TOWN OF PAXTON STORM WATER REGULATIONS

Final Revised March 2012

1.0 PURPOSE

The purpose of these Storm Water 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 Storm Water Bylaw of the Town of Paxton.

2.0 DEFINITIONS

Definitions are in Appendix A of these Regulations and shall apply to issuance of a Storm Water Management Permit (SMP) established by the Town of Paxton Storm Water Bylaw and implemented through these Storm Water Regulations. Terms not defined in Appendix A shall be understood according to their customary and usual meaning.

3.0 AUTHORITY

A) These Regulations have been adopted by the Planning Board in accordance with the Town of Paxton Storm Water Bylaw.

B) These Regulations are adopted to administer the Storm Water Bylaw and do not replace the requirements of the Town of Paxton Floodplain Zoning Bylaw, the Watershed Protection District or any Rules and Regulations adopted thereunder.

C) These Storm Water Regulations may be periodically amended by the Planning Board in accordance with the procedures outlined in Section 4.0 of the Town of Paxton Storm Water Bylaw.

4.0 ADMINISTRATION

A) The Planning Board shall administer these Regulations. The Conservation Commission, Water Department and Board of Health, who have formally adopted these regulations, either directly, or by reference, shall be requested to give their approval under these Storm Water Regulations. Projects or activities approved by these boards/department and commission shall be deemed in compliance with the intent and provisions of these Storm Water Regulations. Each approving board /department and commission must forward written approval and all conditions of approval to the Planning Board within 10 business days of approval. Upon receipt of this written approval, the Planning Board shall review and make a final determination on the issuance of a Storm Water Management Permit to the applicant within 10 business days.

5.0 APPLICABILITY

A) These Storm Water Regulations apply to all new development and redevelopment that are not exempt under the Town of Paxton Storm Water Bylaw. Projects within the jurisdiction of the Storm Water Bylaw must obtain a Storm Water Management Permit from the Planning Board in accordance with the permit procedures and requirements defined in Section 6 of these Regulations. For projects and/or activities within the jurisdiction of delegated Town Boards, the specific application requirements, public notices and fees of that board shall govern. The Storm Water Management Plan Contents, Operation and Maintenance requirements, and Storm Water Review Fee, under Section 6.0 L and Section 6.0 M of these Regulations must also be met.

6.0 PERMIT PROCEDURES AND REQUIREMENTS

A) Projects requiring a Storm Water management permit shall submit the materials specified in this section, and meet the Storm Water management criteria as specified in Section 7. Applications filed with a delegated Town Board shall submit the Storm Water Management Plan as additional information required for a development project review.

B) Permit Required
1. Applicants shall not receive any building, grading or land development permits without first meeting the requirements of these Regulations.
2. The project shall begin within a 180 day period after issuance of the Storm Water permit. If the project does not begin within 180 days, and the Planning Board finds that the approved Storm Water Management Plan is inadequate, the applicant shall submit a modified Plan that requires approval prior to the commencement of land-disturbing activities.

C) Filing Application
1. The applicant shall file with the Planning Board, 3 copies of an application for a Storm Water Management Permit (SMP). A permit must be issued prior to any site altering activity. The permittee must be the owner of the site. The SMP Application package shall include:
   a) A completed Application Form with original signatures of all owners;
   b) A list of abutters, certified by the Assessors Office; including owners of land within 300 feet of the property line of the applicant, including any in another municipality or across a body of water;
   c) Storm Water Management Plan and project description;
   d) Payment of the application and review fees;
   e) Inspection and Maintenance agreement;
   f) Erosion and Sediment Control Plan;
   g) Surety bond.

D) Entry
Filing an application for a permit grants the Planning Board or its agent, permission to enter the site to verify the information in the application and to inspect for compliance with the resulting permit.

E) Fees
Application fees established by the Planning Board are required to cover expenses for the review of the Storm Water Management Permit, including professional services. The Planning Board is authorized to retain a Registered Engineer or other professional consultant to advise on any aspects of the permit application. Applicants must pay the following fees before the review process may begin:
1. Rules
   a) Application fees are in addition to any other local or state fees that may be charged.
   b) The fee schedule may be altered by the Planning Board at a public hearing at least 30 days before the effective date of the change.
2. Application Fees
   a) A non-refundable application fee of the larger of $30.00 or $0.0030 per square foot of the parcel to which the permit will be issued, which shall be payable to the Town of Paxton when an application is filed.
3. Engineering and Consultant Reviews and Fees
   a) The Planning Board is authorized 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 Planning Board to come to a decision on the application.
   b) Payment may be required at any point in the deliberations prior to a final decision.
   c) An application filed with the Planning Board must be accompanied by a completed Engineering Consultant Fee Acknowledgement form.
   d) Consultant fees shall be determined at the time of project review.
   e) The services for which a fee may be utilized include wetland survey and delineation, hydrologic and drainage analysis, wildlife evaluation, Storm Water quality analysis, site inspections, as-built plan review, and analysis of legal issues.
   f) Any unused portion of fees collected shall be returned by the Planning Board to the applicant within 45 calendar days of a written request by the applicant.

g) The Engineering and Consultant Review fees collected under this section shall be deposited in a revolving account.

F) Public Hearings

The Planning Board need not hold a public hearing for projects or activities outside the delegated jurisdiction of delegated Town Boards. For projects or activities within the jurisdiction of delegated Town Boards, a public hearing shall be held in accordance with their procedures.

G) Actions

The Planning Board's action, rendered in writing, shall consist of either:

1. Approval of the Storm Water Management Permit Application based upon determination that the proposed plan meets the Standards in Section 7 and is in compliance with the requirements in this Bylaw;
2. Approval of the Storm Water Management Permit Application subject to any conditions, modifications or restrictions required by the Planning Board;
3. Disapproval of the Storm Water Management Permit Application based upon a determination that the proposed plan, as submitted, does not meet the Standards in Section 7 or the requirements in this Bylaw;
4. The Planning Board may disapprove an application "without prejudice" where an applicant fails to provide requested additional information that in the Planning Board's opinion is needed to adequately describe the proposed project.

H) Failure of the Planning Board to take final action upon an application within 90 calendar days of receipt of a complete application shall be deemed to be approval of that application.

I) Plan Changes

The permittee must notify the Planning Board in writing of any change in a Storm Water Management Permit before any change or alteration is made. If the change or alteration is significant, the Planning Board may require that an amended application be filed.

J) Appeals

A decision of the Planning Board shall be reviewable in 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 the written approval until the appeal process has been resolved.

K) Project Completion

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

All nonstructural Storm Water practices and techniques within individual lots and/or within Town easements adjacent to the lots shall be: a.) placed on the final approved Definitive Subdivision Plan and final As-built Plan; b.) recorded at the Worcester County Registry of Deeds as a condition of approval of the above-referenced plan; c.) placed on individual deeds as restrictions and d.) filed with the Building Commissioner.

L) Storm Water Management Plan Contents

1. A Storm Water Management Plan submitted with the permit application shall contain sufficient information for the Planning Board to evaluate the environmental impact and effectiveness of the measures proposed for reducing adverse impacts from Storm Water runoff. This plan shall comply with the criteria established in these regulations and must be submitted with the stamp and signature of a Professional Engineer (PE) licensed in the Commonwealth of Massachusetts.
2. The Storm Water Management Plan shall fully describe the project in drawings, narrative, and calculations. It shall include:
   a) Contact Information. The name, address, and telephone number of all persons having a

legal interest in the property and the tax reference number and parcel number of the property or properties affected;

b) A locus map;
c) The existing zoning, and land use at the site;
d) The proposed land use;
e) The location(s) of existing and proposed easements;
f) The location of existing and proposed utilities;
g) The site's existing & proposed topography with contours at 2 foot intervals,
h) The existing site hydrology;
i) A description & delineation of existing Storm Water conveyances, impoundments, and wetlands on or adjacent to the site or into which Storm Water flows;
j) A delineation of 100-year flood plains, if applicable;
k) Estimated seasonal high groundwater elevation in areas to be used for Storm Water retention, detention, or infiltration;
l) The existing and proposed vegetation and ground surfaces with runoff coefficients for each;
m) A drainage area map showing pre and post construction watershed boundaries, drainage area and Storm Water flow paths, including municipal drainage system flows;
n) A description and drawings of all components of the proposed Storm Water management system including:
    i. Locations, cross sections, and profiles of all brooks, streams, drainage swales and their method of stabilization;
    ii. All measures for the detention, retention or infiltration of water;
    iii. All measures for the protection of water quality;
    iv. The structural details for all components of the proposed drainage systems and Storm Water management facilities;
    v. Notes on drawings specifying materials to be used, construction specifications, and expected hydrology with supporting calculations;
    vi. Proposed improvements including location of buildings or other structures, impervious surfaces, and drainage facilities, if applicable;
    vii. Any other information requested by the Planning Board.
    viii. Any surface water resource areas shown on plans submitted under the Storm Water Bylaw, shall be delineated in the field in accordance with 310 CMR 10.00, Wetland Protection Act, and the handbook "Delineating Bordering Vegetated Wetlands under the Massachusetts Wetlands Protection Act" (Department of Environmental Protection, Division of Wetlands and Waterways, 1995, or as updated).
o) Hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in this Regulation. Such calculations shall include:
    i. Description of the design storm frequency, intensity and duration;
    ii. Time of concentration;
    iii. Soil Runoff Curve Number (RCN) based on land use and soil hydrologic group;
    iv. Peak runoff rates and total runoff volumes for each watershed area;
    v. Information on construction measures used to maintain the infiltration capacity of the soil where any kind of infiltration is proposed;
    vi. Infiltration rates, where applicable;
    vii. Culvert capacities;
    viii. Flow velocities;
    ix. Data on the increase in rate and volume of runoff for the specified design storms, and
    x. Documentation of sources for all computation methods and field test results.
p) Post-Development downstream analysis if deemed necessary by the Planning Board;
q) Soils Information from test pits performed at the location of proposed Storm Water 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 Registered Soil Evaluator, or a Massachusetts Registered Professional Engineer;

r) Landscaping plan describing the woody and herbaceous vegetative stabilization and management techniques to be used within and adjacent to the Storm Water practice.

M) Operation and Maintenance of Storm Water Structures

All property owners are responsible for maintaining the proper operation of all permitted Storm Water control features on their property. Storm Water structures shall be maintained to ensure compliance with the Permit, this Bylaw and that the Massachusetts Surface Water Quality Standards are met in all seasons and throughout the life of the system.

1. Storm Water Management Easement(s)
   a) Where the Planning Board determines it is necessary, a Storm Water management easement shall be provided by the property owner(s) to allow access to Storm Water facilities for inspection and maintenance. Easements shall be recorded with the Worcester County Registry of Deeds prior to issuance of a Certificate of Final Completion by the Planning Board.

7.0 POST-DEVELOPMENT STORM WATER MANAGEMENT CRITERIA

A) All projects shall comply with the most recent version of Massachusetts Storm Water Management Policy and achieve the following performance standards:

B) General Criteria

1. No Untreated Discharges
   Storm Water shall not be discharged directly to a wetland, local water body, municipal drainage system, or abutting property, without adequate treatment.
2. Channel Protection
   The post-development peak discharge rate from the 2-year storm event shall be equal to the pre-development rate in order to prevent stream bank erosion and channel degradation.
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 wash out, chemicals, litter and sanitary wastes. BMPs shall be in conformity with the *Massachusetts Erosion & Sediment Control Guidelines for Urban & Suburban Areas* (FHHCD, 1997).
4. 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.
5. Groundwater Recharge
   Post-development recharge rates shall equal pre-development conditions. Annual groundwater recharge rates shall be maintained by use of structural and non-structural management practices. The Storm Water runoff volume to be recharged to groundwater shall be determined using the methods in the latest version of the Massachusetts DEP Storm Water Management Handbooks. The Planning Board may relax or eliminate the recharge requirement if the site is in a redevelopment area where contaminated soils are documented.
6. Structural Practices for Water Quality
   All structural Storm Water management facilities shall be based on design criteria from the most recent version of the Massachusetts DEP Storm Water Management Handbooks and shall remove at least 80% of the total suspended solids (TSS).
7. Water Quality Volume
   The volume for sizing a structural Storm Water facility shall be designed according to criteria specified by the Massachusetts DEP Storm Water Management Policy.
8. Hydrologic Basis for Design of Structural Practices
   For facility sizing criteria, the basis for hydrologic and hydraulic evaluation of development sites are as follows:

a.) 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 paved parking lots, sidewalks, roof tops, driveways, patios, and paved, gravel and compacted dirt surfaced roads.

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

c.) For purposes of computing runoff, all pervious lands in the site shall be assumed prior to development to be in good condition.

d.) 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.

e.) Proposed residential and commercial development shall apply these Storm Water 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.

9. Sensitive Areas
   Storm Water discharges to swimming beaches, aquifer recharge areas, water supplies and other sensitive water resources may be subject to special criteria established by the Planning Board after conducting a public hearing in accordance with the Town of Paxton Storm Water Bylaw.
10. Hotspots
    Storm Water discharges from land uses with higher pollutant loadings, known as "hotspots", require treatment practices specified in the MA DEP Storm Water Management Handbooks.
11. Storm Water Credits
    Improved site design and nonstructural controls are encouraged to minimize the use of structural Storm Water controls. The applicant may request credit for site design practices that can reduce other requirements in these regulations. The Planning Board shall adopt criteria for site design practices that qualify as Storm Water credits. The site design practices that qualify for these credits and procedures for applying and calculating the credits are identified in Appendix B of this Regulation.
12. Compliance with Existing Storm Water and Drainage Requirements
    For Storm Water Management Permits in subdivisions, the Planning Board may apply the requirements for the management of Storm Water and drainage specified in Sections 4.8.6 and 5.4 of the Town of Paxton Rules and Regulation Governing the Subdivision of Land, in addition to the above criteria.

8.0 WAIVERS

A) The Planning Board 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 Paxton Storm Water Bylaw.

B) 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 Storm Water Bylaw.

C) All waiver requests shall be acted on within 60 days and the Planning Board will provide a written decision. If additional information is required, the Planning Board may extend the review period. If the applicant objects to an extension, or fails to provide requested information, the waiver request may be denied "without prejudice" by the Planning Board.

9.0 SURETY

The Planning Board may require the permittee to post a bond, cash or other acceptable surety. The form of the bond shall be approved by town counsel, 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 of the project is completed in compliance with the permit, but the bond shall not be fully released until the Planning Board has received the final inspection report and issued a Certificate of Final Completion.

10.0 CONSTRUCTION INSPECTIONS

A) The applicant must notify the Planning Board before starting a land disturbing activity. The applicant must also notify the Planning Board before constructing the key components of the Storm Water management system.

B) At the discretion of the Planning Board, periodic inspections of the Storm Water management system construction shall be conducted by the Town or a professional engineer approved by the Planning Board. Inspections shall include, but not be limited to: Initial site inspection, prior to approval of any plan; inspection of site erosion controls; inspection of the Storm Water management system prior to backfilling of any underground drainage or Storm Water conveyance structures; and a final inspection before the surety is released. The Storm Water system shall be inspected to verify its as-built features, and the inspector shall also evaluate the system during a storm event. If the inspector finds the system adequate, this shall be reported to the Planning Board which will issue a Certificate of Final Completion.

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

C) Written reports of inspections shall include, but not be limited to: the inspection date and location; evaluation of compliance with the Storm Water permit; any variations from approved construction specifications or violations of the Storm Water Management Plan.

D) If the system is found to be inadequate due to operational failure, even though built according to the Storm Water Management Plan, the system shall be corrected by the applicant. If the applicant fails to act, the Planning Board may use the surety bond to complete the work. If the system does not comply with the Plan, the applicant 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 Planning Board.

11.0 CERTIFICATE OF FINAL COMPLETION

A) Upon completion, the applicant shall certify that the project is in accordance with plan specifications and shall provide inspections to adequately document compliance.

B) The Planning Board shall issue a Certificate of Final 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

A) Maintenance Responsibility

1. Storm Water management facilities and practices shall be inspected to document maintenance and repair needs and ensure compliance with the requirements of the Storm Water Management Plan and these Regulations. The 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 and as recorded in the property deed.

B) Maintenance Inspections

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 Planning Board shall be executed for privately-owned Storm Water systems which specify the responsible party for conducting and financing long term inspections.
2. Inspection reports shall be submitted to and maintained by the Planning Board. Inspection

reports shall include: the date of inspection; an evaluation of the condition of structures and practices used to manage Storm Water; and a description of any needed maintenance.

C) Right-of-Entry for Inspection
The inspection agreement shall allow the Planning Board or its designee to enter the property at reasonable times and in a reasonable manner for the purpose of inspection.

D) Records of Maintenance and Repair Activities
Parties responsible for the operation and maintenance of a Storm Water management facility shall provide records of all maintenance and repairs to the Planning Board, upon request, and shall retain those records for 5 years.

E) Failure to Maintain
1. If a responsible person fails to meet the requirements of the inspection agreement, the Planning Board, may take action to restore the Storm Water facility or practice 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 Planning Board 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

A) The Planning Board or its designee 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 Paxton to correct violations and to obtain reimbursement from the property owner. Within 30 days after correcting the violation, the violator and the property owner shall be notified of the costs incurred by the Town of Paxton including administrative costs.

B) Any person who violates any provision of the Town of Paxton Storm Water Bylaw, or any Regulation, or permit issued thereunder, may be ordered to correct the violation and/or shall be punished by a fine of not more than $100.00 per day or part thereof that such violation occurs or continues shall constitute a separate offense.

C) Appeals. The decisions or orders of the Planning Board 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 DEFINITIONS

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."

APPLICANT: A property owner or agent of a property owner who has filed an application for a Storm Water management permit.

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 Storm Water volumes and flows, reduce point source and nonpoint source pollution, and promote Storm Water quality and protection of the environment. "Structural" BMPs are devices that are engineered and constructed to provide temporary storage and treatment of Storm Water 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 Storm Water management practices. Better site design includes conserving and protecting natural areas and greenspace, reducing impervious cover, and using natural features for Storm Water management.

CERTIFICATE OF FINAL COMPLETION (COFC): A document issued by the Planning Board after all construction activities have been completed which states that all conditions of an issued Storm Water Management Permit (SMP) have been met and that a project has been completed in compliance with the conditions set forth in a SMP.

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 Storm Water runoff or existing water flow.

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 of similar earth material.

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

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

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.

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.

ILLICIT DISCHARGE: A discharge that is not entirely comprised of storm water. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used from street washing and water used to clean residential buildings without detergents.

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, 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 Storm Water runoff from a project site.

MASSACHUSETTS STORM WATER MANAGEMENT POLICY: 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 Storm Water impacts through implementation of performance standards to reduce or prevent pollutants from reaching water bodies and control the quantity of runoff from a site.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) or MUNICIPAL STORM DRAIN SYSTEM: The system of conveyances designed or used for collecting or conveying Storm Water, including any road with a drainage system, street, gutter, curb, inlet, piped storm drain, pumping facility, retention or detention basin, natural or man-made or altered drainage channel, reservoir, and other drainage structure that together comprise the storm drainage system owned or operated by the Town of Paxton.

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 Storm Water 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 Paxton, and any other legal entity, its legal representatives, agents, or

assigns.

PRE-DEVELOPMENT: The conditions that exist at the time that plans for the land development of a tract of land are submitted to the Planning Board. 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.

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.

RECHARGE: The replenishment of underground water reserves.

REDEVELOPMENT: Any construction, alteration, or improvement exceeding land disturbance of 10,000 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, or Town of Paxton Flood Plain Zoning Bylaw.

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.

PLANNING BOARD: Town of Paxton Planning Board has the authority to administer, implement, and enforce these Storm Water Regulations. The Planning Board 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 5 of these Storm Water Regulations.

STORM WATER: Storm water runoff, snow melt runoff, and surface water runoff and drainage.

STORM WATER DISCHARGE: Conveyance or system of conveyances (including pipes, conduits, ditches and channels) primarily used for collecting and conveying storm water runoff.

STORM WATER MANAGEMENT: The use of structural or non-structural practices that are designed to reduce storm water runoff pollutant loads, discharge volumes, and/or peak flow discharge rates.

STORM WATER MANAGEMENT PERMIT (SMP): A permit issued by the Planning Board, after review of an application, plans, calculations, and other supporting documents, which is designed to protect the environment of the Town from the deleterious affects of uncontrolled and untreated Storm Water runoff.

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 Storm Water runoff volume. Numerically (WQv) will vary as a function of drainage area or impervious area.

APPENDIX B EXAMPLE SYSTEM OF STORM WATER MANAGEMENT CREDITS AND INCENTIVES

B.1 Storm Water Credits

The current Storm Water management criteria in Massachusetts provide a strong general incentive to reduce impervious cover at the site level. The storage required to meet all of the sizing criteria (water quality, recharge, 2-year, 10-year, and 100-year control) are directly related to impervious cover. Any reductions in impervious cover result in smaller required storage volumes and, consequently, smaller land consumption areas and lower construction costs. In an effort to apply a more holistic approach to Storm Water management, five specific non-structural practices called *Storm Water credits*, or incentives 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 Storm Water management, particularly with respect to site design. In most cases, non-structural practices will need to be combined with structural practices to meet Storm Water requirements. The key benefit of non-structural practices is that they can reduce the generation of Storm Water from the site. In addition, they can provide partial removal of many pollutants and contribute to groundwater recharge. The five proposed non-structural Storm Water credits are:

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

This section describes each of the credits for the five groups of non-structural practices and specifies minimum criteria to be eligible for the credit. Towns may need to update or revise some of the local subdivision regulations and/or zoning bylaws to ensure that the credit will be applicable to their jurisdiction. In addition, 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 credits does not relieve the design engineer or reviewer from the standard of engineering practice associated with safe conveyance of Storm Water runoff and good drainage design.

Several of the Storm Water credits apply towards meeting the Massachusetts Storm Water Policy's recharge requirement. The Massachusetts Storm Water Policy currently only recognizes a volume based approach to meeting this criterion. 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 criterion 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:
>
> Compute a weighted F = [(0.25 in)(10 ac) + (0.10 in)(10 ac)]/20 ac = 0.175 inches
> Re_v = (0.175 in) (50 ac) (0.4)/(12 in/ft) = 0.29 ac-ft

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 (this is where Storm Water credits are most applicable). The calculation is as follows:

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

Where: Re_a = Recharge area requiring treatment (acres)
F = Recharge factor based on 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 Storm Water credits that can meet both recharge, water quality and, in a few cases, some of the water quantity controls as well.

B.2 Credit No. 1: Disconnection of Rooftop Runoff Credit

A credit is given 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 credit is typically obtained by grading the site to promote overland flow through vegetated channels or by providing bioretention[1] 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 the Credit

The rooftop disconnection credit 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 ft^2;
- The length of the "disconnection" shall be equal to or greater than the contributing rooftop length;
- Disconnections will only be credited 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 are encouraged 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 is needed to provide sheetflow over grass surfaces. In some cases, dry wells (see Figure B.1), 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 only use either the rooftop disconnection credit or the stream buffer credit (Credit 3), not both; and
- To take credit for rooftop disconnection for a designated hotspot land use, the rooftop runoff must not co-mingle with runoff from any paved surfaces.

[1] Bioretention systems (also referred to as "rain gardens" or "biofilters") are so-called low impact development Storm Water management systems that manage and treat Storm Water 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.

An example of this credit is provided below.

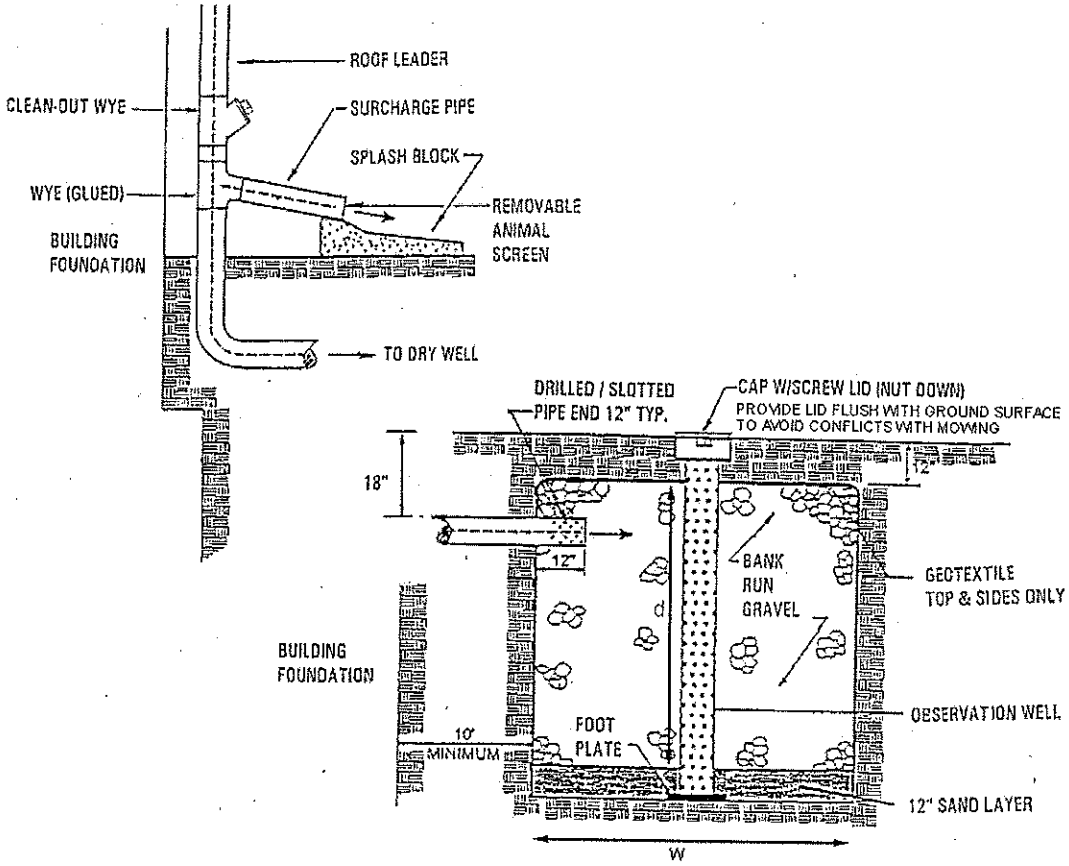


Figure B.1 **Schematic of Dry Well (Source: adapted after Howard County, MD)**

Rooftop Disconnection Credit Example Application

Given the following base data:

Site Data: 108 Single Family Residential Lots (~ ½ 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"/impervious acre = 1.0"(12.0 ac)/12 = 1.0 acre-foot (site is located in a critical area)

Rooftop Credit (see Figure B.2)
42 houses disconnected
Average house area = 2,500 ft^2
Net impervious area reduction = (42)(2,500 ft^2) / (43,560 ft^2/ac) = 2.41 acres
New impervious area = 12.0 – 2.41 = 9.59 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 acre-feet; or a 0.20 acre-foot reduction

Percent Reductions Using Rooftop Disconnection Credit:

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

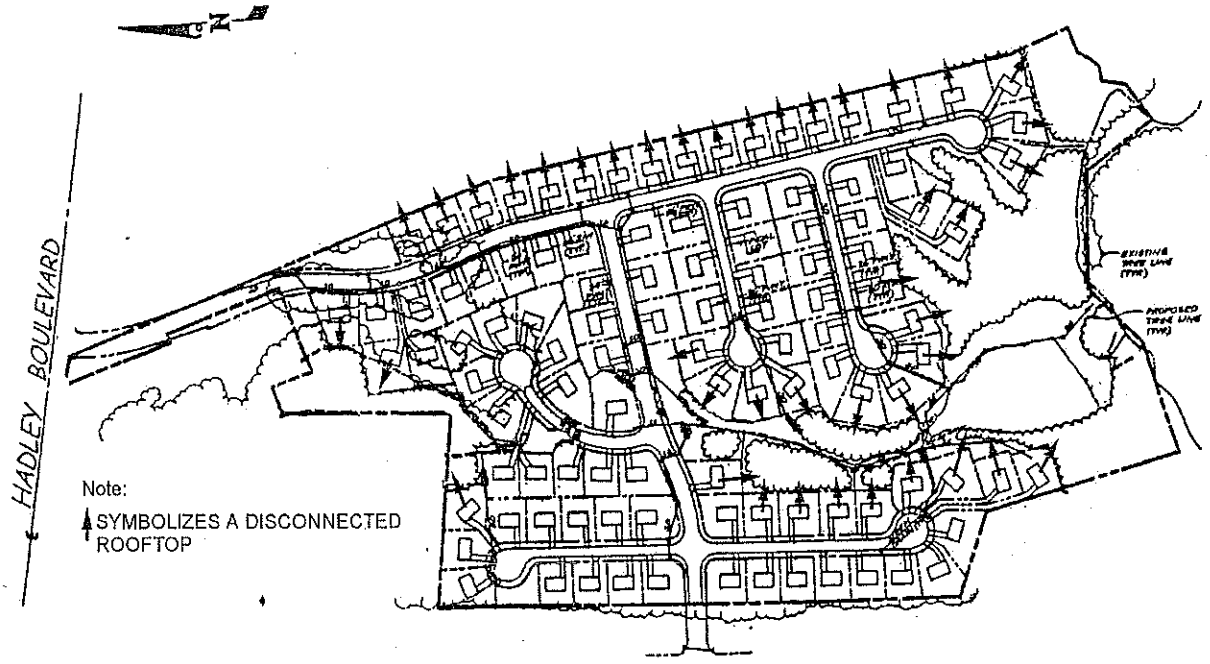


Figure B.2 Schematic of Rooftop Disconnection Credit

B.3 Credit No 2: Disconnection of Non-Rooftop Runoff Credit

Credit is given for 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 credit can be obtained 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 the Credit

The credit 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 ft^2;

- Disconnections are encouraged 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 buffer, only the non-rooftop disconnection credit or the stream buffer credit can be used, not both;

See Section B.8 for an example application of this credit draining to a filter strip.

B.4 Credit No. 3: Stream Buffer Credit

This credit is given when Storm Water runoff is effectively treated 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 B.3). The credits include:

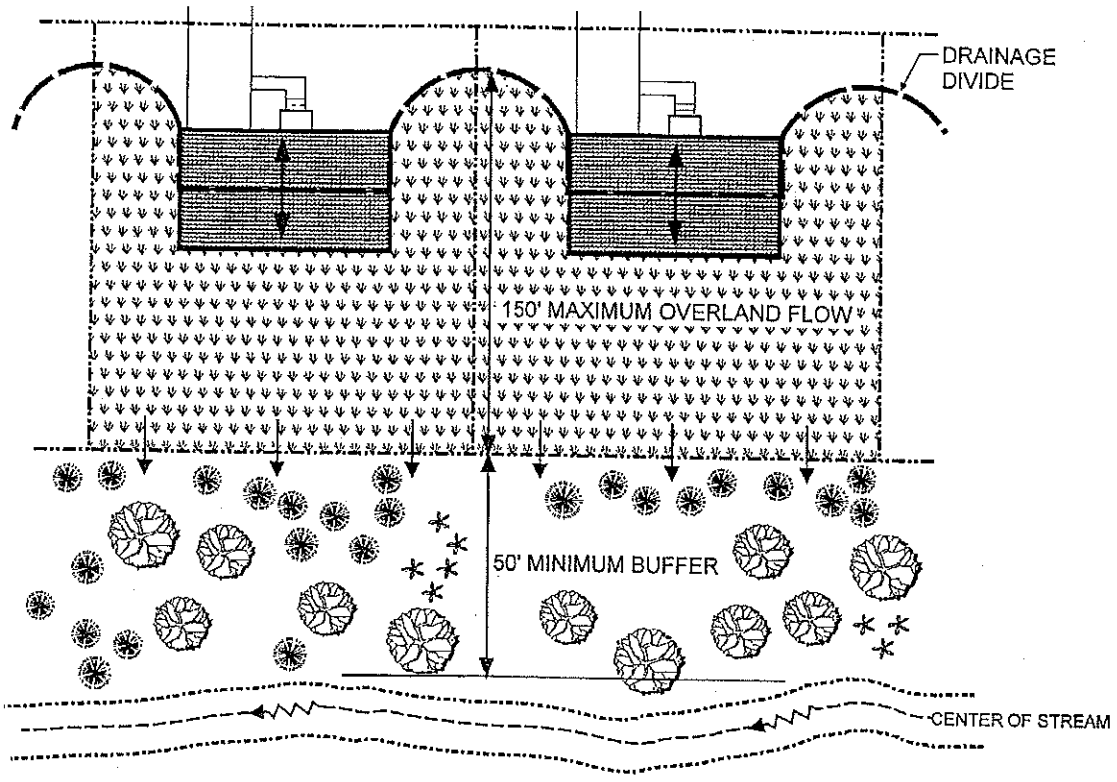
- The impervious area draining by sheet flow to a stream buffer is subtracted from the site's initial impervious area in the water quality calculation.
- The impervious area draining to stream buffer contributes to the recharge requirement, (Re_v), under the **Percent Area Method**.

Restrictions on the Credit

The credit 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 credit is <u>not</u> 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;

See Section B.8 for an example application of this credit.



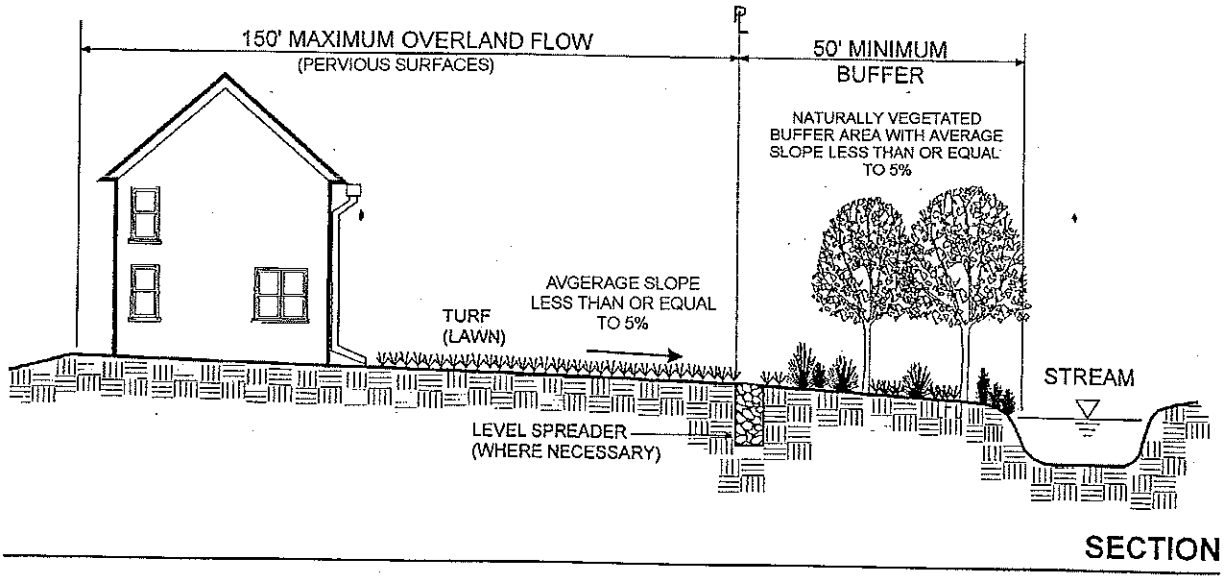


Figure B.3 **Example of Stream Buffer Credit Option**

B.5 Credit No. 4: Grass Channel Credit

Credit may be given when open grass channels are 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

The credit is obtained if a grass channel meets the following criteria.

- Land use is moderate to low density residential (maximum density of 4 du/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 3H:1V 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 length.

Grass Channel Credit Example Application

Base Data
Site Data: 108 Single Family Residential Lots (~ ½ 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 Credit (see Figure B.4)
Entire site is open section road, but only 11.2 acres meet the water quality requirement design criteria for the grass channel credit (i.e., 3:1 side slopes, 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 ac) = 9.0 acres.
New WQ_v = 1.0"(9.0)/12 = 0.75 acre-feet; or a 0.25 acre-foot reduction

Percent Reductions Using Grass Channel Credit:

- Re_v = 100%
- WQ_v = (1.0 – 0.75) / 1.0 = 25.0%

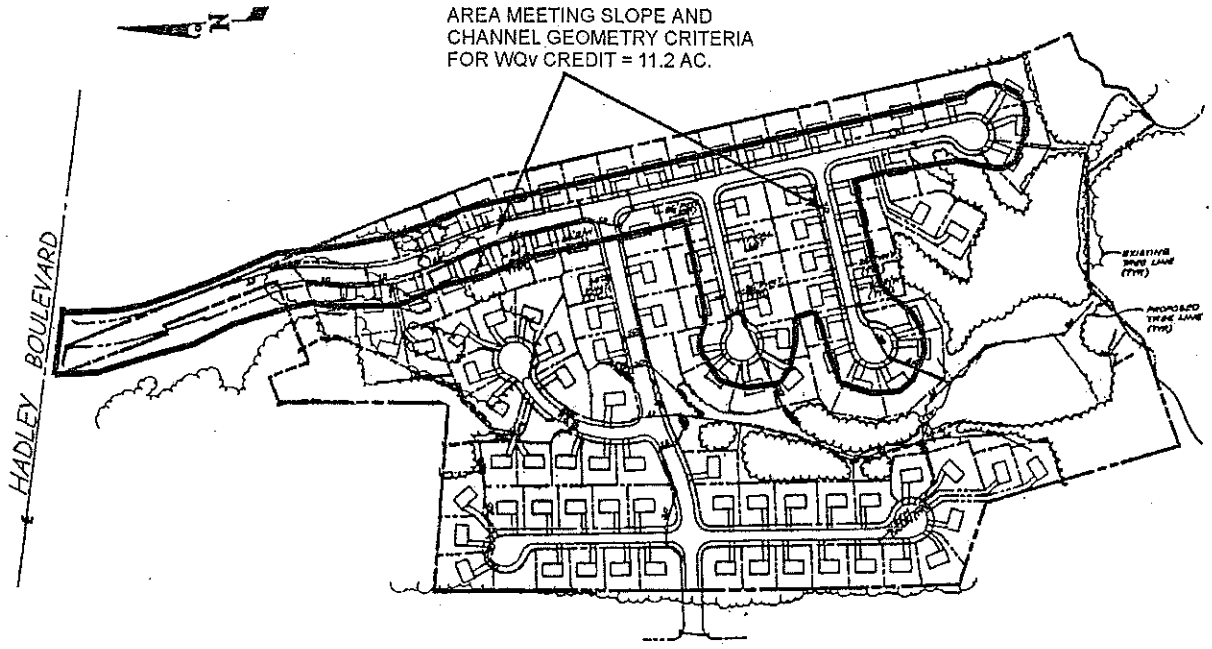


Figure B.4 Schematic of Grass Channel Credit

B.6 Credit No. 5: Environmentally Sensitive Development Credit

This credit is given when a group of environmental site design techniques are applied to lower density or rural residential development. The credit 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 Criteria for Credit

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 criteria outlined under Credit 1 (Section B.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 Storm Water detention for all roadway and connected impervious surfaces (i.e, 2-year, 10-year, and 100-year control).

Environmentally Sensitive Rural Development Credit 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 ft^3
Original Re_v = (2.5) (0.08) (.25) (43,560/12) = 182 ft^3

Environmentally Sensitive Rural Credit (see Figure B.5)
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 Credit:

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

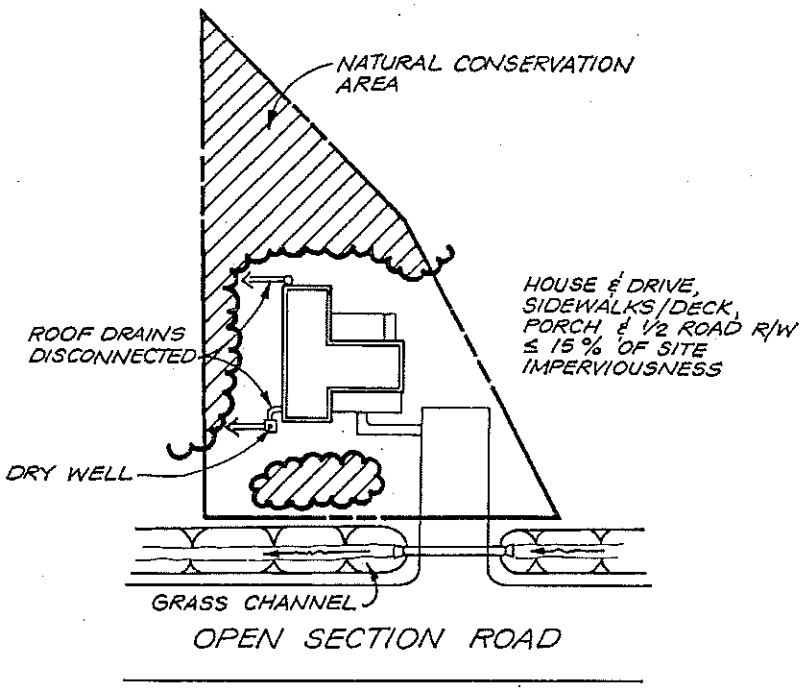


Figure B.5 **Schematic of Environmentally Sensitive Rural Development Credit**

B.7 Dealing with Multiple Credits

Site designers are encouraged to utilize as many credits as they can on a site. Greater reductions in Storm Water storage volumes can be achieved when many credits are combined together (e.g. disconnecting rooftops and utilizing grass channel for drainage design). However, credits 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).

B.8 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 feasible[2]. 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 Storm Water 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
CN = curve number for the appropriate pervious cover

Figures B.6 and B.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,

[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.

establishment of a stream buffer, reduced parking ratios, compact and pervious overflow parking spaces, and use of vegetated Storm Water 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 B.6 and B.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 B.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 ac)/12 = 0.54 acre-feet

Site Planning Strategies (see Figure B.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 (Credit No. 3: stream buffer credit).
- 0.28 acres of parking lot/loading area drain to a filter strip with an overland flow path less than 75 feet (Credit No. 2: disconnection of non-rooftop runoff credit).
- 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 ac/2) + 0.10 (5.8 ac/2)]/5.8 = 0.18
- New Re_v (**Percent Volume Method**) = 0.18 (5.8 ac)/12 = 0.09 acre-feet
- New Re_a (**Percent Area Method**) = FAI = 0.18 (9.3 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 ac – (0.46 ac + 0.28 ac) = 0.3 acres
- Therefore, the remaining Re_v = (0.3 ac/1.04 ac) (0.09 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 take credit for non-rooftop disconnection and buffer credits) = 5.8 ac – (0.28 ac + 0.46 ac) = 5.06 acres;
- New water quality requirement = 1.0"(5.06 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.

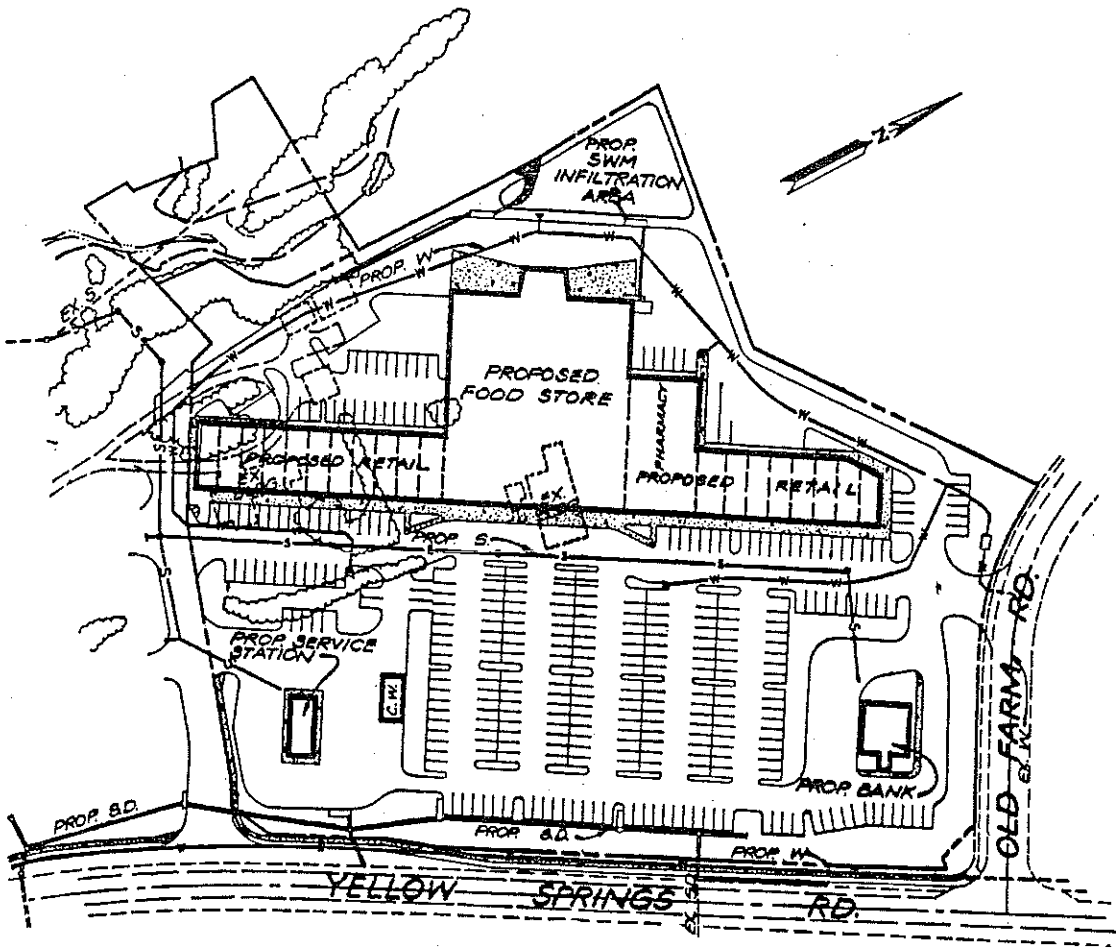


Figure B.6 Example of Conventional Retail Site Design

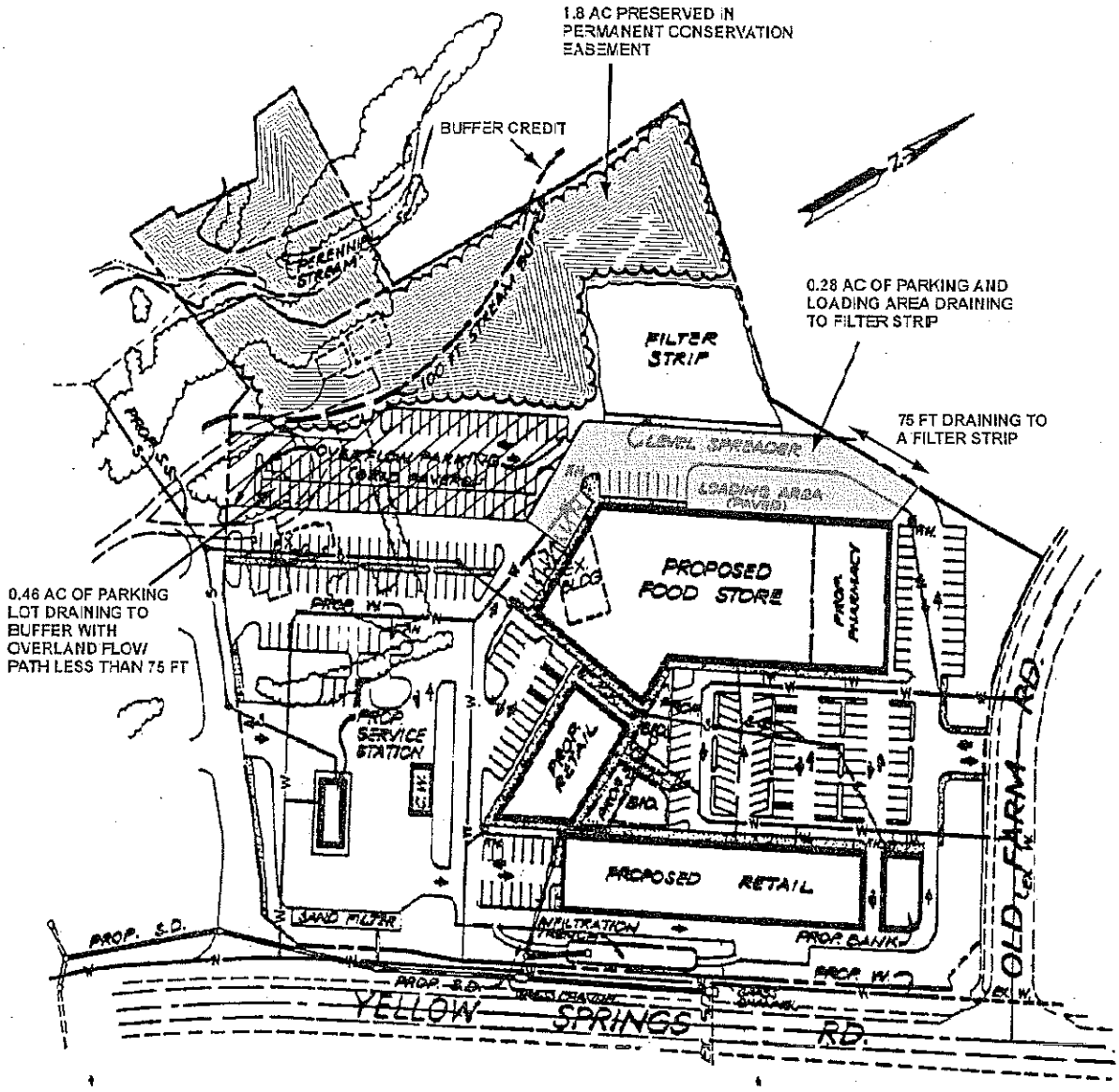


Figure B.7 Example of Improved Retail Site Design