Chapter 3

QUALIFYING LOCAL SWM PROGRAMS

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3.0 INTRODUCTION

To effectively deal with the problems of urban stormwater runoff and meet the regulatory requirements addressed in Chapter 2, Virginia communities need to adopt a comprehensive approach to stormwater management that ties together stormwater quantity control with water quality protection, protection of stream channels and riparian corridors, floodplain management, and the use of stormwater facilities for multiple purposes.

Given this broad charge, the development of a local stormwater management program often involves a *rethinking* about stormwater by local communities. Those responsible for stormwater management can no longer limit their mission to drainage and flood control. Instead, local government agencies need to broaden their mission to encompass these broader goals.

Urban stormwater runoff needs to be viewed as a valuable water resource that can and should be managed within the context of the locality and watershed as a whole. Furthermore, as all of the actions within a watershed ultimately impact Virginia's downstream waters, a holistic approach to stormwater management must be developed.

Local governments have a large responsibility for stormwater management in Virginia, since it is at the local level where land use, development and infrastructure decisions are typically made. The overall purposes of a local stormwater management program are to:

- Minimize the adverse impacts of stormwater runoff on the locality and individual properties;
- Meet the state and federal regulatory requirements for stormwater runoff quantity and quality management; and
- Ensure that the locality's priorities, needs and desires are taken into account in meeting stormwater management goals.

In addition, an effective local stormwater management program requires an institutional structure that includes the following:

- Adequate legal authority
- Performance standards for development
- Design guidance and assistance
- Program funding and staffing
- Commitment to enforcement
- Public education and citizen involvement
- Accountability

This chapter provides guidance regarding what is necessary for a locality to become authorized as a qualifying local stormwater management program, or Virginia Stormwater Management Program (VSMP) Authority, and the key components that need to be addressed by a VSMP. The components include but are not limited to administrative requirements, plan review, issuance of coverage under the VSMP general permit for discharges of stormwater from construction activities, inspection, enforcement, stormwater facility maintenance, and reporting.

3.1 BOARD AUTHORIZATION OF A VIRGINIA STORMWATER MANAGEMENT PROGRAM (VSMP) AUTHORITY

The VSMP is a stormwater program administered by a local government which has been authorized by the Virginia Water Control Board (board) to administer, through a local ordinance, the elements of the General Permit for Discharges from Construction Activities (construction general permit). All Virginia counties and cities, as well as any towns subject to MS4 permits, are required by the Virginia Stormwater Management Act (Act) to adopt a VSMP. Incorporated towns not subject to MS4 permits have the option to adopt a VSMP, but if they do not, then land development within their jurisdiction will be subject to the VSMP of the county within which the town is located. If a town is on the border of two or more counties, it will be subject to the VSMP of the largest of those counties. Large and mid-sized Virginia localities with municipal separate storm sewer systems (MS4s, listed in **Table 3.1** below are subject to permit conditions pursuant to the Virginia Pollutant Discharge and Elimination System (VPDES), as set forth in Parts VI – XII (9 VAC 25-870-210 – 9 VAC 25-870-680) and Part XV (9 VAC 25-870-1200 - 9 VAC 25-870-1240) of the Virginia Stormwater Management Regulations. These localities should consider integrating their MS4 permit requirements, Erosion and Sediment Control requirements and, where applicable, Chesapeake Bay Preservation Act requirements into their VSMP.

Table 3.1. MS4 Localities in Virginia [1]

Type of Permit	Communities Subject to the Permit	
Phase I (Individual Permits)	Arlington County	Newport News (City)
	Chesapeake (City)	Norfolk (City)
	Chesterfield County	Portsmouth (City)
	Fairfax County	Prince William County
	Hampton (City)	Virginia Beach (City)
	Henrico County	
Phase II (General Permits)	Abingdon (Town)	Loudoun County
	Albermarle County	Lynchburg (City)
	Alexandria (City)	Manassas (City)
	Ashland (Town)	Manassas Park (City)
	Blacksburg (Town)	Montgomery County
	Botetourt County	Petersburg (City)
	Bridgewater (Town)	Poquoson (City)
	Bristol (City)	Radford (City)
	Charlottesville (City)	Richmond (City)
	Christiansburg (Town)	Roanoke (City)
	Colonial Heights (City)	Roanoke County
	Danville (City)	Salem (City)
	Dumfries (Town)	Spotsylvania County
	Fairfax (City)	Stafford County
	Falls Church (City)	Staunton (City)
	Fredericksburg (City)	Suffolk (City)
	Hanover County	Vienna (Town)
	Harrisonburg (City)	Vinton (Town)
	Herndon (Town)	Warrenton (Town)
	Hopewell (City)	Waynesboro (City)
	Isle of Wight County	Williamsburg (City)
	James City County	Winchester (City)
	Leesburg (Town)	York County

[1] List current as of summer 2013

Based on a schedule established by the board, the above specified localities are required to adopt local VSMPs no sooner than 15 months but no later than 21 months following the effective date of the latest revision of the VSMP permit regulations (September 13, 2011), which establishes local program criteria and delegation procedures. The board may provide a locality an extension of up to an additional 12 months, provided the board's or its designee's review of the VSMP warrants an extension and the locality has made substantive progress towards adoption.

Each locality adopting a VSMP must submit a complete application package for review by the board or its designee. The information contained in the application package must demonstrate that the locality will administer the VSMP in a manner consistent with the requirements of the Act and VSMP permit regulations.

The application package must include:

1. The draft VSMP ordinance(s) as required in 9 VAC 25-870-148;
2. A funding and staffing plan;
3. The policies and procedures including, but not limited to, agreements with Soil and Water Conservation Districts, adjacent localities, or other public or private entities for the administration, plan review, inspection, and enforcement components of the program; and
4. Such ordinances, plans, policies, and procedures must account for any town lying within the county as part of the locality's VSMP program unless such towns choose to adopt their own program.

The board or its designee will have 20 calendar days to review the application package for completeness. If the application package is not complete, the locality will be notified in writing the reason the application package is considered incomplete. Once an application is determined to be complete the review period is 90 calendar days. The application will be reviewed for compliance with the Act and the VSMP permit regulations. During the review period, the locality will be notified by the board or its designee in writing, approving, disapproving, or time extension for reviewing the application. If an application is disapproved, the notification will include an explanation as to why the application was disapproved.

3.2 VSMP ADMINISTRATION (9 VAC 25-870-148)

To be a VSMP Authority, a locality needs to adopt a stormwater management ordinance. The ordinance provides the legal foundation for program implementation, compliance determinations, and enforcement of the local program requirements. A model ordinance is provided on the Department's website at:

http://www.deq.virginia.gov/Programs/Water/LawsRegulationsGuidance/Guidance/StormwaterManagementGuidance.aspx

This can be used to assist localities in developing their own ordinances. The local ordinance must include the following elements:

1. Identification of the authority accepting complete registration statements and of the authorities completing plan review, plan approval, inspection, and enforcement;

2. Submission and approval of erosion and sediment control plans in accordance with the Virginia Erosion and Sediment Control Law and attendant regulations and the submission and approval of stormwater management plans;
3. Requirements to ensure compliance with 9 VAC 25-870-54, 9 VAC 25-870-55, and 9 VAC 25-870-56 of the VSMP regulations;
4. Requirements for inspections and monitoring of construction activities by the operator for compliance with local ordinances;
5. Requirements for long-term inspection and maintenance of stormwater management facilities;
6. Enforcement procedures and civil penalties where applicable;

The VSMP Authority may require a permittee to provide a bond or other financial surety in accordance with § 10.1-603.8 of the Act to ensure that corrective actions could be taken by the VSMP Authority at the permittee's expense if, after proper notice and a specified time, the permittee does not take corrective actions to meet the conditions of the CGP. If the locality is going to require a financial surety it needs to be included in the ordinance, as well as a provision that the financial surety will be refunded within 60 days of the completion of the requirements of the CGP.

3.3 PLAN REVIEW (9 VAC 25-870-108 et seq.)

A VSMP Authority must require the submission of a complete stormwater management plan for review and approval prior to commencement of a land-disturbing activity. **Appendix 6-A** in **Chapter 6** of this Handbook describes the general procedures for preparation of a stormwater management site plan and supporting documentation. The following steps are suggested to provide a locality with a review process and checkpoints that complement the procedure from the site developer's perspective.

1. **Pre-Application Conference.** This is an optional step that can help communicate the local program requirements and procedures from various local departments at one time to an applicant and help to avoid confusion and missteps during the process.
2. **Review of the Stormwater Concept Plan.** This is also an optional step but, again, a very helpful one aimed at developing an optimum stormwater management plan for the site.
3. **Review a Preliminary Stormwater Management Site Plan.** This is also an optional step that helps to fine-tune the SWM plan prior to committing it to final design.

> **NOTE:** The three steps above are dependent on the local government having sufficient staff to invest time in additional meetings that help to guide proposed projects to more effective outcomes from the perspective of managing stormwater. These steps also depend on the developer's willingness to spend additional money at the concept and design stages and his recognition of a benefit to the project through the greater likelihood of a smoother approval and project oversight process.

4. **Review of Final Stormwater Site Plan.** In the absence of the above interactions, there is a lot invested in the final plans submitted for review. If there are mistakes in the designs or if alternative designs might have produced better outcomes at lower cost, this is a late stage to learn that.

5. **Pre-Construction Meeting.** This is an optional meeting as well, but it is strongly recommended, especially if there was no initial consultation and joint site visit. It is very useful to have the local regulators walk the site with the design consultants and contractors to discuss how the plans will be implemented and identify key pitfalls to avoid.

3.3.1 Pre-Application Meeting

Perhaps the most important action that can take place at the beginning of the development project is a pre-consultation meeting between the local plan review authority and the developer and his team. The goal is to outline the stormwater management and other applicable local requirements, and to assist the developer in assessing constraints, opportunities, and the potential for integrating environmental site design concepts. This is an optional step, but very helpful in identifying key issues and helping the developer to avoid time-consuming and costly missteps.

This recommended step helps to establish a constructive partnership throughout the development process. A joint site visit, if feasible, can yield a conceptual outline of the stormwater management plan and strategies. By walking the site, the two parties can identify and anticipate problems, define general expectations, and establish general boundaries of natural feature protection and conservation areas. A major incentive for pre-consultation is that permitting and plan approval requirements will become clear at an early stage, increasing the likelihood that the approval process will proceed faster and more smoothly and reducing the opportunity for unexpected surprises that can throw a project off track.

The site developer should be made familiar with the local stormwater management and other development requirements and the design criteria that apply to the site. These may include:

- Minimum design and performance standards for stormwater management
- Design storm frequencies
- Conveyance design criteria
- Floodplain criteria
- Buffer/setback criteria
- State and federal wetlands regulations
- Local TMDL requirements
- Erosion and sediment control requirements
- Maintenance requirements
- The need for physical site evaluations (infiltration tests, geotechnical evaluations, etc.)

This guidance could be provided to the developer at the pre-application meeting and should be detailed in various local ordinances (e.g., subdivision codes, stormwater management and drainage codes, etc.). This information could also be contained in a set of checklists provided to the developer. **Appendix 3-E** contains example checklists outlining the recommended steps to prepare preliminary and final stormwater management site plans.

Current land use plans, comprehensive plans, zoning ordinances, road and utility plans, floodplain regulations, watershed or overlay districts, and public facility plans should all be consulted to determine the need for compliance with other local and state regulatory requirements.

Opportunities for special types of development (e.g., clustering, etc.) or special land use opportunities (e.g., conservation easements or tax incentives, etc.) should be investigated. There may also be an ability to partner with the site developer in the development of greenways or open-space parks.

3.3.2 Review the Stormwater Management Concept Plan

During the concept plan stage, the site designer will perform most of the layout of the site, including the preliminary stormwater management system design and layout. The stormwater concept plan allows the design engineer to propose a potential site layout and gives the developer and local authorities a "first look" at the stormwater management system for the proposed development. Where the locality chooses to engage in this step, the stormwater concept plan should be submitted to the local plan review authority for feedback before detailed preliminary site plans are developed.

It is extremely important at this stage that the stormwater design is integrated into the overall site design concept in order to best reduce the impacts of the development as well as provide for the most cost-effective and environmentally sensitive approach to minimizing and managing runoff from the site.

3.3.3 Review the Initial or Preliminary Stormwater Management Site Plan

Preliminary stormwater management plans are typically limited to clearing and grading of the site unless the VSMP Authority allows for other construction activities in the plan. An initial plan may be submitted for review by the VSMP Authority with an erosion and sediment control plan, preliminary stormwater design for current and future construction activity and other information normally part of a complete plan as required by the VSMP.

The preliminary plan ensures – prior to submitting final plans – that all local requirements and criteria are being complied with and that opportunities are being taken to minimize adverse impacts from the development. The preliminary stormwater management site plan should consist of maps, narrative, and supporting design calculations (both hydrologic and hydraulic) for the proposed stormwater management system, including the following elements from **Section 3.5.4** below:

- A hydrologic analysis for the existing conditions at the site (pre-development)
- A post-development hydrologic analysis
- The stormwater management system design
- A downstream analysis

The applicant should demonstrate that appropriate and effective stormwater control measures have been selected and adequately designed. The preliminary plan should also include, among other things, street and site layout, delineation of natural feature protection and conservation areas, soils data, existing and proposed topography, relation of the site to upstream drainage, limits of clearing and grading, and proposed methods to manage and maintain conservation areas (e.g., easements, maintenance agreements/responsibilities, etc.)

3.3.4 Review the Final Stormwater Management Site Plan

The final stormwater management site plan adds further detail to the preliminary plan and reflects changes that are requested or required by the local review authority. The final stormwater site plan should include all of the revised elements from the preliminary plan as well as the following:

- Erosion and Sediment Control Plan
- Landscaping Plan
- Operations and Maintenance Agreement/Plan
- Evidence of Acquisition of Applicable Local and State/Federal Permits
- Waiver/Exception Requests

This process may be iterative. The reviewer should ensure that all submittal requirements have been satisfactorily addressed and permits, and pertinent legal agreements (e.g., maintenance agreements, easements, performance bonds, etc.) have been obtained and/or executed.

The completed final stormwater site plan should be submitted to the local plan review authority for final approval *prior to* any construction activities on the development site. Approval of the final plan is the last major milestone in the stormwater planning process. The remaining steps ensure that the plan is implemented as approved, and the facilities are installed and maintained properly.

As noted above, the VSMP Authority may allow a Stormwater Concept Plan or a Preliminary Stormwater Management Plan to be submitted for discussion, review and approval. However, a complete Final Stormwater Management Plan is still required to be submitted for review even if a VSMP Authority allows and approves a preliminary plan. The fee form can be found at:

http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/VSMPPermits/ConstructionGeneralPermit.aspx

Fifty percent (50%) of the of the required CGP fee is required to be submitted for complete or initial plans.

The VSMP Authority must determine the completeness of a stormwater management plan and notify the applicant within 15 calendars days of receipt of the plan that it is either complete or incomplete. If the plan is incomplete, the applicant must be notified in writing by the VSMP Authority of the reason(s) the plan is incomplete and what is specifically needed to make it complete. If the plan is complete and the applicant is notified of that determination within 15 calendar days of the plan's receipt, the VSMP Authority has an additional 60 calendar days from the date of notification to complete the review of the plan. If a determination of completeness is not made by the VSMP Authority and the applicant is not notified within 15 days of the plan's receipt, the stormwater management plan shall be considered complete as of the date of submission, and the VSMP Authority will have a total of 60 calendar days from that date to complete the review of the plan.

During this review period, the stormwater management plan must be approved or disapproved by the VSMP Authority. Approval or denial is based on the plan's compliance with the requirements

in the state regulations/local ordinance. The applicant or his/her designated agent must be notified in writing by the VSMP Authority of the final decision. If the plan is not approved, the reason(s) for not approving the plan must be provided in the notification. If a plan meets all requirements when submitted but no action is taken or notification given by the VSMP Authority within the time specified above, the plan shall be deemed approved. The VSMP Authority must act within 45 days on any plan that has been previously disapproved and resubmitted.

After a stormwater management plan has been approved by the VSMP Authority, the applicant or his/her designated agent may request permission to modify the plan. The VSMP Authority has 60 calendar days to respond in writing, either approving or disapproving the request. The VSMP Authority may also require modifications to the approved plan to address deficiencies noted during an inspection.

To be considered complete, the plan must contain all of the following information (9 VAC 25-870-55 B):

- Information on the type of and location of stormwater discharges, information on the features to which stormwater is being discharged including surface waters or karst features if present, and predevelopment and post-development drainage areas;
- Contact information including the name, address, and telephone number of the owner and the tax reference number and parcel number of the property or properties affected;
- A narrative that includes a description of current site conditions and final site conditions or if allowed by the stormwater program administrative authority, the information provided and documented during the review process that addresses the current and final site conditions;
- A general description of the proposed stormwater management facilities and the mechanism through which the facilities will be operated and maintained after construction is complete;
- Information on the proposed stormwater management facilities, including the type of facilities, location, including geographic coordinates, acres treated, and the surface waters or karst features into which the facility will discharge;
- Hydrologic and hydraulic computations;
- Documentation and calculations verifying compliance with the water quality and quantity requirements of these regulations;
- A map or maps of the site that depicts the topography of the site and includes:
  - All contributing drainage areas;
  - Existing streams, ponds, culverts, ditches, wetlands, and other water bodies;
  - Soil types, geologic formations if karst features are present in the area, forest cover, and other vegetative areas;
  - Current land use including existing structures, roads, and locations of known utilities and easements;
  - Sufficient information on adjoining parcels to assess the impacts of stormwater from the site on these parcels;
  - The limits of clearing and grading, and the proposed drainage patterns on the site;
  - Proposed buildings, roads, parking areas, utilities, and stormwater management facilities; and
  - Proposed land use with tabulation of the percentage of surface area to be adapted to various uses, including but not limited to planned locations of utilities, roads, and easements.

The VSMP Authority could provide guidance for developers and their consultants on site plan preparation via handout or web link as a useful tool to help ensure that submitted plans are complete and meet the requirements of the regulations.

3.3.5 Pre-Construction Meeting

This step provides an opportunity to ensure that all involved parties –the contractor, design consultant(s), inspector, and plan reviewer –understand how the plan will be implemented on the site. A pre-construction meeting should occur before any clearing or grading is initiated on the site. This is the appropriate time to ensure that natural feature protection areas and limits of disturbance have been adequately staked and adequate erosion and sediment control measures are in place or ready to be installed. The sequence of construction should also be discussed, noting that permanent SWM BMPs should be constructed late in the process, after their contributing drainage areas are stabilized. This timing will minimize potential sediment delivery to these facilities and potential clogging of filter/infiltration media.

3.4 AUTHORIZATION OF COVERAGE UNDER THE CONSTRUCTION GENERAL PERMIT (CGP) (9 VAC 25-870-1170)

Prior to the VSMP Authority notifying the applicant that VSMP Construction General Permit (CGP) coverage has been authorized, the applicant must have completed the following:

- Obtained approved of an initial or complete stormwater management plan;
- Submitted a proposed right-of-entry agreement or easement(s) from the owner, for purposes of inspection and maintenance;
- Submitted proposed maintenance agreement(s) with inspection schedule(s);
- Submitted a complete registration statement for the CGP; and
- Submitted the required fee form and fee.

The VSMP Authority must notify the applicant if the submitted registration statement is incomplete within 15 working days of its receipt by the VSMP. The notification must (1) identify what information is required to be submitted to complete the registration statement and (2) clarify that the land-disturbing activity does not have coverage under the CGP until that information is provided. Coverage or termination of coverage shall be authorized through a standardized database or other method provided by the DEQ. At a minimum, the database must include the permit number, operator name and contact information (address, telephone number and email address), activity name, number of acres disturbed, date of permit coverage, and site address and location, as well as the date of the termination of coverage.

3.5 INSPECTIONS (9 VAC 25-870-114 et seq.)

Construction sites should be inspected periodically by local agencies to ensure that the project is being built in accordance with the approved designs and that conservation areas have been adequately protected. Inspection frequency may vary with regard to site size and location. In addition, it is recommended that some inspections occur after significant storm events (e.g., 1/2 inch and greater). The inspection process should prevent subsequent problems that could result in environmental damage, added costs or penalties for developers. An added benefit of a formalized and regular inspection process is that it should help to motivate contractors to internalize regular maintenance of sediment controls as part of the daily construction operations.

The VSMP Authority or its designee is responsible for inspecting the land-disturbing activity during construction for compliance with the VSMP permit. Since a locality is responsible for erosion and sediment control (ESC) inspections, inspections for compliance with the VSMP permit may be conducted in conjunction with the locality's ESC inspections.

In accordance with the VSMP regulations, the locality administering an approved VSMP program must:

A. Inspect the land-disturbing activity during construction for:
   1. Compliance with the approved erosion and sediment control plan;
   2. Compliance with the approved stormwater management plan;
   3. Development, updating, and implementation of a pollution prevention plan; and
   4. Development and implementation of any additional control measures necessary to address a TMDL.

B. Establish an inspection program that ensures that stormwater management facilities are being adequately maintained and be documented by records.

A final inspection is needed to ensure that the construction conforms to the intent of the approved design. Prior to issuing an occupancy permit and releasing any applicable bonds, the review authority should ensure that: (1) temporary erosion control measures have been removed; (2) stormwater controls are unobstructed and in good working order; (3) permanent vegetative cover has been established in areas of exposed soil; (4) any damage to natural feature protection and conservation areas has been repaired or restored; (5) conservation areas and buffers have been adequately marked or signed; and (6) any other applicable conditions have been met.

As-built drawings of the structural stormwater control measures and drainage facilities should also be acquired by the locality, since these are important in the long-term maintenance of the facilities. The review authority should keep copies of these drawings and associated documents in the local stormwater control inventory and data storage system. With GIS and CAD systems becoming more widely used, much of these data can be stored electronically.

As discussed in **Section 3.8** below and in **Chapter 9**, *ongoing* inspection and maintenance of stormwater management facilities is often the weakest component of stormwater management systems. The stormwater management plan and maintenance agreement must clearly establish

which entity has responsibility for operation and maintenance (O&M) of all stormwater control measures and drainage facilities. Typically, the responsibility for maintenance is transferred from the developer and contractor to the property owner. Communication about this important responsibility is usually inadequate; therefore, localities may need to consider ways to notify property owners of their responsibilities. For example, notification can be made through a legal disclosure upon sale or transfer of property, or public outreach programs may be instituted to describe the purpose and value of maintenance.

The VSMP Authority must establish an O&M inspection program that will ensure stormwater management facilities continue to be maintained and to function as designed. The O&M inspection procedures developed by the VSMP Authority must be submitted to the Virginia State Water Control Board for review and approval prior to local program implementation. These inspection procedures must be enforceable and meet the intent of the VSMP permit regulations.

The O&M inspection program must also require that, after completion of construction, the owner(s) of stormwater management facilities conduct inspections in accordance with an inspection schedule in the recorded maintenance agreement(s), and submit written inspection and maintenance reports to the VSMP Authority upon request. Of course, the VSMP Authority has the option of taking responsibility for all or a portion of post-construction BMP inspection and maintenance if sufficient staffing and funding are available (perhaps through a stormwater utility).

The VSMP Authority's O&M inspection program needs to be based on a system of priorities that takes into consideration the purpose and type of the facility, ownership and the existence of a recorded maintenance agreement and inspection schedule, the contributing drainage area, and downstream conditions. In addition, each stormwater management facility must be inspected by the VSMP Authority or its designee at least every five years. The VSMP Authority must generate and keep on file an inspection report for each stormwater management facility inspected by the VSMP Authority or its designee.

Inspections of stormwater management facilities are normally conducted by the locality. However, a VSMP Authority may use the stormwater management facility owner's inspection report, provided the inspection was conducted by a person who is licensed as a professional engineer, architect, certified landscape architect or land surveyor pursuant to Article 1 (§ 54.1-400 et seq.) of Chapter 4 of Title 54.1 of the Code of Virginia, or who holds a certificate of competence from the board. In addition, the owner's inspection and report must be consistent with the board approved local inspection program procedures and kept on file by the VSMP Authority.

3.6 ENFORCEMENT (9 VAC 25-870-116 - 118 et seq.)

A VSMP Authority must develop policies and procedures that outline the steps to be taken to enforce compliance pursuant to the Act, VSMP regulations, and the local ordinance. A stormwater program administrative authority may use the *Stormwater Management Enforcement Manual* as guidance in establishing policies and procedures. This *Manual* is on the Department's website at:

http://www.deq.virginia.gov/Programs/Water/LawsRegulationsGuidance/Guidance/StormwaterManagementGuidance.aspx

The enforcement program developed by the local VSMP Authority may include separate informal (e.g., inspection reports, notices to comply, etc.) and formal (e.g., notices of corrective actions, consent orders, and emergency special orders, etc.) administrative procedures. In addition, the enforcement program may include procedures for civil penalties, criminal penalties, and injunctions.

3.7 STORMWATER MANAGEMENT FACILITY MAINTENANCE (9 VAC 25-870-112 et seq.)

An essential component of a comprehensive stormwater management program is the ongoing operation and maintenance of the various components of the stormwater drainage, control, and conveyance systems. Failure to provide effective maintenance can reduce the hydraulic capacity and the pollutant removal efficiency of BMPs and conveyance systems. Historically, many localities have not ensured adequate on-going maintenance of BMPs, to the detriment of local water quality.

The question is not whether stormwater management system maintenance is necessary in a locality. Rather, the question is how a locality's maintenance programs will be budgeted, staffed and administered, and who has responsibility for managing inspections, scheduling periodic required maintenance, and funding remedial work. *Ideally, a VSMP Authority should address operations and maintenance concerns proactively, instead of reacting after the fact to problems that occur, such as flooding or water quality degradation.*

Operations and maintenance activities can include cleaning and maintenance of catch basins, drainage swales, open channels, storm sewer pipes, stormwater ponds, and other structural controls. Other pollution reduction activities (e.g., street sweeping, illicit discharge identification and removal, etc.) also fall under operations and maintenance activities. Stormwater system operations and maintenance can also include restoring degraded stream channels and banks and retrofitting existing development with BMPs to meet water quality and/or water quantity goals of the locality.

A clear assignment of stormwater inspection and maintenance responsibilities – whether accomplished by the local government, land owners, private concerns, or a combination of these – is essential to ensuring that stormwater management systems function as they were intended. It is imperative that localities require the maintenance of private stormwater systems and develop the necessary legal framework to ensure compliance.

The VSMP Authority must require the person responsible for the land-disturbing activity or his/her designated agent to submit construction record drawings for permanent stormwater management facilities. The drawings must be appropriately sealed and signed by an appropriate professional, in accordance with all minimum standards and requirements pertaining to that person's professional discipline, certifying that the stormwater management facilities have been constructed in accordance with the plan approved by the VSMP Authority. The VSMP Authority must have the construction record drawings and certification on file *prior to* the release of the portion of the performance bond or surety associated with the stormwater management facility.

The responsibility for operation and maintenance of stormwater management facilities remains with the property owner or other legally established entity and passes to any successor, unless assumed by the VSMP Authority. In accordance with the VSMP Regulations, the VSMP authority must require long term responsibility for and maintenance of stormwater management facilities set forth in an instrument such as a BMP maintenance agreement that is recorded in the local land records. Such agreements must:

1. Be submitted to the VSMP authority for review and approval prior to the approval of the stormwater management plan;
2. Be stated to run with the land;
3. Provide for all necessary access to the property for purposes of maintenance and regulatory inspections;
4. Provide for inspections and maintenance and the submission of inspection and maintenance reports to the VSMP authority; and
5. Be enforceable by all appropriate governmental parties.

The owner must notify the VSMP Authority of any transfer or conveyance of ownership or responsibility for maintenance of a stormwater management facility. The VSMP Authority must also require a BMP maintenance agreement from the property owner and be a party to each maintenance agreement.

As authorized by § 15.2-906 of the Code of Virginia, the agreement may also contain provisions specifying that the VSMP Authority may perform the necessary maintenance and repairs and recover the costs from the owner where:

- Maintenance or repair of a stormwater management facility located on the owner's property is neglected; or
- The stormwater management facility becomes a public health or safety concern and the owner has failed to perform the necessary maintenance and repairs, after receiving notice from the locality.

In the specific case of a public health or safety danger, the agreement may state that the VSMP Authority's written notice to the owner may be waived by the locality. **Chapter 9** of this Handbook provides much more specific information about BMP maintenance and local government maintenance programs.

3.8 REPORTING AND RECORD KEEPING (9 VAC 25-870-126 et seq.)

The VSMP Authority is required to provide the following information to the Department on a fiscal year basis (July 1 to June 30) by October 1st of each year, in a format specified by the Department:

- Pertinent information regarding each permanent stormwater management facility completed during the fiscal year, to include the following:
  - The type of stormwater management facility;

  - The facility's geographic or GPS coordinates;
  - Acres treated; and
  - The surface waters or karst features into which the stormwater management facility will discharge.
- The number and type of enforcement actions taken during the fiscal year; and
- The number of exceptions applied for and the number granted or denied during the fiscal year.

The VSMP Authority must maintain CGP files for three (3) years following permit termination. After three years, the CGP files are to be delivered to the DEQ by October 1st of each year. The VSMP authority needs to maintain stormwater facility maintenance inspection reports on file for five (5) years from the date of inspection. Stormwater maintenance agreements, design standards and specifications, post-construction surveys/as-built drawings, and maintenance records must be maintained in perpetuity by the VSMP Authority.

DEQ will have an online enterprise database into which VSMP Authorities can input local stormwater program and permit data. This will enable DEQ to gather and generate reports on critical information, such as types of BMPs being installed, the drainage area they serve, and total pollution loads being removed. This capability should result in a minimization of additional reporting by localities. Integrating local stormwater management into the local GIS System may also make the generation of reports easier, especially if the GIS system is linked to a database.

3.9 REFERENCES

Atlanta Regional Commission (ARC). 2001. *Georgia Stormwater Management Manual*. Prepared by AMEC, the Center for Watershed Protection, Debo and Associates, Jordan Jones and Goulding, and the Atlanta Regional Commission. Atlanta, Georgia.

Center for Watershed Protection (CWP). July 2008. *Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program*. Ellicott City, MD. available at: http://www.cwp.org/Resource_Library/Center_Docs/SW/pcguidance/Manual/PostConstructionManual.pdf

Appendix 3-A

POTENTIAL ELEMENTS OF A COMPREHENSIVE STORMWATER MANAGEMENT PROGRAM

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APPENDIX SECTION HEADINGS

TABLES

3-A.1.0 INTRODUCTION

The various program activities that will be included in a local program will vary according to the goals, requirements and resources of the locality in question. The following is a description of elements that should be considered when developing a comprehensive local program.

3-A.1.1 Stormwater Management System Information/Inventory

Information needs are critical to a successful local program. The development of an inventory of the stormwater system is one of the first steps in developing a comprehensive stormwater management program. Relevant information includes the location and classification of storm drains; drainage networks; structural stormwater control facilities; streams, ponds and wetlands; industrial discharges and combined sewer outfalls; watershed boundaries; floodplains; existing and proposed land use and zoning; and known water quality problem areas (especially impaired waters subject to TMDLs). This information can be collected and stored on paper maps or, ideally, in an integrated municipal GIS system. Stormwater system inventories and geographic information tools are covered in more depth in **Appendix 3-B** of this chapter.

3-A.1.2 Watershed-Based Planning

Stormwater master planning and watershed planning help to establish priorities for stormwater management decision-making and should be incorporated early into an effective local program. Watershed-based planning is a tool which allows a locality to assess current and future stormwater problems as well as potential solutions within a drainage basin. It can be used to assess the health of existing water resources and make informed land use, transportation, green space and other local decisions based upon current and projected land use and development within a watershed and its associated subwatersheds. Watershed plans assist communities in developing and evaluating stormwater management scenarios and alternatives.

Watershed and stormwater master plans can be used to identify drainage system and stream segments in need of channel improvement or restoration, and potential locations for regional stormwater control facilities. Watershed planning can also provide a locality with the necessary information for conserving natural areas and open space as well as the development of riparian buffers and greenways. In addition, they may also promote a wide range of additional goals, including water supply protection, wetland protection and preservation, stream bank and stream corridor restoration, habitat protection, protection of historical and cultural resources, enhancement of recreational opportunities, and aesthetic and quality of life issues.

In addition to providing better opportunities for managing stormwater problems and watershed resources, the watershed planning approach also involves stakeholder input and establishes local consensus in the land use and stormwater management decision-making process. Further, watershed plans promise a reduction in the overall capital and operation and maintenance costs for stormwater management from reduced downstream flooding and optimal siting and sizing of stormwater control measures. This potentially includes opportunities for more flexible compliance with local requirements, including options such as local fee-in-lieu, off-site mitigation, and nutrient trading programs. Other benefits include contributions to local land use plans, more sustainable

development, and increased equity and opportunities for developers. The process of watershed plan development and implementation of watershed plans are discussed in more detail in Chapter 5.

3-A.1.3 Development Requirements

Adoption of a comprehensive and integrated set of stormwater management requirements for all new development and redevelopment is critical to addressing the problems of post-construction urban stormwater runoff and is required for NPDES/VPDES municipal stormwater programs. These requirements must be built into a locality's land development code and supported by an effective plan review process. The VSMP permit regulations (9 VAC 25-870-10 et seq.) and this Handbook provide performance requirements and recommended environmental site design practices (**Chapter 6** of this Handbook), and tools and methods (**Chapters 10-13** of this Handbook). Additional guidance can be found on the DEQ stormwater management web page at:

http://www.deq.virginia.gov/Programs/Water/StormwaterManagement.aspx

Also see the BMP design specifications (DEQ Stormwater BMP Clearinghouse web site, at http://www.vwrrc.vt.edu/swc/) and other guidance that can constitute the standards for new development and redevelopment upon which local ordinances can be based.

3-A.1.4 Design Criteria, Guidance and Training

In support of local development standards and requirements, a community must provide supporting guidance and technical criteria for the design, construction and maintenance of stormwater management facilities. For many communities in Virginia, the inclusion of water quality provisions into stormwater management activities represents a new approach to "traditional" drainage responsibilities. Practitioners who work in the land development (i.e., site designers and engineers) also must face a host of new concepts and ideas that alter their "traditional" approach to managing stormwater on development sites. Therefore, it is important that adequate design assistance, guidance and training be provided to those being regulated by the local stormwater management program.

A formal set of design criteria and specifications for structural control and drainage system design is critical to ensuring that local requirements and goals are met. Communities can adopt this Handbook and the BMP design criteria on the BMP Clearinghouse as the primary design criteria and guidance for developers and design consultants. These criteria are designed to support the minimum stormwater management standards in the regulations and include information and criteria regarding stormwater site plan preparation, environmental site design, recommended hydrologic and hydraulic methods, BMP selection and design, and inspection and maintenance provisions. A locality may wish to prepare an addendum that contains any local criteria (such as specific TMDL requirements) and/or additional reference material. Additional design aids (e.g., karst or coastal area guidance) may be necessary, depending on the locality's needs and requirements.

Training on the design, construction, inspection and maintenance of stormwater management facilities and controls is an essential part of providing technical guidance to developers, engineers and contractors. Regular education programs are important to assure that individuals remain current in the latest requirements and design criteria. They also provide opportunities to train the large influx of new personnel each year in the design, engineering and construction industries, as well as local site plan review and inspection staff. Education programs help all parties to understand their roles and responsibilities, which is essential to effective program implementation. The Department provides training and directs stakeholders to other relevant educational and certification resources (e.g., private sector, institutional and NGO seminars, workshops and conferences).

3-A.1.5 Floodplain Management

Floodplain management involves the designation of flood-prone areas and the limiting of their uses to those compatible with a given degree of risk. It is also aimed at minimizing modifications to streams, reducing flood hazards and protecting the water quality of streams. As such, floodplain management can be seen as a subset of the larger consideration of surface water and stormwater management within a locality. Though it is regulated independent of the SWM program in Virginia and is often considered separately in most communities, there are many areas in which floodplain management directly overlaps with other areas of stormwater management. The development of riparian buffers and greenway corridors along streams and rivers can also preserve floodplain areas and protect their function in safely conveying floodwaters. Floodplain regulations and development restrictions, particularly when based upon the full build-out 100-year floodplain, can greatly reduce future flooding impacts and may allow communities to waive stormwater quantity control (i.e., detention requirements) for larger storm events in some areas.

Ideally, flooding and floodplains should be managed at the watershed level, and floodplain management should be an important goal of comprehensive watershed plans. Consequently, floodplain management activities should be fully integrated into comprehensive stormwater management programs and handled in a complementary and coordinated approach. More information on requirements, strategies and tools for improved local floodplain management are provided by the Virginia Department of Conservation and Recreation's Division of Dam Safety and Floodplain Management, which can be accessed online at:

http://www.dcr.virginia.gov/dam_safety_and_floodplains/index.shtml .

3-A.1.6 Erosion and Sediment Control

Sediment loadings to receiving water are highest during the construction phase of development. Consequently, erosion and sediment control on construction sites is an important element of a comprehensive stormwater management program for water quality and habitat protection. A combination of clearing restrictions, erosion prevention, and sediment controls, coupled with a diligent plan review and strict construction enforcement are needed to help mitigate potential impacts. Indeed, these elements are the focus of the Virginia Erosion and Sediment Control Regulations (9 VAC 25-870-10 et seq.) and Handbook and the USEPA's/Virginia's VSMP General Permit for Discharges of Stormwater from Construction Activities (9 VAC 25-870-1170

et seq.). Every locality in the Commonwealth is subject to these requirements, as administered by local governments.

Guidance on BMPs for construction site erosion and sediment control can found in the *Virginia Erosion and Sediment Control Handbook, Third Edition* (1992). In addition, a number of environmental site design practices discussed in **Chapter 6** can reduce the total amount of area that is cleared and graded. It is essential that erosion and sediment control be considered in stormwater concept plans and implemented throughout the construction phase to prevent damage to natural stormwater drainage systems and post-construction stormwater control measures and conveyance facilities.

3-A.1.7 Local Ordinances

Local ordinances are a key implementation mechanism for many stormwater program objectives. They can include provisions for stormwater management requirements for development, protection of natural areas, erosion and sediment control, the prohibition of non-stormwater discharges to municipal storm sewers, and nonpoint source pollution control. **Table 3-A.1** outlines some types of local ordinances used to support stormwater management activities.

Table 3-A.1. Types of Local Ordinances Used to Support Stormwater Management Activities

Ordinance	How It Addresses Stormwater
Zoning Ordinance	Specifies land uses and site plan minimums that support stormwater management through the use of buffers, setbacks, densities, open spaces, dedications, etc. May also contain the FEMA floodplain regulations implementing the National Flood Insurance Program.
Subdivision Ordinance	Specifies the proper design, permitting and inspection procedures for the subdivision of land for the purpose of development. May contain performance standards similar to a Stormwater Ordinance.
Erosion and Sediment Control Ordinance	Specifies requirements for preventing soil erosion, trapping sediment and protecting receiving waters from sediment and runoff discharge damage during construction activities. Also typically sets forth the procedures to follow for obtaining approval for construction.
Stormwater Management Ordinance	Typically contains comprehensive performance criteria for all components of the stormwater management system along with procedures for obtaining approval for construction.

In Virginia communities, the stormwater requirements are typically scattered among the above ordinances rather than being consolidated into a single comprehensive ordinance. Therefore, it is helpful for the locality to develop a special informational publication that can conveniently and clearly communicate to a developer where the various applicable requirements are found and how they are tied together to achieve the locality's regulatory purposes in the development process. This will help to ensure that all stormwater requirements are met, regardless of the source of authority.

Virginia local governments also have an important policy document that can and should relate to stormwater management. This is the Comprehensive Plan for managing land use (these may have different names from one jurisdiction to another). The comprehensive plan establishes the long range vision for land development, economic growth and quality of life in a locality, and it typically includes goals, objectives and policies for achieving that vision. Ideally, local ordinances should be connected to the comprehensive plan such that their requirements are established to actually achieve the aims of the comprehensive plan. Virginia law does not require this, but localities are free to strengthen the connection between the plan and ordinances, if they choose.

In order to implement a truly effective stormwater management program, localities should consider reviewing and evaluating all the rules, ordinances and policies that may affect implementation of stormwater management, to (1) assure that these documents enable developers to use the best practices and (2) assure that any internal conflicts among the documents are eliminated in favor of encouraging or requiring use of the best development principles and practices. **Appendix C** of this chapter discusses the use of Code and Ordinance Worksheets to conduct such an evaluation. This Appendix also provides two example Worksheets for local use.

3-A.1.8 Plan Review

Having an effective local review process for stormwater management plans (including erosion and sediment control plans) for development is a key element in the successful implementation of stormwater management objectives. The review should be comprehensive, considering all of the potential impacts of a development project. This is an element of the local program where appropriate training of staff is very important. Plan review staff members need to understand the rudiments of drainage engineering and BMP design in order to be able to critically review site plans typically submitted by licensed professionals and to recognize when design choices are beneficial or risky.

The project review and approval process should be clearly explained and readily understandable to the those in the development industry, including all submittal and permit requirements. **Section 3.4** of Chapter 3 discusses Virginia requirements for the plan review process in more detail.

3-A.1.9 Site Inspection and Enforcement

A locality needs to provide the means for the enforcement of established ordinances and permit requirements. Trained personnel are required to inspect and ensure compliance for erosion and sediment control, stormwater management plans, removal of illicit connections, and private maintenance of structural stormwater controls. **Sections 3.7 and 3.8** below discuss Virginia requirements for inspection and enforcement in more detail. More specific guidance for establishing an inspection/maintenance element of the local program can be found in **Chapter 9** of this Handbook.

3-A.1.10 Stormwater System Improvements

There are several ways that a local government can make physical improvements to the stormwater management system. These can include capital improvements, such as the design and construction of conveyance structures or regional controls, stream stabilization and restoration programs, and the acquisition of floodplain areas and natural areas, such as buffers and wetlands. It is important for older communities to keep aging drainage infrastructure in mind and have, as part of its capital improvement budget, a methodical plan for repairing and replacing it in a manner that causes minimal displacement or inconvenience for local citizens.

3-A.1.11 Long-Term Operation and Maintenance

An essential component of a comprehensive stormwater management program is the on-going operation and maintenance of the various components of the stormwater drainage, control, and conveyance systems. Failure to provide effective maintenance can reduce the hydraulic capacity and the pollutant removal efficiency of stormwater controls and conveyance systems.

Operation and maintenance activities can include cleaning and maintenance of catch basins, drainage swales, open channels, storm sewer pipes, stormwater ponds, and other stormwater control measures. Street sweeping and other pollution reduction activities also fall under operation and maintenance. Ideally, the best program addresses operation and maintenance concerns proactively, rather than reacting to problems such as flooding, stream channel erosion or water quality degradation after they occur.

A clear assignment of stormwater inspection and maintenance responsibilities is essential to ensuring that the system continues to function as it was intended. This is true whether inspection and maintenance are accomplished by the local government, land owners, private concerns, or a combination of these approaches. Maintenance requirements are an important consideration in the selection and design of BMPs. Therefore, site designers should strive to make their systems accessible and as simple and maintenance-free as possible.

Stormwater system operation and maintenance can also include retrofitting existing development to meet water quality and/or water quantity goals and restoring the bed, banks and profiles of degraded streams. **Section 3.9** below discusses Virginia requirements for SWM facility maintenance in more detail.

3-A.1.12 Monitoring

Regular monitoring data can alert the local program about failures in the system and assist local staff in making sound management decisions and provide support for enforcement actions. Typical monitoring data include water quality and streamflow measurements, as well as stream stability and habitat assessments. The monitoring program can be designed to address specific issues or problems within individual watersheds. Short-term monitoring can be used to evaluate the performance of implemented solutions. Long-term data collection can be used to identify trends. Some TMDL implementation plans call for monitoring to determine if controls are working, and new USEPA effluent limitation criteria for construction sites will necessitate monitoring by some developers (typically, very large projects).

3-A.1.13 Pollution Prevention

Also known as *source controls*, pollution prevention management practices are an important way to reduce or prevent water quality problems in stormwater runoff from a variety of sources. The intent of source control practices is to prevent stormwater from coming in contact with pollutants in the first place, rather than having to provide more structural controls for treatment and pollutant removal. Pollution prevention programs are required in communities subject to MS4 permits, but source control programs are a good idea whether or not they are required by law. Pollution prevention includes categories of measures such as the following:

- Materials management (storage, use, exposure, and disposal/recycling controls)
- Spill prevention and cleanup
- Removal of illicit connections to storm sewers
- Prevention of illegal dumping
- Street and storm drain cleaning and maintenance
- Public information and education

Examples of source control practices include covering stockpiles of soil, mulch, and road deicing chemicals to prevent erosion and exposure to runoff; safe hazardous waste storage; dry weather screening of stormwater outfalls to detect illicit connections; storm drain stenciling; street sweeping; fertilizer use restrictions; leaf collection programs; and efforts to educate and influence citizen behaviors (e.g., proper motor oil disposal and household hazardous waste management). All of these activities impact stormwater runoff quality.

Many of these practices are easily implemented and are cost-effective means of reducing stormwater contaminants. As such, they should be considered, where appropriate, for all residential, commercial, industrial, institutional, and municipal projects and activities. In addition, many are required activities for MS4 permit programs. Additional information regarding pollution prevention is provided in **Chapters 5 and 8** of this Handbook.

3-A.1.14 Public Education and Involvement

In order to gain public support for local stormwater management programs, citizens and the business community alike need to be educated and involved in the process. General education efforts can provide information about stormwater issues and pollution prevention practices. Educational efforts include the following:

- Meetings and presentations
- Newsletters, fact sheets and brochures, both in hard copy and on the locality's web site
- Homeowner educational materials (realtors can help to distribute such material)
- Media campaigns
- Coordination with citizen groups for program support

In addition, programs such as Adopt-A-Stream and the Save-Our-Streams citizen monitoring program can involve local citizens in the cleanup and monitoring of local streams. The public can also be involved in the development of watershed plans and overall stormwater management

policy. More information on stormwater public information and education programs is provided in **Chapter 5** of this Handbook.

3-A.1.15 Funding

Adequate funding of local stormwater management program activities is perhaps one of the most critical and yet most difficult aspects of establishing an effective, comprehensive program. The best-designed stormwater management program is likely to founder without sufficient local support and a stable and sufficient funding source. An effective and on-going program includes planning, engineering, plan review, capital improvements, inspections, maintenance, and enforcement activities. This will often require more resources than what is typically available from general appropriations, which is the funding source used by most local governments in Virginia to fund drainage and stormwater infrastructure activities.

Local citizens often take stormwater management for granted, because the water typically runs through underground pipes that are out of sight and, therefore, out of mind. However, when individuals suffer the consequences of poorly planned or maintained control measures (flooding, enlarged stream channels, pervasive sediment damage, etc.), stormwater leaps into focus. It is important to design projects and manage the system so that no citizen has to suffer such consequences.

Therefore, ensuring sufficient program funding is an effort worthy of an effective public education and stakeholder involvement campaign. Local citizens should understand the importance of managing runoff effectively and the potential consequences of not doing so. Public education can help citizens to view stormwater management as a *service* to them, in the same way that providing and maintaining their local roads is a governmental service that has a cost attached. The next section provides an overview of various approaches that a locality can take to establish a dedicated funding source, including the creation of a stormwater utility.

Appendix 3-B

DEVELOPING AN EFFECTIVE LOCAL STORMWATER MANAGEMENT PROGRAM

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TABLES

3.B.0 INTRODUCTION

To effectively deal with the problems of urban stormwater runoff and meet the regulatory requirements addressed in Chapter 2, Virginia communities need to adopt a comprehensive approach to stormwater management that ties together stormwater quantity control with water quality protection, protection of stream channels and riparian corridors, floodplain management, and the use of stormwater facilities for multiple purposes.

Given this broad charge, the development of a local stormwater management program often involves a *rethinking* about stormwater by local communities. Those responsible for stormwater management can no longer limit their mission to drainage and flood control. Instead, local government agencies need to broaden their mission to encompass these broader goals.

Urban stormwater runoff needs to be viewed as a valuable water resource that can and should be managed within the context of the locality and watershed as a whole. Furthermore, as all of the actions within a watershed ultimately impact Virginia's downstream waters, a holistic approach to stormwater management must be developed.

Local governments have a large responsibility for stormwater management in Virginia, since it is at the local level where land use, development and infrastructure decisions are typically made. The overall purposes of a local stormwater management program are to:

- Minimize the adverse impacts of stormwater runoff on the locality and individual properties;
- Meet the state and federal regulatory requirements for stormwater runoff quantity and quality management; and
- Ensure that the locality's priorities, needs and desires are taken into account in meeting stormwater management goals.

In addition, an effective local stormwater management program requires an institutional structure that includes the following:

- Adequate legal authority
- Performance standards for development
- Design guidance and assistance
- Program funding and staffing
- Commitment to enforcement
- Public education and citizen involvement
- Accountability

This chapter provides guidance regarding what is necessary for a locality to become authorized as a qualifying local stormwater management program, or Virginia Stormwater Management Program (VSMP) Authority, and the key components that need to be addressed by a VSMP. The components include but are not limited to administrative requirements, plan review, issuance of coverage under the VSMP general permit for discharges of stormwater from construction activities, inspection, enforcement, stormwater facility maintenance, and reporting.

3-B.1 DEVELOPING AN EFFECTIVE LOCAL STORMWATER MANAGEMENT PROGRAM

Developing an efficient and effective local stormwater management program requires planning and forethought regarding a locality's needs and resources. There are four key considerations involved in establishing an effective program:

- Program Goals and Requirements
- Program Components and Priorities
- Organizational Structure and Staffing
- Program Funding

A locality must determine the best approach for implementing and building public support for the program. The goal of this section is to provide an overview of the necessary steps that must be undertaken in putting together an effective local stormwater management program.

3-B.1.1 Defining Problems, Program Goals and Requirements

The first step in building an effective and comprehensive local stormwater management program is to evaluate and document the current problems, needs, and regulatory requirements for stormwater management facing the local government. This includes the following:

- Identifying the location and magnitude of existing and/or potential stormwater-related problems, including flooding, property damage, water quality impairment, streambank erosion, and habitat degradation; and
- Determining the state and/or federal regulatory requirements that must be met by the locality.

Documenting stormwater-related problems and legal mandates can help elected officials recognize the need for a local SWM program and establish practical and legal foundations for the program. This step should ideally be performed with a team from several departments to ensure inter-agency coordination. The public should be involved through the use of a stakeholder or citizens' advisory group.

All stormwater program goals should be based on problems that are clearly recognized as being important by the general public and that can be addressed by the basic powers and responsibilities of the local government. A consensus-building approach, with citizen input, can be used to develop general program goals. These goals often reflect the following general responsibilities:

- Protect life and health
- Minimize property damage
- Ensure a functional drainage system
- Protect water quality
- Protect drinking water supplies
- Guide development
- Protect floodplain functions
- Encourage economic development
- Protect and enhance the environment
- Improve quality of life

In addition, a local government may have a number of local priorities, such as protecting fisheries and wetlands, which may become additional goals for the local stormwater management program to address.

Objectives are then formed for each key program functional area (see **Table 3.2** below), keeping the basic goals in mind. For example, a goal might be to protect streams so they maintain any beneficial uses established by the state or the locality. Objectives might include floodplain acquisition, establishing riparian buffer requirements, implementing a monitoring program, or establishing a greenway master plan. Written policies, ordinances, etc. then grow out of these objectives.

3-B.1.2 Determining Program Components and Priorities

Once stormwater needs and requirements have been identified, and goals and objectives developed, a locality can begin to formulate the activities that need to be undertaken. It is best to do this in two steps:

1. Develop overall stormwater program priorities in each of the key functional areas; then

2. Translate these priorities into actual program components with an organizational chart and implementation schedule.

Questions to ask include the following:

1. What should the major stormwater program priorities be in the next 3-5 years?
   - Priorities are developed to address program requirements and goals/objectives.
   - A special effort is made to identify specific opportunities to move in a more proactive direction rather than simply being reactive (e.g., taking ownership and focusing on broader local stormwater issues, and not just doing the minimum necessary to comply with the state requirement to adopt a program).
   - Efforts are made at anticipating future concerns not currently identified and planned.

2. How should these program priorities be translated into specific program changes or new program activities in terms of resources, manpower, and policy?
   - Specific program elements and/or changes are proposed.
   - A 3-5 year cost-of-service estimate is made to assess the ability of the local government to accomplish the program priorities under the program.
   - The needs of each program priority are also defined in terms of policy changes and tools required to implement the policy.

The various elements and activities that will be included in a local stormwater management program will vary depending on the needs, priorities and resources of the locality in question. **Section 3.1** above and **Table 3.2** below outline program elements that should be considered in a comprehensive program.

3-B.1.3 Organizing Program Structure and Staffing

The next step is to evaluate the current stormwater management activities within the locality and determine how the planned program will be handled organizationally. This includes assessing current local programs and activities that may be applicable to the stormwater management program and determining which governmental department or agency will be assigned to a program element or task. The functions that need to be addressed for a stormwater management program can be divided into the following areas:

- General Administration
- Financial Management
- Stormwater Planning and Engineering
- Capital Improvements
- Operations and Maintenance
- Regulation and Enforcement

Table 3-B.1 below can be used as an initial tool to help identify the operational or program functions needed. This table has divided a generic stormwater management program into the six major functional areas reflecting the elements that may be included in the local stormwater management program and that require financial and other resources. This chart can be used both as a starting point in locality's assessment of its stormwater program, and as a tool to seek ways to improve the program and allocation of resources and staff.

Traditionally stormwater has been the concern of drainage engineers. However, comprehensive stormwater management is a multi-disciplinary undertaking that also requires the expertise of urban planners, development specialists, transportation planners and engineers, civil engineers, landscape architects, environmental scientists, code inspectors, and many others. As such, stormwater responsibilities are often dispersed among several departments and/or organizations. These departments often work independently, and sometimes at cross purposes.

Some of the local government departments or agencies that may need to be part of the development and/or implementation of the stormwater management program and related policies include the following:

- Planning and Community Development
- Engineering
- Public Works
- Transportation/Streets
- Building/Code Enforcement
- Parks and Recreation
- Facilities and Fleet Management
- Water and Sewer Utilities
- Sanitation
- Police/Fire
- Legal
- Finance and Accounting

Table 3-B.1. Stormwater Management Functional Areas and Typical Program Components

Functional Area	Typical Program Components
Administration	General Administration Program Planning and Development Personnel Intra-Local Coordination Public Awareness and Involvement State and Federal Regulation Compliance
Billing and Finance	Financial Management and Budgeting Capital Outlay Customer Service Billing Operations (if there is a Stormwater Utility)
Stormwater Planning and Engineering	Stormwater and Watershed Master Planning Development Requirements Design Criteria and Standards (local Guidance Manual or by reference) Development Plan Review and Approval Field Data Collection Stormwater Modeling Design, Field and Operations Engineering Hazard Mitigation Retrofitting Program Zoning Support Multi-Objective Planning Support GIS and Database Management
Capital Improvements	Construction Land Acquisition Easements and Rights-of-Way Structural Control Retrofits Infrastructure Repair/Replacement Planning and Execution
Operations and Maintenance	General Routine and Remedial Maintenance Emergency Response Maintenance Street Maintenance Program Spill Response and Cleanup Infrastructure Management Public Assistance
Regulation and Enforcement	Code Development and Enforcement General Permit Administration Drainage System Inspection Drainage System Regulation Development Site Inspections Stormwater Monitoring Program Specialized Inspection Programs Zoning and Land Use Regulation Flood Insurance Program Floodplain Management Erosion and Sediment Control Program Illicit Connection and Illegal Dumping Program

Source: ARC (2001)

Table 3-B.2 shows an example of several stormwater program elements and the departments or agencies and staff members that might be responsible.

Table 3-B.2. Example of Stormwater Program and Potentially Responsible Departments and Staff

Program Element	Potential Department/Staff Responsible
Review of Stormwater Management Plans	Development Department (engineers, planners) Engineering Department (engineers, technicians)
Stormwater Quality Monitoring	Water & Sewer Department (engineers, technicians, lab analysts) Health Department (scientists, lab analysts)
Site Inspections	Development Department (inspectors, planners) Engineering Department (inspectors, engineers) Building Department (inspectors, engineers) Transportation Department (engineers, maintenance personnel)
Maintenance of Structural Controls	Public Works Department (maintenance personnel) Transportation Department (engineers, maintenance personnel)

Source: ARC (2001)

A locality's options for organizing a stormwater management program typically falls into one of three basic configurations:

- Organization within Another Department. This is a very common organizational structure for a local government. Typically, stormwater activities would be organized under an already existing agency or department, such as a public works, engineering, transportation, or utilities department that has traditionally handled drainage issues.
- Stand-Alone Organization. Some local governments have established a fully functioning stormwater management department or agency that operates independently from other departments. Funding may come from an independent source, such as a stormwater utility. These types of organizations typically have more latitude to issue revenue bonds and respond directly to stormwater-related issues.
- Array or Multi-Matrix Organization. Sometimes no formal stormwater entity exists within a local government. Instead, stormwater responsibilities are shared internally among several department or agencies. This type of organization is typical of smaller cities and counties. Some communities may also choose to hire outside contractors (e.g., the nearby Soil and Water Conservation District, Planning District Commission, or private consultant) to perform some services such as stormwater planning, plan review, engineering design or maintenance activities. These types of programs are typically funded by general revenues or impact/permit fees, and they demand careful coordination to assure effective operation..

Whether a new stormwater management department is created or existing departments handle this program, a variety of staff expertise and inter-departmental coordination will be required. It is important to develop a consensus among the various departments that provide stormwater management services in a locality regarding program goals and priorities and operational responsibilities. Any process that shifts staff, budget and responsibilities (and perhaps prestige) between managers and departments – especially those that require reorganization – require careful

attention. This may involve educating all levels of staff; directing and coaching managers who are increasing their department's size, budget and responsibilities; and reprogramming and refocusing managers who are losing staff and resources.

Since the need to organize stormwater programs rarely brings about a total governmental reorganization, communities can remedy the situation of an ineffective stormwater organization by the following methods:

- Forming an ad hoc staff committee to seek ways to work jointly and in coordination for all the various aspects and functions of the stormwater program;
- Reorganizing to the extent necessary to align programs that have primary stormwater duties;
- Assigning overall stormwater coordination duties at a level at which all authority comes together, often in the form of a stormwater manager; and
- Developing a stormwater policy and procedures document in which all significant stormwater duties and actions are outlined (often with flow charts) with defined authority, responsibility and procedures.

3-B.1.4 Funding the Program

The best designed stormwater management program will founder without sufficient local support and funding. Funding is required for both the formation and on-going operation of a local stormwater program. In terms of the long-term operation of the program, there are two key funding issues to resolve: (1) how much money is required to fund the program annually; and (2) how to support the program with a consistent and dedicated funding base.

The Center for Watershed Protection has developed a Stormwater Management Program Budgeting Tool that can assist in determining how much money will be needed to adequately fund the local program. The documentation is available online at:

http://www.cwp.org/Resource_Library/Center_Docs/SW/pcguidance/Tool2.pdf **[check link]**

The accompanying MS-Excel spreadsheet tool is available online at:

http://www.cwp.org/Resource_Library/Center_Docs/SW/pcguidance/Tool2programspreadsheet.xls **[check link]**

In Virginia, general revenues from real estate taxes have historically been the main funding source for local stormwater management activities. However, there are a number of alternative funding methods for stormwater management programs:

- Permit and/or plan review fees
- General funds
- Sale of bonds
- Loans from the Virginia Water Utilities Revolving Fund for SWM Facilities
- Establishing a pro rata share funding system
- Establishing stormwater user fee systems (known as stormwater utilities)

- Grants

Each funding approach has its own advantages and limitations. These methods are discussed below and should be explored and assessed as potential sources of revenue, based on suitability and public acceptance.

3-B.1.4.1 Permit and Plan Review Fees

Part XIII of the Virginia Stormwater Management Regulations (9 VAC 25-870-700 et seq.) establishes a schedule of fees associated with obtaining coverage under the General Permit for Discharges of Stormwater From Construction Activities (permits for stormwater management for land-disturbing activities). This is a new and dedicated source of revenue for local governments to use, as a result of the most recent revisions to the regulations.

The fees are split 72% to the local program and 28% to DEQ. These fees were established at levels that allow a local program to cover stormwater program costs. Likewise, the DEQ portion allows the Department to cover its costs of administering the statewide stormwater management program. Permit fees are established for:

- Construction activity coverage (Individual and General Permit, based on project acreage)
- Construction activity modifications or transfers (Individual and General Permit). This provision is for those permits that require significant additional administrative expenses such as additional plan reviews, etc.
- Construction activity annual permit maintenance fees (Individual and General Permit) This provision is for those projects that have not been completed and terminated within a year.

The amounts of the fees were determined based on surveys of local governments and state regulatory staff, based on the following factors:

- Amount of time and materials needed to accomplish the various elements of a stormwater management program
- The numbers of permits requested annually for different scales of construction and development
- The varying levels of effort involved at each of these scales
- The level of effort involved in DEQ oversight reviews of local programs
- Enforcement activities at both the state and local levels.

No more than 50% of the fees may be due upon application, and the remaining fee is due at issuance of coverage. A locality may establish lower fees for its program if it can demonstrate its ability to fully and successfully implement a qualifying program at a lower rate or from a different funding source. Fees may also be increased with the approval of the Virginia Soil and Water Conservation Board if the locality can show the increase is necessary to properly implement the program.

When establishing the fees, the Department did consider whether or not to add a long-term BMP inspection and maintenance component to the fee regulations. While recognizing the importance

of BMP inspections and maintenance, the Department chose to *not* include this additional cost in calculating the permit fees being paid by the development industry, for two reasons. First, longterm inspection and maintenance, although very important for the continued proper functioning of BMPs, is not directly associated with the construction process for which the permit fees are assessed. Second, other provisions of state law authorize local governments to establish stormwater utility service fees (discussed in **Section 3.2.4.6** below) to address inspection and maintenance of BMPs and other functions involved with the Regulation of stormwater.

Finally it should be noted that, in addition to the VSMP permit fees, the Virginia Erosion and Sediment Control Law and associated regulations authorize localities to establish fees to cover the costs of reviewing and approving plans for preventing erosion and sedimentation, an element of comprehensive stormwater management. Communities can therefore continue to collect these fees in addition to the permit fees described above, in order to ensure sufficient funds to administer their local programs effectively.

3-B.1.4.2 General Fund

General appropriations are the traditional way of funding most governmental programs and services. The strongest advantage of general funding is that it represents a relatively stable funding source from local taxes. However, as we have observed during the national economic crisis beginning in 2007, severe economic recessions can result in significant reductions in property values upon which local revenues are based. Recently this has resulted in a reduction in the amount of general funds available for many important programs and services in most Virginia localities. Another disadvantage is that, even when general funds are relatively stable, stormwater activities must compete with other local programs and activities for limited funds. A government which chooses to use its general fund may subject its stormwater operations to budget deliberations each fiscal year, resulting in the program having a fluctuating revenue stream and, by extension, inconsistent program implementation from year to year.

3-B.2.4.3 General Obligation Bonds

Debt financing of capital and operation and maintenance (O&M) costs can be accomplished through issuing general obligation bonds, revenue bonds, or a combination of the two. A bond issue requires voter approval on a referendum ballot and is subject to state legislative limits and local administrative policy in the form of debt ceilings. Most stormwater project debt has been financed through issuance of 15-year term bonds. These bonds are repayable from service charge proceeds, general revenues and other sources (e.g., development fees), depending on the type of debt issued.

3-B.1.4.4 Use of the Virginia Water Facilities Revolving Fund for Stormwater Management

Section 62.1-229.4 of the Code of Virginia, adopted by the General Assembly in 2010, adds stormwater management BMPs and facilities to the list of purposes for which the Virginia Water Facilities Revolving Fund may be used, subject to guidelines, terms and conditions developed by the State Water Control Board and DEQ. However, there are conditions that apply to the granting of loans from the fund for stormwater management purposes, as follows:

- Loans for stormwater management BMPs and facilities may be granted only after requests for funding needed for eligible wastewater treatment facilities/upgrades designed to meet state water quality standards have first been satisfied;
- Communities that have adopted local stormwater management pro rata share program (subject to § 15.2-2114) will then have first priority for such loans;
- Projects designed to reduce or prevent pollution in a water body in violation of state water quality standards will have second priority;
- Local governments subject to a MS4 permit will have third priority;
- Communities that have adopted local stormwater management programs (subject to § 62.1-44.15:26) will have fourth priority; and
- All others will have fifth priority.

3-B.1.4.5 Use of the Stormwater Local Assistance Fund

Through the state budget process, the 2013 General Assembly established a new fund, called the Virginia Stormwater Local Assistance Fund, as a source of matching grants to local governments for the planning, design, and implementation of stormwater best management practices that address cost efficiency and commitments related to reducing water quality pollutant loads. Moneys in the Fund must be used to meet:

- Obligations related to the Chesapeake Bay total maximum daily load (TMDL) requirements;
- Requirements for local impaired stream TMDLs;
- Water quality requirements of the Chesapeake Bay Watershed Implementation Plan (WIP); and
- Water quality requirements related to the permitting of small municipal stormwater sewer systems.

The grants must be used solely for capital projects meeting all pre-requirements for implementation, including but not limited to:

- New stormwater best management practices;
- Stormwater best management practice retrofits;
- Stream restoration;
- Low impact development projects;
- Buffer restoration;
- Pond retrofits; and
- Wetlands restoration.

3-B.1.4.6 Pro-Rata Share Program

Section 15.2-2243 of the Code of Virginia provides that if a locality has established a general improvement program for an area having related and common sewer, water and drainage conditions, the locality may provide in its subdivision ordinance for payment by a developer of land within the designated area of the pro rata share of the cost of providing the necessary facilities. The local ordinance or regulations governing the pro rata share program must establish reasonable standards for determining each developer's proportionate share of the total estimated cost of the

ultimate sewer, water and drainage facilities needed to serve the designated area, which must be developed in accordance with the local comprehensive plan. The proportionate share is limited to:

- The amount necessary to protect water quality based on the pollutant loading caused by the subdivision or development; and
- The proportion of the total estimated cost which the increased sewage flow, water flow, and/or increased volume and velocity of storm water runoff caused by the new subdivision or development bears to the total estimated volume and velocity of such sewage, water, and/or runoff from the *entire* area in its fully developed state.

In calculating the pollutant loading caused by the subdivision or development, or the volume and velocity of storm water runoff, the governing body must take into account the effect of all on-site stormwater management facilities or BMPs constructed or required to be constructed by the developer and must give appropriate credit for them.

Pro rata share payments received by the locality may be expended only for (1) necessary engineering and related studies and (2) the construction of those facilities identified in the established sewer, water, and drainage program. The payments may not be used for maintenance of stormwater facilities. The payments received must be kept in a separate interest-bearing account for each of the individual improvement programs until they are actually spent for the improvement program. The law provides for circumstances under which the interest would revert to the benefit of the property owner.

Pro rata share programs are often adopted by communities to support watershed-scale comprehensive stormwater management plans, where the funds collected are used to design and build regional-scale BMPs at designated sites in lieu of having the developers build BMPs on individual development sites within the watershed or planning area. Nevertheless, within the constraints of its authorizing language, a pro rata share program can provide a portion of the funds a locality needs to pay for its stormwater management program.

3-B.1.4.7 User Fees / Stormwater Utilities

A stormwater user fee system is a financing option that provides a stable and dedicated revenue source for stormwater management. As authorized by § 15.2-2114 of the Code of Virginia, user fees for stormwater management present an alternative to increased taxes or impact fees for the support of local program operations and maintenance, as well as the funding of other stormwater program activities. In a stormwater user fee system, stormwater infrastructure and programs are considered a public service or utility similar to wastewater and water programs that are funded on a similar basis.

The Code of Virginia allows income derived from these charges to be dedicated as special revenue and may be used only to pay or recover costs for the following:

- The acquisition of real and personal property, and interest therein, necessary to construct, operate and maintain stormwater control facilities;
- The cost of administration of such programs;

- Engineering and design, debt retirement, construction and maintenance costs for new facilities and enlargement or improvement of existing facilities, including the enlargement, improvement or maintenance of dams, whether publicly or privately owned (subject to additional provisions of law);
- Monitoring of stormwater control devices;
- Pollution control and abatement, consistent with state and federal regulations; and
- Planning and operation

Similar to water and wastewater rates, stormwater fees are assessed on users of the system based on average conditions for groups of customers with similar service requirements. Typically, fees are based on some measure of a property's impervious area (which adds to the amount of stormwater runoff that must be treated or otherwise managed). Rates may be assessed in charges per either equivalent dwelling unit (e.g., "x" dollars per EDU per month) or unit area (e.g., "x" dollars per 100 square feet of impervious area per month). Alternative methodologies include the use of a runoff factor or coefficient based on the type or category of land use, a flat fee per customer, or a combination of any of these methods. There should be a clear nexus between the amount of the fee and the problem creating the need for funding.

A stormwater utility operates similarly to water, sewer, or fire districts, which are funded through service fees and administered separately from the general tax fund, ensuring stable and adequate funding for these public services. Stormwater utilities have existed for a number of years in several states, including Virginia. Prince William County, the City of Richmond, and numerous Hampton Roads localities, among others, have established stormwater utilities.

Generally a locality enacts two ordinances to create a stormwater utility, one to establish the various components of the utility and the other to determine the rate structure. Forming the utility through two separate ordinances allows the flexibility to alter the rate structure without having to revise the ordinance governing the basic structure of the utility. The first ordinance may also include a statement of the goals of the utility. The second ordinance structures the service charges to create a logical and equitable relationship between the quantity of stormwater leaving a property, the benefits received from the stormwater system, and the amount assessed.

The stormwater utility rate should be designed to defray the costs of the service provided by the municipality. It is important that there is an equitable relationship between the amount of stormwater generated by a given property, the benefit received by the rate payer, and the corresponding fee assessed. Generally, case law suggests that a rate will be deemed valid where (1) the revenue generated benefits for the payers primarily, even if not exclusively; (2) the revenue is only used for the projects for which it was generated; (3) the revenue generated does not exceed the costs of the projects (i.e., utilities are not supposed to be profit centers); and (4) the rate is uniformly applied among similarly situated properties.

The following are features of a utility which should enhance its chances of surviving any legal challenge:

- Operation as a separate public utility (similar to a water, wastewater, or power utility);

- Detailed findings explaining why the project is needed to protect the public health, safety and welfare;
- Revenues from fees are segregated and managed as a separate fund;
- Fees are proportionate to the burden placed on the system by each class of property;
- Credits can be implemented;
- Findings and resultant fees are based upon a professional analysis; and
- An appeal process is provided.
- In Virginia, authority is included to issue general obligation bonds or revenue bonds in order to finance the cost of infrastructure and equipment for a stormwater control program.

Though they are not without significant administrative, political and potential legal hurdles, stormwater utilities are worth considering as a potential funding source for local stormwater management activities. There are numerous models in practice, and some now have decades of experience and success. **Appendix 3-E** of this chapter provides a case study regarding establishment of a Stormwater Utility in the city of Staunton, Virginia.

3-B.1.4.8 Grants

There are governmental and private sources of grant funding for which stormwater management efforts may be eligible. The upside of grant funding is that it is essentially *free* money. That is, it is someone else's money that can be used to fund your project or program, at least for a short period of time. The downside of grant funding is that it is typically a very competitive process, and a fair amount of effort is involved in identifying applicable grants and crafting proposals that are strong enough to out-compete other applicants. There is also time involved in managing the grant during its execution and providing required reports and accounting to the funding source.

Grant funding may be most appropriately used in a local SWM program to fund one-time, short-term projects, such as a base-line water quality monitoring project or establishment of a GIS network of the stormwater management infrastructure in the locality. Routine operational budgets are often not equipped to fund these kinds of projects, unless the budget has a set-aside component for the random (or long-term scheduled) project, similar to corporate research and development funds. **Table 3-B.3** provides a summary of the advantages and disadvantages of the various stormwater program funding approaches.

3-B.1.5 Implementing the Program

Once the framework for the local stormwater management program has been established, it is important to develop a plan and schedule for implementing the program. A concerted effort should be made to inform the public of the locality's stormwater management needs, of the fact that a plan of action for local stormwater management has been developed, and that all parties must share responsibility for solving the problems.

Table 3-B.3. Advantages and Disadvantages of Various SWM Program Funding Approaches

Funding Approach	Advantages	Disadvantages
Permit and Plan Review Fees	Dedicated fees that function as the core funding for local stormwater management programs. A new and substantial stream of revenue for local governments that is not dependent upon their own taxing authorities.	State sets the fee schedule in regulation and can adjust it annually based on the CPI-U, but localities have no direct control over setting the amount of the fees. The basis for these fees does not account for long-term BMP inspection/maintenance.
General Fund	Short lead time; ease of implementation. Capitalizes on existing resources; may be attached to public works, planning, or another appropriate department; existing funding base is known. If locality-wide benefits are realized, is a very equitable approach. May have more options available for funding capital projects; therefore, the cost of capital may be lower.	Initial capital outlays likely to require significant general fund withdrawal or tax increase. If funding levels increase through contributions from other programs or departments, subject to budget deliberations each year; this may impede research and maintenance activities. If funding levels increase through taxes, subject to political sensitivity of raising taxes of those who may not benefit from improvements. Success dependent on general financial health of local government. Inflexible structure for setting funding priorities – funding may not be consistent with actual program needs.
General Obligation Bonds	Covers funding needs for significant time period. Results in dedicated, known source of funds that may include funding for operating requirements. May be linked to other projects (e.g., road improvements) to improve acceptability.	Likely to require tax increase on all constituents, some of whom may not benefit from improvements. Interest, dividend and issuance costs added to total costs for the life of the payoff. Not stable enough to support all O&M indefinitely; unlikely to attract investors if not supplemented with other funding sources.
Use of the Virginia Water Facilities Revolving Fund for SWM Facilities	This provides still another new source of funding for local stormwater management BMPs and facilities.	There are significant constraints and priorities that may limit the extent to which funds are actually available for this purpose.
Use of the Stormwater Local Assistance Fund	This provides still another new and significant source of funding for local stormwater management BMPs and facilities.	There are conditions that apply to the use of competitive grants from this funding source.
Pro-Rata Share Program	In the context of a watershed management plan, a means to generate funding to support the design and construction of regional-scale stormwater control measures.	There are constraints applicable to the use of the funds collected, as well as to use of at least some of the interest generated from investing the funds prior to actual construction of planned facilities.

Funding Approach	Advantages	Disadvantages
Stormwater Utility	Stable funding source allows accurate forecasting of revenues. Link costs to damages avoided. Fees likely to be relatively low. Dedicated funding source allows flexibility in setting funding priorities, long-term strategies. Allows utility to differentiate rates based on varying levels of service, drainage basin, other specific features. Rates create incentive to protect resource. Dedicated funding source enhances ability to secure grant, bond monies for projects.	Ease of implementation and administration highly dependent on establishing equitable, cost-based user fees. Implementation, start-up time may be significant, depending on structure of public works or other existing department from which fees are administered. Proven "track record" required to issue revenue bonds; may have to rely on other sources, or "pay-as-you-go" strategy, for several years. Will require significant public education/ support building efforts to gain acceptance for level of fees to cover requirements. Administrative costs may be significant, depending on existing administrative resources.
Grants	Winning grant funds is essentially providing free money to help fund local stormwater program activities. Some grants can be sizeable and can apply over several years. Therefore, they may be appropriate for significant expenditures for one-time events, such as a monitoring project, establishment of a GIS system, or a retrofit or demonstration project.	Grant funds only become available if the locality makes the cut in the competition for the funds, so such funding is by no means assured and is typically periodic at best. Also, the criteria for specific grants may be too limiting to apply to the real needs of the local program.

Source: Adapted from ARC (2001)

In developing stormwater policy tools and procedures, a local government should make sure that any policy under consideration meets the following criteria:

- Have sufficient legal authority;
- Be consistent with other guidance;
- Be short, clear and to the point;
- Have a sound technical basis;
- Be properly staffed and supported with adequate financial resources;
- Be backed by appropriate administrative procedures and technical support;
- Be integrated into the community with appropriate training and indoctrination; and
- Be strongly enforced.

Implementation of a comprehensive stormwater management program is not a quick or painless process. It requires the commitment of the locality, trained individuals, and effective leadership to ensure that the program meets its long-term goals and objectives. Some of the elements of a "successful" stormwater management program include the following:

- Strong institutional motivation to act on the problem;
- Political and/or grassroots support for the action;
- Skilled personnel;
- A dedicated funding source;
- An environment of institutional cooperation and a long-term commitment to work together; and

- A targeting strategy or process to maximize the use of limited resources.

Effective local stormwater management programs are built upon numerous institutional, economic and technical factors. Setting up a functional program requires outlining problems and goals, determining the required program components and priorities, identifying and obtaining stable funding, and implementing the program. Finally, it should be remembered that stormwater management solutions and programs must be tailored to each locality's particular circumstances and needs.

3-B.2 REFERENCES

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Appendix 3-C

INFORMATION TOOLS FOR LOCAL STORMWATER MANAGEMENT

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3-C.1.0. INTRODUCTION

Stormwater management is becoming increasingly complex. The simple notion of collecting runoff and sending it efficiently to the nearest stream is being replaced with considerations of stormwater quantity and quality control, infrastructure management, master planning and modeling, financing, complaint and maintenance tracking, and more. Information needs are critical to a successful local program. Virginia communities need to both invest in and be aware of new and emerging technologies that can provide the ability to collect, organize, maintain and effectively use vast amounts of data and information for their community's stormwater management activities.

This Appendix covers the following information tools that can be used by a community to assist in their stormwater management program:

- Stormwater management system inventories
- Geographic Information Systems (GIS) and Databases
- Global Positioning Systems (GPS)
- Remote Sensing
- Computer Models

3-C.2.0. STORMWATER MANAGEMENT SYSTEM INVENTORIES

The development of an inventory of the stormwater system is the first step in developing a comprehensive stormwater management program. Like any other public infrastructure (water, wastewater, streets, etc.), having a knowledge of the stormwater infrastructure is important in its proper and efficient management.

Relevant information includes location and classification of storm drains; drainage networks; structural stormwater control facilities; streams, ponds and wetlands; industrial discharges and combined sewer outfalls; watershed boundaries; floodplains; existing and proposed land use and zoning; and known water quality problem areas. This information can be collected and stored on paper maps or, ideally, in an integrated municipal GIS system. For localities with MS4 permits, the inventory should distinguish between components of the system that are part of the MS4 and those that are not (public vs. private; man-made vs. natural, etc.).

Perhaps it is easiest to understand the advantages of an inventory by stating what can be accomplished when a local city or county has effective inventory information. The uses of stormwater infrastructure inventory information include:

- ***Complaint Response***. The ability to quickly and effectively respond to a customer complaint by having on-line current information linked to addresses, past history of the address, a site map when arriving on the scene, and other information.
- ***Inspection and Maintenance Management.*** This includes a wide array of functions as illustrated below in **Table 3-C.1** and other routine maintenance activities (e.g., mosquito larvae surveillance, inlet cleaning, BMP inspections and repairs, MS4 outfall inspections, complaint responses, etc.).

Table 3-C.1. Stormwater Infrastructure Inventory Information & Uses

	Basic Information					Geometry			Condition							Admin./Mgmt. Info.				
	element number	element type	location	elevation	connectivity	size	geometry information	digital picture	material type	age	structural condition	maintenance condition	environmental condition	upstream land use	adjacent flooding potenti	ownership	complaints	utility credits	easement	past activity
initial complaint response	X	X	X						X		X	X		X	X	X	X		X	X
maintenance management	X	X	X		X	X	X	X	X	X	X	X	X			X	X		X	X
remedial construction	X	X	X	X		X	X	X	X		X	X		X			X		X	X
capital construction	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X		X	X
inventory control	X	X				X	X		X	X										
master planning	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X
financial tracking	X		X													X	X	X	X	X
material testing	X	X	X			X		X	X	X	X	X	X			X	X			X
legal support information	X	X	X											X		X	X	X	X	X
regulatory control	X	X	X			X		X					X	X	X	X	X		X	X

- ***Remedial Construction***. Quick turn-around construction on minor systems or minor repairs to larger systems which require little design time and would be handled with unit cost open-ended contracts.
- ***Capital Construction.*** Programmed construction of larger items handled with pay as you go or bonded capital funds.
- ***Inventory Control.*** Handling of drainage structures and spare parts in storage locations and warehouses.
- ***Master Planning***. System-wide analysis and planning of capital construction for problem areas and for areas facing new development.
- ***Financial Tracking***. Tracking of costs, efficiencies, crediting information, assessments, etc.
- ***Materials Testing***. Tracking of the age and relative life-cycle costs of different materials.
- ***Legal Support Information***. Tracking of easements, ownership, complaints, and other legal information.
- ***Regulatory Control.*** Including NPDES/VPDES/TMDL monitoring reports, easements, permitting, negotiating requirements for new developments, flood insurance program, floodplain management, erosion control, permits issued, and other regulatory issues.

For each of these applications, information from an inventory serves as the basis for the program function. For example, knowing pipe sizes and general condition allows for long term budgeting and capital planning. Without this information, the city or county is left to simply respond on a reactive case-by-case basis to needs and complaints as they occur.

3-C.2.1. Organizing Information

Organizing an inventory can become a complex undertaking. Considerations should include (1) types of structures inventoried; (2) type of information needed; and (3) program/purpose for collecting the information.

The following are stormwater infrastructure components that can be included in a system-wide inventory:

- Streams and rivers
- Ditches
- Pipes
- Culverts
- Manholes
- Outfalls
- Inlets
- Bank or stream protection
- Stream enhancement
- Greenways, corridors
- Junctions
- Stormwater controls
- Detention ponds
- Dams
- Other structures
- Easements
- Floodplains
- Floodways
- Adjacent structures
- Waters of the state
- Drainage area to regulated outfalls
- Other

The type of information collected about stormwater infrastructure falls into several categories Including the following:

- Structure type (e.g., channel, BMP)
- Purpose (e.g., water quantity or quality)
- Size
- Drainage area served/treated by BMP
- Material type
- Maintenance condition
- Structural condition
- Elevation
- Connectivity
- Age
- Complaints
- Utility credits
- Geometry information
- Location

Integrating the information collected for each component with the uses of the information is the next step in an infrastructure inventory. **Table 3-C.1** above depicts an example chart that lists of functional uses of inventory information and the types of information necessary to support those uses.

3-C.2.2. Conducting the Inventory

The following items should be considered before undertaking a stormwater system inventory:

1. ***Determine who will use the inventory information and what specific types of information and accuracy are required.*** For example, if the information on street location simply needs a general location of streets then a street centerline file would suffice. But if the actual edges of

pavement are required, a much greater level of complexity is involved including aerial photography and ground surveys. It is critically important to bring all stakeholders into the discussion of data needs, both for cost sharing and to make sure the data is sufficiently accurate for its most stringent use.

2. ***Determine the types of data and the methods of data collection***. It is important to insure accuracy in the collection, storage, and maintenance of the information. In many instances new technology is available for some data and information. Data may already be available from a government agency (such as land use information from other aerial flights or satellite imagery). There is always a tradeoff between the use of new technology and the opportunity for it to either fail or for unknown errors to be introduced due to lack of familiarity with the technology. Inefficient use of GPS has been an example of this, where some inventories have ended up being more expensive than conventional surveying when the extra time needed to restore lost satellite lock and for training is factored in.

3. ***Determine the technology and organizational responsibilities that will be used to store and maintain the data***. What types of hardware and software are necessary to collect and manipulate the information? Who will have access to the information and for what purposes? How will it be maintained and by whom? How will the costs be allocated?

4. ***Collect the data and information***. Quality assurance is paramount. A single simple error repeated consistently over and over can render the whole data effort fruitless. Checks should be made for random errors, systematic errors, blunders, and system assumption errors.

   - ***Random errors occur due to both human error and the inability of equipment to accurately read information***. They tend to vary around the correct value both high and low. These can be taken into account in planning for the use of the data, and minimized through repeated readings.
   - ***Systematic errors are consistent ways to doing something, but doing it wrong***. Systematic errors always render a reading high or low, and can be very dangerous. Close supervision at the beginning of the inventory should smoke out most of these types of errors.
   - ***Blunders occur when a reading is simply wrong, and wrong to the point that the information is way off the mark***. Blunders can usually be caught by error checking software during the input process (i.e. automated out of bounds checking) or during graphical plotting of information to check for outliers.
   - ***System assumption errors are those errors introduced during the planning of the inventory, when the planner simply makes a mistake on specifying how equipment is to be used or data read***. A simple example of this might be the assumption that a certain datum is correct when it is in error.

5. ***Store and test the data***. Make sure it is accessible. Develop the data access software and programming. Concentrate on the procedures for data handling and access. Collect and manipulate trial data first, when possible, to make sure the system works as planned.

6. ***Maintain the data***. Make sure that responsibilities for data updates have been assigned and budgeted. Procedures which are triggered by changes in the specific data (such as subdivision approval or use and occupancy permit issuance) should be set up and worked out.

7. ***Develop and foster applications of the data***. Data is only as good as the use that is made of it. Therefore it is vitally important that applications are developed for easy use of the inventory data and that a pool of potential users is trained in their use. Those applications envisioned early in the process should be quickly brought on line. The greater amount of time that passes after the inventory, the less chance there is that full use of the information is ever made. One key application will be to use the system to "mine" and organize data needed for required reports to state and federal regulators, as well as to local officials.

3-C.3.0. GEOGRAPHIC INFORMATION SYSTEMS

A Geographic Information System (GIS) is a collection of components designed to collect, process, store, analyze, and display geographic data. GIS software stores information about a given area as a collection of thematic layers that can be linked together by geography or geo-referencing. This simple but extremely powerful and versatile concept has proven invaluable for solving many real-world stormwater problems, from tracking complaints to master planning applications and infrastructure management.

3-C.3.1. GIS Components

A functional GIS integrates four key components: hardware, software, data, and trained users:

- ***Hardware.*** Desktop computers and data servers are the primary hardware components of a typical local GIS system.
- ***Software.*** GIS software provides the functionality and tools needed to capture, store, analyze, display, and output geographic information. It links the spatial view of data with the database table entries.
- ***Data.*** Generally the most costly part of a GIS is data development. Some geographic data and related tabular data can be collected in-house or purchased from commercial data providers. A GIS can also integrate tabular data, such as computer aided design (CAD) data and digital imagery, to build information into the GIS database.
- ***Users.*** GIS technology is of limited value without trained operators who understand the data, system, organization and how to apply the resources to achieve the desired results. This technology tends to change and improve rapidly, so periodic training updates should be factored into system administration and use.

3-C.3.2. GIS Functions

General purpose geographic information systems essentially perform the following six processes or tasks.

3-C.3.2.1. Data Input

Before geographic data can be used in a GIS, the data must be converted into a suitable digital format. The process of converting data from paper maps or non-coordinate-controlled images into computer files is called digitizing. Modern GIS technology can sometimes automate this process using scanning technology; but most jobs may require some form of manual digitizing to capture clean data. Today many types of geographic data already exist in GIS-compatible formats. These data can be obtained from a number of different sources including local and regional government agencies, the federal government, and state agencies such as the Virginia Geographic Information Network (VGIN) (http://gisdata.virginia.gov/Portal/).

3-C.3.2.2. Data Conversion

It is likely that some needed data may not be in the correct format or proper map projection to use with your system. Most GIS software has the ability to do this conversion. If yours cannot, then try requesting the data in a format you can use rather than hope it will be compatible. In some cases you may need the services of a contractor who specializes in GIS. Be careful with third party data; it is imperative that you understand the source, quality, age, accuracy and limitations of a dataset. This and other information about a dataset is often provided in the metadata that accompanies the dataset. While most data providers automatically make the metadata available, that is not always the case. Therefore, it is wise to request the accompanying metadata when you request any dataset.

3-C.3.2.3. Query and Analysis

Once there is a functioning GIS containing geographic information, and assuming that you have collected the necessary information and data, the system can be used to answer questions such as the following:

- Who owns the land parcel being flooded?
- What is the distance between two stream locations?
- Which homes are located in the updated floodplain?
- How will the new development impact downstream properties?
- What types of infrastructure give us the most complaints and where are they located?
- When was a particular BMP last inspected/maintained?
- What is the nearest access point to a section of broken/clogged pipe?

GIS provides both simple point-and-click query capabilities and sophisticated spatial analysis tools to provide timely information to stormwater managers and analysts alike. GIS technology can also be used to analyze geographic data to look for patterns and trends and to undertake "what if" scenarios. Most modern GISs have many powerful analytical tools including:

- ***Measurement Capabilities.*** Allows the measurement of areas and distances not specifically recorded in the databases (e.g., what is the distance between two culverts?)
- ***Proximity Analysis.*** Determines relationships between objects and areas (e.g., who is located within 100 feet of the streambank?)

- ***Overlay Analysis.*** Performs integration of different data layers (e.g. what is the NRCS curve number for this sub-watershed, considering soils, and land use?) **Figure 3-C.1** below illustrates the overlay concept.
- ***Network Analysis.*** Analyzes the connectivity of linear features and establishes routes or direction of flow (e.g. which pipes feed into this junction box?)
- ***Raster Analysis.*** Uses a raster model to address a number of hydrologic issues (e.g. what does the 3-D model of this watershed look like? Where does the water flow?)

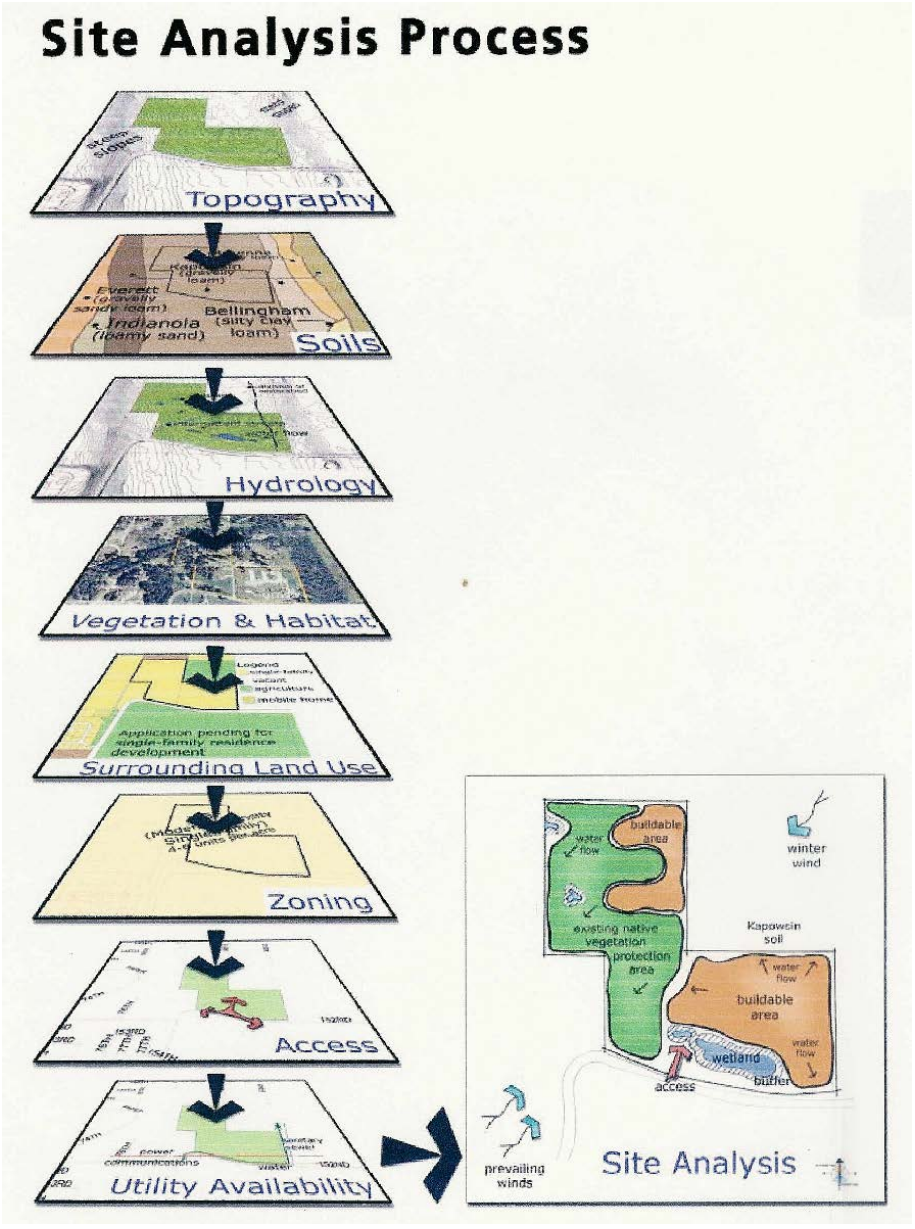

Figure 3-C.1. Example of a GIS Overlay Analysis
Source: Puget Sound LID Technical Manual (2005)

3-C.3.2.4. Data Display, Output and Visualization

Geographic information systems excel at being able to create rich and detailed maps, graphs and other types of output which allow local staff, elected officials and the general public to be able to visualize and understand complex problems and large amounts of information. These maps and charts can be integrated with reports, three-dimensional views, photographic images, and multimedia presentations.

3-C.3.3. Use of GIS in Stormwater Management

3-C.3.3.1. Types of Uses

GIS can be useful to a community in a wide variety of stormwater-related applications:

- GIS can be used for the mapping of surface features, land uses, soils, rainfall amounts, watershed boundaries, slopes, land cover, etc.
- A GIS can manage a stormwater system inventory and information about facility conditions, storm sewer networks, maintenance scheduling, and problem areas.
- GIS can be used to automate certain tasks such as measuring the areas of subwatersheds, plotting floodplain boundaries, or assessing stormwater utility fees. **Figure 3-C.2** shows an example of automated hydrologic mapping.

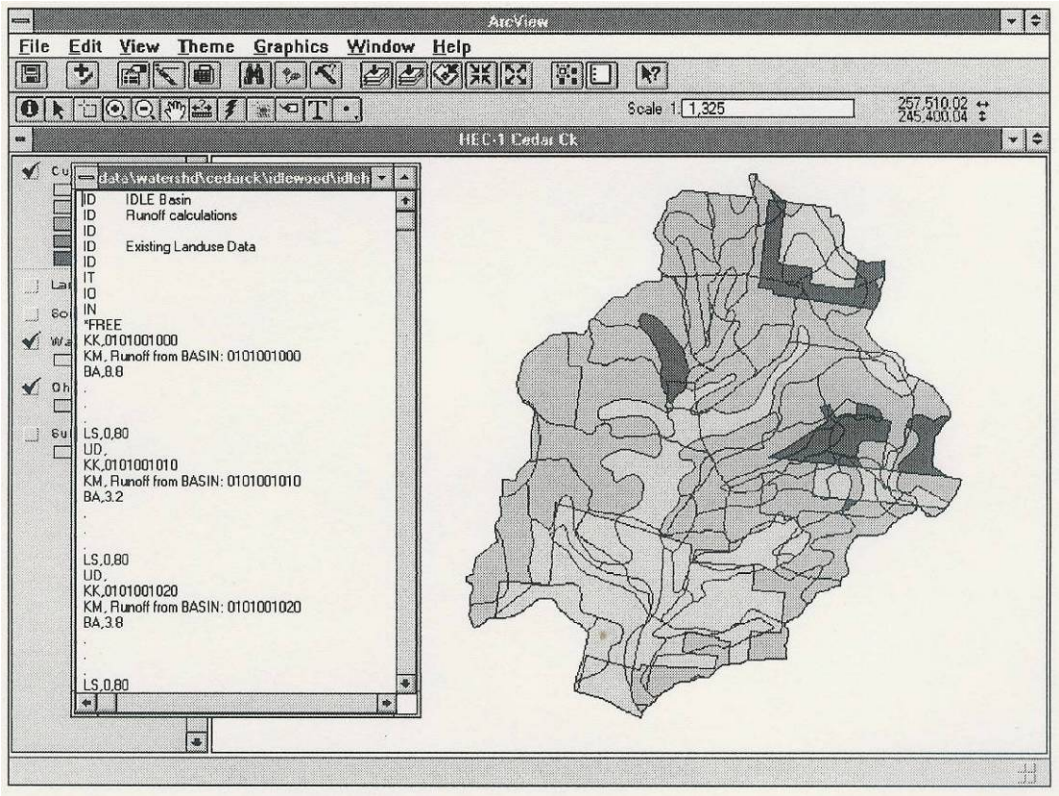

Figure 3-C.2. Automated Hydrologic Modeling
Source: ARC (2001)

- A GIS can be used to evaluate water quality impacts and answer cause and effect questions, such as the relationship between various land uses and in-stream pollution monitoring results.
- "What if" analyses can be undertaken with GIS. For example, various land use scenarios and their impacts on pollution or flooding can be tried in various combinations to determine the best management solutions or to determine the outcome of current decisions. When tied to hydrology, hydraulics and/or water quality models, this type of analysis becomes a powerful tool to assess the impacts of new development on downstream properties. For example, **Figure 3-C.3** shows the flooding impacts on a small tributary for a proposed new development approved during a rezoning.

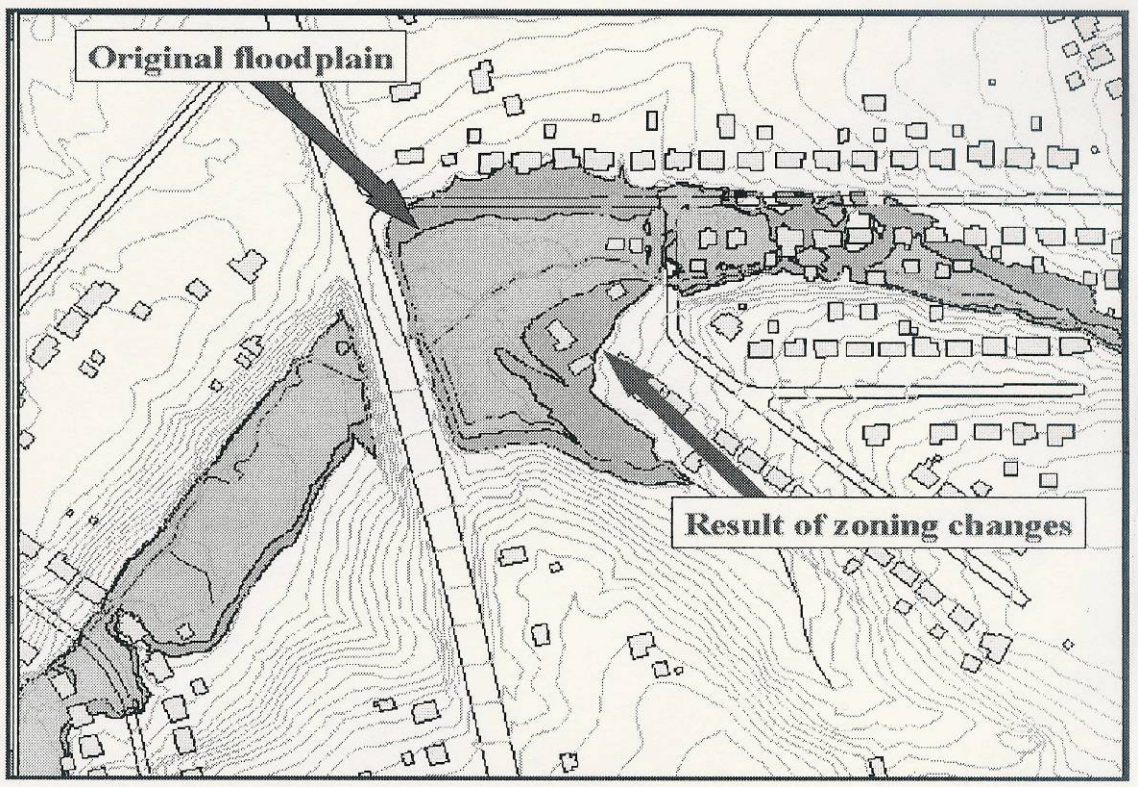

Figure 3-C.3. Use of a GIS to Map Current and Potential Floodplains & Flood-Prone Homes
Source: ARC (2001)

Figure 3-C.4 below is an image from a commercial GIS application displaying, in this case, an inventory of storm sewer system maintenance.

- GIS databases can provide staff, elected officials, and citizens with immediate answers and ready information. For example, inventory, complaints and other information about stormwater infrastructure (including pictures) can be placed in a database tied to geographic location. Henrico County is an excellent example of a locality that has developed this kind of GIS capability.
- Complex problems or changes over time, such as water quality improvements, can be easily visualized in maps and graphs generated by GIS systems.

- GIS maps can be used to educate or persuade citizens and political leadership concerning a course of action or a project's viability.

Figure 3-C.4. Commercial GIS Application Showing Storm Sewer Maintenance
Source: *Storm Water Solutions* (Mar-Apr 2010)

3-C.3.3.2. Implementation Issues

Communities often make the mistake of making enormous expenditures on data, hardware and software and databases but little on planning, staff familiarization, training and graphical user interface (GUI) and applications development. The end result is often an unusable system accessible by only a few who have the resources both to learn the system, hire competent staff, and develop applications. It is often better to target the GIS implementation to certain needs and quickly roll out applications that work for these needs, even prior to the complete development of the database and overall system.

Proper implementation of GIS applications for stormwater management involves planning for both stormwater-only applications and to integrate these applications with other potential users within the municipality.

3-C.3.4. Other Related Technologies

GIS is closely related to several other types of information systems, and can be used with these other information tools, including the following.

3-C.3.4.1. CAD

Computer-Assisted Design (CAD) systems evolved to create designs and plans of buildings and infrastructure. The systems are designed to do very detailed drafting and drawing but have only limited capability to attach data fields to the electronic drawing. As a result these systems do not have the capability to perform spatial analysis. Fortunately these drawings can be input to a GIS, saving significant digitizing efforts. Once in a GIS, attribute data can then be added to the graphic features.

3-C.3.4.2. Database Management Systems (DBMS)

Database Management Systems specialize in the storage and management of all types of data including geographic data. DBMSs are optimized to store and retrieve data, and many GISs rely on them for this purpose. They do not typically have the analytic and visualization tools common to GIS.

3-C.3.4.3. SCADA

SCADA stands for Supervisory Control and Data Acquisition System. These systems combine the ability to monitor information (e.g. rainfall, stream flow, flood level, etc.) remotely through telemetry. SCADA systems can also execute commands to do such things as open gates or close valves from a distance. Examples of the use of SCADA include automating stormwater pump station operation, automated alarms for flood warning, automated triggering of flow and water quality monitoring devices, and automated lowering of traffic control barrier arms during high water periods. SCADA systems can be combined with GIS to create comprehensive tracking systems.

3-C.4.0. GLOBAL POSITIONING SYSTEMS

The Global Positioning System (GPS) is a space satellite-based radio positioning system for obtaining accurate positional information for mapping or navigational purposes. GPS is made up of three distinct parts:

- ***Satellites***. A constellation of 24 satellites orbiting the earth continuously emit a timing signal, provided by an on-board atomic clock, which is used to calculate the distance from each satellite to the receiver.
- ***Receiver.*** A GPS receiver located on the ground converts satellite signals into position, velocity, and time estimates.
- ***Ground Control.*** The U.S. Department of Defense (DOD) developed and currently manages the maintenance of the satellite system. The DOD uses tracking antennas to constantly monitor the precise position of the NAVSTAR satellites. These positions can be used to correct for errors in the calculated positions of the roving receivers.

The GPS was built and is maintained by the U.S. government. The satellites orbit at an altitude of approximately 12,000 miles in a 12-hour pattern that provides coverage to the entire earth. The system is capable of serving an unlimited number of users free of charge.

A GPS receiver uses information from at least 4 of the 24 satellites to precisely triangulate its position on the earth. Depending on the quality of GPS receiver being deployed, captured coordinate location accuracy can be from within 10 meters to within just centimeters of true ground location. If a receiver cannot "see" four satellites, it can calculate a less-accurate estimate based on three satellites. Virtually all GPS receivers display basic positional information including latitude, longitude, elevation and speed (if moving). Most receivers also display time, heading, the number of satellites in view, where those satellites are positioned in the sky, and signal quality. GPS receivers for data collection can collect both the location (coordinates) and the attribute data of a given geographical feature.

3-C.4.1. GPS Application to Stormwater Management

Stormwater infrastructure inventories can be conducted more easily and in far less time using GPS. In the past, traditional geodetic surveying was used to locate and map stormwater system components. A transit survey requires traversing between a known point to the point of interest, which may take half to one day per point. GPS surveying is much more efficient, possibly taking as little as a few seconds to map each point. Using bicycle or car-mounted equipment, a community may be able to survey up to 500 points per day.

GPS inventory work can be integrated with GIS application software. For example, a GIS layer of structural control locations can be created using GPS data and linked to a maintenance database. GPS data can also be used in computer modeling activities for stormwater management. For instance, GPS data can be used to create a ground surface for automated stream floodplain modeling and mapping.

3-C.5.0. REMOTE SENSING

Remote Sensing is a technique for collecting observations of the earth using airborne platforms (airplanes and satellites) that have on-board instruments, or sensors. These sensors record physical images based on light, temperature or other reflected electromagnetic energy. This sensor data may be recorded as either analog data, such as photos or digital image data. **Figure 3-C.5** gives an example of low- (25-meter), medium- (5-meter) and high- (1-meter) resolution satellite imagery.

Figure 3-C.5. Low-, Medium- and High-Resolution Satellite Imagery
Source: Space Imaging, Inc. and ARC (2001)

Ground reference data is then applied to aid in the analysis and interpretation of the sensor data, to calibrate the sensor, and to verify the information extracted from the sensor data. Remotely sensed images have a number of advantages to on-the-ground observation, including the following:

- Remote sensing can provide a regional view.
- Remote sensing can provide repetitive looks at the same area over time.
- Remote sensors "see" over a broader portion of the electromagnetic spectrum than the human eye.
- Sensors can focus on specific bandwidths in an image and can also look at a number of bandwidths simultaneously.
- Remote sensors often record signals electronically and provide geographically referenced data in digital format.
- Remote sensors operate in all seasons, at night, and in bad weather.

The airborne platforms that carry remote sensing instruments can be any kind of aircraft or satellite observing the Earth at altitudes anywhere from a few thousand feet to orbits of hundreds of miles. Satellites may employ a variety of sensors for numerous of applications. Currently, no single sensor is sensitive to all wavelengths. All sensors have fixed limits of spectral sensitivity and spatial sensitivity, the limit on how small an object on the earth's surface can be seen. The common type of sensors aboard satellites include the following:

- ***Multispectral Scanner (MSS) Sensors***. Data are sensed in six spectral bands simultaneously: visible (green and red), UV, near-infrared (IR), mid-IR and thermal.
- ***Thematic Mapper (TM) Sensors.*** Data are sensed in seven spectral bands simultaneously: visible (blue, green, red), near-IR, and two in mid-IR. The seventh band detects only the thermal portion of the spectrum.
- ***Radio Detection and Ranging (RADAR).*** Examples are Doppler radar systems used in weather and cloud cover predictions.
- ***Light Detection and Ranging (LIDAR).*** Lasers are beamed to the ground and the return time is measured to capture detailed terrain images.

The appropriate band or combination of MSS bands should be selected for each interpretive use. For example bands 4 (green) and 5 (red) are usually best for detecting cultural features such as urban areas, roads, new subdivisions, gravel pits, and quarries. The TM bands are more finely tuned for vegetation discrimination than those of the MSS due in part to the narrower width of the green and red bands.

Examples of remote sensing satellites include the early U.S. LandSat satellites, the Indian Remote Sensing (IRS) satellites, Canada's RADARSAT, and the European Space Agency's Radar Satellite, as well as more recent higher resolution satellites from a number of private companies. Images from these satellites have spatial resolutions ranging from approximately 30 meters to sub-meter, and they may capture different parts of the electromagnetic spectrum. Therefore, the choice of satellite imagery must be made with consideration of the precision needs of the application.

3-C.5.1. Digital Orthophoto Quarter Quadrangles

Digital orthophoto quarter quadrangles (DOQQs) combine the image characteristics of a photograph with the geometric qualities of a map. Unlike standard aerial photography, relief displacement in orthophotos has been removed, displaying ground features in their true ground position, thus allowing for direct measurement of distance, area, angles, and positions. They also are placed in a real-world coordinate system, allowing for the collection of coordinates from them in a heads-up digitizing mode (on the computer screen) and to be overlayed with other spatial data in a GIS. **Figure 3-C.6** is a DOQQ of the Virginia State Capitol campus in Richmond.

Figure 3-C.6. Example of a DOQQ: Virginia State Capitol Campus
Source: Virginia Base Mapping Program

All Virginia localities have access to recent high resolution imagery (1-foot to 6-inch pixels) through the Virginia Base Mapping Program. This imagery is now being collected in two-year cycles. More information about this image product and how to acquire it can be found at the following web site: http://gisdata.virginia.gov/Portal/ptk?command=openchannel^channel=24 .

3-C.5.2. Remote Sensing Applications for Stormwater Management

Satellite imagery offers a diverse set of mapping products for projects ranging from land use/land cover evaluation to urban and regional planning, tax assessment and collection, and growth monitoring. In the case of stormwater runoff, multispectral imagery can be used to measure impervious surfaces, such as rooftops, streets, and parking lots. Pervious surfaces, such as tree and grass-covered areas can also be measured or delineated. Applying runoff coefficients to the area of each surface type can provide the best available estimates for nonpoint source water pollution. By adding parcel boundaries, it is possible to provide estimates of runoff per parcel in order to calculate stormwater user fees. Similarly, designated land use categories can be applied to the area of each surface type and, in combination with known soil type data, can be used to calculate hydrologic curve numbers. Flood boundaries can be measured within a few meters accuracy in areas without tree cover, using sub-meter multispectral fused imagery. Individual buildings and parcel boundaries can also be identified in order to assess flood vulnerability.

3-C.6.0. COMPUTER MODELS

There is a great deal of computer software that has been developed based on intensive research efforts in urban hydrology, hydraulics and stormwater quality. Computer models use the computational power of computers to automate the often tedious and time-consuming manual calculations. Most models also include extensive routines for data management, including input and output procedures, and possibly including graphics and statistical capabilities.

Computer modeling became an integral part of storm drainage planning and design in the mid-1970s. Several agencies undertook major software development projects, and these were soon supplemented by a plethora of proprietary models, many of which were simply variants of the originals. The proliferation of personal computers in the 1990s has made it possible for virtually every engineer to use state-of-the-art analytical technology for purposes ranging from analysis of individual pipes to comprehensive stormwater management plans for entire cities.

In addition to the simulation of hydrologic and hydraulic processes, computer models can have other uses. They can provide a quantitative means to test alternatives and controls before implementation of expensive measures in the field. If a model has been calibrated and verified at a minimum of one site, it may be used to simulate non-monitored conditions and to extrapolate results to similar ungauged sites. Models may be used to extend time series of flows, stages and quality parameters beyond the duration of measurements, from which statistical performance measures then may be derived. They may also be used for design optimization and real-time control.

A local staff or design engineer will typically use one or more of these pieces of software in stormwater facility design and review, according to the design objectives and available resources. However, keep in mind that proper use of computer modeling packages requires a good knowledge of the operations of the software model and any assumptions that the model makes. The engineer should have knowledge of the hydrological, hydraulic and water quality processes simulated and knowledge of the algorithms employed by the model to perform the simulations.

3-C.6.1. Types of Models

In urban stormwater management there are typically three types of computer models that are commonly used: *hydrologic*, *hydraulic* and *water quality* models.

- ***Hydrologic Models*** attempt to simulate the rainfall-runoff process to tell us "how much water, how often." They use rainfall information or models to provide runoff characteristics including peak flow, flood hydrograph, and flow frequencies.
- ***Hydraulic Models*** take a known flow amount (typically the output of a hydrologic model) and provide information about flow height, location, velocity, direction and pressure.
- ***Water Quality Models*** simulate the various processes and interactions of stormwater pollution. Water quality models have been developed with an ability to predict loadings of various types of stormwater pollutants.

There are also a number of other specialty models to simulate any number of ancillary topics (some of which are sub-sets of the three main categories) including sediment transport, scour, lake quality, dissolved oxygen, channel stability, evapotranspiration, etc.

3-C.6.2. Model Applications

Stormwater computer models can also be categorized by their use or application:

- ***Screening level models*** are typically equations or spreadsheet models that give a first estimate of the magnitude of urban runoff quality or quantity. At times this is the only level that is necessary to provide answers. This is true either because the answer needs to be only approximate or because there is no data to justify a more refined procedure.
- ***Planning level models*** are used to perform "what if" analyses comparing in a general way design alternatives or control options. They are used to establish flow frequencies, floodplain boundaries, and general pollution loading values.
- ***Design level models*** are oriented toward the detailed simulation of a single storm event for the purposes of urban stormwater design. They provide a more complete description of flow or pollution values anywhere in the system of concern and allow for adjustment of various input and output variables in some detail. They can be more exact in the impact of control options, and tend to have a better ability to be calibrated to fit observed data.
- ***Operational models*** are used to produce actual control decisions during a storm event. They are often linked with SCADA systems described earlier. They are often developed from modified or strongly calibrated design models, or can be developed on a site specific basis to appropriately link with the system of concern and accurately model the important physical phenomena.

3-C.6.3. Basic Computer Modeling Principles

The following basic principles apply to all forms of computer modeling:

- All computer models require site-specific information to be supplied by the user. Inputs are the measured or estimated parameters the model needs to make calculations. For example, for basic hydrologic models it might include: area, slope, land use, channel forms and roughness, connectivity, and rainfall. A basic hydraulic model would include: channel slope, discharge, roughness, shape, obstructions or constrictions, and connectivity. Water quality models may add pollution loading or build-up-washoff factors, and fate and transport information. All models, for planning and design, allow the modeler to try different combinations of variables to see what happens (called a “what if" analysis).
- While modeling generally yields more information, simpler methods may provide sufficient information for design or solving management issues. In general, the simplest method that provides the desired analysis should be used. The risk of using a more complex (and presumably "better") model is that it requires more expertise, data, support, etc. to use and understand, with a consequent higher probability of misapplication.
- If water quality problems are being considered, it still may not be necessary to simulate quality processes, since most control strategies are based on hydrologic or hydraulic considerations. Quality processes are very difficult to simulate accurately. If abatement strategies can be developed without the simulation of water quality parameters, the overall modeling program will be greatly simplified.

Models sometimes may be used to extrapolate beyond the measured data record. It is important to recognize, however, that models do not extend data, but rather generate simulated numbers that should never be assumed to be the same as data collected in the field. Careful consideration should be given when using models to provide input to receiving water quality analyses. The quality response of most receiving waters is relatively insensitive to short-term variations. In many instances, the total storm load will suffice to determine the receiving water response. Simulation of short-time increment changes in concentrations and loads is generally necessary only for analysis of control options, such as storage, or high-rate treatment, for which efficiency may depend on the transient behavior of the quality constituents.

3-C.6.4. Selecting the Appropriate Computer Model

Models can be simple, representing only a very few measured or estimated input parameters or can be very complex involving 20 times the number of input parameters. The “right” model is the one that: (1) the user thoroughly understands, (2) gives adequately accurate and clearly displayed answers to the key questions, (3) minimizes time and cost, and (4) uses readily available or collected information. Complex models used to answer simple questions rarely provide an advantage. However, simple models that do not model key necessary physical processes or that involve arguable data inputs are useless.

Appendix 11-D of Chapter 11 of this Handbook provides additional information and guidance for local governments and engineers on computer models for stormwater management modeling and design.

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Appendix 3-D

LOCAL CODE AND ORDINANCE REVIEW AND EVALUATION

Table of Contents

Appendix Section Headings

LIST OF TABLES

3-D.1.0. INTRODUCTION

The language, policies and requirements in local land development codes drives development patterns. Developers are constrained to follow the local requirements (and sometimes state requirements, such as subdivision street design criteria, that are passed down to localities).

While some land developers hold to more traditional development models, others are now pursuing Low Impact Development (LID) and Environmental Site Design (ESD) concepts, recognizing that doing so not only protects natural resources but avoids future problems such as inadequate space for necessary best management practice facilities. However, they often find that the more traditional local codes prevent them from incorporating many of the best design practices. It is also important to note that eliminating obstacles to ESD techniques through local ordinance amendments is a key component of an effective local stormwater management program, since various Runoff Reduction techniques cannot be implemented on development sites if local land use ordinances don't allow their use. This situation pushes the site designer toward the use of the more traditional on site detention and retention basins and away from the protection of natural areas to reduced runoff. Because of the amount of money involved to complete land development projects, minimizing the time involved is very important. For that reason, developers understandably prefer to take the path of least resistance. If localities don't provide incentives to do things in better ways or, much worse, put up impediments to using better practices, then developers will continue to do things in ways that are tried and true for them.

As noted in **Section 6.4** of **Chapter 6** of this Handbook, some local codes actually discourage or prohibit the use of LID and ESD practices and techniques. In other cases, local development review authorities are hesitant to approve innovative LID and ESD techniques, due to their unfamiliarity and lack of a locally demonstrated effectiveness. In a recent survey, the Center for Watershed Protection asked respondents to identify the three most common impediments to implementing LID and ESD principles within their jurisdictions. **Table 3-D.1** displays the top issues that make it difficult for developers to employ some of the best and most sustainable approaches to site design and BMP implementation.

Table 3-D.1. Barriers to the Use of LID and Environmental Site Design Techniques

What are the 3 most common impediments to implementing LID and ESD in your community?		
Answer Options	**Response Percent**	**Response Count**
Developers seek to maximize development of the parcel	87.1%	27
Developers seek to achieve minimum local requirements	54.8%	17
Standard design template (e.g., "cookie cutter" development	54.8%	17
Not part of current regulations	51.6%	16
Training needed to better understand situations where ESD is applicable or where ESD techniques can be implemented	22.6%	7
Regulations restrict more innovative practices (e.g., curb and gutter requirements prohibit open-section streets and roads)	19.4%	6
Existing and/or dated regulations limit flexibility	16.1%	5
Limited staff or resources to change existing practices and to discuss options	12.9%	4
Review process limits time with client/developer (no pre-construction meeting)		

Source: CSN and CWP (2010)

These problems must be addressed in order to gain widespread acceptance and adoption of LID and ESD techniques. Communities may also need to carefully reevaluate their local codes and ordinances to overcome barriers to LID and ESD.

Code and Ordinance Worksheets allow an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development is accomplished in a community. The Worksheets guide on through a systematic comparison of local development rules with the model development principles (Environmental Site Design practices and Sustainable Site principles discussed in this chapter). Institutional frameworks, regulatory structures and incentive programs are included in such a review. These Worksheets consist of series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks associated with the Environmental Site Design benchmarks.

The Worksheets provided in this Appendix are intended to guide the user through the first two steps of a local site planning roundtable:

Step 1: Inventory the land use ordinances within the locality code.

Step 2: Determine how these requirements may conflict with LID, ESD and the Runoff Reduction approach fostered by the Virginian Stormwater Management Program (VSMP) Regulations.

This type of evaluation helps to identify which local development rules are potential candidates for change.

3-D.2.0. PREPARING TO COMPLETE A CODE AND ORDINANCE WORKSHEET

The initial and key task that needs to be performed before beginning to use a Worksheet is to identify all the development rules that apply in the locality. A team approach may be helpful, involving the locality's local VSMP program administrator, a site plan reviewer, a staff planner, and the locality's attorney. Their real-world experience with the development process is often very useful in completing the Worksheet. In addition, there are some watershed-focused non-profit organizations that have experience and can provide assistance in such reviews, and DEQ staff also may be able to provide advice and assistance.

3-D.2.1. Indentify the Development Rules

The first step is to assess existing development codes and ordinances and then, compared with the principles of LID and ESD, to identify which ones may need changing. A Codes and Ordinances Worksheet helps a locality systematically compare their existing development requirements to the recommended ESD techniques by asking specific questions regarding how development actually occurs in the locality. To use the worksheet, localities assemble all local and state ordinances that collectively govern how development occurs in the community, including documents such as:

In some cases, information on a particular development rule may not be explicitly articulated in local code or may be hidden in supporting design manuals, review checklists, or as an unwritten review policy. Once current development rules and regulations are identified, the codes and ordinances worksheet can be completed. The CWP's Worksheet consists of 66 questions that compare local development rules against their 22 Better Site Design principles (CWP, 1998). Each question focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. Points are awarded if local development rules agree with the benchmark for a particular site design practice. In some instances, local codes and ordinances might not explicitly address a particular practice. In these cases, evaluators should use appropriate judgment based on standard community practices.

- Zoning Ordinance
- Subdivision Ordinance
- Comprehensive Land Use Plan
- Green Infrastructure Plan
- Street Standards or Road Design Manual
- Parking Requirements (these are often contained in a local zoning ordinance)
- Building and Fire Regulations/Standards
- Stormwater Management or Drainage Criteria
- Buffer or Floodplain Regulations
- Environmental Regulations
- Septic and Sewer Regulations
- Tree Protection or Landscaping Ordinance
- Erosion and Sediment Control Ordinance
- Public Fire Defense Master Plan
- Grading Ordinance
- Locality Comprehensive Plan
- Other documents that influence how development is conducted

The information sought about a particular development rule may not be found in ordinances or regulations, but may be found in supporting design manuals, review checklists, guidance documents, or construction specifications. Few localities include all their rules in a single document. It may be necessary to contact state and federal agencies and other local agencies to obtain copies of needed documents.

Once current development rules and regulations are identified, the codes and ordinances worksheet can be completed. The CWP's Worksheet consists of 66 questions that compare local development rules against their 22 Better Site Design principles (CWP, 1998). Each question focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. If the locality wants to keep score, points can be awarded where local development rules agree with the benchmark for a particular site design practice. In some instances, local codes and ordinances

might not explicitly address a particular practice. In these cases, evaluators should use appropriate judgment based on standard community practices.

3-D.2.2. Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local departments are responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. **Table 3-D.2** on the following pages provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, floodplains, some road design, and stormwater).

Table 3-D.2 Local, State and Federal Authorities Responsible for Development in Your Community

Development Responsibility	Contact Info	State/Federal	County	Town
Sets road standards	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Review/approve subdivision plans	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Establishes zoning ordinances	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Establishes subdivision ordinances	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Establishes Stormwater Management or drainage criteria	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Provides fire protection and fire protection code enforcement	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____

Development Responsibility	Contact Info	State/Federal	County	Town
Oversees buffer ordinance or requirements	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Oversees wetland protection	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Oversees floodplain regulation	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Establishes grading reqmts or oversees Erosion & Sediment Control program	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Reviews/approves septic systems	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____
Reviews/approves utility plans (e.g., water and sewer)	Agency: Contact Name: Phone No.	_____ _____ _____	_____ _____ _____	_____ _____ _____

Development Responsibility	Contact Info	State/Federal	County	Town
Reviews/approves forest conservation / tree protection plans	Agency:	_____	_____	_____
	Contact Name:	_____	_____	_____
	Phone No.	_____	_____	_____
Establishes the comprehensive land use plan	Agency:	_____	_____	_____
	Contact Name:	_____	_____	_____
	Phone No.	_____	_____	_____
Responsible for Green Infrastructure and/or Greenways planning	Agency:	_____	_____	_____
	Contact Name:	_____	_____	_____
	Phone No.	_____	_____	_____

Source: Adapted from CWP

3-D.2.3. Consider Establishing a Stakeholder Roundtable

It is often productive to use a roundtable process to accomplish a productive evaluation of local development codes and ordinances. This process harvests the best ideas and gets buy-in from those most affected by any changes that result from this process. An effective method for promoting code change is to establish a local land use/land development roundtable. Roundtables involve key stakeholders from the local government, development, and environmental communities that influence the development process in a community (see **Table 3-D.**3 below).

Table 3-D.3. Potential Members to Invite to a Roundtable

Planning Agency or Commission	Manufacturer Associations
Department of Public Works	Engineering Consultants
Road or Highway Department	Homeowner Associations
Developers	Chamber of Commerce
Land Trusts	Elected Officials
Realtors	Urban Foresters
Real Estate Lenders	Site Plan Reviewers
Civic Associations	Stormwater Management Authority
Fire Official	Municipal Insurers
Health Department	Watershed Organization
Land Use Lawyers	Residents and Owners
Home Building Organizations	State Agencies
Industrial & Office Park Building Organizations	Environmental and Other NGOs

Source: MPCA (2006)

The Center for Watershed Protection has a *Do-It-Yourself Local Site Planning Roundtable CD-ROM* available from their web site at:

http://bmb.goemerchant.com/cart/cart.aspx?ST=buy&Action=add&Merchant=centerforwatershedprotection&ItemNumber=WLK!45DIYRound

The roundtable approach is but one of many different approaches that can be used for public participation in the development of improved local ordinances. The development of a good comprehensive plan that involves a local water or watershed component that includes an inventory of natural amenities and a stormwater management plan is another. The roundtable discussion is included here as an option that might not be as familiar as the comprehensive planning approach. The roundtable is a consensus process to negotiate new development guidance in the context of local conditions. Having already researched the applicable development codes and ordinances, a site planning roundtable is normally conducted in three steps, as described below.

3-D.2.3.1. Introduce Stakeholders to the Roundtable Process

The first meeting of a roundtable focuses on educating stakeholders to ensure they have a firm grasp of its purpose and goals. The initial meeting introduces stakeholders to three key topics:

- Provide education about LID and ESD techniques. Stakeholders initially may have different levels of understanding about ESD techniques, stormwater impacts or the development process. Stakeholders need to be educated on each topic so everyone starts off on a level playing field.
- Introduce them to the roundtable process. Roundtables are a structured process that consists of numerous facilitated meetings. Since participation entails a significant time commitment, stakeholders should clearly understand how the roundtable process works and the expectations for their participation.

- Review of the codes and ordinance analysis. Stakeholders should get a chance to review the codes and ordinances worksheet and help identify the real and perceived barriers that impede adoption of ESD techniques.

3-D.2.3.2. Conduct the Roundtable and Facilitate Consensus

The roundtable process may extend over an entire year. Subcommittee meetings are often used to focus the efforts of a smaller group of stakeholders on a limited number of topics, such as road and parking lot design. Several subcommittees work on their topics concurrently, and then report their recommendations during full roundtable meetings. An independent third party is often needed to manage stakeholders through the process and guide them toward consensus.

3-D.3.2.3. Implement Code and Ordinances Changes

The product of a roundtable is a list of specific recommendations on local code change that promote adoption of ESD techniques in new development projects. In addition, the roundtable may also recommend incentives, training, education or other measures to encourage greater use of ESD techniques. The full package of consensus recommendations is then presented to local elected officials and the larger community as well. In most cases, additional education of elected officials is needed to ensure that changes to local code and ordinance change are adopted or enacted.

3-D.3.0. CODE AND ORDINANCE REVIEW TOOLS THAT MAY BE USED TO IDENTIFIED CONFLICTS IN RUNOFF REDUCTION & ENVIRONMENTAL SITE DESIGEN PRINCIPLES

3-D.3.1. Completing the Worksheet

Two worksheets are presented at the end of this Appendix.

The first worksheet (**Section 3-D.4.0**) has been used in the past to determine how well local ordinances in Virginia address water quality. This worksheet consists of two parts. The first part is a checklist addressing local requirements that address the three “general criteria” aimed at protecting water quality:

- minimize land disturbance
- Preserve Indigenous Vegetation
- Minimize Impervious Cover

This checklist also addresses general water quality protection provisions of local ordinances and plans.

The second worksheet (**Section 3-C.5.0**) is borrowed from the Center for Watershed Protection. It presents 77 site planning benchmarks, including some that are not included in the worksheet. The CWP worksheet is subdivided into three categories:

- Residential streets and parking lots (CWP model development principles 1-10)
- Lot development (CWP model development principles 11-16)
- Conservation of natural areas (CWP model development principles 17-22)

The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. The user should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule(s) that applies in each case. The questions require either a *yes* or *no* response or a specific numeric criteria. If the development rule agrees with the site planning benchmark, points are awarded.

3-D.3.2. Calculating Your Score (*Optional)*

Keep in mind that the CWP model development ("Better Site Design") principles are reflected in the 23 ESD practices discussed in **Chapter 6** of this Handbook. If the locality chooses to keep score, a place is provided on each page of the CWP worksheet to keep track of the running score. For each category, the user may also subtotal the score. *However, the locality does not have to score the worksheet – the basic purpose is to identify impediments to effective land development, with or without a score.*

This ***Time to Assess*** allows the user to consider which development requirements are most consistent with the site planning benchmarks and which requirements may represent conflicts and are potential candidates for change.

Once the worksheet is completed, the user should review the responses to determine if the development rules are generally consistent or if there are specific areas that result in impediments to ESD and need improvement. This review is a key to achieving more sustainable development in within the locality. It also directly leads to the next step of the process: convening a site planning roundtable (stakeholder advisory group) process, conducted by the local government to develop consensus regarding fruitful changes to local codes. The primary tasks of a local roundtable are to systematically review existing development requirements and determine if changes can or should be made. The roundtable can also review good examples of improved criteria from communities already implementing them, and recommend specific changes to local policies and rules. By providing an effective framework for overcoming barriers to better development practices, the site planning roundtable can serve as an important mechanism for local change.

3-D.4.0. CHECKLIST FOR ADVISORY REVIEW OF LOCAL ORDINANCES

DEQ has a checklist that both Department and local staff have used to review local land development ordinances and recommend needed revisions, in order to ensure these ordinances adequately address the protection of the quality of state waters. Three key categories of land use performance criteria that both address water quality, foster the use of ESD and advance the techniques used in the Runoff Reduction method include:

1. Land disturbance is minimized;
2. Indigenous vegetation is preserved; and
3. Impervious cover is minimized

There are two sections of this checklist: (1) *General Performance Criteria Implementation Options,* and (2) *General Water Quality Protection and Improvement Provisions*. These sections are used for advisory evaluation of local ordinances in preparation for future compliance evaluations and to provide technical assistance to localities that choose to add provisions to address the three performance criteria.

Section 1, *General Performance Criteria Implementation Options,* evaluates existing local land development ordinances to identify specific language that promotes or requires minimizing land disturbance (Part 1), maximizes protection of indigenous vegetation (Part 2), and minimizes impervious cover (Part 3) within a locality. This Section of the Checklist includes possible measures that implement the three general performance criteria that may be contained within a locality's land development ordinances. There is also space for a local government to reference specific measures that are included in an ordinance, but which are not included in this portion of the Checklist.

Part 4 (*General Water Quality Protection and Improvement Provisions*) of the Checklist includes practices and programs that may not fit into a general performance criterion, but which can be important to protecting and improving water quality.

In completing all sections of this Checklist, DEQ or local government staff review local ordinances and other documents adopted by the local governing body outlining specific requirements related to the development and use of land, to determine which of the measures within the Checklist are included in local ordinances.

The land development ordinances and other adopted documents should include specific standards that would address one or more of the three general performance criteria. Local governments are encouraged to indicate which of the three performance criteria the contents of a particular ordinance or adopted document may address. For example, a landscaping ordinance may include standards that would address the requirement to maximize the protection of indigenous vegetation.

CHECKLIST FOR ADVISORY REVIEW OF LOCAL ORDINANCES

LOCALITY: _____
DATE OF REVIEW: _____
REVIEWER: _____

GENERAL PERFORMANCE CRITERIA IMPLEMENTATION OPTIONS

PART 1 – MINIMIZE LAND DISTURBANCE: ____ PROVISIONS

PART 2 – PRESERVE INDIGENOUS VEGETATION: ____ PROVISIONS

PART 3 – MINIMIZE IMPERVIOUS COVER: ____ PROVISIONS

PART 4 – GENERAL WATER QUALITY PROTECTION PROVISIONS ____ PROVISIONS

____ TOTAL NUMBER OF PROVISIONS

SUPPLEMENTAL REVIEW INFORMATION

LOCAL DOCUMENTS REVIEWED: _____

TRACKING SHEET:

General Performance Criteria Implementation Options	61 questions
	_____
Part 1 – Minimize Land Disturbance:	**18 questions**
1A – Open Space Requirements:	_____
1B – Clearing and Grading Requirements:	_____
1C – Utility and Easement Requirements:	_____
1D – LID/Environmental Site Design Concepts:	_____
1E – Other Standards:	_____
Part 2 – Preserve Indigenous Vegetation:	**18 questions**
2A – Sensitive Land Protection/Preservation:	_____
2B – Vegetation and Tree Protection Requirements:	_____
2C – LID/Environmental Site Design Concepts:	_____
2D – Other Standards:	_____
Part 3 – Minimize Impervious Cover:	**25 questions**
3A – Parking Requirements:	_____
3B – LID/Environmental Site Design Concepts:	_____
3C – Redevelopment and Infill Development Concepts:	_____
3D – Road Design Requirements:	_____
3E – Pedestrian Pathways and Driveways:	_____
3F – Other Standards:	_____
Part 4 – General Water Quality Protection Provisions	**7 questions**
	_____

GENERAL PERFORMANCE CRITERIA IMPLEMENTATION OPTIONS

PART 1: MINIMIZE LAND DISTURBANCE — 18 QUESTIONS

The minimization of land disturbance can be accomplished through the application of four general techniques included below as four sections. Each of these general techniques is presented below, with examples of more specific requirements that might minimize land disturbance. Additionally, space has been provided for the locality to include other options not listed in this Checklist.

Section 1A – Open Space Requirements – 3 questions

What is the definition of "open space" used by the locality, and in what document(s) is this term defined?
Definition: _____
Ordinance name and citation: _____

1. Is there an ordinance provision, or other adopted document that requires a certain portion or percentage of undisturbed open space as part of zoning district requirements?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____
   Zoning Districts and required percentages: _____

2. Is there a cluster ordinance, other ordinance provision, or other adopted document that allows flexibility for development intensity or density (through cluster developments, height flexibility, density bonuses, etc.) in exchange for increased resource protection (open space, preservation of natural, undisturbed buffers, etc.)?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____

3. Do open space or other requirements within an ordinance, or other adopted document, protect land, other than RPAs?
   - Wetlands Yes ☐ No ☐
   - Steep slopes Yes ☐ No ☐
   - Intermittent Streams Yes ☐ No ☐
   - Highly erodible soils Yes ☐ No ☐
   - Floodplains Yes ☐ No ☐
   - Other lands Yes ☐ No ☐

   Ordinance name and citation: _____
   Other adopted document: _____

Section 1B – Clearing and Grading Requirements – 8 questions

4. Is there an ordinance provision, or other adopted document, that requires that all clearing and grading plans or equivalent (including individual lots) specify limits of clearing and restricts clearing to the minimum necessary for the construction of the project?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____

5. Is there an ordinance provision, or other adopted document, that authorizes staff to establish limits on clearing and grading?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____

6. Is there an ordinance provision, or other adopted document, that includes a definition of *"construction footprint"* and limits clearing and grading to the construction footprint?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____

7. Is there an ordinance provision, or other adopted document, that requires that the RPA be physically marked on-site prior to any clearing and /or grading and throughout the development process?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____

8. Is there an ordinance provision, or other adopted document, that requires the limits of clearing and grading to be physically marked on-site?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____

9. Is there an ordinance provision, or other adopted document, that requires documentation of the condition of the RPA to be provided before and after development?
   Yes ☐ No ☐
   Ordinance name and citation: _____
   Other adopted document: _____

10. Is there an ordinance provision, or other adopted document, that prohibits clearing and grading on sensitive lands (i.e., steep slopes, highly erodible soils, etc.) in addition to require RPA features?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Other lands: _____

11. Is there an ordinance provision that designates other sensitive lands, such as steep slopes, highly erodible soils, non-RPA nontidal wetlands, etc. as RPA features?
    - Wetlands Yes ☐ No ☐
    - Steep slopes Yes ☐ No ☐
    - Intermittent Streams Yes ☐ No ☐
    - Highly erodible soils Yes ☐ No ☐
    - Floodplains Yes ☐ No ☐

- Other lands Yes ☐ No ☐

Yes ☐ No ☐

Ordinance name and citation: _____

Other adopted document: _____

Section 1C – Utility and Easement Requirement (Public and Private) – 3 questions

For the purposes of this checklist, the term *public utilities* means those outlined under Section 9 VAC 10-20-150 B 2 of the regulations: *"Construction, installation and maintenance of water, sewer, natural gas, and underground telecommunications and cable television lines, owned, permitted or both by a local government or regional service authority."*

12. Is there an ordinance provision, or other adopted document, that requires approval of utility installation plans, including temporary construction areas, prior to land disturbance?

    Yes ☐ No ☐

    Ordinance name and citation: _____

    Other adopted document: _____

13. Is there an ordinance provision, or other adopted document, that requires a replanting plan, other than for stabilization required for erosion and sediment control, when vegetation is removed for temporary construction easements?

    Yes ☐ No ☐

    Ordinance name and citation: _____

    Other adopted document: _____

14. Is there an ordinance provision, or other adopted document, that allows or requires the placement of public utilities within the right-of-way for public or private roads or alleys, when present?

    Yes ☐ No ☐

    Ordinance name and citation: _____

    Other adopted document: _____

Section 1D – Low Impact Development/Environmental Site Design Concepts – 3 questions

For the purposes of this checklist, the term *Low Impact Development (LID)* includes those practices that combine hydrologically functional site designs with pollution prevention measures to compensate for land development impacts on hydrology and water quality.

15. Does the locality provide incentives for retaining natural, undisturbed open space on a site: These incentives may include intensity or density bonuses, stormwater credit, etc.
    - Wetlands Yes ☐ No ☐
    - Intermittent Streams Yes ☐ No ☐
    - Steep slopes Yes ☐ No ☐
    - Highly erodible soils Yes ☐ No ☐
    - Floodplains Yes ☐ No ☐
    - Other lands _____ Yes ☐ No ☐

    Types of incentives provided: _____

Ordinance names and citations: _____
Other adopted documents: _____

16. Do local ordinance provisions, or other adopted documents, allow flexibility in practices to enable the implementation of LID practices that limit land disturbance?
    Yes ☐ No ☐
    Ordinance names and citations: _____
    Other adopted documents: _____

17. Are there ordinance provisions, or other adopted documents, that require the incorporation of existing drainageways and the integration of natural drainage patterns into site drainage plans?
    Yes ☐ No ☐
    Ordinance names and citations: _____
    Other adopted documents: _____

Section 1E – Other Standards

18. Are there other ordinance provisions, or other specific standards in other adopted documents, that limit land disturbance?
    Yes ☐ No ☐
    Ordinance names and citations: _____
    Other adopted documents: _____
    Other standards: _____

PART 2: PRESERVE INDIGENOUS VEGETATON — 18 QUESTIONS

The preservation of indigenous vegetation can be accomplished through the application of three general techniques addressed in the following three sections. Each of these general techniques is presented below, with examples of more specific requirements that preserve indigenous vegetation. Additionally, space has been provided for the locality to include other options not currently listed in this Checklist.

Section 2A – Sensitive Land Protection/Preservation – 9 questions

19. Is there an ordinance provision, or other adopted document, that requires conservation areas or corridors (e.g., greenways, green infrastructure corridors, green belts, etc.)?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

20. Is there an ordinance provision, or other adopted document, that requires riparian vegetated buffers adjacent to non-perennial water bodies or wetlands not required to be include in RPAs?
    - Wetlands Yes ☐ No ☐
    - Intermittent Streams Yes ☐ No ☐
    - Floodplains Yes ☐ No ☐
    - Other lands _____ Yes ☐ No ☐

    Ordinance name and citation: _____
    Other adopted document: _____

21. Is there an ordinance provision, or other adopted document, that requires the permanent marking of the RPA boundaries and, if so, to which zoning districts does this apply?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Zoning districts: _____

22. Is there an ordinance provision, or other adopted document, that requires a portion of open space, other than RPAs, to be left in a natural, vegetated condition?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Percentage to be left natural: _____

23. Is there an ordinance provision, or other adopted document, that requires a building setback from the RPA boundary?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Setback distance:_____

24. Is there an ordinance provision, or other adopted document, that requires a building setback from other sensitive lands, such as intermittent streams and non-RPA nontidal wetlands?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Setback distance: _____
    Sensitive lands protected: _____

25. Is there an ordinance provision, or other adopted document, that requires the preservation of indigenous vegetation on sensitive lands other than required RPA land types?
    - Steep slopes Yes ☐ No ☐
    - Highly erodible soils Yes ☐ No ☐
    - Floodplains Yes ☐ No ☐
    - Wetlands Yes ☐ No ☐
    - Other lands _____ Yes ☐ No ☐

    Ordinance name and citation: _____
    Other adopted document: _____
    Land types protected: _____

26. Is there an ordinance provision, or other adopted document, that limits removal of indigenous vegetation for temporary construction easements for utilities?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

27. Is there an ordinance provision, or other adopted document, that limits removal of indigenous vegetation for maintenance of utility easements?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Section 2B – Vegetation and Tree Protection Requirements – 7 questions

28. Does the locality have a tree protection ordinance that protects existing trees (if permitted by state law)?
    Yes ☐ No ☐
    Ordinance name and citation: _____

29. Are there ordinance provisions, or other adopted documents, that include more specific tree preservation requirements for the preservation of stands of trees or contiguous wooded areas?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

30. Is there an ordinance provision, or other adopted document, that awards credit for maintaining indigenous vegetation when meeting landscaping requirements?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

31. Is there an ordinance provision, or other adopted document, that requires vegetated buffers adjacent to non-RPA wetlands, streams or other water bodies to be left undisturbed?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

32. Is there an ordinance provision, or other adopted document, that includes clear language to protect woody vegetation outside of the construction footprint on individual lots or development sites?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

33. Is there an ordinance provision, or other adopted document, that requires a landscape maintenance agreement or similar mechanism to protect indigenous vegetation to be preserved on-site throughout the construction process?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

34. Is there an ordinance provision, or other adopted document, that requires the preservation of indigenous vegetation in open space as a component of cluster development?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Section 2C – Low Impact Development/Environmental Site Design Concepts – 1 question

35. Is there an ordinance provision, or other adopted document, that requires a natural resources (or environmental) assessment as the initial part of the plan-of-development review process (e.g., pre-submission/pre-application requirement for site plans, preliminary subdivision plats, etc.) and uses this information in the review of proposed projects to limit the impacts on natural resources?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Section 2D – Other Standards

36. Are there other ordinance provisions, or other specific standards in other adopted documents, that preserve indigenous vegetation?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Other standards: _____

PART 3: MINIMIZE IMPERVIOUS COVER — 25 QUESTIONS

The minimization of impervious cover can be accomplished through the application of five general techniques addressed below in five sections. Each of these general techniques is presented below, with examples of more specific requirements that minimize impervious cover. Additionally, space has been provided for the locality to include other options not currently listed in this Checklist.

Section 3A – Parking Requirements – 11 questions

37. Is there an ordinance provision, or other adopted document, that sets maximum parking space requirements for some or all zoning districts?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Applicable zoning districts: _____

38. Is there an ordinance provision, or other adopted document, that allows or requires the use of alternative pervious surfaces for required parking and/or overflow parking areas?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

39. Are there ordinance provisions, or other adopted documents, that allow for shared and off-site parking in certain zoning districts, such as commercial and office districts?
    Yes ☐ No ☐
    Ordinance names and citations: _____
    Other adopted document: _____
    Zoning districts where allowed: _____

40. Is there an ordinance provision, or other adopted document, that allows or requires a percentage of parking spaces for compact cars or motorcycles?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Percentage of total: _____
    Size of compact car spaces: _____

41. Is there an ordinance provision, or other adopted document, that provides incentives for structural parking versus surface parking?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

42. Is there an ordinance provision, or other adopted document, that limits the width of travel lanes in parking areas to the following chart of minimum widths?

Parking Angle	*1-Way*	*2-Way*
90 degree	*20 feet*	*24 feet*
60 degree	*16 feet*	*24 feet*
45 degree	*14 feet*	*24 feet*
30 degree	*12 feet*	*24 feet*
Parallel	*12 feet*	*24 feet*

    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

43. Is there an ordinance provision, or other adopted document, that allows single travel aisles versus double aisles in parking areas?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

44. Is there an ordinance provision, or other adopted document, that limits the size of parking stalls to 9 feet x 18 feet for all passenger vehicle parking stalls (non-parallel parking) except handicapped stalls?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

45. Is there an ordinance provision, or other adopted document, that allows on-street parking to count towards required minimum parking spaces?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

46. Is there an ordinance provision, or other adopted document, that sets parking space minimums for commercial and office uses to 4 spaces or less per 1,000 net square feet of floor area?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

47. Is there an ordinance provision, or other adopted document, that sets parking space minimums for churches, schools, theaters, etc. to 1 space or less for every 4 fixed seats, or 10 spaces or less per 1,000 net square feet of floor space?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Section 3B – Low Impact Development/Environmental Site Design – 4 questions

For the purpose of this Checklist, *"lot coverage"* means all impervious surfaces, such as buildings, structures, decks, driveways, patios, parking lots and sidewalks, etc.

48. Is there an ordinance provision, or other adopted document, that sets maximum impervious coverage or lot coverage for lots and/or parcels based on zoning districts?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____
    Zoning districts and percentage of impervious coverage allowed: _____

49. Is there an ordinance provision, or other adopted document, that allows or encourages increased building height, floor area ration, density, etc. to limit impervious coverage?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

50. Is there an ordinance provision, or other adopted document, that allows or encourages the use of vegetated bioretention facilities to meet parking lot landscaping requirements?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

51. Is there an ordinance provision, or other adopted document, that allows or promotes LID practices (e.g., green roof, bioretention, etc.) for new development projects?
    Yes ☐ No ☐
    Ordinance names and citation: _____

Other adopted document: _____

Section 3C – Redevelopment or Infill Development Concepts – 3 questions

52. Are there ordinance provisions that promote infill or redevelopment through techniques such as tax and other local incentives, or through other methods?
    Yes ☐ No ☐
    Ordinance names and citations: _____
    Other adopted documents: _____
    Promotion methods: _____

53. Is there an ordinance provision, or other adopted document, that allows or promotes LID practices (e.g., green roof, bioretention, etc.) in redevelopment projects in urban areas?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

54. Is there an ordinance provision, or other adopted document, that reduces impervious cover on redevelopment projects?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Section 3D – Road Design Requirements – 4 questions

55. Is there an ordinance provision, or other adopted document, that establishes the maximum radius of cul-de-sacs that does not exceed VDOT's minimum standards?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

56. Is there an ordinance provision, or other adopted document, that permits the pavement width of private roads to be narrower than specified in VDOT standards?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

57. Is there an ordinance provision, or other adopted document, that limits turn lanes, road widths and other pavement requirements to the minimum specified in VDOT standards?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

58. Is there an ordinance provision, or other adopted document, that allows permeable surfaces for required emergency vehicle access lanes (aside from main roads)?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Section 3E – Pedestrian Pathways and Residential Driveways – 3 questions

59. Is there an ordinance provision, or other adopted document, that permits shared driveways?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

60. Is there an ordinance provision, or other adopted document, that limits sidewalks and other pedestrian pathways to the minimum VDOT standards or other minimum required standards?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

61. Is there an ordinance provision, or other adopted document, that provides for the use of alternative permeable materials for sidewalks and/or driveways?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Section 3F – Other Standards

62. Are there other ordinance provisions, or other specific standards in other adopted documents, that limit impervious cover?
    Yes ☐ No ☐
    Ordinance names and citations: _____
    Other adopted documents: _____
    Other standards: _____

PART 4: GENERAL WATER QUALITY PROTECTION PROVISIONS – 8 QUESTIONS

These questions relate to general water quality protection or improvement provisions or program elements.

63. Does the locally designated Chesapeake Bay Preservation Ordinance or implementation of all CBPA performance criteria cover more than 50 percent of the locality's total land area or greater than 50 percent of the total land area in the Chesapeake Bay watershed portion of the locality?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Documentation: _____

64. Does the locally designated Chesapeake Bay Preservation Ordinance or implementation of all CBPA performance criteria apply to all land area within the locality or all land area within the Chesapeake Bay watershed portion of the locality?
    Yes ☐ No ☐

Ordinance name and citation: _____
Other adopted document: _____

65. Is there an ordinance provision, or other adopted document, that requires or provides incentives for LID techniques during the plan review process or mandates their use when technically feasible?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

66. Is there an ordinance provision, or other adopted document, that requires environmental site design to be undertaken before land disturbance is approved?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

67. Is there an ordinance provision, or other adopted document, that permits the Purchase of Development Rights or the Transfer of Development Rights?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

68. Is there an ordinance provision, or other adopted document, that requires or provides incentives for the use of vegetated BMPs or additional vegetation as part of traditional BMPs, to enhance their pollution removal function?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

69. Is there an ordinance provision, or other adopted document, that includes other standards that provide for general water quality protection or improvement?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

70. Is there an ordinance provision, or other adopted document, that includes standards to promote the revegetation of cleared areas for the purpose of general water quality protection or improvement?
    Yes ☐ No ☐
    Ordinance name and citation: _____
    Other adopted document: _____

Virginia Department of Conservation & Recreation
State Parks • Soil & Water Conservation • Natural Heritage
Chesapeake Bay Local Assistance • Land Conservation
Outdoor Recreation Planning • Dam Safety & Floodplains

SITE PLAN AND PLAT CONSISTENCY REVIEW CHECKLIST

LOCALITY: _____
DATE OF REVIEW: _____
REVIEWER: _____

The following questions relate to the requirements for information to be included on site plans and/or plats as outlined in the CBPA regulations. For consistency with the regulations, each applicable question should be answered in the affirmative. In cases where no new on-site septic systems are permitted by the local government, Questions #3 and #4 may not be applicable.

For the purposes of reviewing local government consistency with the requirements of 9 VAC 10-20-191 A 4 and 5, the terms *"plat"* and *"site plan"* will be interpreted as follows:

"Plat" means a survey developed for the purposes of subdividing from a larger parcel of land or adjusting the boundaries of the parcel showing the boundary lines and existing features of the property.

"Site plan" means those plans that are required by the local government as a part of the plan-of-development review process required by 9 VAC 10-20-120 4.

1. Do local land development ordinances require the depiction of Resource Protection Area (RPA) and Resource Management Area (RMA) boundaries on submitted plats and site plans? (9 VAC 10-20-191 A 4 i)
   Yes ☐ No ☐
   Which ordinance(s): _____
   Ordinance section(s): _____
   Is this information required through some other mechanism? If so, please describe it: _____

2. Do local land development ordinances require a notation on plats of the requirement to retain an undisturbed and vegetated 100-foot wide riparian buffer area? (9 VAC 10-20-191 A 4 i)
   Yes ☐ No ☐

Which ordinance(s): _____
Ordinance section(s): _____
Is this information required through some other mechanism? If so, please describe it: _____

3. For areas that require on-site (including remotely located) sewage treatment systems, do local land development ordinances require plats to have a notation regarding the requirement for periodic pump-out of on-site sewage treatment systems? (9 VAC 10-20-191 A 4 ii)
   Yes ☐ No ☐
   Which ordinance(s): _____
   Ordinance section(s): _____
   Is this information required through some other mechanism? If so, please describe it: _____

4. For areas that require on-site (including remotely located) sewage treatment systems, do local land development ordinances require plats to have a notation regarding the requirement that each on-site sewage treatment system must have a 100% reserve drainfield site? (9 VAC 10-20-191 A 4 ii)
   Yes ☐ No ☐
   Which ordinance(s): _____
   Ordinance section(s): _____
   Is this information required through some other mechanism? If so, please describe it: _____

5. Do local land development ordinances require a notation on plats specifying that permitted development in the RPA is limited to water-dependent facilities or redevelopment, including in the 100-foot wide vegetated riparian buffer? (9 VAC 10-20-191 A 4 iii)
   Yes ☐ No ☐
   Which ordinance(s): _____
   Ordinance section(s): _____
   Is this information required through some other mechanism? If so, please describe it: _____

6. Does the local government require, within the plan-of-development review process, the delineation of the buildable areas on each lot, based on the performance criteria, local front and side yard setbacks, and any other relevant easements or limitations regarding lot coverage? (Please note that this requirement is only applicable to plans, not plats) (9 VAC 10-20-191 A 4 i)
   Yes ☐ No ☐
   Which ordinance(s): _____
   Ordinance section(s): _____
   Is this information required through some other mechanism? If so, please describe it: _____

3-D.5.0 CENTER FOR WATERSHED PROTECTION (CWP) CODE AND ORDINANCE WORKSHEET

Development Feature	***Your Local Criteria***
1. Street Width	
What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 average daily trips (ADT)?	_____ feet
*If your answer is between **18-22 feet**, give yourself **4** points*	
At higher densities, are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)?	YES / NO
*If your answer is **YES**, give yourself **3** points.*	
2. Street Length	
Do street standards promote the most efficient street layouts that reduce overall street length?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
3. Right-of-Way Width	
What is the minimum right-of-way (ROW) width for a residential street?	_____ feet
*If your answer is **less than 45 feet**, give yourself **3** points.*	
Does the code allow utilities to be placed under the paved section of the ROW?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
4. Cul-de-Sacs	
What is the minimum radius allowed for cul-de-sacs?	_____ feet
*If your answer is **less than 35 feet**, give yourself **3** points.*	
*If your answer is **36 to 45 feet**, give yourself **1** point.*	
Can a landscaped island be created within the cul-de-sac?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Are alternative turn-arounds, such as “hammerheads,” allowed on short streets in low-density residential developments?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	

CWP Community Codes and Ordinances Worksheet	***Subtotal Page 1***

Development Feature	*Your Local Criteria*
5. Vegetated Open Channels	
Are curbs and gutters required for most residential street sections?	YES / NO
*If your answer is **NO**, give yourself **2** points.*	
Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)?	YES / NO
*If your answer is **YES**, give yourself **2** points.*	
6. Parking Ratios	
What is the minimum parking ratio for a professional office building (per 1000 ft^2 of gross floor area)?	_____ spaces
*If your answer is **less than 3.0 spaces**, give yourself **1** point.*	
What is the minimum required parking ratio for shopping centers (per 1000 ft^2 of gross floor area)?	_____ spaces
*If your answer is **less than 4.5 spaces**, give yourself **1** point.*	
What is the minimum required parking ratio for single family homes (per home)?	_____ spaces
*If your answer is **less than 2.0 spaces**, give yourself **1** point.*	
Are your parking requirements set as maximum or median (rather than minimum) requirements?	YES / NO
*If your answer is **YES**, give yourself **2** points.*	
7. Parking Codes	
Is the use of shared parking arrangements promoted?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Are model shared parking agreements provided?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Are parking ratios reduced if shared parking arrangements are in place?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
If mass transit is provided nearby, is the parking ratio reduced?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	

CWP Community Codes and Ordinances Worksheet ***Subtotal Page 2***	

Development Feature	***Your Local Criteria***
8. Parking Lots	
What is the minimum stall width for a standard parking space?	_____ feet
*If your answer **9 feet or less**, give yourself **1** point.*	
What is the minimum stall length for a standard parking space?	_____ feet
*If your answer **18 feet or less**, give yourself **1** point.*	
Are the last 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Can permeable paving materials be used for spillover parking areas?	YES / NO
*If your answer is **YES**, give yourself **2** points.*	
9. Structured Parking	
Are there any incentives to developers to provide parking within garages rather than surface parking lots?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
10. Structured Parking	
Is a minimum percentage of a parking lot required to be landscaped?	YES / NO
*If your answer is **YES**, give yourself **2** points.*	
Is the use of bioretention islands and other stormwater practices allowed within landscaped areas or setbacks?	YES / NO
*If your answer is **YES**, give yourself **2** points.*	
CWP Community Codes and Ordinances Worksheet ***Subtotal Page 3***	

Time to Assess: Principles 1-10 focused on the codes, ordinances, and standards that determine the size, shape and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1-10. What was your total score?

Subtotal Page 1 _____ + Subtotal Page 2 _____ + Subtotal Page 3 _____ =

Where were your codes and ordinances most in line with the principles? What codes and ordinances present potential impediments to better development?

_____

_____

_____

11. Open Space Design

Development Feature	***Your Local Criteria***
Are open space and cluster development designs allowed in your community?	YES / NO
*If your answer is **YES**, give yourself **3** points.* *If your answer is **NO**, skip to question No. 12.*	
Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Are the submittal or review requirements for open space design greater than those for conventional development?	YES / NO
*If your answer is **NO**, give yourself **1** point.*	
Is open space or cluster design a by-right form of development?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Are flexible site design criteria available for developers that use open space or cluster design options (e.g., setbacks, road widths, lot sizes, etc.)?	YES / NO
*If your answer is **YES**, give yourself **2** points.*	
12. Setbacks and Frontages Are irregular lot shapes (e.g., pie-shaped, flag lots, etc.) allowed in the community? *If your answer is **YES**, give yourself **1** point.*	YES / NO
What is the minimum requirement for front setbacks for a **one-half (1/2) acre** residential lot? *If your answer **20 feet or less**, give yourself **1** point.*	_____ feet
What is the minimum requirement for rear setbacks for a **one-half (1/2) acre** residential lot? *If your answer **25 feet or less**, give yourself **1** point.*	_____ feet
What is the minimum requirement for side setbacks for a **one-half (1/2) acre** residential lot?? *If your answer **8 feet or less**, give yourself **1** point.*	_____ feet
What is the minimum frontage distance for a **one-half (1/2) acre** residential lot?? *If your answer **less than 80 feet**, give yourself **2** points*	_____ feet

CWP Community Codes and Ordinances Worksheet ***Subtotal Page 4***

Development Feature	***Your Local Criteria***
13. Sidewalks	
What is the minimum sidewalk width allowed in the community?	_____ feet
*If your answer **4 feet or less**, give yourself **2** points.*	
Are sidewalks always required on both sides of residential streets?	YES / NO
*If your answer is **NO,** give yourself **2** points.*	
Are sidewalks generally sloped so they drain to the front yard rather than the street?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
14. Driveways	
What is the minimum driveway width specified in the community?	_____ feet
*If your answer **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2** points.*	
Can pervious materials be used for single family home driveways (e.g., grass, gravel, permeable pavers or pavement, etc.)?	YES / NO
*If your answer is **YES** give yourself **2** points.*	
Can a "two track" design be used for single family home driveways?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	
Are shared driveways permitted in residential developments?	YES / NO
*If your answer is **YES**, give yourself **1** point.*	

Development Feature ***Your Local Criteria***

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space? YES / NO
*If your answer is **YES**, give yourself **2** points.*

Are open space areas required to be consolidated into larger units? YES / NO
*If your answer is **YES**, give yourself **1** point.*

Does a minimum percentage of open space have to be managed in a natural condition? YES / NO
*If your answer is **YES**, give yourself **1** point.*

Are allowable and unallowable uses for open space in residential developments defined? YES / NO
*If your answer is **YES**, give yourself **1** point.*

Can open space be managed by a third party using land trusts or conservation easements? YES / NO
*If your answer is **YES**, give yourself **1** point.*

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas? YES / NO
*If your answer is **YES**, give yourself **2** points.*

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops? YES / NO
*If your answer is **YES**, give yourself **2** points.*

CWP Community Codes and Ordinances Worksheet ***Subtotal Page 6***

Time to Assess: Principles 11-16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11-16. What was your total score?

Subtotal Page 4 _____ + Subtotal Page 5 _____ + Subtotal Page 6 _____ =

Where were your codes and ordinances most in line with the principles? What codes and ordinances present potential impediments to better development?

_____

_____

_____

_____

Development Feature	***Your Local Criteria***

17. Buffer Systems YES / NO

Is there a stream buffer requirement or ordinance in the community?
*If your answer is **YES**, give yourself **2** points.*

If so, what is the minimum buffer width? _____ feet

*If your answer **75 feet or more**, give yourself **1** point.*

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required? YES / NO
*If your answer is **YES**, give yourself **1** point.*

18. Buffer Maintenance YES / NO

Does the stream buffer requirement/ordinance specify that at least part of the stream buffer be maintained in native vegetation?
*If your answer is **YES**, give yourself **2** points.*

Does the stream buffer requirement/ordinance outline allowable uses within the buffer area? YES / NO
*If your answer is **YES**, give yourself **1** point.*

Does the buffer requirement/ordinance specify enforcement and education mechanisms? YES / NO
*If your answer is **YES**, give yourself **1** point.*

19. Clearing and Grading YES / NO

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites?
*If your answer is **YES**, give yourself **2** points.*

Do reserve septic field areas need to be cleared of trees at the time of development? YES / NO
*If your answer is **NO**, give yourself **1** point.*

20. Tree Conservation YES / NO

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved?
*If your answer is **YES**, give yourself **2** points.*

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction? YES / NO
*If your answer is **YES**, give yourself **1** point.*

CWP Community Codes and Ordinances Worksheet ***Subtotal Page 7***

Development Feature ***Your Local Criteria***

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (e.g., open space design, density bonuses, stormwater credits, lower property tax rates, etc.)? YES / NO

*If your answer is **YES**, give yourself **2** points.*

Is flexibility to meet regulatory or conservation restrictions (e.g., density compensation, buffer averaging, transferable development rights, off-site mitigation, etc.) offered to developers? YES / NO

*If your answer is **NO**, give yourself **2** points.*

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged? YES / NO

*If your answer is **YES**, give yourself **2** points.*

Are there effective design criteria for stormwater best management practices (BMPs)? YES / NO

*If your answer is **YES**, give yourself **1** point.*

Can stormwater be directly discharged into a jurisdictional wetland without pre-treatment? YES / NO

*If your answer is **NO**, give yourself **1** point.*

Does the community have a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain? YES / NO

*If your answer is **YES**, give yourself **2** points.*

CWP Community Codes and Ordinances Worksheet ***Subtotal Page 8***

Time to Assess: Principles 17-22 addressed codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of **24** points available for Principles 17-22. What was your total score?

Subtotal Page 7 _____ + Subtotal Page 8 _____ =

Where were your codes and ordinances most in line with the principles? What codes and ordinances present potential impediments to better development?

_____

_____

_____

_____

To determine your final score, add up the subtotals from each **Time to Assess** box:

Principles 1 – 10 (page 3) _____
Principles 11 - 16 (page 6) _____
Principles 17 – 22 (page 8) _____

Development Feature ***Your Local Criteria***

SCORING (A total of **100** points available): **TOTAL**
(See page 9 to see where your community'

Your Community's Score		
90 – 100	☐	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 – 89	☐	Your local development rules are pretty good, but they could use some tweaking in some areas.
70 – 79	☐	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 – 69	☐	Development site rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
Less than 60	☐	Your development rules definitely are not environmentally –friendly. Significant reform of the development rules is recommended.

3-D.6.0 REFERENCES

Center for Watershed Protection (CWP). 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Center for Watershed Protection. Ellicott City, MD.

CWP. July 2008a. Tool 4: Codes and Ordinance Worksheet. *Post-Construction Guidance Manual*. Ellicott City, MD. available from the CWP online at: http://www.cwp.org/Resource_Library/Center_Docs/SW/pcguidance/Tool4.pdf

CWP. July 2008b. *Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program*. Ellicott City, MD. available from the CWP online at: http://www.cwp.org/Resource_Library/Center_Docs/SW/pcguidance/Manual/PostConstructionManual.pdf

Chesapeake Stormwater Network (CSN) and CWP. March 9-11, 2010. *From the Rooftop to the Bay* Workshop. Staunton, Virginia.

Appendix 3-E

CASE STUDY: SETTING UP A LOCAL STORMWATER UTILITY, CITY OF STAUNTON, VIRGINIA

Table of Contents

APPENDIX SECTION HEADINGS

LIST OF FIGURES

LIST OF TABLES

Staunton, Virginia (**Figure 3-D.1**), is a small city with a population of approximately 25,000 people and approximately 11,500 individual properties. Staunton is subject to Phase II MS4 permit coverage. The city has identified nearly $14 million in drainage improvements that need to be made, mainly to address flooding problems (**Figures 3-C.2** and **3-C.3**) that occur more and more frequently and an aging stormwater infrastructure that needs to be repaired or replaced. In October, 2008, the City Council directed the public works staff to proceed with preparation of an ordinance to implement a stormwater utility. The stormwater utility will bill city residents and businesses a monthly service fee, with the funds used to pay for progressive drainage system repairs and upgrades to solve the flooding and other drainage problems that exist.

Figure 3-E.1. Map of the City of Staunton, Virginia

The City Council adopted the final stormwater utility ordinance in July, 2009. Public Works staff then proceeded to procure the billing software and set up implementation staffing and mechanisms. The stormwater utility fee went into effect on February 1, 2010.

Figure 3-E.2. Roadway Flooding

Figure 3-E.3. Residential Flooding

Figure 3-E.4. Flood Debris in Stream

Figure 3-E.5. Clogged Storm Drains That Need to Be Cleaned Out

While there are a number of stormwater-related issues to which stormwater utility funding may be directed, Staunton chose at least initially to focus on funding their drainage infrastructure needs,

in order to alleviate flooding occurrences and repair or replace infrastructure, as needed. As used by many stormwater utilities across the nation, Staunton selected the *Equivalent Runoff Unit (ERU)* as its base billing unit. An ERU is defined as the *average area of impervious surface for single-family or duplex residential lots* within the municipality. This area was determined to be *2,600 square feet* for Staunton.

A base billing rate was established for each ERU , and a *tiered billing rate structure* was established (**Table 3-E.1**), with each tier reflecting a range of impervious area. Using such a system results in a manageable number of billing tiers and makes the system simpler for the public to understand.

Based on more billable properties, a higher ERU base billing rate, or other factors, a community might be able to generate considerably more revenue and thus be able to address stormwater issues more comprehensively. For example, a locality might be able to assume some or all of the routine maintenance responsibilities for BMPs.

Table 3-E.1. City of Staunton Stormwater Utility's Tiered Monthly Billing Rate Structure

Range of Impervious Area on the Property (Square Feet)	Tier	Monthly Utility Billing Rate Per Property	Median Equivalent Runoff Units (ERUs)
< 3,400	1	$3.20	1.0
3,400 - 6,800	2	$6.28	2.0
6,800 - 10,000	3	$10.34	3.2
10,000 - 20,000	4	$18.46	5.8
20,000 - 30,000	5	$30.77	9.6
30,000 - 40,000	6	$43.08	13.5
40,000 - 50,000	7	$55.38	17.3
50,000 - 60,000	8	$67.69	21.2
60,000 - 70,000	9	$80.00	25.0
70,000 - 80,000	10	$92.31	28.8
80,000 - 90,000	11	$104.62	32.7
90,000 - 100,000	12	$116.92	36.5
100,000 - 200,000	13	$184.62	57.7
200,000 - 300,000	14	$307.69	96.2
300,000 - 400,000	15	$430.77	134.6
400,000 - 500,000	16	$553.85	173.1
500,000 - 1,000,000	17	$923.08	288.5
> 1,000,000	18	$1,230.77	384.6

Source: CSN and CWP (2010)

Properties within the city were then assessed by multiplying the *Base Rate* of $3.20/month by the number of ERUs determined for the property. **Table 3-C.2** below**,** which is based on this formula, shows how many of each type of property are being billed in each tier and total revenues generated.

Table 3-E.2. Sources of Staunton Stormwater Utility Fees

TIER	BILLING RATE ($)	NO. SINGLE-FAM. RES. PROPERTIES	NO. MULTI-FAMILY / COMM. PROPERTIES	TOTAL NO. PROPERTIES	TOTAL REVENUE ($)
1	3.20	7,444	1,033	8,477	27,126.40
2	6.28	1,288	323	1,611	10,117.08
3	10.34	114	142	256	2,647.04
4	18.46	77	200	277	5,113.42
5	30.77	13	88	101	3,107.77
6	43.08	6	50	56	2,412.48
7	55.38	1	27	28	1,550.64
8	67.69	0	17	17	1,150.73
9	80.00	1	13	14	1,120.00
10	92.31	0	9	9	830.79
11	104.62	0	8	8	836.96
12	116.92	0	6	6	701.52
13	184.62	2	27	29	5,353.98
14	307.69	0	6	6	1,846.14
15	430.77	0	7	7	3,015.39
16	553.85	0	2	2	1,107.70
17	923.08	0	1	1	923.08
18	1,230.77	0	1	1	1,230.77
Totals		**8,946**	**1,960**	**10,906**	**70,191.89**
					x 12
Total Annual Revenue (not including reductions for credits):					**842,302.68**

Source: CSN and CWP (2010)

The City Council recognized that some landowners have city-approved stormwater management BMPs located on their properties. These landowners are held responsible for maintaining these BMPs so they will continue to function as designed. Therefore, Council established two types of credits (for water quantity BMPs or water quality BMPs) and up to three tiers of credit for each type of BMP (a maximum of six tiers of credit).

This means that the normal billing rate will be reduced by from 1 to 6 tiers, based on the types and effectiveness of BMPs located on the property. Properties that are less than 16 percent impervious or less than 8 percent impervious receive automatic credits of 3 tiers or 6 tiers, respectively. This credit system functions as an incentive to minimize impervious cover. However, the minimum property billing rate is the Tier 1 rate of $3.20/month, regardless of the credits that might apply.

With the dedicated and predictable revenues from the Stormwater Utility program, Staunton established the annual budget for stormwater system improvements shown in **Table 3-E.3** below. It should be clear that this budget exceeds the total annual revenues shown in **Table 3-E.2** above (minus whatever credits apply and are deducted from customer bills. Staunton makes up this difference from other sources of funding (general fund, capital improvements budget, etc.).

Table 3-E.3. Staunton Stormwater Utility: Initial Stormwater Improvements Annual Budget

Budget Category	Amount ($)
Capital Projects	416,000
Operations & Maintenance Equipment	150,000
New Staff (Salaries & Benefits): • Maintenance Employees: 2 • Projects/Design Engineer: 1 • Finance & Accounting Specialist: 1	200,000
Cover SWM Credits (revenue reduction)	170,000
Total Budget:	**936,000**

Source: CSN and CWP (2010)

Appendix 3-F

EXAMPLE SITE PLAN REVIEW CHECKLISTS

Table of Contents

Section Headings

3-F.1.0. INTRODUCTION

Site design and plan review checklists provide general guidance for both the designer and plan reviewer. Many items listed on the checklists may not apply to any given design and it is therefore up to the designer to indicate items as "*not applicable*" or "*NA*" as appropriate. Similarly, the reviewer must be able to distinguish which items are required based on the local conditions or requirements and verify the status of those items. These checklists serve as a tool for providing the designer with the necessary information needed to develop an approvable plan, as well as for providing the plan review authority with a consistent review procedure.

3-F.2.0. EXAMPLE CHECKLIST FOR AN *PRELIMINARY* STORMWATER MANAGEMENT SITE PLAN PREPARATION AND REVIEW

1. Applicant Information

Initial/Preliminary Plan Submission Date_____
Project Name_____
Site Plan/Permit Number_____
Site Address_____
Applicant_____ Phone Number_____
Applicant Legal Address_____
Owner_____ Phone Number_____
Principal Designer_____ Phone Number_____
General Contractor_____ Phone Number_____

2. Plan Status

_____ Approved
_____ Not Approved

Legend:

✓	-	Complete
Inc.	-	Incomplete/Incorrect
N/A	-	Not Applicable

3. _____ Common address (with latitude and longitude coordinates or GPS position) and legal description of the site, including the tax reference number(s) and parcel number(s) of the property or properties affected.

_____
_____
_____

4. Existing and proposed mapping and plans (recommended scale of 1" = 50', or greater detail), which illustrates the following at a minimum:

_____ North arrow
_____ Legend
_____ Vicinity map
_____ Existing and proposed topography (minimum of 2-foot contours recommended)
_____ Property lines
_____ Perennial and intermittent streams
_____ Mapping of predominant soils from USDA soils surveys
_____ Boundaries of existing predominant vegetation, areas of the site to be protected from disturbance, and proposed limits of clearing and grading

_____ Location and boundaries of natural feature protection and conservation areas, such as wetlands, lakes, ponds, aquifers, public drinking water supplies, and applicable setbacks, etc.)
_____ Identification of any on-site or adjacent water bodies included on the Virginia 303(d) list of impaired waters
_____ Current and proposed land use and location of existing and proposed roads, buildings, parking lots and other impervious areas
_____ Location and description of any planned demolition of existing structures, roads, etc.
_____ Location of existing and proposed utilities [e.g., water (including wells), sewer (including septic systems), gas, electric, telecommunications, cable TV, etc.] and drainage and other easements
_____ Preliminary estimates of unified stormwater sizing criteria requirements
_____ Preliminary identification and calculation of stormwater site design credits, if any apply
_____ Preliminary selection and location of stormwater control measures
_____ Location of existing and proposed conveyance systems, such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow
_____ Flow paths
_____ Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages
_____ Preliminary location of all contributing drainage areas and points of stormwater discharge, receiving surface waters or karst features into which stormwater discharges, the pre-development and post-development conditions for drainage areas, and the potential impacts of site stormwater on adjoining parcels
_____ Note all critical areas on the plan, such as critical slopes.

5. Hydrologic and hydraulic analysis, including the following:

_____ A hydrologic analysis for the existing (pre-development) conditions, including runoff rates, volumes, and velocities, showing the methodologies used and supporting calculations
_____ A hydrologic analysis for the proposed (post-development) conditions, including runoff rates, volumes, and velocities, showing the methodologies used and supporting calculations
_____ Hydrologic and hydraulic analysis of the stormwater management system for all applicable design storms
_____ Preliminary sizing calculations for stormwater control measures, including contributing drainage areas, storage, and outlet configurations
_____ Preliminary analysis of the potential downstream impacts/effects of the project, where necessary

6. _____ Preliminary erosion and sediment control plan that, at a minimum, meets the requirements outlined in the Virginia Erosion and Sediment Control Regulations and Handbook

7. _____ Preliminary landscaping plans for stormwater control measures and any site reforestation or revegetation

8. _____ Preliminary identification of waiver/exception requests

3-F.3.0. EXAMPLE CHECKLIST FOR A FINAL STORMWATER MANAGEMENT SITE PLAN PREPARATION AND REVIEW

1. Applicant Information

Final Plan Submission Date_____
Project Name_____
Site Plan/Permit Number_____
Site Address_____
Applicant_____ Phone Number_____
Applicant Legal Address_____
Owner_____ Phone Number_____
Principal Designer_____ Phone Number_____
General Contractor_____ Phone Number_____

2. _____ Signature and stamp of licensed professional consultant and owner certification

3. Plan Status

_____ Approved
_____ Not Approved

Legend:

___	- Complete
Inc.	- Incomplete/Incorrect
N/A	- Not Applicable

4. _____ Common address and legal description of the site, including the tax reference number(s) and parcel number(s) of the property or properties affected.

_____
_____
_____

5. _____ A narrative that includes a description of current site conditions and proposed development and final site conditions, including proposed use of environmental site design techniques and practices, stormwater control measures, relevant information pertaining to long-term maintenance of these measures (see item #12 below), and a construction schedule.

6. Existing and proposed mapping and plans (recommended scale of 1" = 50', or greater detail), which illustrates the following at a minimum:

_____ North arrow
_____ Legend
_____ Vicinity map
_____ Existing and proposed topography (minimum of 2-foot contours recommended)
_____ Property lines
_____ Perennial and intermittent streams
_____ Mapping of predominant soils from USDA soils surveys as well as the location of any site-specific test bore hole investigations that may have been conducted and information identifying the hydrologic characteristics and structural properties of soils used in the installation of stormwater management facilities
_____ Boundaries of existing predominant vegetation and proposed limits of clearing and grading

_____ Location and boundaries of natural feature protection and conservation areas (e.g., wetlands, lakes, ponds, aquifers, public drinking water supplies, etc.) and applicable setbacks (e.g., stream buffers, drinking water well setbacks, septic drainfield setbacks, building setbacks, etc.)
_____ Identification of any on-site or adjacent water bodies included on the Virginia 303(d) list of impaired waters
_____ Current land use and location of existing and proposed roads, buildings, parking lots and other impervious areas
_____ Location and description of any planned demolition of existing structures, roads, etc.
_____ Proposed land use(s) with a tabulation of the percentage of surface area to be adapted to various uses, including but not limited to planned locations of utilities, roads, parking lots, stormwater management facilities, and easements
_____ Location of existing and proposed utilities [e.g., water (including wells), sewer (including septic systems), gas, electric, telecommunications, cable TV, etc.] and easements
_____ Earthwork specifications
_____ Selection, location and design of both structural and non-structural stormwater control measures, including maintenance access and limits of disturbance
_____ Storm drainage plans for site areas *not* draining to any BMP(s)
_____ Location of existing and proposed conveyance systems, such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow, including grades, dimensions, and direction of flow
_____ Final drainage patterns and flow paths
_____ Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainage systems
_____ Location of all contributing drainage areas and points of stormwater discharge, receiving surface waters or karst features into which stormwater discharges, the pre-development and post-development conditions for drainage areas, and the potential impacts of site stormwater on adjoining parcels
_____ Location and dimensions of proposed channel modifications, such as bridge or culvert crossings
_____ Final stabilization and landscaping plans

7. Hydrologic and hydraulic analysis, including the following:

_____ Site map with locations of design points and drainage areas (size in acres) for runoff calculations
_____ Identification and calculation of stormwater site design credits, if any apply
_____ Estimates of unified stormwater sizing criteria requirements
_____ Time of concentration (and associated flow paths)
_____ Imperviousness of the entire site and each drainage area
_____ NRCS runoff curve numbers or volumetric runoff coefficients
_____ A hydrologic analysis for the existing (pre-development) conditions, including runoff rates, volumes, and velocities, showing the methodologies used and supporting calculations
_____ A hydrologic analysis for the proposed (post-development) conditions, including runoff rates, volumes, and velocities, showing the methodologies used and supporting calculations
_____ Hydrologic and hydraulic analysis of the stormwater management system for all applicable design storms
_____ Pollution load and load reduction requirements and calculations

_____ Final good engineering and sizing calculations for stormwater control measures, including contributing drainage areas, storage, and outlet configurations, verifying compliance with the water quality and water quantity requirements of the regulations
_____ Stage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities
_____ Final analysis of the potential downstream impacts/effects of the project, where necessary
_____ Downstream analysis, where detention is proposed
_____ Dam safety and breach analysis, where necessary

8. Representative cross-section and profile drawings and details of stormwater control measures and conveyances which include the following:

_____ Existing and proposed structural elevations (e.g., inverts of pipes, manholes, etc.)
_____ Design water surface elevations
_____ Structural details of BMP designs, outlet structures, embankments, spillways, grade control structures, conveyance channels, etc.

9. _____ Applicable construction and material specifications, including references to applicable material and construction standards (ASTM, etc.)

10. _____ Erosion and sediment control plan that, at a minimum, meets the requirements outlined in the Virginia Erosion and Sediment Control Regulations and Handbook

11. _____ Landscaping plans for stormwater control measures and any site reforestation or revegetation

12. Operations and maintenance plan/agreement that includes the following:
_____ Name, legal address and phone number of the party or parties responsible for long-term maintenance activities
_____ Description and schedule of maintenance tasks
_____ Identification/description of the source of funding to support maintenance activities
_____ Description of access and safety issues
_____ Procedures for testing and disposal of sediments, if required
_____ Right-of-entry authorization for local government inspections/repairs, as needed

13. _____ Evidence of acquisition of all applicable local and non-local permits

14. _____ Waiver/exception requests

15. _____ Evidence of acquisition of all necessary legal agreements (e.g., easements, covenants, land trusts, etc.)

16. _____ Applicable supporting documents and studies (e.g., infiltration tests, geotechnical investigations, TMDLs, flood studies, etc.)

17. _____ Other required permits

Appendix 3-G

SWM AND BMP CONSTRUCTION INSPECTIONS

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APPENDIX SECTION HEADINGS

3-G.1.0. INTRODUCTION

The purpose of construction inspections and an as-built survey is to verify that constructed Stormwater Management (SWM) facilities and associated conveyance systems have been built in accordance with the approved plan and design specifications. An as-built survey, including construction inspection logs, should be provided prior to final site approval and release of the performance guarantee. This is in the best interest of the owner as well as the local program, since long term maintenance costs can increase significantly, if the facility is not built correctly. Furthermore, the owner and locality want assurance that the facilities are constructed properly and will provide the quantitative and/or qualitative control prescribed by the approved plan. Liability issues arise if a downstream property owner is adversely affected and can prove that the facility does not conform to the approved plan.

3-G.1.1 Construction Inspections

Adequate construction inspection of stormwater BMPs will usually require an on-site inspector to verify that the materials, methods, and placement, are in accordance with the approved plans and specifications. Critical components of the design; such as the anti-seep collar or filter and drainage diaphragm on the outlet conduit, the embankment foundation, riser footing, and other sub-surface components, must be examined for compliance to the design prior to being backfilled with the earthen embankment. The use of an on-site inspector will help to avoid delays by allowing the contractor to proceed with the earthwork rather than waiting for a scheduled (or non scheduled) inspection of a critical component.

Localities will usually provide regular inspections of SWM facilities under construction. The frequency of these inspections will vary based on the workload represented by active projects and the number of inspectors on staff. These inspections should verify that the contractor and on-site inspector are documenting the construction inspections in order to adequately substantiate the as-built certification. In the case of a local program requirement of inspections at critical points during construction, a signed inspection log by a qualified individual (other than the contractor) should be acceptable. Otherwise, the locality should establish a construction inspection schedule with the contractor prior to construction. All inspection logs and other related information should be incorporated into a file for each individual project. The BMP Design and Plan Review Checklists in **Appendix 8-A of Chapter 8** can also be used for construction inspections.

3-G.1.2. As-Built Survey and Plan

Some as-built documentation must be obtained *during* the construction process, since some vital components are hidden in the final product. Therefore, construction inspections and inspection records are included in the as-built survey, which is the responsibility of the owner/permittee. For purposes of discussion, an as-built survey may be broken down into three components. These components are *earthwork specifications*, *material specifications* (other than earthwork) and a *dimensions and elevations survey*. The items noted within these components should be checked, and documentation be retained as needed to substantiate that the SWM BMP has been

constructed in accordance with the approved plan and specifications. The following provides a discussion of the components of an as-built survey.

3-G.1.2.1 Earthwork Specifications

The acceptable completion of earthwork in the construction of a SWM facility is crucial in assuring that a facility is structurally sound. This category covers all aspects pertaining to the completion of earthwork for a facility. It is essential that specific elements of the construction inspection, as well as the pre-construction feasibility analysis of the soils, be documented. This may include compaction tests, inspections of the removal of unsuitable materials under and adjacent to the embankment foundation, construction of the cut off trench and other seepage control measures, compaction around the barrel, riser structure footing, and any other element that is hidden in the final condition. All work should be completed under supervision of a licensed geotechnical engineer. The inspection logs and test results should be included in the final as-built survey.

3-G.1.2.1.1. Geotechnical/Geophysical Testing

The examination of existing underlying strata indicates the composition of that strata and if that strata will support a SWM facility. For example, the presence of bedrock at the natural ground surface or in "cut" provides a plane of weakness that water may follow or exfiltrate to. This is especially critical in areas of karst. Also, the presence of organics or other unsuitable materials under the embankment and embankment footing may require additional excavation. This must be documented as having been completed.

Normally, in non-karst terrain (east of the Blue Ridge), simple geotechnical logs taken at the SWM site will provide adequate interpretative results. However, in karst environments it is extremely useful that the testing be expanded to geophysical (seismic) evaluation. These tests provide images of underlying strata and indicate the presence of anomalies. This is critical since limestone geology exhibits extensive caves and cavities where ponding of runoff may exacerbate collapse of underlying cavities, which ultimately results in extremely expensive repairs.

3-G.1.2.1.2. Fill Classification

The geotechnical portion of the approved plan should provide a listing of soil classification types that are suitable for use at the project infill. Specialized criteria may also specify the classification of impermeable soil to be used for clay liners in areas of sandy soils or karst. Fill soils containing such materials as excessive or large rock, organic material or "fatty clay" (CH) classification are not acceptable due to the inability to achieve proper compaction or because of their shrink-swell properties. Verification must also be provided that the specifications for materials to be used in the construction of drainage and filter diaphragms have been complied with.

3-G.1.2.1.3. Compaction

The application of "lifts" in proper thickness and density is essential in attaining a stable SWM structure. The compaction of dam embankment to a percentage at or above the percent compaction specified in the approved plan and within the optimal range of moisture content assures that there will not be adverse settlement of the embankment. Careful compaction in areas adjacent to the barrel and seepage control measures is critical to eliminate excessive "void space" along the outlet barrel where the potential for embankment failure is high. Sufficient test results should be retained to document uniform compaction of the dam embankment and density/permeability of **existing soil formation and/or soils to be** used for liners (where applicable), in accordance with the approved plan.

3-G.1.2.2 Material Specifications

Construction materials may be classified as those items other than earthwork. A large number of component items needed for the construction of SWM facilities are grouped into this category. Some of these components must be inspected during installation. Materials would include, but not be limited to, concrete, reinforcing steel, concrete pipe, metal pipe, woodwork, masonry, and any other items that are applicable to the facility and satisfy all the requirements of the local program. The following provides a general discussion of some of the components of a SWM facility:

3-G.1.2.2.1 Riprap and Aggregate

The size distribution (diameter of aggregate), the amount of "fines" and integrity of rock may be factors, since aggregate sizing should be in accordance to the plan.

1. Aggregate sizing plays a role in two distinct areas. In underground reservoir use, the size of aggregate dictates the amount of void space available for infiltration or retention/detention of runoff. In riprap use, the minimum size is critical in maintaining stability during high velocity flow, while a size in great excess of the stone specified may be equally as detrimental in regards to aesthetics and/or proper placement.

2. The amount of fines contained within aggregate is generally a visual observation, although quarry delivery tags should bear out the specifications per VDOT specs. The percentage of fines generally is important where washed stone is to be utilized for an underground aggregate reservoir, or where the outlet protection of a facility is discharging into a stream or other sensitive area that is susceptible to turbidity.

3. Rock integrity and shape is generally the visual observation that the aggregate used will meet specifications without long term decay. For example, sandstone does not make good riprap since it may be expected to disintegrate over time. Slate usually exhibits cleavage planes and therefore lays flat. When used for outlet protection, insufficient surface roughness of the slate may not dissipate concentrated flow energy.

3-G.1.2.2.2. Control Structure

There are an infinite number of design configurations for a control structure. Whatever the design, there should be project specifications for dimensions, strength and specific materials in accordance with the specifications found in the particular BMP Design Specification and any other local requirements. Appropriate documentation from the manufacturer should be retained (as applicable) to document each component. For example, pre-cast concrete risers normally arrive with as-built shop drawings that indicate specifications of the item furnished. Where components are constructed at the site, such as a cast in-place riser footing, test information and/or delivery tags from the concrete plant should be retained, while rebar reinforcement and dimensional information is documented in the construction log. Other items normally applicable to the control structure include:

1. An outlet barrel, normally affixed to the control structure, is used to convey flow to an accepted discharge point. Items related to proper conduit installation include the procedure used in sealing joints of conduit together, the method of attachment to the control structure and the use of inlet and floor shaping (as applicable) within the control structure.

   There is also a need to inspect and document the existence, location and spacing of anti-seep collars, concrete cradles or other seepage control measures (at the outlet barrel) as specified in the approved plan. Documentation should include verification of critical dimensions, existence of reinforcement, and indication of concrete mix strength. In the case of filter diaphragms, both earthwork and materials need to be considered in the installation**.**

2. Trash racks of varying design and construction are normally affixed to a control structure and in some cases inlets which "feed" the SWM facility. Visual observation (with inspection log entry) should indicate bar size, spacing grate configuration, and proper attachment to the control structure, or inlet and the application of rust resistant coating to the same where applicable.

3-G.1.2.2.3 Geotextiles

Synthetic fabrics are frequently specified for application beneath various components, under riprap or individually in spillways or for low flow channels. Proper selection of a manufacturer's product along with installation consistent with the plan and/or manufacture's directives is necessary to assure the performance intended. The method of installation should be observed and a tag provided from the product that verifies compliance with the product specification given in the approved plan.

3-G.1.2.2.4 Conveyance System Components

One portion of a SWM design that is frequently overlooked in inspections is the collection of components comprising the drainage system for the site. It is obvious that if the system is not built as intended in the approved plan, then the facility may not function as expected. Critical items such as conveyance conduit diameter, slope, inlet and grate length/configuration are essential to insure that the required design storm (generated by the contributing drainage area) is

adequately conveyed to the SWM facility for control and/or that runoff from other drainage areas is diverted away from SWM facilities.

3-G.1.2.3 Dimensions and Elevations Survey

The approved plan provides detailed information for specific elevations such as the inverts of the outlet conduits, control orifice and weir invert elevations, invert of emergency spillway, top of the dam, as well as pond bottom and slope of the same. Additional dimensional information exclusive of the control structure should also be provided. This could include the dimensions of the impoundment area at specific elevations and the top width and side slope of a dam embankment. The purpose of the as-built survey is to confirm that elevations and dimensions are consistent with the approved plan.

3-G.1.3. As-Built Submittal Requirements

As-built information should be documented and submitted as follows: (1) a copy of the applicant's inspection log book; (2) a red-line revision of the approved SWM plan sheets; and (3) certification by a qualified professional that the as-built plan conforms to the approved plan.

3-G.1.3.1. Inspection Log Book

A copy of the inspection log book should be kept at the project site. The log should document all aspects of the construction of the facility (with copies of applicable test results) to insure compliance with the approved plan. Any significant inconsistencies should immediately be reported to the engineer for evaluation and possible modification.

3-G.1.3.2. Red-Line Revision of Plans

Red-line revision plans should be submitted upon completion of the facility. The plans should indicate any changes to the approved plan. Items that differ from the original approved plans and computations should be shown in red on both the plans and computations as follows:

- A red check mark must be made beside design values where they agree with actual constructed values
- For changed values, "line out" the design value and enter the actual value in red
- Elevations to the nearest 0.1-foot are sufficient
- A stage-storage summary table, comparing the design values and the as-built values, should be provided for each facility with a storage volume

3-G.1.3.3. Certification Statement

The project owner should have those persons responsible for the inspection and implementation of the plan submit written certification that the SWM facility(s) and conveyance system have been built in accordance to the approved plan since this will cover underground facilities as well. Survey work during stake out and construction should be documented to verify underground volumes, elevations, pipe sizes, etc.