STORMWATER REGULATIONS FOR THE TOWN OF DEERFIELD
(as adopted by the Planning Board/Stormwater Authority 04.04.2011)

1.0 PURPOSE

The purpose of these Stormwater 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 Stormwater Bylaw of the Town of Deerfield.

2.0 DEFINITIONS

Definitions are in Appendix A of these Regulations and shall apply to issuance of a Stormwater Permit established by the Town of Deerfield Stormwater Bylaw and implemented through these Stormwater 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 Deerfield Stormwater Bylaw.

B.) These Regulations are adopted to administer the Stormwater Bylaw and do not replace the requirements of the Town of Deerfield Environmental Regulations, Watershed Protection Districts, Flood Plain District, or any other Rules and Regulations adopted thereunder.

C) These Stormwater Regulations may be periodically amended by the Stormwater Authority in accordance with the procedures outlined in Section 155-6, Administration, of the Town of Deerfield Stormwater Bylaw.

4.0 ADMINISTRATION

A) The Stormwater Authority shall administer, implement and enforce these Regulations. The Stormwater Authority may designate another Town Board, including, but not limited to, the Conservation Commission for the purpose of reviewing Stormwater submittals and providing recommendations to the Stormwater Authority as requested from time to time by the Stormwater Authority as its authorized agent for the purposes of reviewing all Stormwater submittals and approving Stormwater Permits for any project within that particular Board's jurisdiction, provided that said Board has formally adopted these regulations either directly or by reference. Each approving Board must forward written documentation of said approval and all conditions of approval to the Stormwater Authority within 10 business days of said approval. Upon receipt of written approval from *[insert board, commission or department]*, the Stormwater Authority shall act on the recommendation of the approving Board within 10 business days.

B) Projects or activities approved by the Stormwater Authority shall be deemed in compliance with the intent and provisions of these Stormwater Regulations. The Stormwater Authority shall issue a Stormwater Permit to the applicant in accordance with the time frames for issuance of a Definitive Subdivision Plan or Site Plan Review Permit.

5.0 APPLICABILITY

A) These Stormwater Regulations apply to all new development and redevelopment that are not exempt under the Town of Deerfield Stormwater Bylaw. Projects within the jurisdiction of the Stormwater Bylaw must obtain a Stormwater Permit from the Stormwater Authority in accordance

with the permit procedures and requirements defined in Section 6 of these Regulations. Projects and/or activities within the jurisdiction of the Stormwater Authority, the specific application submission requirements, public notices, and fees of that board shall govern. The Stormwater Management Plan Contents, Operation and Maintenance Requirements, and Stormwater Review Fee, (under Sections 6.0 L, 6.0 M and 6.0 E) of these Regulations must also be met.

6.0 PERMIT PROCEDURES AND REQUIREMENTS

- A) Projects requiring a Stormwater Permit shall submit the materials specified in this section, and meet the Stormwater criteria as specified in Section 7, Performance Standards: Stormwater Criteria.
-

B) Permit Required

1. Applicants shall not commence land disturbing activities without first meeting the requirements of these Regulations and receiving a Stormwater Permit.
2. The project shall begin within one year after issuance of the Stormwater Permit. If the project does not begin within one year, the permittee may apply for a Permit extension of one year. A Permit extension shall be granted unless the Stormwater Authority finds that the approved Stormwater Management Plan is inadequate, in which case the permittee shall submit a modified Plan that requires approval prior to the commencement of land-disturbing activities. When a permittee files for a Permit extension, the permittee shall adhere to the Stormwater Regulations current at the time of filing for the extension.

C) Filing Application

1. The applicant shall file with the Stormwater Authority, seven (7) copies and one (1) electronic file in a format specified by the Town of Deerfield of an application for a Stormwater Permit. A Permit must be issued prior to any site altering activity. While the applicant may be a representative, the permittee must be the owner of the site or holder of an easement. The Stormwater Application package shall include:
   a) A completed Application Form with original signatures of all owners;
   b) A list of abutters, provided by the Assessors' Office; including owners of land within 300 feet of the property line of the applicant, including any land in another municipality or across a body of water. Duplication of a list of abutters is not necessary when an abutters' list is required for a definitive plan or site plan.
   c) Stormwater Management Plan and project description;
   d) Payment of the application and review fees;
   e) Operation and Maintenance Plan;
   f) Inspection and Maintenance agreement;
   g) Erosion and Sediment Control Plan;
   h) Surety bond, if required by the Stormwater Authority. See Section 9.0, Surety.

D) Entry

Filing an application for a permit grants the Stormwater Authority, 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 Stormwater Authority are required to cover expenses for the review of the Stormwater Permit, including professional services. The Stormwater 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 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 Stormwater Authority 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 $100.00 which shall be payable to the Town of Deerfield when an application is filed. At its discretion the Stormwater Authority may waive the application fee. Where the Stormwater Authority requires that abutters be notified, the applicant shall pay fees to cover the Town's costs of preparing and mailing notification letters via regular mail at the rate of $1.00 per letter plus first class postage.
3. Engineering and Consultant Reviews and Fees
   a) The Stormwater Authority 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 Stormwater Authority to come to a decision on the application.
   b) Payment may be required at any point in the deliberations and shall be paid prior to a final decision.
   c) Any application filed with the Stormwater Authority 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 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.
   f) Any unused portion of any fees collected, other than Application fees, shall be returned by the Stormwater Authority to the applicant within forty-five (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 Stormwater Authority need not hold a public hearing to review an application for a Stormwater Permit. The Stormwater Authority shall hold a public hearing in accordance with their usual procedures for Subdivision Review, Special Permit and Site Plan Review.

G) Actions

The Stormwater Authority's action, rendered in writing and filed with the Town Clerk, shall consist of either:

1. Approval of the Stormwater Permit Application based upon determination that the proposed plan meets the standards in Section 7 and is in compliance with the requirements in the Stormwater Bylaw and Regulations;
2. Approval of the Stormwater Permit Application subject to any conditions, modifications or restrictions required by the Stormwater Authority;
3. Disapproval of the Stormwater 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 Stormwater Bylaw and Regulations; or
4. Disapproval of an application "without prejudice" where an applicant fails to provide requested additional information that in the Stormwater Authority's opinion is needed to adequately describe the proposed project.

H) Failure of the Stormwater Authority to take 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 Stormwater Authority in writing of any proposed change in a Stormwater Permit, and no further land disturbing activity may take place until the Stormwater Authority has determined that the proposed change meets the standards in Section 7 and is in compliance with the Stormwater Bylaw and Regulations.

J) Appeals of Actions of the Stormwater Authority
A decision of the Stormwater Authority shall be reviewable in the Superior Court by an appeal filed within 60 days of the written decision filed with the Town Clerk. 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 record drawings of all structural stormwater controls which shall show any deviations from the approved plans and be certified by a Registered Professional Engineer. At its discretion the Stormwater Authority may require as-built drawings.

All Stormwater 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: a.) placed on the final approved Plan; and b.) recorded at the Franklin County Registry of Deeds as a condition of approval of the above-referenced Plan; and c.) placed on individual deeds as restrictions; and d.) filed with the Town Building Commissioner.

L) Stormwater Management Plan Contents
1. The Stormwater Management Plan submitted with the permit application shall contain sufficient information for the Stormwater 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) who is licensed in the Commonwealth of Massachusetts.
2. The Stormwater Management Plan shall fully describe the project in drawings, narrative, and calculations. It shall include:
    a) 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 parcel number of the property or properties affected;
    b) A locus map;
    c) The existing and proposed land use at the site;
    d) The existing and proposed zoning at the site;
    e) The existing and proposed property lines;
    f) The location(s) of existing and proposed easements;
    g) The location of existing and proposed utilities;
    h) The location of existing and proposed open storage areas and facilities for waste disposal;
    i) The site's existing & proposed topography with contours at 2-foot intervals;
    j) All areas of the site designated as open space;
    k) 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;

l) A delineation of 100-year flood plains, if applicable;
m) Estimated seasonal high groundwater elevation in areas to be used for stormwater retention, detention, or infiltration;
n) The existing and proposed vegetation and ground surfaces with runoff coefficients for each;
o) A drainage area map showing pre- and post-construction watershed boundaries, drainage area and stormwater flow paths, including municipal drainage system flows, at a scale that enables verification of supporting calculations;
p) A recharge area analysis that calculates pre-and post-project annual groundwater recharge rates on the parcel;
q) A description and drawings of all components of the proposed stormwater 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. Descriptions of non-structural best management practices (BMPs);
    iv. All measures for the protection of water quality;
    v. The structural details for all components of the proposed drainage systems and stormwater management facilities;
    vi. Notes on drawings specifying materials to be used, construction specifications, and expected hydrology with supporting calculations;
    vii. Proposed site plan including location of buildings or other structures, impervious surfaces, and drainage facilities, if applicable;
    viii. Any other information requested by the Stormwater Authority.

r) 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:
    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.
s) Post-Development downstream analysis to a location where the watershed to project size ratio is ~ 10:1, if deemed necessary by the Stormwater Authority;
t) Soils Information from test pits performed at the location of proposed Stormwater Management facilities, including soil descriptions, depth to seasonal high groundwater and depth to bedrock. Soils information will be based on site test pits logged by a Massachusetts Certified Soil Evaluator;
u) Landscaping plan describing the woody and herbaceous vegetative stabilization and management techniques to be used within and adjacent to the stormwater impact area.

M) 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 Stormwater Bylaw and that the Massachusetts Surface Water Quality Standards are met in all seasons and throughout the life of the system.

1. Stormwater Management Easements/Agreements: Where the Stormwater Authority determines it is necessary, a stormwater management easement or agreement 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 Franklin County Registry of Deeds prior to issuance of a Certificate of Completion by the Stormwater Authority.
2. Operation and Maintenance Plan: An Operation and Maintenance Plan (O&M Plan) is required at the time of application for a Stormwater Permit and shall remain on file with the Stormwater Authority. The O&M Plan shall include: a.) the name and contact information of the owners of all components of the system; b.) a map showing the location of the stormwater management devices including all structural and nonstructural components; c.) maintenance agreements that specify names and addresses of person(s) responsible for operation and maintenance and its financing, an Inspection and Maintenance schedule, including an O&M estimated budget, maintenance tasks to be performed, a list of easements with the purpose and location of each and the signature(s) of the owner(s).

7.0 PERFORMANCE STANDARDS: STORMWATER CRITERIA

A) All projects shall comply with the most recent version of the Massachusetts Department of Environmental Protection (DEP) Stormwater Standards. Where the Town of Deerfield's Stormwater Bylaw and Regulations apply standards or requirements that are more strict than those of the MA DEP Stormwater Management Standards and Handbook, the standards and requirements of the Town of Deerfield's Stormwater Bylaw and Regulations shall apply. Projects shall achieve the following performance standards:

B) General Criteria

1. Site Planning Process
   The site planning process shall be documented and shall include the following steps: 1) identify and map critical environmental resources, 2) delineate potential building envelopes avoiding environmental resource areas and appropriate buffers, 3) develop methods to minimize impervious surfaces, and to protect and preserve open space.
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(B)3 through 12 of these Stormwater Regulations.
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)**.**
4. Channel Protection
   The post-development peak discharge rate from the 2-year storm event shall be equal to or less than the pre-development rate in order to prevent stream bank erosion and channel degradation.
5. Flood Protection
   The post-development peak discharge rate for the 10-year, 24-hour frequency storm event

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

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 Handbook. The Stormwater Authority may relax or eliminate the recharge requirement if the site is an area where contaminated soils are documented or where high groundwater prevents reasonable efforts.
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 Handbook and shall remove at least 80% of the average annual post-construction load of total suspended solids (TSS).
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.
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:
   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) 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.

   c) 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.

   d) Flooding and channel erosion impacts to streams due to development shall be determined at each point of discharge from the development project.

   e) The design storms shall be defined as a 24-hour storm using the rainfall distribution recommended by the USDA, Natural Resource Conservation Service’s *Urban Hydrology for Small Watersheds*, TR 55, June 1986.

   f) 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 proposed land development as a whole and shall be used in all engineering calculations.
10. Sensitive Areas
    Stormwater discharges to areas defined by the MA DEP stormwater regulations as Critical Areas, including but not limited to, swimming beaches, aquifer recharge areas, water supplies

and other sensitive water resources, are subject to the MA DEP stormwater regulations for proposed development in a Critical Area.

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 Handbook. These include, but are not limited to: auto salvage yards, auto fueling facilities, fleet storage yards, commercial parking lots generating more than 1,000 trips per day, road salt storage areas, outdoor storage and loading areas of hazardous substances, railroad yards and vehicle wash bays.
12. Low Impact Development (LID) Credits
    Improved site design and nonstructural controls are encouraged to minimize the use of structural stormwater controls. The applicant may request credit for site design practices that may reduce other requirements in these Regulations. The Stormwater Authority may adopt criteria for site design practices that qualify for LID Credits. The site design practices that qualify for these credits and procedures for applying and calculating the credits are identified in Appendix B of these Regulations.

8.0 WAIVERS

A) The Stormwater 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 Deerfield Stormwater 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 Stormwater Bylaw and is in the public interest.

C) All waiver requests shall be acted on within 60 days and the Stormwater Authority will provide a written decision. If additional information is required, the Stormwater 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 "without prejudice" by the Stormwater Authority.

9.0 SURETY

The Stormwater 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 Stormwater Authority has received the final inspection report and issued a Certificate of Completion. Where applicable, the Stormwater surety shall be coordinated with other surety requirements.

10.0 CONSTRUCTION INSPECTIONS

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

B) At the discretion of the Stormwater 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 Stormwater 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 Stormwater Management Plan.

C) 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 Stormwater Authority which will issue a Certificate of Completion.

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

D) 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 Stormwater Management Plan, the system shall be corrected by the permittee. If the permittee fails to act, the Stormwater 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 Stormwater Authority.

11.0 CERTIFICATE OF COMPLETION

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

B) The Stormwater 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

A) Maintenance Responsibility

1. Stormwater management devices and practices shall be inspected to document maintenance and repair needs and ensure compliance with the requirements of the Stormwater Management Plan, the O&M 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.

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 Stormwater Authority shall be executed for privately-owned stormwater management systems which specifies the responsible party for conducting and financing long term inspections.
2. Inspection reports shall be submitted to and maintained by the Stormwater 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.

C) Right-of-Entry for Inspection

The inspection agreement shall allow the Stormwater Authority 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 stormwater management device shall provide records of all maintenance and repairs to the Stormwater Authority, upon request, and shall retain those records for 5 years.

E) Failure to Maintain
   1. If the responsible person fails to meet the requirements of the inspection agreement, the Stormwater 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 Stormwater 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

A) The Stormwater Authority 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 Deerfield 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 Deerfield including administrative costs.

B) Any person who violates any provision of the Town of Deerfield Stormwater 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. Each day or part thereof that such violation occurs or continues shall constitute a separate offense.

C) Appeals**.** The decisions or orders of the Stormwater 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 other section, provision, paragraph, sentence, or clause thereof, nor shall it invalidate any permit or determination that previously has been issued.

APPENDIX A: DEFINITIONS

The definitions set forth below shall apply in the interpretation and implementation of the Regulations. Terms not defined in this Appendix shall be understood according to their customary and usual meaning. The Stormwater Authority may adopt additional definitions in these Regulations.

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 Stormwater Permit.

AGREEMENT: A contract including all the elements of a legal contract: offer, acceptance, and consideration (payment or performance), based on specific terms.

AUTO FUELING FACILITY: A facility dedicated to the transfer of fuels from a stationary pumping station to mobile vehicles or equipment. It includes above- or under-ground fuel storage facilities. In addition to general service gas stations, an auto fueling facility includes pumping stations at 24-hour convenience stores, construction sites, warehouses, car washes, manufacturing establishments, port facilities, and businesses with fleet vehicles. Stormwater contamination at fueling facilities is caused by leaks/spills of fuels, lube oils, radiator coolants, and vehicle wash water.

AUTO SALVAGE YARD: A facility for the dismantling, storage and/or sale of vehicles for reusable parts and fluids. Fluids associated with auto salvage yards may include, but are not limited to: drained motor oil, window cleaner, antifreeze, battery acid, hydraulic oil/fluid, transmission fluid, brake fluid and oil and water recovered from steam cleaning. These fluids may enter stormwater runoff from storage areas.

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 Stormwater Management practices. Better site design includes conserving and protecting natural areas and greenspace, reducing impervious cover, and using natural features for Stormwater 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 Stormwater Authority after all construction activities have been completed which states that all conditions of an issued Stormwater Permit have been met and that a project has been completed in compliance with the conditions set forth in a Stormwater 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.

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.

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

FLEET STORAGE YARD: A facility for the storage and maintenance of vehicles owned or operated as a unit, including but not limited to, automobiles, trucks, buses and motorcycles.

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, outdoor storage and loading areas of hazardous substances, railroad yards and vehicle wash bays.

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 stormwater runoff from a project site.

LANDSCAPING: Landscaping includes a range of maintenance and construction activities aimed at shaping, defining, and enhancing out-door spaces and environments inhabited by people. It is practiced as both a science and an art. Landscaping involves working with functional site conditions of water, soil, seasonality, wind, and light conditions, requires a thorough

knowledge of plant materials, and strives to shape our living environments to achieve aesthetic effects.

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.

LOW IMPACT DEVELOPMENT (LID) CREDIT SYSTEM: A form of incentive for developers to promote conservation of natural and open space areas. Projects that comply with prescribed requirements are allowed reductions in stormwater management requirements when they use techniques to reduce stormwater runoff at the site.

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 Bylaws 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 Stormwater Management system to insure that it continues to function as designed.

OUTDOOR STORAGE AND LOADING AREAS OF HAZARDOUS SUBSTANCES: Facilities that perform the loading/unloading and outside storage of liquid and solid materials at industrial and commercial locations. These areas include, but are not limited to, shipping and receiving, outside above and below ground storage, and fueling areas. Materials transferred may include, but are not limited to, products, raw materials, intermediate products, waste materials, fuels, and scrap metals. Leaks and spills of fuels, oils, powders, organic chemicals, heavy metals, salts, acids, and alkalis during transfer are potential causes of stormwater contamination. Spills from hydraulic line breaks are a common problem at loading docks.

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 Deerfield, 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 Stormwater 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.

RAILROAD YARD: A facility for the storage, maintenance, repair and movement of locomotives and rail cars. Railroad yards include terminals, switching yards, maintenance yards and all associated equipment, structures and storage areas. Pollutant sources from railroad yards can include drips/leaks of vehicle fluids onto the railroad bed, human waste disposal, litter, locomotive/railcar/equipment cleaning areas, fueling areas, outside material storage areas, the erosion and loss of soil particles from the railroad bed, maintenance and repair activities at railroad terminals, switching yards, and maintenance yards, and herbicides used for vegetation management. Waste materials can include waste oil, solvents, degreasers, antifreeze solutions, radiator flush, acids, brake fluids, soiled rags, oil filters, sulfuric acid and battery sludge, and machine chips with residual machining oil and toxic fluids/solids lost during transit. Potential pollutants include oil and grease, sediment, organic chemicals, pesticides, and metals.

RECHARGE: The replenishment of underground water reserves.

REDEVELOPMENT: Any construction, alteration, transportation, improvement exceeding land disturbance of 12,500 square feet, where the existing land use is commercial, industrial or institutional.

RESOURCE AREA: Any area protected under, including without limitation: the Massachusetts Wetlands Protection Act, Massachusetts Rivers Act, Town of Deerfield Environmental Regulations, Watershed Protection Districts, Flood Plain District, or any other Bylaw that has been or may be adopted by the Town of Deerfield.

ROAD SALT STORAGE AREA: A facility for the storage of deicing materials, most commonly salts such as sodium chloride, gravel, sand and other materials that are applied to highways and roads to reduce the amount of ice during winter storm events.

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.

STORMWATER AUTHORITY: The Planning Board shall be the Stormwater Authority which shall have the authority to administer, implement, and enforce these Stormwater Bylaws. The Stormwater Authority is responsible for coordinating the review, approval and permit process as defined in this Bylaw and these Regulations. Other Boards and/or departments participate in the review process as defined in Section 155-6 of the Stormwater Bylaw.

STORMWATER 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.

STORMWATER PERMIT: A permit issued by the Stormwater Authority, for projects in the categories and meeting the standards defined in the Stormwater Bylaw and Regulations, 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 the Stormwater Bylaw which is designed to protect the environment of the Town of Deerfield from the deleterious affects of uncontrolled and untreated stormwater runoff.

TSS: Total Suspended Solids**.**

VEHICLE WASH BAY: Facilities include automatic systems found at individual businesses or at gas stations and 24-hour convenience stores, as well as self-service car washes. Types of vehicle was bays include tunnels, rollovers and hand-held wands. The tunnel washes are housed in a long building through which the vehicle is pulled. At a rollover wash, the vehicle remains stationary while the equipment passes over. Wands are used at self-serve car washes. Wash wastewater may contain detergents and waxes that contribute to polluted stormwater runoff. Other potential pollutants from vehicle was bays include oil, grease and sediment.

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

APPENDIX B: Example System of Low Impact Development (LID) Credits and Incentives

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 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 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 proposed non-structural LID credits are:

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

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.

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 stormwater runoff and good drainage design.

Several of the LID credits apply towards meeting the Massachusetts Stormwater Standards' recharge requirement. The Massachusetts Stormwater Standards formerly only recognized 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

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 (this is where LID 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 Hydologic 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 credits that can meet both recharge, water quality and, in a few cases, some of the water quantity controls as well.

Credit No. 1: 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 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 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 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 Credit:
- Re_v = 100%
- Water quality requirement = 100%

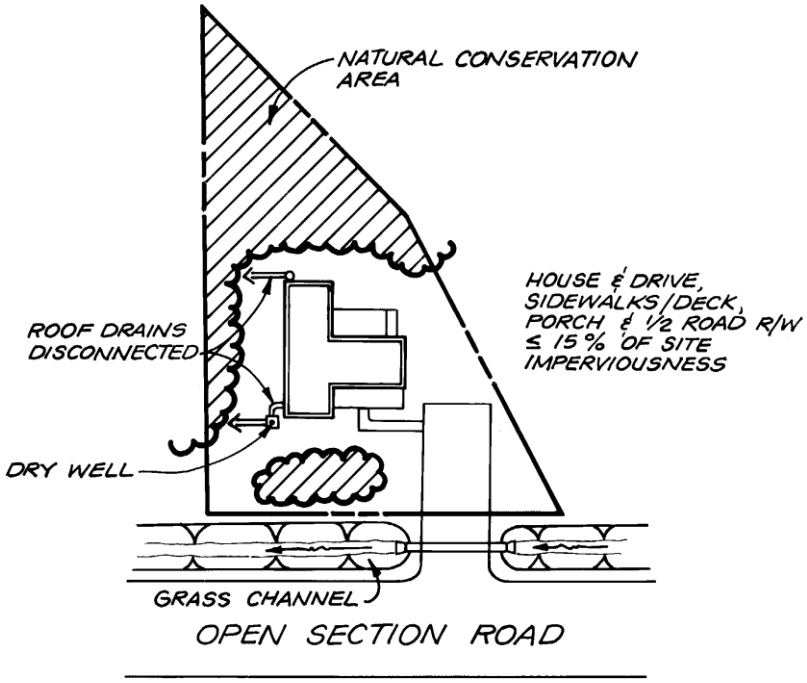

Figure 1. Schematic of Environmentally Sensitive Rural Development Credit

Credit No. 2: 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 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 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.

An example of this credit is provided below.

[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.

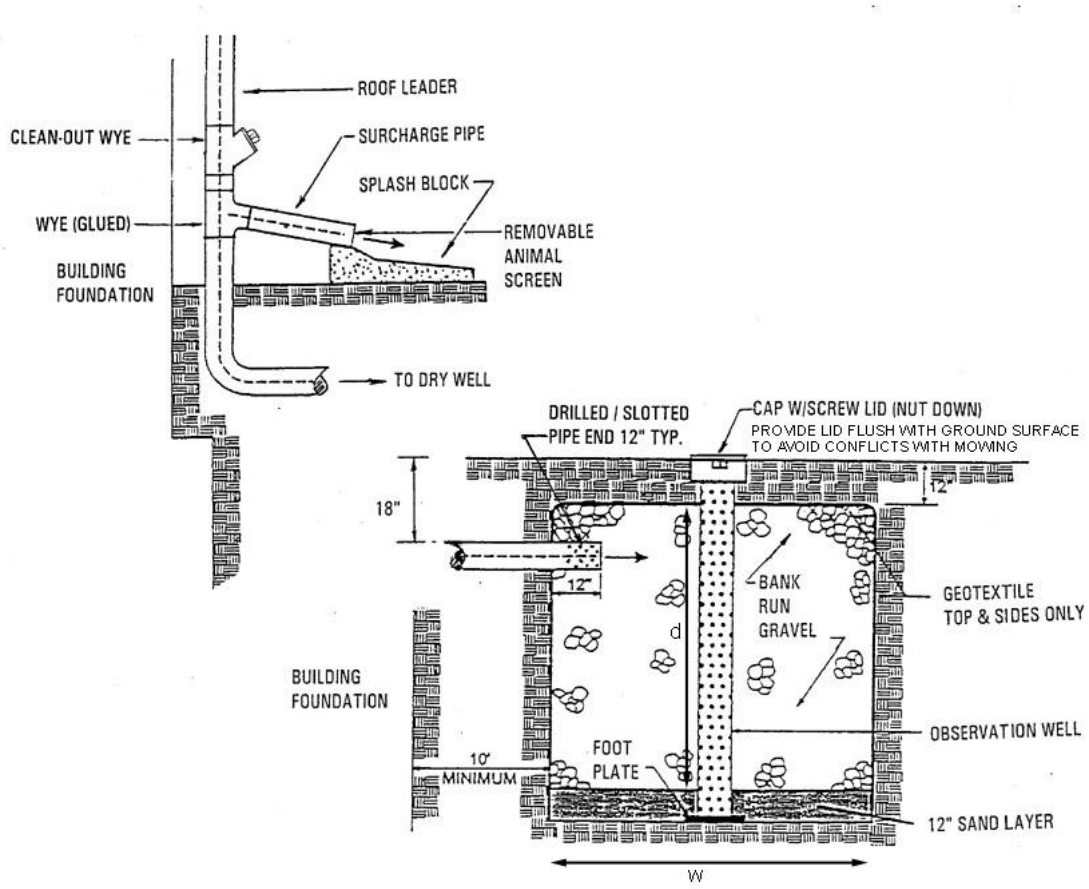

Figure 2. Schematic of Dry Well (Source: adapted after Howard County, MD)

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 3)
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%

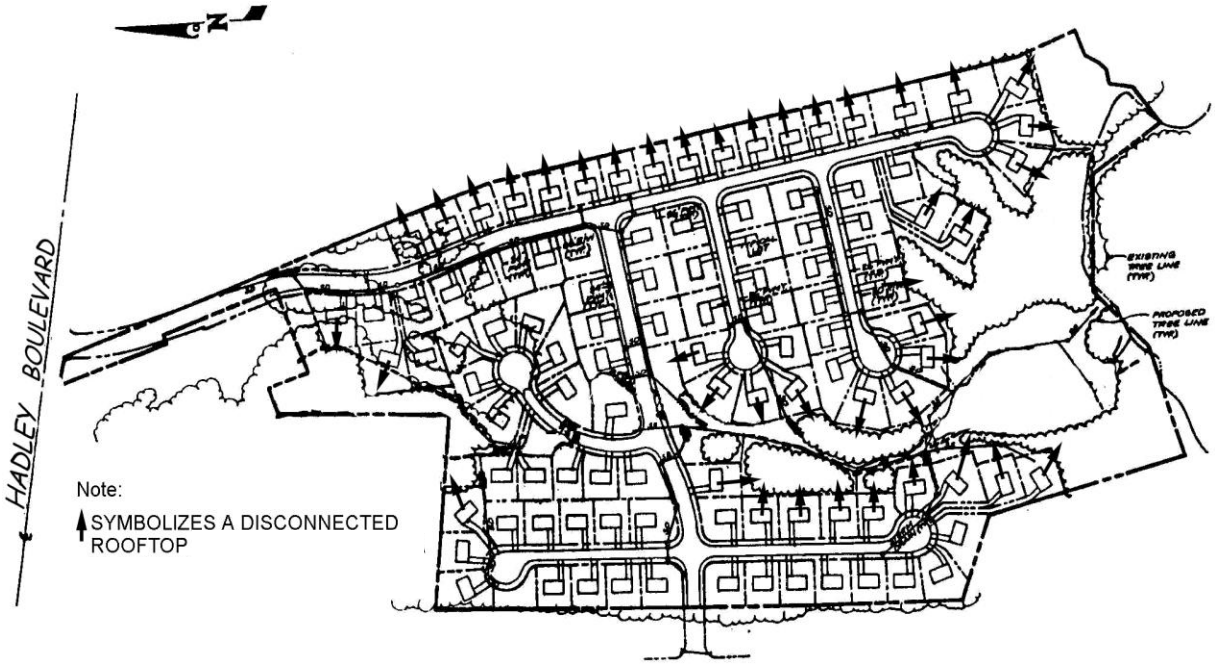

Figure 3. Schematic of Rooftop Disconnection Credit

Credit No 3: 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 wetlands or stream buffer, only the non-rooftop disconnection credit or the stream buffer credit can be used, not both.

Credit No. 4: Stream Buffer Credit

This credit is given when stormwater 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 4). 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.

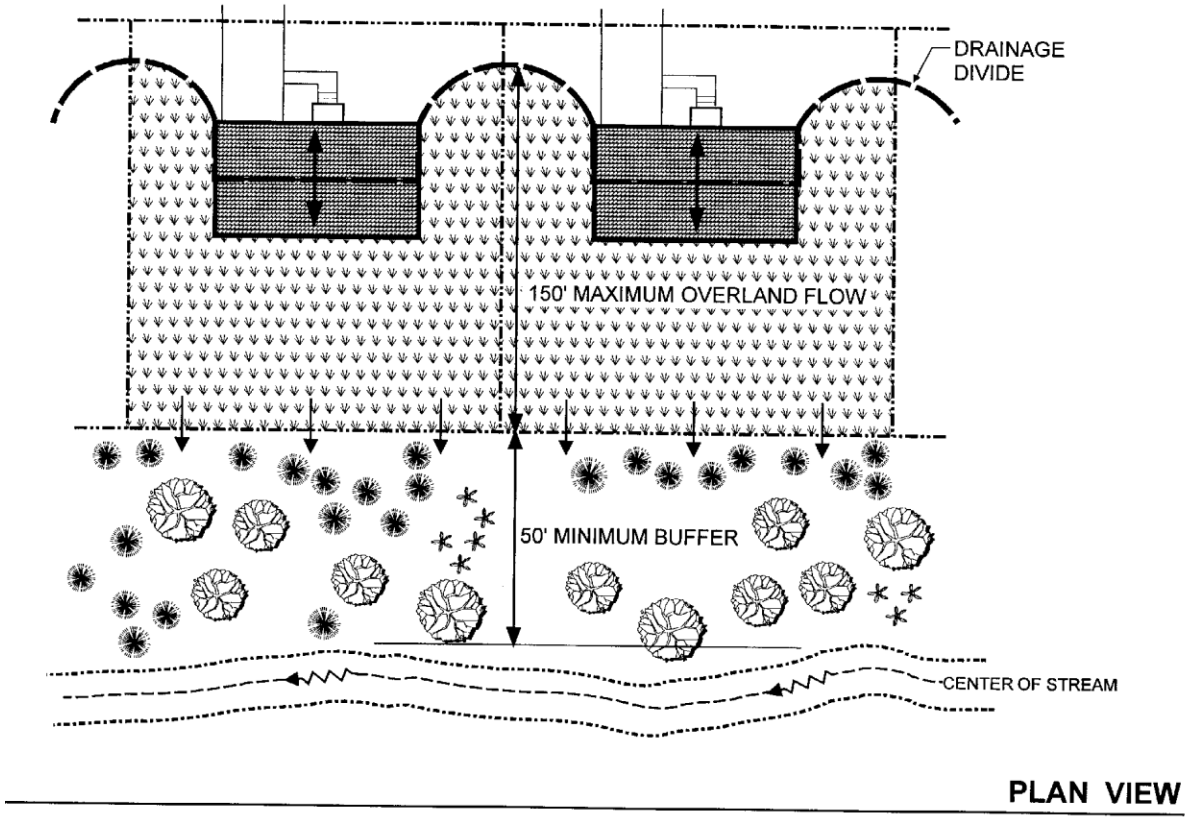

Figure 4. Example of Stream Buffer Credit Option

Credit No. 5: 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 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:1Verticle 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 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 5)
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 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 ac) = 9.0 acres.
New WQ_v = 1.0”(9.0 acres)/12 inches/foot = 0.75 acre-feet; or a 0.25 acre-foot reduction

Percent Reductions Using Grass Channel Credit:
- Re_v = 100%
- WQ_v = (1.0 acre-feet– 0.75) / 1.0 acre-feet = 25.0%

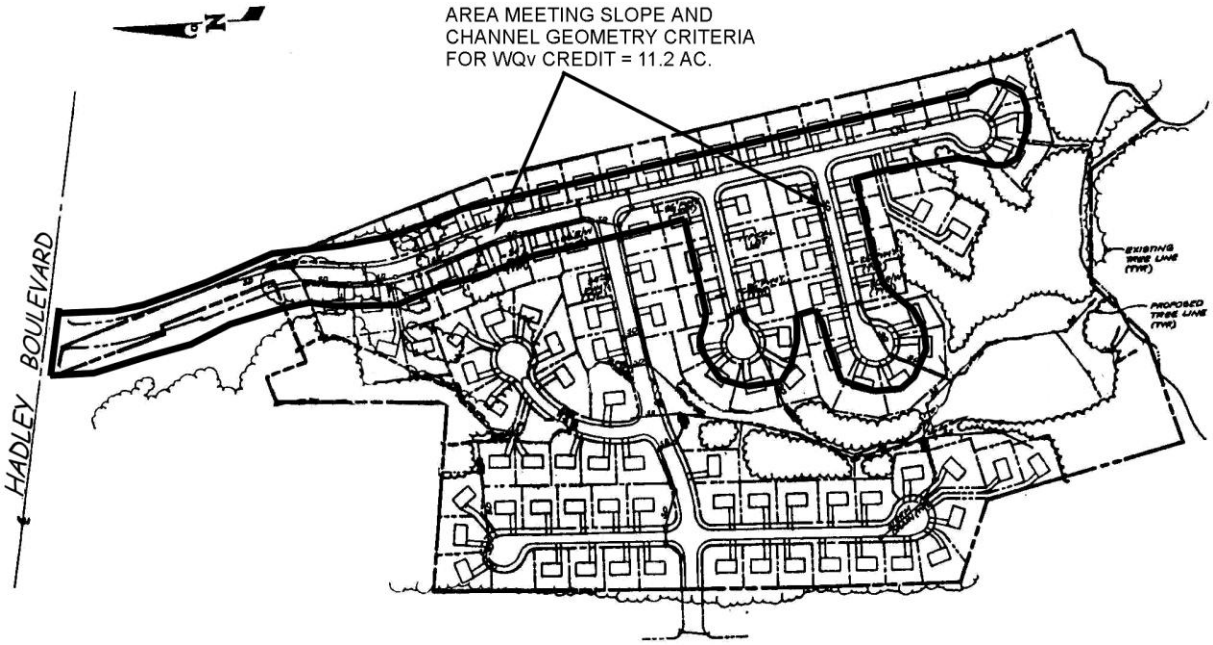

Figure 5. Schematic of Grass Channel Credit

Dealing with Multiple Credits

Site designers are encouraged to utilize as many credits as they can on a site. Greater reductions in stormwater 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).

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 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
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

[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.

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 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 (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.

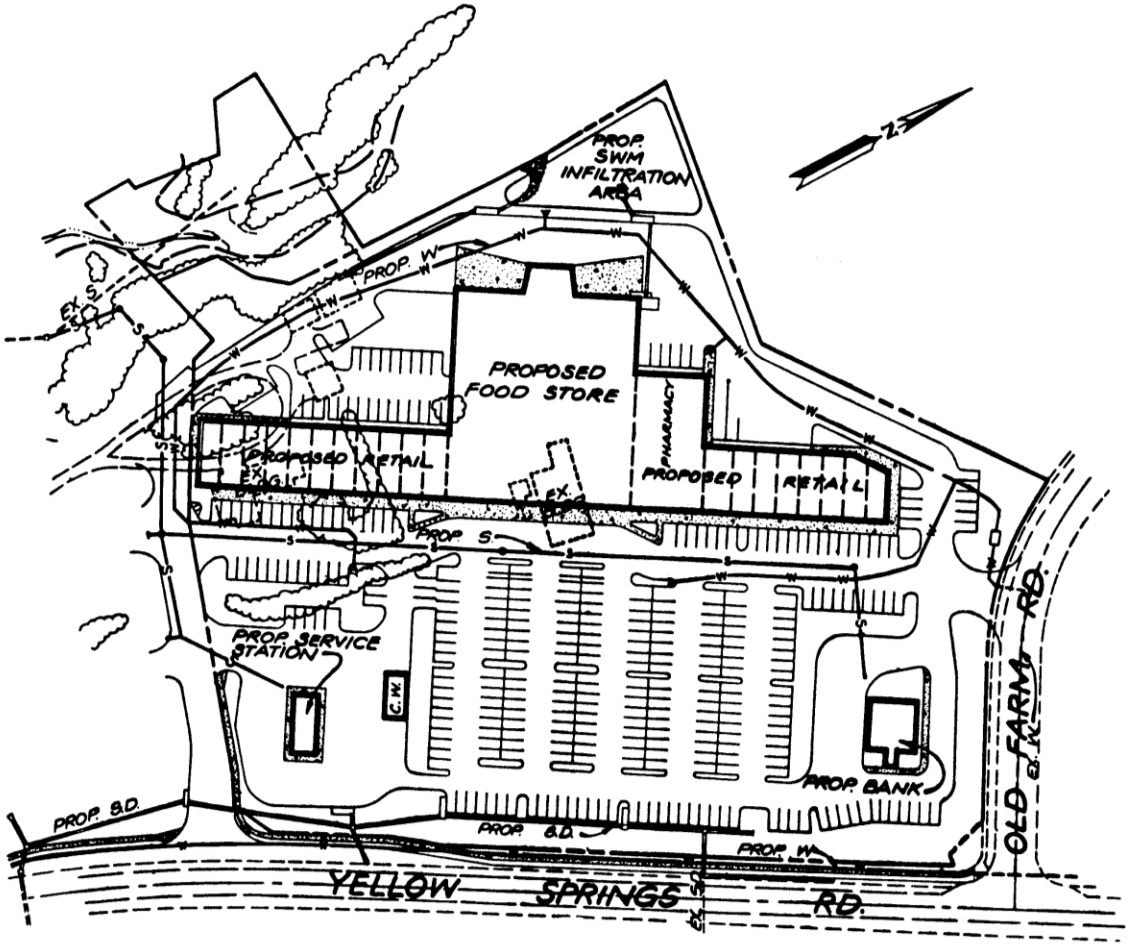

Figure 6. Example of Conventional Retail Site Design

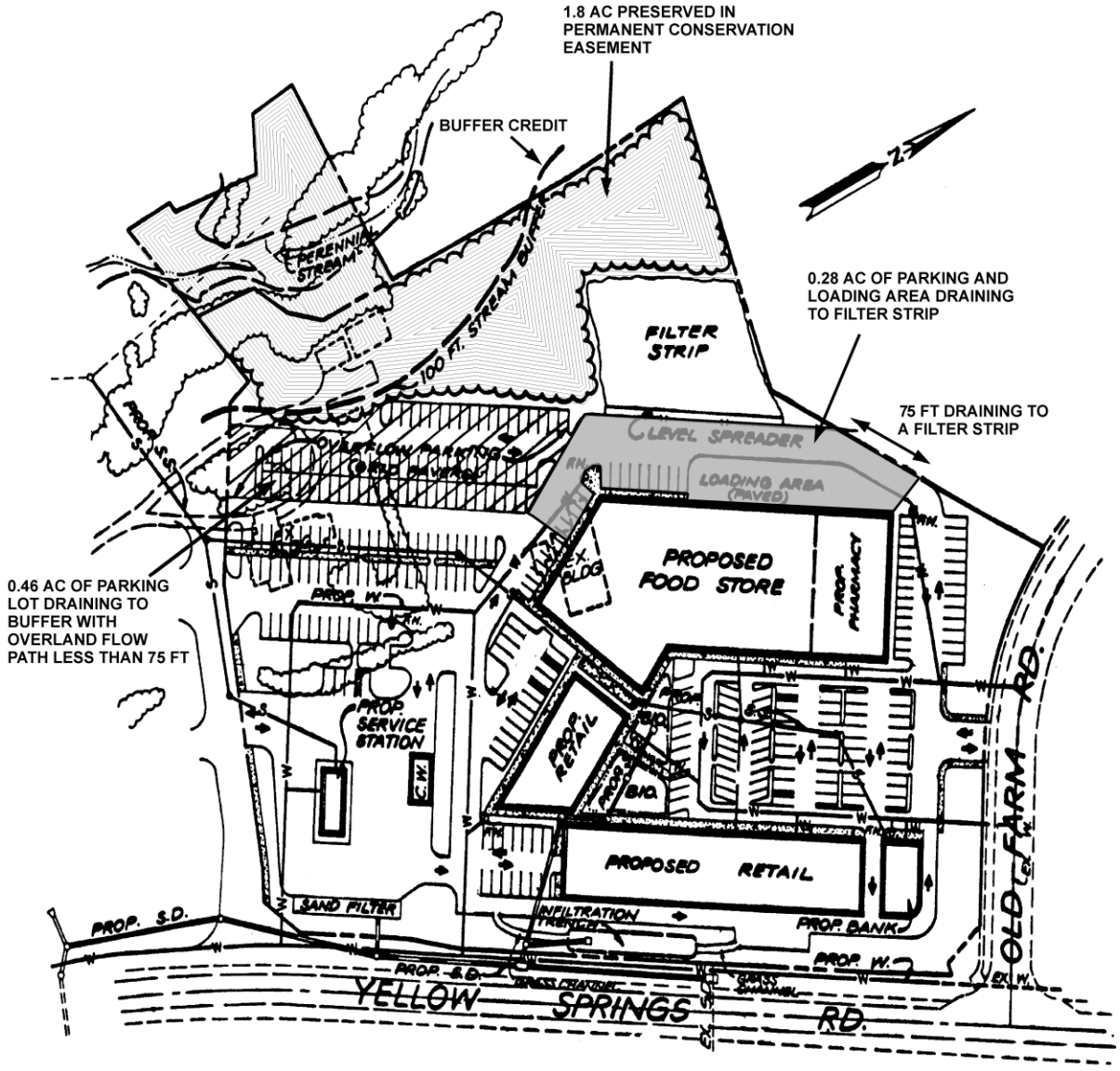

Figure 7. Example of Improved Retail Site Design