stabilization after new growth.

seeding and sod, and bank regrading. The Village also worked to educate property owners on the merits of maintaining vegetated buffers along the creek instead of typical turf grass lawns. Overall the project has been a success, and the Village hopes that the stabilized streambanks will continue to preserve private yards and improve water quality, fish habitat, and aesthetics. The first phase of the project, which is partially funded by the Illinois Environmental Protection Agency, cost $791,000, approximately $66 per linear foot.

The City of Wood Dale began its streambank stabilization work in 1992, when the degree of erosion damage by flood waters along public and private properties became too severe to ignore. A 1996 preliminary study by DuPage County called for a three-phase project to design and install appropriate bioengineering techniques to stabilize 5,650 feet of streambank. The Illinois Environmental Protection Agency supplied $600,000 of project costs, while the City of Wood Dale, DuPage County, and the Kane-DuPage Soil and Water Conservation District picked up the rest of the total $1,000,000 cost. Wood Dale is currently setting aside funds for long-term maintenance of the newly-stabilized banks. The project has been a success on many levels: improved water quality, attractive private yards, and reduced sediment pollution to help the city comply with stormwater management regulations. This project, which employed A-Jacks, lunkers, fiber rolls, erosion control matting, live stakes, seed, sod, trees, and shrubs, resulting in a cost of approximately $177 per linear foot.



A-Jacks stabilizing a streambank in Wood Dale.

Naturalized Detention Basins – Improving the Function

Why is this Important?

Naturalized detention basins are similar to typical wet detention basins containing a permanent pool of water, but areas along the water's edges and the side slopes are planted with native plant buffers. Some naturalized detention basins include water of varying depth and wetland vegetation planted in the bottom and near the edges.

Like conventional detention basins, naturalized detention basins can effectively control runoff rates and volumes from both small and very large storm events. Unlike conventional detention, however, naturalized basins are more effective at filtering, settling, and absorbing stormwater runoff pollution. Some pollutants can be reduced by up to 90 percent. In addition to runoff remediation, naturalized detention basins provide valuable habitat for wildlife and aesthetic benefits for nearby property owners. Native vegetation planted around naturalized detention basins also discourages geese, whose unpleasant waste contributes a substantial amount of phosphorous to water.

Ideas for Implementation

Naturalized detention basins are appropriate for almost all development types requiring stormwater storage, but on very small sites rain gardens or infiltration practices may be more appropriate. Existing detention basins can be retrofitted to include features of a naturalized detention basin. However, these basins may be restricted to using the existing engineering specifications and design, though riprap and other artificial bank stabilization can be replaced with gentle slopes and native vegetation.

Natural detention basin at Prairie Stone business park in Hoffman Estates.

New detention basins present a good opportunity to use a highly natural design up front, including such elements as a basin bottom of varying depths, which replicates a natural pond. Wet detention basins should include sedimentation basins at major inlets, an area of open water at the basin outlet, and fairly flat, irregularly graded bottoms, all or part of which can be planted with wetland vegetation. Using native vegetation in these basins requires a good understanding of the hydroperiod (water depth and duration for a specific storm event) to determine which plants can survive in the basin, and where to plant aquatic wetland or upland species.

Naturalized detention basins often cost less than other basin techniques that utilize riprap for stabilization. Average cost ranges from $17,000 to $22,000 per acre-foot of active detention storage. Naturalized detention basins require annual mowing or burning of native vegetation around the edges, which, with the assistance of natural areas management personnel, typically costs roughly $500 per acre. Due to their substantial sediment removal capabilities, naturalized detention basins may require dredging, though this should only be necessary every 10 to 15 years.

Infiltration Practices – Let the Soil do its Thing

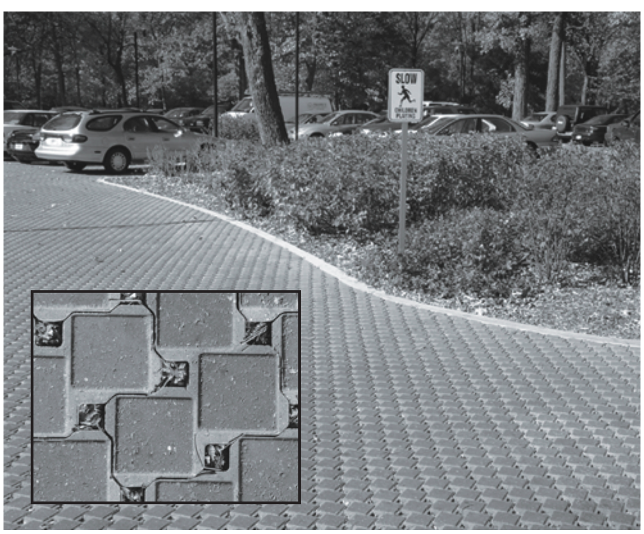
Why is this Important?

Runoff and non point source pollution are directly related to the amount of impervious surface in a watershed. Stormwater flows over asphalt and cement without being absorbed by the soil, picking up pollutants such as fertilizer, pet waste, and oil and grease on its way to nearby bodies of water. Well-designed infiltration practices can reduce the volume of stormwater runoff by allowing it to slowly infiltrate into the ground naturally and improve its quality. This can reduce the need for stormwater detention, reduce flooding, and enhance groundwater recharge. Infiltration practices can reduce both surface runoff volume and pollutants by up to 95 percent.

Ideas for Implementation

Techniques for minimizing the area of impervious surfaces, such as clustered development, narrower streets, and reduced setbacks, usually occur during the design stages of new development. However, it is often difficult to significantly reduce impervious area in urbanized watersheds such as Salt Creek, so reducing the effects of impervious surfaces by capturing, filtering, and infiltrating runoff becomes an important practice.

Permeable paving with blocks made of concrete, stone, or plastic allows rain and snowmelt to soak into the ground. Paving blocks contain openings that are filled with sand or soil to support grass or other vegetation. Runoff is trapped in the blocks' depressions and filters through the vegetation into the soil below. The benefits of permeable paving vary according to the size of the block openings and the infiltration capacity of the soil below; sandy soils are better. Runoff volumes from the blocks should be lower than from conventional pavement, but higher than from totally pervious areas.



Permeable pavers such as these at Dominican University are attractive and functional.

The DuPage County government complex uses permeable paving techniques for an emergency access road.

Because paving blocks are less strong and durable than normal paving, they are best suited to areas which receive relatively lightweight or infrequent traffic such as emergency access roads, walkways, and supplemental parking. Though experience in this region is limited, national usage indicates that paving blocks may cost as much as two to three times more than normal paving techniques, and most likely take longer to install. However, because they can substantially reduce runoff volume, stormwater infrastructure costs are lower, which can offset the higher installation costs. They also may require more frequent repair, and snow plowing may require extra care due to the slightly uneven surface of the blocks.

Though the complete removal of parking lots is often unfeasible, especially in a heavily urbanized watershed, the large amount of impervious area of parking lots makes them a good target for **parking lot retrofit** efforts. Reduced parking stall dimensions allow more cars to fit into existing space, lessens the demand for large parking lots. Shared parking between businesses also can result in decreased demand for total parking area. For example, a bank parking lot can serve as parking for a restaurant in the evening hours.

One technique for reducing the impact of parking lots is to direct runoff into depressional medians or islands planted with native plants or through curb cuts into naturally landscaped areas instead of into storm sewers. This increases infiltration, reduces runoff pollution, and adds aesthetic features to parking facilities, and can be done on a small scale for nearly any parking lot. These medians also can be planted with trees that shade the lot in summer reducing the urban heat island effect. Parking lot retrofits are relatively inexpensive if the medians already exist, more expensive if they have to be installed. Maintenance requirements of these features are minimal – typically only weeding and debris removal are required.

Success Stories

The DuPage County government complex in Wheaton installed permeable paving blocks on an emergency access roadway. The roadway now produces less runoff and blends in with adjacent turf grass areas.

The Village of Brookfield Runoff Pollution Prevention project will reduce non point source pollution by treating runoff from the parking lot and the roof of the Village Hall (approximately 2.28 acres.) The Village is constructing a swale planted with native vegetation to filter pollutants and reduce the volume and velocity of runoff. A manufactured treatment system of oil and grit separators will further filter suspended sediment, metals, oil and grease, and nutrients and reduce pollutant loading in Salt Creek.

Green Roofs – The Earth above your Head

Why is this Important?

Green roofs are living systems of soil and vegetation that absorb stormwater and filter up to 95 percent of pollutants found in the atmosphere and rainwater. They also insulate the building below, reduce cooling and heating costs, and reduce the urban heat island effect of reflective roof materials. As an added bonus, roof life can be extended by 2 to 3 times with a green roof due to less exposure to the sun's radiation and fluctuating temperatures. In built up areas and properties with small lot sizes, green roofs can provide compensatory storage needed to comply with local stormwater management ordinances.

Ideas for Implementation

Green roofs can be implemented on many types of buildings, but the major considerations for selecting a green roof system are the structural integrity and load-bearing capability of the building, types of plants, soil depth and weight, waterproofing, and drainage system. The load-bearing capacity of the roof is usually the determining factor.

Two different types of green roofs are common. In *extensive systems* soil is 2 to 4 inches deep and weighs 12 to 40 pounds per square foot. Plants are short, have shallow root systems, and are easy to maintain. *Intensive systems* are more similar to typical residential gardens, with 6 to 12 inches of soil weighing 80 to 150 pounds per square foot. Plants can be deeper-rooted than for extensive systems, and trees and shrubs may be used.

Intensive systems absorb more stormwater and provide more insulation and water filtration than extensive systems.

Once established green roofs need little maintenance beyond that for a typical garden such as watering, weeding, and replanting. The roof waterproof membrane and drainage system should be inspected periodically to ensure proper function. Green roofs typically cost between $18 and $24 per square foot. Initial capital costs are offset by long-term cost savings for roof maintenance and heating and cooling costs. They can be installed as a retrofit to existing buildings or built as part of new construction.

Success Stories

The Villa Park Police Station was designed to be a model "green" building using innovative stormwater management practices. The site's stormwater management system features a porous paver parking area with an underground infiltration system to allow stormwater to percolate back into the groundwater table. The system also contains natural rain gardens to help maintain, cleanse, and infiltrate stormwater on site. A green roof will utilize plants in a lightweight growing medium to hold water in place for slow release through evaporation back into the air. The goal of the system is to produce zero runoff of stormwater from the site, which helps the development meet DuPage County stormwater runoff regulations. The project is budgeted to cost the same as a conventional design. The only identifiable cost which exceeded expectations was the porous pavers, but in light of their long-term durability as compared to asphalt, they were considered a valued addition to the project. The opportunity to show how these techniques for stormwater management could be used in infill development led to an Illinois Environmental Protection Agency grant to help design, build, and exhibit the techniques. In addition, DuPage County Department of Environmental Concerns awarded a grant to help quantify the runoff reduction resulting from the stormwater practices. The project will be an important opportunity to monitor these ideas and show their value in future developments in the region.

Resources

1. **The Northeastern Illinois Planning Commission produces numerous resources related to water resource protection and natural resource management. Call the NIPC Publications Department at 312.454.0400 to order copies, or visit www.nipc.org.**

   - The Best Management Practice Guidebook for Urban Development (NIPC, 1992) provides proven techniques for reducing the impact of urban development on natural resources.
   - The Conservation Design Resource Manual (NIPC, 2003) presents guidelines and language for updating municipal ordinances to incorporate conservation design.
   - Draft Technical Policy Directive for Maintenance and Monitoring of Naturalized Stormwater Management Facilities Vegetated with Wetland and Prairie Plantings (NIPC and the Butterfield Creek Steering Committee, 1999) provides information on maintaining naturalized detention basins.
   - Environmental Considerations in Comprehensive Planning – A Manual for Local Officials (NIPC, 1994) provides information on incorporating environmental protection into comprehensive plans.
   - A Guide to Illinois Lake Management (NIPC, 1991) describes Illinois' lake ecosystems, problems and solutions, and costs and benefits of lake management.
   - Landscaping Techniques and Materials for Urban Illinois Stream Corridors and Wetland Edges (NIPC, 1991) provides basic information, via case studies, about stream management and bank stabilization, buffer strips, greenway planning, landscape design, stream restoration, and recommended plant materials for such projects.
   - Pavement Deicing: Minimizing the Environmental Impact (NIPC) provides information about the effects of and alternatives to ice as a deicing agent.
   - Protecting Nature in Your Community (NIPC, 2000) provides numerous tools and techniques for preserving and enhancing local habitats, green space, and water quality.
   - Reducing the Impacts of Urban Runoff: The Advantages of Alternative Site Design Approaches (NIPC, 1997) presents alternative development techniques that help protect water quality.
   - Restoring and Managing Stream Greenways: A Landowner's Handbook (NIPC, 1998) provides information for stream management and protection.
   - The Tool Kit on Natural Landscaping (NIPC, 1997) contains an attractive poster-brochure that summarizes benefits and principles of natural landscaping; a slide show; and Natural Landscaping for Public Officials: A Sourcebook (NIPC, 1996 and updated in 2004) that explains the principles, benefits and feasibility of natural landscaping, the role of local governments and leadership, tools and techniques for installation of natural landscapes, and case studies.
   - The Urban Stormwater Best Management Practices for Northeastern Illinois (NIPC, 2000) is a course curriculum for designing and installing stormwater BMPs.

2. NIPC also publishes a number of model ordinances to help local governments protect water resources:

- Model Floodplain Ordinance (Illinois Department of Natural Resources and NIPC, 1996.)
- Model Stormwater Drainage and Detention Ordinance (NIPC, 1994.)
- Model Stream and Wetland Protection Ordinance for the Creation of a Lowland Conservancy Overlay District (NIPC, 1988.)
- Model Soil Erosion and Sediment Control Ordinance. NIPC 1991.
- Model Watershed Management Strategy for the Control of Urban Waterbody Use Impairments in Lake County, Illinois. NIPC 1994

3. Information is also available at the Salt Creek Watershed Network website at www.saltcreekwatershed.org.

4. The United States Environmental Protection Agency National Pollutant Discharge Elimination System (NPDES) website contains a number of fact sheets related to pollution control. The factsheets can be viewed at cfpub.epa.gov/npdes/stormwater/menuofbmps.

For *Post-Construction Storm Water Management in New Development & Redevelopment*, the following topics are addressed:

- Dry extended detention ponds
- Wet ponds
- Storm Water Wetlands
- Wet Detention Ponds
- Infiltration basin
- Infiltration trench
- Porous pavement
- Bioretention
- Storm water wetland
- Grassed swales
- Vegetative Swales
- Grassed filter strip
- On-Lot treatment
- Buffer zones
- Open space design
- Urban forestry
- Conservation easements
- Infrastructure planning
- Narrower residential streets
- Eliminating curbs and gutters
- Green parking
- Alternative turnarounds
- Alternative pavers
- BMP inspection and maintenance
- Ordinances for post construction runoff
- Zoning

For *Pollution Prevention and Good Housekeeping for Municipal Operations*, the following topics are addressed:

- Pet waste collection
- Automobile maintenance
- Vehicle washing

- Illegal dumping control
- Landscaping and lawn care
- Pest control
- Parking lot and street cleaning
- Roadway and bridge maintenance
- Septic system controls
- Storm drain system cleaning
- Alternative discharge options for chlorinated water
- Materials management
- Alternative products
- Hazardous materials storage
- Road salt application and storage
- Spill response and prevention
- Used oil recycling
- Materials management
- Environmental Effects from Highway Ice and Snow Removal Operations

5. **The Low Impact Development (LID) Urban Design Tools website at www.lid-stormwater.net provides tools and techniques for water protection including bioretention, green roofs, permeable pavement, rain barrels and cisterns, soil amendments, and tree box filters.**

6. **The Stormwater Managers Resource Center at www.stormwatercenter.net provides a good selection of resources related to water quality protection and best management practices. The topic areas and specific resources are as follows:**

Aquatic Buffers

- Buffer Zones Factsheet
- Stream Buffer Ordinances
- Practice articles on Aquatic Buffers
- Aquatic Buffers Slideshow

Better Site Design

- Better Site Design Factsheets
- Introduction to Better Site Design Slideshow
- Practice articles on Better Site Design

Erosion & Sediment Control

- Erosion and Sediment Control Factsheets
- Erosion and Sediment Control Ordinances
- Practice articles on Erosion and Sediment Control
- Erosion and Sediment Control Slideshow

Impacts of Urbanization

- Impacts of Urbanization Slideshow
- Indicator Profiles
- RSAT
- Simple Method
- Practice articles on the Impact of Urbanization

Land Conservation

- Open Space Ordinances
- Conservation Easements Factsheet
- Practice articles on Land Conservation

Land Use

- Introduction to the Eight Tools of Watershed Protection Slideshow
- Watershed-Based Zoning Factsheet
- Impervious Cover Model
- Practice articles on Land Use

Non-Stormwater Discharges

- Septic Systems Factsheet
- Illicit Detection Ordinances
- Practice article on Non-Stormwater Discharges

Restoration Practices

- Stream Restoration Factsheets
- Assessment of Urban Stream Restoration Practices Slideshow

Stormwater Management Practices

- The Manual Builder Section
- The Sizing of Stormwater Treatment Practices Slideshow
- Stormwater Retrofitting: The Art of Opportunity Slideshow
- Design of Stormwater Ponds and Wetlands
- Design of Vegetative Filtering Systems: Open Channels and Filter Strips Slideshow
- Stormwater Management Practices Factsheets
- Post-Construction Stormwater Management Ordinances
- Operation and Maintenance Criteria Ordinances
- Resource Protection Templates
- Practice articles on Stormwater Management Practices
- Stormwater Practices for Cold Climates

Watershed Stewardship

- Pollution Prevention Factsheets
- Practice articles on Watershed Stewardship
- Watershed Education Program Resources
- Watershed Education Slideshow

7. Additional Resources

- Better Site Design: A Handbook for Changing Development Rules in Your Community (Center for Watershed Protection, 1998) presents principles for reducing impervious cover, conserving natural areas, and reducing stormwater pollution from new development. See www.cwp.org.
- Chicago's Green Rooftops: A Guide to Rooftop Gardening. (City of Chicago Department of Environment, 2001) and other information. See www.cityofchicago.org/Environment/rooftopgarden.
- A Citizen's Streambank Restoration Handbook (The Izaak Walton League of America, 1995) helps residents and local government planners and officials plan and implement stream restoration projects. Visit www.iwla.org for more information.
- Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs (Metropolitan Washington Council of Governments, 1987) provides detailed guidance for engineers and site planners on how to plan and design urban best management practices (BMPs) to remove pollutants and protect stream habitats. Visit www.mwcog.org for details.

- Deicing Salt and Our Environment (The Salt Institute, 1990) and The Snowfighter's Handbook (The Salt Institute, 1991) can be downloaded from www.saltinstitute.org.
- Fight Winter and Win: A Survival Guide for Public Officials (American Public Works Association, 1992) can be ordered from www.state.me.us/mdot/mlrc/mlrc-pubs.php.
- The Greenroof Industry Resource Portal is the international greenroof industry's resource and online information portal and can be accessed at www.greenroofs.com.
- The City of Chicago's online Guide to Disconnecting Downspouts can be viewed at www.cityofchicago.org/environment/html/DownspoutDisconnect.html.
- A Guide to Stormwater Best Management Practices: Chicago's Water Agenda (City of Chicago, 2003) can be downloaded from www.cityofchicago.org/Environment/html/WhatsNew.html.
- The Illinois Urban Manual: A Technical Manual Designed for Urban Ecosystems Protection and Enhancement (Natural Resources Conservation Service, 2003) provides detailed BMP information for soil erosion and sediment control, stormwater management, and special area protection. The manual can be viewed at www.il.nrcs.usda.gov/engineer/urban/index.
- The Indiana Drainage Handbook (Indiana Department of Natural Resources Department of Water, 1996) provides detailed information on drainage, including BMPs. The document can be downloaded at www.in.gov/dnr/water/surface_water/DrainageHandbook/.
- The Lake County Watershed Development Ordinance (Lake County Stormwater Management Commission, 1999) demonstrates one regulatory means of implementing water resource protection measures. www.co.lake.il.us/ smc/regulatory/wdo/default.asp
- Living With Wetlands. A Handbook for Homeowners in Northeastern Illinois (The Wetlands Initiative, 1998) is designed to provide basic information about wetlands as natural systems, wetland protection, and wetland management techniques. The handbook can be downloaded from www.co.lake.il.us/smc/publications.
- The United States Golf Association and the Audubon International are partnering to support the Audubon Cooperative Sanctuary Program for Golf Courses, and environmental stewardship program highlighting habitat and water resource protection on golf courses. Visit www.usga.org/green/environment/audubon_program.html for more information. The following golf courses in Illinois are currently enrolled in the program:
  - Aldeen Golf Club in Rockford
  - Arrowhead Golf Club in Wheaton
  - Aurora Country Club in Aurora
  - Biltmore Country Club in North Barrington
  - Brae Loch Golf Course in Grayslake
  - Cantigny Golf Club in Wheaton
  - Countryside Golf Course in Mundelein
  - Elgin Country Club in Elgin

   - Emerald Hill Golf & Learning Center in Sterling
   - Flossmoor Country Club in Flossmoor
   - Forest Hills Country Club in Rockford
   - Heritage Bluffs Public Golf Course in Channahon
   - Jackson Park Golf Course in Chicago
   - The Ivanhoe Club in Ivanhoe
   - Kemper Lakes Golf Course in Long Grove
   - Naperville Country Club in Naperville
   - North Shore Country Club in Glenview
   - Olympia Fields Golf Club in Olympia Fields
   - Park Hills Golf Club in Freeport
   - Pottawatomie Golf Course in St. Charles
   - Prairie Landing Golf Club in West Chicago
   - Rock River Country Club in Rock Falls
   - Sandy Hollow Golf Course in Rockford
   - Settlers Hill Golf Course in Batavia
   - St. Charles Country Club in St. Charles
   - Silver Lake Country Club in Orland Park
   - Skokie Country Club in Glencoe
   - The Den in Bloomington
   - Village Links of Glen Ellyn in Glen Ellyn

- The Urban Small Sites Best Management Practice Manual (Metropolitan Council Environmental Services, 2001) provides details on 40 BMPs that are aimed at managing stormwater pollution for small urban sites in a cold-climate setting. View the manual at www.metrocouncil.org/environment/watershed/bmp/manual.htm.

- The Native Plant Guide for Streams and Stormwater Facilities in Northeastern Illinois (United States Department of Agriculture, Natural Resources Conservation Service, 1997) provides information for selection and placement of native species and species mixes along streams and stormwater facilities. Contact 847.468.0071 in north Cook County or 630.584.7961 in DuPage County for the Soil and Water Conservation District.

- Nonpoint Source Pollution: A Handbook for Local Governments (American Planning Association Planning Advisory Service Report Number 476, 1998) provides officials with strategies and approaches to reduce the effects of nonpoint source pollution. Visit www.planning.org.

- The Practice of Watershed Protection (Center for Watershed Protection, 2000) is a manual covering many aspects of watershed protection and can be ordered from the Center's website at www.cwp.org.

- Rain Gardens of West Michigan provides good general information on rain gardens at www.rain-gardens.org.

- Rain Gardens: A household way to improve water quality in your community (brochure) and Rain Gardens: A how-to manual for homeowners (technical manual) are available for downloading from the University of Wisconsin-Extension website at clean-water.uwex.edu/pubs/raingarden/.

- Site Planning for Urban Stream Protection (Schueler, T.R., for the Metropolitan Washington Council of Governments, 1995) can be downloaded from www.cwp.org/SPSP/TOC.htm or purchased from the Center for Watershed Protection at 410.461.8323.

- The United States Environmental Protection Agency natural landscaping website provides information on landscaping with native plants. See www.epa.gov/greenacres.
- Wild Ones-Natural Landscapers is a non-profit organization that provides information and support for those interested in natural landscaping. Visit www.for-wild.org.

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Other Salt Creek Documents include:

Guide for Funding Watershed Improvements and Projects
Salt Creek Watershed Map

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Suite 1800
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