APPENDIX A
INTRINSIC GSP SPECIFICATIONS

MINIMIZE SOIL COMPACTION

Description and Function:

Minimizing soil compaction relates directly to reducing total site disturbance, site clearing, site earthwork, the need for soil restoration, and the size and extent of costly, engineered stormwater management systems. Maintaining native soils can significantly reduce the cost of landscaping vegetation (higher survival rate, less replanting) and landscaping maintenance. Fencing off an area pre-construction can help minimize unnecessary soil compaction.

Soil is a physical matrix of weathered rock particles and organic matter that supports a complex biological community. This matrix has developed over a long time period and varies greatly within the northwest Arkansas region. Healthy soils which have not been compacted due to human activities perform numerous valuable stormwater functions, including:

- Effectively cycling nutrients,
- Minimizing runoff and erosion,
- Maximizing water-holding capacity,
- Reducing storm runoff surges,
- Absorbing and filtering excess nutrients, sediments, and pollutants to protect surface and groundwater,
- Providing a healthy root environment,
- Creating habitat for microbes, plants, and animals, and
- Reducing the resources needed to care for turf and landscape plantings.

Undisturbed soil consists of pores that have water-carrying and holding capacity. When soils are overly compacted, the soil pore spaces and permeability can be drastically reduced. In fact, the runoff response of vegetated areas with highly compacted soils closely resembles that of impervious areas, especially during large storm events (Schueler, 2000).

Applications

Minimizing soil compaction can be performed at any land development site during the design phase. It is especially suited for developments where significant “pervious” areas (i.e., post-development lawns and other maintained landscapes) are being proposed. If existing soils have already been excessively compacted, soil amendment may be used (see Appendix C for soil amendment information).

Design Considerations

Early in a project’s design phase, the designer should develop a soil management plan based on soil types and existing level of disturbance (if any), how runoff will flow off existing and proposed impervious areas, trees and natural vegetation that can be preserved, and tests indicating soil depth and quality. The soil management plan should clearly show the following:

1. ***No disturbance areas***. Soil and vegetation disturbance is not allowed in designated no disturbance areas. Protecting healthy, natural soils is the most effective strategy for preserving soil functions. Not only can the functions be maintained, but protected soil organisms are also available to colonize neighboring disturbed areas after construction.
2. ***Minimal disturbance areas.*** Limited construction disturbance occurs. These areas may allow some clearing, but no grading should be performed in these areas. If any clearing occurs, the area should be immediately stabilized, revegetated, and protected from construction traffic and related activity. Minimal disturbance areas do not include construction traffic areas.
3. ***Construction traffic areas***. Construction traffic is allowed in these areas. If these areas are to be considered fully pervious following development, a soil restoration program will be required.
4. ***Topsoil stockpiling and storage areas.*** If these areas are needed, they should be protected and maintained.
5. ***Topsoil quality and placement.*** Soil tests are necessary to determine if proposed topsoil meets minimum parameters. Critical parameters include: adequate depth (four inches minimum for turf, more for other vegetation), organic content minimum of 5%, and compaction that does not exceed that for native or in-place soils in adjacent undisturbed areas (Hanks and Lewandowski, 2003). To allow water to pass from one layer to the other, scarify then till the topsoil/subsoil contact consistent with Construction Guideline #4 to allow bonding when topsoil is reapplied to disturbed areas.

Construction Guidelines

1. At the start of construction, no disturbance and minimal disturbance areas must be identified with signage and fenced as shown on the construction drawings.
2. No disturbance and minimal disturbance areas should be strictly enforced.
3. No disturbance and minimal disturbance areas should be protected from excessive sediment and stormwater loads while adjacent areas remain in a disturbed state.
4. Topsoil stockpiling and storage areas should be maintained and protected at all times. When topsoil is reapplied to disturbed areas it should be “bonded” with the subsoil. This can be done by spreading a thin layer of topsoil (2-3 inches), tilling it into the subsoil, and then applying the remaining topsoil. Topsoil should meet City of Fayetteville specifications/requirements.

Stormwater Functions and Calculations

Volume and peak rate reduction:Minimizing soil compaction can reduce the volume of runoff by maintaining soil functions related to stormwater infiltration and evapotranspiration. Designers that use this intrinsic GSP should apply the relevant volumetric runoff coefficients (Rv) listed in Section 3 of Chapter 5 for the protected area to calculate the Rv for the contributing drainage area and determine if additional stormwater controls should be applied to meet the stormwater management goals (i.e. 80% reduction). The following guidance shall be following when applying Rv values for this Intrinsic GSP.

- ***No Disturbance Areas:*** No disturbance areas with post-development uses of forest or undisturbed open space should use Rv values for "forest cover" for the corresponding soil type.
- ***Minimal Disturbance Areas:*** Minimal disturbance areas with post-development land use of landscaped area and lawn should use the Rv values for "disturbed soils", due to the potential for compaction of the soils.
- ***Construction Traffic Areas:*** Non-impervious areas that were used as construction traffic areas should use the "disturbed soils" Rv value of 0.23 for Hydrologic Soil Group (HSG) Type D unless they have been amended. If soil has been amended in accordance with Appendix C, the Rv values for the respective soil type may be used.
- ***Topsoil stockpiling and storage areas:*** Non impervious areas that were used as topsoil stockpiling and storage areas should use the "disturbed soils" Rv value of 0.23 for HSG Type D unless they have been amended. If soil has been amended in accordance with Appendix C, the Rv values for the area's respective soil type may be used.
- ***Water quality improvement***: Minimizing soil compaction improves water quality through infiltration, filtration, chemical and biological processes in the soil and a reduced need for fertilizers and pesticides after development.

Maintenance

Sites with minimal soil compaction during the development process will require considerably less maintenance than sites with more compaction. Landscape vegetation, either retained or re-planted, will likely be healthier, have a higher survival rate, require less irrigation and fertilizer, and have better aesthetics.

Some maintenance activities such as frequent lawn mowing can cause considerable soil compaction after construction and should be kept to a minimum. Planting low-maintenance native vegetation (see vegetation list in Appendix D) is the best way to avoid damage due to maintenance. Areas designated as 'no disturbance areas' on private property should have an easement, deed restriction, or other legal measure imposed to prevent future disturbance or neglect.

Cost

Minimizing soil compaction generally results in significant construction cost savings. Design costs may increase due to a more time intensive design.

REFERENCES:

Hanks, D. and Lewandowski, A. *Protecting Urban Soil Quality: Examples for Landscape Codes and Specifications*. USDA-NRCS, 2003.

Ocean County Soil Conservation District. *Impact of Soil Disturbance during Construction on Bulk Density and Infiltration in Ocean County*, New Jersey. 2001. www.ocscd.org/publications.shtml

Schueler, T. "The Compaction of Urban Soils," *Watershed Protection Techniques*. Technical Note #107, 3(2): 661-665, January 2000.

Southeast Michigan Council of Governments. (SEMCOG) 2008 *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers*. Southeast Michigan Council of Governments, Detroit, MI.

MINIMIZE TOTAL DISTURBED AREA

A key component of LID is to reduce the impacts during development activities such as site grading, removal of existing vegetation, and soil mantle disturbance. This can be achieved through developing a plan to contain disturbed areas.

Description and Function

Disturbance at a development site can occur through normal construction practices, such as grading, cutting, or filling. Minimizing the total disturbed area of the site requires the consideration of multiple Intrinsic GSPs, such as cluster development and identifying and protecting sensitive areas. These GSPs serve to protect area resources by reducing site grading and maintenance required for long-term operation of the site.

Minimizing the total disturbed area of a site specifically focuses on how to minimize the grading and overall site disturbance, maximizing conservation of existing native plant communities and the existing soil mantle of a site. If invasive plant species are present in the existing vegetation, proper management of these areas may be required to maximize runoff reduction and evapotranspirative capacity.

Minimize grading: Reduction in grading can be accomplished in several ways, including conforming site design to existing topography and land surface, and aligning roads to follow existing contours as much as possible.

Minimize overall site disturbance: Site design criteria have evolved in municipalities to ensure that developments meet safety standards (i.e. sight distance and winter icing) as well as certain quality or appearance standards. Roadway design criteria should be flexible in order to optimize the fit for a given parcel and achieve optimal roadway alignment. The avoidance of environmentally sensitive resources, such as important woodlands, may be facilitated through flexible roadway layout.

Applications

Minimizing the total disturbed area of a site is best applied in lower density single-family developments, but can also be applied in residential developments of all types including commercial, office park, retail center, and institutional developments. Larger industrial park developments can also benefit from this GSP. However, as site size decreases and density and intensity of development increases, this GSP is uniformly more difficult to apply successfully. At some larger sites where Ultra Urban, Retrofit, or Highway/Road development is occurring, limited application may be feasible.

Design Considerations

During the initial conceptual design phase of a land development project, the following information should be provided; ideally through development of a Minimum Disturbance/Minimum Maintenance Plan:

1. ***Identify and Avoid Special Value/Sensitive Areas***: Delineate and avoid environmentally sensitive resources using existing data from appropriate agencies and based on field reconnaissance.
2. ***Minimize Disturbance at Site***: Modify road alignments (grades, curvatures, etc.), lots, and building locations to minimize grading, and earthwork as necessary to maintain safety standards and

municipal code requirements. Minimal disturbance design should allow the layout to best fit the land form without significant earthwork, such as locating development in areas of the site that has been previously cleared, if possible. If cut/fill is required, the use of retaining walls is preferable to earthwork. Limits of grading and disturbance should be designated on plan documentation submitted to the City for review/approval and should be physically designated at the site during construction via flagging, fencing, etc. In addition, utilizing natural drainage features generally results in less disturbance and requires less re-vegetation.

3. ***Minimize Disturbance at Lot:*** To decrease disturbance, grading should be limited to roadways and building footprints. Maintain maximum setbacks from structures, drives, and walks. Guidelines for limits of disturbance are given in the U.S. Green Building Council's Leadership in Energy & Environmental Design Reference Guide (Version: LEED 2009 November 2008). LEED's guidance is 40 ft beyond the building perimeter, 10 ft beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter, 15 ft beyond primary roadway curbs and main utility branch trenches, and 25 ft beyond constructed areas with permeable surfaces. The City may alter these maximum setbacks at its discretion.

Stormwater Functions and Calculations

Volume and Peak Rate: Any portion of a site that can be maintained in its pre-development state by using this GSP will not contribute increased stormwater runoff.

It may not be necessary to route these undisturbed areas through stormwater management control structures. If it is necessary to route them to stormwater control structures due to the site layout, the runoff should be routed through vegetated swales or low berms that direct flow to natural drainageways.

Water quality improvement

Water quality is benefited substantially by minimizing the disturbed area.

Maintenance

Minimizing site disturbance will reduce required site maintenance in both the short- and long-term. Areas of the site left as intact native plant communities do not typically require replacement with hard surfaces or additional vegetation to retain function. On the other hand, artificial surfaces such as pavement or turf grass require varying levels of maintenance throughout the life of a development. Higher levels of disturbance will also typically require significant maintenance of erosion control measures during the active development of a parcel, thus adding to short-term development costs.

While intact natural areas may require small amounts of occasional maintenance (typically through invasive species control) to maintain function, levels of maintenance required for hard surfaces or turf grass will remain static or, in most cases, increase over time. Avoiding disturbance to natural areas benefits the short term developer and the long-term owner by minimizing time and money needed to maintain artificial surfaces.

Cost

The reduced costs of minimized grading and earthwork should benefit the developer. Cost issues include both reduced grading and related earthwork as well as costs involved with site preparation, fine grading, and seeding.

REFERENCES

Arendt, Randall G, 2001. *Growing Greener: Conservation by Design.* Pennsylvania Department of Conservation and Natural Resources, Governor's Office of Local Government Services.

Center for Watershed Protection, 1998*, Better Site Design: A Handbook for Changing Development Rules in Your Community.* Ellicott City, MD.

Coffman, Larry. 2000, *Low Impact Development Design Strategies: An Integrated Design Approach.* EPA 841 B 00 0023. Prince George's County, MD: Department of Environmental Resources, Programs and Planning, 2000.

Delaware Department of Natural Resources and Environment Control, 1997. *Conservation Design for Stormwater Management: A Design Approach to Reduce Stormwater Impacts from Land Development.* Dover, DE

Metropolitan Washington Council of Governments, 1995, *Site Planning for Urban Stream Protection.* Washington, DC.

Minnesota Pollution Control Agency, 2006, *Minnesota Stormwater Manual Version 1.1.,* Minneapolis, MN. www.pca.state.mn.us/water/stormwater/stormwater-manual.html

Natural Resources Defense Council, June 2006, *Rooftops to Rivers: A Policy Guide for Decision Makers on How to Use Green Infrastructure to Address Water Quality and Volume Reduction for Communities with Combined Sewer Overflow Issues.* Washington, DC: www.nrdc.org/water/pollution/rooftops/contents.asp

Pennsylvania Department of Environmental Protection. 2006, *Pennsylvania Stormwater Best Practices Manual*. Harrisburg PA:, December 2006.

Southeast Michigan Council of Governments. (SEMCOG), 2008, *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers,* Detroit, MI.

Tyne, R., 2000, *Bridging the Gap: Developers Can See Green, Economic Benefits of Sustainable Site Design and Low- Impact Development*, Land Development, Spring 2000, pp. 27-31.

U.S. Environmental Protection Agency, 1993, *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Ocean Waters.* Washington, DC: report. 840 B 92 002. Section 6217 (g)

U.S. Environmental Protection Agency, 2007, *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*. PA 841-F-07-006. Washington, DC

PROTECT NATURAL FLOW PATHWAYS

A main component of LID is to identify, protect, and use natural drainage features, such as swales, depressions, and watercourses to help protect water quality. By incorporating natural drainage features, designers can reduce the need for structural drainage elements.

Description and Function

Many natural undeveloped sites have identifiable drainage features such as swales, depressions, and watercourses which effectively manage the stormwater generated on the site. By identifying, protecting, and using these features, a development can minimize stormwater impacts.

Naturally vegetated drainage features tend to slow runoff and thereby reduce peak discharges, improve water quality through filtration, and allow some infiltration and evapotranspiration to occur. Protecting natural drainage features can provide for significant open space and wildlife habitat, improve site aesthetics and property values, and reduce the generation of stormwater runoff itself. If protected and used properly, natural drainage features generally require very little maintenance and can function effectively for many years.

Site designs should use and/or improve natural drainage pathways whenever possible to reduce or eliminate the need for stormwater pipe networks. This can reduce costs, maintenance burdens, and site disturbance related to pipe installation. Natural drainage pathways should be protected from significantly increased runoff volumes and rates due to development. The design should prevent the erosion and degradation of natural drainage pathways through the use of upstream volume and rate control BMPs, if necessary. Level spreaders, erosion control matting, revegetation, outlet stabilization, and check dams can also be used to protect natural drainage features.

Variations

Natural drainage features can be modified to increase efficacy through the design and construction process. Examples include constructing slight earthen berms around natural depressions or other features to create additional storage, installing check dams within drainage pathways to slow runoff and promote infiltration, and planting additional native vegetation within swales and depressions.

Applications

As density and overall land disturbance decreases, this GSP can be used with a greater variety of land uses and development types. It is best used in residential development, particularly lower density single-family residential development. Where municipal ordinances already require a certain percentage of the total development area to remain as undeveloped open space, this open space requirement can be overlain onto natural flow pathways/drainage features, as well as floodplains, wetlands, and related riparian areas. After minimizing runoff as much as possible, reduced runoff quantities can then be distributed into this natural flow pathway system, on a broadly distributed basis, lot by lot.

Other land uses such as commercial and industrial developments tend to be associated with higher density development. This results in higher impervious coverage and greater site disturbance, making protecting and conserving natural flow pathways/drainage areas more difficult.

Applications for both retrofit and highway/road uses are limited. In terms of retrofitting, some developed sites may have elements of natural flow pathways/drainage features intact, although many presettlement site features may have been altered and/or eliminated. Lower density developments may offer limited retrofit potential. Similarly, highway/road projects are likely to be limited due to overall available area and significant drainage feature disturbance.

Design Considerations

1. ***Identify natural drainage features:*** Identifying and mapping natural drainage features is generally done as part of a comprehensive site analysis. This process is an integral first step of site design. Subtle site features such as swales, drainage pathways, and natural depressions should be delineated in addition to more commonly mapped hydrologic elements such as wetlands, perennial, intermittent and ephemeral streams, and waterbodies.

Source: Delaware Department of Natural Resources and Environmental Control - Conservation Design for Stormwater Management

2. ***Use natural drainage features to guide site design:*** Instead of imposing a two-dimensional paper design on a particular site, designers can use natural drainage features to steer the site layout. Drainage features define contiguous open space and other undisturbed areas as well as road alignment and building placement. The design should minimize disturbance to natural drainage features. Drainage features that are to be protected should be clearly shown on all construction plans. Methods for protection, such as signage and fencing, should also be noted on applicable plans.

3. ***Use native vegetation:***Natural drainage pathways should be planted with native vegetative buffers and the features themselves should include native vegetation where applicable. If drainage features have been previously disturbed, they can be restored with native vegetation and buffers.

Stormwater Function and Calculations

Volume reduction and Peak rate

Protecting natural flow pathways can reduce the volume of runoff in several ways. Reducing disturbance and maintaining a natural cover reduces the volume of runoff through infiltration and evapotranspiration. Using natural flow pathways further reduces runoff volumes through allowing increased infiltration to occur, especially during smaller storm events. Encouraging infiltration in natural depressions also reduces stormwater volumes. Employing strategies that direct non-erosive sheet flow onto naturally vegetated areas also promotes infiltration – even in areas with less permeable soils (Hydrologic Soils Groups C and D).

Water quality improvement

Protecting natural flow pathways improves water quality through filtration, infiltration, sedimentation, and thermal mitigation.

Maintenance

Natural drainage features that are properly protected and used as part of site development should require very little maintenance. However, periodic inspections are important. Inspections should assess erosion, bank stability, sediment/debris accumulation, and vegetative conditions, including the presence of invasive species. Problems should be corrected in a timely manner.

Cost

Protecting natural flow pathways generally results in construction cost savings by reducing infrastructure. Protecting these features results in less disturbance, clearing, and earthwork and requires less revegetation. Using natural flow pathways reduces the need and size of more costly engineered stormwater conveyance systems.

REFERENCES

Center for Watershed Protection. 1998. *Better Site Design: A Handbook for Changing Development Rules in your Community.* Ellicott City, MD,

Coffman, Larry. 2000. *Low Impact Development Design Strategies: An Integrated Design Approach.* EPA 841 B 00 0023. Department of Environmental Resources, Programs, and Planning, Prince George's County, MD.

Delaware Department of Natural Resources and Environment Control. 1997. *Conservation Design for Stormwater Management: A Design Approach to Reduce Stormwater Impacts from Land Development.* Dover DE.

Pennsylvania Department of Environmental Protection. 2006. *Pennsylvania Stormwater Best Practices Manual*. Harrisburg, PA.

Southeast Michigan Council of Governments (SEMCOG). 2008. *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers.* Detroit, MI.

U.S. Environmental Protection Agency. 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Ocean Waters.* 840 B 92 002. Section 6217 (g) Report. Washington, DC.

Washington State Department of Ecology. 1992. *Stormwater Program Guidance Manual for the Puget Sound Basin*. Olympia, WA.

PROTECT RIPARIAN BUFFERS

Description

Riparian buffer areas are important elements of local communities' green infrastructure. These areas are critical to the biological, chemical, and physical integrity of our waterways. Riparian buffer areas protect water quality by cooling water, stabilizing banks, mitigating flow rates, and providing for pollution and sediment removal by filtering overland sheet runoff before it enters the water. The Environmental Protection Agency defines buffer areas as, "areas of planted or preserved vegetation between developed land and surface water, [which] are effective at reducing sediment and nutrient loads." The City of Fayetteville's Streamside Protection Best Management Practices Manual establishes the requirements for protecting riparian buffers.

Applications

As with the "protect sensitive areas" Intrinsic GSP, protecting riparian buffer areas has great value and utility for virtually all types of development proposals and land uses. This GSP works best on larger sites but can be used on any site. Although riparian buffer programs could be used in the densest of settings, their application is likely to be limited in high density contexts. Creative design can maximize the potential of riparian buffers. Clustering and density bonuses are design methods available to increase the amount and connectedness of open space areas such as riparian buffers.

Design Considerations

Physical design

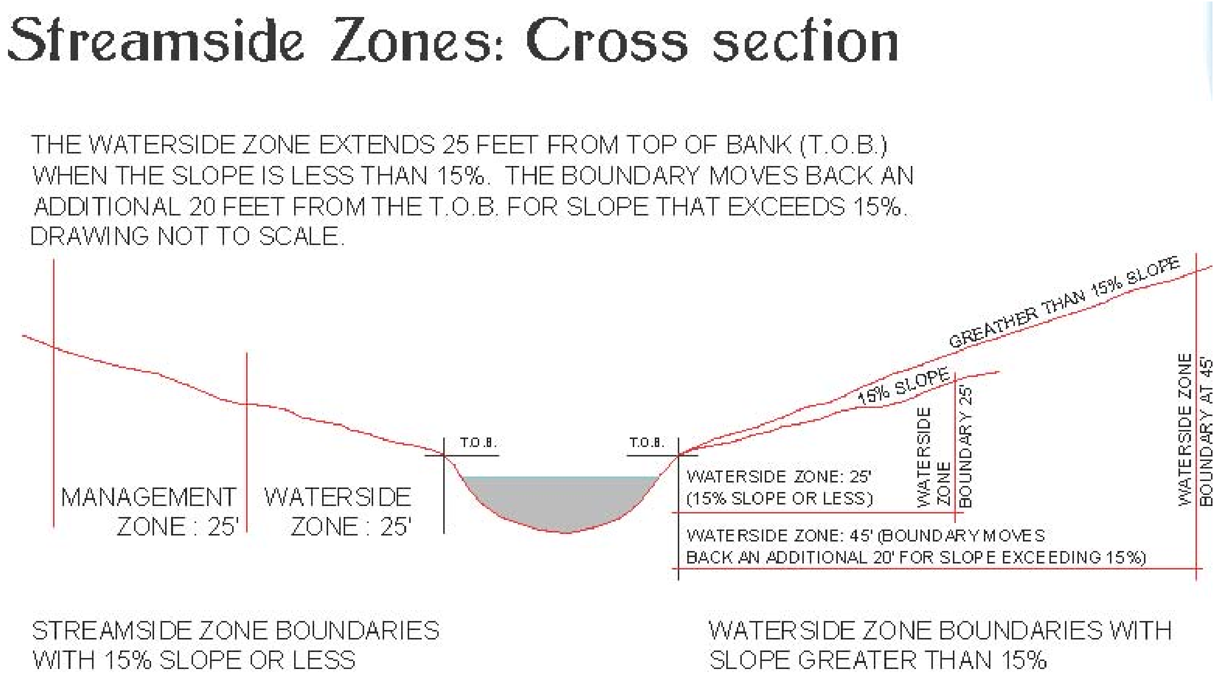
Consider the following when establishing additional riparian buffer area widths and related specifications:

- Existing or potential value of the resource to be protected,
- Site, watershed, and buffer characteristics,
- Intensity of adjacent land use, and
- Specific water quality and/or habitat functions desired. (Chesapeake Bay Riparian Handbook).

Riparian buffers can be divided into different zones that include various vegetation targets to enhance the quality of the body of water.

Zone 1: Also termed the "waterside zone," begins at the edge of the top of the stream bank of the active channel and extends a minimum distance of 25 ft, measured horizontally on a line perpendicular to the water body. The waterside zone should extend an additional 20 ft from the top of the bank for slopes that exceed 15%. Undisturbed vegetated area aims to protect the physical and ecological integrity of the stream ecosystem. The vegetative target for the streamside zone is undisturbed native woody species with native plants forming canopy, understory, and duff layer. Where such forest does not grow naturally, then native vegetative cover appropriate for the area (such as grasses, forbs, or shrubs) is the vegetative target.

Zone 2: Also termed the "management zone," extends immediately from the outer edge of Zone 1 for a minimum distance of 25 ft. This managed area of native vegetation protects key components of the stream ecosystem and provides distance between upland development and the streamside zone. The vegetative target for the middle zone is either undisturbed or managed native woody species or, in its absence, native vegetative cover of shrubs, grasses, or forbs. Undisturbed forest, as in Zone 1, is encouraged strongly to protect future water quality and the stream ecosystem.



Source: Streamside Protection Best Management Practices Manual

Stormwater Functions and Calculations

Volume reduction and Peak rate - Protecting riparian buffers can reduce the volume of runoff in several ways. Reducing disturbance adjacent to waterways and maintaining a natural cover reduces the volume of runoff through infiltration and evapotranspiration.

Water quality improvement

Water quality is benefited substantially by avoiding negative impacts which otherwise would have resulted from impacts to riparian buffers (e.g., loss of water quality functions from riparian buffers, from wetland reduction, etc.).

Cost

The costs of protecting riparian areas relate to a reduction in land available for development. However, most riparian areas are located in wetlands or floodplains, restricting the amount of buildable area.

REFERENCES

Center for Watershed Protection. 1998. *Better Site Design: A Handbook for Changing Development Rules in your Community*. Ellicott City, MD.

Cwikiel, Wilfred. 2003. *Michigan Wetlands – Yours to Protect: A Citizen's Guide to Wetland Protection* (third edition). Petoskey, MI: Tip of the Mitt Watershed Council.

Huron River Watershed Council. 2008. *Riparian Buffer Model Ordinance.*

Keller, Chency, et al. 1993. *Avian Communities in Riparian Forests of Different Widths in Maryland and Delaware, Wetlands,* Volume 13: (2): 137-144.

Meehan, William, Editor. 1991. *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*, Special Publication 19. American Fisheries Society. Bethesda, MD.

Metropolitan Washington Council of Governments. 1995. *Riparian Strategies for Urban Stream Protection.* Washington, DC.

Nutrient Subcommittee of the Chesapeake Bay Program. 1995. *Water Quality Functions of Riparian Buffer Systems in the Chesapeake Bay Watershed*. EPA 903-R-95-004.

Oakland County Planning and Economic Development Services. 2007. *Planning for Green River Buffers: A Resource Guide for Maximizing Community Assets Related to Rivers*.

Southeast Michigan Council of Governments. (SEMCOG) 2008. *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers.* Detroit, MI.

U.S. Department of Agriculture, Forest Service, Northeastern Area, State and Private Forestry. 1998. *Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers.*

U.S. Department of Agriculture, Forest Service, Northeastern Area, State and Private Forestry. 1991. *Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources.*

U.S. Department of Agriculture, Forest Service, Southern Region. 1992. *Stream Habitat Improvement Handbook*. Tech Pub R8-TP16.

U.S. Environmental Protection Agency. 1992. *Notes on Riparian and Forestry Management, USEPA Nonpoint Source News Notes*. Washington DC.

PROTECT SENSITIVE AREAS

Protecting sensitive and special value features is the process of identifying and avoiding certain natural features during development. This allows these features to be used for various benefits, including reducing stormwater runoff.

Protecting sensitive areas can be implemented both at the site level and throughout the community. For prioritization purposes, natural resources and their functions may be weighted according to their functional value. Sensitive areas should be preserved in their natural state to the greatest extent possible and are not the appropriate place to locate stormwater infrastructure.

Description and Function

Protecting sensitive areas challenges the site planner to inventory and then, to the greatest extent possible, avoid resource sensitive areas at a site, including riparian buffers, wetlands, hydric soils, floodplains, steep slopes, woodlands, valuable habitat zones, and other sensitive resource areas. Development, directed away from sensitive areas, can be held constant, if BMPs such as cluster development are also applied.

A major objective of LID is to accommodate development with fewer impacts to the site. If development avoids encroachment upon, disturbance of, and impact to those natural resources which are especially sensitive to land development impacts and/or have special functional value, then low impact development may be achieved.

The first step in protecting sensitive areas is for the site planner to define, inventory, and map which resources are especially sensitive and/or have special value at a site proposed for development. Many sensitive areas exist within the City of Fayetteville. The following is a partial list of potential sensitive area resources.

- Lakes and Streams
- Natural Rivers
- Wetlands or Wetland Indicator Areas
- Flood Prone Areas, Special Flood Hazard Areas
- Parks and Recreation Areas
- Historic Sites
- Historic Bridges
- Wet Prairie
- Conservation Easements
- Karst areas or Recharge Zones

Potential Applications

Regardless of land use type, protecting sensitive areas is applicable across all types of land development projects, whether residential of varying densities or office park, retail center or industrial and institutional uses. As density and intensity of uses increases, ease of application of this BMP decreases.

Design Considerations

In the future, the City may develop an inventory of sensitive areas. However, sensitive areas should be identified regardless of whether they have been inventoried by the City. Sensitive areas are subject to applicable state and federal regulations.

Potential requirements but the City may consider in the future are listed below.

- Conservation easement – Given to land conservancy or maintained by homeowners association.
- Requirements in the master deed and bylaws for protection and preservation.
- Boundary markers at edges of lots to minimize encroachment.
- Cooperative agreements for stewardship of sensitive areas between homeowners' associations and local conservation organizations.

Stormwater Functions and Calculations

Volume reduction and Peak rate – Designers that use this intrinsic GSP can use natural predevelopment hydrologic conditions within protected areas thereby reducing site runoff.

Water Quality Improvement

Water quality is benefited substantially by avoiding negative impacts which otherwise would have resulted from impacts to sensitive areas (e.g., loss of water quality functions from riparian buffers, from wetland reduction, etc.).

Construction Guidelines

Although protecting sensitive areas happens early in the site plan process, it is equally important that the developer and builder protect these areas during construction.

The following guidelines describe good planning practices that will help ensure protection of a few common environmentally sensitive resources during construction.

Water Resources

- If vegetation needs to be reestablished, plant native species, or use hydroseed and mulch blankets immediately after site disturbance.
- Use bioengineering techniques, where possible, to stabilize stream banks.

- Block or protect storm drains in areas where construction debris, sediment, or runoff could pollute waterways.
- During and after construction activities, sweep the streets to reduce sediment from entering the storm drain system.
- Avoid hosing down construction equipment at the site unless the water is contained and does not get into the stormwater conveyance system.
- Implement spill control and clean-up practices for leaks and spills from fueling, oil, or use of hazardous materials. Use dry clean-up methods (e.g., absorbents) if possible. Never allow a spill to enter the stormwater conveyance system.
- Avoid mobile fueling of equipment. If mobile fueling is necessary, keep a spill kit on the fueling truck.
- Properly dispose of solid waste and trash to prevent it from ending up in our lakes and streams.
- When protecting riparian buffer areas, consider the three buffer zones in protection criteria.

Wetlands

- Avoid impacts to wetlands whenever possible. If impractical, determine if a wetland permit is needed from the state or local government. (If any permit requirements or wetland regulations conflict with these guidelines, comply with the permit or regulation).
- Excavate only what is absolutely necessary to meet engineering requirements. Do not put excavated material in the wetland. (Excavated material could be used in other areas of the site to improve seeding success).
- If construction activities need to occur within a wetland, activities should be timed, whenever possible, when the ground is firm and dry. Avoid early spring and fish-spawning periods.
- Install flagging or fencing around wetlands to prevent encroachment.
- Travel in wetlands should be avoided. Access roads should avoid wetlands whenever possible. Crossing a wetland should be at a single location and at the edge of the wetland, if possible.
- Never allow a spill to enter area wetlands.

Floodplains

- Design the project to maintain natural drainage patterns and runoff rates if possible.
- Maintain as much riparian vegetation as possible. If riparian vegetation is damaged or removed during construction, replace with native species.
- Use bioengineering techniques to stabilize stream banks.
- Keep construction activity away from wildlife crossings and corridors.
- Stockpile materials outside of the floodplain and use erosion control techniques.

Woodlands

- Protect trees on sites with severe design limitations, such as steep slopes and highly erodible soils.
- Preserve trees along watercourses to prevent bank erosion, decreased stream temperatures, and to protect aquatic life.
- Protect the critical root zone of trees during construction. This is the area directly beneath a tree's entire canopy. For every inch of diameter of the trunk, protect 1.5 ft of area away from the trunk.
- Avoid trenching utilities through the tree's critical root zone.
- Avoid piling excavated soil around any tree.
- Replace trees removed during construction with native trees.
- Conduct post-construction monitoring to ensure trees impacted by construction receive appropriate care.

General construction considerations

- Conduct a pre-construction meeting with local community officials, contractors, and subcontractors to discuss natural resource protection. Communicate agreed-upon goals to everyone working on the project.
- Insert special requirements addressing sensitive natural areas into plans, specifications, and estimates provided to construction contractors. Note the kinds of activities that are not allowed in sensitive areas.
- Confine construction and staging areas to the smallest necessary and clearly mark area boundaries. Confine all construction activity and storage of materials to designated areas.
- Install construction flagging or fencing around sensitive areas to prevent encroachment.
- Excavate only what is absolutely necessary to meet engineering requirements. Do not put excavated material in sensitive areas. (Excavated material could be used in other areas of the site to improve seeding success.)
- Conduct onsite monitoring during construction to ensure sensitive areas are protected as planned. Conduct post-construction monitoring to ensure sensitive areas that were impacted by construction receive appropriate care.

Maintenance

Ownership of these natural areas will be assumed by homeowners' associations or simply the specific individual property homeowners where these resources are located. Specific maintenance activities will depend upon the type of vegetation present in the preserved natural area where woodlands require little to no maintenance and open lawn require higher maintenance.

Cost

When development encroaches into sensitive areas, dealing with their special challenges invariably adds to development and construction costs. Sometimes these added costs are substantial, as in the case of working with wetlands or steep slopes.

Sometimes costs emerge only in longer-term operation, like encroachment in floodplains. This can translate into added risk of building damage for future owners, as well as health and safety impacts, insurance costs, and downstream flooding. If all short- and long-term costs of impacting sensitive areas were quantified and tallied, total real costs of sensitive area encroachment would increase substantially. Conversely, protecting sensitive areas results not only in cost savings, but also in water quality benefits.

At the same time, reduction in potential development areas resulting from protecting and conserving sensitive areas can have the effect of altering - even reducing - a proposed development program, thereby reducing development yield and profit. To address this, this Intrinsic GSP can be applied together with a cluster development approach if appropriate.

REFERENCES

Arendt, Randall G. 2001. *Growing Greener: Conservation by Design.* Pennsylvania Department of Conservation and Natural Resources, Natural Lands Trust, Governor's Office of Local Government Services.

Coffman, Larry. 2000. *Low Impact Development Design Strategies: An Integrated Design Approach.* EPA 841 B 00 0023. Department of Environmental Resources, Programs and Planning, Prince George's County, MD.

Delaware Department of Natural Resources and Environment Control. 1997. *Conservation Design for Stormwater Management: A Design Approach to Reduce Stormwater Impacts from Land Development.* Brandywine Conservancy Environmental Management Center.

Minnesota Pollution Control Agency. 2006. *Minnesota Stormwater Manual, Version 1.1.* www.pca.state.mn.us/water/stormwater/stormwater-manual.html

Natural Resources Defense Council. 2006. *Rooftops to Rivers: A Policy Guide for Decision Makers on How to Use Green Infrastructure to Address Water Quality and Volume Reduction for Communities with Combined Sewer Overflow Issues.* Washington, DC. www.nrdc.org/water/pollution/rooftops/contents.asp

Southeast Michigan Council of Governments (SEMCOG). 2008. *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers. Detroit, MI.*

Stormwater Program Guidance Manual for the Puget Sound Basin. 1992. Washington State Department of Ecology, Olympia, WA.

U.S. Department of Agriculture-Soil Conservation Service. 1988. *Effects of Conservation Practices on Water Quantity and Quality,* Vols. 1-4., Washington, DC.

U.S. Environmental Protection Agency. 2007. *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices.* PA 841-F-07-006. Washington, DC.

REDUCE IMPERVIOUS AREA

Reducing impervious surfaces includes minimizing areas such as streets, parking lots, and driveways. By reducing the amount of paved surfaces, stormwater runoff is decreased while infiltration and evapotranspiration opportunities are increased.

Description and Function

Reducing street imperviousness performs valuable stormwater functions in contrast to conventional development in the following ways:

- Increases infiltration,
- Decreases runoff volumes,
- Increases stormwater time of concentration,
- Improves water quality by decreasing nonpoint source pollutant loading, and
- Decreases the concentration and energy of stormwater.

Imperviousness greatly influences stormwater runoff volume and quality by increasing the rapid transport of stormwater and collecting pollutants from atmospheric deposition, automobile leaks, and additional sources. Stream degradation has been observed at impervious levels as low as 10-20 percent watershed-wide (Center for Watershed Protection, 1995), when these areas are managed conventionally. Recent findings indicate that degradation is observed even at much lower levels of imperviousness (Villanova University 2007 Stormwater Management Symposium, Thomas Schueler, Director, Chesapeake Stormwater Network). Reducing imperviousness improves an area's hydrology, habitat structure, and water quality.

Design Considerations

Refer to the City of Fayetteville Master Street plan and applicable subdivision regulations for minimum street width and parking requirements. The runoff from rooftop imperviousness can be mitigated through the use of green roofs. Refer to GSP-12 specification in Appendix B. Other GSPs may also apply.

Stormwater Functions and Calculations

Quantifying impervious areas at a proposed development site, pre- to post-development continues to dominate stormwater calculations. Stormwater calculations, as discussed in Section 3 of Chapter 5, are sensitive to pervious areas and their contribution to total volume of runoff, increased peak rate of runoff, and increased generation of nonpoint source pollutants. A reduction in imperviousness achieved through reduced street widths and lengths and reduced paved parking areas automatically reduces both the volume and peak rate of runoff. As water quality is affected by runoff volume, reduction in imperviousness generally translates into a reduction in water quality management requirements.

Maintenance
A reduction in impervious area results in decreased maintenance. For example, whether publicly or privately maintained, reducing roadway or parking lot imperviousness typically translates into reduction in all forms of maintenance required, from basic roadway repair to winter maintenance and snow removal.

Cost
Significant cost reductions can be achieved through minimizing the amount of impervious area on the developed site.

REFERENCES

Center for Watershed Protection. 1994. "*The Importance of Imperviousness", Watershed Protection Techniques*, Vol.1, No.3. Ellicott City, MD.

Center for Watershed Protection. 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*.

Maryland Department of the Environment. 2000. *Maryland Stormwater Design Manual*.

Schueler, Tom. 1995. *Site Planning for Urban Stream Protection*. Center for Watershed Protection. Silver Spring, MD.

SEMCOG. 2003. *Land Use Tools and Techniques: A Handbook for Local Communities*. Detroit, MI,

SEMCOG. 2002. *Opportunities for Water Resource Protection in Plans, Ordinances, and Programs*. Detroit, MI.

Southeast Michigan Council of Governments (SEMCOG). 2008. *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers.* Detroit, MI.