LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID OVERVIEW

Low Impact Development

WHAT IS IT?

Low Impact Development (LID) is defined as "an innovative land planning and design approach which seeks to maintain a site's pre-development ecological and hydrological function through the protection, enhancement, or mimicry of natural processes." There are many reasons to use LID, but stormwater management is typically the primary one.

TRADITIONAL DEVELOPMENT VERSUS LOW IMPACT DEVELOPMENT

Many of the developed properties we see today were designed with limited regard for the landscape's natural features or hydrology. Excessively wide roads and expansive parking lots, curbs and catchbasins, fragmented forest blocks, and straightened stream channels are fairly common occurrences throughout the landscape. This is not surprising, as traditional development focuses on maximizing the land area available for active human use. Unfortunately, such development typically brings with it a variety of problems including but not limited to decreased infiltration, lower evaporation and transpiration rates, and increased surface runoff.

LID practitioners recognize and value the critical functions and benefits that the natural landscape provides and ensures that those functions are balanced with active human use through sustainable planning and design through an extensive site assessment of hydrology, topography, soils, vegetation and water features, the planner/designer is better able to place structures and site elements to minimize potential impacts. The end result is a development that balances human benefit with environmental function. Such developments often have higher aesthetic and recreational value and thus lead to increased land and home values.

HOW DOES LID RELATE TO GREEN STORMWATER INFRASTRUCTURE (GSI)?

For many years, the terms GSI and LID were used interchangeably. When these concepts were first introduced, the field of practice was fairly narrow and this worked well. However, as the field broadened and developed, the interchangeable nature of the terms became confusing. In Vermont, a clear distinction is made between the two terms. LID refers to an approach to land planning and site design that tries to prevent and minimize environmental degradation. GSI, on the other hand, refers to and relies on the physical elements (natural or man-made) of the landscape when addressing or minimizing impacts from stormwater runoff. In other words, LID is a series of planning principles and GSI is a set of physical best management practices.

Factsheet prepared by the Vermont Green Infrastructure Initiative, a program of the Watershed Management Division of the VT Department of Environmental Conservation (http://watershedmanagement.vt.gov/).

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WATERSHED MANAGEMENT DIVISION
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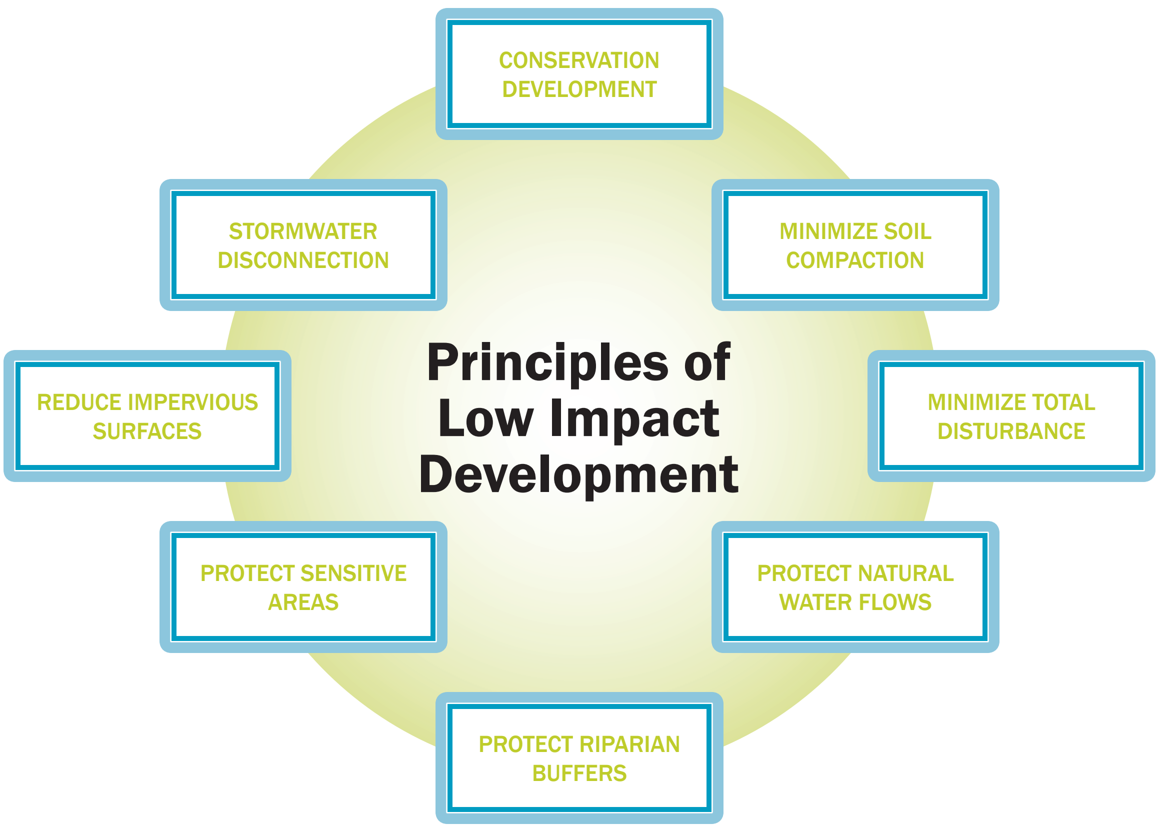
LID OVERVIEW

PUTTING THE CONCEPT TO WORK

LID is based on an adherence to eight main principles (see below). When these principles are used to plan/design a new development, they can help avoid potential environmental issues down the road. It is, however, important to note that LID can only go so far. While impacts may be minimized, they are not completely eliminated, especially in regards to stormwater. Throughout the design process, planners/designers should identify and evaluate locations where best management practices and green stormwater infrastructure can be used to further enhance the LID strategy. Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

THE FOLLOWING FACTSHEETS ARE AVAILABLE IN THE LID SERIES:

- > LID PRINCIPLE #1: CONSERVATION DEVELOPMENT
- > LID PRINCIPLE #2: MINIMIZE SOIL COMPACTION
- > LID PRINCIPLE #3: MINIMIZE TOTAL DISTURBANCE
- > LID PRINCIPLE #4: PROTECT NATURAL WATER FLOWS
- > LID PRINCIPLE #5: PROTECT RIPARIAN BUFFERS
- > LID PRINCIPLE #6: PROTECT SENSITIVE AREAS
- > LID PRINCIPLE #7: REDUCE IMPERVIOUS SURFACES
- > LID PRINCIPLE #8: STORMWATER DISCONNECTION



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LOW IMPACT DEVELOPMENT (LID) FACT SHEET

LID PRINCIPLE #1

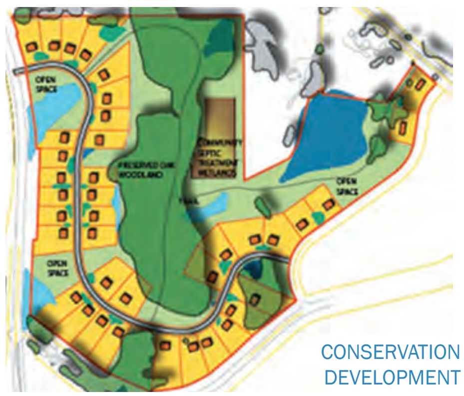
Conservation Development

WHAT IS IT?

Conservation development is a method of planning that seeks to protect the natural environment of an area by preserving open space, protecting wildlife habitats and corridors, and enhancing site features. For residential developments, this approach is considered 'density neutral,' meaning that the overall number of lots is similar to what would be found in a traditional development yet the major difference is in the size and placement of each lot. Conservation developments often have a high percentage of open/protected space with development clustered around significant natural features. When done on a large scale, conservation development can result in large networks of interconnected conservation lands that provide a number of environmental, recreational, and aesthetic benefits.

Source: Minnesota Stormwater Manual

TRADITIONAL DEVELOPMENT



CONSERVATION DEVELOPMENT

WHAT ARE THE ADVANTAGES?

Conservation developments are designed and planned around a site's most significant resources. In fact, natural elements are the first aspect of a site to be looked at during the planning phase. As a result, the ecological integrity of these areas remains mostly or fully intact, thereby providing a community with a variety of ecological and recreational benefits that would otherwise have been lost. Furthermore, the preservation of open/natural space improves the viewshed and general aesthetic of the developed areas, leading to increased property values.

In relation to stormwater, since a high percentage of the area remains undeveloped, the impacts of hydrologic modification are minimized. By keeping a majority of the pre-development hydrology intact, stormwater runoff volumes are kept low and water quality is kept high. As an added benefit, existing site features may on occasion be used as green stormwater infrastructure, negating the need for other structural methods of management. In some cases, this can result in additional space being available for development.

WHAT ARE THE BARRIERS?

Conservation development, like many other LID principles, can be either hindered or enhanced by municipal bylaws and ordinances. Many municipal bylaws in Vermont are based on minimum parcel sizes, conditional use requirements, and rigid zoning and subdivision regulations which often conflict with the conservation development approach. This lack of flexibility can result in difficulties during the review process, unnecessary steps for the developer, and delays in approval. In this way, municipalities unwillingly create a disincentive to conservation development and the use of other LID principles.

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PUTTING THE CONCEPT TO WORK

Conservation development is a step-wise planning process that begins with general mapping and a survey of natural or undisturbed conditions. Details such as wetlands, floodplains, steep slopes, soil type, woodlands, drainage features, large trees, meadows and other features that contribute to the character of the site are all included. Once this base information is collected and mapped, landowners and their consultants schedule an on-site visit with municipal and/or state officials. This provides the municipal officials with a better understanding of the site and its features. This is followed by a concept plan that shows areas of proposed development and proposed conservation. Feedback from municipal officials and other stakeholders is crucial at this point in the process and can save a great deal of design and engineering cost in the long run.

With a concept plan in place, a designer can then officially begin the design process. It is generally agreed that this is done in sequential order as outlined below:

> Designate open space, primary, and secondary conservation areas
> Locate building sites
> Layout streets, trails, or other transportation routes
> Delineate lot lines as necessary

Whether done in a residential, commercial, or industrial setting, the resulting design is one that provides a multitude of benefits with little impact to the surrounding landscape.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

AN EXAMPLE OF TRADITIONAL DEVELOPMENT

AN EXAMPLE OF CONSERVATION DEVELOPMENT

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET

LID PRINCIPLE #2

Minimize Soil Compaction

WHAT IS IT?

Minimizing soil compaction is the process of protecting a site's existing soils from unnecessary damage during construction. This is usually done by identifying high quality or highly permeable soils during the design phase and setting limits of disturbance during construction. Undisturbed soil contains air spaces that have water-carrying and holding capacity. When soils are compacted by heavy equipment, those spaces disappear and the ability of the soil to infiltrate and absorb water is reduced. Studies have shown that runoff volumes from vegetated areas with highly compacted soils closely resemble those of impervious areas, especially during large storm events (Schueler, 2000).

Source: www.vineandbranch.net

FENCING MARKS THE LIMIT OF DISTURBANCE ON THIS CONSTRUCTION SITE

WHAT ARE THE ADVANTAGES?

Minimizing soil compaction has a number of advantages. Maintaining soils in their natural condition, specifically sandy and loamy soils, allows for the maximum use of those soils for rainwater infiltration, reducing the overall cost of stormwater infrastructure and management on a site. As an additional benefit, undisturbed soils in unforested areas provide an ideal environment for the establishment of vegetation including grasses, shrubs, and trees. Plants will thrive and see dramatically increased vigor and survivability in uncompacted soils. Undisturbed soils also provide important water quality benefits, specifically through the biological breakdown of pollutants. There are roughly 50 billion microbes in one tablespoon of soil. These microbes perform key roles in nitrogen fixation, the phosphorus cycle, pollution immobilization, and mineralization. When soils are damaged by compaction and other disturbance, the ability of microbes to perform these key functions is compromised.

WHAT ARE THE BARRIERS?

Identifying and protecting high quality soils can be a difficult task, particularly on small or densely urban sites. In general it requires a good deal of forethought, some additional work during the design phase, and a general understanding of soil and groundwater characteristics. It also requires strong communication between the design and construction teams to ensure that limits of disturbance are clearly understood. There may be a perception that minimizing soil compaction will cost more money due to increased design time and oversight. However, those costs are often balanced by the savings found during construction.

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #2: MINIMIZE SOIL COMPACTION

PUTTING THE CONCEPT TO WORK

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

> Protected Areas

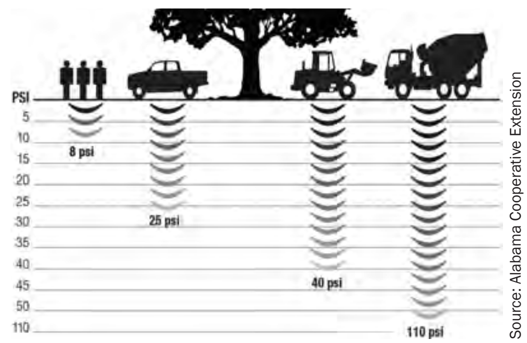
Soil and vegetation disturbance is not allowed. Protection of healthy, natural soils is the most effective strategy for preserving soil health and function.

> Minimal Disturbance Areas

Limited construction disturbance occurs. Any area to be vegetated after development should be designated as a minimal disturbance area. If areas are to be to be considered fully pervious following development, a program of soil remediation will be necessary.

> Construction Traffic Areas

Construction traffic is allowed. If areas are to be to be considered fully pervious following development, a program of soil remediation will be necessary.



SOURCES OF COMPACTION AND THEIR RELATIVE INFLUENCE ON SOIL IN POUNDS PER SQUARE INCH

> Topsoil Stockpiling and Storage Areas

Clearly defined areas to store soil, gravel and other media. These areas should maintained using soil erosion prevention and sediment control measures.

If high quality soils are not properly protected, they can be partially restored using soil remediation techniques such as aeration and compost amendment. These techniques should happen during the final phases of a construction project.

Sites that have minimized soil compaction properly during construction should require less maintenance than sites that have not. These sites will also likely have higher aesthetic value due to healthier vegetation.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

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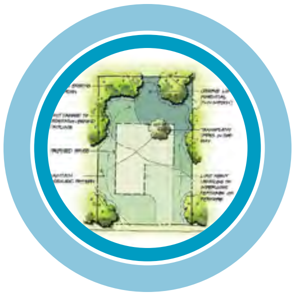
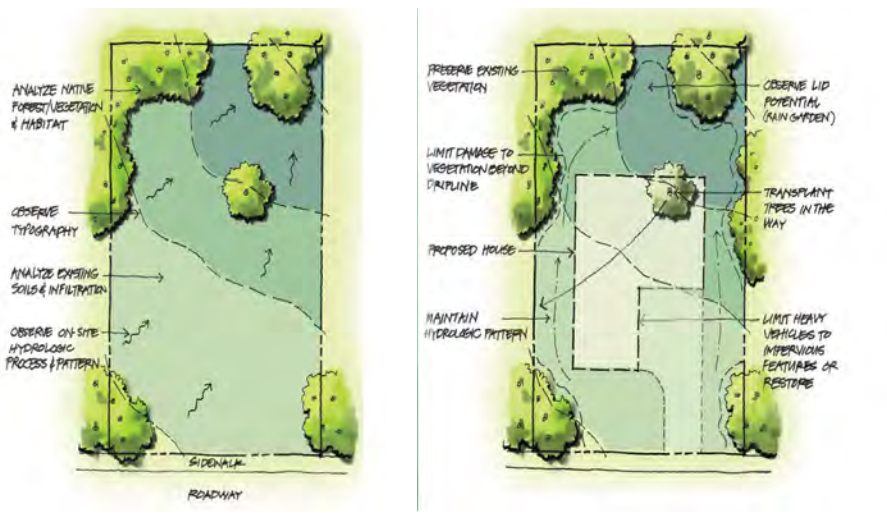


LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #3

Minimize Total Disturbance

WHAT IS IT?

Major disturbances on a site occur through normal construction practices such as grading, cutting, or filling. These practices can quickly damage the ecological integrity and hydrology of a site by denuding vegetation, compacting soil, and altering water flows. This is particularly an issue when the footprint of the construction area extends well beyond what is necessary. Minimizing total disturbance specifically focuses on limiting the extent of vegetation removal, grading and other site altering activities to only what is needed. The intent is to allow for the development of a site while maximizing existing ecological, hydrological and aesthetic function.



Source: http://buildgreen.ufl.edu

PLANNING FOR A HOUSE SITE WITH MINIMAL DISTURBANCE.

WHAT ARE THE ADVANTAGES?

Even small changes made to a site can have drastic effects such as increased surface runoff, degraded water quality, denuded topsoils, and diminished health of vegetation. Minimizing total disturbance keeps those impacts to a minimum. Reducing paving and soil compaction helps to curb surface runoff and peak discharge volumes. Reducing the overall size of the construction footprint and stockpiling within that envelope reduces damage to adjacent environments. Maintaining existing topography and associated drainages encourages dispersed flow across the landscape, reducing the chance for channelization. Preserving existing vegetation through the creation of tree protection zones helps improve site aesthetics and vegetation health. Minimizing total disturbance can also save money by reducing the cost of clearing and filling, planting, paving, chipping, and seeding among other activities. Maintenance costs over the long haul will likely also be less.

WHAT ARE THE BARRIERS?

Achieving minimal disturbance means a great deal of up front planning. As part of the initial concept work, designers must identify special value and sensitive areas, carefully detail road alignments, and create disturbance setbacks. Designers must also think through stockpiling of materials, construction sequencing and soil restoration/remediation. This can be quite a challenge, especially in areas where ultra urban or highway/road development is occurring. At the town level, planning boards can make a greater effort to encourage minimal disturbance in their review of development projects.

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #3: MINIMIZE TOTAL DISTURBANCE

PUTTING THE CONCEPT TO WORK

Site specific strategies for minimizing total disturbance are numerous and can be easily employed during design and construction and it is up to the site planner to determine which strategies are most relevant. Many of the strategies are dependent on existing conditions and will vary from site to site. Forested sites with streams, wetlands, and steep slopes, for example, will require very different strategies than open sites with minimal drainage and flat grades. Regardless of the existing conditions, however, the site planner should always focus on the site's inherent ability to manage stormwater.

Strategies to minimize total disturbance include:

> Limiting areas of heavy equipment access and staging/storage of materials

> Identifying and protecting high-quality and environmentally sensitive areas

> Identifying areas which will be vegetated after construction and avoiding disturbance in these areas

> Avoiding extensive and unnecessary clearing and stockpiling of topsoil

> Minimizing paving and compaction

> Restoring soil permeability to areas compacted during construction

> Marking vegetation protection areas to prevent damage to roots and surrounding soil

These strategies work well with the principle of conservation development, adding an in-depth site scale element to the development process.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

Source: http://smartgrowthusa.worpress.com

EXCESSIVE SITE DISTURBANCE

Source: http://smartgrowthusa.worpress.com

MINIMAL SITE DISTURBANCE

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #4

Protect Natural Water Flows

WHAT IS IT?

The purpose of protecting natural water flows is to reduce erosion and downstream impacts such as increased flooding. Under natural conditions, surface runoff will often move in a slow, dispersed fashion across the landscape. Vegetative cover, soil permeability and landscape roughness (unevenness) ensure that surface flows are naturally managed in a controlled fashion. Drainage areas are often fragmented and few opportunities for channelization of flows exist. Traditional development practices drastically alter this natural management regime, resulting in increased stormwater runoff, soil erosion, degraded water quality, and a greater frequency of flooding. During the design and construction phase of site development, it is imperative to recognize and maintain natural drainage patterns and characteristics.

Source: http://www.semcog.org

NATIVE GRASSES IN A NATURAL FLOW PATH

WHAT ARE THE ADVANTAGES?

Natural flows are of critical importance in sustaining the ecological and hydrological function of aquatic ecosystems. These systems are often defined by the magnitude, frequency, duration, timing, and rate of change of flows. Even small changes in a flow regime can have short and long-term implications on habitat, water quality, and stream stability.

Under natural conditions, water initially flows along the land surface as sheetflow, eventually concentrating in small valleys and depressions, such as wetlands. Water moving along the surface in this way takes a long time to reach a critical velocity or volume. As a result, peak flows are minimized, infiltration is maximized, pollutants are reduced, and groundwater recharge and storage is increased.

Site's that utilize natural flow patterns need less physical stormwater infrastructure. Much of the stormwater can be managed as sheetflow or with grassed swales and bioretention facilities. This can lead to significant savings for the developer and landowner.

WHAT ARE THE BARRIERS?

Conventional development proponents view stormwater as a by-product with little to no value that should be directed away from a site. The use of pipes and other conveyances to concentrate flows directly to streams is seen as the easiest way to accomplish this.

Excessive grading, clear-cutting, and soil compaction during site preparation and construction is often standard practice. These methods of development generate unnecessary amounts of stormwater runoff that can necessitate the need for structural stormwater facilities such as large detention ponds.

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LID PRINCIPLE #4: PROTECT NATURAL FLOW PATTERNS

PUTTING THE CONCEPT TO WORK

There are a number of ways to protect natural flow patterns during the design and construction phases of site development. The methods below are particularly focused on limiting alterations to natural surface flows.

Source: http://www.susdrain.org

SUSTAINABLE URBAN DRAINAGE

> Optimize site layout

Analyze drainage patterns early in the process and direct development to areas where impacts can be kept to a minimum. Choose locations that have reasonable setbacks to surface water and require minimal grading and clearing.

> Slow runoff

Maintain runoff as sheetflow to the fullest extent possible. This lengthens the time it takes that water to reach its final destination. Protect ground surface roughness and vegetation. Plantings and uneven grades intercept and slow water velocity

Source: http://www.thecherokeescout.com

ALTERED HYDROLOGY ON A STEEP SLOPE

> Use pervious surfaces

Pervious surfaces, such as permeable pavers, allow for infiltration of stormwater into the ground. Where soils support them, pervious surfaces can completely negate the runoff from small and moderately sized storms.

> Disperse runoff

Direct runoff to stable vegetated areas and provide treatment before discharging to a waterbody or wetland. If flows must be concentrated, look for opportunities to break up long sections into shorter ones with outlets and turnouts.

> Preserve natural depressions

Existing low areas or natural depressions such as wetlands can attenuate runoff, reduce peak discharges and should therefore be preserved and utilized on site.

> Flatten slopes

Keep grades to the minimum necessary. Swales and other constructed drainages should have wide bottoms and gently sloping sides.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #5

Protect Riparian Buffers

WHAT IS IT?

Riparian buffers are vegetated ecosystems that grow along the banks of rivers, lakes and streams and serve to buffer a water body from the effects of runoff by providing filtration, bank stability, recharge, attenuation, volume reduction, and shading. In the process, buffers reduce pollution, minimize erosion, control flooding, enhance aesthetic quality, and provide aquatic and terrestrial habitat. For these reasons, riparian buffers are extremely important and any effort to protect them, whether through zoning bylaws, permitting or better site design, should be encouraged.

A WELL BUFFERED STREAM

AN UNBUFFERED STREAM

WHAT ARE THE ADVANTAGES?

Riparian buffers are critical to protecting the quality of surface water resources. When runoff enters a buffer as sheet flow, native grasses, shrubs, and trees filter out sediment, nitrogen, phosphorus, pesticides and other pollutants.

The vegetative overhang of buffers keeps water cool in the summer and provides a source of food for aquatic organisms. Long expanses of riparian buffers act as habitat corridors providing land creatures an area to travel and safely reach water.

Deep-rooted trees and shrubs are a large source of energy and nutrients for stream communities, particularly in small headwater streams. They also maintain stream bank stability, reducing erosion and excessive channel movement.

For a property owner, a riparian buffer means less maintenance (due to decreased mowing and landscaping),improved aesthetics, improved wildlife habitat, higher land values, shoreland protection, and potential protection from property loss due to channel erosion.

WHAT ARE THE BARRIERS?

The value and function of riparian buffers is often not taken into consideration during traditional development which seeks to maximize the amount of developable land. The same is true for many farming operations hoping to maximize land productivity. As a result, riparian buffers in both rural and urban environments suffer encroachment. Changing this pattern of land use is a difficult task but can be assisted by bylaws that protect buffers, funding, and leadership in the design/development community.

Efforts to enhance or establish riparian buffers on existing sites can also be difficult as landowners must be willing to change their current land management practices.

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #5: PROTECT RIPARIAN BUFFERS

PUTTING THE CONCEPT TO WORK

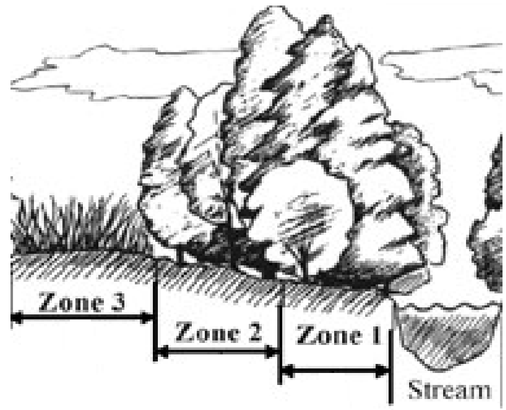
Vegetated and undisturbed riparian buffers are a natural form of green infrastructure and play a critical role in protecting the quality of surface waters. The benefits provided by buffers are directly related to their width and length so it's important to keep them intact. A well functioning buffer will have three distinct zones that each serve a unique function:

> Zone 1

Provides stream bank and channel stabilization, soil loss and sedimentation reduction, quality habitat, and shade to cool the water surface.

> Zone 2

Removes, transforms, and stores nutrients, sediments, and other pollutants flowing as sheet or sub-surface flow. Healthy vegetation slows surface runoff while filtering sediment and particulate bound phosphorus.



Source: USDA NRCS

THE THREE BUFFER ZONES

> Zone 3

Provides the first stage in managing upslope runoff so that runoff flows are slowed and evenly dispersed into Zone 2. Some physical filtering of pollutants may be accomplished as well as a limited amount of infiltration.

Disturbance within 50-100′ of a buffer or waterbody should be avoided. The easiest way to avoid damage is by denoting limits of disturbance on designs and site plans. Buffers along rivers, lakes, ponds and wetlands should be clearly marked and understood by site workers.

Riparian buffers will continue to function when long-term protections and stewardship plans are put into place.

Homeowners can reduce their impact by planting more trees and shrubs in their yard to reduce grass area, and keeping lawn maintenance activities away from buffers and waterbodies. Commercial property owners with large amounts of impervious area near stream buffers can replace underutilized iparking or driving areas with permeable pavement or even woody vegetation. Surface flows to the area can be managed with vegetated swales and level spreaders.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET

LID PRINCIPLE #6

Protect Sensitive Areas

WHAT IS IT?

Protecting sensitive areas is the process of identifying and avoiding certain natural features during development. These features include floodplains, wetlands, prime habitat blocks, steep slopes, riparian buffers, and well drained soils. Sensitive areas are particularly prone to degradation from development and often provide ecological and hydrological functions that cannot be easily replaced due to their complexity. Such features should be preserved in their natural condition to the fullest extent possible.

A NATURALLY FUNCTIONING WETLAND

AN IMPACTED WETLAND

WHAT ARE THE ADVANTAGES?

Sensitive areas frequently provide valuable and irreplaceable goods and services such as clean air, fresh water, groundwater recharge, greenhouse gas mitigation, flood mitigation, wildlife and fish habitat, and aesthetically pleasing landscapes.

Some sensitive areas act as critical habitat. Wetlands, for example, are considered the most biologically diverse of all ecosystems, serving as a home to a wide range of plants and animals.

Degradation of sensitive areas can have unintended consequences.

Development on steep slopes creates a significant threat to water quality and infrastructure through increased erosion and sedimentation. Poorly managed development in these areas can lead to bank destabilization, streambank erosion, and runoff of nutrients.

Development in certain natural areas can be costly and problematic from a permitting perspective. Many sensitive areas are protected by law and development must follow strict rules. Failure to comply with local or state regulations can mean project delays and monetary fines.

WHAT ARE THE BARRIERS?

Protection of sensitive areas can be at odds with the intent of traditional development which looks to maximize the development potential of each parcel. Reduction in potential development areas resulting from protecting and conserving sensitive areas can have the effect of altering — even reducing — a proposed development scope, thereby reducing development yield and profit.

In order to protect sensitive areas they must first be identified. This requires additional time during the site analysis phase and also additional coordination and review.

This principle can be difficult to practice on small sites in densely urban areas.

Factsheet prepared by the Vermont Green Infrastructure Initiative, a program of the Watershed Management Division of the VT Department of Environmental Conservation (http://watershedmanagement.vt.gov/).

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #6: PROTECT SENSITIVE AREAS

PUTTING THE CONCEPT TO WORK

Protecting sensitive areas can be implemented in most land uses and at both the site and community level. At the site level, this may involve fencing out construction activities from specific areas. At the community level, this may involve protecting large areas of land in perpetuity, like town forests.

Sensitive areas should be identified and mapped early in the planning process. Such areas include riparian buffers, wetlands, hydric soils, floodplains, steep slopes, woodlands, valuable habitat zones, and other sensitive resource areas. Disturbances and impacts in and around these areas should be avoided. If disturbance or impacts are necessary, they must be minimized through best management practices.

On small sites, natural resources and their functions may be weighted according to their functional value. This prioritization ensures that the most important natural functions are protected. It's important to remember that this prioritization may change from site to site based on localized conditions and values.

Municipalities can help protect sensitive areas by requiring a thorough site analysis to help identify developable and non-developable areas of a site as well as existing hydrology. Public input during this process can help highlight areas of particular value to the community, whether it be a recreational trail or scenic viewshed.

Protecting sensitive areas is a low-cost practice that provides significant water quality benefits and preserves the ecological and hydrological function of the site.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

A HEALTHY WETLAND

A ROBUST RIPARIAN BUFFER

REFERENCES

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #7

Reduce Impervious Surfaces

WHAT IS IT?

An impervious surface is an area on the earth that impedes or prevents the flow of water into the soil. Impervious surfaces increase runoff volume, velocity, temperature, and pollutant loads. Some impervious surfaces, such as bedrock outcrops and clay soils, occur naturally. More often, however, they are a result of human development. Rooftops, parking lots, severely compacted soils, and even gravel roads are all considered impervious surfaces. Studies suggest that noticeable degradation to water bodies begins when watersheds reach just 10% imperviousness. Reducing impervious surfaces involves the minimization of rooftops and pavements, the use of permeable surfacing, the protection of natural conditions, the use of disconnection practices and the application of LID principles.

ASPHALT PARKING LOT

POROUS CONCRETE PARKING SPACES

WHAT ARE THE ADVANTAGES?

Reducing impervious surfaces can help mitigate the impact that urbanization has on important portions of the water cycle. When impervious surfaces are minimized, water infiltration into the ground, pollution filtration by soils, recharge of groundwater supplies, and control of flash flooding is maximized. Collectively this improves water quality, decreases chemical, nutrient and pathogen contamination, reduces erosion, protects habitats, and helps keep recreation areas safe for human use and enjoyment.

Since less impervious area means less stormwater runoff, the volume of water entering the storm drain system and the amount of revenue needed for operation and maintenance is decreased. The need for the development and installation of new stormwater systems is also decreased

Reductions in impervious cover also help reduce localized heat island effects. Traditional pavements can reach temperatures in excess of 120–150°F in the summer, heating stormwater as it runs off the pavement.

WHAT ARE THE BARRIERS?

There exist several barriers to reducing impervious surfaces within our communities. Pervious pavements, while promising, are fairly new to the market and have limited applicability. Pervious pavements often cost more than traditional concrete or asphalt (due to a deeper base) and thus it is costly for large sections of pavement to be transitioned into a pervious surface. Pervious pavements are also more complicated to install Furthermore, existing zoning regulations sometimes conflict with LID goals by requiring minimum amounts of impervious cover.

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET

LID PRINCIPLE #7: REDUCE IMPERVIOUS SURFACES

PUTTING THE CONCEPT TO WORK

In its simplest form, reducing impervious surfaces consists of using design principles and best management practices to keep surfaces permeable to the fullest extent possible and to maintain and promote infiltration. This can be accomplished in number of ways:

> Cluster development using conservation design principles

Reduce the area of impervious surfaces required and preserve publicly-accessible green space. Promote the use of shared driveways

POROUS CONCRETE

> Consider roadway and path design

Use curvilinear designs on roads and trails to promote sheetflow of runoff. Reduce standard roadway widths whenever possible.

> Incorporate vegetated swales

Use vegetatetd swales for drainage instead of concrete curbs and gutters. Swales gather water, which can then soak into the ground.

GREEN ROOF

> Use permeable materials

Replace solid concrete and asphalt driveways with pavers, cobble-stones, brick and turf stone, all of which will slow down the flow of water and allow it to settle into the ground. Solid concrete can also be divided with decorative and functional paver inlays.

> Go vertical

Multi-story parking structures or underground parking can be built instead of sprawling one-level parking lots to reduce the area of land required for parking.

CISTERNS

> Use a green roof

Green roofs can transform an impervious rooftop into a beautiful building amenity that absorbs stormwater, reduces energy use, and lengthens roof life.

> Disconnect stormwater

If impervious surfaces must be used, drain to a vegetated area or capture the runoff in a rain barrel or cistern for homes, or utilize bioretention areas for larger buildings/sites.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

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LOW IMPACT DEVELOPMENT (LID) FACT SHEET
LID PRINCIPLE #8

Stormwater Disconnection

WHAT IS IT?

Stormwater disconnection involves "breaking" direct connections between impervious areas and storm/sewer systems or adjacent waterbodies. In urban areas, for example, rooftop runoff sometimes flows directly to a storm drain system through a downspout connection. A design that incorporates stormwater disconnection might include a modified downspout that directs the runoff towards an adjacent landscaped area where the water can be filtered and absorbed. This reduces the amount of 'effective' impervious cover in a watershed, reducing runoff volumes in the process.

WHAT ARE THE ADVANTAGES?

Disconnecting impervious surfaces from the hydrologic cycle has many benefits.

Directing runoff to vegetated areas reduces peak discharge and stormwater volume by providing an opportunity for infiltration and evapotranspiration to occur. This is particularly important in areas with combined sewer systems that are looking to reduce overall system loads.

Water quality benefits are gained from disconnection practices because a percentage of the overall stormwater volume can be filtered and treated by vegetation and soils.

When rooftop runoff is disconnected and captured in a rain barrel or cistern, the runoff can be used as a supplemental nonpotable water supply. When done on a small scale it can be used for watering outdoor plants. On a larger scale, and with advance design consideration, the water can be used to flush toilets or irrigate recreation fields.

The practice of disconnection is easily employed in a new development or redevelopment situation and can be applied in residential developments, large office parks, and retail centers. In any case, disconnection is most effective when there is an adequate natural area available to receive the redirected water.

Disconnection at a home scale is very inexpensive, costing less than $100 in most cases. Materials are readily available at the local hardware store.

Maintenance associated with disconnections is limited and depends on the style of disconnection being used (simple or complex). The bulk of the maintenance needed will be at the areas designated to receive stormwater runoff.

Source: Blue Water Baltimore

ONE FORM OF DOWNSPOUT DISCONNECTION

WHAT ARE THE BARRIERS?

There are some limitations to stormwater disconnection. For rooftop disconnections, stormwater should be directed at least five feet away from any structure. Stormwater should never be directed to neighboring properties. Disconnection may not be possible in dense urban areas due to limited space. Poorly drained soils also pose potential problems as do inadequately sized landscaped areas.

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LID PRINCIPLE #8: STORMWATER DISCONNECTION

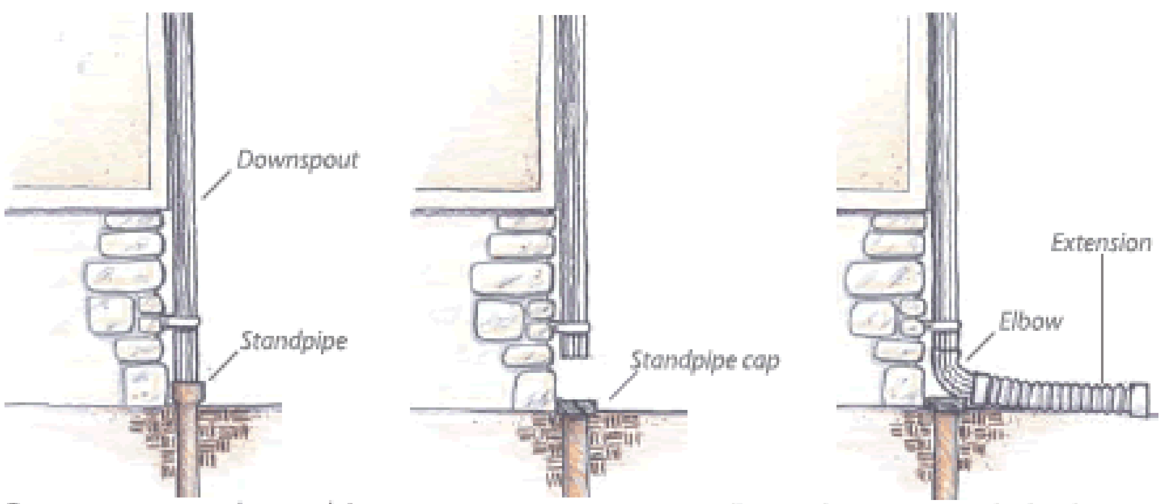
PUTTING THE CONCEPT TO WORK

Disconnection is most often associated with rooftop runoff but can also be used as a mechanism for managing runoff from other impervious surfaces such roads, driveways, and parking lots. In a majority of cases, runoff is directed to an appropriate best management practice or simply to soils with good to high infiltrative capacity.

Residential rooftop runoff can easily be managed by a rain barrel, cistern, or lawn area. Driveway runoff may necessitate grading towards a rain garden. Road and parking lot runoff can be managed with curb cuts, bioswales, bioretention areas, and infiltration trenches. Designers looking to practice stormwater disconnection need to be familiar with and comfortable sizing a variety of best management practices.

Careful consideration should be given to the design of vegetated collection areas. Concerns pertaining to basement seepage, water-soaked yards and septic systems are warranted, with the potential arising for saturated depressed areas and eroded water channels. Care should also be exercised if disconnecting stormwater in a wellhead or source protection area.

Disconnecting impervious areas on residential sites requires little construction and few materials. Rooftop disconnection, for example, requires minimal modification to downspouts to redirect runoff away from the storm drain system or other impervious areas. The diagram below shows the progression from connection to disconnection at a residential site.



Downspout connected to standpipe.

Elbow and extension attached to downspout.

Visit http://www.watershedmanagement.vt.gov/stormwater/htm/sw_green_infrastructure.htm for more information about LID.

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