



STORMWATER DESIGN MANUAL

Public Services Department

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1 Introduction

1.1 General

The Town of Leland (Town) Stormwater Design Manual is intended to present pertinent information related to stormwater management for new development and redevelopment of parcels within the Town of Leland and the Town’s Planning & Extraterritorial Jurisdiction (ETJ). More specifically, this manual describes the Town’s stormwater management policy, the permitting process, design standards, construction recommendations, project close out, and maintenance. In addition to that information, copies of all the forms required for the stormwater management permit application process and ongoing operation and maintenance are included in this manual. This manual is intended to be used in tandem with the Town’s Stormwater Ordinance. This Design Manual and the Town’s stormwater ordinance should be used to guide stormwater management design, construction, and operation and maintenance activities within the Town. All questions related to stormwater management in the Town should be directed to the stormwater administrator. The stormwater administrator has the authority to enforce the provisions of the stormwater ordinance and has the power to make final decisions on conflicts. The stormwater administrator can be reached by contacting Leland Town Hall. The information presented herein is intended to simplify the design, review, and maintenance processes for stormwater management systems in the Town of Leland.

1.2 Relationship to Ordinance

The Town’s Stormwater Ordinance is found in Article III of Chapter 26 in the *Code of Ordinances, Town of Leland, North Carolina (Code)*. This manual does not take precedence over the Code; the Code shall be the final rule as it relates to stormwater management in the Town. This manual is intended to be a guide to assist with application of the ordinance and should be utilized in tandem with the ordinance and as a reference by all parties who hold a stake in the Town’s management of stormwater.

1.3 State of North Carolina Stormwater Design Manual

In addition to this design manual, the North Carolina Department of Environmental Quality (NCDEQ) provides a stormwater design manual to the public for guidance on how to meet state stormwater rules. Information included in that manual will be referenced by the Town in their ordinance and design manual. The NCDEQ *Stormwater Design Manual* can be used as a reference for projects within the Town of Leland to improve stormwater management and provide a level of continuity to landowners and developers. The NCDEQ manual will be utilized by the Town to help meet the objectives of the Town’s stormwater policy. A copy of the NCDEQ *Stormwater Design Manual* is available for download from the NCDEQ’s website.

1.4 Definitions

Where stated in the requirements, the following definitions shall apply.

Culvert	A single run of pipe or conduit open at each end.
Impervious Surface	Surfaces that are highly resistant to absorption of water.
Runoff	The rainfall which runs off the land into the waterway.
Runoff Coefficient	Ratio of runoff to rainfall.

Time of Concentration	The time necessary for the water to flow from the most remote point in the drainage basin along the watercourse to the point of design.
Velocity	The mean velocity of flow, measured in feet per second.

2 Stormwater Management Policy

2.1 Purpose

The purpose of the Town's stormwater ordinance is to protect, maintain and enhance the public health, safety, environment, and general welfare by establishing requirements and procedures to control the adverse effects of increased post development stormwater runoff and non-point and point source pollution associated with new development and redevelopment, as well as illicit discharges into municipal stormwater systems. Proper management of construction related and post-development stormwater runoff will minimize damage to public and private property and infrastructure; safeguard the public health, safety, and general welfare; and protect water and aquatic resources.

2.2 Objectives

The Town's stormwater management policy, as described in the Town's stormwater ordinance, seeks to accomplish the following:

- Establish decision-making processes for new development and redevelopment that protect the integrity of watersheds and preserve the health of water resources
- Require that new development and redevelopment:
 - maintain the pre-development hydrologic response in their post development state as nearly as practicable for the applicable design storm
 - reduce flooding, stream bank erosion, non-point and point source pollution and increases in stream temperature
 - maintain the integrity of stream channels and aquatic habitats
- Establish stormwater management standards and design criteria to regulate and control post-development stormwater runoff quantity and quality
- Establish design and review criteria for the construction, function, and use of stormwater control measures (SCMs) that may be used to meet the post-development stormwater management standards
- Encourage the use of better management and site design practices, such as the preservation of green space, riparian buffers, and other conservation areas to the maximum extent practicable
- Establish provisions for long-term responsibility for and maintenance of SCMs to ensure that they continue to function as designed, are maintained appropriately, and pose no threat to public safety
- Establish administrative procedures:
 - for the submission, review, approval, and disapproval of stormwater management plans
 - for the inspection of approved projects
 - to ensure long-term maintenance
- Control illicit discharges into the municipally maintained stormwater system
- Control erosion and sedimentation from construction activities

2.2.1 Off-Site Stormwater Flow

To prevent adverse impacts from proposed development the Town requires the evaluation of impacts at the discharge point of proposed developments as part of the permitting process. Designers will be required to evaluate stormwater conditions at the discharge point related to stability in the receiving

channel and/or existing downstream flooding as deemed necessary by the stormwater administrator. Please refer to Division 3 in the Town's stormwater ordinance for additional information.

2.2.2 Stream Flow through Culverts

Flow through culverts crossing public and private streets is required to be evaluated and designed per North Carolina Department of Transportation (NCDOT) standards as part of the Town's stormwater management policy. Improper sizing or lack of sizing of culverts can lead to severe ponding problems that are costly to fix and difficult to remedy. Please refer to Section 5.0 of this manual and the Town's stormwater ordinance for additional information.

2.2.3 Conveyance of Public Stormwater Across Private Property

Designers are required to evaluate flows generated from upstream of their sites and accommodate those flows in their stormwater conveyance system and stormwater control measure design or provide an adequate by-pass conveyance for upstream flows through the site. In addition, designers are required to analyze the impacts to the receiving conveyances at the point of discharge for a proposed project. Please refer to Division 3 in the Town's stormwater ordinance for additional information.

2.2.4 Maintenance Easements

Owners will be required to record maintenance easements for proposed SCMs and execute an operation and maintenance agreement as part of the stormwater management permit application. The owner will be responsible for maintaining all SCM's associated with the proposed project. The Town has authority to access SCM's through the maintenance easement and make necessary repairs if the owner has not followed appropriate maintenance provisions. Any work completed by the Town will be required to be reimbursed by the owner or fines will be levied. Please refer to Section 8.7 of this manual for additional information.

2.2.5 Cooperatively Funded Stormwater Projects

The Town of Leland will review requests for joint funding of stormwater projects within the Town. The entity requesting joint funding must clearly demonstrate how the proposed project will assist the Town in more effectively managing stormwater and meeting the objectives of the Town's stormwater ordinance. Please contact the stormwater administrator for more information regarding these types of projects.

2.2.6 Low Impact Development (LID)

The Town of Leland allows and encourages owners/developers and designers to implement stormwater LID practices on all projects located within the Town's jurisdiction. The Town defines stormwater LID according to the definition provided to the public by NCDEQ. Please refer to NCDEQ's website for information regarding LID including requirements and guidance on specific practices that can be applied to a proposed site to meet stormwater LID requirements. Contact the stormwater administrator during the planning phase of a project if the owner/developer is interested in utilizing stormwater LID practices to discuss site specific goals and constraints.

2.3 Applicability and Jurisdiction

The Town's stormwater ordinance applies within the corporate limits of the Town and the Town's Planning & Zoning Extraterritorial Jurisdiction (ETJ), as shown in a map maintained by the Town Clerk. In addition, all development and redevelopment projects must comply with the Town's stormwater ordinance unless they are exempt under one of the criteria outlined in the Town's Ordinance. Refer to Division 1 in the Town's stormwater ordinance for specific details regarding applicability.

3 Stormwater Management Permitting Procedure

3.1 Applicability

All development or redevelopment projects, regardless of project type and density, need to consider stormwater management early during the design phase. Owners and design professionals must consider the effects development/redevelopment will have on stormwater at a site. Even if projects are exempt from the regulations listed in the Town's stormwater ordinance, the owner and design professional must work to mitigate the effects of stormwater runoff that a proposed development/redevelopment project may create. Projects that are pursuant to the requirements of the Town's stormwater ordinance must apply for and be issued a stormwater management permit prior to any construction taking place, in addition to any other permits required for development/redevelopment. Exempt projects, as described in Division 1 of the Town's stormwater ordinance, will not be required to have a stormwater management permit.

3.2 Required Documentation

It is recommended that owners and design professionals contact the Town and schedule a predevelopment meeting prior to the submission of any permit applications. Although not required, this meeting can help identify project-specific constraints at an early stage in the design process. A complete stormwater management application consists of all documents listed in Section VI of the stormwater management permit application. The required documents are also listed below.

- One (1) original copy of the executed stormwater management permit application form
- One (1) original copy of the executed deed restrictions and protective covenants form (if applicable)
- One (1) original copy of the executed operation and maintenance agreement and copies of the project specific inspection forms
- Permit application processing fee made payable to the Town of Leland
- One (1) copy of the stormwater management narrative and supporting calculations
- One (1) copy of any applicable soils report
- One (1) copy of sealed plans and specifications
- One (1) digital copy of all documents and plans included in the submittal

Additionally, in order for a project closure to proceed properly, specific close out documents must also be received by the Town. Refer to Section 7 for detailed information regarding project close out.

3.3 Review Procedures

The Town will review complete stormwater management permit applications on a first come, first served basis. Applicants should ensure that all applicable sections of an application and all required attachments are complete prior to submitting to the Town. Incomplete applications will not be reviewed and will be returned to the applicant, delaying the review process. Please refer to Division 2 in the Town's stormwater ordinance for additional information regarding permit application reviews.

3.4 Existing Permits

Revisions to existing stormwater permits become necessary when alterations at a site substantially change how stormwater is managed. The changes to an existing permit as a result of site modifications will be handled by the original permitting authority. Please refer to Division 2 in the Town's stormwater ordinance for additional information regarding existing permits.

4 Stormwater Management Design Standards

4.1 Project Types

The Town of Leland requires all designers to complete project density and built-upon area calculations as part of the stormwater management permit application. Based on the results of these calculations a project density classification can be determined. Specific design standards related to the project density can be found in Division 3 in the Town's Stormwater Ordinance. In addition to project density, designers will also need to determine NCDEQ surface water classifications in the vicinity of the proposed project site. Certain surface water classifications carry specific stormwater management design standards with them that must be implemented for a proposed project.

4.2 Water Quality Standards

All projects, regardless of project density, shall treat the runoff from all surfaces generated by 1½ inches of rain. Runoff drawdown time shall be a minimum of 48 hours, but not more than 120 hours.

4.3 Water Quantity Standards

All development or redevelopment activities, regardless of project density, shall control the post-development peak discharge rate of the two-year, ten-year, and twenty-five-year storm events in order to not exceed the predevelopment peak runoff discharge rate for the same storm events. This can be achieved via the use of one or more approved SCM's. A compensatory design approach is allowable if the discharge points are conveyed to the same receiving stream and the discharge also complies with limitations on downstream impacts. Approval of compensatory treatment as part of a development permit is to the discretion of the Town.

4.4 Stormwater Control Measures Design

Some projects may require the use of one or more stormwater control measures to meet the requirements set forth by the Town. In those instances, SCMs shall be designed in accordance with the minimum design criteria (MDC) set forth in the NCDEQ *Stormwater Design Manual*. If SCMs designed to meet NCDEQ requirements are also intended to address Town water quality standards, the design shall include provisions to prevent hydraulic overload of the SCM that may re-entrain or short-circuit captured pollutants. Please refer to Division 3 in the Town's stormwater ordinance for a detailed description of where to find the MDC in the *North Carolina Administrative Code (NCAC)*.

4.5 Calculations Guidance

All calculations related to stormwater for a proposed project must be completed as described in the NCDEQ *Stormwater Design Manual* and associated design aids shall be included in the stormwater management permit application package. Any questions related to approved calculation methods should be directed to the stormwater administrator.

5 Piping and Culvert Design Standards

5.1 Introduction

The following design standards should be followed unless the designer requests and receives approval for alternative designs from the stormwater administrator or designee.

All calculations related to stormwater for a proposed project must be completed as described in the NCDEQ *Stormwater Design Manual* and associated design aids shall be included in the stormwater management permit application package. Any questions related to approved calculation methods should be directed to the stormwater administrator.

5.2 Culvert and Piped Drainage Systems

Culverts crossing residential and collector streets shall be designed in accordance with the latest NCDOT standards, which at a minimum must pass the 25-year design storm. Culverts crossing all major thoroughfares shall be designed at a minimum to pass the 100-year design storm.

Catch basins in streets may be designed for gutter spread using the 2-year storm with a 5 minute time of concentration and the remainder of the system is designed for the 10 year storm assuming each inlet captures 100 percent of the flow (to provide additional capacity for future additions to the system and off-site drainage). Inlet capacity at sags, where relief by curb overflow is not provided, shall allow for debris blockage by providing twice the required computed opening for the 2-year storm.

Storm drainage pipes in the Town-maintained rights-of-way shall be reinforced concrete with a minimum diameter of 15 inches or Type S or Type D double walled HDPE pipe with a minimum size of 15 inches. All reinforced concrete pipe used within Town maintained rights-of-way shall be Class III or higher and all Type S or Type D HDPE pipe shall meet the NCDOT standards.

Minimum cover for pipes within the right of way (ROW) shall be provided based on the following table:

MINIMUM PIPE CLEARANCE FROM INVERT TO SUBGRADE	
<u>Pipe Size (in.)</u>	<u>Clearance distance (ft.)</u>
15	2.50
18	2.75
24	3.30
30	3.60
36	4.50
42	5.00
48	5.50
54	6.00
60	6.50

Minimum cover for pipes outside of the ROW is 1 foot.

Minimum pipe slope is 0.5%. Maximum slopes for concrete pipe and HDPE pipe is 12.0%. Greater slopes may be approved by the Town Engineer upon submittal of appropriate detailed structural designs and other supporting documentation. Where storm drainage lines cross or are parallel to water or sewer mains, appropriate clearances shall meet NCDEQ requirements.

5.3 Catch Basins, Curb Inlets, and Drop Inlets

Catch basins or curb inlets in the roadway shall be placed in such a way that the spread for the 2-year storm does not exceed one half of a lane width on 2 or 3 lane streets and one lane width on wider streets. When the typical section includes a full shoulder or parking lane, no encroachment into the travel lane will be allowed. Inlets shall be provided at sags, up-grade of intersections, up-grade of super-elevation crossovers, and where driveways would discharge more than 3 cfs into a street for the 10-year storm.

Standard inlets meeting the Town of Leland Standard Details shall be used for all streets to be maintained by the Town unless an alternative is specifically requested and approved by the Town Engineer. Where streets are to be maintained by the State, other inlets (acceptable to the State) may be used. No flow greater than 3 cfs, for the 10-year storm, should be discharged into the street at any one point. Inlets should be provided to capture runoff and carry flow into the drainage system before it reaches the right of way.

No concentrated flow shall be discharged across walkways. Provisions are to be made through piping or other means to carry the flow under the walkway. All structures shall allow for access to the storm drainage system with a grate, manhole ring and cover, or a lid capable of being removed. No "blind boxes" are permitted.

- A. Maximum pipe lengths permitted without some type of structure providing access

<u>Diameter</u>	<u>Maximum Pipe Length</u>
48 inches or greater	400 feet
Less than 48 inches	300 feet

- B. Minimum drops in inlets, junction boxes and other structures

Change in alignment:

0 - 45 degrees.....	0.1 foot
45 - 90 degrees.....	0.2 foot

- C. Maximum change in pipe size without means of access
Catch basin or drop inlet required when the storm drainage pipe changes size.
- D. Decrease in pipe size
Only permitted with detailed study and special provisions for maintenance.

Headwalls or flared end sections plus an appropriate velocity dissipater will be required at the end of all culvert systems (excluding driveway pipes) based on the following table:

Pipe Size	End Treatment for Culverts
18" or less	FES or headwall on upstream end only*
24" to 48"	FES or headwall on upstream and downstream ends*
Greater than 48"	Headwall on upstream and downstream ends
Multiple culverts greater than 18"	Headwalls required on upstream and downstream ends

*Headwalls are required if the skew exceeds 75 to 105 deg.

5.4 Swales, Ditches, and Other Open Channels

All open watercourses including swales and ditches except V swales shall be graded to a maximum 6-foot bottom width with side slopes of 3 foot horizontal to 1 foot vertical, graded to prevent erosion, and be in accordance with the NCDOT Standard Details. Erosion control devices such as matting or straw will be required to protect the side slopes until a sufficient ground cover or other permanent means of erosion control is established. The unlined open watercourses may not have a velocity of greater than 2 feet per second. The liner must be approved in advance by the stormwater administrator.

Where a change in the alignment of man-made open channels is required, a minimum radius of 4 times the top width of the channel is recommended. Where no other options are available, sharper changes in alignment may be allowed under the following conditions:

- 20 - 45 degrees Bank stabilization must be provided according to tractive force analysis.
- >45 degrees Same as for above but in addition, freeboard equal to or greater than 1/2 of the Q10 depth of flow must be provided, utilizing berms or other appropriate means to increase depth of the channel.

5.5 Easements

Drainage easements are required for any development that involves more than one lot. This includes commercial developments without parcels, phased developments, and other developments with surrounding land under the same ownership as the tract being developed.

Drainage easements shall be provided for all pipe drainage systems, all new or existing open channels or watercourses that carry water from public rights of way or convey water from adjoining property across the developing property and at other locations deemed appropriate by the stormwater administrator.

Drainage easements, containing only storm drainage facilities, should be centered over the pipe or watercourse with minimum widths based on the following:

Easement Widths for Piped Drainage Systems:

Easement Width = the greater of 20' or 10' + the diameter or total outside width for multiple culverts + 2 x invert depth (rounded to the nearest 5 feet).

Easement Widths for Open Channels:

<u>Drainage Area</u>	<u>Easement width*</u>
<10 acres	10' on each side
10 - <25 acres	20' on each side
25 - <50 acres	30' on each side
50 - <100 acres	40' on each side
>100 acres	the greater of the floodway width or 50'

*Note: Widths shall be determined from the top of the bank or centerline if no banks are discernible.

Following construction and prior to acceptance by the Town for maintenance, all permanent drainage easements must be recorded with the Brunswick County Register of Deeds. The easement maps should be based on field surveys and the drainage structure located to ensure that the drainage structure or watercourse is centered within the easement (unless specifically offset). Where this is not possible, a note shall be added to recorded plats establishing that easements are to be centered over the pipe or channel.

All drainage easements shall be designed to tie into existing easements, existing watercourses, or to other appropriate locations when possible.

6 Construction

6.1 Standards

All stormwater improvements shall be constructed in accordance with Town of Leland or NCDOT Roadway Standard Drawings. Please specify these drawings, or equals that have been approved by the Town, on all engineering plans related to a proposed project.

6.2 Construction Procedures for Stormwater Control Measures

Please refer to Part A in the NCDEQ *Stormwater Design Manual* for guidance on construction considerations for SCMs. In addition to being properly sized and maintained, SCMs must be constructed using appropriate design criteria that include, but not limited to, equipment usage, water management, and stabilization, as these are critical to ensure intended function is realized. The information included in the construction procedures should be communicated to the contractor by the owner's engineer and be monitored by regular inspections.

7 Project Close Out

7.1 Close Out Process

Upon completion of a project, and before any certificate of occupancy or certificate of zoning compliance shall be granted, the applicant shall certify that the completed project is in accordance with approved stormwater management plans and designs and shall submit as-built plans for all stormwater management facilities or practices to the stormwater administrator.

7.2 Close Out Documents

Please refer to Division 2 in the Town's stormwater ordinance for detailed information regarding the required documents that must be submitted for close out of a project. All required operation and maintenance forms and documents must be approved by the stormwater administrator prior to releases of stormwater performance securities and certificates of occupancy or certificates of zoning compliance.

7.3 As-Builts Record Drawing Requirements

The as-built plans shall show final design specifications for all stormwater management facilities and practices, as well as the field location, size, depth, and planted vegetation as prescribed for all measures, controls, and devices, as installed. A registered North Carolina professional engineer shall prepare a signed and sealed certification stating that all as-built stormwater measures, controls, and devices have been constructed consistent with the approved stormwater management plans and designs. The note "As-Built Record Drawing" shall be clearly placed on all sheets.

7.4 Digital As-Built Requirements

A digital copy of the as-built plans shall be submitted by the owner. The digital format of the as-built shall be in ESRI GIS shapefile (.shp) format on a USB flash drive, CD, DVD, or file-sharing site. The shapefiles must include appropriately annotated stormwater pipes, structures, culverts, conveyances, and SCM's associated with the project in accordance with Town of Leland as-built shapefile requirements. All annotations shall be provided in an attribute table. The Town will review the digital as-built and contact the owner if there are any issues with the digital as built data.

8 Stormwater Measures Operation and Maintenance

8.1 Responsibility

The owner shall maintain and operate SCMs to preserve and continue their function in controlling stormwater quality and quantity at the degree or amount of function for which the SCM was designed. Until the transference of the stormwater permit through the Town or State is completed the original owner or applicant shall have primary responsibility for carrying out the provisions of the maintenance agreement. The owner or legally bound transferee will have sole responsibility for maintaining the SCMs. The Town will not be responsible for completing SCM maintenance. Maintenance items shall be described in an operation and maintenance agreement that details the requirements for each individual SCM. A maintenance easement at each SCM is also required for Town access. Please see the NCDEQ *Stormwater Design Manual* for maintenance easement requirements.

8.2 Acceptable Entities

An acceptable entity shall be responsible for maintenance of the stormwater management system. The Town recognizes the following entities as acceptable:

- Governmental units and private corporations
 - If the entity is a governmental unit or private corporation, written proof shall be supplied in an appropriate form stating that the entity will operate and maintain the facilities.
- Non-profit corporations including homeowners' associations, property owners' associations, condominium associations or associations of unit owners
 - The property owner or developer as applicant for site plan or subdivision plat approval is normally not acceptable as a responsible entity, especially when the property is to be sold to various third parties. However, the property owner may be acceptable if the property will be retained by the owner and will be rented, leased, or operated by the owner. The property owner shall supply evidence acceptable to the Town that they will operate and maintain the stormwater improvements.

8.3 Powers

If a homeowner's association, property owner's association, or association of unit owners is proposed for maintenance of the facilities, the applicant shall submit draft articles of incorporation, declarations of protective covenants, deed restrictions, declarations of unit ownership, or by-laws.

The association shall have the general power to:

- Own and convey property
- Operate and maintain common property
- Establish rules and regulations
- Assess members and enforce assessments
- Sue and be sued
- Contract for services to provide operation and maintenance

All lot owners, all homeowners, or unit owners shall be members of the association and the association shall exist in perpetuity

8.4 Maintenance Claims

The articles of incorporation, declaration of protective covenants, deed restrictions, declaration of unit ownership, or by-laws shall set forth the following:

- That it is the responsibility of the association to operate and maintain that portion of the stormwater management system not maintained by the Town. A description specifying the areas of responsibility shall be included. These areas also shall be indicated on the subdivision plat or on the site plan on non-subdivision projects.
- A maintenance plan with schedules and work.
- A statement that those areas to be maintained by the association are owned by the association or that they are common areas or common property.
- The method of assessment and collection for operation and maintenance costs of the stormwater management system.
- The declaration of covenants shall be in effect for a minimum of 25 years with provisions for renewal in accordance with the law.

8.5 Phased Development

If a property owner's association or association of unit owners is proposed for a development that will be constructed in phases or that will be added to in the future; the organization shall be created with the ability to accept future phases into the organization in order to ensure the continued operation and maintenance of the stormwater management system for the development.

8.6 General Maintenance Guidelines

All maintenance requirements shall be met to ensure the functionality of a stormwater system. Maintenance requirements for each individual stormwater control measure shall be outlined in an operation and maintenance agreement that is executed by the owner and remains with the property. Please utilize NCDEQ's O&M EZ Form to create an operation and maintenance agreement for a project.

8.7 Enforcement and Penalties

If maintenance requirements for the stormwater management system are not met the Town has the right to enforce the maintenance provisions for the system and levy penalties on the responsible party. Please refer to Division 5 in the Town's stormwater ordinance for detailed information regarding enforcement and penalties.

9 Fees and Forms

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