

LOW IMPACT DEVELOPMENT (LID) REGULATIONS FOR THE TOWN OF WINCHENDON

Adopted 11.17.09

1.0 PURPOSE

The purpose of these Low Impact Development (LID) Regulations is to protect the public health, safety, environment, and general welfare by establishing requirements and procedures for new development and redevelopment to prevent water pollution and maintain groundwater recharge as provided by the Low Impact Development Bylaw of the Town of Winchendon.

2.0 DEFINITIONS

These definitions are in addition to those provided in the LID Bylaw and shall apply to issuance of a LID Permit established by the Town of Winchendon LID Bylaw and implemented through these Low Impact Development Regulations. Terms not defined in this section or in the Bylaw shall be understood according to their customary and usual meaning.

ACCESSORY BUILDING: A subordinate or secondary building situated on the same lot or parcel with a principal building, the use of which is customarily incidental to that of the main building or land use.

ALTER: Any activity, which will measurably change the ability of a ground surface area to absorb water or will change existing surface drainage patterns. Alter may be similarly represented as “alteration of drainage characteristics,” and “conducting land disturbance activities.” A land altering activity includes the cutting of trees of greater than 6 inch caliper Diameter Breast Height (DBH).

APPLICANT: A property owner, agent of a property owner, person or persons, including a corporation, trust or other legal entity, who applies for issuance of a LID Permit in accordance with this bylaw.

BEST MANAGEMENT PRACTICE (BMP): Structural, non-structural and managerial techniques that are recognized to be the most effective and practical means to prevent and/or reduce increases in stormwater volumes and flows, reduce point source and nonpoint source pollution, and promote stormwater quality and protection of the environment. “Structural” BMPs are devices that are engineered and constructed to provide temporary storage and treatment of stormwater runoff. “Nonstructural” BMPs use natural measures to reduce pollution levels, do not require extensive construction efforts, and/or promote pollutant reduction by eliminating the pollutant source.

BETTER SITE DESIGN: Site design approaches and techniques that can reduce a site’s impact on the watershed through the use of nonstructural LID Management practices. Better site design includes conserving and protecting natural areas and

greenspace, reducing impervious cover, and using natural features for LID Management.

BUILDING ENCLOSURE: The building assemblies comprising the outer structure of a building that enclose living and storage spaces including walls, windows, doors, roof, floors and foundation; also, building envelope, building shell.

CERTIFICATE OF COMPLETION (COC): A document issued by the LID Authority after all construction activities have been completed which states that all conditions of an issued LID Permit have been met and that a project has been completed in compliance with the conditions set forth in a LID permit.

CONVEYANCE: Any structure or device, including pipes, drains, culverts, curb breaks, paved swales or man-made swales of all types designed or utilized to move or direct stormwater runoff or existing water flow.

CURRENT FEE SCHEDULE: The schedule of Fees as most recently adopted by the LID Authority.

DEVELOPER: A person who undertakes or proposes to undertake land disturbance activities.

DEVELOPMENT: The modification of land to accommodate a new use or expansion of use, usually involving construction.

DISTURBANCE OF LAND: Any action that causes a change in the position, location, or arrangement of soil, sand, rock, gravel or similar earth material. A land altering activity includes the cutting of trees of greater than 6 inch caliper Diameter Breast Height (DBH).

DRAINAGE EASEMENT: A legal right granted by a landowner to a grantee allowing the use of private land for LID management purposes.

EROSION CONTROL: The prevention or reduction of the movement of soil particles or rock fragments.

EROSION CONTROL PLAN: A plan that shows the location and construction detail(s) of the erosion and sediment reduction controls to be utilized for a construction site.

FLOOD CONTROL: The prevention or reduction of flooding and flood damage.

FLOODING: A local and temporary inundation or a rise in the surface of a body of water, such that it covers land not usually under water.

GRADING: Changing the level or shape of the ground surface.

GROUNDWATER: All water beneath any land surface including water in the soil and bedrock beneath water bodies.

HOTSPOT: Land uses or activities with higher potential pollutant loadings, such as auto salvage yards, auto fueling facilities, fleet storage yards, commercial parking lots with high intensity use, road salt storage areas, commercial nurseries and landscaping, outdoor storage and loading areas of hazardous substances, or marinas.

IMPERVIOUS SURFACE: Any material or structure on or above the ground that prevents water from infiltrating through the underlying soil. Impervious surface is defined to include, without limitation: paved parking lots, sidewalks, roof tops, driveways, patios, paved recreation areas and paved, gravel and compacted dirt surfaced roads.

INFILTRATION: The act of conveying surface water into the ground to permit groundwater recharge and the reduction of stormwater runoff from a project site.

LOW IMPACT DEVELOPMENT: Low Impact Development (LID) is an approach to land development that uses land planning and design practices and technologies to simultaneously conserve and protect natural resource systems and reduce infrastructure costs. LID seeks to design the built environment to remain a functioning part of an ecosystem rather than exist apart from it. LID tools are used to plan and engineer urban and rural sites to maintain or restore the hydrologic and ecological functions of their watersheds.

LID AUTHORITY: The Town of Winchendon Planning Board is duly authorized to administer, implement, and enforce these LID Bylaws. The LID Authority is responsible for coordinating the review, approval and permit process as defined in this Bylaw. Other Boards and/or departments participate in the review process as defined in Section 4 of the LID Bylaw.

LID DESIGN CRITERIA: Best management practices and specifications for the use of LID. Projects that comply with prescribed requirements may be allowed reductions in stormwater management requirements when techniques are used to reduce stormwater runoff at the site.

LID MANAGEMENT: The use of structural or non-structural stormwater management devices that are designed to reduce stormwater runoff pollutant loads, discharge volumes, and/or peak flow discharge rates.

LOW IMPACT DEVELOPMENT PERMIT (LIDP): A permit issued by the LID Authority, for projects in the categories and meeting the standards defined in this Bylaw, after review of an application, plans, calculations, and other supporting documents. Projects in these categories that meet these generic standards and are

properly implemented are assumed to meet the requirements and intent of this Bylaw which is designed to protect the environment of the Town of Winchendon from the deleterious affects of uncontrolled and untreated stormwater runoff.

MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS AND HANDBOOK: The policy issued by the Department of Environmental Protection, and as amended, that coordinates the requirements prescribed by state regulations promulgated under the authority of the Massachusetts Wetlands Protection Act G.L. c. 131 § 40 and Massachusetts Clean Waters Act G.L. c. 21, §. 23-56. The policy addresses stormwater impacts through implementation of performance standards to reduce or prevent pollutants from reaching water bodies and control the quantity of runoff from a site.

NEW DEVELOPMENT: Any construction or land disturbance of a parcel of land that is currently in a natural vegetated state and does not contain alteration by man-made activities.

NONPOINT SOURCE POLLUTION: Pollution from many diffuse sources caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into water resource areas.

OPERATION AND MAINTENANCE PLAN: A plan that defines the functional, financial and organizational mechanisms for the ongoing operation and maintenance of a LID Management system to insure that it continues to function as designed.

OWNER: A person with a legal or equitable interest in a property.

PERSON: Any individual, group of individuals, association, partnership, corporation, company, business organization, trust, estate, the Commonwealth or political subdivision thereof to the extent subject to Town Bylaws, administrative agency, public or quasi-public corporation or body, the Town of Winchendon, and any other legal entity, its legal representatives, agents, or assigns.

POINT SOURCE: Any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, or container from which pollutants are or may be discharged.

POST-DEVELOPMENT: The conditions that reasonably may be expected or anticipated to exist after completion of the land development activity on a specific site or tract of land. Post-development refers to the phase of a new development or redevelopment project after completion, and does not refer to the construction phase of a project.

PRE-DEVELOPMENT: The conditions that exist at the time that plans for the land development of a tract of land are submitted to the LID Authority. Where phased development or plan approval occurs (preliminary grading, roads and utilities, etc.), the existing conditions at the time prior to the first plan submission shall establish pre-development conditions. For the purpose of meeting the sizing criteria of structural stormwater management devices as required in these LID Regulations [Section 7.2.9.2], the standard for characterizing pre-development land use for on-site areas shall be woods.

RECHARGE: The replenishment of underground water reserves.

REDEVELOPMENT: Any construction, alteration, transportation, improvement exceeding land disturbance of 20,000 square feet, where the existing land use is commercial, industrial, institutional, or multi-family residential.

RESOURCE AREA: Any area protected under including without limitation: the Massachusetts Wetlands Protection Act, Massachusetts Rivers Act, Town of Winchendon Wetlands Protection Bylaw, Wetland Conservancy District and Flood Plain Conservancy Districts.

RUNOFF: Rainfall, snowmelt, or irrigation water flowing over the ground surface.

SEDIMENTATION: A process of depositing material that has been suspended and transported in water.

SITE: The parcel of land being developed, or a designated planning area in which the land development project is located.

STOP WORK ORDER: An order issued which requires that all construction activity on a site be stopped.

TSS: Total Suspended Solids.

WATER QUALITY VOLUME (WQ_v): The storage needed to capture a specified average annual stormwater runoff volume. Numerically (WQ_v) will vary as a function of drainage area or impervious area.

3.0 AUTHORITY

3.1 These Regulations have been adopted by the Planning Board in accordance with the Town of Winchendon LID Bylaw.

3.2 These Regulations are adopted to administer the LID Bylaw and do not replace the requirements of the Town of Winchendon Zoning Bylaw, Wetlands Protection Bylaw, Wetland Conservancy District, Flood Plain Conservancy Districts, Groundwater

Protection Overlay District or any Rules and Regulations adopted thereunder.

3.3 These LID Regulations may be periodically amended by the LID Authority in accordance with the procedures outlined in Section 4.0, Administration, of the Town of Winchendon LID Bylaw.

4.0 ADMINISTRATION

4.1 The Planning Board is the LID Authority and shall administer, implement and enforce these Regulations. The LID Authority may, with the concurrence of the Applicant, designate another Town Board, including, but not limited to, the Conservation Commission, Zoning Board of Appeals and Board of Health, as its authorized agent for the purposes of reviewing LID submittals and approving LID Permits for any project within that particular Board's jurisdiction, provided that the designated Board has formally adopted these regulations, either directly, or by reference. A designated Board shall have approval authority under these LID Regulations in those instances where Planning Board review is not required.

4.2 If the approving board is other than the Planning Board, that Board must forward written documentation of said approval and all conditions of approval to the LID Authority within 10 business days of said approval. Upon receipt of written approval, the LID Authority shall issue a LID Permit to the applicant within 10 business days.

4.3 Projects or activities approved by the LID Authority shall be deemed in compliance with the intent and provisions of these LID Regulations. The LID Authority shall issue a LID Permit to the applicant in accordance with the time frames for issuance of a Definitive Subdivision Plan, Special Permit or Site Plan Review Permit. Where none of these is required, the LID Authority shall act upon a complete application within 90 days unless an extension is mutually agreed upon. There shall, however, be no right for constructive approval.

5.0 APPLICABILITY

5.1 These LID Regulations apply to all new development and redevelopment that are not exempt under the Town of Winchendon LID Bylaw. Projects within the jurisdiction of the LID Bylaw must have received a LID Permit from the LID Authority in accordance with the permit procedures and requirements defined in Section 6 of these Regulations before any site disturbance or construction begins. For projects and/or activities within the jurisdiction of the LID Authority, the specific application submission requirements, public notices, and fees of that board shall govern. The contents of the LID Management Plan, Operation and Maintenance Requirements, and LID Review Fee, (under Sections 6.12, 6.13 and 6.5) of these Regulations must also be met.

6.0 PERMIT PROCEDURES AND REQUIREMENTS

6.1 Applicants for projects requiring a LID Permit shall submit the materials specified in this section, and meet the LID criteria as specified in Section 7, Performance Standards: LID Design Criteria.

6.2 Permit Required

6.2.1 Applicants shall not receive any permits affecting the development or redevelopment of land without first meeting the requirements of these Regulations.

6.2.2 The project shall begin within two years after issuance of the LID Permit. If the project does not begin within two years, the permittee may apply for a Permit extension. A Permit extension shall be granted unless the LID Authority finds that site conditions have changed so that the approved LID Management Plan and/or the Operation and Maintenance Plan are inadequate, in which case the permittee shall submit a modified Plan which will require approval prior to the commencement of land disturbing activities.

6.3 Filing Application

6.3.1 The applicant shall file with the LID Authority a properly completed, tax certified application, five (5) full-size paper copies of the

- LID Management Plan;
- Operation and Maintenance Plan;
- Erosion and Sediment Control Plan;

ten (10) paper copies of said plans in reduced size of no less than 11”X17”; fifteen (15) copies of the required supporting narrative for the LID Management Plan, Operation and Maintenance Plan, Erosion and Sediment Control Plan, Inspection and Maintenance agreements and Surety bond; and one electronic file of the complete application. A LID Permit must be issued prior to any site disturbing or altering activity. While the applicant may be a representative, the permittee must be the owner of the site or holder of an easement. The LID Application package shall include all items described in Sections 6.3.1.1 through 6.3.1.8.

6.3.1.1 The applicant shall submit a completed Application with original signatures of all applicants and owners. The Application shall be made on the appropriate form of the Department of Planning and Development. Any communication, purporting to be an application, shall be treated as mere notice of intention to seek approval until such time as it is made on the official application form, tax certified by the Town Collector/Treasurer, accompanied by all required supporting documents and materials, filed as required by statute or LID Authority regulation, and the required fees have been paid.

6.3.1.1.1 All information requested on the form and by these LID Regulations shall be furnished by the applicant. If an application is signed other than by the property owner, the applicant’s interest in the property and her/his authority to sign shall be clearly indicated. Supporting documentation shall be provided if the LID Authority so requires. If an applicant signs in more than one capacity, each capacity shall be clearly indicated. If some person, other than the applicant, is authorized to sign other documents related to the matter, that authority shall be clearly indicated in the application or in a separate document. The **names and full contact information** for every person involved in developing the plan and who may be contacted for clarifications or additions shall be provided. Such information must include mail

address, land line phone number, fax number and email address. A cellular phone number shall be included, if available.

6.3.1.2 The LID application shall include a list of abutters, to include owners of land directly opposite on any public or private street or way, and abutters to abutters within 300 feet of the property line of the petitioner as they appear on the most recent applicable tax list (notwithstanding that the land of any such owner is located in another city or town or across a body of water) and the planning boards of Ashburnham, Fitzwilliam (NH), Gardner, Rindge (NH), Royalston, and Templeton. The names and addresses supplied by the assessors office for this purpose must be certified by the assessors and such certification shall be conclusive for all purposes. A list prepared by the Assessors showing the Assessor's parcel numbers, names and addresses of all owners of property abutting upon the land included in the site plan as they appear on the most recent tax assessor's list shall also be provided.

6.3.1.3 The LID application shall include the LID Management Plan and project description (1 electronic, 5 full-size, 10 reduced size, 11”X17” copies and 15 copies of supporting narrative);

6.3.1.4 Payment of the application and review fees;

6.3.1.5 Operation and Maintenance Plan (1 electronic, 5 full-size, 10 reduced size, 11”X17” copies and 15 copies of supporting narrative);

6.3.1.6 Inspection and Maintenance agreements (1 electronic and 15 paper copies of narrative);

6.3.1.7 Erosion and Sediment Control Plan (1 electronic, 5 full-size, 10 reduced size, 11”X17” copies and 15 copies of supporting narrative);

6.3.1.8 Surety bond, if required by the LID Authority (1 electronic and 15 paper copies of narrative). See Section 9.0, Surety.

6.4 Entry

Filing an application for a permit grants the LID Authority, or its agent(s), permission to enter the site to verify the information in the application and to inspect for compliance with the resulting permit.

6.5 Fees

Application fees established by the LID Authority are required to cover expenses for the review of the LID Permit, including professional services. The LID Authority is authorized to retain a Registered Professional Engineer or other professional consultant to advise on any aspects of the permit application. Applicants must pay the fees specified in the Board’s current fee schedule before the review process will begin. These fees are in addition to any other local or state fees that may be charged.

6.5.1 The fee schedule may be altered by the LID Authority at a public hearing at least 30 days before the effective date of the change.

6.5.2 Application Fees

6.5.2.1 File with the Planning Agent as representative of the LID Authority, a properly completed, tax certified Application for a LID Permit, and pay the Application filing fee and Consultant Review Deposit required by the current LID fee schedule.

6.5.3 Engineering and Consultant Review Deposit and Fees

6.5.3.1 The LID Authority is authorized under the provisions of M.G.L. Ch. 44, Section 53G to require an applicant to pay an "Engineering and Consultant Review Fee" for the reasonable costs for engineering and other consultant services necessary for the LID Authority to come to a decision on the application.

6.5.3.2 Payment may be required at any point in the deliberations and shall be paid prior to a final decision.

6.5.3.3 Consultant fees shall be determined at the time of project review. A fee under the provisions of Mass.General Laws, Chapter 44, section 53G may be required to cover the cost of consultants performing review of LID plans and compliance monitoring of such plans. The initial fee deposit will be as specified in the fee schedule adopted by the Board. Payment of the initial fee will be required with the application. An additional amount as determined by the Board will be required before any on site work is started. In the case of a phased project, the deposit fee may be phased as well with payment due prior to the start of each phase. Should the actual cost of consultants exceed the amount on deposit with the Town, the developer shall pay an additional amount as the Board or the Planning Agent may determine. **[M.G.L. Chapter 44, section 53G: “**Notwithstanding section 53, any city or town that provides by rules promulgated under section 9 or 12 of chapter 40A, section 21 of chapter 40B, section 81Q of chapter 41...for the imposition of reasonable fees for the employment of outside consultants may deposit such fees in a special account. Such rules shall provide for an administrative appeal from the selection of the outside consultant to the city council or town board of selectmen. The grounds for such an appeal shall be limited to claims that the consultant selected has a conflict of interest or does not possess the minimum required qualifications. The minimum qualifications shall consist either of an educational degree in or related to the field at issue or three or more years of practice in the field of issue or a related field. The required time limits for action upon an application by a municipal permit granting board shall be extended by the duration of the administrative appeal. In the event that no decision is made by the city council or the town board of selectmen within one month following the filing of the appeal, the selection made by the municipal permit granting authority shall stand. Such an administrative appeal shall not preclude further judicial review, if otherwise permitted by law, on the grounds provided for in this section. Any such account shall be established by the municipal treasurer in the municipal treasury and shall be kept separate and apart from other monies. The special account, including accrued interest, if any, shall be expended at the direction of the authorized board or authority without further appropriation; provided however, that such funds are to be expended by it only in connection with carrying out its responsibilities under the law. Any excess amount in the account attributable to a specific project, including any accrued interest, at the completion of said project shall be repaid to the applicant or to the applicant’s successor in interest and a final report of said account shall be made available to the applicant or to the applicant’s successor in interest...”]

6.5.3.4 The services for which fees may be utilized include, but are not limited to, wetland survey and delineation, hydrologic and drainage analysis, wildlife evaluation, analyses of stormwater quality and other site characteristics, site inspections, as-built plan review, and analysis of legal issues.

6.5.3.5 Any unused portion of any fees collected, other than Application fees, shall be returned by the LID Authority to the applicant, along with accrued interest, within forty-five (45) calendar days of a written request by the applicant or his successor.

6.5.3.6 Engineering and Consultant Review Deposit and Fees collected under this section shall be deposited in a revolving account.

6.6 Public Hearings No separate public hearing shall be required for a LID Permit. The applicant will be afforded an opportunity to appear before the Board to explain and, if necessary, defend the application. The LID Authority shall hold a public hearing in accordance with their usual procedures for Subdivision Review, Special Permit and Site Plan Review. If the LID Permit is to be issued in conjunction with another required permit, approval, or order of conditions for which a public hearing is required, the conformity of the pending project to the LID bylaw and these regulations shall be considered as part of that required hearing. No LID permit shall be issued unless such other permit or approval is granted. No LID permit shall issue unless the application meets the requirements of the LID Bylaw and Regulations.

6.7 Actions

The LID Authority's action, rendered in writing, shall consist of either:

6.7.1 Approval of the LID Permit Application based upon determination that the proposed plan meets the Standards in Section 7 and is in compliance with the requirements in the LID Bylaw and Regulations;

6.7.2 Approval of the LID Permit Application subject to any conditions, modifications or restrictions required by the LID Authority;

6.7.3 Disapproval of the LID Permit Application based upon a determination that the proposed plan, as submitted, does not meet the Standards in Section 7 or the requirements in the LID Bylaw and Regulations.

6.8 The LID Authority shall act on an application within the time limits prescribed for any concurrent proceeding or as have been extended by mutual agreement. If there is no concurrent proceeding, the LID Authority shall act within 90 days of the receipt of the completed application.

6.9 Plan Changes

The permittee must notify the LID Authority in writing of any proposed change in a project regulated by a LID Permit, and no further land disturbing activity may take place until the LID Authority has determined that the proposed change meets the standards in Section 7 and is in compliance with the LID Bylaw and Regulations.

6.10 Appeals of Actions of the LID Authority

A decision of the LID Authority shall be reviewable in the Superior Court by an appeal filed within 60 days of the decision. An appeal of a decision by a delegated Town Board shall be conducted under the applicable appeal provisions of that Board. An appeal shall result in revocation of a written approval for a LID Permit until the appeal process has been resolved.

6.11 Project Completion

6.11.1 The permittee shall submit as-built drawings of all structural stormwater controls which shall show deviations from the approved plans and be certified by a Registered Professional Engineer.

6.11.2 All LID practices and techniques within or on individual lots and/or within Town easements adjacent to the lots, and the terms of the Operation and Maintenance Plan, shall be:

6.11.2.1 Recorded at the Worcester County Registry of Deeds as a condition of approval of the Plan referenced below in Section 6.11.2.4;

6.11.2.2 Placed on individual deeds as restrictions;

6.11.2.3 Filed with the Department of Planning and Development, with the Town Building Commissioner; and

6.11.2.4 Placed on the final approved Definitive Subdivision Plan, Special Permit or approved Site Plan.

6.12 LID Management Plan Contents

6.12.1 The LID Management Plan submitted with the permit application shall contain sufficient information for the LID Authority to evaluate the environmental impact and effectiveness of the measures proposed for reducing adverse impacts from stormwater runoff. This plan shall comply with the criteria established in these Regulations and must be submitted with the stamp and signature of a Registered Professional Engineer (PE) and/or a Registered Landscape Architect, both of whom are licensed in the Commonwealth of Massachusetts. If the plan shows structural stormwater controls, such plans must include detailed stormwater disposal calculations.

6.12.1.1 The LID Authority or its agent may allow the applicant to omit from the Application such of the materials listed in section 6.12 (LID Management Plan Contents) that will not be needed to adequately evaluate the proposal. If the LID Authority later finds that such materials are needed, the applicant shall then supply them.

6.12.1.2 It will **not be necessary to repeat** in the LID Application information included in other applications, e. g. Subdivision or Site Plan, being submitted concurrently or already under LID Authority consideration, but appropriate references to that material shall be included in the LID Management Plan.

6.12.1.3 All LID Management Plan data as required by Section 6.3.1 of these LID Regulations shall be submitted on compact disk in a format that can be read by AUTO CAD with all data related to state plane coordinates. Narrative and tables may be in WORD or EXCEL format.

6.12.2 The LID Management Plan shall fully describe the project in drawings, narrative, and calculations. It shall include:

6.12.2.1 Contact Information. The name, address, telephone number and email of all

persons having a legal interest in the property and the tax reference number and street address(es) of the property or properties affected;

6.12.2.2 A locus map;

6.12.2.3 The existing and proposed land use at the site;

6.12.2.4 The existing and proposed zoning at the site;

6.12.2.5 The existing and proposed property lines;

6.12.2.6 The location(s) of existing and proposed easements;

6.12.2.7 The location of existing and proposed utilities;

6.12.2.8 The location of existing and proposed open storage areas and facilities for waste disposal;

6.12.2.9 The site's existing and proposed topography with contours at 2-foot intervals;

6.12.2.10 All areas of the site designated as open space;

6.12.2.11 A description and delineation of existing stormwater conveyances, impoundments, and wetlands, wetland buffer zones, water supply areas, swimming beaches or other environmental resources on or adjacent to the site into which stormwater flows;

6.12.2.12 A delineation of 100-year flood plains, if applicable;

6.12.2.13 Estimated seasonal high groundwater elevation in areas to be used for stormwater retention, detention, or infiltration;

6.12.2.14 The existing and proposed vegetation and ground surfaces with runoff coefficients for each;

6.12.2.15 A drainage area map showing pre- and post-construction watershed boundaries, drainage area and stormwater flow paths, including municipal drainage system flows;

6.12.2.16 A recharge area analysis that calculates pre-and post-project annual groundwater recharge rates on the parcel;

6.12.2.17 A description and drawings of all components of the proposed LID stormwater management system including:

6.12.2.17.1 Locations, cross sections, and profiles of all brooks, streams, drainage swales and their method of stabilization;

6.12.2.17.2 All measures for the detention, retention or infiltration of water;

6.12.2.17.3 Descriptions of non-structural best management practices (BMPs);

6.12.2.17.4 All measures for the protection of water quality;

6.12.2.17.5 The structural details for all components of the proposed drainage systems and LID Management facilities;

6.12.2.17.6 Notes on drawings specifying materials to be used, construction specifications, and expected hydrology with supporting calculations;

6.12.2.17.7 Proposed site plan including location of buildings or other structures, impervious surfaces, and drainage facilities, if applicable;

6.12.2.17.8 Any other information requested by the LID Authority.

6.12.2.18 Hydrologic and hydraulic design calculations for the pre-development and post development conditions for the design storms specified in these Regulations. Such calculations shall include:

6.12.2.18.1 Description of the design storm frequency, intensity and duration;

6.12.2.18.2 Time of concentration;

- 6.12.2.18.3** Soil Runoff Curve Number (RCN) based on land use and soil hydrologic group;
- 6.12.2.18.4** Peak runoff rates and total runoff volumes for each watershed area;
- 6.12.2.18.5** Information on construction measures used to maintain the infiltration capacity of the soil where any kind of infiltration is proposed;
- 6.12.2.18.6** Infiltration rates, where applicable;
- 6.12.2.18.7** Culvert capacities;
- 6.12.2.18.8** Flow velocities;
- 6.12.2.18.9** Data on the increase in rate and volume of runoff for the specified design storms, and
- 6.12.2.18.10** Documentation of sources for all computation methods and field test results.
- 6.12.2.19** Post-Development downstream analysis if deemed necessary by the LID Authority;
- 6.12.2.20** Soils Information from test pits performed at the location of proposed LID Management facilities, including soil descriptions, depth to seasonal high groundwater, depth to bedrock, and percolation rates. Soils information will be based on site test pits logged by a Massachusetts Certified Soil Evaluator;
- 6.12.2.21** Landscaping plan prepared by a Massachusetts licensed Registered Landscape Architect, describing the woody and herbaceous vegetative stabilization and management techniques to be used within and adjacent to the stormwater impact area.

6.13 Operation and Maintenance of Stormwater Management Devices

All property owners are responsible for maintaining the proper operation of all permitted stormwater management devices on their property. Stormwater management devices shall be maintained to ensure compliance with the Permit, the LID Bylaw and that the Massachusetts Surface Water Quality Standards are met in all seasons and throughout the life of the system.

6.13.1 Stormwater Management Easements: Where the LID Authority determines it is necessary, a stormwater management easement shall be provided by the property owner(s) to allow access to stormwater management devices for inspection and maintenance. Easements shall be recorded with the Worcester County Registry of Deeds prior to issuance of a Certificate of Completion by the LID Authority.

6.13.2 Operation and Maintenance Plan: An Operation and Maintenance Plan (O&M Plan) is required at the time of application for a LID Permit and shall remain on file with the LID Authority. The O&M Plan shall include:

6.13.2.1 The name and contact information of the owners of all components of the system;

6.13.2.2 A map showing the location of the stormwater management devices including all structural and nonstructural components;

6.13.2.3 Inspection and Maintenance agreements that specify names and addresses of person(s) responsible for operation and maintenance and its financing, an Inspection and Maintenance schedule, including maintenance tasks to be performed, a list of easements with the purpose and location of each and the signature(s) of the owner(s).

6.13.3 Where applicable, the O&M Plan shall also comply with the requirements of a

Homeowners Agreement as required by the Planning Board.

7.0 PERFORMANCE STANDARDS: LID DESIGN CRITERIA

7.1 All projects shall comply with the most recent version of the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards and Handbook and achieve the following performance standards:

7.2 General Criteria

7.2.1 Site Planning Process

The site planning process shall include the following steps: 1) Identify, map and clearly delineate on plans critical environmental resources that shall be withheld from development as conservation areas. These areas shall include wetlands, riverfront areas, floodplains and their buffers that are regulated by local, state and federal law. They may also include steep slopes, mature woodlands, prime farmland, meadows and Core and Priority Habitats as defined by the MA Natural Heritage and Endangered Species Program. The potentially developable area shall consist of land outside identified conservation areas; 2) Identify, map and clearly delineate on plans potential building enclosures within the potentially developable area, avoiding environmental resource areas and buffers. Include the delineation of private yards and shared amenities, so as to reflect an integrated community; 3) Identify, map and clearly delineate on plans proposed roadways, sidewalks and other impervious surfaces. Align streets and walkways to access house lots and to create internal and external connections to existing and/or potential future streets, sidewalks and trails; 4) Draw in the lot lines; 5) Develop methods to minimize impervious surfaces and to protect and preserve open space.

7.2.2 No Untreated Discharges

Stormwater shall not be discharged directly to a wetland, local water body, municipal drainage system or abutting property without adequate treatment, as defined in Section 7.2.3 through 7.2.12 of these LID Regulations.

7.2.3 Construction/Land Disturbance

A sediment and erosion control plan shall show best management practices for site conditions and minimize the area of the land disturbance. The plan shall also establish requirements for the control of wastes, including discarded building materials, concrete truck washout, chemicals, litter and sanitary wastes. BMPs shall be in conformity with the most recent version of the Massachusetts Erosion & Sediment Control Guidelines for Urban & Suburban Areas (FHHCD, 1997).

7.2.4 Channel Protection

The post-development peak discharge rate from the 2-year, 24-hour storm event shall be equal to the pre-development rate in order to prevent stream bank erosion and channel degradation.

7.2.5 Flood Protection

The post-development peak discharge rate for the 10-year, 24-hour frequency storm event shall be equal to the pre-development rate in order to protect downstream property. The 100-year, 24-hour return frequency storm event shall be controlled and conveyed to prevent extreme flooding and protect public safety.

7.2.6 Groundwater Recharge

Post-development recharge rates shall equal pre-development conditions. Annual groundwater recharge rates shall be maintained by use of structural and nonstructural management practices. The stormwater runoff volume to be recharged to groundwater shall be determined using the methods in the latest version of the Massachusetts DEP Stormwater Management Standards and Handbook. The LID Authority may relax or eliminate the recharge requirement if the site is an area where contaminated soils are documented.

7.2.7 Structural Practices for Water Quality

All structural Stormwater Management devices shall be based on design criteria from the most recent version of the Massachusetts DEP Stormwater Management Standards and Handbook and shall remove at least 80% of total suspended solids (TSS).

7.2.8 Water Quality Volume

The volume for sizing a structural stormwater management device shall be designed according to criteria specified by the Massachusetts DEP Stormwater Management Standards and Handbook.

7.2.9 Hydrologic Basis for Design of Structural Practices

For facility sizing criteria, the basis for hydrologic and hydraulic evaluation of development sites include, but are not limited to the following:

7.2.9.1 Impervious cover is measured from the site plan and includes any material or structure that prevents water from infiltrating through the underlying soil. These include, but are not limited to, paved parking lots, sidewalks, roof tops, driveways, patios, and paved, gravel and compacted dirt surfaced roads.

7.2.9.2 The standard for characterizing pre-development land use for on-site areas shall be woods.

7.2.9.3 Peak discharge rates will be determined using the most recent version of models approved for use by MA DEP. Maximum length of sheet flow for time of concentration calculations shall be no more than 50 feet for pre- and post-development conditions.

7.2.9.4 For purposes of computing runoff, all pervious lands in the site shall be assumed prior to development to be in “good hydrologic condition” (as referenced in the USDA, Natural Resource Conservation Service’s *Urban Hydrology for Small Watersheds*, TR 55, June 1986), and regardless of conditions existing at the time of computation.

7.2.9.5 Flooding and channel erosion impacts to streams due to development shall be determined at each point of discharge from the development project. A determination of impacts shall include runoff from the watershed which also contributes to that point of discharge.

7.2.9.6 The design storms shall be defined as a 24-hour storm using the rainfall distribution recommended by the Northeast Regional Climate Center Atlas of Precipitation Extremes for the Northeastern United State and Southeastern Canada.

7.2.9.7 Proposed residential, commercial, or industrial development shall apply these stormwater management criteria to the land development as a whole. Individual lots in new subdivisions shall not be considered separate land development projects, but rather the entire subdivision shall be considered a single land development project. Hydrologic parameters shall reflect the ultimate land development and shall be used in all

engineering calculations.

7.2.10 Sensitive Areas

Stormwater discharges to swimming beaches, aquifer recharge areas, water supplies and other sensitive water resources may be subject to additional criteria, established by the LID Authority after conducting a public hearing in accordance with the Town of Winchendon LID Bylaw.

7.2.11 Hotspots

Stormwater discharges from land uses with higher potential pollutant loadings, known as “hotspots,” require treatment practices specified in the most recent version of the MA DEP Stormwater Management Standards and Handbook.

7.2.12 Low-Impact Development (LID) Design Criteria

Applicants are required to use LID Design Criteria to assess the effectiveness of the use of LID better site design practices to decrease stormwater runoff at the site. Projects that comply with LID Design Criteria may be allowed reductions in stormwater management requirements specified in this section (Section 7) of the Regulations. Improved site design and nonstructural controls may minimize the use of structural stormwater controls. The LID Authority may adopt additional criteria for LID site design practices. The LID site design criteria and procedures for their calculation and application are identified in Appendix A of these Regulations.

8.0 WAIVERS

8.1 The LID Authority may waive strict compliance with these regulations if such action is allowed by federal, state and local statutes and/or regulations; is in the public interest; and is consistent with the purposes of the Town of Winchendon LID Bylaw.

8.2 Any applicant may submit a written request for a waiver, accompanied by supporting information explaining how the waiver will comply with the purposes of the LID Bylaw and is in the public interest.

8.3 All waiver requests shall be acted on within 90 days, and the LID Authority will provide a written decision. If additional information is required, the LID Authority may extend the review period. If the applicant objects to an extension, or fails to provide requested information, the waiver request may be denied by the LID Authority. All waivers shall be granted only conditionally until the final LID Permit is granted. Should other changes in a plan so require, the LID Authority may rescind a waiver which has been conditionally approved.

9.0 SURETY

The LID Authority may require the permittee to post a bond, cash, or other acceptable surety in an amount deemed sufficient to ensure that the work will be completed in accordance with the permit. A portion of the bond may be released as each phase is completed in compliance with the permit, but the bond shall not be fully released until the LID Authority has received the final inspection report and issued a Certificate of Completion. Where applicable, the LID surety shall be coordinated with other surety requirements.

10.0 CONSTRUCTION INSPECTIONS

10.1 The permittee must notify the LID Authority at least three (3) business days before starting a land disturbing activity. The permittee must also notify the LID Authority at least three (3) business days before constructing the key components of the stormwater management system.

10.2 At the discretion of the LID Authority, periodic inspections of the construction of stormwater management devices shall be conducted by the Town, a professional engineer or a landscape architect approved by the LID Authority. Written reports shall include: the inspection date and location; evaluation of compliance with the stormwater permit; any variations from approved construction specifications or violations of the LID Management Plan. The inspection report shall be filed with the LID Authority.

10.3 At a minimum, inspections shall include: Initial site inspection, prior to approval of any plan; inspection of site erosion controls; inspection of stormwater management devices prior to backfilling of any underground drainage or stormwater conveyance structures; evaluation of the system within 24 hours of a 2-year storm event, if possible; and a final inspection before the surety is released. The stormwater management system shall be inspected to verify its as-built features. If the inspector finds the system adequate, this shall be reported to the LID Authority which will issue a Certificate of Completion.

As-built plans shall be full size plans and include all final grades. All changes to project design shall be recorded on plans.

10.4 Prior to the issuance of a Certificate of Completion, if the system is found to be inadequate due to operational failure, even though built according to the LID Management Plan, the system shall be corrected by the permittee. If the permittee fails to act, the LID Authority may use the surety bond to complete the work. If the system does not comply with the Plan, the permittee shall be notified in writing of the violation and the required corrective actions. A Stop Work order shall be issued until any violations are corrected and all work previously completed has received approval by the LID Authority.

11.0 CERTIFICATE OF COMPLETION

11.1 Upon completion, the permittee shall certify that the project is in accordance with Plan specifications and shall provide inspections to adequately document compliance.

11.2 The LID Authority will issue a letter certifying completion upon its receipt and approval of the final inspection and reports and/or upon otherwise determining that all work was completed in conformance with these Regulations.

12.0 PERPETUAL INSPECTION AND MAINTENANCE

12.1 Maintenance Responsibility

Stormwater management devices and practices shall be inspected to document maintenance and repair needs and ensure compliance with the requirements of the LID

Management Plan, the O&M Plan and these Regulations. The current owner of the property shall maintain in good condition and promptly repair all grade surfaces, walls, drains, dams, vegetation, and erosion controls and other protective measures in accordance with approved Plans.

12.2 Maintenance Inspections

12.2.1 Inspections shall occur during the first year of operation and at least once every three years thereafter. An agreement between the property owner and the LID Authority shall be executed for privately-owned stormwater management systems which specifies the responsible party for conducting and financing long term inspections.

12.2.2 Inspection reports shall be submitted to and maintained by the LID Authority. Inspection reports shall include: the date of inspection; an evaluation of the condition of structures and devices used to manage stormwater; and a description of any needed maintenance.

12.3 Right-of-Entry for Inspection

The inspection agreement shall allow the LID Authority or its designee to enter the property at reasonable times and in a reasonable manner for the purpose of inspection.

12.4 Records of Maintenance and Repair Activities

Parties responsible for the operation and maintenance of a stormwater management device shall provide records of all maintenance and repairs to the LID Authority, upon request, and shall retain those records for 5 years.

12.5 Failure to Maintain

If the responsible person fails to meet the requirements of the inspection agreement, the LID Authority, may take action to restore the stormwater management device after 30 days written notice. If the violation is an immediate threat to public health or public safety, 24 hours notice shall be sufficient prior to actions required to return the facility or practice to proper working condition. The LID Authority may assess the owner(s) of the facility for the cost of repair work which shall be a lien on the property.

13.0 ENFORCEMENT

13.1 The LID Authority or an authorized agent of the LID Authority shall enforce these Regulations, and may pursue all remedies for violations, including a written enforcement order. If remediation is required, the order may set forth a deadline when work shall be completed. Said order may advise that failure to remedy violations may require the Town of Winchendon to correct violations and to obtain reimbursement from the property owner. Within thirty days after correcting the violation, the violator and the property owner shall be notified of the costs incurred by the Town of Winchendon including administrative costs.

13.2 Criminal Penalties and Non-Criminal Disposition Any person who violates any provision of the Town of Winchendon LID Bylaw, or any Regulation, order or permit issued thereunder, may be ordered to correct the violation and/or shall be punished as

provided by Town bylaw. The LID Bylaw will include the provisions for non-criminal disposition of complaints.

13.3 Appeals The decisions or orders of the LID Authority may be appealed to a court of competent jurisdiction. The remedies described in these Regulations do not exclude other remedies available under any applicable federal, state or local law.

14.0 SEVERABILITY

The invalidity of any section, provision, paragraph, sentence, or clause of these Regulations shall not invalidate any section, provision, paragraph, sentence, or clause thereof, nor shall it invalidate any permit or determination that previously has been issued.

APPENDIX A: Example System of Low Impact Development (LID) Design Criteria

Low Impact Development encourages minimization of impervious surfaces, protection of critical environmental resource areas, and preservation of naturally-vegetated buffers. Any reductions in impervious cover result in reduced stormwater runoff and, consequently, smaller land consumption areas and lower construction costs. In an effort to apply a more holistic approach to stormwater management, five specific non-structural practices called *LID Design Criteria* for better environmental site design, are provided for designers that will significantly reduce the size and cost of structural practices.

Non-structural practices are increasingly recognized as a critical feature of effective stormwater management, particularly with respect to site design. In most cases, non-structural practices will need to be combined with structural practices to meet stormwater requirements. The key benefit of non-structural practices is that they can reduce the generation of stormwater from the site. In addition, they can provide partial removal of many pollutants and contribute to groundwater recharge. The five non-structural LID Design Criteria are:

- Criterion 1. Environmentally Sensitive Development
- Criterion 2. Disconnection of Rooftop Runoff
- Criterion 3. Disconnection of Non-Rooftop Runoff
- Criterion 4. Stream Buffers
- Criterion 5. Grass Channels

This section describes each of the criteria for the five groups of non-structural practices and specifies minimum standards for their application to a site.

The Massachusetts Department of Environmental Protection (DEP) will need to validate the volume reductions in order to ensure compliance with the Massachusetts Wetlands Protection Act.

The application of these criteria does not relieve the design engineer or reviewer from the standard of engineering practice associated with safe conveyance of stormwater runoff and good drainage design.

Several of the stormwater criteria apply towards meeting the Massachusetts Stormwater Policy's recharge requirement. The Massachusetts Stormwater Policy currently only recognizes a volume based approach to meeting this standard. Recently however, it has been demonstrated that disconnecting impervious area to drain over pervious areas can result in significant recharge to groundwater. Therefore, some jurisdictions (most notably the States of Vermont and Maryland) have developed recharge criteria that credit recharge based on an "area method," as opposed to strictly a volume method. To better understand this approach both the "volume method" and "area method" are described as follows.

The intent of the recharge criteria (which is often denoted as Re_v) is to maintain pre-developed groundwater recharge rates at development sites to preserve existing water table elevations,

thereby helping to support baseflow to streams and wetlands, as well as to help augment drinking water supplies.

The objective of the criteria is to mimic the average annual recharge rate for the prevailing hydrologic soil group(s) (HSG) present at a development site. Therefore, the recharge volume can be determined as a function of annual predevelopment recharge for a given soil group, average annual rainfall volume, and amount of impervious cover at a site. Being a function of site impervious cover, the criterion provides an incentive to engineers and developers to reduce site imperviousness.

The recharge can be satisfied by one of two methods or a combination of both. The first is designated as the “**Percent Volume Method**,” and is based on infiltrating the recharge volume using one or more of the approved structural practices (such as infiltration trench, infiltration basins, or drywells). The second method is designated as the “**Percent Area Method**,” and is based on draining runoff from some or all of a site impervious area through one or more of the approved nonstructural practices.

Based on this approach, the **Percent Volume Method** is as follows:

$$Re_v = (F)(A)(I)/12$$

Where: Re_v = Recharge volume (acre-feet)
 F = Recharge factor (in inches, see below)
 A = Site area (in acres)
 I = Site imperviousness (expressed as a decimal)

Hydrologic Soil Group	Recharge Factor (F)
A	0.40
B	0.25
C	0.10
D	waived

An example calculation of this method is provided below.

Example: A 50-acre site is to be developed as a residential subdivision near Burlington, MA. The impervious area for the development will be 20 acres (i.e., 40% imperviousness). Half of the impervious area overlays HSG "B" soils and half of the impervious area overlays HSG "C" soils. The recharge requirement would be calculated as follows:

$$\text{Compute a weighted } F = [(0.25 \text{ in})(10 \text{ ac}) + (0.10 \text{ in})(10 \text{ ac})]/20 \text{ ac} = 0.175 \text{ inches}$$

$$Re_v = (0.175 \text{ in}) (50 \text{ ac}) (0.4)/(12 \text{ in/ft}) = 0.29 \text{ ac-ft}$$

The pervious area method is an option to the volume method to allow nonstructural practices to meet the volume-based re-charge criteria.

Under the **Percent Area Approach**, the recharge requirement can be met by draining a calculated recharge area through one or more of several nonstructural approaches. The calculation is as follows:

$$Re_a = (F)(A)(I)$$

Where: Re_a = Recharge area requiring treatment (acres)
F = Recharge factor based on Hydrologic Soil Group (HSG) (same values as above, but dimensionless)
A = Site area in acres
I = Site imperviousness (expressed as a decimal)

The required recharge area (Re_a) is equivalent to the recharge volume and can be achieved by a non-structural practice (e.g., filtration of sheet flow from disconnected impervious surfaces). In addition, a combination of both of the methods can be used to meet the recharge requirement at a site.

If an applicant elects to utilize both the Percent Volume and Percent Area Methods to meet the recharge requirement, the following applies:

1. Calculate both the Re_v and Re_a for the site;
2. The site impervious area draining to an approved nonstructural practice is subtracted from the Re_a calculation from step 1, above;
3. The remaining Re_a is divided by the original Re_a to calculate a pro-rated percentage that needs to be met by the Percent Volume Method;
4. The pro-rated percent is multiplied by the original Re_v to calculate a new Re_v that must be met by an approved structural practice(s).

With this basic understanding of how the recharge requirement can be met on a project, it is now appropriate to review the suite of LID Design Criteria that can meet both recharge, water quality and, in a few cases, some of the water quantity controls as well.

Criterion No. 1: Environmentally Sensitive Development

This practice is utilized when a group of environmental site design techniques are applied to lower density or rural residential development. The criterion eliminates the need for structural practices to treat both the Re_v and water quality and can reduce required volumes for peak control of the 2-year, 10-year and 100-year storms.

Minimum Standards

The Re_v and water quality requirements are completely met without the use of structural practices in certain low density (less than 1 dwelling unit per acre) residential developments when the following conditions are met:

- The total impervious cover footprint is less than 15 % of lot area;
- A minimum of [25%] of the site is protected in natural conservation areas;
- Rooftop runoff is disconnected in accordance with the specifications outlined under Criterion 2;
- Grass channels are used to convey runoff versus curb and gutter for roads and/or driveways (with no specific constraints on water quality volume, velocity or minimum retention time); and
- Stream buffers are incorporated into the site design on both perennial and intermittent streams (where applicable).

The designer must still address applicable stormwater detention for all roadway and connected impervious surfaces (i.e, 2-year, 10-year, and 100-year control).

Environmentally Sensitive Rural Development Example Application

Base Data

Site Data: a single-family lot that is part of an 8-acre low density subdivision in a critical area

Lot Area = 2.5 ac

Conservation Area = 0.65 ac

Impervious Area = .35 ac = 14%

Site Soils Types: 100% "B"

F = 0.25

Original water quality volume = 1.0" (.35) (43,560/12) = 1,270.5 ft³

Original Re_v = (2.5) (0.08) (.25) (43,560/12) = 182 ft³

Environmentally Sensitive Rural Criterion (see Figure 1)

Required recharge is considered met by site design.

Required water quality volume is considered met by site design.

2-year, 10-year & 100-year control: No change in CN, t_c may be longer which would reduce storage requirements.

Percent Reductions Using Environmentally Sensitive Rural Criterion:

- $Re_v = 100\%$
- Water quality requirement = 100%

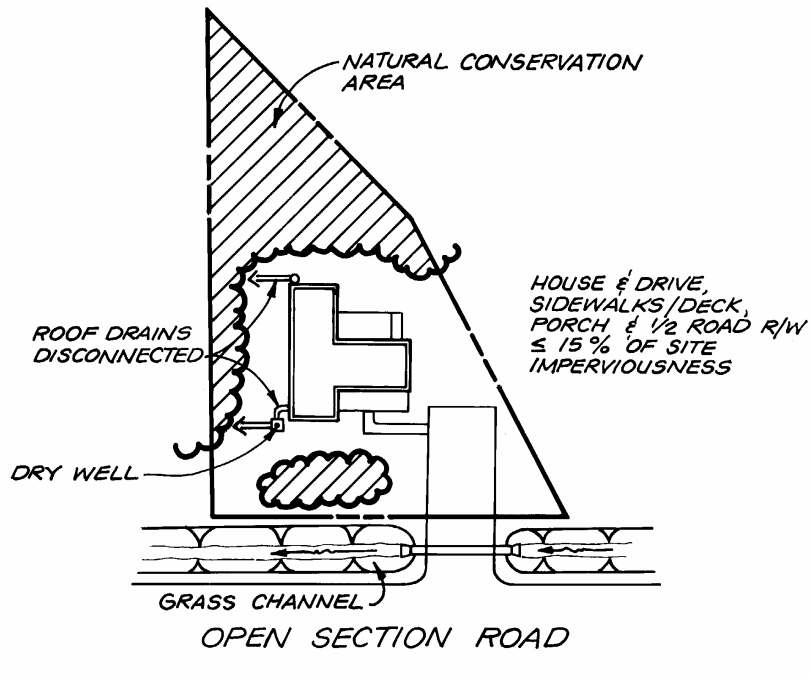


Figure 1. Schematic of Environmentally Sensitive Rural Development

Criterion No. 2: Disconnection of Rooftop Runoff

This criterion may be satisfied when rooftop runoff is “disconnected” and then directed over to a pervious area where it can either infiltrate into the soil or flow over it with sufficient time and velocity to allow for filtering. The standard is typically met by grading the site to promote overland flow through vegetated channels or by providing bioretention¹ areas either on-lot or in common areas.

If a rooftop is adequately disconnected, the disconnected impervious area can be deducted from total impervious cover, therefore reducing water quality volume requirements. In addition, disconnected rooftops can be used to meet the recharge requirement as a non-structural practice under the **Percent Area Method**.

Restrictions on Application of the Criterion

The rooftop disconnection criterion is subject to the following restrictions:

- Disconnection must be designed to adequately address the issue of basement seepage;
- The contributing length of rooftop to a discharge location shall be 75 feet or less;
- The rooftop contributing area to any one discharge location cannot exceed 1,000 ft²;
- The length of the "disconnection" shall be equal to or greater than the contributing rooftop length;
- Disconnections will only be allowed for residential lot sizes greater than 6,000 sq. ft.;
- The entire vegetative "disconnection" shall be on a slope less than or equal to 5.0%;
- Where provided, downspouts must be at least 10 feet away from the nearest impervious surface to discourage re-connection to the drainage network;
- Where a gutter/downspout system is not used, the rooftop runoff must drain as either sheetflow from the structure or drain to a subsurface drain field that is not directly connected to the drainage network;
- Disconnections shall be used on relatively permeable soils (HSGs A and B); therefore, no soil evaluation is required;
- In less permeable soils (HSGs C and D), the water table depth and permeability shall be evaluated by a responsible professional engineer to determine if a spreading device is needed to provide sheetflow over grass surfaces. In some cases, dry wells (see Figure 2), french drains or other temporary underground storage devices may be needed to compensate for a poor infiltration capability;
- For those rooftops draining directly to a stream buffer, one can meet either the rooftop disconnection criterion or the stream buffer criterion (Criterion 3), not both; and

¹ Bioretention systems (also referred to as "rain gardens" or "biofilters") are so-called low impact development stormwater management systems that manage and treat stormwater runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. The method combines physical filtering and adsorption with bio-geochemical processes to remove pollutants. The system consists of an inflow component, a pretreatment element, an overflow structure, a shallow ponding area (less than 9" deep), a surface organic layer of mulch, a planting soil bed, plant materials, and an underdrain system to convey treated runoff to a downstream facility.

- To utilize rooftop disconnection for a designated hotspot land use, the rooftop runoff must not co-mingle with runoff from any paved surfaces.

An example of this criterion is provided below.

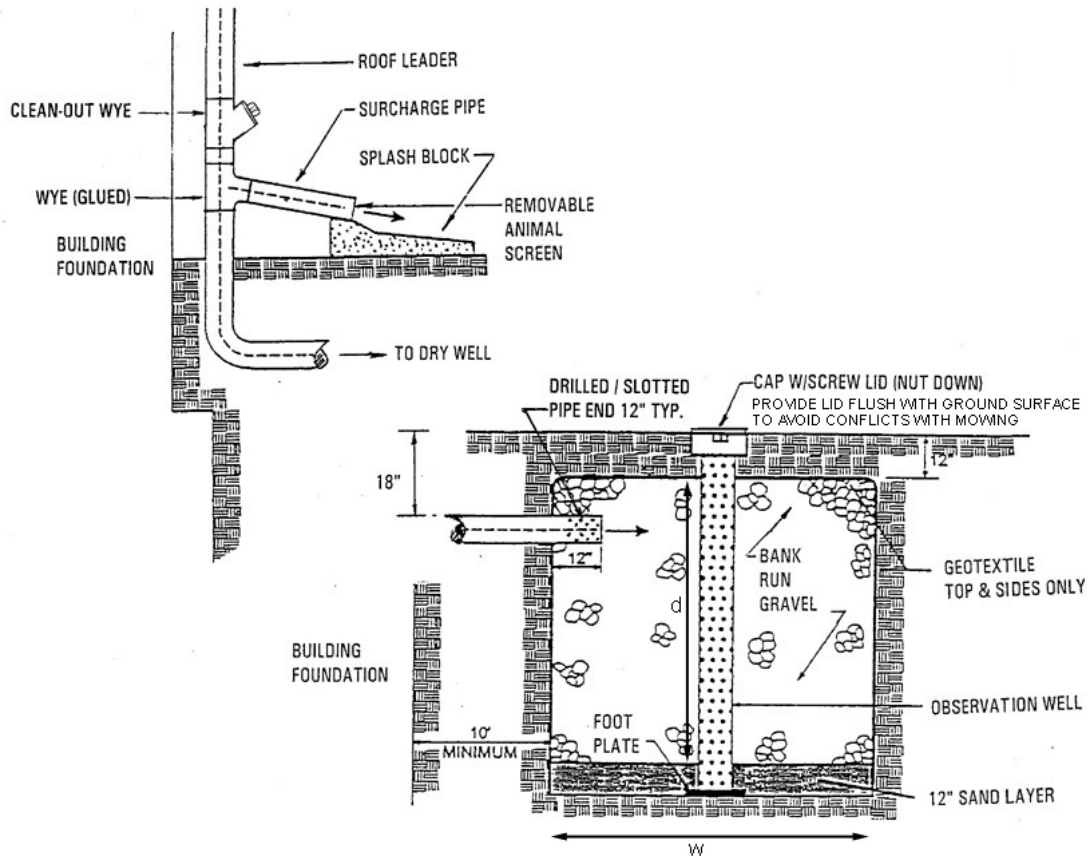


Figure 2. Schematic of Dry Well (Source: adapted after Howard County, MD)

Rooftop Disconnection Example Application

Given the following base data:

Site Data: 108 Single-Family Residential Lots (~ 1/2-acre lots)

Site Area = 45.1 ac

Original Impervious Area = 12.0 ac;

Site Soils Types: 78% "C", 22% "D"

Composite Recharge Factor, $F = 0.08$

Original $Re_v = 0.08$ acre-feet; $Re_a = 0.96$ acres

Original water quality requirement = $1.0''/\text{impervious acre} = 1.0''(12.0 \text{ ac})/12 = 1.0$ acre-foot
(site is located in a critical area)

Rooftop Criterion (see Figure 3)

42 houses disconnected

Average house area = 2,500 ft²

Net impervious area reduction = $(42)(2,500 \text{ ft}^2) / (43,560 \text{ ft}^2/\text{ac}) = 2.41 \text{ acres}$

New impervious area = $12.0 - 2.41 = 9.59 \text{ acres}$;

Required recharge (Re_a) is 0.96 acres and 2.41 acres were disconnected thereby meeting 100% of the recharge requirement.

New water quality volume = $1.0'' (9.59)/12 = 0.80 \text{ acre-feet}$; or a 0.20 acre-foot reduction

Percent Reductions Using Rooftop Disconnection Criterion:

- $Re_v = 100\%$
- Water quality = $(1.0 - 0.8) / 1.0 = 20.0\%$

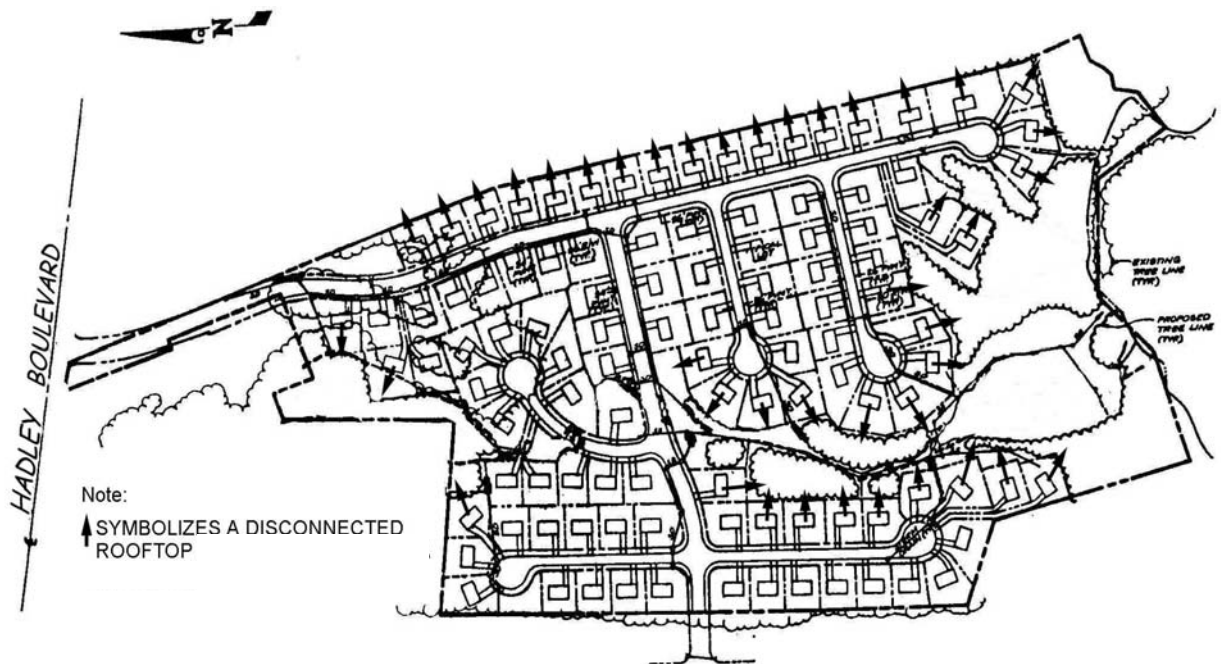


Figure 3. Schematic of Rooftop Disconnection

Criterion No 3: Disconnection of Non-Rooftop Runoff

These standards apply to practices that disconnect surface impervious cover runoff by directing it to pervious areas where it is either infiltrated into the soil or filtered (by overland flow). This criterion can be satisfied by grading the site to promote overland vegetative filtering.

These "disconnected" areas can be subtracted from the site impervious area when computing the water quality treatment volume. In addition, disconnected surface impervious cover can be used to meet the recharge requirement as a non-structural practice under the **Percent Area Method**.

Restrictions on Application of the Criterion

The criterion is subject to the following restrictions:

- The maximum contributing impervious flow path length shall be 75 feet;
- Runoff cannot come from a designated hotspot land use;
- The length of the "disconnection" must be equal to or greater than the contributing length;
- The entire vegetative "disconnection" shall be on a slope less than or equal to 5.0%;
- The surface impervious area to any one discharge location cannot exceed 1,000 ft²;
- Disconnections shall be used on relatively permeable soils (HSGs A and B); therefore, no soil evaluation is required;
- In less permeable soils (HSGs C and D), the water table depth and permeability shall be evaluated by a professional engineer to determine if a spreading device such as a french drain, gravel trench or other temporary storage device is needed to compensate for poor infiltration capability; and
- For those areas draining directly to a wetlands or stream buffer, only the non-rooftop disconnection criterion or the stream buffer criterion can be used, not both.

Criterion No. 4: Stream Buffer

These standards apply to treat stormwater runoff by a stream buffer. Effective treatment constitutes capturing runoff from pervious and impervious areas adjacent to a stream buffer and treating runoff through the overland flow in a natural vegetative or forested buffer. The use of a filter strip is also recommended to treat overland flow in the green space of a development site (see Figure 4). The standards include:

- The impervious area draining by sheet flow to a stream buffer is subtracted from the site's initial impervious area in the water quality calculation.
- The impervious area draining to stream buffer contributes to the recharge requirement, (Re_v), under the **Percent Area Method**.

Restrictions on Application of the Criterion

The criterion is subject to the following conditions:

- The minimum stream buffer width (i.e., perpendicular to the stream flow path) shall be 50 feet as measured from the bank elevation of a stream or the boundary of a wetland;
- The maximum contributing path shall be 150 feet for pervious surfaces and 75 feet for impervious surfaces;
- The average contributing overland slope to and across the stream buffer shall be less than or equal to 5.0%;
- Runoff shall enter the stream buffer as sheet flow. A level spreading device shall be utilized where local site conditions prevent sheet flow from being maintained;
- The criterion is not applicable if rooftop or non-rooftop disconnection is already provided (i.e., no double counting); and
- Stream buffers shall remain ungraded and uncompacted, and the over-story and under-story vegetation shall be maintained in a natural condition.

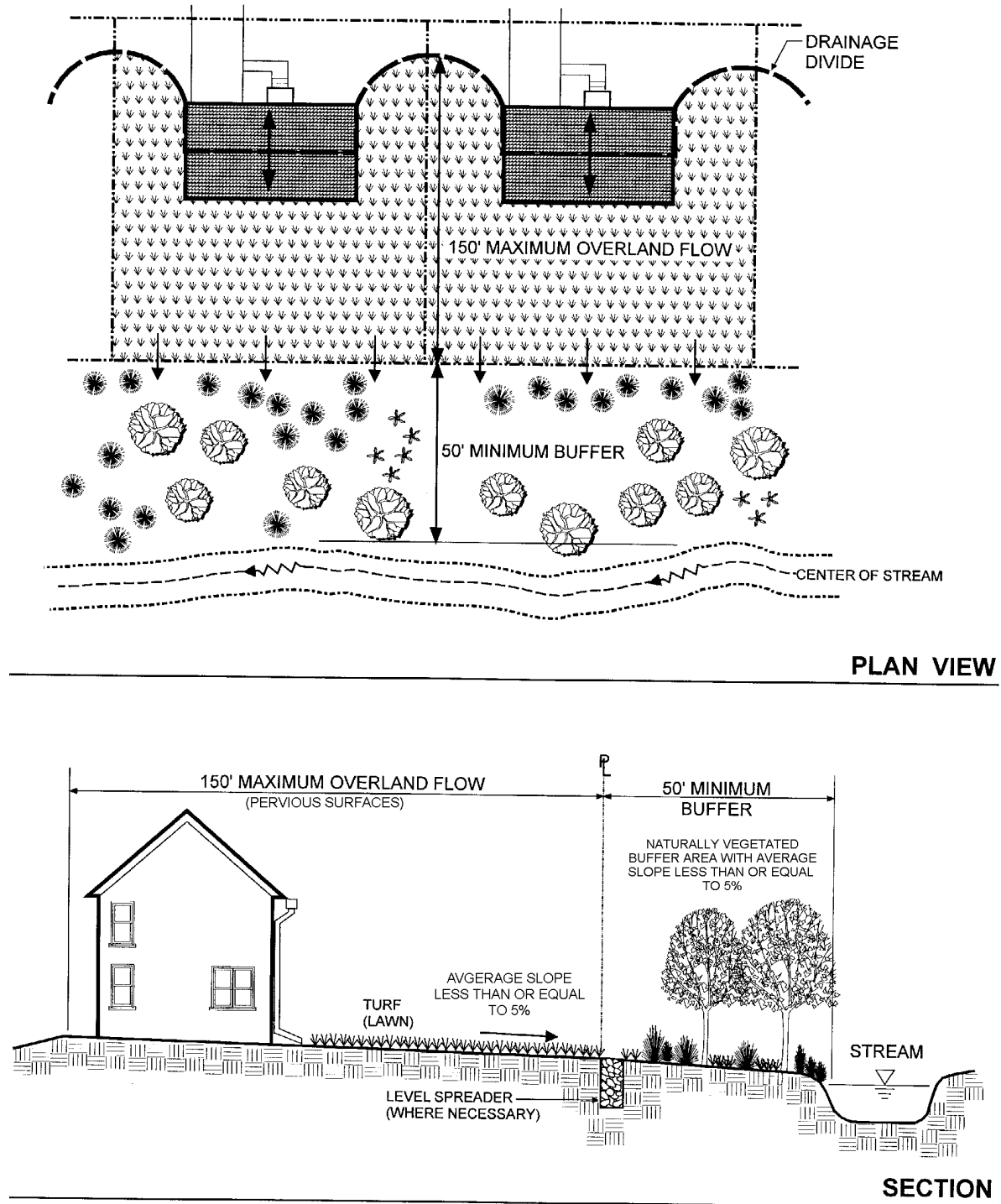


Figure 4. Example of Application of Stream Buffer Criterion

Criterion No. 5: Grass Channel

Open grass channels may be used to reduce the volume of runoff and pollutants during smaller storms (i.e., 1.0 inches and less).

Use of a grass channel will automatically meet the minimum recharge Re_v requirement (under the **Percent Area Method**) regardless of the geometry or slope. If designed according to the following design criteria, the grass channel will meet the water quality treatment requirements for certain kinds of residential development.

Note: Runoff curve numbers (CNs) for 2-year, 10-year, and 100-year control will not change.

Grass Channel Design Criteria

Grass channels shall meet the following specifications.

- Land use is moderate to low density residential (maximum density of 4 dwelling unit/ac);
- The bottom width shall be 2 foot minimum and 6 foot maximum (if a larger channel is needed, a compound cross section may be used);
- The side slopes shall be 3Horizontal:1Vertical or flatter;
- The channel slope shall be less than or equal to 4.0%; and
- The length of the grass channel shall be equal to the roadway or parking lot length.

Grass Channel Example Application

Base Data

Site Data: 108 Single Family Residential Lots (~ 1/2 acre lots)

Site Area = 45.1 ac

Original Impervious Area = 12.0 ac; or $I = 12.0/45.1 = 26.6\%$

Site Soils Types: 78% "C", 22% "D"

Composite F = 0.08

Original $Re_v = 0.08$ acre-feet; $Re_a = 0.96$ acres

Original $WQ_v = 1.0$ acre-feet

Grass Channel Criterion (see Figure 5)

Entire site is open section road, but only 11.2 acres meet the water quality requirement design criteria for the grass channel (i.e., 3:1 sideslopes, 2 foot bottom width and slope less than or equal to 4%).

Required recharge (Re_a) is 0.96 acres and the full site is drained by grass channels, thereby meeting 100% of the recharge requirement.

New water quality Area = $(45.1 - 11.2) = 33.9$ acres, assume new impervious cover = $0.266(33.9 \text{ ac}) = 9.0$ acres.

New $WQ_v = 1.0''(9.0 \text{ acres})/12 \text{ inches/foot} = 0.75$ acre-feet; or a 0.25 acre-foot reduction

Percent Reductions Using Grass Channel Criterion:

- $Re_v = 100\%$
- $WQ_v = (1.0 \text{ acre-feet} - 0.75) / 1.0 \text{ acre-feet} = 25.0\%$

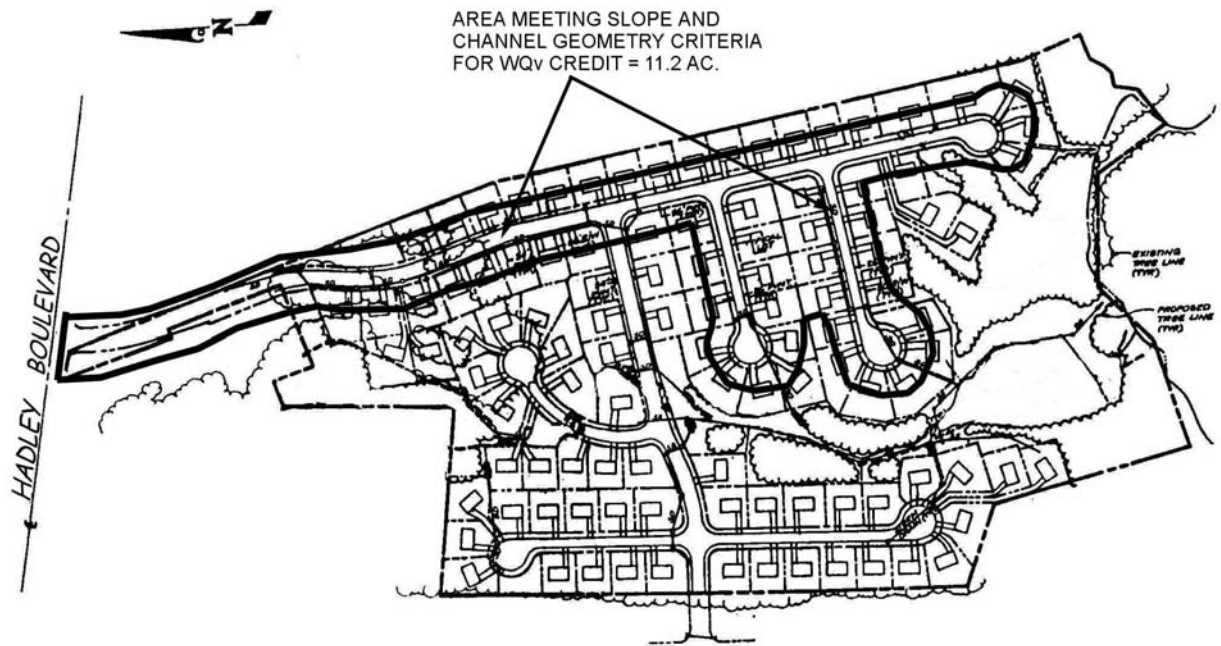


Figure 5. Schematic of Grass Channel

Dealing with Multiple LID Design Criteria

Site designers shall utilize as many LID Design Criteria as they can on a site. Greater reductions in stormwater storage volumes can be achieved when many criteria are combined together (e.g., disconnecting rooftops and utilizing grass channel for drainage design). However, criteria cannot be claimed twice for an identical area of the site (e.g., claiming credit for stream buffers and disconnecting rooftops over the same site area, draining to the same location).

Other Strategies to Reduce Impervious Cover

Site planning practices that reduce the creation of impervious area in new residential and commercial developments and therefore reduce the water quality requirements for the site should be encouraged whenever feasible². Examples of progressive site design practices that minimize the creation of impervious cover include:

- Narrower residential road sections;
- Shorter road lengths;
- Smaller turnarounds and cul-de-sac radii;
- Permeable spill-over parking areas (these areas should be valued as 50% impervious, unless designed specifically for infiltration);
- Smaller parking demand ratios;
- Smaller parking stalls for a percentage of lots;
- Angled one way parking;
- Cluster subdivisions;
- Smaller front yard setbacks;
- Shared parking and driveways; and
- More creatively designed pedestrian networks.

Where these techniques are employed, it may be possible to reduce stormwater storage volumes. For example, since the water quality treatment volume is directly based on impervious cover, a reduction in impervious cover reduces required storage. For 2-year, 10-year, and 100-year management, the designer can compute curve numbers (CNs) based on the actual measured impervious area at a site using the following equation (adopted from TR-55, 1986):

$$(98) I + (CN) P = CN$$

where: I = percent impervious area at the site
P = percent pervious area at the site

² The reader is referred to the following two references for a more detailed presentation of better site design and low impact development: 1) Center for Watershed Protection. 1998. *Better Site Design A Handbook for Changing Development Rules in Your Community*. Ellicott City, MD; and 2) Prince George's County MD Dept. of Environmental Resources. 1999. *Low Impact Development Design Strategies: An Integrated Design Approach*. Largo, MD.

CN = curve number for the appropriate pervious cover

Figures 6 and 7 show an example of a retail site designed as a conventional development, and as a site planned using improved site design practices and techniques, respectively. Some of the noteworthy features of the innovative site plan include: preservation of some forested areas, establishment of a stream buffer, reduced parking ratios, compact and pervious overflow parking spaces, and use of vegetated stormwater practices such as filter strips and bioretention areas.

Though not all land use types and developments are amenable to every approach described here, there are more opportunities for flexibility and creativity in site design than many realize. Redevelopment sites also can utilize several of these practices and techniques in the redesign of an area.

The following example (using Figures 6 and 7) quantifies the water quality and recharge requirement reductions that can be realized by implementing several of these practices and design techniques.

Base Data (see Figure 6)

Site Area = 9.3 ac

Original Impervious Area = 6.5 ac; or $I = 6.5/9.3 = 69.9\%$

Site Soils Types: 50% "B", 50% "C," split evenly over the impervious area

Composite F = $[0.25 (6.5/2) + 0.10 (6.5/2)]/6.5 = 0.18$

Original $Re_v = 0.18 (6.5)/12 = 0.10$ acre-feet

Original Water Quality Requirement = $1.0(6.5 \text{ ac})/12 = 0.54$ acre-feet

Site Planning Strategies (see Figure 7)

The revised site incorporates the following features:

- 1.8 acres preserved in a conservation easement.
- 0.46 acres of parking lot drain to a buffer with an overland flow path less than 75 feet (Criterion No. 3: stream buffer).
- 0.28 acres of parking lot/loading area drain to a filter strip with an overland flow path less than 75 feet (Criterion No. 2: disconnection of non-rooftop runoff).
- The total site impervious area was reduced from 6.3 acres to 5.8 acres by the site design revision; the new site $I = 5.8/9.3 = 62.4\%$.

The new storage requirements for Re_v :

- New composite F = $[0.25 (5.8 \text{ ac}/2) + 0.10 (5.8 \text{ ac}/2)]/5.8 = 0.18$
- New Re_v (**Percent Volume Method**) = $0.18 (5.8 \text{ ac})/12 = 0.09$ acre-feet
- New Re_a (**Percent Area Method**) = FAI = $0.18 (9.3 \text{ ac})(.624) = 1.04$ acres
- Using the **Percent Area Method** and noting that 0.46 acres drain to the buffer and 0.28 acres drain to a filter strip, then $Re_a = 1.04 \text{ ac} - (0.46 \text{ ac} + 0.28 \text{ ac}) = 0.3$ acres
- Therefore, the remaining $Re_v = (0.3 \text{ ac}/1.04 \text{ ac}) (0.09 \text{ ac-ft}) = 0.02$ acre-feet

0.02 acre-feet must be managed by an approved “structural” practice.

The new storage requirement for water quality control is:

- New Impervious Area (to satisfy specifications for non-rooftop disconnection and buffer criteria) = 5.8 ac – (0.28 ac + 0.46 ac) = 5.06 acres;
- New water quality requirement = $1.0''(5.06 \text{ ac})/12 = 0.42$ acre-feet; or a 0.12 acre-foot reduction

Percent Reductions Using Site Planning Strategies:

- $Re_v = (0.10 - 0.02) / 0.10 = 80.0\%$
- $WQ_v = (0.54 - 0.42) / 0.54 = 22.0\%$

Also, with a 0.5-acre net reduction in site imperviousness, the CN for computing the 2-year, 10-year and 100-year control will be lower, thereby reducing the storage requirements for these storms by a modest amount.

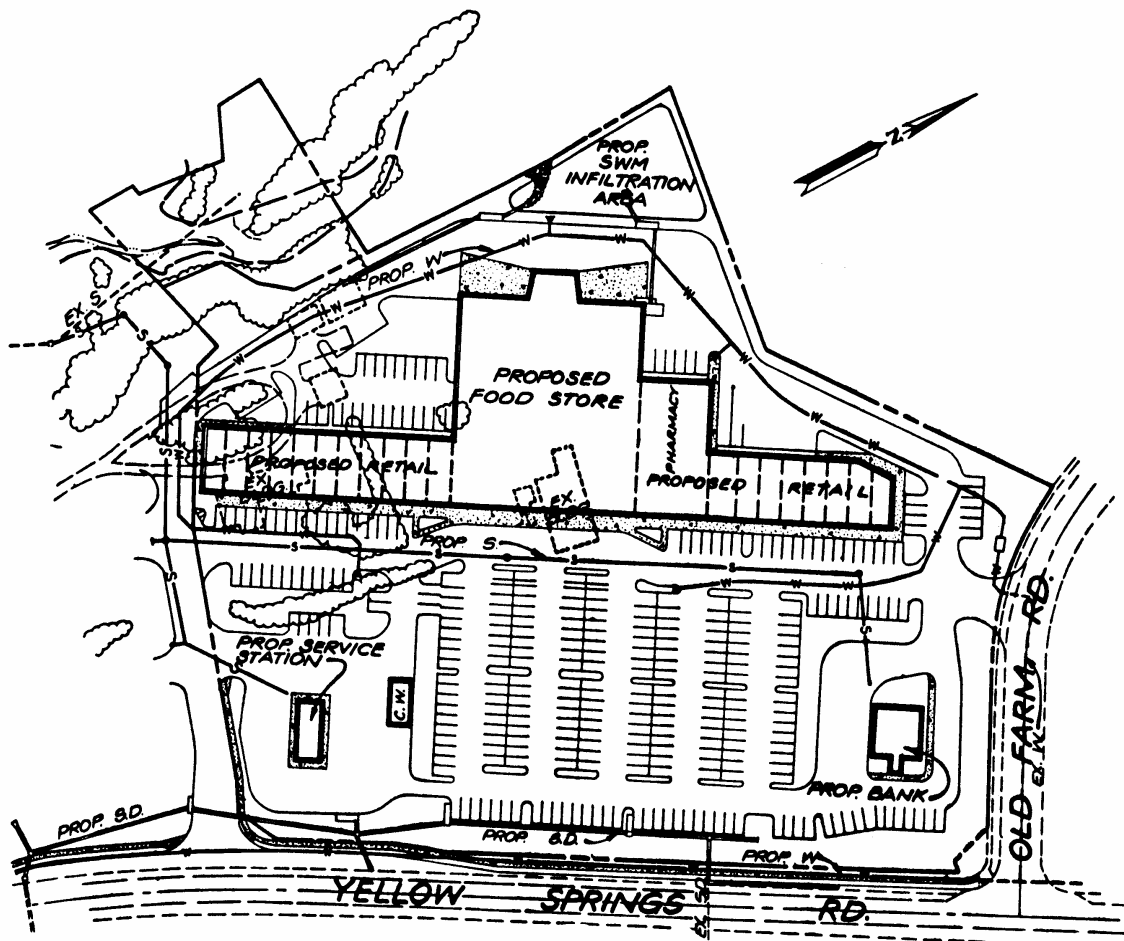


Figure 6. Example of Conventional Retail Site Design

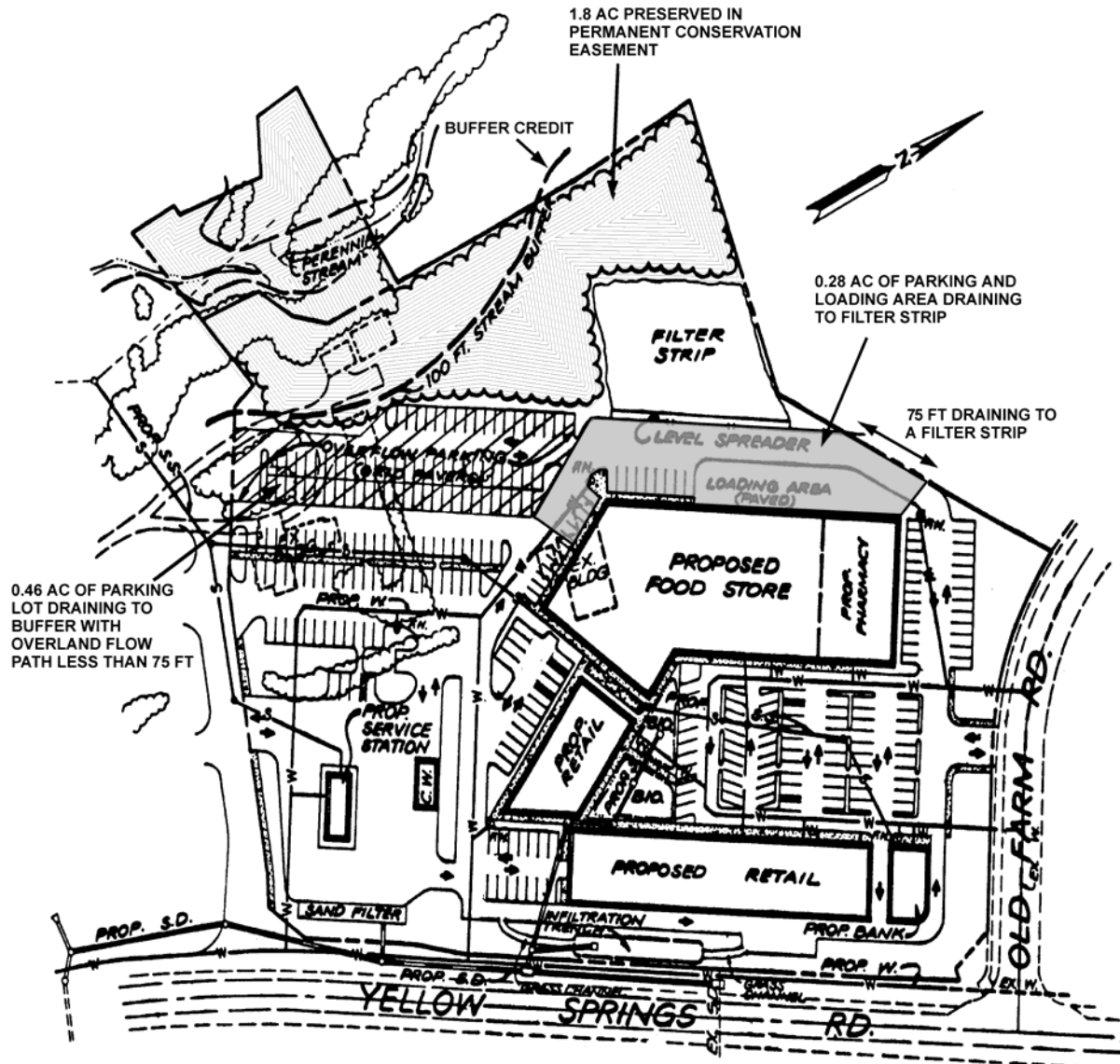


Figure 7. Example of Improved Retail Site Design