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Appendix A

Public Review Process – Comprehensive Update 2021

APPENDIX A

Public Review Process

The fifth comprehensive review of the Harford County Critical Area Program will be complete in 2022. The major changes to the Program will be the incorporation of new requirements brought about by the adoption of updated regulations for water-dependent facilities, agriculture, and surface mining. The adopted regulations for renewable energy, specifically solar energy generating systems, will not be incorporated into the County Program due to County-adopted restrictions of minimum acreage requirements and location constraints within the CBCA.

Additional changes to the Program will include updates to the enforcement provisions, variance language, revised growth allocation calculations, new Buffer language, and a revised list of permissible mitigation offsets. The definition of lot coverage will be revised to include a list of various kinds of impervious surfaces, including stone, pavers, pools, and man-made ponds. Many updates to agency names, code references, and other editorial changes will occur.

Critical Area boundary maps and resource inventory maps were updated based on the latest information provided by the Maryland Department of Natural Resources. Property owners were notified by the Critical Area Commission and given the opportunity to meet with State and County staff to discuss the change(s). Mapping changes have been

The Program changes were presented to the Environmental Advisory Board (EAB) and the Planning Advisory Board (PAB) at separate meetings in April 2022. The changes to the code, map, and program were approved by the county council in a process with public hearing. The legislative package was subsequently approved by Critical Area Commission. Copies of decisions on council bills and commission items are available on their respective websites.

Environmental Site Design Criteria for the Maryland Critical Area

Prepared for Maryland Critical Area Commission
Annapolis, MD

Prepared by Chesapeake Stormwater Network
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May 24, 2011

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List of Acronyms

CAC	Critical Area Commission
CDA	Contributing Drainage Areas
CIDA	Contributing Impervious Drainage Area
CSN	Chesapeake Stormwater Network
ESC	Erosion and Sediment Control
ESD	Environmental Site Design
EMC	Event Mean Concentration
GIS	Geographic Information System
HSG	Hydrologic Soil Group
IC	Impervious Cover
IDA	Intensely Developed Area
LDA	Limited Development Area
MDE	Maryland Department of Environment
MEP	Maximum Extent Practicable
NRCS	Natural Resources Conservation Service
Pe	ESD Target Volume
RCA	Resource Conservation Area
RCN	Runoff Curve Number
SA	Surface Area
TP	Total Phosphorus
TMDL	Total Maximum Daily Load
WQv	Water Quality Volume

Part 1
Introduction

The Chesapeake Bay Critical Area Protection Act was originally enacted in 1984 by the Maryland General Assembly to help reverse the deterioration of the Chesapeake Bay and the surrounding environment. In 2002, the Act was amended to add the Atlantic Coastal Bays to the area protected by the Critical Area regulations. The Act was amended again in 2008 to strengthen its provisions to protect water quality and habitat. A summary of the new provisions can be found at www.dnr.state.md.us/criticalarea/guidancepubs/052008overviewofhousebill1253.pdf.

The Critical Area Protection Act is designed to promote environmentally sensitive stewardship of land and water resources in the Critical Area. It addresses three principal concerns: minimizing adverse impacts on water quality that result from pollutants that are discharged from structures or conveyances or that have run off from surrounding lands; to conserve fish, wildlife and plant habitat; and to accommodate future growth in the most environmentally protective means possible. More detailed information about the Critical Area Act and the local Critical Area regulations designed to preserve and protect the Chesapeake Bay and the Atlantic Coastal Bays can be found online at: www.dnr.state.md.us/criticalarea.

1.1 The Maryland Critical Area and Buffer

The Maryland Critical Area is defined as all land and water areas within 1,000 feet of the landward boundary of tidal waters or tidal wetlands. It also includes the waters of and the lands under the Chesapeake and Atlantic Coastal Bays. The Critical Area Law and Regulations apply to 16 counties, Baltimore City, and 47 municipalities surrounding Maryland's tidal waters. Each locality must implement a land use and resource protection program that is designed to minimize the damaging impact of water pollution and loss of natural habitat, while also accommodating the jurisdiction's future growth. The Critical Area was created with the recognition that land use immediately adjacent to the Bay and its tributaries has the greatest potential to influence water quality and natural habitats.

Since 1986, Critical Area regulations have required a minimum Buffer of 100 feet of natural vegetation extending landward from the Mean High Water Line of tidal waters or the edge of tidal wetlands and tributary streams. The Buffer is critical for habitat protection and water quality enhancement, and acts as a transition zone between human disturbance and sensitive land and water resources. The Buffer also acts as a filter for the removal or reduction of sediment, nutrients, and toxic substances that enter adjacent waterways in land runoff.

In 2010, the Critical Area Commission issued new regulations for the Critical Area Buffer; a synopsis can be found at www.dnr.state.md.us/criticalarea/pdfs/LGAG_BR0210.pdf. Most notably, the new regulations now specify how Buffers are to be established in forest vegetation and provide clearer rules on Buffer management, mitigation and enforcement. Further, a minimum 200-foot Buffer is now required for all new subdivisions or site plans within the Resource Conservation Area (RCA).

The Critical Area Buffer may be disturbed only for certain activities, such as water-dependent structures, access to the shoreline, and shore erosion control measures. Also, agricultural activities are permitted within the Buffer under special guidelines. In general, cutting or clearing of trees, except those that are diseased or damaged, is not permitted within the Buffer. A Buffer Management Plan, approved by the local government, can be used to allow for reasonable access to the water, for the removal of invasive species, and for enhancement of the Buffer. Overall, the Buffer should be maintained in natural forest vegetation and must be expanded to include adjacent sensitive resources, such as steep slopes, and hydric or highly erodible soils.

No other types of development or other land disturbances are permitted in the Buffer (e.g., swimming pools, tennis courts, structures, stormwater management structures, and septic fields). If such activities are proposed within the Buffer, the property owner is required to request a variance from their local jurisdiction that both demonstrates unwarranted hardship and proves that the project will not have a negative impact to water quality, plant, fish, or wildlife habitat.

1.2 Evolution of Stormwater Management in the Critical Area

The Critical Area has three primary land use overlay zones: Resource Conservation Areas (RCA), Limited Development Areas (LDA), and Intensely Developed Areas (IDA). *Intensely Developed Areas* are dominated by residential, commercial, industrial, and institutional land uses (at the time of the original Critical Area mapping) and possess relatively little natural habitat. IDAs are also considered the preferred locations for future growth through redevelopment and/or new development.

The original criteria developed under the Critical Area Act required that any development within the IDA be accompanied by practices to reduce water quality impacts associated with stormwater runoff. The Criteria further specified that these practices must be capable of reducing stormwater pollutant loads from a development site to a level at least 10% below the load generated by the same site prior to development. This requirement is commonly referred to as the "10% Rule."

The Critical Area Commission published a guidance document in 1987 to provide a consistent approach to compliance with the 10% Rule (MWCOG, 1987). This document was revised in 1993 and then again in 2003 to reflect changes in stormwater science, treatment technology and state regulations and design manuals (CAC, 2003). The new stormwater criteria presented in this edition apply to all new and redevelopment projects in all three land use overlay zones in the Maryland Critical Area.

The responsibility to review Critical Area stormwater criteria is delegated to each local government for most projects, although there is a subset of projects which must also be submitted to the Critical Area Commission staff.

Over the past decade, stormwater management has evolved dramatically in Maryland, both in terms of the overall strategies to treat stormwater and the most effective types of stormwater Best Management Practices (BMPs). In 2009, the Maryland Department of

the Environment (MDE) revised the 2000 Maryland Stormwater Design Manual, Vol. I & II to reflect the use of environmental site design (ESD) practices. The revised Maryland Stormwater Design Manual can be accessed online at: http:/ www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp

1.3 Why the New Edition was Created

This new edition replaces the CAC (2003) stormwater guidance manual and Appendix D.4 of MDE (2000). It is intended to streamline and improve compliance with both the phosphorus removal standard and the new environmental site design regulations. Consequently this new edition seeks to integrate compliance with both stormwater requirements in a single spreadsheet compliance tool. This edition also reflects improvement in our scientific and engineering understanding of stormwater management over the last decade. The goal of this edition is to ensure that runoff from development projects in the Critical Area does not represent an additional nutrient load to the Chesapeake Bay, as defined under Maryland's nutrient allocation under the Bay-wide nutrient TMDL (MDE, 2010).

1.4 What's New in the 2011 Edition?

- To be consistent with new state-wide ESD requirements, *the phosphorus removal performance standards apply to all projects with more than 5000 square feet of disturbance in all three overlay zones in the Critical Area -- Resource Conservation Areas (RCA), Limited Development Areas (LDA), and Intensely Developed Areas (IDA).* Any development within these three overlay zones must be accompanied by ESD practices to reduce water quality impacts associated with stormwater runoff.

- The stormwater phosphorus removal performance standard for the Critical Area has been enhanced and refined. *The standard is now expressed in terms of a maximum acceptable annual phosphorus load of 0.3 pounds per acre for new development projects in the Critical Area.* The new performance standard ensures that phosphorus loads from new development in the Critical Area will meet water quality standards in the Maryland portion of the Chesapeake Bay, as derived for the Bay-wide TMDL (MDE, 2010). The new standard also reflects a factor of safety to account for the close proximity of the Critical Area to the waters of the Chesapeake Bay. The technical basis for the new standard is documented in Appendix B. The practical implication for communities is that new development projects that meet the performance standard in the Critical Area will not add to their nutrient reduction liability under their local watershed implementation plans.

- The Critical Area phosphorus removal standard is triggered automatically by the spreadsheet once the proposed impervious cover for a site exceeds 10% (note: sites with less impervious cover are still subject to MDE ESD requirements). Phosphorus removal requirements become progressively more stringent as site

impervious increases, with a maximum TP removal requirement of 85% at the most intensively developed sites (i.e., 100% impervious cover --IC).

- This edition also establishes a two-track plan review process that distinguishes between very small projects (250 to 5000 square feet of site disturbance) and the larger projects (5000 or more square feet of site disturbance that trigger the new MDE ESD stormwater requirements). *This edition applies to all development projects above 5000 square feet in the Critical Area.* Another guidance document is currently being developed to streamline the review of very small development projects.

- This edition adopts a definition for redevelopment that is consistent with the more stringent MDE ESD stormwater regulations. *The key change is that the threshold at which a project is classified as redevelopment increases to 40% pre-existing impervious cove*r (compared to the 15% impervious cover threshold proposed in CAC, 2003).

- This edition also integrates the site analysis of predevelopment hydrologic soil groups to better conform to the state-wide methods and equations prescribed for ESD to the MEP compliance (MDE, 2009). The permeability of predevelopment soil types at a development site determines the magnitude of the target volume that must be treated by ESD practices. Soil properties also govern which ESD practices are feasible at a given site, and can strongly influence the phosphorus removal rate they can achieve.

- For the sake of consistency, *this edition uses the same nomenclature and practice names as outlined in the new state-wide ESD regulations and stormwater manual*. New phosphorus removal rates were developed to conform to the new list of ESD practices (see Appendix A). In some cases, designers need to meet criteria that are more stringent than the new MDE stormwater manual in order to achieve the highest removal rate.

- This edition and the accompanying spreadsheet presents “design level” approach for estimating the phosphorus removal capability of certain stormwater practices, based on a two-tiered design approach in the Critical Area. *A practice designed to Level 1 achieves a lower phosphorus removal rate than the more stringent Level 2 designs*.

- In general, Level 1 design equates to the minimum design criteria for ESD practices, as outlined in MDE (2009). Level 2 design includes an enhanced list of design features known to maximizes phosphorus removal, and, consequently, earn a higher phosphorus reduction rate. The technical basis for the two design levels are outlined in CWP and CSN (2008). The specific phosphorus removal rate and required design elements differ for each practice: more detailed Level 1 and 2 design criteria can be found in Section 4.

- This edition presents two new non-structural ESD credits that can be used at Critical Area development sites -- *impervious cover conversion and natural area reforestation*. In addition, several new design criteria are presented for existing MDE ESD credits to ensure they perform effectively in the Critical Area.

- The edition also provides expanded design guidance for alternative surfaces, micro-ESD practices, and ESD practices. *It explicitly recognizes that infiltration, dry swales and regular bioretention areas are acceptable ESD practices to use in the Critical Area*. In addition, this edition treats green roofs and permeable pavements as micro-ESD practices rather than alternative surfaces, which provides greater flexibility in applying these innovative practices. The expanded design guidance also promotes more reliable phosphorus removal, and is specifically adapted to withstand the unique conditions and constraints of the Maryland Coastal Plain (CSN, 2008).

- This edition *is linked to an accompanying spreadsheet tool that simultaneously allows designers to track their environmental site design and phosphorus removal requirements*. The spreadsheet should be used for all development projects that disturb more than 5000 square feet in the Critical Area. The spreadsheet enables designers to quickly find the most cost-effective combination of ESD practices that can comply with both laws.

- The compliance spreadsheet replaces the paper worksheets first introduced in CAC (2003). The spreadsheet automatically computes both the ESD target volume and TP removal requirements, and then shows incremental reductions achieved by various combinations of non-structural ESD credits, alternative surfaces, micro ESD practices and conventional structural practices. Part 3 of this document provides further detail on how to use the spreadsheet, in the context of the Critical Area phosphorus removal performance standard.

- This edition also clarifies *the conditions under which ESD practices can or cannot be used in the 100 foot Critical Area Buffer*.

- The new edition acknowledges that *sea-level rise will affect the location of stormwater infrastructure in the Critical Area,* and proposes several adaptive engineering criteria with respect to the elevation of stormwater outfalls and ESD practices relative to mean high water line.

- Finally, the new edition updates the 2003 CAC guidance for setting offset fees or allowing off-site restoration in the event that full compliance is not possible under the phosphorus removal standard. Part 5 presents *an updated offset fee structure and qualifying criteria for off-site restoration projects.*

Part 2
Standard Critical Area Stormwater Design Review Policies

Over the last 25 years, a series of recurring plan review issues have arisen when local planners evaluate stormwater plan submittals in the Critical Area. This section presents standard design review policies to resolve these issues, which should reduce conflicts between the designer and plan reviewer during the approval process.

2.1 To Whom Do You Submit Your Critical Area Stormwater Plan?

Traditionally, a stormwater plan is either reviewed by the local Critical Area planning authority or the engineering review staff in the Department of Public Works (who is also responsible for ensuring state-wide ESD compliance). Applicants should consult with their local jurisdiction to determine where to submit their Critical Area stormwater plan. It is now possible to consolidate the local stormwater review process within a single review agency that checks for compliance with the "ESD to the MEP" requirement and the Critical Area phosphorus removal standard.

The following table lists those projects which are required to be sent to the Critical Area Commission via the local jurisdiction which will require stormwater calculations. This is not an exhaustive list of required project submittals but rather only those which have a stormwater component. The complete listing of projects required to be submitted to the Commission for review can be found in COMAR 27.01.03.

Table 1
Projects Requiring Stormwater Submittals to the Critical Area Commission

Type of Application	IDA	LDA	RCA
1. Variance from Critical Area provisions	Y	Y	Y
2. Development of less than 5000 square feet of disturbance- (outside of any Habitat Protection Area)	N	N	N
3. Development of between 5,000 and 15,000 square feet of Disturbance (outside of HPA)	N	N	Y
4. Development resulting in greater than 15,000 square feet of disturbance	Y	Y	Y
5. Subdivision of 3 lots or fewer	N	N	Y
6. Subdivision of 4 to 10 lots	N	Y	Y
7. Subdivision of greater than 10 lots	Y	Y	Y
8. Subdivision affecting growth allocation	N/A	Y	Y
9. Intra-family transfer	N/A	N/A	Y

Under the new ESD regulations, stormwater plans must be submitted for review during three stages of site plan review: the concept plan, the preliminary plan and the final plan. It is strongly recommended that the phosphorus removal spreadsheet

computations and ESD plans should be submitted and reviewed concurrently in each stage of local stormwater plan review.

2.2 What are the Rules for Measuring Impervious Cover?

The degree of phosphorus removal required at a development site is strongly influenced by the amount of post-development impervious cover (IC). Therefore, it is extremely important to accurately measure IC when preparing Critical Area stormwater plans.

Table 2 Defining Impervious Cover in the Maryland Critical Area

Land Cover	Material	Is it Impervious?	Counts Toward Lot Cover?
Roads & Parking Lots	Concrete, asphalt, dirt, gravel or oyster shell	Yes	Yes
Driveways	Concrete, asphalt, dirt, gravel or oyster shell	Yes	Yes
Sidewalks/Path	Concrete, asphalt, dirt, gravel or oyster shell	Yes	Yes
Sidewalks/Path	Woodchip	No	No
Buildings	All Roof Surfaces	Yes	Yes
Rooftop	Green Roof	No [2]	Yes
Permeable Paver	Concrete, Asphalt or Pavers	No [2]	Yes
ESD practices	MDE (2009)	No	No
Conventional Structural Practices	MDE (2000)	No	No
Decks	Pervious Design [1]	No	No
Decks	Impervious Design	Yes	Yes
Swimming Pools and Landscaping Ponds		Yes	Yes
Bridges or marine facilities over open water		Yes	Yes

1. The deck is constructed with gaps between the boards and, instead of a concrete pad, a sloping gravel bed is placed under the deck to allow stormwater to infiltrate into the soil. Sheet flow from deck runoff can be insured and erosion reduced by the placement of a gravel bed with vegetative stabilization
2. It is initially entered as impervious cover in Step 2, but the spreadsheet automatically computes the effect of these alternative surfaces in reducing runoff volumes for the site

Impervious cover is broadly defined as those surfaces in the landscape that impede the infiltration of rainfall and result in an increased volume of surface runoff. As a simple rule, all surfaces that are not vegetated will be considered impervious. Impervious surfaces include roofs, buildings, paved streets and parking areas and any concrete, asphalt, compacted dirt or compacted gravel surface. Table 2 provides more detail on what surfaces are classified as impervious or not.

The following policies pertain to the measurement of impervious cover:

- Existing and proposed impervious cover must be measured directly from the most recent and accurate site plan. The use of a planimeter is recommended.

- In addition, the specific contributing impervious drainage area (CIDA) to each ESD credit and/or practice should be delineated on the ESD concept plan.

- Estimates of impervious cover based on general land use type or hydrologic modeling programs are not allowed for submission (e.g., TR-55).

- If land is subdivided prior to construction, it is recommended that the applicant complete the compliance spreadsheet at the time of initial subdivision for lots with an average density of one acre or less, with imperviousness calculated using maximum building envelopes and proposed road layouts.

2.3 How do Permeable Pavement or Green Roofs Affect Your Site IC Footprint?

Prior to 2008, sites within the Critical Area's Limited Development Area (LDA) and Resource Conservation Area (RCA) were limited to a maximum of 15% impervious cover. Impervious surfaces could generally be defined as those man-made surfaces that do not allow stormwater to be infiltrated into the soil. However, certain types of materials were granted a percentage of pervious cover if they provided some degree of infiltration (e.g., pervious pavers). Often, the use of these types of materials created scenarios where individuals could greatly expand the footprint of development on a site. As a result, in 2008 the Commission amended Natural Resources Article §8-1808 to change the term "impervious surface" to "lot coverage" in order to limit the footprint of development on properties designated as LDA and RCA. Lot coverage is now defined as follows:

"Lot Coverage" means the percentage of a total lot or parcel that is:

> Occupied by a structure, accessory structure, parking area, driveway, walkway, or roadway; or
> Covered with gravel, stone, shell, impermeable decking, a paver, permeable pavement, or any manmade material.

Lot coverage does not include:

> A fence or wall that is less than one foot in width that has not been constructed with a footer;
> A walkway in the Buffer or expanded Buffer, including a stairway, that provides direct access to a community or private pier (local governments shall ensure that impacts to the Buffer associated with access are minimized);
> A wood mulch pathway; or

A deck with gaps to allow water to pass freely.

The Critical Area commission has also adopted the following definitions to clarify the review process:

Impermeable decks - Lot coverage includes the ground area covered or occupied by an impermeable deck, even when that deck is not directly touching the ground surface.

Stairways - Lot coverage does not include walkways or stairways in the Buffer that provide direct access to a community or private pier. All other stairs or walkways count.

Stormwater management and erosion control measures - Lot coverage does not include these practices when they are approved only for the specific purpose of performing stormwater management or erosion control.

The 2008 Critical Area amendments specify that lot coverage may not exceed 15% within the Limited Development Area (LDA) and Resource Conservation Area (RCA). Designers frequently ask whether this threshold can be exceeded if alternative surfaces such as green roofs or permeable pavers are used. The policy of the Critical Area Commission is that while these practices are encouraged to meet stormwater requirements, they **cannot** be used to increase the site lot coverage footprint.

2.4 How do you define limits of disturbance for new and redevelopment projects?

The project area subject to both Critical Area and ESD stormwater requirements is defined as the area bounded by the limits of disturbance (i.e., any area subject to clearing, grading, excavation or stockpiling activities during all stages or phases of site development). This definition applies to both new and redevelopment projects.

In general, the Critical Area Buffer and other "down-gradient" natural conservation areas are protected by locating them outside the limits of disturbance. Therefore, the site area devoted to the Critical Area Buffer and related natural areas can be excluded from the analysis of the phosphorus removal standard.

2.5 What are rules for working in the Critical Area Buffer?

The Critical Area Buffer is strictly protected from disturbance to maintain its habitat and water quality functions. Therefore, it can only be disturbed for limited activities such as water-dependent structures, access to the shoreline, and for the installation of shore erosion control measures.

- The general rule is that stormwater treatment practices are not permitted within the 100-foot or expanded Buffer

- Stormwater pipes and outfalls are allowed to cross the Buffer, since they are considered to be water-dependent facilities. Outfalls must discharge to open water but be located at least one foot above the mean high water line to account for extreme tides and future sea level rise. The size and capacity of stormwater pipes should be minimized by using ESD practices to the maximum extent possible. Large diameter stormwater outfall pipes are normally a sign of a poor stormwater plan.
- In limited circumstances, it may be permissible to construct regenerative conveyance wetlands (also known as Coastal Plain Outfalls) for restoration purposes within the Buffer if there is an existing erosion problem around a stormwater outfall or within a stream valley. These proposals are considered on a case-by-case basis.
- The Critical Area Buffer cannot be used for disconnection purposes (rooftop, non-rooftop, or sheet flow to conservation areas) unless there is a minimum 75-foot distance between the closest impervious surface to the landward edge of the 100-foot Buffer.
- In portions of the Buffer which have been designated as Buffer Exemption Areas (also known as Modified Buffer Areas, Buffer Management Areas or Special Buffer Areas), there may be certain ESD practices that are permitted within the Buffer. Generally, acceptable practices must be vegetated (i.e., bioretention areas, rain gardens and landscape infiltration) with a mix of native trees, shrubs and ground covers that replicate natural plant communities while still providing effective runoff reduction and pollutant removal.
- If a Buffer currently lacks forest cover, stormwater credits may be obtained if it meets qualifying conditions for soil restoration and reforestation, as outlined in Section 4.1. The use of native species adapted to the coastal plain is required. A guide to recommended species can be found at http://www.nps.gov/plants/pubs/chesapeake/pdf/chesapeakenatives.pdf.

2.6 Where do you get data on hydrologic soil groups present at your site?

The new ESD regulations require that the hydrologic soil groups present at the site must be mapped to determine the ESD target volume. This information is readily available from the Natural Resources Conservation Service, which publish soil surveys in both hard copy and on-line editions. Please consult the following url to determine the soils data available in your community.

http://soils.usda.gov/survey/printed_surveys/state.asp?state=Maryland&abbr=MD

The most convenient format are the web-based soil surveys that make it easy to analyze soil properties using a GIS format. More information on how to use the web soil survey can be found at:

http://websoilsurvey.nrcs.usda.gov/app/Help/WSS_HomePage_HowTo.pdf
If soils are classified as urban fill or equivalent (e.g., urban land, cut and fills, or made land), they should generally be assigned to hydrological soil group “D”, which has the greatest runoff response (CSN, 2011). Designers also have the option of conducting on-

site soil tests to determine the appropriate HSG using the soil testing methods outlined in Appendix E of NJDEP (2009). If testing indicates the soils have acceptable infiltration rates throughout the entire soil profile and there are no signs of suspicious materials, then the site can be considered suitable for infiltration. If the soil tests are negative, then infiltration should be avoided.

Infiltration is prohibited in cases where a site history investigation indicates that the redevelopment site is a brown-field (US EPA, 2008). Contaminated soils should be capped and stormwater practices should treat surface runoff in a "closed" system which does not allow any interaction with groundwater. This typically involves the use of stormwater filtering practices such as sand filters and bioretention that have impermeable bottom liners. Designers should also avoid infiltration at sites that are expected to become severe stormwater hotspots.

2.7 How do you deal with projects that split the Critical Area boundary?

Many development projects cross the boundary of the Critical Area, such that portions of the site are subject to the phosphorus removal performance standard and others are not. In the past, this situation required special paper worksheets to split the site that perplexed designers and reviewers alike.

While it is still a local call, it is now strongly recommended that the phosphorus removal calculations be performed **for the site as a whole.** The rationale is that the entire site must meet the ESD to MEP standard, and in doing so, may be sufficient to also meet the phosphorus removal standard. In the rare cases where this is not possible, the designer may elect to enter site data for the Critical Area portion of the site into the spreadsheet to see if compliance can be achieved in that manner.

2.8 How do you handle off-site runoff to your project from another property?

Some projects receive additional stormwater runoff from off-site properties. In general, applicants are not required to treat this runoff to the meet the phosphorus removal standard, although they should ensure that their drainage system and ESD practices have sufficient capacity to safely convey this upstream runoff during the ten year storm event without erosion.

A designer may elect to treat some or all of the off-site runoff on their property in order to meet their own phosphorus removal requirement. This can be documented by using the spreadsheet to determine their on-site phosphorus removal requirement, and then running the spreadsheet a second time using the inputs for the off-site drainage area (and proposed treatment areas) to calculate the total load reduction. The offsite load reduction can then be compared to the on-site removal requirement to determine if compliance has been achieved.

2.9 What constitutes a direct stormwater discharge to tidal waters, and does it exempt the need for channel protection storage?

The 2000 MDE stormwater manual waives channel protection storage requirements in situations where stormwater directly discharges to tidal waters. The rationale at the time was that the erosive energy of urban stormwater does not come into play in tidal waters. The 2000 manual also specifically exempted Eastern Shore counties from the channel protection requirement (although they are now subject to higher ESD volumes as a result of the new ESD regulations, which provide some form of channel protection).

It is important to note that the Western shore projects are not exempted from the channel protection requirement unless they can demonstrate that the stream channel to which they directly discharge to is tidal in nature.

Direct discharge is defined in the Code of Maryland Regulations 26.17.02.02(12) as "the concentrated release of stormwater to tidal waters or vegetated tidal wetlands from new development or redevelopment projects in the Critical Area." In addition, under COMAR 26.24.01.02 "Filling" (of tidal waters or wetlands) includes "storm drainage projects which flow directly in tidal waters of the State." Thus, a tidal wetland permit must be applied for from MDE's Tidal Wetlands Division for any direct stormwater discharge, unless the peak discharge rate is less than 2.0 cfs for the one year storm event.

Both designers and plan reviewers have struggled with the interpretation of what constitutes a direct discharge and what is the receiving channel. The current policy of the Critical Area Commission is as follows:

- A direct discharge occurs when a storm drain pipe or ESD outflow discharges to a point no more than 50 lateral feet from tidal water, and at an invert elevation no higher than two feet above the mean high tide line.
- All other stormwater discharges on the Western shore must meet the entire calculated P_e volume to satisfy the channel protection requirement
- Projects on the Eastern shore must still treat their entire calculated P_e volume with acceptable ESD practices.

2.10 How close to you need to be to meet the phosphorus removal performance standard?

Full compliance may be hard to achieve at new development sites with high impervious cover or at high intensity redevelopment projects. Plan reviewers often ask how close to the phosphorus load removal requirement a project needs to be in compliance.

Given the inherent uncertainties associated with the spreadsheet, it is not appropriate to rely on them to more than one significant digit. Consequently, if a project is shown to be within 0.1 pounds per acre per year of the removal requirement, the site can be considered to be compliant.

2.11 How does this guide compare to the MDE stormwater manual?

This document expands on the guidance presented in MDE (2009) for the sizing and design of ESD practices. Within the Critical Area, this document supersedes MDE with respect to design criteria for the following practices:

- The design standards for certain ESD credits are more stringent than the MDE manual to assure reliable phosphorus removal.
- Two new ESD credits for reforestation and impervious cover conversion are now available within the Critical Area.
- Design standards have been adopted for ESD micro-practices in the Critical Area that expand on the guidelines proposed in MDE (2009).
- A more flexible design approach has been developed to size green roofs and permeable pavements.
- Due to their proven runoff reduction capability, infiltration, dry swales and bioretention practices are all considered acceptable ESD practices within the Critical Area.
- A new two-tier design standard has been adopted for conventional stormwater practices as outlined by MDE (2000) to assure proper phosphorus removal credit.

Localities may elect to use the Critical Area design criteria throughout their jurisdiction, or wait for the next edition of the MDE stormwater manual.

Part 3
The Critical Area Spreadsheet Tool

The ESD to MEP spreadsheet tool was developed, tested and refined during 2010 to allow designer engineers and local plan reviewers to evaluate compliance with the new ESD regulations and phosphorus removal performance standard. Version 3.0 of the spreadsheet, released in May 2011, enables the user to track phosphorus reductions and ESD volume reductions at new and redevelopment projects within both the State of Maryland and the Critical Area.

These phosphorus calculations have been integrated within the new ESD to MEP framework, which provides, for the first time, a unified basis for addressing both the MDE and Critical Area stormwater regulations in a single tool. This tool should help streamline project review and reduce the need for duplicate submittals. The spreadsheet is only needed for Critical Area projects with a minimum threshold of 5000 square feet or more of disturbed area. The reader should consult the entire user's guide (CSN, 2010, www.chesapeakestormwater.net); the ensuing section describes how to apply it to satisfy the Critical Area phosphorus removal performance standard.

3.1 Getting Started

The first step is to consult with your local Critical Area planning authority to determine whether your development project lies in all or part of the 1,000 foot Critical Area Zone. A map of the Critical Area for each County can also be found online at the Maryland Environmental Resources and Land Information Network (MERLIN) website (http://mdmerlin.net/). Please note that the maps found on MERLIN are for guidance purposes only. You still must consult with your local Critical Area planning department to officially verify whether your site is located within the Critical Area.

If your project is located within the Critical Area, the next step is find out which local agency to submit your Critical Area stormwater plan. This local agency may not always be the same agency that reviews your ESD stormwater plan. Several tasks should be conducted prior to using the spreadsheet including a site reconnaissance visit and an analysis of environmental mapping features. The minimum environmental and site mapping data needed are outlined on page 5.7 of MDE (2009), and localities often have additional mapping requirements. The importance of early stormwater planning and analysis cannot be over-emphasized, as early decisions about site layout and the development footprint can make it much easier to comply with the phosphorus removal standard.

In particular, designers thoroughly understand the pre-development flow paths, hydrology, soils and environmental features present and work with them to layout the ideal development footprint and locate the best sequence of ESD practices.

As a general rule, designers should split the site up into logical drainage areas of 3 to 5 acres or less, and try to maintain natural flow paths. Designers should focus on the most permeable soils at the site that can be exploited for ESD practices. The product of this

effort is a draft site plan that shows the proposed development foot print, impervious cover areas, protected natural areas, pervious areas and basic soils information.

3.2 Users Guide for the ESD to MEP/Critical Area Spreadsheet

The spreadsheet is large and complex and can certainly be intimidating to first time users. In reality, however, there are only a handful of inputs to prepare and enter. With a bit of practice, the spreadsheet is easy to use in the Critical Area, once you understand a few of its key aspects:

- Most of the Critical Area TP reduction calculation outputs are on the extreme right hand side of the spreadsheet, and will not be visible when the spreadsheet is opened. They can be found by scrolling about ten columns to the right.

- Most of the key spreadsheet inputs are located on the left hand side of the spreadsheet, and are clearly shown as blue cells.

- For most projects, designers will need to follow an iterative process and it may take several tries before you successfully comply. The trick is to keep track of your incremental progress in phosphorus reductions at several key cells in the spreadsheet, which are identified later in this section.

- Designers should seek to apply some kind of ESD 0r credit or practices to all of the impervious cover present at the site.

- The equations in the spreadsheet are locked so they cannot be changed by the user.

The remainder of this section provides a step by step guide on how to analyze ESD practices in the context of the spreadsheet, and provides general advice for designers and plan reviewers on how to most efficiently comply with the phosphorus removal standard.

Step 1: Complete ESD Planning Checklist

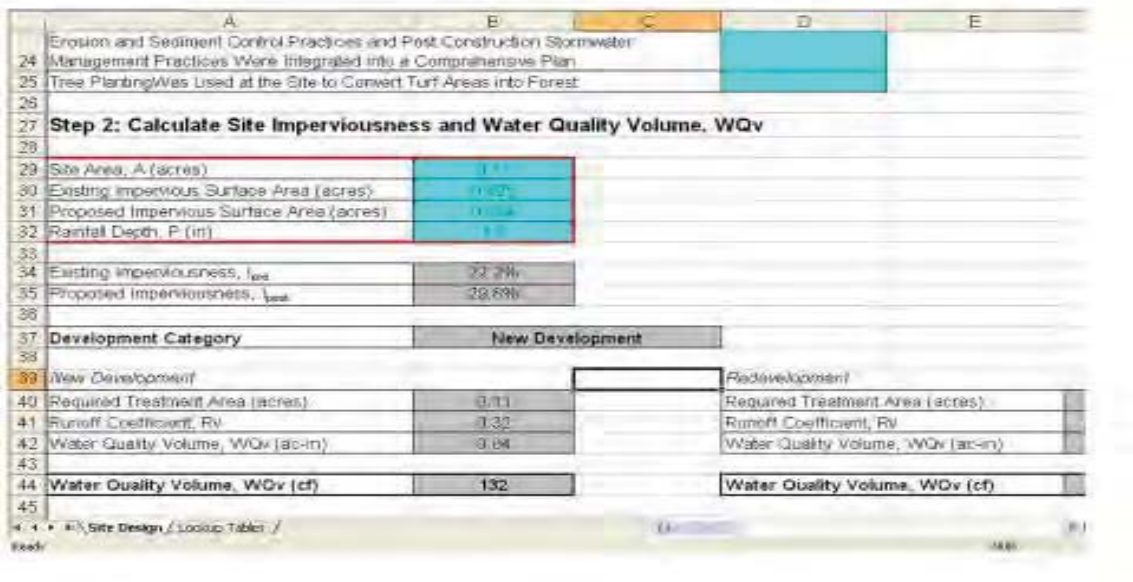
In the first step, designers analyze environmental and soil maps to layout the site and maximize utilization of ESD practices. Designers are asked to answer 12 questions in Table 3 to determine whether they have maximized these early stormwater opportunities. The basic idea is that a compliant concept plan has a “Yes,” or “N/A” selected for each question.

It is recommended that designers clearly show these practices on their stormwater concept plan. In the case that a question is answered “No”, the designers must provide a narrative justification as to why the practice could not be used on the project.

Table 3. ESD Implementation Checklist			
Check all of the Following ESD Practices That Were Implemented On-Site	Yes	No	N/A
1. Environmental site mapping was conducted prior to site layout			
2. Natural areas were conserved (e.g., forests, wetlands, steep slopes)			
3. Stream, wetland and shoreline buffers were reserved			
4. Disturbance of permeable soils was minimized			
5. Natural flow paths were maintained across the site			
6. Building layout was fingerprinted to reduce site clearing/grading			
7. Site grading promoted sheet flow from impervious areas to pervious ones			
8. Better site design was used to reduce needless impervious cover			
9. Site Design maximized disconnection of impervious cover			
10. Future site operations evaluated to identify potential stormwater hotspot			
11. Installation of ESC and ESD Practices are integrated together			
12. Tree planting was used at the site to convert turf areas into forest			

Step 2: Input Pre and Post Development Site Variables. The basic inputs for this step are simple: Site Area **(B29)**, Existing Site Impervious Cover Area **(B30)**, and Proposed Site Impervious Cover Area **(B31)**. Figure 1 shows where the input cells are located within the spreadsheet. Designers should directly measure impervious cover from the site plan using the Critical Area definitions for impervious cover outlined in Table 2. The spreadsheet calculates the percentage of impervious cover for both existing and proposed conditions. If the existing site is greater than 40% impervious, redevelopment rules will apply. The designer also needs to indicate the rainfall depth **(B32)** in order to calculate the required water quality volume. For the Maryland Critical Area, the appropriate choice is 1.0 inch. The Site Area input is defined as the post-development limits of disturbance.

Figure 1: The Four Key Spreadsheet Inputs in Step 2



Step 3: Calculate Phosphorous Removal Requirement

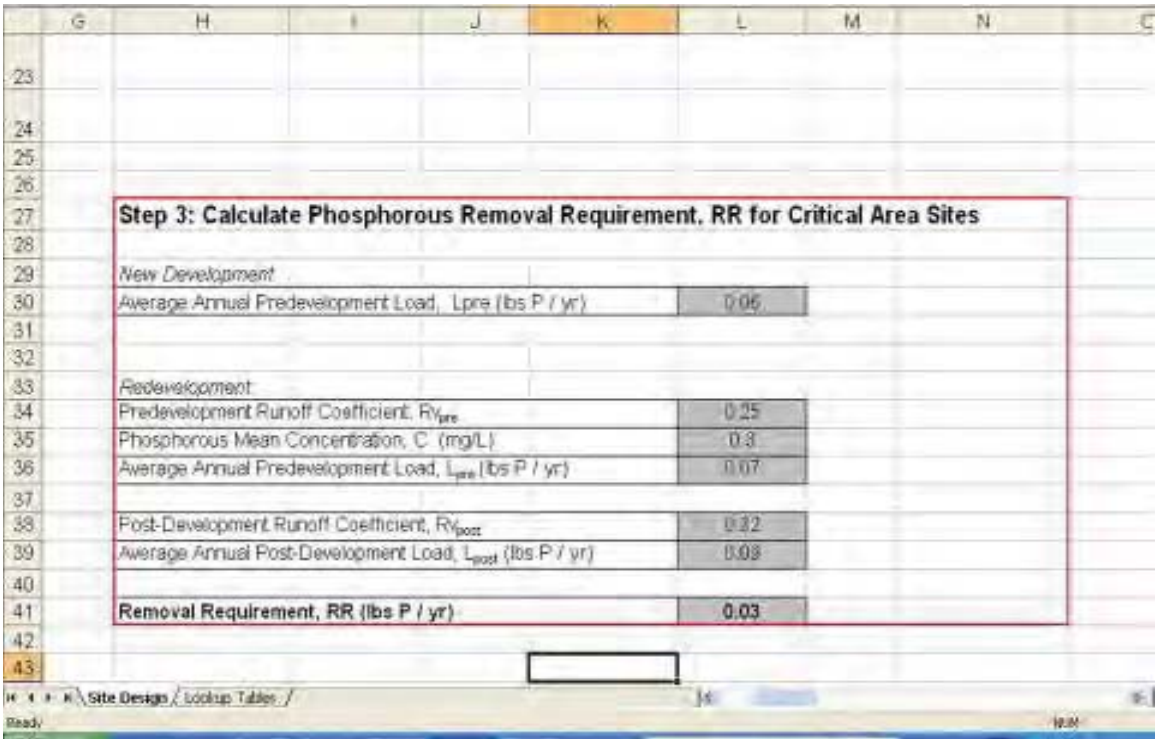
The spreadsheet automatically calculates the average annual predevelopment load based upon whether the project is a new development or redevelopment site. For new development, the predevelopment load for the Critical Area is now defined as an annual load of 0.3 pounds of P per acre.

Redevelopment rules apply if the existing site has more than 40 % impervious cover. In these cases, the predevelopment load is calculated based upon the runoff coefficient and an average runoff concentration of 0.3 mg/L for total phosphorus. The phosphorus removal requirement for redevelopment sites is to reduce the pre-development phosphorous load by 50%.

Figure 2 shows where these phosphorus removal calculations occur within the spreadsheet. The spreadsheet first reports the phosphorus removal requirement for the site in **cell 41-L.** Incremental phosphorus reductions achieved by subsequent ESD practices can be tracked in the following spreadsheet cells:

- Effect of ESD Credits and Micro-Practices: **Cell 133- R**
- Additional Effect of Conventional Structural Practices: **Cell 168-K**

Figure 2: Where the Phosphorus Removal Requirement is Automatically Calculated



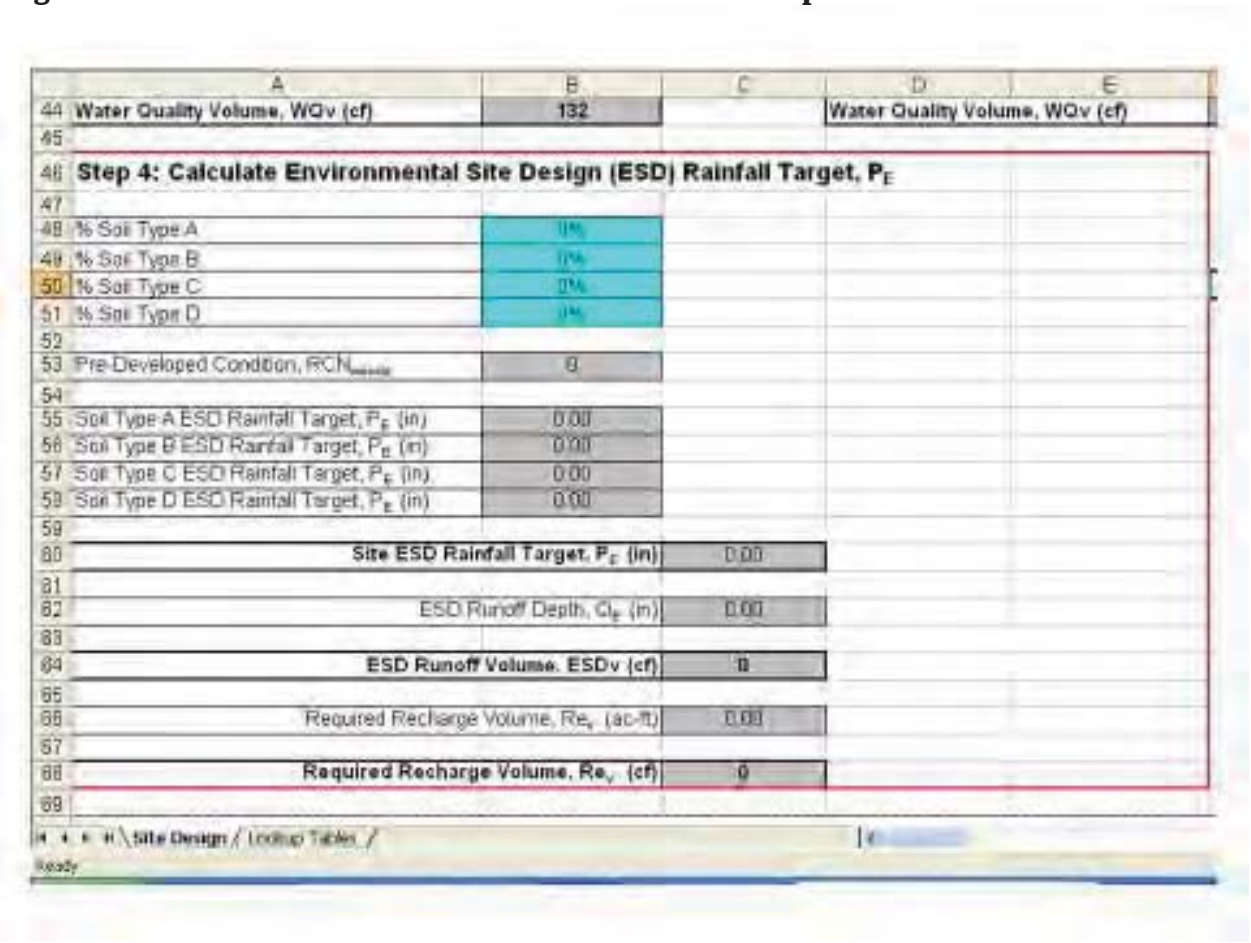
Step 4: Calculate the Environmental Site Design Rainfall Target

In this step, designers need to enter the percentage of the site in each of the four Hydrol0gic Soil Groups (HSGs) on **rows B48-51**. The soil data is used to calculate a pre-development runoff curve number (RCN), which in turn, is used to compute the ESD Rainfall Target. Figure 3 shows where these soil inputs are located in the spreadsheet.

For new development, the ESD rainfall target is defined as the depth of rainfall that must be treated to reduce the site's post-development RCN to the pre-development RCN (i.e., woods in good condition). Required recharge volume is also calculated based upon specific recharge rates for each soil type.

For redevelopment sites, the spreadsheet calculates the required water quality treatment volume, based on the net change in proposed site impervious cover relative to existing site impervious cover.

Figure 3 Where HSG Soil Data is Entered in the Spreadsheet



If the proposed impervious cover at a redevelopment site exceeds existing impervious cover, the spreadsheet also computes the incremental recharge and channel protection volume for the site. Since most redevelopment sites will be on urban fill soils (CSN,

2010), designers should generally assume that 100% of site area will behave as HSG "D" unless they have an on-site soil test to the contrary.

Designers should always look for the most permeable soils present at the site in order to locate the best ESD practices that possess the highest possible phosphorus reductions.

Step 5: Evaluate Effect of Non-Structural ESD Credits

In this step, designers can apply for credits for non-structural practices that effectively disconnect impervious cover. The five credits include:

1. Impervious Cover Conversion
2. Reforestation and Soil Restoration
3. Rooftop Disconnection
4. Non-Rooftop Disconnection
5. Sheet flow to Conservation Area

The designer enters the contributing impervious drainage area **(Column D)**, as well as site-specific design parameters that are needed to receive each credit **(Column G & H).** Based on this information, the spreadsheet automatically computes an ESD runoff volume credit (P_E) that is used to reduce the site ESD rainfall target volume. The credits are calculated based upon the following MDE relationships:

Disconnection of Rooftop Runoff						
	Disconnection Flow Path Length (ft)					
Western Shore	0	15	30	45	60	75
Eastern Shore	0	12	24	36	48	60
P_E Credit	0	0.2	0.4	0.6	0.8	1

Disconnection of Non-Rooftop Runoff						
Ratio of Disconnection Length to Contributing Length	0	0.2	0.4	0.6	0.8	1
P_E Credit	0	0.2	0.4	0.6	0.8	1

Sheet Flow to Conservation Areas				
Minimum Conservation Area Width	0	50	75	100
P_E Credit	0	0.6	0.8	1

The technical basis for the reforestation and impervious cover conversion credits are documented in Part 4.

To obtain the credits, designers must input the predominant predevelopment HSG over the filter path or reforestation areas (i.e., A/B or C/D). The soils data is needed to determine the specific phosphorus removal rates for each hydrological soil group. Designers should always double check the actual distances and slopes of the contributing impervious areas and filter path on the site plan to ensure they conform to the minimum qualifying criteria outlined in Part 4 of this document.

Step 6: Evaluate Effect of ESD Micro-Practices

The spreadsheet presents a somewhat simplified approach to handling ESD micro-practices, which include:

- Green Roof
- Permeable Pavements
- Rainwater Harvesting
- Submerged Gravel Wetlands
- Micro-infiltration (or Dry Wells)
- Rain Gardens
- Micro-Bioretention
- Landscape Infiltration
- Grass Swales
- Bioswales
- Wet Swales

Designers can optimize the types of ESD micro-practices that are most suitable for their site by analyzing the predevelopment HSG as shown in Table 4.

Table 4 Acceptable Soils for ESD Micro-Practices

ESD PRACTICE	HSG A	HSG B	HSG C	HSG D
Green Roof	**X**	**X**	**X**	X
Permeable Pavement	**X**	**X**	**X**	
Rainwater Harvesting	**X**	**X**	**X**	**X**
Submerged Gravel Wetlands			**X**	**X**
Infiltration	**X**	**X**		
Rain Garden		**X**	**X**	**X**
Bioretention		**X**	**X**	**X**
Landscape Infiltration	**X**	**X**		
Grass Swales	**X**	**X**	**X**	
Bioswales	**X**	**X**	**X**	**X**
Wet Swales			**X**	**X**
X= may be suitable depending on depth to water table, bedrock and slope				

In addition, designers should consult Table 5 to identify the most effective micro-ESD practices, based on their contributing drainage area, higher phosphorus removal or capacity to be "upgraded" to a Chapter 3 ESD practice (MDE, 2000).

Enhanced filters can be added as a supplemental design option to the appropriate ESD practices in **Column L.** Infiltration berms are only considered a design element to improve the effectiveness of various disconnection credits in Step 5.

The appropriate hydrologic soil group associated with several ESD micro-practices must be entered into the spreadsheet; this is done to compute differential phosphorus removal rates for the Critical Area computation, as well as to clearly show the most appropriate soil conditions where they can be effectively used.

Table 5 Comparing the ESD Micro-Practices

ESD PRACTICE	Removal tied to HSG?	Max CIDA [2] (sf)	Upgrade? [3]
Green Roof	No	**None**	**No**
Permeable Pavements	Yes	**Varies**	**Yes**
Rainwater Harvesting	No	**~20,000**	**Yes**
Gravel Wetlands	No	**< 1 acre**	**No**
Infiltration	Yes	**500**	**Yes**
Rain Garden	Yes	**2,000**	**No**
Bioretention	Yes	**20,000**	**Yes**
Landscape Infiltration	Yes	**20,000**	**No**
Grass Swales	Yes	**< 1 acre**	**No**
Bioswales	Yes	**< 1 acre**	**Yes**
Wet Swales	No	**< 1 acre**	**N0**
Enhanced Filters	No	**n/a**	**No**

[1] Practice has a higher phosphorus removal rate when situated on permeable A or B soils
[2] The contributing drainage area limits, as prescribed in MDE, Chapter 5
[3] The practice be "upgraded" to a Chapter 3 practice that also meets the ESD criterion (e.g., micro-bioretention upgraded to a regular bioretention area)

This step begins with an overlay of the site layout, pervious areas and soil conditions. Designers should work to direct contiguous impervious areas to pervious areas, and draw the approximate drainage areas to each micro-practice. The spreadsheet assumes that 100% of the impervious area is treated by the individual micro-practice. The designer then estimates the surface area of the micro-practice. The designer can then aggregate the total contributing impervious drainage area (CIDA) and surface area for each category of micro-practice for the drainage area as a whole.

The designer enters the CIDA into **Column D**, as well as any practice-specific design parameters in **Column G & H** for each set of ESD micro-practices planned for the site. One of the new features in this version of the spreadsheet constrains the practice design parameters so they do not exceed reasonable combinations of surface area to CIDA.

The combined phosphorus reductions achieved by ESD micro-practices can be tracked in spreadsheet cell **133-R.**

Dealing with ESD Credits and Practices in Series.

Designers can select a down-gradient ESD practice to which runoff from an up-gradient ESD practice will be directed from the dropdown box in **Column N** (e.g., bioretention to a bioswale). The spreadsheet allows for proper accounting of ESD practices in series, and produces the aggregate ESD rainfall target credit and the increment of phosphorus load reduction for the entire system of ESD micro-practices at the site.

Important Note: When practices are to be used in series, select the down-gradient practice from the pull-down menu in Column N, but DO NOT input the same drainage area into Column D of the down-gradient practice. The spreadsheet automatically directs the proper runoff volume to the down-gradient practice. The only time Column D would be filled in for the down-gradient practice would be if the practice receives runoff from additional impervious cover that was not treated by the up-gradient practice.

Step 7: Check for Site Compliance with Phosphorous Reduction Requirement

The spreadsheet summarizes the total phosphorous load reduced by the ESD practices at **cell 133-R.** This load is then compared to the site reduction requirement to determine whether the site has complied with the phosphorus removal standard. Operationally, this requirement is satisfied when sufficient ESD practices are used to meet the entire ESD rainfall target volume and the entire phosphorus load reduction requirement for the project.

If full compliance with the phosphorus removal performance standard cannot be demonstrated, the designer must re-evaluate the site to achieve greater phosphorus reductions. This involves an iterative process to investigate more ESD options, using the spreadsheet. Some useful strategies include:

Run the Spreadsheet Just For the Critical Area Portion of the Site: If your project contains portions inside and outside the Critical Area boundary, you may want to run the spreadsheet twice, once for the entire site and a second time just using the portion of total site area within the Critical Area. If either run indicates compliance, you are done (see Part 3.6).

Evaluate Whether Off-site Treatment Helps: You may also want to investigate whether it is possible to treat off-site stormwater on your site and credit this towards your on-site phosphorus removal requirement, using the protocols outlined in Part 3.7

Go Back to Step 1 and Adjust Site Layout to Reduce Impervious Cover or Increase Forest Cover. Designers should particularly focus on any of the ESD planning practices that were not used in the ESD implementation checklist.

Go Back to Step 5 and Expand Site Area Subject to Credits. The site plan should be reexamined to determine if more impervious cover could be treated through disconnection and filter strips, either by additional disconnection, or improving the soil and slope conditions within the filter strip, using infiltration berms (p. 5.87 of MDE, 2009), compost amendments, grading, or engineered level spreaders or other measures so that a greater CIDA can be treated.

Go Back to Step 6 and Apply More Effective ESD Practices For Phosphorus Removal. Designers have a number of options to improve the aggregate ESD performance for the site in this step. Consult Table 6 to see whether a different ESD practice or design level could boost the phosphorus removal rates.

1. Add more micro-ESD practices to pick-up additional untreated CIDA
2. Over-control at individual micro-ESD practices by treating the entire target ESD volume
3. Change the mix of micro-ESD practices to increase runoff reduction (shift from grass swale to bio-swale, or from rain garden to micro-bioretention, etc.)
4. Add Enhanced Filters to the bottom of select ESD micro-practices (MDE, 2009, see page 5.113)
5. Use ESD practices such as infiltration trenches, bioretention and dry swales that serve a larger CIDA and/or have a greater phosphorus removal capability (these can be entered directly into the micro-ESD spreadsheet)

Go forward to Step 9 to see if Conventional Stormwater Practices are capable of removing your remaining phosphorus load (e.g., sand filters, wetlands and ponds).

If you still cannot fully comply, then you should build the maximum system of ESD practices, and apply for an offset with the local Critical Area planning authority to handle the remaining untreated phosphorus load (see Part 5).

Step 8: Compute Reduced RCN for the Channel Protection Volume

If your site is subject to the Channel Protection requirement, you can use this step to determine whether the volume can be reduced due to the ESD volume that you have already provided on the site. The spreadsheet automatically calculates a reduced RCN based upon the ESD rainfall depth treated in prior steps. If the required ESD rainfall depth has not been completely treated through acceptable ESD practices, this revised and reduced RCN is used to calculate the Channel Protection Volume that must be treated through structural practices, such as ponds or wetlands.

The reduced RCN values **should not be used** for the larger design storms used for flood control analysis (e.g., the 10 or 100 year design event).

Step 9: Select Structural Practices to Meet Remaining Phosphorus Load

This step is only performed when the system of ESD practices cannot meet the phosphorus removal standard. Designers can then consider traditional structural stormwater practices such as ponds, wetlands, and filtering systems to obtain the remaining phosphorus reduction.

Designers will need to design the structural practice (or practices) at the most downstream point in the project drainage area, and then independently calculate the treatment volume. These values should then be imported into the respective entry fields for contributing impervious drainage area (**column B**) and the design treatment volume (**column E**). The spreadsheet then recalculates the phosphorous load reduction achieved by the additional structural practices utilized (**cell 168-K**).

The spreadsheet shows two levels of design for structural stormwater practices, which are used to estimate their phosphorus removal capability for the Critical Area requirement. Level 1 is a baseline design using the minimum criteria for the practice as outlined in MDE (2000), whereas Level 2 is an enhanced design that maximizes phosphorus removal. The technical basis for the two design levels are outlined in CWP and CSN (2008). More detailed Level 1 and 2 design criteria can be found in Part 4.

Step 10: Evaluate Feasibility of the Stormwater Plan

Your local review authority may require additional information to evaluate the feasibility of your ESD plan (beyond the spreadsheet result). Several important elements are needed to finalize the concept plan, as follows:

- A detailed stormwater site plan should be drafted to show the spatial distribution of ESD practices in such a manner that plan reviewers can verify spreadsheet areas related to CIDA and ESD practice surface area.

- The designer should also analyze the site to confirm the feasibility of individual ESD practices (e.g., depth to water table, depth to bedrock, contributing slopes, sheet flow distances, minimum practice surface area) as described in Part 4 of this document.

- Designers must also solve the tricky problem of how to sequence installation of ESD practices in the context of plans for grading and erosion and sediment control (ESC).

- Many ESD practices must be protected from disturbance during construction and/or installed after the site has been permanently stabilized. At the same time, the ESC plan must provide effective controls during construction to prevent the discharge of sediments.

- Soil borings and infiltration testing may also be needed to confirm infiltration rates and underlying soil conditions at the site.

- Designers should also carefully review the plan to ensure safe and non-erosive conveyance of large storms through the sequence of ESD practices across the site. This analysis dictates the consequent need for overflows, flow splitters, channel stability and other measures to protect ESD practices from larger storms events, such as peak discharges from the 2 or 10 year storm design event.

- Lastly, the concept plan must meet the minimum submittal requirements established by the State (i.e., pages 5.15-16 of MDE, 2009), in addition to any requirements established by the local stormwater review authority.

Step 11: Final ESD Design Plan and Verification After Installation

The compliance spreadsheet should be run again to verify that the final ESD plan meets the ESD to MEP criterion. At this point, the CIDA, surface areas, design parameters and treatment volume for individual ESD practices can be more accurately measured and defined. The revised values should be entered into the spreadsheet to ensure that the results from the concept plan can be verified or exceeded. The spreadsheet can be submitted as part of the final ESD design package. The package must meet the minimum submittal requirements established by the State (i.e., Page 5.11 of MDE, 2009), in addition to any requirements established by the local stormwater review authority.

Several steps are crucial after the final plan is approved to ensure ESD practices are properly installed. Inspections are needed to ensure ESD areas are protected from disturbance during the construction stage, and when the site has been adequately stabilized to permit the installation of ESD practices. Post-construction inspections are needed to verify that ESD practices have been properly installed, are functioning as intended, and meet any vegetative cover requirements.

Part 4
Enhanced Design Criteria for ESD Practices in the Critical Area

This section documents the phosphorus removal rates for various design levels for stormwater practices installed within the Critical Area (Table 6).

Table 6. Summary of TP Removal Rates For ESD Credits and Practices and Conventional Stormwater Practices in the Maryland Critical Area

ESD Practices	TP Removal Rates (%)		Where is entered on the spreadsheet
	A & B Soils	C & D Soils	
Impervious Cover Conversion	Varies	Varies	Row 31 B2
Simple Rooftop Disconnection	50	25	Rows 80 to 83
Non-Rooftop Disconnection	50	25 *	Rows 84 to 87
Sheet-flow to Conservation Area	50	25 *	Rows 88 to 91
Reforestation/Soil Restoration	Varies	Varies	Rows 76 to 79
Green Roof	Level 1: 45	Level 2: 60	Rows 96 to 99
Permeable Pavements	80	60	Rows 100 to 103
Rainwater Harvesting	45		Rows 104 to 105
Submerged Gravel Wetlands	60		Rows 106 to 107
Landscape Infiltration	75	NA	Rows 118 to 119
Micro-infiltration (Dry Well)	65	NA	Rows 108 to 109
Infiltration	90	60	Rows 165 to166
Rain Gardens	50	25	Rows 110 to 113
Micro and Regular Bioretention	75	50	Rows 114 to 117
Urban Bioretention	50	25	Rows 110 to 113
Grass Channels	40	20*	Rows 120 to 123
Bio Swales and Dry Swales	75	50	Rows 124 to 127
Wet Swales	40		Rows 128 to 129
Sand Filters	Level 1: 60 Level 2: 65		Rows 163 to 164
Wet Ponds and Wet ED Ponds	Level 1: 50 Level 2: 75		Rows 159 to 160
Constructed Wetlands	Level 1: 50 Level 2: 75		Rows 161 to 162

See Appendix A for how these removal values were derived
NA = not applicable * higher rates possible if soils are restored

4.1 Non-structural ESD Practices and Credits

Impervious Cover Conversion

Applicability: Impervious cover conversion involves the removal of existing impervious cover at a redevelopment site, followed by soil restoration such that the new pervious area performs hydrologically as if it were un-compacted grass, and filters runoff from adjacent hard surfaces. This practice primarily applies to redevelopment projects which seek to reduce their required water quality volume. The practice may also apply to new development projects that have some pre-existing impervious cover.

MDE Reference: No specific design criteria are provided.

TP Removal Rate: Computed internally by the spreadsheet, based on how much predevelopment impervious cover is being reduced. The reduced TP removal requirement associated with the impervious cover conversion can be found in cell **41-L.**

Additional Design Criteria for Critical Area

The following design standards apply to impervious cover conversion:

- The minimum surface area for the impervious cover conversion credit is 250 square feet.
- Site plans shall show the specific areas where concrete or asphalt will be removed and recycled.
- Underlying compacted soils shall be deep tilled and amended with compost to restore porosity, using the methods outlined in the most current edition of the Bay-wide soil restoration design specification.
- The new pervious area can be graded to accept runoff from adjacent hard surfaces.
- A project is eligible for additional phosphorus removal credit for the pervious area if it is designed to provide further infiltration or bioretention.
- The pervious area must be planted with an acceptable vegetative cover, which reflects landscaping objectives and anticipated future uses at the redevelopment site.
- The conversion shall be permanent, and accompanied by a deed or covenant that specifies that the area cannot be rebuilt in the future (unless it is adequately mitigated).
- The maintenance plan shall specify that the vegetative condition of the pervious area shall be regularly inspected and must be regularly maintained to ensure no soil erosion occurs.

Where it is Entered in the Compliance Spreadsheet: Go to Row 31, Col B and enter the lower proposed existing impervious area.

Simple Rooftop Disconnection

Applicability: Works best at low to moderate density residential dwellings on individual roof leaders, although it can also be used for very small parking lots. The maximum contributing impervious area that can drain to a single disconnection is limited to 500 square feet for residential projects, and 1000 square feet for all other projects. Disconnections are acceptable for soils in HSG A, B and C; soil restoration is usually needed for disconnections on D soils or urban fill soils.

MDE Reference: Page 5.57 in MDE (2009)

Key MDE Design Criteria:

- The disconnection filter path must be at least 15 ft in length, although performance is maximized when the filter path extends to 75 ft, at which point there is no further phosphorus reduction credit.
- There must be a 10 feet lateral setback from the filter path to any adjacent impervious cover (i.e., driveways or sidewalks).
- The filter path cannot have a slope greater than 5%. Infiltration berms can be used to break up slopes.
- Flow velocities in the filter path shall be non-erosive for two year storm.

Critical Area TP Removal Rate

- 50% for qualifying disconnections on HSG A and B Soils
- 25% for qualifying disconnections on HSG C and D Soils (see Table 7).

Table 7 Simple Disconnection

Level 1 Design TP:25%	Level 2 Design TP: 50%
C and D Soils	A and B Soils, OR Restored C and D Soils *
Filter path is 15 to 50 feet long	Filter path exceeds 50 feet *
Slope of filter path is more than 3%	Slope of filter path is less than 3% *
*All three criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- The filter path shall have a minimum slope of 1% and a maximum slope of 3%.
- Steeper slopes can be broken up with infiltration berms or site grading to meet these limits.
- The depth between the filter path surface and the seasonally high water table cannot be less than two feet in the coastal plain.
- The lateral distance between any two individual disconnections must exceed 25 feet.

Where it is Entered in the Compliance Spreadsheet. Go to Row 80 to 83 and select the row that corresponds to the predevelopment HSG for your practice, and then enter the acreage of contributing impervious cover, the flow path length (in feet) and its geographic location (Eastern or Western shore).

Non-rooftop Disconnection (Filter Strip)

Applicability: This option works best for commercial sites with sidewalks, driveways and very small parking lots (approximately 6 to 10 spaces). The maximum contributing impervious area that can drain to a single disconnection is limited to 1000 square feet. This disconnection is designed as a filter strip to ensure phosphorus removal.

MDE Reference: page 5.61 in Chapter 5 of MDE (2009)

Key MDE Design Criteria: The basic design criteria are very similar to simple rooftop disconnection:

- The disconnection filter path must be at least 15 ft in length, although performance is maximized when the filter path extends to 75 ft, at which point there is no further phosphorus reduction credit.
- There must be a 10 feet lateral setback from the filter path to any adjacent impervious cover (i.e., driveways or sidewalk).
- The filter path cannot have a slope greater than 5%. Infiltration berms can be used to break up slopes.
- Flow velocities across the filter strip shall be non-erosive for two year storm.

Critical Area TP Removal Rate:

- 50% for qualifying disconnections on HSG A and B Soils
- 25% for qualifying disconnections on HSG C and D Soils (see Table 8)
- Performance can be increased when C and D soils are restored.

Table 8 Non-Rooftop Disconnection (aka filter strip)

Level 1 Design TP:25%	Level 2 Design TP:50%
C and D Soils	A and B Soils OR Restored C and D Soils *
Filter path is 15 to 50 feet long	Filter path exceeds 50 feet *
Slope of filter path is more than 3%	Slope of filter path is less than 3% *
*All three criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- A gravel diaphragm shall be installed at top of filter strip and an infiltration berm at the toe.
- Heavy equipment must be kept out of the filter strip area during construction, unless the soils are restored.
- The depth between the filter path surface and the seasonally high water table cannot be less than two feet in the coastal plain.
- The lateral distance between any two individual disconnections must exceed 25 feet.

Where it is Entered in the Compliance Spreadsheet: Go to Row 84 to 87 and select the row that corresponds to the predevelopment HSG for your practice, and then enter the acreage of contributing impervious cover, the disconnection length (in feet) and the contributing length of impervious cover (in feet).

Sheet flow to Conservation Area

Applicability: This credit is a good option at the boundary of the Critical Area Buffer, or adjacent to other stream or wetland buffer or other natural areas that must be conserved at the site. The credit cannot be used if stormwater runoff is directed to a buffer that protects a wetland of special state concern.

MDE Reference: page 5.66 in Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- The maximum permissible slope within the Conservation Area is 5%.
- The maximum distance from impervious cover to the conservation area is 75 ft.
- The conservation area must be at least 20,000 square feet in area and have a minimum width of 50 feet.
- The conservation area cannot have managed turf.

Critical Area TP Removal Rate (Table 9)

- 50% for qualifying conservation areas on HSG A and B Soils
- 25% for qualifying conservation areas on HSG C and D Soils

Table 9 Sheet flow to Conservation Area	
Level 1 Design TP:25%	**Level 2 Design TP: 50%**
C and D Soils	A and B Soils OR restored C and D Soils *
Filter path is 15 to 50 feet long	Filter path exceeds 50 feet *
Slope of filter path is more than 3%	Slope of filter path is less than 3% *
*All three criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- If runoff is directed to the Critical Area Buffer, a grass filter strip must extend at least 75 feet from the nearest contributing impervious cover.
- A grass filter strip with compost amended soils may be suitable to treat small areas of impervious cover, up to a maximum of 5000 square feet.
- The filter strip needs to be equipped with a gravel diaphragm, infiltration berm or engineered level spreader to spread flows.
- The water table must be at least 18 inches below surface the surface of the strip.
- Designers must perform a site reconnaissance to confirm topography, slope, and soil conditions prior to design.
- The boundary zone shall consist of ten feet of level grass, and have a maximum entrance slope of less than 3% in the first ten feet of filter.
- The conservation area must be located outside the limits of disturbance and be protected by ESC perimeter controls.

Where it is Entered in the Compliance Spreadsheet: Go to Row 88 to 91 and select the row that corresponds to the predevelopment HSG for your practice, and then enter the acreage of contributing impervious cover, the width of the conservation area (feet) and the contributing length of impervious cover (feet).

Soil Restoration/Reforestation Credit

Applicability: This practice is used to improve the hydrologic capacity of open areas by restoring soils and planting trees to achieve forest cover. The proposed reforestation must be for the purpose of reducing runoff. Reforestation required under the Maryland Forest Conservation Act or the CAC Forest and Woodland Protection Criteria are not eligible for the credit. Even small units of soil reforestation and reforestation in urban watersheds can help meet local forest canopy goals and provide effective stormwater treatment at the same time.

MDE Reference: No specific design criteria are provided in MDE (2009).

Critical Area TP Removal Rate: Variable. On projects with HSG A or B soils, for each five square feet of soil restoration and reforestation, one square foot of impervious cover can be deducted from the site. On project with HSG C or D soils, for each ten square feet of soil restoration and reforestation, one square foot of impervious cover can be deducted for the site. The credit is further increased if the restored area is graded to receive runoff from adjacent areas of impervious cover.

Additional Design Criteria for Critical Area

Additional phosphorus removal credit for treatment of adjacent impervious cover directed to restoration areas using the sheetflow to conservation area credit
The practice must be subject to a long term reforestation plan that is capable of creating 75% forest canopy in 10 years

- Soil restoration is a required component of the reforestation credit.
- The planting plan must be approved by the appropriate local forestry or conservation authority, including any special site preparation needs. It must contain a long term vegetation management plan to maintain the reforestation area in a healthy forest condition.
- After 10 years, the required density of native trees is 300 stems per acre.
- Planting plans must include at least 5 different native tree species.
- Under urban conditions, planting plans should emphasize balled and burlapped native tree stock from 1 to 4 inches in diameter. The primary reason is to quickly achieve the desired tree canopy and ensure that the individual trees are visible enough so they are not disturbed, mowed or otherwise damaged as they grow.
- In rural or suburban settings, planting plans should include at least a minimum 10% of larger stock (1" caliper or more).
- The reforestation area must be protected by a perpetual stormwater easement or deed restriction which stipulates that no future development or disturbance may occur within the area, unless it is fully mitigated.
- The construction contract should contain a care and replacement warranty extending at least 3 growing seasons, to ensure adequate growth and survival of the plant community. Control of invasive tree species should be a major part of the initial maintenance plan.
- The reforestation area shall be shown on all construction drawings and erosion and sediment control plans during construction.

Where it is Entered in the Compliance Spreadsheet: Go to Row 76 to79 and select the row that corresponds to the predevelopment HSG for your restoration area, and then enter the acreage of contributing impervious cover and the surface area of the reforestation area (square feet).

Note on Soil Restoration

Applicability: The phosphorus removal capability of disconnections, filter strips and grass channels can be boosted when soils are restored to increase their permeability. The soil restoration process involves deep tilling, grading and soil compost amendments using the methods outlined in the Bay-wide soil restoration specification. There are a few limits on the use of soil restoration, as they are not feasible when:

Existing soils have high infiltration rates (e.g., HSG "A" soils)
The water table or bedrock is located within 1.5 feet of the soil surface.
Slopes exceed 10%.
Existing soils are saturated or seasonally wet
They would harm roots of existing trees (stay outside the tree drip line)
The downhill slope runs toward an existing or proposed building foundation

Soil Amendment: The depth of compost amendment is based on the relationship of the surface area of the soil amendment to the contributing area of impervious cover that it receives. Table 10 presents some guidance on the required depth to which the compost must be incorporated.

Table 10 Short-Cut Method to Determine Compost and Incorporation Depths

	Contributing Impervious Cover to Soil Amendment Area Ratio [1]			
	IC/SA = 0 [2]	**IC/SA = 0.5**	**IC/SA = 0.75**	**IC/SA = 1.0 [3]**
Compost (in) [4]	2 to 4 [5]	3 to 6 [5]	4 to 8 [5]	6 to 10 [5]
Incorporation Depth (in)	6 to 10 [5]	8 to 12 [5]	15 to 18 [5]	18 to 24 [5]
Incorporation Method	Rototiller	Tiller	Subsoiler	Subsoiler

Notes:
[1] IC = contrib. impervious cover (sq. ft.) and SA = surface area of compost amendment (sq. ft.)
[2] For amendment of compacted lawns that do not receive off-site runoff
[3] In general, IC/SA ratios greater than 1 should be avoided
[4] Average depth of compost added
[5] Lower end for B soils, higher end for C/D soils

More information on the design, construction, and inspection of the soil restoration practice can be accessed at www.chesapeakestormwater.net

4.2 Environmental Site Design Practices

Green Roof

Applicability: Green Roofs (also known as *vegetated roofs, living roofs* or *eco-roofs*) are alternative roof surfaces that typically consist of waterproofing, drainage materials and an engineered growing media that is designed to support plant growth. Green roofs capture and temporarily store stormwater runoff in the growing media before it is conveyed into the storm drain system. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites.

The most common design is the *extensive* green roof system which have a shallow growing media (4 to 8 inches), planted with carefully selected drought tolerant vegetation. Green roofs are preferred because they incorporate stormwater treatment directly into the architecture of the building, which eliminates the need to consume surface land. They provide modest levels of runoff reduction, and can be major compliance element at many high intensity redevelopment sites. Their high installation cost is compensated by long term savings in energy consumption and roof longevity.

MDE Reference and Design Criteria: page 5.42 in Chapter 5 of MDE (2009)

Critical Area TP Removal Rate:

- Design Level 1: 45%
- Design Level 2: 60%
- The requirements for each design level are outlined in Table 12

Table 12 Design Levels for Green Roof	
Level 1 Design TP: 45%	**Level 2 Design TP: 60%**
Depth of media up to 4 inches	Media depth 4 to 8 inches
Drainage mats	2-inch stone drainage layer
No more than 20% organic matter in media	No more than 10% organic matter in media
*All three criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- Select species that can tolerate both drought and salt spray
- Further guidance on green roof design and installation can be found in CSN Bay-wide Design Specification No. 4.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 96 to 99, and select the row that corresponds to the predevelopment HSG for the project site. Next, enter the acreage of contributing impervious cover to the green roof, and the estimated thickness of the media layer (in inches).

Permeable Pavements

Applicability: Permeable pavements are alternative paving surfaces that allow stormwater runoff to filter through voids in the pavement surface into an underlying stone reservoir, where it is temporarily stored and/or infiltrated. Permeable pavement is an attractive option to treat runoff from driveways, plazas, sidewalks, and parking lots, particularly when soils are in HSG A, B and C. Permeable pavement should be avoided if they are located close to sand dunes, due to the risk of blowing sand, at sites where water table is close to the soil surface, and for some HSG D soils.

MDE Reference and Design Criteria: page 5.42 in Chapter 5 of MDE (2009)

Critical Area TP Removal Rate (see Table 11)

Table 11 Permeable Pavement Design Criteria

Level 1 Design TP: 60%	Level 2 Design TP: 80%
Store and treats the entire WQv	Storage exceeds the one inch WQv *
C or D Soils with infiltration rates less than 0.5 in./hr	A, B or C soils with infiltration rate exceeding 0.5 in./hr *
Under drain required	Under drain not required; ***OR*** if an under drain is used, a 12-inch stone sump must be provided below the under drain invert *
The ratio of external contributing area to permeable pavement does not exceed 2:1.	The ratio of external contributing area to permeable pavement does not exceed 1. *
*All four criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- Permeable pavers with acceptable storage may be constructed on D soils if the facility can achieve a 48 hour drain time. The design volume and contributing drainage area should be entered as a design level 1 filtering system (Row 164).
- A minimum separation distance of two feet from the bottom of the storage reservoir to the seasonally high water table must be maintained for Level 2 designs.
- This separation distance can be reduced to a foot if the reservoir is equipped with a stone sump and under drain.
- A minimum slope of 0.5% shall be maintained in the under drain system.
- CSN released a Bay-wide design specification in 2010 for permeable pavers which can be accessed at www.chesapeakestormwater.net

Where it is Entered in the Compliance Spreadsheet: Go to Rows 100 to 103 and select the row that corresponds to the predevelopment HSG for under the pavers. Next, enter the acreage of contributing impervious cover to the paver and estimated thickness of the paver bed in feet. If an enhanced filter is added to the facility, the cubic feet of additional storage should be entered.

Rainwater Harvesting

Rainwater Harvesting systems intercept, divert, store and release rainfall for future use. Rainwater harvesting is also known as cisterns or rain tank. Rainwater that falls on a rooftop is collected and conveyed into an above or below ground storage tank where it can be used for non-potable water uses and on-site stormwater disposal/infiltration. Non-potable uses may include flushing of toilets and urinals inside buildings, landscape irrigation, exterior washing, fire suppression systems, water cooling towers, water fountains, and laundry, if approved by the local authority.

Applicability: Rain tanks or cisterns are useful for treating rooftop runoff from low density residential homes, and hi-intensity redevelopment projects. High redevelopment intensity often generates higher demand for both indoor non-potable water and outdoor landscape irrigation water, which means that substantial runoff volumes can be reused throughout the year.

MDE Reference: page 5.91 of Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- Rain barrels and cisterns shall be designed to capture at least 0.2 inches of rainfall from the contributing rooftop area.
- A P_E credit based on the fraction of the ESDv captured and re-used shall be applied to the contributing rooftop area.

Critical Area TP Removal Rate: default of 45%, but may be greater depending on how much rainfall is reused.

Additional Design Criteria for Critical Area

- A spreadsheet available to determine the ESD volume actually captured based on indoor and outdoor demand at www.chesapeakestormwater.net
- Designers should consult Bay-wide Design Specification No. 6 for Rainwater Harvesting.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 104 and 105 and enter the acreage of contributing impervious cover and the design volume of the rainwater harvesting practice (cubic feet).

Submerged Gravel Wetlands

Applicability: This practice is recommended for development projects located on the Eastern Shore that have high water tables. The best soils are in HSG C and D, although they can be used on HSG A and B Soils if the water table is within three feet or less from the land surface.

MDE Reference: page 5.77 of Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- The submerged gravel wetland must have a minimum CDA of one acre.
- The wetland gravel bed should be no shallower than 18 inches and no deeper than 48 inches.
- A pretreatment forebay sized at a minimum of 10% of the incoming ESD volume is required to keep sediments from accumulating in the gravel.

***Critical Area TP Removal Rate*:** 60%

Additional Design Criteria for Critical Area

- More detailed guidance on the design, installation and maintenance of submerged gravel wetlands can be found in UNHSC (2009).

Where it is Entered in the Compliance Spreadsheet: Go to Rows 106 and 107 and enter the acreage of contributing impervious cover to the wetland and the depth of the submerged gravel wetland (in feet).

Landscape Infiltration

Applicability. This is a good option for small residential and commercial projects that are located on highly permeable soils. The maximum contributing drainage area to an individual landscape infiltration practice cannot exceed 10,000 square feet, and is not feasible for projects that have HSG C and D soils.

MDE Reference: page 5.82 of Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- The facility should be designed to fully dewater in 48 hours.
- The typical cross-section from top to bottom includes 6 to 9 inches of surface ponding, 12 to 18 inches of soil media, 12 inches of gravel and 12 inches of sand
- Practice restricted to HSG A and B soils.
- The maximum CDA to an individual practice is 10,000 square feet.
- A larger CDA is permissible with on-site soil testing and pretreatment measures.
- Standard setbacks to building foundations and septic systems must be maintained.

Critical Area TP Removal Rate: 75% (for A and B soils only)

Additional Design Criteria for Critical Area

Designers may upgrade to an infiltration or bioretention practice to serve a larger drainage area, provided that they conduct soil testing to confirm infiltration capability and install pretreatment measures.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 118 and 119 and enter the acreage of contributing impervious cover, surface area (square feet) and the depth of the landscape infiltration practice (feet).

Dry Well and Micro-infiltration

Applicability: This is a good option for small residential and commercial projects that are located on highly permeable HSG A and B soils. The maximum contributing drainage area to an individual dry well cannot exceed 500 square feet. Dry wells are not feasible for projects with HSG C and D soils.

MDE Reference: page 5.91 of Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- Pretreatment is required in gutters or using grass filter strip.
- A 6 to 12 inch bottom sand layer must be provided below stone reservoir.
- Standard setbacks to building foundations and septic systems must be maintained.
- Dry wells are restricted to slopes of 2% or less.
- The facility should be designed to fully dewater in 48 hours.

Critical Area TP Removal Rate: 65%

Additional Design Criteria for Critical Area

- The modified dry well design presented on page 45 of CCBRM (2010) is strongly recommended for use in the Critical Area. The improved design includes a simple but more effective pretreatment system, and standardized "plumbing" components that are readily available from most hardware stores and can be assembled together easily.
- Designers may wish to upgrade to an infiltration practice to serve a larger drainage area, as long as they conduct soil testing to confirm infiltration capability and install pretreatment measures. These larger infiltration systems are classified as ESD practices in the Critical Area, and also possess a higher phosphorus removal rate.
- If soils are extremely permeable (infiltration rates exceed 4 inches per hour), landscape infiltration or rain gardens are preferred since they provide more treatment before reaching groundwater.
- It is recommended that the depth of stone reservoir be kept to two or three feet to maximize surface area.
- A minimum separation distance of two feet from the bottom of the dry well and the seasonally high water table must be maintained.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 108 and 109 and enter the acreage of contributing impervious cover, the surface area of the micro-infiltration practice (in square feet) and its depth (feet).

Infiltration

Applicability. Infiltration is considered a good option on most HSG A and B soils, and some HSG C soils. It is considered a preferred environmental site design practice in the Critical Area due to its higher runoff reduction and phosphorus removal capability. Infiltration practices are restricted or prohibited at development projects that are expected to become stormwater hotspots in the future (i.e., Table 2.6 in MDE 2000).

MDE Reference and Design Criteria: Page3.38 in Chapter 3 of MDE (2000)

Critical Area TP Removal Rate:

- Design Level 1: 60%
- Design Level 2: 90%
- The requirements for each design level are outlined in Table 13.

Table 13 Infiltration Design Levels	
Level 1 Design TP:60%	**Level 2 Design TP:90%**
Infiltrates the entire WQv	Infiltrates at least 75% of the ESD Target Volume *
At least one pre-treatment device	At least two forms of pre-treatment*
Soil infiltration rate 1/2 to 1 inch/hr.	Soil infiltration rates of 1.0 to 4.0 inch/hr *
Treatment volume infiltrates in less than 36 hours	Treatment volume infiltrates within 36 hours or more *
*All four criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- The New Jersey soil testing protocols are strongly recommended to evaluate soil infiltration rates (NJDEP, 2009, Appendix E).

- A minimum separation distance of two feet from the bottom of the infiltration practice and the seasonally high water table must be maintained for all designs.

Where it is Entered in the Compliance Spreadsheet

Go to Rows 165 and 166 and enter the acreage of contributing impervious cover and the design treatment volume of the infiltration practice (in cubic feet).

Rain Gardens

Applicability: Rain gardens are an option to treat rooftop runoff at individual homes or small commercial projects. They are effective on A and B soils, but are restricted on C soils. The contributing drainage area (CDA) to an individual rain garden should not exceed 2,000 square feet (sf) for residential applications and 10,000 sf for non-residential projects.

MDE Reference: page 5.104 of Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- The maximum depth of temporary ponding in the rain garden is 6 inches.
- The filter bed in the rain garden can range from 12 and 18 inches deep.
- The basic rain garden design uses soil infiltration to dispose of stormwater, so no under drain is used.

Critical Area TP Removal Rate:

- Design Level 1 25% (HSG C Soils)
- Design Level 2: 50% (HSG A and B Soils)
- The requirements for each design level are outlined in Table 14

Table 14 Rain Garden Design Levels	
Level 1 Design TP 25%	**Level 2 Design TP 50%**
HSG C Soils	HSG A and B Soils

Additional Design Criteria for Critical Area

- Rain gardens will generally be located on individual roof leaders for detached single family homes.

- To ensure proper homeowner maintenance, the builder must disclose their location, purpose and function when property is sold. The GPS coordinates of the rain garden must be recorded, and some form of easement, covenant or right of way be provided to ensure they are not filled in.

Where it is Entered in the Compliance Spreadsheet

Go to Rows 110 to 113 and select the row that corresponds to the predevelopment HSG for the rain garden, and then enter the acreage of contributing impervious cover and the surface area of the rain garden (in square feet).

Micro-Bioretention

Applicability: Micro-Bioretention is a versatile ESD practice that can be applied to all soil types and most development conditions.

MDE Reference: page 5.96 of Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- The CDA for micro-bioretention should not exceed 0.5 acres.
- The maximum depth of ponding in the bioretention area is 12 inches.
- The filter bed should range from 2 and 4 feet in depth.

Critical Area TP Removal Rate: See Table 15

Table 15 Micro-Bioretention Design Levels

Level 1 Design TP:50%	Level 2 Design TP: 75%
HSG C and D Soils and/or under drain	HSG A and B Soils, OR has full ESD to MEP storage, OR has 12 inch stone sump below under drain invert.*
Filter Media Depth less than 36 inches	Filter Media depth 36 inches or more *
One cell	Two cells, if CDA is more than 10,000 sf *
*All three criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- The minimum depth of the filter bed shall be no less than 18 inches.
- The minimum depth from the bottom of the bioretention area and the seasonally high water table can be one foot, if an under drain is used. Otherwise, a minimum separation distance of two feet is needed to groundwater.
- The recipe for the filter media is to consist of 85%-88% sand, 8%-12% soil fines and 3%-5% organic matter in the form of leaf compost.
- The soil fines be supplied by vendor must be tested to ensure that soils have a phosphorus index (P-Index) between 10 and 30, or a test to show soil media has between 7 and 21 mg/kg of P in the soil media.
- The design shall include a landscaping planting plan that includes herbaceous vegetation, shrubs, and/or trees to achieve surface area coverage of at least 75% within 2 years.
- Plant species selected should reflect coastal plain ecosystems and be salt tolerant. A bioretention plant list can be found in CSN Bayside Design Spec No. 8.
- In residential areas, it is acceptable to use turf as an alternative surface cover in lieu of mulch.
- Maintain at least a 0.5% slope in the under drain to ensure drainage.
- The following building setbacks apply to bioretention: 10 feet if down-gradient from building or level (coastal plain); 50 feet if up-gradient.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 114 to 117 and select the row that corresponds to the predevelopment HSG for the bioretention area, and then enter the acreage of contributing impervious cover and the surface area of the bioretention area (in square feet).

Regular Bioretention

Applicability: Regular bioretention is considered a preferred ESD practice in the Critical Area due to its high runoff reduction and phosphorus removal capability. It can be applied to all soil types and most development conditions.

MDE References: Page 3.38 in Chapter 3 of MDE (2000)

Critical Area TP Removal Rate: (see Table 16)

Table 16 Regular Bioretention Design Levels

Level 1 Design TP:50%	Level 2 Design TP: 75%
HSG C and D Soils and/or under drain	HSG A and B Soils *OR* has full ESD to MEP storage *OR* has 12 inch stone sump below under drain invert*
Filter Media Depth less than 36 inches	Filter Media Depth 36 inches or more *
One cell	Two Cells, if CDA is more than 10,000 sf *
*All three criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- Meet all of the design criteria for micro-bioretention, plus:
- Sub-soil infiltration testing: one infiltration test per 1,000 sq. ft. of filter surface; Min infiltration rate > 1/2 inch/hour in order to remove the under drain requirement. Soil infiltration testing is not needed if an under drain is used.
- A pretreatment cell *plus* one of the following: a grass filter strip, gravel/stone diaphragm, gravel/stone flow spreader, or another approved (manufactured) pre-treatment structure. Ideally, bioretention will be provided in a series of cells leading to a ditch system or stream.
- To prevent short-circuiting, the ratio of the length of shortest flow path to the overall average length of the practice must exceed 0.5. If this ratio cannot be attained, shift to a multiple cell design.
- The maximum contributing drainage area to an individual bioretention area shall not exceed 2.5 acres.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 114 to 117 and select the row that corresponds to the predevelopment HSG for the bioretention area, and then enter the acreage of contributing impervious cover and the surface area of the bioretention area (in square feet). If an enhanced filter is added, enter the cubic feet of additional storage provided.

Note on Urban Bioretention: Urban bioretention includes expanded tree pits, street bioretention and foundation planters that are used to treat runoff at high intensity redevelopment projects (CSN, 2011). Due to redevelopment constraints, most urban bioretention practices do not fully meet ESD sizing criteria, and therefore have less phosphorus removal capability. Therefore, they should be entered in the spreadsheet as if they are a rain garden (Row 110 to 113).

Grass Channels

Applicability: Grass channels are a good option along open section roads at low density development projects. They require permeable soils in HSG A , B or C. They **are not** allowed for use on parking lots or rooftops. A bio-swale or dry swale is more effective in TP removal. If the water table is within a foot of the surface, wet swales or linear wetlands are a preferred alternative.

MDE Reference: Page 5.108 in MDE (2009) and described as a credit in MDE (2000).

Key MDE Design Criteria:

- The length of the grass channel must be at least the length of the contributing impervious cover to it.
- The maximum slope of a grass channel cannot exceed 4%, and check dams or infiltration berms should be installed to break up slopes.
- The maximum depth of the flow during the ESD storm shall not exceed 4 inches
- The surface area of the bottom of the grass channel shall be at least 2% of the contributing drainage area.
- The maximum contributing drainage area to an individual grass channel shall not exceed one acre.
- Flow velocities through the channel shall be non-erosive during the two year design storm, and the channel should have sufficient hydraulic capacity to safely convey the 10 year storm.

Critical Area TP Removal Rate (see Table 17)

Table 17 Design Levels for Grass Channels	
Level 1 Design TP:20%	**Level 2 Design TP:40%**
C and D Soils	A or B Soils OR restored C and D Soils *
Slopes from 2 and 4%	Slopes less than 2% *
* Both criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- The minimum width of the grass channel is 4 feet.
- The water table must be at least 12 inches below the channel bottom.
- The grass channel must provide at least 10 minutes of residence time for the water quality storm event prior to any discharge to an inlet, pipe or stream.
- One foot of restored soil along channel bottom is required for C and D soils and mass graded B soils.
- No more than 3% slope is permitted in any 50 foot grass channel segment (e.g., low check dams).
- A minimum slope of 0.5% must be maintained in the grass channel to ensure positive drainage.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 120 to 123 and select the row that corresponds to the predevelopment HSG for the grass channel and then enter the acreage of contributing impervious cover and the surface area of the channel bottom (in square feet).

Bioswales and Dry Swales

Applicability: Bioswales and dry swales are a versatile practice for low to moderate density development projects over the entire range of soil conditions.

MDE Reference:

- Bioswales: page 5.108 in Chapter 5 of MDE (2009)
- Dry Swales: page 3.45 of MDE (2000)

Key MDE Design Criteria: The geometric design criteria for bioswales are identical to the preceding criteria for grass channels.

Critical Area TP Removal Rate

- Design Level 2: 75% (HSG A and B Soils)
- Design Level 1: 50% (HSG C and D Soils)

Table 18 Design Levels for Bio-swales and Dry Swales	
Level 1 Design TP:50%	**Level 2 Design TP:75%**
Treats the WQv	Filters at least 75% of the ESD Target Volume *
Bioswale design	Dry Swale OR bioswale with stone sump *
C and D Soils	A and B Soils, OR C soils with enhanced filter *
Effective swale slope ≤ 2%	Effective swale slope less than 2% *
Media Depth of 18 inches or less	Media Depth of 24 inches or more *
* All five criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area

- The minimum depth of the swale filter bed is 18 inches.
- The recipe for the swale filter media are the same as for regular bioretention
- It is acceptable to use turf as an alternative surface cover in lieu of mulch.
- The minimum depth from the bottom of the swale and the seasonally high water table can be one foot, if an under drain is used. Otherwise, a separation distance of two feet is needed to the seasonally high water table. In cases where the water table is close to the surface, consider shifting to a wet swale or linear wetland.
- Maintain at least a 0.5% slope in the under drain to ensure drainage.
- Sub-soil testing: one per 200 linear feet of filter surface; min. infiltration rate must be > 1/2 inch/hour to remove the under drain requirement. Testing is not required if an under drain is used.
- The following residential road setbacks apply to bio swales and dry swales: five feet down-gradient and one foot below road grade.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 124 to 127 and select the row that corresponds to the predevelopment HSG for the bioswale (or dry swale), and then enter the acreage of contributing impervious cover and the surface area of the swale bottom (in square feet).

Wet Swales

Applicability: Wet swales are most feasible on flat terrain with a high water table and HSG C and D soils. They are not recommended for HSG A and B soils, unless the seasonally high water table is within three feet of the land surface. They are primarily applied in non-residential settings.

MDE Reference: Page 3.45 of MDE (2000) and page 5.108 in Chapter 5 of MDE (2009)

Key MDE Design Criteria:

- Check dams or infiltration berms should be installed to break up slopes.
- The maximum depth of the flow during the ESD storm shall not exceed 4 inches.
- The surface area of the bottom of the wet swale shall be at least 2% of the contributing drainage area.
- The maximum contributing drainage area to an individual wet swale shall not exceed one acre.
- Flow velocities through the swale shall be non-erosive during the two year design storm, and the swale should have sufficient hydraulic capacity to safely convey the 10 year storm.

Critical Area TP Removal Rate: 40%

Additional Design Criteria for Critical Area

- The maximum slope of a wet swale shall not exceed 2%
- The average dry weather ponding depth in the wet swale shall not exceed 6 inches.
- The wet-weather ponding depth may not exceed 18 inches. The basic idea is to design for saturated soils and not a permanent pool of standing water.
- Wet swales work best when designed as a series of on-line or off-line cells in the ditch system, with individual cells that are 50 to 75 feet long. Cells may be formed by check dams, infiltration berms or earthen berms.
- A planting plan must be provided on how emergent wetland species will grow in the swale, although it is acceptable to use wetland seed mixes to establish the plant community.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 128 to 129 and enter the acreage of contributing impervious cover to the wet swale, the surface area of the bioswale (in square feet) and the depth of the swale (in feet).

4.3 Conventional Stormwater Practices

Sand Filters

Applicability: Sand filters are an effective treatment option when there is a groundwater contamination risk, such as at stormwater hotspots and brown-fields, or at redevelopment sites located on urban fill soils. Sand filters are suitable for all soil types. There are many different sand filter design variations that can work in difficult site conditions.

MDE Reference and Design Criteria: Page 3.38 in MDE (2000)

Critical Area TP Removal Rate:

- Design Level 1: 60%
- Design Level 2: 65%
- The requirements for each design level are outlined in Table 19

Table 19 Design Levels for Sand Filters

Level 1 Design TP: 60%	Level 2 Design TP: 65%
Filters the WQv	Filters at least 75% of the ESD Target Volume*
One cell design	Two cell design, with one cell for pretreatment*
Contributing Drainage Area (CDA) contains more than 10% pervious area	CDA is nearly 100% impervious*
* All three criteria must be met to qualify for Level 2	

Additional Design Criteria for Critical Area:

- The perimeter or non-structural design variants are the most feasible sand filter option under most coastal plain conditions.
- The combined depth of the sand filter bed and under drain layer can be reduced to a minimum of 24 inches if site conditions are problematic.
- The minimum depth between the water table and the bottom of the sand filter can be reduced to one foot, if it is equipped with an under drain.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 163 and 164 and select the row that corresponds to the design level achieved by the sand filter. Next, enter the acreage of contributing impervious cover to the filter and the water quality treatment volume (in cubic feet).

Shallow Constructed Wetlands

Applicability: While constructed wetlands are technically not classified as an ESD practice, they are an effective biological treatment practice for the Critical Area (particularly when the water table is close to the surface). New wetland designs that emphasize shallow, linear, multi-cell configurations, and seek to replicate forested wetland conditions are recommended for the Critical Area (Flores et al, 2009 and Cappiella et al, 2008).

MDE Reference and Design Criteria: page 3.8 in MDE (2000)

Critical Area TP Removal Rate (see Table 20)

Table 20 Design Levels for Constructed Wetlands

Level 1 Design TP:50%	Level 2 Design TP:75%
Pool volume treats the one- inch WQv	Pool volume treats 1.25WQv or more *
Single cell (with a forebay)	Multiple cells **
Uniform wetland depth	Diverse microtopography with varying depths **
Mean wetland depth is *more* than 1 foot	Mean wetland depth is *less* than 1 foot **
The surface area of the wetland is *less* than 3% of the contributing drainage area (CDA).	The surface area of the wetland is *more* than 3% of the CDA. **
Length/Width ratio *OR* Flow path = 1:1 or more	Length/Width ratio *OR* Flow path = 2:1 or more **
Length of shortest flow path/overall length = 0.5 or more	Length of shortest flow path/overall length = 0.8 or more**
Emergent wetland plant community	Mixed of forested wetland community **
* Mandatory to qualify for Level 2 ** Must meet at least 4 of 7 of these criteria to qualify for Level 2	

Additional Design Criteria for Critical Area

- It is acceptable to excavate up to 6 inches below the water table to create a wetland, and to dig pools up to 3 feet to control mosquitoes. The wetland volume is equal to the water quality volume, if the basic geometric criteria in Table 20 are met.
- Flashboard risers are recommended for constructed wetlands in flat terrain.
- The creation of forested stormwater wetland plant communities is strongly encouraged, (e.g., cypress, tupelo, Atlantic white cedar and other wet-footed tree species).
- The Regenerative Conveyance System is recommended in the Critical Area, particularly when there is significant gradient across the site (Flores et al, 2009).

Where it is Entered in the Compliance Spreadsheet: Go to Rows 161 and 162 and select the row that corresponds to the design level achieved by the constructed wetland. Next, enter the acreage of contributing impervious cover to the wetland and the water quality treatment volume provided (in cubic feet).

Wet Ponds

Applicability: The use of wet ponds in the Critical Areas is not encouraged, since they are not considered an ESD practice, and recent research indicates their nutrient removal performance is limited under coastal plain conditions (Appendix A, CSN, 20o9). In general, shallow constructed wetlands are a preferred alternative to wet ponds.

MDE Reference and Design Criteria: page 3.8 in MDE (2000)

Critical Area TP Removal Rate:

- Design Level 1: 50%
- Design Level 2: 75%
- The requirements for each design level are outlined in Table 21.

Table 21 Design Levels for Wet Ponds	
Level 1 Design TP: 50%	**Level 2 Design TP: 75%**
Pool volume treats the one- inch WQv	Pool volume treats 1.25 WQv or more *
Single Pond Cell (with forebay)	Multiple Cell Design **
Length/Width ratio OR Flow path = 1:1 or more	Length/Width ratio OR Flow path = 2:1 or more**
Length of shortest flow path / overall length = 0.5 or more	Length of shortest flow path/overall length = 0.8 or more**
Standard aquatic benches	Wetlands more than 10% of pond surface area **
* Mandatory to qualify for Level 2 ** Must meet at least 3 of 4 of these criteria to qualify for Level 2	

Additional Design Criteria for Critical Area

- A pond landscaping plan is required to achieve a natural ground cover of native perennials, shrubs, and trees in the buffer zone.
- Ponds that are dugout below the water table are poor performers, and no WQv credit is given for any storage below the seasonally water table.
- Fountains may prevent stagnation and sediment release in summer.

Where it is Entered in the Compliance Spreadsheet: Go to Rows 159 and 160 and select the row that corresponds to the design level achieved by the wet pond. Next, enter the acreage of contributing impervious cover to the pond and its water quality treatment volume (in cubic feet).

Part 5
Stormwater Offset Fees and Offsite Compliance

5.1 Updated Stormwater Offset Fee Schedule

Offsets are defined as "structures or actions that compensate for undesirable impacts." Offsets address the impacts associated with uncontrolled stormwater runoff generated from a development site by providing alternative ways to reduce pollutants when on-site ESD practices are insufficient or impractical. Offsets must remove a phosphorus load equal to or greater than the phosphorus removal requirement. Offset fees must be equivalent to the cost of planning, designing, constructing, and maintaining stormwater retrofits or other restoration practices capable of reducing an equivalent load of phosphorus.

Recent cost data suggests that stormwater offset fees need to be increased to fully recover the public sector cost to build retrofits that can remove an equivalent amount of phosphorus (CSN, 2011). The new recommended offset fee is $32,500 per pound of phosphorus that must be mitigated. The fee assumes that the phosphorus removal will occur in storage retrofits and/or stream restoration practices located on larger public or parcels within the same watershed. This option works best in larger counties with moderate development intensity, abundant retrofit opportunities and past experience in delivering watershed retrofits.

A higher offset fee may be warranted in larger cities that are already intensively developed, since they often lack the abundant and less expensive storage retrofit opportunities of their suburban counterparts. Setting the price for offsets should always be a local decision, given that each is unique with respect to its existing development intensity, expected redevelopment activity, retrofit opportunities, staff capability, business climate and future nutrient reduction liability.

5.2 Basic Principles for Critical Area Stormwater Offset Programs

The following principles are offered to develop effective and accountable programs to handle stormwater offsets for Critical Area projects.

> *Offsets Should be Simple to Administer and Verify*. The offset fee should be expressed in simple unit terms that can be directly computed from redevelopment site data and/or stormwater spreadsheet computations. In the Maryland Critical Area, this common unit will be pounds of phosphorus load remaining at the site above the phosphorus removal standard.
>
> *Offsets Must Occur Within the Same Sub-Watershed*, which is operationally defined as the scale associated with the USGS 12 digit hydrologic unit code mapping systems. These subwatersheds normally range from about 15 to 65 square miles in area in the Bay watershed. For smaller cities, this scale means the offset project can occur pretty much anywhere in their jurisdiction. In a larger

county, this scale ensures that there is a linkage between where the impact occurs and where it is mitigated.

*Offsets Should Require Some On-Site ESD Treatment***.** Offsets are only allowed if a designer can demonstrate that a reasonable effort has been made to install ESD practices at the site. The basic idea is that you can't just write a check to avoid the entire cost of ESD implementation. Some ESD practices can always be implemented to some degree at nearly every development site, except for certain brown-field sites.

The Off-site Compliance Option: Another way to get to compliance is for the developer to find an off-site retrofit or restoration project that can achieve an equivalent degree of phosphorus removal. This situation may occur when the developer has a large property that extends across the Critical Area boundary. Off-site compliance is only allowed for retrofits of existing impervious cover, and not new impervious cover. The local Critical Area review authority makes the final decision as to whether the off-site compliance option is acceptable.

Local Stormwater Offset Programs Should Be Accountable. It is critically important to craft a stormwater offset program that is transparent and can quantitatively demonstrate that it is providing the desired load reduction under the phosphorus removal performance standard. Therefore, a good local phosphorus offset program has the following accountability elements:

Dedicated Account. All funds collected from offset fees should be parked in a dedicated fund for the sole purpose of constructing qualifying offset projects. The fund should be restricted so that it cannot be tapped to meet other municipal needs.

Fiscal Accountability. A locality should track offset fees collected and funds disbursed for offset projects over time, and provide the annual balance and financial status on an annual basis.

Reversion Clause. If the locality accumulates offset fees but does not expend them within a five year time period, the funds should automatically revert to a pre-defined state agency, foundation or watershed group with capacity to expend them on restoration projects.

Watershed Restoration Inventory. The program should have a current watershed restoration inventory that identifies priority retrofit and restoration projects for offset implementation. Most localities in the Critical Area have conducted watershed restoration plans in the past.

Retrofit Registry. The locality should develop and maintain a retrofit registry that tracks the status of offset project implementation and the estimated phosphorus load reduced. The registry should also track the cumulative acres of impervious cover for which offsets have been granted.

The registry can be configured to show whether there is a surplus or deficit in offset treatment, and should be prominently displayed on their local websites. Localities are also advised to link their retrofit registry with their overall nutrient accounting system to meet their phosphorus load reduction requirements under their Bay-wide nutrient TMDL allocation for Maryland.

Offset Fees Should be Indexed for Inflation. One of the most common mistakes is to include a fixed offset fee schedule in a local stormwater ordinance that cannot be increased unless the statute is re-enacted. Within a few short years, revenues collected from offset fees can no longer recover the full cost to the public sector to build the projects. Therefore, the offset fee schedule should be indexed for construction inflation so that it can keep up with the true cost of retrofit implementation over the years. The accepted industry index to cite is the annual construction inflation index published by the *Engineering News Record*.

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Appendix A
Standardized TP Removal Rates for the Critical Area

Tables A-1 and A-2 provide updated total phosphorus removal rates for new ESD practices and traditional stormwater practices in order to integrate the ESD approach with the Critical Area phosphorus removal performance standard. These values are used in the ESD to the MEP compliance spreadsheet in order to track the progressive phosphorus reduction by ESD practices at a development site. The values reflect the mass removal rate for each practice, using the VA DCR technical memo. The mass removal rate reflects the relative contribution from runoff reduction and the change in phosphorus concentration as it flows through the practice. In most cases, the mass removal rate differs based on the hydrologic soils group of the underlying soils. In some cases, an enhanced level of design is possible to increase the TP mass removal rate.

Table A-1
Adjusted Removal Rates for Critical Area Stormwater Practices

ESD Practices	Old CA P Rate/ Credit	New Data Source	Recommended New Rates		Rationale and Documentation
			A & B Soils	C & D Soils	
Green Roof	Credit[1]	VA DCR	Less than 6 : 45 More Than 6 : 60		Depth of vegetated roof. High runoff reduction but no change in TP EMC
Permeable Paver	Credit[2]	VADCR	80	60	Research has shown high rates of both runoff reduction and TP removal, depending on degree of soil infiltration.
Rooftop Disconnect	Credit[4]	VADCR	50	25	The 25% removal rate for C/D soils can be increased to 50% if it conforms to more stringent design criteria
Non- Rooftop Disconnect (Filter Strip)	None [5]	VADCR	50	25	The 25% removal rate for C/D soils can be increased to 50% if soils are restored
Sheet flow t0 Conservatn Area	None[6]	VADCR	50	25	Subject to Critical Area buffer restriction.
Impervious Cover Conversion and Reforestation Credit are taken by reducing post development IC					

Notes

[1] Credit is for surface area of the rooftop is not considered impervious

[2] Credit is for surface area of pavers which are considered 50 to 90% imperviousness, depending on product

[4] Credit is for all contributing impervious area which is excluded from total site impervious cover

[5] Non-rooftop disconnection to a filter strip is allowed as MDE credit but is not directly called out in the 10% guidance

[6] This MDE credit is specifically disallowed within the Critical Area's 100 foot buffer

Table A-2
Adjusted Removal Rates for Critical Area Stormwater Practices

ESD Practices	Old CAP Rate/ Credit	New Data Source	Recommended New Rates		Rationale and Documentation
			A & B Soils	C & D Soils	
Rainwater Harvesting	None[7]	VA DCR	45%		TP rates are based on default volume of runoff reused
Landscape Infiltration	None [7]	VADCR	75%	Not Allowed	This a hybrid of both infiltration and bioretention
Sub Gravel Wetlands	None [7]	UNH	Not Allowed	60%	Based on recent research from New Hampshire
Infiltration Berm	None [7]	None	0%	0%	This is not a stand-alone practice, but can help enhance NRD filter strip and grass channel performance
Dry Well	65% [8]	63% NPRD	65%	Not Allowed	Retain same rate as for infiltration practices
Infiltration	65%	VADCR	90%	60%	See Table A-3
Rain Gardens	None [7]	VADCR	50%	25%	Several key design elements that contribute to P removal of this form of bioretention are absent
Micro-bioretention	50% [9]	VADCR	75%	50%	Performance related to degree of soil infiltration achieved
Grass Channels	Credit [10]	VADCR	40%	20%	The 25% removal rate for C/D soils can be increased to 50% if soils are restored
Wet Swales	40%	VADCR	Not Allowed	40	
Bio swales [11]	65	VADCR	75%	50%	Performance related to degree of soil infiltration achieved

Notes

[7] There was no removal rate provided for this practice in the 2003 10% guidance manual

[8] Assumed to be comparable to rates for infiltration practices

[9] Assumed to be comparable to rates for bioretention practices

[10] Credit is for all contributing impervious area which is excluded from total site impervious cover, although parking lots are excluded

[11] Bio-swales are comparable to dry swales

Table A-3
Adjusted Removal Rates for Critical Area Stormwater Practices

ESD Practices	Old CA P Rate/ Credit	New Data Source	Recommended New Rates		Rationale and Documentation
			A & B Soils	C & D Soils	
Infiltration Systems [12]	65%	VADCR	Level 1: 60% Level 2: 90%		Level 1 is the base removal rates for the practice using standard design criteria in MDE (2000). Level 2 includes additional design elements that enhance TP removal rate, following the VADCR approach
Filtering Systems [12]	50%	VADCR	Level 1: 60% Level 2: 65%		
Ponds [12]	50-65	VADCR	Level 1: 50% Level 2: 75%		
Wetlands[12]	40-55	VADCR	Level 1: 50% Level 2: 75%		

Notes
[12] TP removal rates for multiple design variants are provided in Table 4.8 of the 10% Guide.

Appendix B

Documentation of the Revised Phosphorus Removal Performance Standard of 0.3o lb/ac/yr

Background

A single urban pollutant was selected as a surrogate for all stormwater pollutants. This "keystone" pollutant was used as the basis for computing pre-development and post-development pollutant loads at a site and ultimately, the necessary pollutant removal requirement. As part of the original guidance, each major stormwater pollutant was evaluated for suitability as a potential keystone pollutant. Based on this review, total phosphorus was recommended as the keystone pollutant to meet the Critical Area 10% Rule (MWCOG, 1987). Total phosphorus was selected as the keystone pollutant because it has the following characteristics:

- The adverse impacts of total phosphorus on the water quality of the Chesapeake Bay are well documented.
- Total phosphorus exists in both soluble and particulate forms, which means that a variety of removal mechanisms such as settling and biological uptake is needed for effective treatment.
- Abundant data exists to characterize total phosphorus concentrations and pollutant removal performance. This enables reviewers to more accurately compute post development stormwater loads and choose an effective stormwater BMP

The original performance standard was to treat post development runoff to achieve a predevelopment background load of no greater than 0.45 lbs of TP per acre per year. This was established in 1987 using the limited runoff monitoring data then available to characterize nutrient loads from Maryland watersheds. The baseline load was 0.5 lbs/ac/year, which represented a composite of the annual phosphorus load from a mixed watershed of forest, crop and pasture land uses.

Over the last two decades, better data has become available to characterize the acceptable post-development phosphorus load from new development projects. The primary data source is the Maryland nutrient loadings from the Chesapeake Bay Basin Model developed by the EPA to support the Bay-wide TMDL, as reported in MDE (2010), and reprised in Table B-1.

Table B-1
Total Phosphorus Loads, By Sector in Maryland Portion of Bay Watershed

Loading Sector	2009 Load	Target Load	% Reduction Needed to Meet Target
	Million pounds per year		
Forest Runoff	0.35	0.35	0
Atmospheric Deposition	0.04	0.04	0
Wastewater [1]	0.87	0.69	34%
Urban and Suburban Runoff	0.67	0.44	36%
Agricultural Runoff [2]	1.44	1.25	12%
RUNOFF SOURCES	2.46	1.99 [3]	
TOTAL	**3.3**	**2.72**	**12%**

Source: MDE (2010)
[1] includes combined sewer overflows
[2] includes confined animal feedlots
[3] excludes CAFO portion of agricultural runoff

The acceptable P TP target load from Bay-wide TMDL from all land-based sources of phosphorus pollution is 1.99 million/lbs/yr. Land sources of phosphorus pollution included runoff from forest, agricultural (excluding CAFOs) and urban and suburban land uses. Wastewater and CSO loads were excluded from the calculation, since they are not runoff-related, as was atmospheric deposition over open waters of the Bay.

The land-based TP target load was then divided by the total land area in Maryland's portion of the Chesapeake Bay watershed (5.866 million acres) to arrive at an average per acre phosphorus load of 0.34 pounds per acre per year.

Given the direct proximity of the Critical Area to the Bay, and to be consistent with the original Critical Area criteria (i.e., 10% reduction from the predevelopment load), the 0.34 lb target TP load was reduced by another 10%, to yield a final value of 0.30 lbs/ac/year.

The Critical Area Phosphorus removal standard is consistent with the proposed phosphorus baseline load for new development projects in Virginia discharging to the Chesapeake Bay, which has ranged between 0.28 to 0.45 lbs/acre/year.

For redevelopment projects, a lower phosphorus removal standard was developed to be consistent with MD ESD requirements. The target load reduction for redevelopment projects is the removal of one pound of phosphorus per impervious acre, or fraction thereof, by an acceptable treatment facility, or a 50% total P removal rate for the site.

Appendi C

Measures Implementing the Harford County
Critical Area Forest Conservation and Protection

APP D C
MA A M D
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D C

Retaining and, where possible, increasing the amount of forest cover is one of the major objectives of the State Chesapea e Bay Critical Area Act and Harford County's Critical Area Management Program This goal includes avoiding disturbance to the Critical Area Buffer wherever possible This goal is pursued with the understanding that forest can be selectively removed according to certain laws Maryland Code allows timber harvest, even in the Critical Area Land development in Harford County can occur with tree removal according to a forest conservation plan The following program guidance shall be applied to any timber harvest or forest conservation plan in the Critical Area

MA A M PLA MB HA

A e uired Plan

All timber harvesting operations private or commercial in the Critical Area of Harford County must conform to a Forest Management Plan Plan prepared by a forester registered in the State of Maryland and submitted to the local office the Maryland Forest Service for review A Forest Resource Conservation Plan may be accepted The Maryland Forest Service typically reviews plans for one or more contiguous acres of forest land However, a Plan is required for timber harvest operations, regardless of si e, in the Critical Area by Harford County to ensure the objectives of the State Chesapea e Bay Critical Area Act and Harford County's Critical Area Management Program are met and disturbance to the Critical Area Buffer is avoided

Plans must be prepared in accordance with the minimum requirements listed below Plans must show how the area will be reforested whether by natural regeneration or by planting with no development ta ing place Provisions in subsections C through E below concern the unusual occasions where a harvest disturbs the Critical Area Buffer or any other identified Habitat Protection Areas per certain circumstances allowed by code or a variance Copies of the Forest Management Plan, signed by the forester with a valid state registration number, shall be sent to the District Forestry Board and the Department of Planning and oning for their review and comments The Department of Planning and oning must give final approval to Forest Management Plans

B Minimum e uirements of orest Management Plans in the Critical Area of Harford County

Name, address, and telephone number of landowner

Description and location of property, including tax map reference, nearest road s , and total acreage of site

Name, address, telephone number, and registration number of professional forester preparing plan

Date of preparation

wner's goals in addition to protection of water quality values and plant and wildlife habitat values including forest incentive programs that the owner is interested in FCMA, cost sharing programs, etc

A detailed map of the site including scale and north arrow which shows

a Cultural features such as property boundaries, roads and building on or immediately adjacent to site
b Tidal waters, tidal wetlands, perennial, and intermittent streams on or adjacent to site
c Boundary of the Critical Area and the Critical Area Buffer, including any associated expanded Buffer
d Forest stands on or immediately adjacent to site identified by SAF forest cover type or as delineated by the FSD, described below
e Identified Habitat Protection Areas and Wetlands of Special State Concern nontidal wetlands, threatened and endangered species habitat, etc on or adjacent to site
f Proposed location of any logging roads, log dec s, stoc pile areas, staging areas, s id trails, haul roads to the nearest public road, stream crossings, culverts, and the limits of disturbance and
g Slopes in excess of as determined from topographic maps

Soils map of site which shows location of soil types associated with steep slopes, highly erodible soils, and soils with hydric inclusions as shown on the Critical Area Maps

Description of measures to be instituted to ensure protection of identified Habitat Protection Areas on or adjacent to site or reference to the Buffer Management Plan, as appropriate

Identification of wildlife corridors and measures to be used to ensure their maintenance

Description of each forest stand including species composition, stoc ing level, acreage, dominant timber si e, class, even or uneven aged characteri ation, site index or growth potential, and understory species composition

Schedule and description of forestry practices to be implemented for each stand, including si e of area affected, current and residual basal area sq ft acre , type and intensity of proposed cuts, times of cuts, etc Proposed forest management practices for the next fifteen years should be generally described

Reforestation provisions including location, method by replanting or by natural regeneration , species, si e of area, stoc , type, spacing, water quality and wildlife habitat values to be obtained, and provisions for maintenance for a three-year period to ensure adequate survival of stoc planted or naturally regenerating and

Sediment Control Plan must be included with the Forest Management Plan if required by Harford County or state code and conform to current Maryland Soil Erosion and Sediment Control Standards and Specifications for Forest Harvest perations The most recent manual was published in

C im er Har est in Critical Area Buffer or other Ha itat Protection Areas

Harford County oning prohibits disturbance to Habitat Protection Areas including the Critical Area Buffer except in special conditions If timber harvest is to occur in these areas per certain circumstances allowed by code or a variance, the following are required

A Critical Area Buffer management plan approved by the Department of Planning and oning

A Forest Management Plan prepared with the following special provisions

- a No cutting of areas within feet of tidal waters, tidal wetlands, and perennial streams
- b Logging roads and s id trails or other vehicular traffic are not permitted within the Critical Area Buffer Trees harvested from the Critical Area Buffer must be removed to the nearest s id trail outside of the Critical Area Buffer by cable
- c Harvests may not occur within the Critical Area Buffer or expanded Critical Area Buffer areas from March to June during the anadromous fish breeding season
- d Reforestation measures must specify replanting and not natural regeneration to ensure maintenance of the Critical Area Buffer's water quality and plant and wildlife habitat values, including its function as a wildlife corridor
- e Commercial harvesting of trees is allowed to the edge of intermittent streams provided that the required Critical Area Buffer Management Plan includes provisions to ensures that
  - i Nontidal wetlands and other Habitat Protection Areas are not disturbed,
  - ii There is no disturbance to the stream ban s,
  - iii Appropriate reforestation measures are used to ensure that the water quality and plant and wildlife habitat values for the Critical Area Buffer are maintained
- f Approval from the District Forestry Board after review by the Department of Planning and oning for adequacy of the measures proposed to ensure maintenance of the integrity of the Buffer and or other Habitat Protection Area s

D Ha itats of Local ignificance

Harvests proposed within feet of Habitats of Local Significance, habitats of threatened or endangered species or habitats of species in need of conservation or their buffers Best Management Practices BMPs recommended by DNR for the protection of these habitats must be included in the Forest Management The habitat protection plan must be reviewed and approved by the Maryland

Department of Natural Resources DNR DNR may restrict the timing of a harvest to avoid a breeding season or anadromous fish stream closure

etlands of pecial tate Concern

Any plans involving harvests within Wetlands of Special State Concern or their -foot buffers must be reviewed and approved by DNR

C A PLA Land De elopment

In the case of development activities, the forest conservation objective of Harford County's Critical Area Program is to be achieved through the preparation of a Forest Conservation Plan This plan provides information required in addition to the more general Forest Management Plan describing the existing forest cover and how its wildlife habitat and water quality protection values are to be maintained

The Forest Conservation Plan describes measures for the protection of existing wildlife corridors, and in the case of developments in areas designated as a Limited Development Area or Resource Conservation Area, describe how the afforestation requirements will be met The Forest Conservation Plan shall be submitted as a component of the Forest Management Plan to the Harford County Department of Planning and oning and reviewed as part of the preliminary plan approval process The information that must be included in a Forest Conservation Plan is described in more detail below

A orest tand Delineation D

nless no forest will be disturbed by the development, an FSD is required for any development within the Critical Area in which forest covers an area greater than , square feet The FSD shall be prepared according to the standards presented in Chapter of the Harford County Forest Cover Conservation and Replacement Manual and show the location of the Critical Area, and any all-appropriate habitat protection areas The FSD shall be developed by a forester registered in Maryland or other approved professionals as detailed in Chapter of the Harford County Forest Cover Conservation and Replacement Manual

B orest Co er etention e uirements

Forested areas to be retained according to the objectives of the Critical Area Program regarding minimi ation of forest cover removal and the limitations on forest cover removal must be shown on the Forest Conservation Plan Retained forest cover shall be protected from development Criteria for priority of retention areas are listed in decreasing order

Forest in or adjacent to the Critical Area Buffer, Habitat Protection Areas, or their Buffers

Forests on hydric soils, highly erodible soils, or slopes in excess of

-year floodplain

Forests with trees of more than inches diameter at breast height, especially champion trees

Forested areas associated with contiguous forests of acres or more and Stands or portions of stands with good species and or structural diversity as defined in Chapter of the *Harford County Forest Cover Conservation and Replacement Manual*

C Afforestation and eforestation e uirements

Plans for the replacement of forest cover removed, or for afforestation of unforested sites shall follow the criteria detailed below or shall pay an in-lieu fee of square foot

Afforestation Reforestation Plans shall detail the si e of area and location of area to be cleared and planted, including species, stoc type, spacing and planting method to be used Afforestation Reforestation Plans shall be developed according to the standards described in Chapter of the *Harford County Forest Cover Conservation and Replacement Manual*

Afforestation Reforestation plans shall be developed by a forester registered in Maryland or landscape architect and reviewed by the Maryland Forest Service

Such plans shall include a description of how such efforts will promote water quality protection and the creation of plant and wildlife habitat

Spacing of plantings shall be at a minimum on a ’x ’ basis, or closer in the case of small trees and shrubs, using caliper seedlings or larger stoc All planting materials greater than one inch caliper shall meet or exceed requirements of *American Standards for Nursery Stock Specifications*

Afforestation Reforestation Plans should include provisions for protection of trees, i e , sta es, guards Plans should also show relative locations of stoc pile areas, limits of disturbance, and measures to protect the root one, as well as surface portions or retained trees and forest

Soil amendments shall be added, and ground cover planted as needed to ensure stabili ation of a site until the tree seedlings become fully established The ground cover should allow surface water infiltration, be beneficial to wildlife, and not inhibit seedling growth

To maximi e wildlife habitat benefits, a tiered canopy shall be created whenever feasible by planting a small shrub or tree in place of every to seedlings or by intermingling rows of trees and rows of shrubs and small trees To create more diversity, or different species with similar growth rates may be planted interchangeably

The percentage of forested area cleared, and the square feet of area to be cleared and replanted shall be included in the plan and

Afforestation reforestation areas are considered in the following priority order

a nforested Critical Area Buffer or nontidal wetland buffer
b Areas of unforested hydric soils, highly erodible soils, or slopes in excess of , or other areas needing reclamation
c nforested -year floodplain and
d nforested areas contiguous to forest areas of greater than acres or areas where wildlife corridors could be created and

Native species shall be used for afforestation and reforestation plantings unless otherwise approved by the Department of Planning and oning For more information on plant species, please visit www harfordcountymd gov Environmental-Planning or call the Department of Planning and oning

Appendix D

Description o rand athered Pro ects

APPENDIX D

RAND A ERED PR EC
part o ori inal Pro ram submittal in 1

. ntroduction

n recognition of the fact that a local jurisdiction may have approved certain projects prior to the approval of its Chesapeake Bay Critical Area Management Program, but these projects were not constructed prior to une , (the date of passage of the Chesapeake Bay Critical Areas Act), the Chesapeake Bay Critical Area Program Development Criteria established certain provisions on whether construction of such developments should count against a County s growth allocation. Projects meeting the following conditions can be grandfathered and not counted against a County s growth allocation provided that they meet the applicable provisions of the County s Critical Area Management program for the protection of identified Habitat Protection Areas, for the development of water-dependent facilities, and for the provision of adequate stormwater management measures

) Construction of a single family dwelling on an undeveloped, legal parcel of land which e isted as of December ,

2) Construction of subdivisions that received final approval prior to une , , provided that lots not individually owned are consolidated or reconfigured to comply with the provisions of the County s Critical Area Management program to the ma imum e tent possible

) Construction of subdivisions which received final approval between une , and December ,

) Construction of subdivisions which received final approval after December , , and prior to the date of approval of the Management Program. Such subdivisions shall be consistent with the provisions of the County s Critical Area Management Program, or the development of these areas must utili e a portion of the County s growth allocation and

) The e pansion of commercial uses on parcels designated DA because they did not meet the minimum 20-acre si e required for DA designation.

. Summary of randfathered Development in the Critical Area

According to a review of the County s development approval records, no development has occurred since une , which should be counted against the County s growth allocation.

The construction activity that has occurred has consisted almost entirely of residential structures (needing only building permit approval) on lots that were part of subdivisions approved prior to une , , located in areas that were designated DA or DA. Such construction has primarily occurred in the Riverside and Harbor aks developments (DA areas on Ta Maps 2 and , respectively) with appro imately 0 building permits issued for the former and appro imately 0 in the latter out of a total of appro imately 200 permits issued in the Critical Area. The remainder was for building structures in other e isting subdivisions, e cept for four on individual lots.

There has also been a resubdivision of land as part of the est Shore development (Ta Map), which is a large, mi ed commercial high density residential development adjacent to tter Point Marsh which was originally approved in the mid- 0 s. n mapping the area in which this development is located, the portion of the area that was built upon as of December , was designated as DA, and the remainder, DA. Nevertheless, since approval was given for high density development in the remainder of the site prior to une , , construction of such development will be considered grandfathered if it satisfies the DA requirements. Approval of a third phase of high density residential development (an appro imately 2 -acre townhouse development) was granted in early as a modification to the subdivision plan approved in the mid- 0s. Since this phase will have a water quality stormwater management pond associated with it and will not involve the alteration of any areas of significant plant and wildlife habitat value, it has been considered as in compliance with the provisions of the Critical Area Criteria.

The remainder of the site will be utili ed for commercial development, and building permits for two commercial structures to be constructed on the edge of the site were issued early in . Two adjacent, commercial- oned lots have not yet been built upon, but the remainder of the property was originally planned and approved as a shopping center. However, it is now proposed to be developed as a lower density commercial development with no development to occur within a 00-foot area adjacent to tter Point Marsh. The first 200 feet of this area is to be left undisturbed and the 00-foot area nearest the development will be utili ed for a water quality oriented stormwater management pong.

There is one other large undeveloped area for which development approval has been long granted that of the church Point property in the orest reens area (Ta Map). This is a forested area adjacent to water and sewer service, and the property is designated DA. t was approved for small lot, high density development in the mid- 0s, but a revised plan is now being developed which would be a modification to the original

approved plan and thus needs County approval. The new plan would retain a 00 foot Buffer, a large wooded area and provide for the creation of wooded lots at DA density. f submitted as planned, it will be considered a reconfiguration of a previously-approved subdivision that would be more in compliance with the provisions of the County s Critical Area Management Program and thus, grandfathered. Due to its previously approved status, the County does not propose to apply the forest replacement requirements of the DA to this development.

ne other proposed subdivision in the Critical Area, Philadelphia Estates, received preliminary plan approval in November, . Appro imately 00 units were planned on a 2 -acre parcel in the ong Bar Harbor Area (Ta Map 2), which is partially in and partially out of the Critical Area. A natural forested Buffer area 00- 00 feet from tidal waters and tidal wetlands is proposed, along with protection of nontidal wetlands and the provision of water quality oriented stormwater management measures. Due to financial considerations, it is e pected that the developer will let his preliminary plan approval lapse in November , and not proceed with construction of the development.

There has been one re oning and subsequent PRD approval on a -acre parcel designated DA in the oppatowne area. The purpose of the re oning, which occurred in , was to allow construction of an unit apartment comple . Adequate stormwater management measures will be provided to comply with the Critical Area requirements.

Several other proposed projects in the Critical Area have been discussed with the Department of Planning and oning staff, but none have ever received preliminary plan approval as of this date.

. Tracking of Development in the Critical Area

The Department of Planning and oning has computeri ed its development approval records and henceforth will be better able to ensure compliance of developments with the provisions of Harford County s Critical Area Management Program. Before computeri ation had taken place, approval records were not geographically referenced, making analysis of project approvals for compliance with the provisions of the Critical Area Program a time-consuming and difficult process.

Appendix E

Pro ram Re uirements or ater Dependent acilities

Appendix E

PAR I

In ormation re uirements or applicants re ardin submittal o proposals or construction or expansion o water dependent acilities

ENERA N RMAT N RE RED

- Name of proposed project site
- Names and addresses of owner, subdivider or developer, land planner, surveyor and or engineer
- ocation of facility site by election district, county and state names of adjacent property owners or adjacent subdivisions
- Type of approval required (subdivision approval, oning modification, building permit, etc.)
- icinity map(s) and
- eneral description of proposed project including justification for any alteration to the Critical Area Buffer and mitigation measures proposed to minimi e impact of such alterations (if any).

DESCR PT N ATERB D N ED AND ASS C ATED A AT C RES RCES RE RED

- Name of waterbody involved
- idth of waterbody at site
- E isting navigational channels, piers or decking areas adjacent to site
- Significant aquatic habitats on or within mile of site (SA beds, tidal wetlands, fish spawning or nursery areas, habitat used by State Designated Threatened or Endangered Species or Species in Need of Conservation, waterfowl staging or concentration areas)
- Bathymetric characteristics and nearshore profile at or near site
- Shoreline characteristics including soil composition, bank height, historic shore erosion rates, description of any shore erosion protection measures at or adjacent to site
- ater quality conditions as designated by State and
- lushing rates of waterbody as determined by EPA flushing model documented in the Coastal Marina Assessment Handbook (if determined necessary by Department of Planning and oning).

N RMAT N RE RED RE AT N T N- ATER C NSTR CT N

- Si e, type and location of proposed structure(s)
- f boating facility, number of slips to be provided
- Description of construction methods, type of equipment and type of materials (including any preservatives) to be used in building structure including measures proposed to minimi e adverse impacts of construction
- Description of any dredging and dredged material disposal involved with project (location, amount of material to be dredged, depth, type of method used, time of year to be undertaken, description of dimension of any basins or channels to be created, location and design of proposed disposal site
- Measures proposed to minimi e potential adverse impacts on water quality, circulation patter, littoral transport of sand or flushing characteristic and
- ocation of, design of, and justification of need for any bulkheads or other structural shore erosion measures proposed.

N RMAT N RE RED RE AT N T AN N-SH RE C NSTR CT N

A. Description of E isting Physical Conditions, including

- Boundary lines of the proposed project site, indicate in heavy outline, and tract acreage
- ield run or photogrammetric topographic contours, references to .S. .S. datum, where practicable, at five ( ) foot intervals
- Soil types according to the Harford County Soil survey (the location of soils with development constraints highly erodible solids, soils with severe septic constraints, soils with high water tables, soils with hydric inclusions shall be identified)
- Slopes greater than or equal
- 00-year floodplains identified in EMA flood insurance study or in more detailed studies undertaken or approved by the County
- Perennial, tributary and intermittent streams located on or adjacent to site
- Nontidal wetlands on or adjacent to site as identified by e istence of hydric soils or hydrophytic vegetation and required buffers
- Chesapeake Bay Critical Area boundary and Critical Area Buffer
- Types of vegetative cover on the site, particularly the location of forested areas on the site and location of significant individual trees
- Plant and wildlife habitat that has been identified as of State or county importance, on or adjacent to the site, including
  a. Habitats of Threatened or Endangered Species,
  b. Species in Need of Conservation,
  c. Natural Heritage areas,
  d. Anadromous fish propagation waters, and
  e. Habitats of ocal Significance and

- ocation and widths of pavement and rights-of-way of all e isting streets or alleys adjoining the project site, or intersecting any street that bounds it (those recorded but unimproved shown with dashed lines) railroads and utility rights-of-way, parks and other public spaces adjoining the site.

B. Description of Proposed Development, including

- ocation and shape of any proposed structures
- ayout widths and names of any proposed streets associated with project
- Any proposed water and sewer lines and facilities
- ocation and number of parking spaces, both e isting and proposed
- ocation and e tent of any other proposed impervious surfaces
- Conceptual grading plan including appro imate limits of disturbance and areas of significant cut and fill
- Proposed method(s) of stormwater management and location of facilities measures for each drainage area in development, including the provision of sufficient information on soil and hydrologic conditions, so that the viability of the proposed measures can be accurately determined
- Any proposed drainage and utility easements and
- Areas of significant natural resource value to be left undisturbed, e.g., tidal and non-tidal wetlands, forested areas to be retained, plant and wildlife habitat identified as of State and County importance.

PERAT NA N RMAT N RE RED

- f the construction or e pansion of boating facilities is proposed, any services to be provided on-shore, e.g., toilet and shower facilities, pump-out facilities, gas pumps, food services, other goods and services provided, boat maintenance, repair or storage services provided, etc.
- f gas pumps or boat maintenance, repair or storage services presently provided or proposed to be provided or e panded, description of the measures proposed to minimi e impacts of such activities on water quality and aquatic habitats shall also be provided e.g., description of maintenance and disposal procedures to be followed, etc. (see Part .2, Best Management Practices , for further detail) and
- Trash collection facilities to be provided.

PAR II

E ANA E EN PRAC ICE

ACT T BAS N DES N

Impact

Basin and entrance channel design affect flushing and sedimentation patterns. Adequate flushing of a marina is necessary for maintaining the water quality of the marina basin and adjacent waterway. Natural circulation near the site should be maintained whenever possible. Poorly flushed marinas can become stagnant and permit the concentration of pollutants from the marine facility and boats. The settling and accumulation of organic material and fine sediments can result in decreased dissolved o ygen levels and shoaling within the marina basin. nadequate flushing and subsequent stagnation may lead to water quality degradation, affecting dissolved o ygen, water temperature, and pollutant concentrations.

Ps

- Design features that promote flushing are
- Basin depths that are not deeper than the open water or channels to which the basin is connected and never deeper than the marina access channel
- Basin and channel depths that gradually increase toward open water
- Two openings at opposite ends of the marina to establish flow-through currents.
- Single entrances that are centered in rectangular basins rather than at one corner.
- Basins with few vertical walls and gently rounded corners or oval shaped.
- Even bottom contours, gently sloping toward the entrance with no pockets or depressions.
- Areas where tidal e change may not adequately flush the marina, tide gates or one-way valves may be used to enhance the flushing rate.
- or harbor-locked marinas dredged from uplands, flushing may be induced by creating a tidal prism with the basin. The basin is flooded on incoming tide and the water flows out smaller diameter pipes on the ebb tide.
- Entrance channels designed with openings as wide as possible and with increasing depth away from the marina basin prompt flushing.
- lushing may also be enhanced when entrance channels are located in the direction of prevailing winds as wind-generated currents can facilitate circulation between the basin and the adjacent waterway.
- Placement of breakwaters may impede shoaling in channels and basin, and help to maintain good flushing.

IN R A I N RE UIRED R RE IE PR CE

- Maps of area proposed for development must indicate pre-and post-development features, including
  a) Depth of basin, entrance channel(s) and adjacent waters with mile radius
  b) Bottom contours of basin.
  c) Sedimentation patterns and
  d) ocation and design of mechanical flushing enhancement structures and breakwater.

- Description of pre-and post-development conditions, which must include
  a) lushing potentials in basin and channel(s), and
  b) Estimates of sedimentation rates

ACT T 2 B AT E N AND PERAT N, C NTR PETR E M PR D CT P T N

Impact

Pollutants discharged to waters in association with the fueling and operation of boats include carbon mono ide, carbon dio ide, oil, gasoline, and other hydrocarbons resulting from combustion of fuels and lubricants, and lead. Data on the impact of chronic low level discharges of the remaining pollutants on coastal organisms and ecosystems are lacking. Most studies concerning the effects of hydrocarbons on marine fauna have been after major oil spills, where the amount of hydrocarbon pollutants is considerably greater than would occur from outboard e hausts. These studies showed that the areas of concern regarding oil pollution were direct lethal to icity, sublethal disruption of physiological or behavioral responses (of which e tremely little is known), persistence and accumulation of oil in invertebrates that is passed up the food web chain, destruction of habitat, and damage to fishery resources through tainted shellfish or finfish meat. utboard motor e haust and bilge water discharges lead into marine waters. ead also enters the aquatic environment in surface runoff, and almost all of the lead that is discharged eventually reaches bottom sediments. ead is very to ic to most plants and is moderately to ic to mammals where it acts as a cumulative poison. ish are most sensitive to lead among aquatic organisms.

Ps

Measures which prevent discharge of petroleum products to the aquatic environment include

- ocation and construction of fuel storage tanks which minimi e potential of accidental puncture
- Tanks should be EPA-approved and filled using approved safety equipment and procedures
- uel pumps should be fitted with automatic shut-off of the feeder line if the pump is knocked off vertical alignment
- ueling no les should be fitted with back-pressure shut-off valves. ocking fuel fills should not be utili ed, requiring the operator to manually hold the on-position during the fueling procedure
- illing of fuel tanks from containers should be prohibited while boats are in marina
- ueling should be supervised by marina personnel who should be trained to prevent and cleanup any fuel spills
- nly low-lead gas and diesel fuel should be sold onsite
- acilities for fueling of ramp-launched boats before launching would help prevent spills directly into the water
- Discharge of oil and gas with bilge water should be controlled by use of oil filtration devices on bilge pumps or soil absorbent pads (sponges placed in the bilge and recovered prior to bilge water discharge)
- Maintenance services provided by the marina may help improve combustion efficiency of resident boats and
- Removal of engines to an upland shop for major maintenance and repair may also help reduce petroleum product losses to the water.

IN R A I N RE UIRED R RE IE PR CE

- ocation and construction of fuel storage tanks
- ocation and design of fuel pumps
- Types of fuel distributed at marina
- Details of maintenance shop facilities at marina
- Design of bilge disposal system with emphasis on control of petroleum products and
- Details of marina personnel training which covers prevention and cleanup of oil or fuel spills.

ACT T B AT MA NTENANCE

Impact

Discharge of to ic chemicals such as copper of tin based antifoulant paints or battery acids may impact aquatic fauna. The bottom paint used on boats is designed to reduce fouling and, thus contain to ic compounds. Because of its e treme to icity, paints containing tributyltin should not be used. Antifoulant compounds enter marina waters while boats are docked and as a result of washing the hull. n addition, marine organisms are also affected by detergents from boat washing. Detergents, including oil dispersants, may be divided into two categories water-based compounds, which are highly to ic to fish and shellfish but not to crustaceans, and solvent-based compounds for which the inverse is true. ther potential impacts due to boat maintenance involve discharge of chemicals due to improper storage or use, such as painting while the boat is in the water.

Ps

Measures which can reduce the potential for discharge of to ic chemicals into marina waters include

- se of antifouling paints restricted to boat hulls only piers and other in-water structures should not be painted with anti-fouling paints
- Elimination of use of paint containing tributyltin in accordance with recently passed State legislation
- Restriction of the number of boats in-water with copper based painted hulls
- Encouragement to use dry dock facilities which may minimi e e posure times of marina waters to antifoulants
- Systems designed to retain and properly dispose of paint flakes and fine particles from hull cleaning and repainting should be used at boat maintenance facilities
- All previously opened containers of miscellaneous chemicals, boat paints, and paint vehicles should be stored in designated facilities
- aste chemicals must be disposed offsite by contract with a private waste handling firm.
- No e plosive chemicals may be stored onsite
- aste motor parts and old batteries must be placed in closed containers before removal offsite and
- Painting of boats while in the water is prohibited.

IN R A I N RE UIRED R RE IE PR CE

- Description of inwater structures, materials and preservatives used on these structures

- Describe dry dock facility in terms of availability, i.e., capacity and cost of use

- Show structures or design features of boat washing facility which prevent discharge of antifoulants, oil grease and detergents to marina waters. These include drainage and filtration systems which may be incorporated in the overall stormwater management plans for the facility and

- Describe boat maintenance facilities indicating storage locations of paints, solvents and other potential to icants and the use of methods to insure their proper storage and disposal, including the proposed penalties for disregarding marina rules on these matters.

ACT T C NSTR CT N N ATER

Impact

A direct water quality impact during construction of bulkheads, revetments, pilings, piers, docks, and breakwaters is a temporary increase in turbidity. All structures may impede water and sediment movements. n addition, in-water structures associated with water-dependent facilities can impact water quality within the marina basin through leaching of wood preservatives from the structures.

Ps

Measures which can reduce the potential for discharge of pollutants into marina waters include

- The use of pile-driving rather than jetting
- Design and placement of all structures for minimal restriction of water circulation or mi ing within the marina basin, and for reduction of shoaling
- Avoidance of solid structures
- Elevation of docks and piers as high as possible, orient in north-south rather than east-west direction, and minimi e structure width to allow for ma imum sunlight penetration
- Encouragement of the use of
  a) Alternative materials such as concrete-filled, steel-reinforced P C, plastics, or other nonconventional materials, and
  b) Highly refined (grade one) creosote that contains less tar or alternative preservatives such as chromated copper arsenate (CCA salt) to minimi e chemical leaching and
- See also Dredging Section for turbidity control measures.

IN R A I N RE UIRED R RE IE PR CE

- Description of construction methods and type of equipment to be used for building in water structures
- llustration of structures on conceptual plans with depths before and after indicated
- Description of types of structure and materials and preservatives to be used
- Mean life e pectancy of structures and
- Type of material and preservatives to be used.

ACT T DRED N (nitial Construction and Periodic Maintenance)

Impact

Dredging temporarily degrades water quality onsite and in the direction of water flow by increasing turbidity through the resuspension of the bottom sediments. These resuspended sediments can affect filter feeding organisms such as shellfish by reducing feeding rates, suffocate organisms by clogging gills, reduce primary productivity by reducing light penetration, and bury benthic organisms through siltation. Resuspended bottom sediments can contain trace metals, to ic substances, nutrients, and organic debris that can be released into the water column. Resulting water quality problems can include lowered dissolved o ygen concentrations and promotion of algal blooms.

Ps

Minimi ation of adverse water quality impacts through use of measures such as the following

- Dredging of channels that follows the course of natural channels
- Building slips for boats with deep drafts in naturally deep water
- E tending priers and docks as far as possible into naturally deep water
- Providing upland storage for smaller boats and using boat lifts to transport them to the water and
- tili ing dredging methods which avoid use of discharge of dredged materials into open waters.

IN R A I N RE UIRED R RE IE PR CE

- Maps of areas proposed for dredging must indicate
  a) Depths and contours of basin, channel(s) and adjacent waters within a mile radius before and after development,
  b) ocation of dredge area and depth of material removed, and
  c) ocation and design of turbidity control structures and

- Conceptual plans must include description of
  a) Dredging schedule indicating no interference with fish spawning season (March une),
  b) Method and equipment used for dredging,
  c) Design features of turbidity control structures, and
  d) Best use of naturally deep waters.

ACT T DRED ED MATER A P ACEMENT

Impact

Dredge material might be potentially disposed of in open water, wetlands, or upland sites. pen water disposal is seldom a viable option for marine projects and disposal on wetlands is unacceptable because of environmental reasons. Current Maryland regulations so severely restrict any open waters disposal that generally only upland disposal is allowed.

Ps

Mitigation measures for dredged material disposal include

- tili ing suitable dredged material for beach replenishment, construction, sanitary landfill, and agricultural soil improvements
- Confining discharges to the smallest practicable deposition one to protect adjacent substrates
- Dedicating permanent upland disposal sites as part of specifications for new marina construction would help eliminate future problems related to disposal of maintenance dredging material. These permanent sites can be sites that have been previously used or represent an environmentally satisfactory alternative
- Raising the height of containment embankments to increase the carrying capacity at e isting disposal areas
- Disposing of to ic and organic materials in impervious containment basins (settling of contaminated suspended particles may be enhanced by the addition of a cationic polyelectrolyte with further treatment using sand filters and activated charcoal before discharge). Currently, only Hart and Miller slands Disposal site will accept significantly contaminated dredged materials
- pland retention or treatment of runoff from the discharge material to remove dissolved pollutants before they reach the aquatic environment (a simple treatment such as o onation or serration can be adequate for reduction of B D and C D before the discharge of supernatant liquid from spoil areas enters into receiving waters)
- Controlling erosion at diked areas by shaping the dike and using stabili ation measures, such as revegetation
- Positioning outfalls to empty back into the dredged area and
- Characteri ing the sediments to be dredged and considering the potential odor problems during the selection of the disposal site and site preparation.
- hen upland disposal is not possible and open water disposal is considered environmentally acceptable, measures that can minimi e problems or impacts include
  a) sing several sites to provide a more even distribution of dredged material overburden,
  b) Maintaining the same elevation as marches and other contiguous area to promote natural tidal flooding and flushing,
  c) Situating spoil islands on the windward side of the dredged channel, and
  d) sing materials for approved tidal wetland development.

IN R A I N RE UIRED R RE IE PR CE

- ocation and design of disposal site
- Treatment for removal of pollutants before discharge of supernatant liquid and
- se of long-term dredged material after dewatering

ACT T SH RE NE PR TECT N

Impact

Modification of shoreline by removal of wetland vegetation, construction, and increased wave action due to boat wake may encourage erosion at a marina site. oss of shoreline area and degraded water quality may result.

Ps

Shorelines may be protected against erosion by employing

- Creation and protection and maintenance of e isting marshes
- Nonstructural vegetation measures
- Rip-rap stabili ation of eroding banks, using armor stone placed near high tide line
- mph speed limit enforcing a No ake one in marina basin and entrance channel
- Basin depth designs which minimi e turbidity due to prop wash and scour
- Designated slips for boats of different drafts and
- Breakwaters near entrance channel or marina mouth.

IN R A I N RE UIRED R RE IE PR CE

- Maps of area proposed for development must indicate pre- and post-development shoreline features such as
  a) location, e tent and quality of wetlands,
  b) slopes of shoreline,
  c) mean high and mean low water lines,
  d) bulkheads, revetments, rip-rap, and breakwaters,
  e) depths of basin, channel and all adjacent waters,
  f) sedimentation patterns, aeration and depletion,
  g) No ake one in marina basin and entrance channel, and
  h) areas of erodible soils and

- utline measures of boater awareness and compliance with No ake rules including description of penalties for non-compliance.

ACT T SE ERA E D SCHAR E TREATMENT

Impact

Raw sewage from boats and filtered discharges from ineffective upland septic systems may impact water quality and aesthetics. Boat sewage can be visually repulsive. ncreased nutrient loadings from sewage may contribute to increased biological demand (B D) in receiving waters. The most serious effect of discharging fresh fecal material is the potential for introducing disease-causing viruses and bacteria (pathogens). Problems may occur if boat sewage is released in the vicinity of shellfish (clam or oyster) beds or into enclosed waterways with limited flushing. Shellfish require clean water to be microbiologically safe for human consumption, regardless of whether they are eaten raw or partially cooked. ecal coliform bacteria, other bacterial pathogens, and viruses found in water and sediments are concentrated by shellfish, depending upon temperature, density of pathogens, salinity, currents, depth, water chemistry, and shellfish feeding activity. nce concentration of pathogens has occurred, microorganisms will not necessarily be flushed at the same rate. nown enteric pathogens associated with feces-contaminated shellfish include typhoid fever, dysentery, gastroenteritis, and infectious hepatitis.

Ps

Marina features which reduce the potential of sewage discharge include

- Newly constructed and renovated marina facilities should, if possible, be connected to the municipal sewage system for disposal of sewage from boats and shore-based facilities
- Ample and conveniently located toilet facilities and showers should be provided onshore
- Pump-out facilities for holding tanks and portable heads should be provided by the marina at the fueling dock
- Cost of pump-out service should be included in slip rental fees and provided on an unlimited basis
- Marina stores should supply Coast uard-approved marine heads, marine sanitation devices, and related supplies
- Boaters should be notified of the prohibition against sewage dumping in marina waters, the pollution levels which result from discharges, and the penalties imposed for violations, by posting prominent signs at points of access to piers and other frequented areas, and in conjunction with slip rental agreements and
- ndividuals leasing slip space should be held responsible for sewage disposal violations by written contract agreements which specify Head discharge overboard will result in voiding this contract immediately and e pulsion from the marina with forfeiture of rental fees. Heads are to be pumped out without a per-service fee at marina as often as requested .

IN R A I N RE UIRED R RE IE PR CE

- Sewage holding and disposal systems for onshore and boat-pump facilities which are connected to municipal systems

- ocation and design of pump-out facilities

- ocation and design of onshore toilet and shower facilities and

- nformation concerning the training of marina personnel concerning the importance of prevention of sewage pollution in marina waters and enforcement of marina rules regarding unlawful discharges.

ACT T S TE CAT N (T M T ATE N- ATER C NSTR CT N PERAT N MPACTS)

mpact

Dredging, construction and increased boat traffic may disturb aquatic resources such as shellfish beds, submerged aquatic vegetation, and fish nurseries These activities may interfere with navigation They may also interfere with circulation or salinity regimes

B M Ps

- Plans and construction design must list and locate aquatic resources potentially impacted and identify measures to be used to ensure minimal impact
- Avoidance of location in areas with poor water quality or in areas with low tidal range activity and low flushing rates such as dead end channels or canals or the upper reaches of tidal cree s
- Avoidance of navigable waterways as identified by the S Army Corps of Engineers

MA D P C

- Maps of the area proposed for development must show aquatic resources located within one mile by surface water connection including, but not limited to spawning areas, SA beds, tidal wetlands, and nontidal wetlands

- Maps and construction plans which indicate locations of navigated waterways and potential interference and expected length of time involved for construction of marina

Information required for S Army Corps of Engineers Section permits includes

a Evaluation of economic, social environmental costs vs benefits,
b Extent of private and public need,
c Desirability of alternate locations,
d Effects on wetlands,
e Impacts on navigation,
f Effects on flood control,
g Compliance with applicable effluent and water quality standards and management practices,
h Interference with adjacent properties or water resource projects,
i Consistency with state, regional or local land use classification,
j Compliance with Coastal one management programs,
Enhancement, preservation or rehabilitation, and
l Cumulative impacts,

N TE nshore construction impacts should be mitigated by application of basic Chesapea e Bay Critical Area Program requirements

ACTI IT P ST-C NSTR CTI N ST RMWATER MANAGEMENT

mpact

Water quality in the marina basin and adjacent waters can be impacted by pollutants in stormwater runoff These pollutants include sediments, nutrients, salts, petroleum hydrocarbons, metals, and bacteria f primary concern is the potential for increased turbidities due directly to suspended sediments and indirectly to increased algal growth Sediment derived turbidity as well as decreased light penetration due to algal blooms can affect the growth of SA ther suspended or dissolved pollutants may be accumulated in fish and shellfish affecting the health of those organisms and the organisms which consume them

B M Ps

Features which minimi e stormwater discharge of pollutants act to control runoff velocity and volume, and retain pollutants before these waters enter the Bay system These features include

- se of infiltration measures, retention ponds and extended detention ponds to handle the first of rainfall, and effect the removal of a minimum of of pollutant loadings, especially sediments, total nitrogen, biochemical oxygen demand total phosphorous, lead, and inc
- se of rip-rap and bul heads as runoff filtering devices by directing runoff through porous surface to such structures lined with filter cloth
- se of porous surfaces crushed stone, shell wherever possible, particularly in par ing lots
- Direction of runoff from impervious surfaces to porous surfaces to improve infiltration capacity
- Minimal clearing of onsite vegetation
- Retention and creation of onsite vegetative buffers between potential sources of pollutants and tidal wetlands or tidal waters
- Conservative use of onsite fertili ers and
- se of non-phosphorous detergents for washing boats

MA D P C

- Maps of the area proposed for development must indicate
  a Post-construction drainage patterns, especially of runoff coming off of nonvegetated area urban runoff ,
  b Type and pervious nature of all surfaces on marina property,
  c Design and location of detention retention systems, and
  d Post-construction vegetation patterns,

- Description of stormwater management plan must include
  a Estimates of pre- and post-construction loadings of major pollutants sediment, nitrogen, phosphorus, lead and inc, and biological oxygen demand in marina waters with all assumptions of controlling conditions detailed,

b Mixing and flushing rates in marina waters,
c Total acreage of major land cover types and infiltration potentials, and
d Maintenance schedule for stormwater management structures

ACTI IT TRASH C NTR L

mpact

Litter is a form of pollution associated with increased boating activity that has an aesthetic as well as an ecological impact During the pea boating season, approximately one-half to one cubic yard of uncompacted garbage per day can be expected for every boats in a marina Plastics are the chief concern To date, percent of the world's species of sea birds are nown to have ingested plastic Plastic has been found in the stomachs of four of the seven species of marine turtles, in at least eight species of fish, in marine mammals including whales, dolphins, and manatees, and in invertebrates Lost or discarded fish netting, monofilament line, and plastic beverage yo es are materials that may lead to strangulation, drowning, or starvation

B M Ps

Measures which prevent loss of trash include

- Provision of equipment carts on all piers for conveyance of refuse to conveniently placed dumpsters and
- Strict enforcement by marina personnel of property disposal of trash by boaters, with potential fines for improper disposal

MA D P C

- Plans should indicate location and type of trash collecting facilities and

- Plans for proper training of marina personnel and the enforcement of property trash disposal should be outlined

Appendix

Description o istorical hore Erosion Processes

In ar ord Count

APPENDIX

DE CRIP I N I RICA RE ER I N PR CE E IN AR RD C UN

. eneral Description of Shore Erosion Processes

Harford County s tidal shorelines are the scene of a dramatic interaction between water, wind, and land. To safeguard their property, shoreline property owners need to know how to work with these natural forces and not against them, and therefore, understanding the dynamics of shore erosion is important.

n summary, there are three basic steps to the erosion process
( ) physical attack by waves and groundwater
(2) erosion of banks and deposition at the base of banks and
( ) removal, transportation, and deposition of bank materials along the shoreline.

Shore erosion may be defined as the net loss of land over a given reach and or segment of a shoreline. However, the rate and amount of erosion along a specific shoreline may vary from year to year. Consequently, while many of the variables which affect these estuarine shorelines are comple and not entirely understood, the most significant variables and processes have been of energy in contact with the shoreline.
These sources of energy are usually associated with either wind-generated wave action or groundwater activity. urthermore, it is not uncommon for both erosive forces to occur together.

n addition, there are several other variables that interact and affect the shoreline.
These variables include
( ) form or type of shoreline
(2) storm frequency
( ) tides and currents
( ) near-shore bottom characteristics and
( ) waves generated from boat activity.

. Harford County Shoreline Characteristics

Harford County is situated along the western shore of the upper Chesapeake Bay. The County has 0 miles of shoreline, of which only 2 miles (2) is directly accessible to the public and within Harford County s Critical Area. The nited States Army s testing installation at the Aberdeen Proving round (AP) controls the remainder of shoreline.

The Susquehanna River serves as the County s northeast boundary, shared by the western boundary of Cecil County. To the southeast, the County is bordered by the

ittle unpowder River, which is a shared boundary with Baltimore County.

Harford County reveals a wide diversity of shore typologies, which contain different characteristics and combinations of shore and fastland ones. The point where Deer Creek flows into the Susquehanna River roughly marks the fall line, which separates the Coastal Plain from the Piedmont uplands region. rom this portion farther downstream to Havre de race, high bluffs and steep banks slope to the water s edge. Throughout much of this area, there are interruptions of rock outcroppings which reveal the region s geologic history.

The segment of shoreline between Havre de race and Swan Creek Point is the only area within Harford County s Critical Area that borders the Chesapeake Bay. The shoreline is predominantly natural, with a few short sandy and gravelly beaches. These areas are interconnected with low to moderate bluffs from akington, having feet tall bluffs, to near Swan Creek Point having an elevation of feet.

The shoreline along Swan Creek and the Bush River seems to e ist in a relatively natural state. ow to moderate bluffs, as well as many sheltered coves with protruding marshlands, are found throughout both areas. n contrast to the basin-like appearance of the Bush River, Harford County s portion of the shoreline on the unpowder River is narrow and marshy. These shorelines are stabili ed with structural erosion protection measures in the Rumsey sland and unpowder Cove areas of oppa, with low to moderate bluffs occurring farther south in the oster Branch area.

. Assessment of Shoreline Conditions in Harford County

Historic shorelines and rates of erosion within Harford County have been mapped by the Maryland eological Survey. These maps are based on erosion rates which occurred in the 0s and 0s Maps were updated and revised in the 0s and in 2000.The most recent effort digiti ed historic shorelines and determined shoreline rates of change. Results were published online on the Maryland Coastal Atlas map service under the Shorelines Historical Archive and Shoreline Rates of Change layers here https gisapps.dnr.state.md.us coastalatlas AB2 . Results were also tabulated a report, State of Maryland Shore Erosion Task orce. (anuary 2000) *Final Report* Shoreline rates of change and the presence of structures like bulkheads and revetments helps guide planned measures.

Based upon these studies, appro imately percent or si teen miles of the 0-mile shoreline within Harford County s jurisdiction is e periencing significant erosion rates of 2 feet or more per year. Most of this shoreline is on military base lands and beyond the regulation of the county. or shoreline under county jurisdiction, unless structural measures are already present along a reach of tidal shoreline or a water-dependent facility requiring structural measures is planned, consideration should be given first to non-structural shore erosion control measures.

Appendix G

Measures Implementing
Harford County's
Critical Area
Agricultural Land Protection Program

APPENDIX G

PART I

AGRICULTURAL WATER QUALITY ENFORCEMENT PROCEDURES

As of 1992, each of the farms operating in Harford County's Critical Area are currently implementing soil and water conservation plans in cooperation with the Soil Conservation District as discussed in Chapter 6 of the Critical Area Program Management Document. The Soil and Water Conservation Plans are the keystone of the County's effort to address the provisions of the Critical Area Program development criteria relating to agricultural activities.

In addition to the Soil and Water Conservation Plans, the Maryland Department of the Environment in cooperation with the Soil Conservation Districts administrates an enforcement program to address agricultural pollution wherever it occurs within the State.

APPENDIX G
PART II

MEMORANDUM OF AGREEMENT

BETWEEN

HARFORD SOIL CONSERVATION DISTRICT

AND

HARFORD COUNTY, MARYLAND, A BODY CORPORATE AND POLITIC OF THE STATE OF MARYLAND, THROUGH THE DEPARTMENT OF PLANNING AND ZONING

WHEREAS the Harford Soil Conservation District, hereinafter called the District, is a political subdivision of the State of Maryland with a responsibility for the conservation of soil and soil resources and for the prevention and control of soil erosion within Harford County (Annotated Code, Agriculture Article, Sec. 8-307); and

WHEREAS, Harford County, hereinafter called the County, is required by the Chesapeake Bay Critical Area Law to have a Local Chesapeake Bay Critical Area Management Program (Annotated Code, Natural Resources Article, Section 8-1808); and

WHEREAS, the Critical Area Commission's Program Development Criteria require that the County's Local Management Program include an Agricultural Protection Plan (COMAR 27.01.06.03A) and specify that the required elements of the program be enforceable (COMAR 27.01.10.01H); and

WHEREAS, Harford County's Department of Planning and Zoning, hereinafter called the Department, has the responsibility for the preparation and implementation of the Local Chesapeake Bay Critical Area Management Program; and

WHEREAS, the Critical Area Criteria specify that the Local Critical Area Management Program is to be developed and implemented in cooperation with the District (COMAR 27.01.05).

NOW THEREFORE, the District and the Department agree to cooperate in the discharge of their mutual responsibilities and enter into this Memorandum of Agreement as a foundation for an enduring, cooperative working agreement, whereby:

THE DISTRICT AGREES TO:

1. Assist each farm within the Critical Area to have in place and implement a mandatory, approved Soil Conservation and Water Quality Plan emphasizing Best Management Practices (COMAR 27.01.06.03C(1), subject to be updated every ten (10) years;
2. Provide the Department with location map(s) of farm areas for which a landowner-farmer

has obtained through the District's Soil Conservation and Water Quality Plan;

3. Incorporate measures in Soil Conservation and Water Quality Plans to protect water quality and areas identified as Habitat Protection Areas in the County's Critical Area Management Program (COMAR 27.01.06.03B);
4. Provide for the establishment of buffer areas along shorelines within which agriculture will be permitted only if best management practices are used in accordance with an approved Soil Conservation and Water Quality Plan (Annotated Code. Natural Resources Article, Section 8-1808c(6); COMAR 27.01.06.03D; COMAR 27.01.09.01C);
5. Inform landowners who propose to harvest timber about the requirements for Forest Management Plans in the Chesapeake Bay Critical Area which ensure protection of water quality and areas identified as Habitat Protection Areas (COMAR 27.01.06.03B);
6. Ensure, in the development and approval of Soil Conservation and Water Quality Plans, that any disturbed expansion of agricultural activities does not involve:
   (a) The destruction, diking, draining, dredging, or filling of wetlands;
   (b) The clearing of forests or woodlands on soils with a slope greater than 15%, or on highly erodible soils with a "Kw" factor greater than .35 and a slope greater than 5%;
   (c) Clearing which would adversely affect water quality or plant and wildlife habitat identified as Habitat Protection Areas in the County's ChesapeakeBay Critical Areas Program (COMAR 27.01.06.02C); or
   (d) Clearing of existing natural vegetation within the 100-foot Critical Area Buffer (COMAR 27.01.09.01).
7. Provide, to District Cooperators who have not yet obtained a Soil Conservation and Water Quality Plan, technical advice on Best Management Practices applicable to the Cooperator's farming operation which will protect water quality and plant and wildlife habitat (COMAR 27.01.06.02E; COMAR 27.01.06.03); and
8. Provide the Department with annual reports of the District's conservation activities within the Critical Area.

THE DEPARTMENT AGREES TO:

1. Notify landowners about the regulations and provisions pertaining to agriculture as delineated in the Local Critical Area Management Program and direct pertinent landowners with agricultural lands (e.g., cropland, pastureland, etc.) to the District to obtain approved Soil Conservation and Water Quality Plans;
2. Review the location maps and, within fifteen (15) working days, provide comments on protective measures which may be needed because of Habitat Protection Areas on or near the site for which the District is preparing or reviewing a Soil Conservation and Water Quality Plan (COMAR 27.01.06.03);
3. Prohibit the creation of new agricultural lands that would disturb the resources specified in Paragraph 6, above (COMAR 27.01.06.02C);
4. Review and maintain files of annual conservation activities performed by the District within the County's Critical Area;
5. Inform landowners who have not voluntarily cooperated with the District to meet the

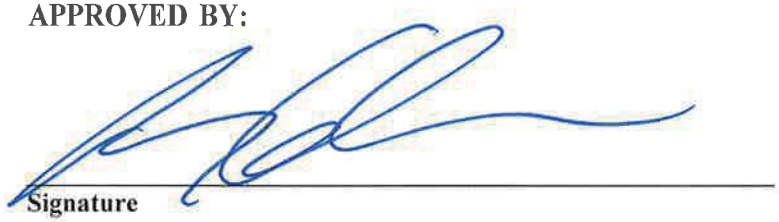
requirements of the Local Protection Program that they are in violation of state law (COMAR 27.01.06) and require the compliance with applicable regulations and provisions; and

6. Inform the Maryland Department of Agriculture regarding agricultural landowners who will not voluntarily comply with the Local Critical Area Management Program.

BOTH PARTIES AGREE AND UNDERSTAND:

1. The Department and the District will cooperate in implementing the Critical Area Law and the County's Local Protection Program;
2. Either party, as mutually agreed upon, and within their respective capacities, will provide or arrange for such additional services, facilities, equipment, materials, and arrangements as may be required to achieve common objectives;
3. Neither the Department nor the District will be bound by an obligation in this Agreement, which will involve the expenditure of funds in excess of the amounts available;
4. This Agreement shall be effective on the date of the last signature hereto; and
5. This Agreement shall be reviewed at least every five (5) years on a mutually acceptable date.

APPROVED BY:



Signature
Barry Glassman, County Executive

9/14/2021
Date

Lee D. McDaniel

Signature
Lee D. McDaniel, Harford Soil Conservation District Chairman

September 8, 2021
Date

Habitat Protection Areas for the Harford County Critical Area

Threatened and Endangered Species, Species In Need of Conservation

Locally Significant Habitats

Colonial Waterbirds

Threatened and Endangered Species, and Species In Need of Conservation (site in bold is new):

Boyer Road Shoreline 2
Gunpowder Shore 4
I-95 Crossing 6
Lower Deer Creek 8
Lower Susquehanna 10
Northern Susquehanna Canal 12
Oakington Shore 14
South Lapidum 16
Stafford Road Slopes 18
Swan Creek 20

Locally Significant Habitats:

Belcamp Beach 23
Grays Run 25
Leight Park Site 27
Otter Point Creek 29
Perryman Woods 31
Swan Creek Point 33
Willoughby Woods 34

Colonial Waterbirds:

Great Blue Heron Colonies 36

Maryland Natural Heritage Program
Wildlife and Heritage Service
Department of Natural Resources
Tawes State Office Building, E1
Annapolis, MD 21401

December 2018

Boyer Road Shoreline

County: Harford

BioNet Tier: 2
Size: 76 ac

Key Wildlife Habitats

- Coastal Beach
- Intertidal Mudflat and Sandflat
- Tidal Freshwater Marsh and Shrubland

Important Features

- Small waterwort (*Elatine minima,* state-listed as Endangered)
- Mudwort (*Limosella australis*, state-listed as Endangered)
- Parker's pipewort (*Eriocaulon parkeri*, state-listed as Threatened)
- Maryland bur-marigold (*Bidens bidentoides*, watchlist)

Ecological Significance

The shallow, sandy-bottomed, intertidal zone at Boyer Road Shoreline supports two species listed as Endangered in Maryland, mudwort (*Limosella australis*) and small waterwort (*Elatine minima*). The mudwort is a small plant of mudflats which is found in several locations in Cecil County, but Boyer Road Shoreline is the only known location in Harford County. The small waterwort, also a minute plant of muddy and sandy shores, is very rare in Maryland. Parker's pipewort (*Eriocaulon parkeri*), a small plant listed as Threatened in Maryland, also grows in the intertidal area, as well as Maryland bur-marigold (*Bidens bidentoides*, watchlist).

The Maryland bur-marigold is a globally rare regional endemic, found only from Maryland northward to New York. It has narrow habitat requirements – tidal mud flats along river edges. In Maryland, this species is limited to tidal marshes of the upper Chesapeake Bay and its tributaries, which makes conservation of Harford County's populations essential to the survival of the species in Maryland.

The habitat of all these rare and uncommon plants is a relatively flat intertidal shoreline with a sandy or muddy substrate. Due to shoreline development and stabilization, this natural shoreline is now very rare in Harford County. Because of the exceptional quality of the habitat, the presence of several rare and uncommon species, and the lack of human disturbance, Boyer Road Shoreline is among the most significant sites in Harford County.

Site Management Considerations

The effects of climate change, such as sea-level rise, increased intensity of coastal flooding, and changes in sediment deposition, will be one of the greatest threats to this coastal wetland /aquatic system. The adjacent uplands and nearby shoreline habitats may

affect the stability and composition of intertidal flats, as well as their ability to shift by migrating inland or along the shoreline as the sea level rises. Additional threats include the construction of structures in the intertidal zone, the clearing of vegetation in the upland buffer, excessive boat wakes, and the landing of boats on the shoreline during the growing season.

This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Gunpowder Shore

County: Harford

BioNet Tier: 2
Size: 42 ac

Key Wildlife Habitats

- Coastal Beach
- Intertidal Mudflat and Sandflat
- Tidal Freshwater Marsh and Shrubland

Important Features

- Parker's pipewort (*Eriocaulon parkeri*, state-listed as Threatened in Maryland)
- Spongy lophotocarpus (*Sagittaria spathulata,* state-listed as Threatened)

Ecological Significance

Gundpowder Shore contains an ecologically fragile intertidal zone consisting of a mixture of cobble, sand, and mud. The sandy intertidal zone supports a very large population of Parker's pipewort (*Eriocaulon parkeri*), a globally rare plant species which is listed as Threatened in Maryland. This species occurs in several locations on the eastern shore, but only in three locations on the western shore, all in Harford County. This population is by far the largest on the western shore. The sandy-bottomed intertidal habitat also supports spongy lophotocarpus (*Sagittaria spathulata,* state-listed as Threatened). Due to shoreline development and stabilization, this type of natural shoreline is now very rare in Harford County.

Site Management Considerations

The effects of climate change, such as sea-level rise, increased intensity of coastal flooding, and changes in sediment deposition, will be one of the greatest threats to this coastal wetland /aquatic system. The adjacent uplands and nearby shoreline habitats may affect the stability and composition of intertidal flats, as well as their ability to shift by migrating inland or along the shoreline as the sea level rises. Additional threats include the construction of structures in the intertidal zone, the clearing of vegetation in the upland buffer, excessive boat wakes, and the landing of boats on the shoreline during the growing season.

This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting

habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

I-95 Crossing
County: Harford

BioNet Tier: 3
Size: 469 ac

Key Wildlife Habitats

- Cliffs and Rock Outcrops
- Montane-Piedmont Floodplain

Important Features

- Northern map turtle (*Graptemys geographica,* state-listed as Endangered)
- Forest interior dwelling species (FIDS) habitat

Ecological Significance

I-95 Crossing includes an old, unused railroad bed (about ten feet high) which runs along the Susquehanna River, and the long, narrow wetland complex to the west of this railroad. A portion of this wetland complex consists of the old Susquehanna Canal, which flows through a flat, floodplain woodland. To the south of this woodland, a very diverse emergent marsh with standing dead trees can be found. Steep, wooded slopes border the wetland complex to the west. These slopes contain many rocky outcrops. Scattered eastern hemlocks (*Tsuga canadensis*), which are indicative of a cool microclimate, can be found growing in the rock crevices on some of these outcrops.

The wetlands, tributaries, old canal, and Susquehanna River shoreline of I-95 Crossing provide suitable habitat for the northern map turtle (*Graptemys geographica*). This mostly aquatic turtle is currently listed as an Endangered species in Maryland. It can be seen basking on logs or along the river banks. In Maryland, this endangered turtle is restricted to the Susquehanna River watershed.

One of the notable features of the I-95 Crossing area is the steep, northeast-facing slopes which occur to the west of the wetlands. The eastern hemlocks which grow in the rocky crevices along the slopes indicate that the slopes have a cool microclimate and thus are likely to provide habitat for species that have adapted to these unusual conditions. Extensive northeast-facing slopes such as the ones found within this area are very unique in the Piedmont province of Maryland and occur only on the Harford County side of the Susquehanna River. These slopes have a high likelihood of harboring rare species and should, therefore, be protected.

An additional value of I-95 Crossing is that it provides habitat for forest interior dwelling birds. Forest interior dwelling birds that have been observed on the site include red-eyed vireo, Acadian flycatcher, ovenbird, and northern parula.

Site Management Considerations

Principal threats to the site include sediment and stormwater runoff from adjacent uplands, which could degrade the quality of the wetlands and tributaries on which the rare species depends. Also, the expansion of the adjacent quarry could lower the water table, which could, in turn, alter the hydrology of the wetlands. Other threats to I-95 Crossing are activities which could alter the character of the steep slopes, or reduce the habitat value of the site for forest interior dwelling birds. Timber harvesting on the site should not occur on slopes of 15% or greater, to prevent a change in the microclimate or species composition of the steep slopes. Substantial removal of forest cover immediately above the steep slopes, which could also alter this microclimate, should be avoided.

This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Lower Deer Creek

County: Harford

BioNet Tier: 1
Size: 8,243 ac

Key Wildlife Habitats

- Piedmont Stream
- Montane-Piedmont Floodplain
- Cliff and Rock Outcrop
- Mesic Mixed Hardwood Forest
- Montane-Piedmont Acidic Seepage Swamp

Important Features

- Chesapeake logperch (*Percina bimaculata,* state-listed as Threatened)
- Habitat for Maryland darter (*Etheostoma sellare*, federally listed as Endangered, state-listed as Endangered)
- Single-headed pussytoes (*Antennaria solitaria*, state-listed as Threatened)
- Rapids clubtail (*Gomphus quadricolor*, state-listed as In Need of Conservation) and other rare dragonflies

Ecological Significance

Lower Deer Creek flows into the Susquehanna River from its origin in Pennsylvania. The Deer Creek watershed is rural, consisting primarily of agricultural fields and forestland, with some scattered development. The lower portion is a healthy body of water with good forest buffer along the riverbanks. This section is low in gradient with rocky riffles, sandy runs, and some scattered sandy pools. The aquatic habitat is very diverse, including silt, sand, gravel, and boulder areas, and much of the creek bottom is vegetated, especially in shallower areas. Pools and runs in the creek are attractive resting areas for spring migratory hickory shad and river herring, causing Deer Creek to be a popular springtime fishing destination. The creek is stocked with hatchery trout but becomes too warm for trout survival in the summer, at which point the trout swim into the Susquehanna River.

Historically, Deer Creek supported spawning runs of anadromous fish such as hickory shad, white perch, yellow perch, alewife, and blueback herring, but a private dam built on Deer Creek blocked approximately 25 miles of spawning habitat from these anadromous fishes. Installation of a fish ladder re-opened historic anadromous fish spawning habitat in Deer Creek in 2000. Since the opening of the fish ladder, all of the historical species of anadromous fishes that ascended Deer Creek to spawn have been documented passing through the fish ladder.

Deer Creek is the last known habitat of the Maryland darter (*Etheostoma sellare*, federally listed as Endangered, state-listed as Endangered), the only vertebrate endemic to Maryland. This species was last sighted in 1988, but recurring survey efforts hope to rediscover the fish in this good quality habitat. Three other rare fish species, the shortnose sturgeon (*Acipenser brevirostrum,* state-listed as Endangered), the Atlantic sturgeon (*Acipenser oxyrhynchus,* state-listed as Endangered), and the Chesapeake logperch (*Percina*

bimaculata, state-listed as Threatened), use Deer Creek for spawning. The Chesapeake logperch maintains a healthy population the lower section of Deer Creek.

Parts of the creek are surrounded by ecologically valuable terrestrial habitat, including mature hardwood forests. Forest interior dwelling bird species such as red-eyed vireos, ovenbird, scarlet tanagers, and Acadian flycatchers have been observed in these woods. The rare plant single-headed pussytoes (*Antennaria solitaria*, state-listed as Threatened) can be found in this forest habitat. This occurrence of pussytoes is the largest population of this plant in Maryland and one of the most northern known populations for this species throughout its range. Seasonally flooded seepage swamps and floodplains along the creek provide habitat for dragonflies and damselflies, as well as some rare wetland plants like ostrich fern (*Matteuccia struthiopteris*, state rare) and the butternut tree (*Juglans cinerea*, state rare).

Site Management Considerations

This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Lower Susquehanna

County: Harford

BioNet Tier: 1
Size: 4,089 ac

Key Wildlife Habitats

- Piedmont River
- Montane-Piedmont Floodplain

Important Features

- Shortnose sturgeon (*Acipenser brevirostrum*, state-listed as Endangered, federally listed as Endangered)
- Atlantic sturgeon (*Acipenser oxyrinchus*, state-listed as Endangered, federally listed as Threatened)
- Chesapeake logperch (*Percina bimaculata,* state-listed as Threatened)
- Northern map turtle (*Graptemys geographica*, state-listed as Endangered)

Ecological Significance

The Lower Susquehanna is an aquatic site encompassing the Susquehanna River from the Conowingo Dam downstream to the I-95 bridge crossing. This portion of the river is diverse in both flow and substrate – from high velocity riffles snaking through boulder and bedrock below the dam to slow water, almost lentic habitats over sand and submerged vegetation near the I-95 bridge. This variety in both flow and substrate creates diverse habitat for a variety of important fisheries and aquatic resources. Several rare fishes are found here, including shortnose sturgeon (*Acipenser brevirostrum*, state and federally listed as Endangered), Atlantic sturgeon (*Acipenser oxyrinchus*, state-listed as Endangered, federally listed as Threatened), and the globally rare Chesapeake logperch (*Percina bimaculata,* state-listed as Threatened). The northern map turtle (*Graptemys geographica*, state-listed as Endangered) can be seen basking on logs or along the riverbanks. It uses numerous islands in the river, as well as the river shore areas for breeding as well. In Maryland, this aquatic turtle is restricted to the Susquehanna River watershed. However, it also occurs northward along the floodplain well into Pennsylvania.

In addition to providing important habitats to these imperiled species, the lower Susquehanna River, including the lower portions of Deer Creek, provide important spawning habitat for important fisheries including migratory alewife, blueback herring, American and hickory shad. The submerged aquatic grass beds of the lower Susquehanna, as well as the Susquehanna Flats, located off of the city of Havre de Grace, are a critical nursery ground for Maryland's state fish, the striped bass.

Site Management Considerations

The effects of climate change, such as increased intensity of storms, rainfall, and flooding events is one of the greatest threats to this aquatic system. The water quality and hydrology in this section of the Susquehanna River is the cumulative result of numerous

effects upstream in the vast drainage basin of the river in Maryland, Pennsylvania, and New York. Many aspects of water quality and hydrology are also greatly influenced and partly controlled by the presence and management of multiple dams along the Susquehanna, including Conowingo Dam.

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Northern Susquehanna Canal

County: Harford

BioNet Tier: 2
Size: 323 ac

Key Wildlife Habitats

- Cliffs and Rock Outcrop
- Mesic Mixed Hardwood Forest
- Montane-Piedmont Floodplain

Important Features

- Short's rockcress (*Boechera dentata,* watchlist)
- Starflower Solomon's-plume (*Maianthemum stellatum,* state-listed as Endangered)
- Sweet-scented Indian-plantain (*Senecia suaveolens*, state-listed as Endangered)
- Valerian (*Valeriana pauciflora,* state-listed as Endangered)
- Forest interior dwelling species (FIDS) habitat

Ecological Significance

Northern Susquehanna Canal is a long narrow site following the western shore of the Susquehanna River for almost three miles. The historic old Susquehanna Canal and the abandoned railroad tracks run the entire length of the site. This site contains a mature floodplain forest dominated by large trees such as sycamore, silver maple, and green ash. In spring, the ground is covered with colorful wildflowers such as Virginia bluebells, golden ragwort, and erect trillium. Northern Susquehanna Canal contains populations of many rare plant species, such as Short's rockcress (*Boechera dentata,* watchlist), starflower Solomon's-plume (*Maianthemum stellatum,* state-listed as Endangered), sweet-scented Indian-plantain (*Senecia suaveolens,* state-listed as Endangered), and valerian (*Valeriana pauciflora,* state-listed as Endangered). In addition, the site contains glade fern (*Diplazium pycnocarpon*), a species which is listed as Threatened in Maryland. This site harbors the only known occurrences in Harford County and the largest extant populations along Maryland's Susquehanna River of all four species. Northern Susquehanna Canal also harbors one of the largest populations in the state of ostrich fern (*Matteuccia struthiopteris,* state rare).

The mature forest covering the bottomland along the Northern Susquehanna Canal provides exemplary breeding habitat for forest interior dwelling birds. Fourteen species of these birds have been observed on the site, five of which are listed as indicators of high-quality habitat which are the hooded warbler, Kentucky warbler, worm-eating warbler, American redstart, and Louisiana waterthrush. This site also provides excellent habitat for other birds, including bald eagle, wood duck, great blue heron, and green-backed heron. Most of this site occurs within Susquehanna State Park.

Site Management Considerations

This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Oakington Shore
County: Harford

BioNet Tier: 2
Size: 149 ac

Key Wildlife Habitats

- Coastal Beach
- Intertidal Mudflat and Sand Flat
- Mesic Mixed Hardwood Forest
- Tidal Freshwater Marsh and Shrubland

Important Features

- Parker's pipewort (*Eriocaulon parkeri,* state-listed as Threatened)
- Maryland bur-marigold (*Bidens bidentoides*, watchlist)
- Forest interior dwelling species (FIDS) habitat

Ecological Significance

The most notable features of the Oakington Shore area are two tidal coves which open directly into Chesapeake Bay. The intertidal zone of these coves is largely undisturbed and consists of a mixture of sand, pebbles, and mud. Some stretches of the sandy-bottomed coves are vegetated with threesquare bulrush, switchgrass, dotted smartweed, and water willow. These sandy coves along the tidal shoreline support two globally rare plant species. One of the rare plants, Parker's pipewort (*Eriocaulon parkeri*) is listed as Threatened in Maryland. The other species, Maryland bur-marigold (*Bidens bidentoides*, watchlist) is a globally rare regional endemic, found from Maryland northward to New York. It has narrow habitat requirements – tidal mud flats along river edges. In Maryland, this species is limited to tidal marshes of the upper Chesapeake Bay and its tributaries, which makes conservation of Harford County's populations essential to the survival of the species in Maryland.

Oakington Shore includes tidal wetlands on both sides of the shallow coves. Scattered patches of submerged aquatic vegetation, such as hydrilla, Eurasian watermilfoil, and wild celery, occur in the coves. The southernmost of these wetlands consists of a young forest dominated by red maple and sweetgum transitioning to a more open wetland dominated by arrow arum, halberd-leaved tearthumb, and swamp rosemallow. A drier beech-oak forest with an understory of flowering dogwood occurs in the ravines above the wetlands. The forest is high quality habitat for forest interior dwelling species (FIDS).

Site Management Considerations

The effects of climate change, such as sea-level rise, increased intensity of coastal flooding, and changes in sediment deposition, will be one of the greatest threats to this coastal wetland /aquatic system. The adjacent uplands and nearby shoreline habitats may affect the stability and composition of intertidal flats, as well as their ability to shift by migrating inland or along the shoreline as the sea level rises. Additional threats include

the construction of structures in the intertidal zone, the clearing of vegetation in the upland buffer, excessive boat wakes, and the landing of boats on the shoreline during the growing season.

Most of the Oakington Shore area is located in Swan Harbor Farm and is owned by Harford County. This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

South Lapidum

County: Harford

BioNet Tier: 3
Size: 344 ac

Key Wildlife Habitats

- Cliffs and Rock Outcrops
- Montane-Piedmont Floodplain

Important Features

- Northern map turtle (*Graptemys geographica,* state-listed as Endangered)
- Forest interior dwelling species (FIDS) habitat

Ecological Significance

South Lapidum includes an old, unused railroad bed (about ten feet high) which runs along the Susquehanna River, and the long, narrow wetland complex to the west of this railroad. A portion of this wetland complex consists of the old Susquehanna Canal, which flows through a flat, floodplain woodland. To the south of this woodland, a very diverse emergent marsh with standing dead trees can be found. This marsh, in turn, drains into an open water wetland complex, just before it meets with an inlet that forms the mouth of the old canal.

Steep, wooded slopes and forested ravines border the wetland complex to the west. These slopes contain many rocky outcrops. Scattered eastern hemlocks (*Tsuga canadensis*), which are indicative of a cool microclimate, can be found growing in the rock crevices on some of these outcrops.

The wetlands, tributaries, old canal, and Susquehanna River shoreline of South Lapidum provide suitable habitat for the northern map turtle (*Graptemys geographica*). This mostly aquatic turtle is currently listed as an Endangered species in Maryland. It can be seen basking on logs or along the river banks. In Maryland, this endangered turtle is restricted to the Susquehanna River watershed.

One other notable feature of South Lapidum is the steep, northeast-facing slopes which occur to the west of the wetlands. The eastern hemlocks which grow in the rocky crevices along the slopes indicate that the slopes have a cool microclimate and thus are likely to provide habitat for species that have adapted to these unusual conditions. Extensive northeast-facing slopes such as the ones found within this area are very unique in the Piedmont province of Maryland and occur only on the Harford County side of the Susquehanna River. These slopes have a high likelihood of harboring rare plant species, and should, therefore, be protected.

An additional value of South Lapidum is that it provides habitat for forest interior dwelling birds. Forest interior dwelling birds that have been observed on the site include red-eyed vireo, Acadian flycatcher, prothonotary warbler, Kentucky warbler, ovenbird , and northern parula.

Site Management Considerations

Principal threats to the site include sediment and stormwater runoff from adjacent uplands, which could degrade the quality of the wetlands and tributaries on which the rare species depends. Other threats to South Lapidum are activities which could alter the character of the steep slopes, or reduce the habitat value of the site for forest interior dwelling birds. Timber harvesting on the site should not occur on slopes of 15% or greater, to prevent a change in the microclimate or species composition of the steep slopes. Substantial removal of forest cover immediately above the steep slopes, which could also alter this microclimate, should be avoided.

This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Stafford Road Slopes

County: Harford

BioNet Tier: 3
Size: 197 ac

Key Wildlife Habitats

- Springs
- Montane-Piedmont Floodplain
- Mesic Mixed Hardwood Forest

Important Features

- Northern map turtle (*Graptemys geographica,* state-listed as Endangered)
- Potomac amphipod (*Stygobromus tenuis potomacus,* watchlist)

Ecological Significance

Stafford Road Slopes consists of a two mile stretch of land along the Susquehanna River, which is comprised of extensive northeast-facing slopes. These slopes are generally very steep, and contain several seeps.

The Susquehanna River shoreline and associated wetlands and upland habitats of Stafford Road Slopes provide suitable habitat for the northern map turtle (*Graptemys geographica*). This mostly aquatic turtle is currently listed as an Endangered species in Maryland. It can be seen basking on logs or along the river banks. In Maryland, this endangered turtle is restricted to the Susquehanna River watershed.

A rich, deciduous forest can be found growing on the slopes. This forest is dominated by tulip poplar and various oaks, with an understory of red maple and a shrub layer of pawpaw (*Asimina triloba*). The herbaceous layer of the forest is very diverse, and contains may-apple (*Podophyllum peltatum*), pale jewelweed (*Impatiens pallida*), blue cohosh (*Caulophyllum thalictroides*), dutchman's breeches (*Dicentra cucullaria*), Christmas fern (*Polystichum acrostichoides*), bloodroot (*Sanguinaria canadensis*), wild ginger (*Asarum canadense*), jack-in-the-pulpit (*Arisaema triphyllum*), and many other species. The ground itself is very stony, and the stones are interspersed with rich, organic soil.

Stafford Road Slopes in comprised of a long stretch of steep, rocky slopes with a northeastern exposure. Extensive northeast-facing slopes such as the ones found within this area are very unique in the Piedmont province of Maryland, and occur only on the Harford County side of the Susquehanna River.

The microclimate of the slopes is very cool and moist. These slopes harbor both the Potomac amphipod (*Stygobromus tenuis potomacus*), a groundwater invertebrate species on the state's watchlist, as well as a tremendously large population of a rare white form of red trillium (*Trillium erectum var. album*). The uniqueness of the slopes, combined with the presence of rare species on the site, make Stafford Road Slopes very worthy of protection.

The slopes along Stafford Road are well-known for their exceptional springtime beauty. This beauty is due primarily to the abundance of wildflowers on the slopes, most notably the rare trilliums and dutchman's breeches. The white color of these flowers carpets the slopes of the area for their entire length.

Site Management Considerations

Most of Stafford Road Slopes falls within Susquehanna State Park. This site is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

One activity which has the potential to destroy the integrity of the site is timber harvesting. This activity could alter the microclimate of the slopes, and subsequently change the species composition of the vegetation on these slopes. Timber harvesting could also cause direct damage to the rare species on the site. For reasons mentioned above, timber harvesting should be prohibited within the protection area, except to remove individual diseased trees, or trees which are in danger of falling where they may threaten human safety (i.e., along Stafford Road at the base of the slopes).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Swan Creek
County: Harford

BioNet Tier: 1
Size: 2954 ac

Key Wildlife Habitats

- Piedmont Stream
- Montane-Piedmont Floodplain
- Mesic Mixed Hardwood Forest
- Tidal Freshwater Marsh and Shrubland

Important Features

- Chesapeake logperch (*Percina bimaculata*, state-listed as Threatened)
- Forest interior dwelling species (FIDS) habitat

Ecological Significance

Swan Creek is a roughly 10-mile long stream that flows into the Chesapeake Bay at the northern end of the U.S. military base, Aberdeen Proving Ground. Much of the Swan Creek watershed is rural, consisting primarily of agricultural fields and forestland, with some development mostly at the southern edge at the town of Aberdeen. The headwaters of this tributary are important for maintaining water quality in downstream reaches. The lower portion of Swan Creek is comprised of good quality forested buffers and tidal marshes along the riverbanks. This section is low in gradient with gravel and sandy runs and sandy pools with large woody debris - providing important habitat for the critically imperiled Chesapeake logperch (*Percina bimaculata,* state-listed as Threatened). This small, globally-rare darter is found primarily in the Lower Susquehanna River in southeastern Pennsylvania and northeastern Maryland. In the past 80 years, its global range has diminished by more than 50 percent as the species has disappeared from the Potomac River basin and parts of the Susquehanna River basin in Pennsylvania. To survive, the logperch needs streams with silt-free gravel, as it feeds on aquatic invertebrates by flipping stones with its nose.

Other rare fishes found historically in the Swan Creek watershed include bridle shiner (*Notropis bifrenatus*) and the federally-endangered Maryland darter (*Etheostoma sellare*). A tributary of Swan Creek was one of the last known habitats of the Maryland darter (*Etheostoma sellare*, both federally listed and state-listed as Endangered), the only vertebrate endemic to Maryland. This species was last sighted in Maryland in 1988, but recurring survey efforts hope to rediscover the fish in this good quality habitat.

Much of the creek is buffered by ecologically valuable terrestrial habitat, including mature mixed hardwood forests. Forest interior dwelling bird species such as red-eyed vireo, ovenbird, scarlet tanager, and Acadian flycatcher have been observed in these woods.

Site Management Considerations

Much of the Swan Creek area within the Critical Area boundary is found on properties owned and managed by Harford County as Swan Harbor Farm and Mullins Park.

Swan Creek is designated as a habitat protection area for state-listed species under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Locally Significant Habitats

Belcamp Beach

County: Harford

BioNet Tier: 2

Size: 18 ac

Key Wildlife Habitats

- Coastal Beach
- Intertidal Mudflat and Sandflat
- Tidal Freshwater Marsh and Shrubland

Important Features

- Salt-marsh bulrush (*Schoenoplectus novae-angliae*, state rare)
- Tickseed sunflower (*Bidens trichosperma,* state rare)
- Spongy lophotocarpus (*Sagittaria spathulata,* state rare)
- Maryland bur-marigold (*Bidens bidentoides*, watchlist)

Ecological Significance

Belcamp Beach has a sandy, gravelly, intertidal zone of beach with a firm bottom and predominantly fresh water. This habitat supports a group of rare wetland plants, including salt-marsh bulrush (*Schoenoplectus novae-angliae,* state rare), spongy lophotocarpus (*Sagittaria spathulata,* state rare), tickseed sunflower (*Bidens trichosperma,* state rare), and Maryland bur-marigold (*Bidens bidentoides*, watchlist).

The Maryland bur-marigold is a globally rare regional endemic, found from Maryland northward to New York. It has narrow habitat requirements – tidal mud flats along river edges. In Maryland, this species is limited to tidal marshes of the upper Chesapeake Bay and its tributaries, which makes conservation of Harford County's populations essential to the survival of the species in Maryland. Common plants found here include common threesquare, switchgrass, rattlesnake-master, seaside goldenrod, and big cordgrass.

Site Management Considerations

The effects of climate change, such as sea-level rise, increased intensity of coastal flooding, and changes in sediment deposition, will be one of the greatest threats to this coastal wetland /aquatic system. The adjacent uplands and nearby shoreline habitats may affect the stability and composition of intertidal flats, as well as their ability to shift by migrating inland or along the shoreline as the sea level rises. Additional threats include the construction of structures in the intertidal zone, the clearing of vegetation in the upland buffer, excessive boat wakes, and the landing of boats on the shoreline during the growing season.

This site has been designated as a locally significant habitat under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Grays Run
County: Harford

BioNet Tier: 3
Size: 106 ac

Key Wildlife Habitats

- Tidal Freshwater Marsh and Shrubland

Important Features

- Salt-marsh bulrush (*Schoenoplectus novae-angliae*, state rare)

Ecological Significance

The Grays Run area consists of a five acre fresh to brackish tidal marsh and a complex of tidal and nontidal wetlands and streams which drain into this marsh from the north. The tidal marsh is dominated by broad-leaved cattail (*Typha latifolia*), narrow-leaved cattail (*Typha angustifolia*), swamp rosemallow (*Hibiscus moscheutos*), wild rice (*Zizania aquatica*), and several bulrushes (*Scirpus sp.*) and other sedges. Grays Run flows in a northeast to southwest direction through the marsh. Pulaski Highway cuts across the marsh near its lower end.

A freshwater pond occurs to the southwest of the tidal marsh. Baltimore and Ohio railroad tracks run in an east to west direction along the northern border of both the pond and the marsh. Temporarily to seasonally-flooded forested nontidal wetlands with associated tributary streams occur to the north of these tracks. These wetlands are dominated by green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*) and box-elder (*Acer negundo*).

Grays Run contains a large population of salt-marsh bulrush (*Schoenoplectus novae-angliae*, formerly named *Scirpus cylindricus*), a state rare sedge. This species is found in only a few locations in the state and is of limited distribution in Harford County, currently known only from two sites in the Grays Run-Church Creek watershed. Salt-marsh bulrush has a broad range along the Atlantic Coastal Plain but has a restricted habitat - the transition zone between saline and fresh water in tidal river systems.

Site Management Considerations

Grays Run is located almost entirely within the Chesapeake Bay Critical Area and was designated a Habitat of Local Significance by Harford County in 1995. This designation prohibits development activites and other disturbances within the defined protection area unless it can be shown that such activities would not adversely affect the designated species or their habitat.

Activities which alter the hydrology of the tidal marsh or adjoining wetlands or increase pollutant runoff into the marsh should be avoided. Draining, filling, or development immediately adjacent to the wetlands could adversely impact the rare species habitat.

Although a portion of the marsh was drained in 1994 to construct a gas pipeline through the site, the project was carefully planned and monitored and the salt-marsh bulrush population was not damaged.

The maintenance of Grays Run in its present condition would provide the rare species population on the site with the best chance for survival over the long term. Monitoring of the rare species and the condition of the habitat should be done annually.

Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Leight Park Site

County: Harford

BioNet Tier: 2

Size: 21 ac

Key Wildlife Habitats

- Coastal Beach
- Intertidal Mudflat and Sand Flat
- Mesic Mixed Hardwood Forest
- Tidal Freshwater Marsh and Shrubland

Important Features

- Spongy lophotocarpus (*Sagittaria spathulata,* state rare)
- Maryland bur-marigold (*Bidens bidentoides*, watchlist)
- Forest interior dwelling species (FIDS) habitat

Ecological Significance

Leight Park Site contains a sizable population of Maryland bur-marigold (*Bidens bidentoides*), a freshwater tidal marsh species that is globally rare and a regional endemic, found from Maryland northward to New York. This species occurs in a number of locations along the upper Chesapeake Bay in Cecil and Harford counties. Because the total range of this species is limited to fresh tidal marshes from New York south to the upper Chesapeake and its tributaries, conservation of Maryland's populations is important for the survival of the species.

The shoreline at Leight Park is a good example of a freshwater-slightly brackish tidal wetland. The intertidal zone is a combination of abruptly dropping mucky shoreline and small coves with gradually sloping sandy shorelines. One sandy cove harbors a small colony of spongy lophotocarpus (*Sagittaria spathulata,* state rare), an intertidal species.

Like other estuaries, this site supports a variety and abundance of wildlife, especially birds, fish, and invertebrates. The wide expanse of water provides good fishing for belted kingfisher, great blue heron, and osprey. Several small streams and seepage areas provide habitat for salamanders and frogs. The forest also is part of a larger block of forest that provides habitat for forest interior dwelling species (FIDS), such as Acadian flycatcher and scarlet tanager.

Site Management Considerations

The effects of climate change, such as sea-level rise, increased intensity of coastal flooding, and changes in sediment deposition, will be one of the greatest threats to this coastal wetland /aquatic system. The adjacent uplands and nearby shoreline habitats may affect the stability and composition of intertidal flats, as well as their ability to shift by migrating inland or along the shoreline as the sea level rises. Additional threats include the construction of structures in the intertidal zone, the clearing of vegetation in the upland

buffer, excessive boat wakes, and the landing of boats on the shoreline during the growing season.

Leight Park is owned and managed by Harford County and is part of the Otter Point Creek component of the Chesapeake Bay National Estuarine Research Reserve. This site has been designated as a locally significant habitat under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Otter Point Creek

County: Harford

BioNet Tier: 3
Size: 117 ac

Key Wildlife Habitats

- Mesic Mixed Hardwood Forest
- Coastal Plain Floodplain
- Tidal Freshwater Marsh and Shrubland

Important Features

- Primrose-willow (*Ludwigia decurrens*, state rare)
- Forest interior dwelling species (FIDS) habitat

Ecological Significance

The Otter Point Creek area contains an extensive forested wetland dominated by sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), and river birch (*Betula nigra*). In canopy openings, the saturated soil supports emergent species such as mud plantain (*Heteranthera reniformis*), cardinal flower (*Lobelia cardinalis*), and Turk's-cap lily (*Lilium superbum*). Along the open shoreline are swamp buttercup (*Ranunculus septentrionalis*), sweetflag (*Acorus calamus*), and sneezeweed (*Helenium autumnale*).

An emergent nontidal wetland in the Otter Point Creek area harbors an exceptionally vigorous population of primrose-willow (*Ludwigia decurrens*), a state rare herbaceous plant. This southern species is near the northern edge of its range in Maryland. It occurs in several counties in southern Maryland, but is known from only one other site in Harford County.

The varied wetland habitats of this site include forested wetlands, old ponds bordered by aquatic and emergent vegetation, nontidal marshes, and freshwater tidal marshes. The large, unbroken tract of deciduous forest wetland provides excellent habitat for forest interior dwelling birds and mammals. Breeding birds known from Otter Point Creek include prothonotary warbler and scarlet tanager. Despite being located in a highly-developed part of the county, many uncommon mammals have been noted, including beaver, muskrat, mink, and river otter.

Site Management Considerations

This area is within the 350-acre Bosely Conservancy, owned and managed by the Harford County chapter of the Izaak Walton League, a private conservation organization. This site is also a component of the Chesapeake Bay National Estuarine Research Reserve. Otter Point Creek has been designated as a locally significant habitat under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03).

Sedimentation from local road and housing construction and runoff from the nearby Pulaski Highway (US-40) threaten the water quality of Otter Point Creek. Invasive

weedy species such as multiflora rose (*Rosa multiflora*) are well established on the trails along the creek. The area is popular with fishermen and local residents.

Recommendations for management of this site include regular monitoring of the water quality, controlling the multiflora rose and other invasive species along the trails, and monitoring local trails for potential impacts to the rare species population.

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Perryman Woods
County: Harford

BioNet Tier: 4
Size: 123 ac

Key Wildlife Habitats

- Vernal Pools
- Coastal Plain Flatwood and Depression Swamp

Important Features

- Forest interior dwelling species (FIDS) habitat

Ecological Significance

According to the Upland Natural Areas Study conducted by the Maryland Department of Natural Resources, Perryman Woods is a flat, wooded site predominated by white oak, tulip poplar, American beech, and sweetgum with diameters generally ranging from 12 to 18 inches. Several larger trees with diameters of 24 inches also occur on the site. Subdominant tree species include northern red oak, black oak, hickory (*Carya* sp.), and red maple. Arrowwood (*Viburnum* sp.), blueberries (*Vaccinium* sp.), and greenbrier (*Smilax* sp.) occur in the understory, as do saplings of overstory trees. Perryman Woods is bisected by a powerline corridor which runs in an east-west direction through the middle of the site. A red maple / green ash tidal marsh with a fringe of cattails (*Typha* sp.) and arrow arum (*Peltandra virginica*) can be found in the southern portion of this site.

Notable features of Perryman Woods are the many temporarily to seasonally flooded nontidal wetlands (vernal pools) which occur throughout the site. Some of these pools support wetland vegetation, including willow oak, smooth arrowwood (*Viburnum recognitum*), spicebush (*Lindera benzoin*), buttonbush, and willow (*Salix* sp.), while others are virtually unvegetated.

The deciduous woodland and associated vernal pools of the Perryman Woods area represent a natural community type called "flatwood" or a depressional forested wetland. This community type is found only in the Coastal Plain portion of the County, and is thus of limited occurrence. Flatwood communities have been substantially fragmented and reduced in Maryland and are considered a rare habitat. In Harford County, most flatwood communities have been destroyed by agricultural and development activities. The Perryman Woods site represents one of the best remaining examples of this community type in the County. The large trees on the site make this community particularly unique.

The vernal pools within Perryman Woods provide breeding and feeding habitat for a large number and variety of amphibians, a few reptile species, and a large number of aquatic invertebrates. Many of these species are vernal pool specialists, and require natural pools to complete their life cycles.

An additional value of Perryman Woods is that it provides habitat for forest interior dwelling birds. Interior dwelling species which have been observed on the site include pileated woodpecker, hairy woodpecker, whip-poor-will, Acadian flycatcher, yellow-throated vireo, red-eyed vireo, northern parula, ovenbird , American redstart, and scarlet tanager .

Site Management Considerations

Potential threats to this site are related to negative impacts to the water quality of the vernal pools. Runoff from the adjoining agricultural field has the potential to adversely impact the vernal pools on the site, and also to impact the water of the tributary streams flowing through the site. Precautionary measures should be taken during any future construction in the vicinity of Perryman Woods to prevent any sedimentation of these streams and pools.

All proposed timber harvesting activities should be conducted so it will not alter the existing vegetation structure or change the existing species composition of the site. Disturbances to vernal pools and the tidal wetland during harvesting operations should be avoided, and the habitat value for forest interior dwelling birds should be retained.

This site has been designated as a locally significant habitat under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Swan Creek Point

BioNet Tier: 2

County: Harford

Size: 41 ac

Key Wildlife Habitats

- Coastal Beach
- Intertidal Mudflat and Sandflat
- Tidal Freshwater Marsh and Shrubland

Important Features

- Maryland bur-marigold (*Bidens bidentoides*, watchlist)

Ecological Significance

The primary feature of Swan Creek Point is the intertidal habitat that supports a population of Maryland bur-marigold (*Bidens bidentoides*, watchlist) which is globally rare and a regional endemic, found only from Maryland northward to New York. The total Maryland range of this species is limited to tidal waters of the upper Chesapeake Bay and its tributaries. Therefore, conservation of Harford County's populations is important to the survival of the species in Maryland and range-wide. This species is often found in association with a few other rare intertidal plants. Therefore, this area is likely to offer potential habitat for these associated rare species.

Site Management Considerations

The effects of climate change, such as sea-level rise, increased intensity of coastal flooding, and changes in sediment deposition, will be one of the greatest threats to this coastal wetland /aquatic system. The adjacent uplands and nearby shoreline habitats may affect the stability and composition of intertidal flats, as well as their ability to shift by migrating inland or along the shoreline as the sea level rises. Additional threats include the construction of structures in the intertidal zone, the clearing of vegetation in the upland buffer, excessive boat wakes, and the landing of boats on the shoreline during the growing season.

The Swan Creek Point area is located within the Eleanor and Millard Tydings Park, owned and managed by Harford County. This site has been designated as a locally significant habitat under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Willoughby Woods

BioNet Tier: 4
County: Harford
Size: 249 ac

Key Wildlife Habitats

- Vernal Pools
- Coastal Plain Flatwood and Depression Swamp

Important Features

- Forest interior dwelling species (FIDS) habitat

Ecological Significance

Willoughby Woods consists primarily of a flat, well-stratified deciduous woodland, dominated by white oak, tulip poplar, and sweetgum, with an understory of red maple and sweetgum, and a shrub layer of blueberries (*Vaccinium* spp.), and saplings of overstory trees. A large alluvial red maple/tulip poplar floodplain occurs in the northwestern portion of the site, which is bisected by Willoughby Beach Road. Notable features of Willoughby Woods are the many temporarily to seasonally flooded nontidal wetlands, known as vernal pools, which occur throughout the site. Most of the vernal pools support wetland vegetation, including willow oak, smooth arrowwood (*Viburnum recognitum*), and spicebush (*Lindera benzoin*), while some of the smaller pools are virtually unvegetated.

Several open nontidal wetlands and one tidal wetland add to the overall diversity of the site. Three nontidal wetlands, along the railroad tracks in the southwestern portion of the site, were once part of the large tidal marsh complex to the south, in Aberdeen Proving Ground. These wetlands are now somewhat impounded by the railroad tracks and, as a result, are semi-permanently to permanently flooded. These wetlands presently support a high diversity of plant species, including sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrushes (*Scirpus* spp.), burreed (*Sparganium* sp.), beggar-ticks (*Bidens* spp.), buttonbush (*Cephalanthus occidentalis*), and bladderworts (*Utricularia* sp.), and also contain some standing dead trees. One wetland, along the north edge of Willoughby Beach Road in the eastern part of the site, contains roses (*Rosa* sp.), narrow-leaved cattails (*Typha angustifolia*), buttonbush, and bladderworts. This wetland is unique in that *Sphagnum* spp. is present over large portions of the wetland, creating somewhat of a bog-like habitat.

The deciduous woodland and associated vernal pools of the Willoughby Woods area represent a natural community type called "flatwood" or a depressional forested wetland. This community type is found only in the Coastal Plain portion of the County, and is thus of limited occurrence. Flatwood communities have been substantially reduced in Maryland and are considered a rare habitat. In Harford County, most flatwood communities have been destroyed by agricultural and development activities. The Willoughby Woods site represents one of the best remaining examples of this community type in Harford County, and is also one of the larger intact woodlands in the Coastal Plain portion of the County.

The vernal pools within Willoughby Woods provide breeding and feeding habitat for a large number and a variety of amphibians, a few reptile species, and a large number of aquatic invertebrates. Many of these species are vernal pool specialists, and require natural pools to complete their life cycles. A high concentration of vernal pools occurs on the Willoughby Woods site, which makes this natural community particularly valuable to species that depend on such pools.

An additional value of Willoughby Woods is that it provides habitat for forest interior dwelling birds. Interior dwelling species which have been observed on the site include ovenbird, red-eyed vireo, scarlet tanager, Acadian flycatcher , hairy woodpecker, and Kentucky warbler .

Site Management Considerations

Potential threats to this site are related to negative impacts to the water quality of the vernal pools. Runoff from the existing housing developments, adjoining agricultural field, and Willoughby Beach Road have the potential to adversely impact the vernal pools on the site, and also to impact the water of the tributary streams flowing through the site. Precautionary measures should be taken during any future construction in the vicinity of Perryman Woods to prevent any sedimentation of these streams and vernal pools.

All proposed timber harvesting activities should be conducted so it will not alter the existing vegetation structure or change the existing species composition of the site. Disturbances to vernal pools and tidal wetlands during harvesting operations should be avoided, and the habitat value for forest interior dwelling birds should be retained.

Small stands of the invasive common reed (*Phragmites australis*) in two of the wetlands along the railroad tracks threaten the integrity of these wetlands and should be eradicated. Sweetgum (*Liquidambar styraciflua*) is beginning to move into an otherwise open wetland along the north edge of Willoughby Beach Road in the eastern part of the site and should be controlled to keep this unique wetland open.

This site has been designated as a locally significant habitat under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.03). Certain wetlands and their adjacent 100 foot upland buffer at this site are regulated as Wetlands of Special State Concern by the Maryland Department of the Environment (COMAR 26.23.06.02).

The Maryland Department of Natural Resources' Natural Heritage Program and cooperative partners completed a State Wildlife Action Plan in 2015 as a requirement of State Wildlife Grant funding. The plan details key wildlife habitats, natural communities, and Species of Greatest Conservation Need (SGCN) statewide, and provides information on threats and conservation needs of Maryland's wildlife resources and supporting habitats. For more information, the full Plan can be accessed at http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_Submission.aspx.

Colonial Waterbird Colonies

The Maryland Department of Natural Resources monitors the location and population sizes of nesting colonial waterbirds throughout Maryland. Colonial waterbirds include such species as egrets, herons, ibis, gulls, terns, and pelicans. For some species, these monitoring activities occur annually. For other species that are more common, such as great blue herons, monitoring may only occur every five years or longer.

Two locations for great blue heron rookeries were located in Harford County in 2013: Park Island off of Havre de Grace and Robert Island in the Susquehanna River. The Park Island colony was rather small, with only four nests detected, while the Robert Island colony was larger with 43 nests.

General Guidelines for Conservation of Great Blue Heron Colonies

With their seven foot wing span and distinctive s-shaped neck, great blue herons are a frequent, magnificent sight around the Chesapeake Bay. They nest in colonies, sometimes called rookeries, in forested areas that are relatively free of predators and disturbance. Colony sites are often adjacent to water, in forested non-tidal wetlands and/or floodplains. Wading in shallow water, great blue herons hunt for fish, frogs, crayfish, and snakes. Their long pointed bill also helps them catch insects, mice, and other small animals. As Maryland continues to grow and develop, secure nest sites for great blue herons may become scarcer. Whenever possible, great blue heron colony sites should be conserved as part of responsible land stewardship. Conservation of great blue heron colonies that are located in the Chesapeake Bay Critical Area is required by state law (§ 8-1801/1806). Significant mortality of chicks or eggs resulting from disturbance of the colony during the breeding season is a violation of the U.S. Migratory Bird Treaty Act. Disturbance includes actions such as cutting nest trees, cutting nearby trees, or nearby construction that causes abandonment of chicks by the adults.

The following guidelines are recommended as measures to protect great blue heron nesting colonies.

1. Establish a protection area of ¼ mile radius from the colony's outer boundary. Within this area establish three zones of protection: Zone 1 extends from the outer boundary of the colony to a radius of 330 feet, Zone 2 extends from 330 feet to 660 feet in radius, and Zone 3 extends from 660 feet to ¼ mile (1,320 feet).

2. During the breeding season, 15 February through 31 July, all human entry into Zone 1 should be restricted to only that essential for protection of the great blue heron colony. Human disturbance of colony sites that results in significant mortality of eggs and/or chicks is considered a prohibited taking under various state and federal regulations.

3. No land use changes, including development or timber harvesting, should occur in Zone 1.

4. Construction activities, including clearing, grading, building, etc., should not occur within Zones 1 and 2.

5. Selective timber harvesting may occur in Zone 2, but clearcutting should be avoided.

6. No construction or timber harvesting activities should occur within Zone 3 during the great blue heron breeding season.

The Department of Natural Resources' Wildlife and Heritage Service provides assistance to those interested in protecting this resource. The above guidelines are usually suitable for protection of most great blue heron colonies. Specific protection measures depend upon site conditions, planned activities, colony site type and history, and other factors. For more specific technical advice regarding planned projects and great blue heron protection, contact the Wildlife and Heritage Service (410/260-8540).

Appendix

Procedures or Identification of Forest Interior Dwelling Bird Species Habitats

A Guide to the Conservation of Forest Interior Dwelling Birds in the Chesapeake Bay Critical Area

June 2000

Martin O'Malley - Governor Anthony G. Brown - Lt. Governor
State of Maryland

Critical Area Commission
for the Chesapeake and Atlantic Coastal Bays
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410-260-3460
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Front Cover Sketch: Wood Thrush (Hylocichla mustelina)
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A GUIDE TO THE CONSERVATION OF FOREST INTERIOR DWELLING BIRDS IN THE CHESAPEAKE BAY CRITICAL AREA

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EXECUTIVE SUMMARY

The Chesapeake Bay Critical Area Criteria direct local jurisdictions to develop a management program for the conservation of forest areas used as breeding habitat by forest interior dwelling birds and other wildlife species. This document replaces the first Guidance Paper, approved in 1986, by the Chesapeake Bay Critical Area Commission for the conservation of forest interior dwelling bird (FIDS) habitat. Included in this paper is a description of the legal basis for the protection of FIDS habitat, a clarification of the methods used to identify FIDS habitat, and a list of FIDS species occurring in the Critical Area. Six species have been added to the list in the original document bringing it to a total of twenty-five.

The paper explains the concept of forest edge and forest interior and emphasizes the use of the *Site Design Guidelines* from the original paper to conserve forest interior. The paper also contains a method for determining the amount of mitigation that should be required when unavoidable impacts occur in FIDS habitat. The mitigation amount is based in large part on the extent to which the *Site Design Guidelines* are followed and includes direct and indirect impacts to the habitat. Mitigation will usually be creation of FIDS habitat, but may include, in some cases, protection of existing habitat.

Local and regional planning for FIDS conservation is addressed in addition to the site-specific methods that are stressed.

INTRODUCTION

What are FIDS?

Forest interior dwelling birds (FIDS) require large forest areas to breed successfully and maintain viable populations. This diverse group includes colorful songbirds---tanagers, warblers, vireos---that breed in North America and winter in the Caribbean, Central and South America, as well as residents and short-distance migrants---woodpeckers, hawks, and owls. FIDS are an integral part of Maryland's landscape and natural heritage. They have depended on large forested tracts, including streamside and Bayside forests, for thousands of years.

Recent declines

Although most of these birds are still fairly common, populations of some forest bird species have been declining during the last 30-40 years. According to the Breeding Bird Survey (BBS), a volunteer bird count conducted each June since 1966, there was a 63% decline in occurrence of individual birds of neotropical migrant species (many of which are FIDS) in Maryland between 1980 - 1989. A census of neotropical migrants in Rock Creek Park near Washington, DC from 1948 - 1988 revealed a drastic decline including the total loss of some species within the park. While the forest and park did not change significantly over that 31-year period, the surrounding landscape became much more urbanized and fragmented (Briggs and Criswell, 1978).

Some species, such as the wood thrush and the cerulean warbler, are rapidly declining. According to the BBS, the wood thrush declined almost 2%, while the population decline of cerulean warbler was close to 4% during the period of 1966 - 1998 (US Geological Survey, 1998).

Factors of decline

While many factors have contributed to the decline of FIDS populations, including the loss of habitat on wintering grounds and loss of migratory stopover areas for neotropical migrants, the loss and fragmentation of forests on the breeding grounds here in North America appear to play a critical role. Though some regions appear to be heavily forested today, our forests are increasingly fragmented and altered compared with the forests of the late 1800's and early 1900's. Unlike forest clearing a hundred or so years ago, landscape changes today are more likely to be permanent. This forest fragmentation results in both direct and indirect impacts for FIDS by reducing both the quantity and quality of forest habitat available to FIDS.

Forest Fragmentation and FIDS

Forest fragmentation is the whittling away of forest tracts into increasingly smaller and more isolated patches due to housing and commercial development, roads, logging and agriculture. This effect can be seen in Figure 1, a schematic of actual land use changes that occurred near

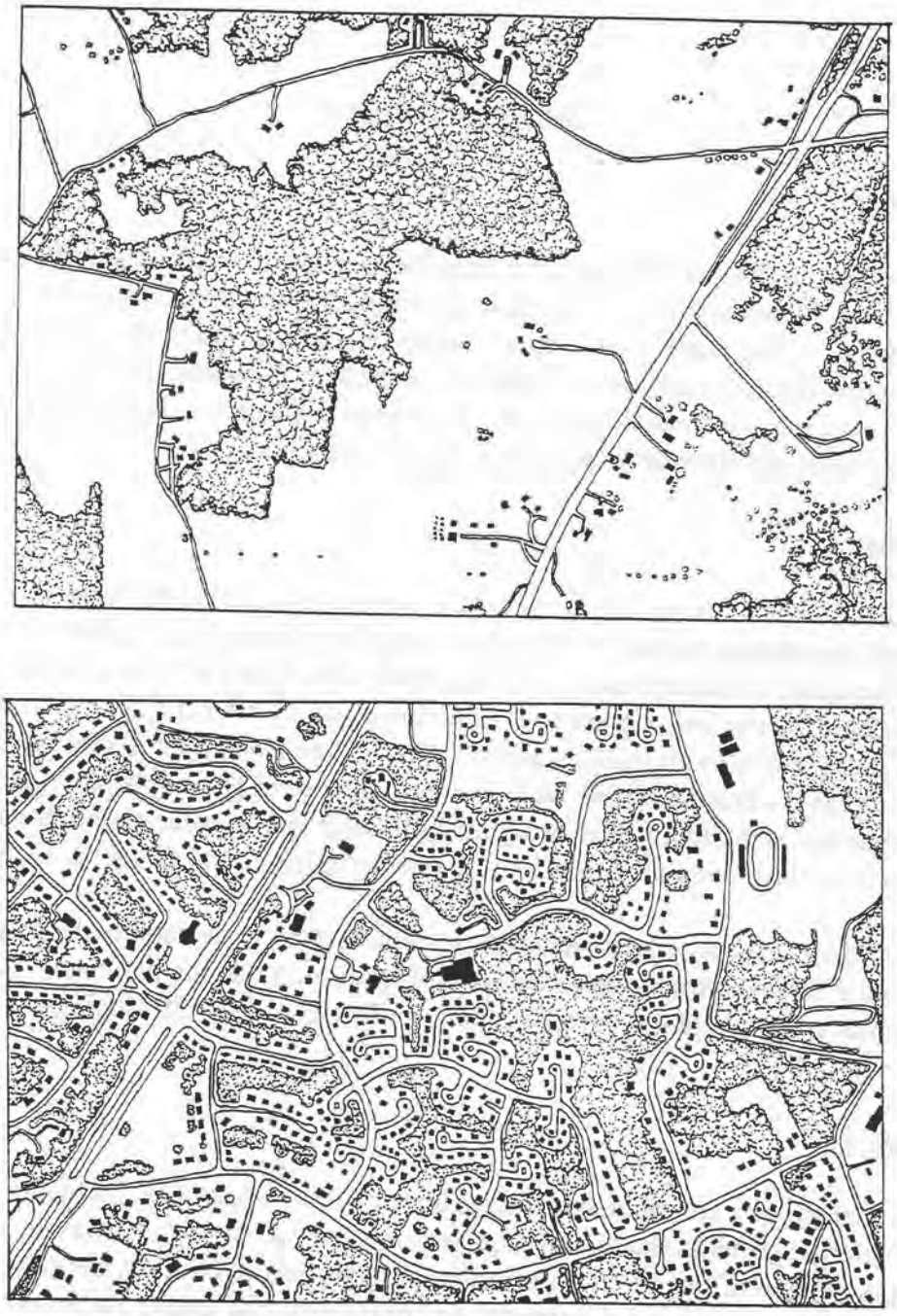


Figure 1. Drawing of actual landscape change between 1952 (top) and the early 1980's (bottom) near Columbia, Maryland. (Based on photograph, Robbins et al. 1989.) Adapted with permission from the Wildlife Society.

Columbia, Maryland between the early 50's and the early 80's. While some birds such as northern cardinals and American robins thrive in and around fragmented forests, most FIDS, such as warblers and vireos, require relatively large unbroken forests to live and successfully reproduce.

Forest fragmentation reduces the size of forest patches, reducing the total area of contiguous habitat available to birds and increases the isolation of habitat, reducing the quality of that which remains. Numerous studies have looked at the relationship between forest patch size and isolation and the abundance of bird species present. A study by Robbins et al. (1989) found that the probability of detecting a particular species of forest interior dwelling bird generally increased as the size of the forest increased, whereas the probability of detecting common nonforest bird species associated with more altered and fragmented forest habitat increased as the

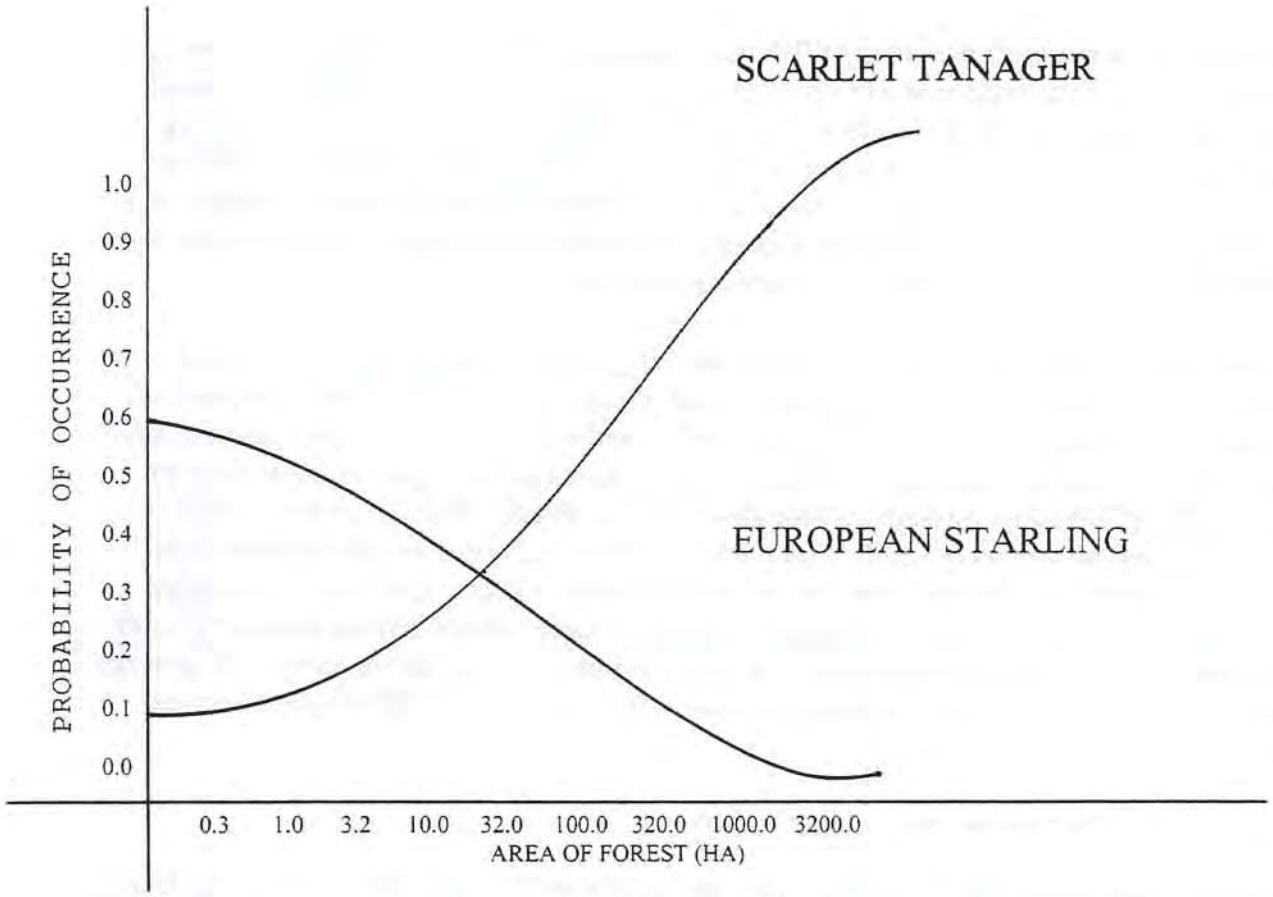


Figure 2. Graph comparing the probability of occurrence by area of forest habitat. Graph shows probability of finding a scarlet tanager (a forest interior dwelling bird species) is higher as the size of forest habitat increases, whereas the probability of finding a European starling (an introduced edge species) decreases as forest size increases. (From Robbins et al., 1989, adapted with permission from the Wildlife Society.)

Direct Habitat Loss

The direct loss of forest habitat results in smaller forest tracts that may no longer be adequate to accommodate a bird's territory, to provide an ample supply of food, or to provide the necessary forest structure for breeding. Many forest tracts are too small to support species with large breeding territories such as the red-shouldered hawk, barred owl and pileated woodpecker. For example, a breeding pair of red-shouldered hawks require from 250-625 acres to sustain them. Most FIDS, even those species that have small breeding territories, will only select larger forest tracts for breeding.

In addition to area requirements, many FIDS have additional habitat requirements for nesting. Reduction of forest size often results in the loss of specialized habitats/microhabitats. Small forests cannot sustain the same environmental conditions that larger forests can, such as higher humidity and complex vegetative structure. The vegetative structure (amount of canopy and lower and midstory vegetation) may be missing or inadequate in smaller forests. Younger, less structurally diverse and highly fragmented forests cannot support the same variety of plant and animal species that older, more pristine forests can support.

FIDS are generally more successful at survival and reproduction in large, older, hardwood-dominated forests; however, there has been a loss of quality habitat through the conversion of hardwood and mixed-hardwood forests to pine and the reduction of "old growth" forest to small isolated patches. Prior to European settlement, it is estimated that old-growth forest covered approximately 95% of the Chesapeake watershed (Kraft & Brush, 1981). Forest coverage in Maryland today is about 44% (USDA Forest Service, 1996) and about 40% of the remaining deciduous forest in the East today consists of small, isolated woodlots of relatively immature trees in agricultural and suburban landscapes. When European settlers arrived in eastern North America in the 1600's, the average height of a hardwood tree was 100 feet or more. The average height of trees in the Chesapeake Bay region today is only 60-80 feet (USDA Forest Service, 1996).

Indirect habitat loss or "edge" effects

Edge effects occur when different habitat types are located next to each other. When considering FIDS, we are concerned about the edge effects on forest when it is adjacent to lawn, agricultural fields, or pasture. A variety of edge effects can adversely impact FIDS depending on the size of the forest, adjacent land use, the amount of forest in the landscape, increase in the penetration of light and wind into the forest, encroachment of invasive plants and the presence of other competing or predatory edge species.

Forest "interior" refers to the area in the center of a forest. It is surrounded by "edge". In the Critical Area, the forest area within 300 feet of a forest edge is considered "edge" habitat. "Interior habitat" is commonly defined as the forest area found greater than 300 feet from the forest edge. Interior habitat functions as the highest quality breeding habitat for FIDS. When a forest becomes fragmented, areas that once functioned as interior breeding habitat are converted

to edge habitat and are often associated with a significant reduction in the number of young birds that are fledged in a year.

Higher rates of nest predation occur in forest edges. In addition, forest edges provide access to the interior for avian predators such as blue jays, crows, grackles and mammalian predators that include foxes, raccoons, squirrels, dogs and cats. These predators eat eggs and young birds still in the nest. They tend to be abundant near areas of human habitation and can be detrimental to nesting success. For example, domestic house cats are estimated to kill 3-4 million birds each day in the United States.

Neotropical migrants are particularly susceptible to brood parasitism by brown-headed cowbirds. Before the 1900's, the cowbird was largely absent from Eastern forests, occurring primarily in the grasslands west of the Mississippi. Pasture land, agricultural fields and suburban lawns are prime feeding habitat for cowbirds. When these grassy areas are interspersed with fragmented forests, cowbirds can be abundant and have dramatic impacts on the breeding success of FIDS. Cowbirds lay eggs in the nests of a variety of birds and the eggs usually hatch ahead of the host's eggs. The young cowbirds develop rapidly and are usually larger and more aggressive than the host's young, taking more than their share of food and often kicking unhatched eggs and nestlings of the host species out of the nest.

Long-distance migrants are more vulnerable to predation and parasitism than resident birds because of their limited breeding season. The migrant species often only have time to produce one brood once they arrive on the breeding grounds and before the fall migration to the south.

The forest edge is exposed to more light and wind than the interior of the forest resulting in a change in moisture and vegetative composition. Small and fragmented forests tend to be drier and to have less leaf litter. Leaf litter is an important component for maintaining arthropod (i.e., insects, spiders) populations for hungry birds. Neotropical migrants, in general, feed almost exclusively on insects while on their Maryland breeding grounds. In addition, increased densities of deer in many of our forests result in loss of plant diversity and structural diversity from overgrazing on the forest floor and in the midstory. Invasive plants such as Japanese honeysuckle and English ivy encroach into smaller forest fragments, limiting the growth of native plants, stifling natural succession, thereby limiting vegetative and structural diversity.

Loss of winter habitat and migratory stopovers

The decline in neotropical migrant species may be due in part to the loss of forest in their winter habitat in the tropics and along migratory routes. These small birds may travel a distance of one thousand miles or more over several days to a week. Providing for the needs of these birds, in addition to keeping adequate areas for breeding, also means conserving the native vegetation that provides both the food needed for refueling and cover from predators during migratory stopovers. Removing understory vegetation in our yards and parks eliminates plants that provide crucial food and cover for migrant songbirds. Another concern about neotropical migrants is the

large-scale loss of wintering habitat in the tropics, as forest is converted to agricultural fields and pasture.

FIDS as Umbrella Species

Forest birds are valued for their diverse beauty, distinct songs and behavioral characteristics and, for the migrants, the wonder of their seasonal journeys. Over 63 million Americans consider themselves to be birdwatchers. FIDS also act as an "umbrella species" for a wide range of forest benefits. The eastern deciduous forest is more than a group of trees. It is an ecosystem of plants and animals that has evolved over thousands of years. In addition to providing habitat for numerous species of wildlife, forests help to protect our watersheds from pollution and have a major effect on the stability of world climates by absorbing carbon dioxide and releasing oxygen. Diversity in bird species is a good indication of the quality, diversity and benefits found from forest habitat overall.

FIDS are an important component of a natural forest system. They spread seeds through their droppings, help control insect numbers and provide food to those higher on the food chain. The habitat needs of FIDS overlap those of many other plant and animal species including large mammals, many wildflower species, wood frogs and wild turkey. When sufficient habitat is protected to sustain a diversity of forest birds, other important components and microhabitats of the forest will be encompassed and be protected. These include the small, forested streams and headwaters critical for fish populations and the vernal pools necessary for the survival of amphibians.

Forest birds are also an important link in a complex food web. Warblers and other insectivores eat untold numbers of insects such as spruce budworms and caterpillars, helping to keep these defoliators in check (Yahner, 1995). Migratory birds journey north from points far south to breed due in part to the abundance of insects in North America in the spring. Without healthy populations of birds, these insects would consume significantly greater quantities of greenery.

The guidance that follows provides a way for landowners, developers and local governments to conserve this suite of birds and the forests on which they depend.

CRITICAL AREA PROVISIONS FOR FIDS HABITAT PROTECTION

The Chesapeake Bay Critical Area Program was established in 1984 with the passage of the Critical Area Act. The law mandated the development of regulations (Critical Area Criteria) by the Governor-appointed Critical Area Commission. Based on goals set forth by the Act, minimum requirements were developed to protect water quality, conserve plant and wildlife habitat and direct growth and development. These requirements are implemented through 61 county and municipal Critical Area Programs.

One of the requirements of the Criteria is the protection and conservation of breeding habitat for forest interior dwelling birds (FIDS). Specifically, the Criteria instruct local jurisdictions to develop Critical Area Programs to:

> *Protect and conserve those forested areas required to support wildlife species identified above in 'C(2)(a)(iii) and (iv)* [these regulations refer to riparian forests and large forest tracts, respectively; see below "What is FIDS habitat"], *by developing management programs which have as their objective, conserving the wildlife that inhabit or use the areas. The programs should assure that development activities, or the clearing or cutting of trees which might occur in the areas, is conducted so as to conserve riparian habitat, forest interior wildlife species and their habitat. Management measures may include incorporating appropriate wildlife protection elements into forest management plans and cluster zoning or other site design criteria which provide for the conservation of wildlife habitat. Measures may also include soil conservation plans that have wildlife protection provisions appropriate to the area defined above and incentive programs which use the acquisition of easements and other similar techniques [COMAR 27.01.09.04C(2) (b)(iv)].*

The Criteria identify two FIDS habitat types for which conservation is mandated:

> *(1) Existing riparian forests (for example, those relatively mature forests of at least 300 feet in width which occur adjacent to streams, wetlands, or the Bay shoreline, which are documented breeding areas) [COMAR 27.01.09.04C(2)(a)(iii)];*
>
> *(2) Forest areas utilized as breeding areas by forest interior dwelling birds and other wildlife species (for example, relatively mature forested areas within the Critical Area of 100 acres or more, or forest connected with these areas) [COMAR 27.01.09.04C(2)(a)(iv)].*

Both definitions give examples of habitat sizes: riparian forests 300 feet or wider, forest tracts 100 acres or larger. Smaller forested areas may support FIDS depending on the characteristics of the forest tract and surrounding landscape and FIDS habitat may be absent in forests larger than 100 acres. Therefore, in addition to considering the acreage of a forest when identifying potential FIDS habitat, forest characteristics like forest age, shape, forest edge-to-area ratio, vegetative structure and composition, topography and degree of human disturbance should be taken into consideration as well as the character of the surrounding landscape, including

proximity to large forested areas, percent of contiguous forest in surrounding area, habitat quality of nearby forest tracts and adjacent land uses.

The following steps are recommended for local jurisdictions to develop, adopt and implement a FIDS protection element into their Critical Area Program:

1. Identify forest areas that are potentially viable breeding habitat for FIDS.

2. Incorporate FIDS habitat and forest protection into long-term planning efforts.

    - identify growth areas outside of large contiguous forested areas
    - evaluate zoning of forested areas during comprehensive planning
    - identify opportunities for conservation and protection of forest (i.e., Rural Legacy, public lands)

3. Incorporate FIDS habitat and forest protection into subdivision and zoning ordinances and site plan review.

    - adopt conservation site design standards into zoning and subdivision ordinances including provisions for mitigation when impacts are unavoidable.

FIDS OCCURRING IN THE CRITICAL AREA

Twenty-five species of Forest Interior Dwelling Birds potentially breed in the Critical Area (Table 1; Stewart and Robbins,1958, Iliff et al., 1996, Robbins and Blom, 1996). The majority are small songbirds such as warblers, vireos and flycatchers. Others include the Barred Owl, Whip-poor-will and several hawk and woodpecker species. Twenty of the 25 species are neotropical migrants that nest in temperate North America in the spring and summer and winter in Central and South America.

Although each species is associated with a particular set of forest conditions, all require relatively large, unfragmented forest blocks located within heavily forested landscapes or regions to successfully breed and maintain viable populations. Thirteen of the 25 species are *highly area-sensitive,* seldomly occurring in small, heavily disturbed or fragmented forests. Highly area-sensitive species are most vulnerable to forest loss, fragmentation and habitat degradation. They are generally rare or uncommon on the Maryland Coastal Plain and have highly specialized breeding habitat requirements. The presence of one highly area-sensitive bird species nesting in a forest during the breeding season is an indicator of high-quality FIDS habitat. A forest that supports populations of six or more of these species is considered exceptional habitat. Few such forests remain in eastern Maryland. The remaining 12 species exhibit less area-sensitivity, but require relatively large contiguous forests to maintain stable populations. A forest containing less than 4 of these 12 species is an indication of severe forest fragmentation and thus, marginal or low quality habitat. These forests may present opportunities for habitat restoration or enhancement. Where there is permanent fragmentation and there is no potential FIDS habitat, FIDS conservation is not required.

This edition of the guidance paper includes six additional revisions to the species list. Additions include broad-winged hawk, brown creeper, veery, black-throated green warbler, cerulean warbler. These species are widely recognized as FIDS and are included on the list because of recent documentation that these species breed on the Maryland Coastal Plain (Robbins and Blom, 1996). All five species are rare breeders on the Maryland Coastal Plain and, with the exception of veery, are highly area-sensitive. The presence of these species holding territory during the breeding season is an indication of high quality FIDS habitat.

A sixth addition to the species list is the wood thrush. Although it breeds Statewide, the wood thrush is experiencing significant population declines in Maryland and throughout much of its breeding range in eastern North America. It is negatively impacted by forest fragmentation and maintenance of viable populations requires large contiguous blocks of mature deciduous or mixed deciduous-conifer forest. One additional revision involves a change in the area-sensitivity designation for black-and-white warblers to "*highly area-sensitive*".

Table 1. List of Forest Interior Dwelling Bird species (FIDS) that potentially breed[a] in the Critical Area.

Common Name	Scientific Name	Safe Date[b]	Migratory Class[c]
Red-shouldered Hawk[d]	*Buteo lineatus*	May 1 - Aug 31	Temperate
Broad-winged Hawk[d]	*Buteo platypterus*	June 5 - Aug 10	Neotropical
Barred Owl[d]	*Strix varia*	Jan 15 - Aug 31	Nonmigratory
Whip-poor-will	*Caprimulgus vociferus*	May 10 - July 15	Neotropical
Hairy Woodpecker	*Picoides villosus*	Mar 15 - Aug 31	Nonmigratory
Pileated Woodpecker	*Dryocopus pileatus*	Mar 15 - Aug 31	Nonmigratory
Acadian Flycatcher	*Empidonax virescens*	May 25 - Aug 5	Neotropical
Brown Creeper[d]	*Certhia americana*	May 15 - Aug 31	Temperate
Veery	*Catharus fuscescens*	June 10 - Aug 31	Neotropical
Wood Thrush	*Hylocichla mustelina*	May 25 - Aug 20	Neotropical
Yellow-throated Vireo	*Vireo flavifrons*	May 25 - Aug 15	Neotropical
Red-eyed Vireo	*Vireo olivaceus*	June 1 - July 31	Neotropical
Northern Parula	*Parula americana*	June 1 - Aug 15	Neotropical
Black-throated Green Warbler[d]	*Dendroica virens waynei*	June 10 - Aug 5	Neotropical
Cerulean Warbler[d]	*Dendroica cerulea*	May 25 - Aug 5	Neotropical
Black-and-white Warbler[d]	*Mniotilta varia*	May 15 - July 25	Neotropical
American Redstart[d]	*Setophaga ruticilla*	June 10 - July 20	Neotropical
Prothonotary Warbler	*Protonotaria citrea*	May 10 - July 20	Neotropical
Worm-eating Warbler[d]	*Helmitheros vermivorus*	May 20 - July 20	Neotropical
Swainson's Warbler[d, e]	*Limnothlypis swainsonii*	April 20 - Aug 31	Neotropical
Ovenbird	*Seiurus aurocapillus*	May 20 - Aug 5	Neotropical
Louisiana Waterthrush[d]	*Seiurus motacilla*	May 1 - July 10	Neotropical
Kentucky Warbler[d]	*Oporornis formosus*	May 25 - July 15	Neotropical
Hooded Warbler[d]	*Wilsonia citrina*	May 25 - July 25	Neotropical
Scarlet Tanager	*Piranga olivacea*	May 25 - Aug 10	Neotropical

[a] Documentation of breeding evidence based on Stewart and Robbins (1958), Iliff et al. (1996), and Robbins and Blom (1996).
[b] Safe dates, as listed in Robbins and Blom (1996), indicate the time of year when a species can be assumed to occupy a breeding territory.
[c] Migratory classes: "neotropical" migrant - breeds in temperate North America and winters primarily in Central and South America; "temperate" migrant - breeds and winters primarily in temperate North America; "nonmigratory" - year-round resident with no migratory movements.
[d] These species are highly area-sensitive and most vulnerable to forest loss, fragmentation and overall habitat degradation.
[e] State-listed as Endangered.

HOW TO DETERMINE IF FIDS HABITAT IS PRESENT

The Critical Area Commission has determined that the presence of FIDS habitat, as used in the Criteria, should be based on the overall quality of FIDS habitat in a forested area. Accordingly, two methods may be used to determine if FIDS habitat is present. The first requires the evaluation of certain forest characteristics such as forest tract size, approximate forest age and forest edge:area ratio. The second method requires that a bird survey be conducted to determine which species are breeding in a particular forest, using appropriate bird survey methods and a qualified observer. Either method, as described below, may be used.

Habitat Determinations Based on Forest Characteristics

The presence and relative abundance or density of many forest nesting bird species is closely related to such features as forest area, age, shape and the proportion of edge habitat present (e.g., Whitcomb et al., 1981, Ambuel and Temple, 1983, Lynch and Whigham, 1984, Robbins et al., 1986, Askins et al., 1987, Keller et al., 1993). The Criteria provide two examples of forest areas that are considered potential FIDS habitat and are to be conserved in the Critical Area: 1) forest with 100 or more contiguous acres, and 2) riparian forest areas with a width of at least 300 feet [COMAR 27.01.09.04C(2)(a)]. In reality, forests that support FIDS have a wider range of characteristics. The following descriptions provide a more accurate guide for identifying FIDS habitat. When these conditions exist, habitat is assumed to be present and protection measures should be employed unless it is determined that the forest does not function as FIDS habitat.

A. Forests at least 50 acres in size with 10 or more acres of "forest interior" habitat (i.e., forest greater than 300 feet from the nearest forest edge). The majority of the forest tract should be dominated by pole-sized or larger trees (5 inches or more in diameter at breast height), or have a closed canopy; or

B. Riparian forests at least 50 acres in size with an average total width of at least 300 feet. The stream within the riparian forest should be perennial, based on field surveys or as indicated on the most recent 7.5 minute USGS topographic maps. The majority of the forest tract should be dominated by pole-sized or larger trees, or have a closed canopy.

In both cases, the size of the forest tract is based on the entire forest area, regardless of Critical Area boundaries or property lines. Two forests tracts may be considered unconnected or disjunct if they are separated by nonforested habitat which results in a permanent 30 - 50-foot break in the forest canopy (e.g., road, cleared right-of-way). The above forest characteristics are intended to be a guide. On occasion, FIDS may be present in smaller forests or absent in larger ones.

Habitat Determinations Based on Bird Surveys

A bird survey can be used in lieu of forest characteristics to determine if FIDS habitat is present; however, a survey is necessary only if an applicant (e.g., for a proposed development or timber harvest) refutes a habitat determination based on forest characteristics and seeks a confirmation of the bird species present. A confirmation is the responsibility of the applicant and must be based on current data obtained by a qualified observer using the bird survey methods described below.

Bird Survey Methods

The primary purpose of the bird survey (herein referred to as a "FIDS survey") is to determine the breeding status and approximate location of all bird species present, especially FIDS, in a given forest. This information is used to determine if FIDS habitat is present, as defined in the preceding section, and help develop appropriate conservation measures.

The Critical Area Commission requires the use of standard biological methods to conduct FIDS surveys. Accordingly, the following combination of methods are recommended: 1) point counts, 2) general searching or canvassing during early to mid-morning hours, and 3) canvassing during evening hours for nocturnal FIDS (e.g., Whip-poor-will, Barred Owl). The point count is a widely used quantitative bird survey method (Ralph et al., 1995). Detailed descriptions and evaluations of point count methodology are provided in such publications as Ralph and Scott (1981), Verner (1985), and Ralph et al. (1995). Generally, this method consists of an observer standing at a point or station for a standardized length of time (e.g., 10 minutes) and recording by species the number of all individual birds seen or heard. The count is then repeated at other stations (usually spaced at least 450-600 feet apart) located throughout a site or habitat. Canvassing, used in conjunction with point counts, helps to ensure that species which may be present are not missed and that sufficient observations have been made to accurately determine each species' breeding status. The minimum amount of field effort required to conduct a survey is three mornings (point counts and canvassing during daylight hours) and two evenings (canvassing for nocturnal species). Minimum standards for conducting FIDS surveys are as follows:

1. Conduct point counts during May 25-June 30, between one-half hour before sunrise, four hours after sunrise. The likelihood of detecting most FIDS during the breeding season, especially songbirds, is greatest during early morning hours within this five-week period. Canvassing should be done during the same five-week period within "safe dates" as listed in Table 1.

2. The minimum number of point count stations that should be located in a forest area is as follows:

Forest Area	No. Point Count Stations
< 200 acres	≥ 1 station per 15 acres
≥ 200-500 acres	≥ 1 station per 25 acres

3. Locate point count stations at least 450 feet apart and, where possible, place them 150 feet or more from the nearest forest edge.

4. Point count stations should be distributed throughout potential FIDS habitat and located in a manner that attempts to maximize the number of forest interior dwelling bird species detected. Habitat associations of each species should be taken into consideration so that relatively species-rich habitats (e.g., mature or old forest, structurally diverse stands, riparian forest, coves and ravines), species with specialized habitat requirements (e.g., Louisiana Waterthrush) and highly area-sensitive species are not overlooked or under surveyed. If possible, stratify the number of stations by major forest type and age class (e.g., mature upland deciduous forest, mature deciduous floodplain forest, pole-stage mixed pine-hardwood forest).

5. Conduct at least three point counts per station, with each count occurring on a different morning and separated by at least five days.

6. During each point count, record the species (including nonFIDS), breeding code (e.g., 'X' for a species seen or heard in breeding habitat within safe dates; see Appendix A), sex and age, if possible, of each individual bird or breeding pair of birds seen or heard. Also, on each day, record the date, start and finish time, general weather conditions and observer name. Record similar information during canvassing efforts.

7. Conduct point counts only during appropriate weather conditions. Avoid days with precipitation, heavy fog and strong winds. Calm, seasonably warm conditions are best.

8. Canvassing for diurnal species should be conducted during early to mid-morning (about one-half hour before sunrise to four hours after sunrise). These surveys can be done on the same mornings as point counts. Canvassing can be used to upgrade the breeding status (e.g., from "possible" to "probable" or "confirmed") of select species or to search areas where no point count stations are located. Canvassing can be particularly useful to upgrade the breeding status of relatively inconspicuous species with large breeding territories (Hairy Woodpecker, Pileated Woodpecker and Red-shouldered Hawk). Point counts alone may fail to detect these species frequently enough to accurately determine their breeding status.

9. Canvassing for nocturnal species should be conducted on at least two evenings, separated by at least five days. Broadcasting taped recordings of Barred Owl and Whip-poor-will calls may increase the probability of detecting these species; however, tape recordings

must be used judiciously since birds may abandon breeding territories if the tapes are played too often. Once a target species is detected, stop using the recording that evening.

10. All surveys on a given forest tract, especially point counts, should be conducted by the same observer.

11. The person conducting the survey must be a qualified observer; i.e., capable of identifying all potentially occurring birds by sight and sound. A current list of qualified observers can be obtained by contacting the Maryland Department of Natural Resources (DNR) or the Critical Area Commission. A person is deemed qualified by DNR if he or she successfully completes a DNR administered field test on bird identification, or is recommended to DNR as qualified by at least two references experienced in forest bird identification. The references should be familiar with the candidate's skills and experience in bird identification and survey methods, particularly in forested habitats. For additional information, please contact the Critical Area Commission or DNR.

12. The minimum data reporting requirements to DNR and the Critical Area Commission are as follows:

    a. For each point count station, the number, sex and age (if possible) of birds observed, by species, during each count.
    b. A table listing the proposed breeding status (observed, possible, probable or confirmed) of each species observed in the survey area and, if appropriate, nearby or adjacent areas. A species shall be considered breeding at a given site if survey data support a "probable" or "confirmed" breeding status determination. (See Appendix A for definitions of these criteria.)
    c. A map showing the location of each point count station and extent of canvassing.

Interpretation of Bird Survey Data

The Critical Area Commission and DNR provide final interpretation of survey data using the breeding status criteria listed in Appendix A as a guide. The entire forest tract is considered when determining the number and breeding status of forest interior dwelling bird species present.

If the survey yields either of the following results, FIDS habitat is present:

A. At least four of the species listed in Table 1 are present with a "probable" or "confirmed" breeding status, as defined by Robbins and Blom (1996); or

B. At least one highly area-sensitive species, as listed in Table 1, is present with a "probable" or "confirmed" breeding status.

CONSERVATION GUIDELINES

This section discusses planning tools that can be used to achieve long-term, wide-scale FIDS habitat conservation as well as FIDS conservation at the site-specific level.

A. Regional and Local Land Use Planning

The land use planning process, whether at the regional or local level, provides an opportunity to pro-actively address protection and conservation of FIDS habitat within and outside of the Critical Area. Land use planning efforts should be used to identify and protect the largest contiguous tracts of forest in a region. When possible, the quality of, and threats to, these habitat areas should be assessed in order to prioritize habitat areas for protection and conservation.

Land use planning tools, like mapping habitat areas or regional growth management, enable local jurisdictions to use local authority to minimize impacts to FIDS habitat at the site level and to protect the highest quality and most valuable forest and FIDS habitat in the region and over time. In addition, FIDS habitat conservation can encompass many other conservation goals that have been identified within a region. For example, by virtue of the size and composition of forest that is needed to protect FIDS, thousands more species will benefit from the protection of large high quality forest areas.

Land use planning tools, such as smart growth, flexibility in zoning and subdivision ordinances, can provide conservation of important forest habitat before it gets to the site planning stage. Growth Management and Smart Growth strategies enable local governments to direct growth away from forested and other sensitive resource areas and encourage development in areas with existing infrastructure.

Certain ordinances, regulations and development standards actually cause unintended forest fragmentation. In some cases, the goals of these ordinances may not allow for a great deal of flexibility, (e.g., public safety); however, wherever possible, these standards should be written to better achieve habitat and natural resources protection goals. Local governments should evaluate the effect of existing standards so that these standards do not result in unnecessary forest clearing, (i.e., requirements for large lots, extensive setbacks that increase the distance between lots, and wide roads).

In order to protect forest habitat, local ordinances should:

- provide flexibility in required road widths and frontage widths to eliminate/reduce gaps in the forest canopy

- reduce minimum lot size requirements to reduce the amount of land that is consumed by single family development

- encourage transfer of development rights from large forested regions to areas with existing infrastructure and fewer natural resources

- provide flexibility in area requirements for septic reserve areas where practicable

- require clustering to reduce forest fragmentation

- encourage shared driveways and shared septic systems to reduce openings in the forest.

See Appendix B for additional information on flexible ordinance language and development standards.

B. Site Design Guidelines for FIDS

In addition to land use planning, site design is an important approach to FIDS habitat conservation. In general, the greatest loss of FIDS habitat occurs when development fragments or intrudes into the forest interior or increases the area of forest edge. The following ***Site Design Guidelines*** (also in Appendix C) provide guidance to landowners and plan reviewers on how to achieve the greatest possible protection and conservation of FIDS habitat when development is proposed. A key to using the ***Site Design Guidelines*** is to determine and assess the amount of interior habitat that would be impacted under a proposed development scenario. When these guidelines are followed, the impacts to interior forest habitat are minimized.

Local governments should evaluate their existing subdivision and zoning ordinances to determine if they will allow the implementation of the following ***Site Design Guidelines***.

Site Design Guidelines

1. Restrict development to nonforested areas.

2. If forest loss or disturbance is unavoidable, concentrate or restrict development to the following areas:

    a. the perimeter of the forest (i.e., within 300 feet of the existing forest edge)
    b. thin strips of upland forest less than 300 feet wide
    c. small, isolated forests less than 50 acres in size
    d. portions of the forest with low quality FIDS habitat, (i.e., areas that are already heavily fragmented, relatively young, exhibit low structural diversity, etc.).

3. Maximize the amount of forest "interior" (forest area > 300 feet from the forest edge) within each forest tract (i.e., minimize the forest edge:area ratio). Circular forest tracts are ideal and square tracts are better than rectangular or long, linear forests.

4. Minimize forest isolation. Generally, forests that are adjacent, close to, or connected to other forests provide higher quality FIDS habitat than more isolated forests.

5. Limit forest removal to the "footprint" of houses and to that which is necessary for the placement of roads and driveways.

6. Minimize the number and length of driveways and roads.

7. Roads and driveways should be as narrow as possible; preferably less than 25 feet in width and 15 feet in width, respectively.

8. Maintain forest canopy closure over roads and driveways.

9. Maintain forest habitat up to the edges of roads and driveways; do not create or maintain mowed grassy berms.

10. Maintain or create wildlife corridors.

11. Do not remove or disturb forest habitat during April-August, the breeding season for most FIDS. This seasonal restriction may be expanded to February-August if certain early nesting FIDS (e.g., Barred Owl) are present.

12. Landscape homes with native trees, shrubs and other plants and/or encourage homeowners to do so.

13. Encourage homeowners to keep pet cats indoors or, if taken outside, kept on a leash or inside a fenced area.

14. In forested areas reserved from development, promote the development of a diverse forest understory by removing livestock from forested areas and controlling white-tailed deer populations. Do not mow the forest understory or remove woody debris and snags.

15. Afforestation efforts should target a) riparian or streamside areas that lack woody vegetative buffers, b) forested riparian areas less than 300 feet wide, and c) gaps or peninsulas of nonforested habitat within or adjacent to existing FIDS habitat

See Figures 3A, 3B, and 3C for illustrations of several of the ***Site Design Guidelines.***

GUIDELINES NOT FOLLOWED GUDELINES FOLLOWED

GUIDELINES NOT FOLLOWED

GUDELINES FOLLOWED

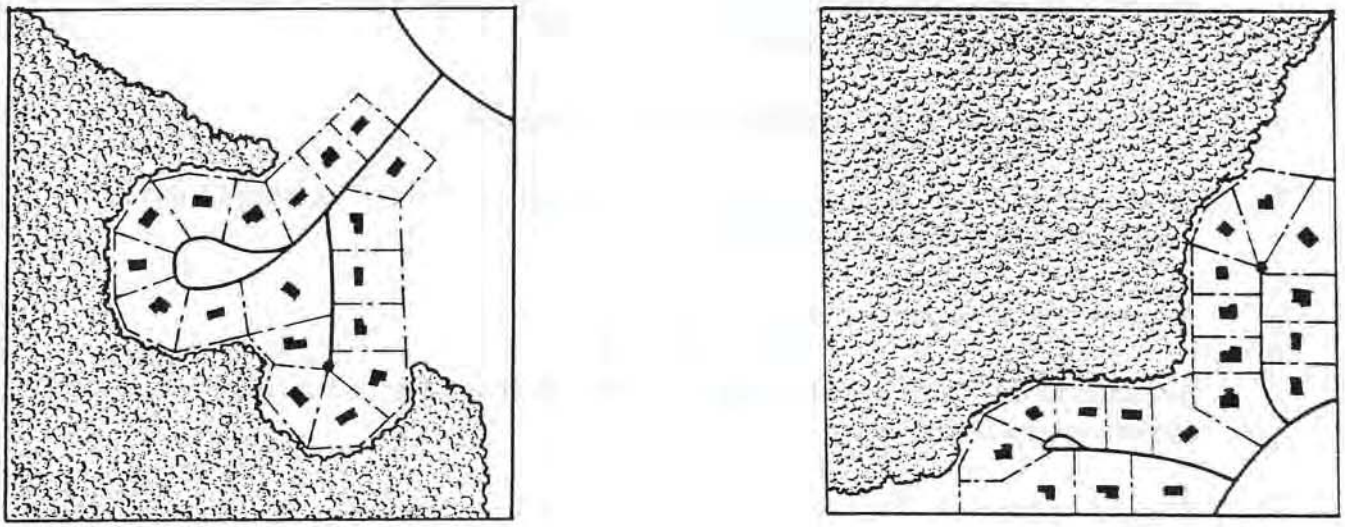


Figure 3A. Restrict development to non-forested areas when possible or limit development to forest edge in order to maximize retention of forest interior.

GUIDELINES NOT FOLLOWED

GUIDELINES FOLLOWED

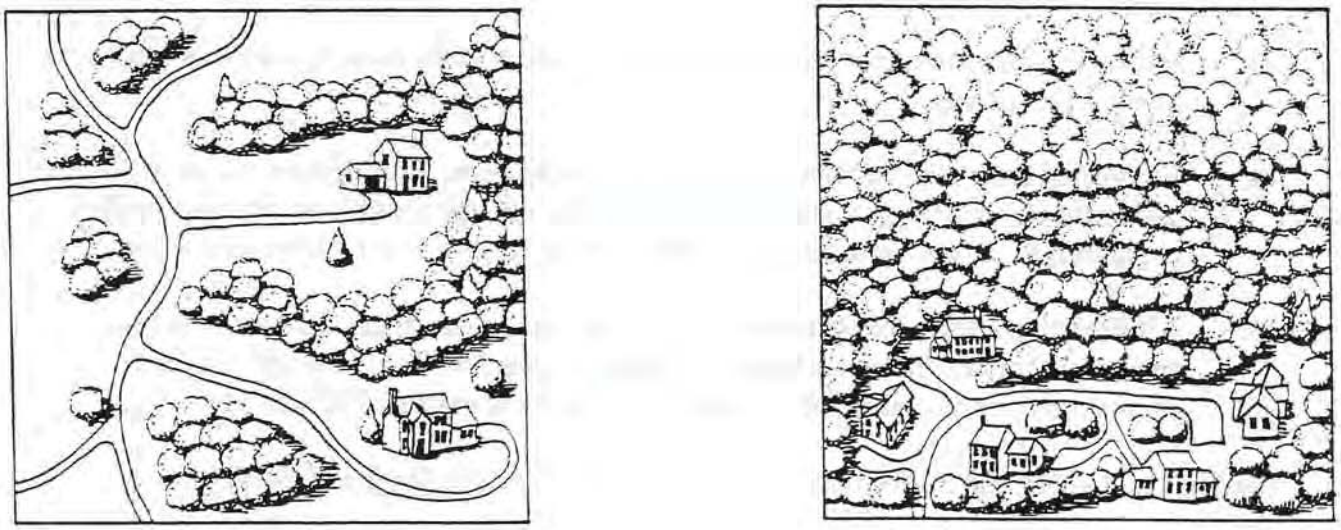
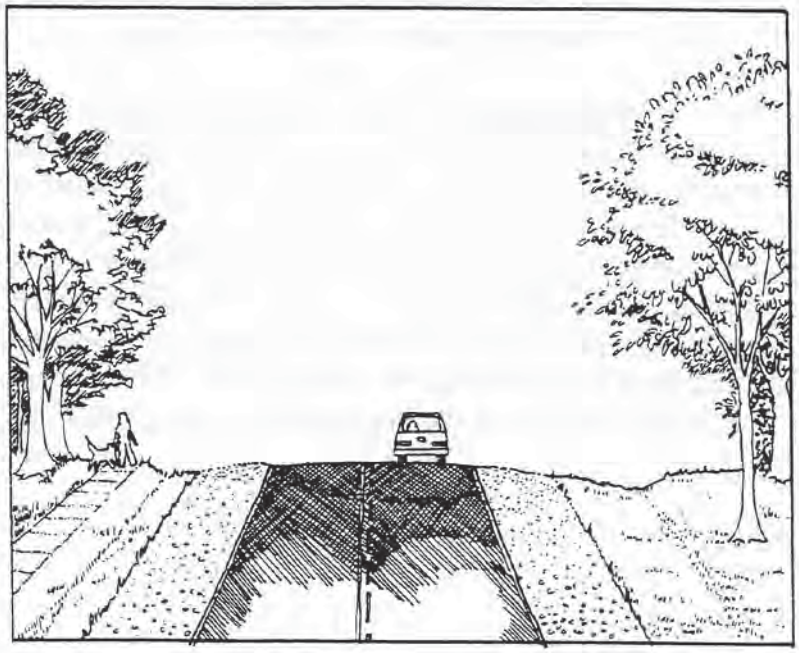


Figure 3B. Limit the amount of forest clearing, reduce the length of driveways and other roads, and cluster development to minimize impacts to forest.

GUIDELINES NOT FOLLOWED



GUIDELINES FOLLOWED

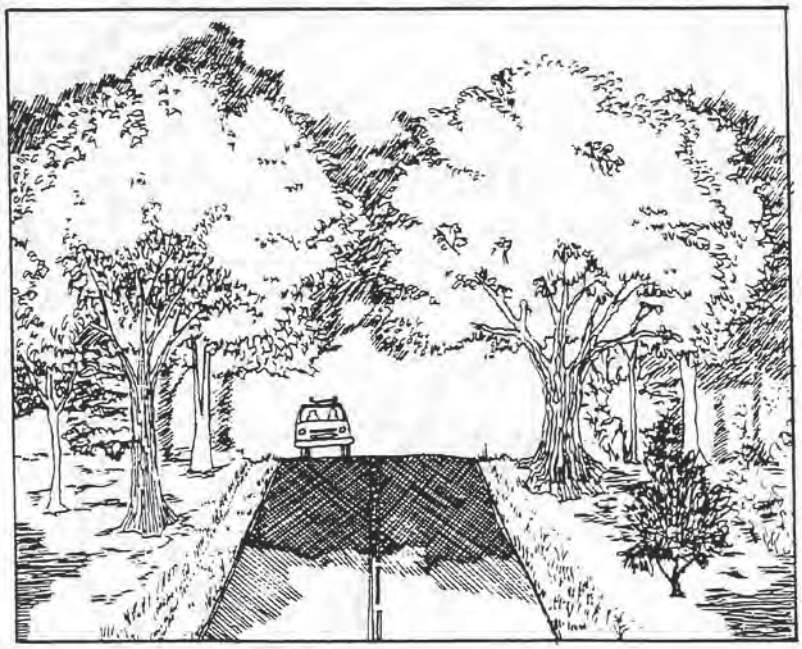


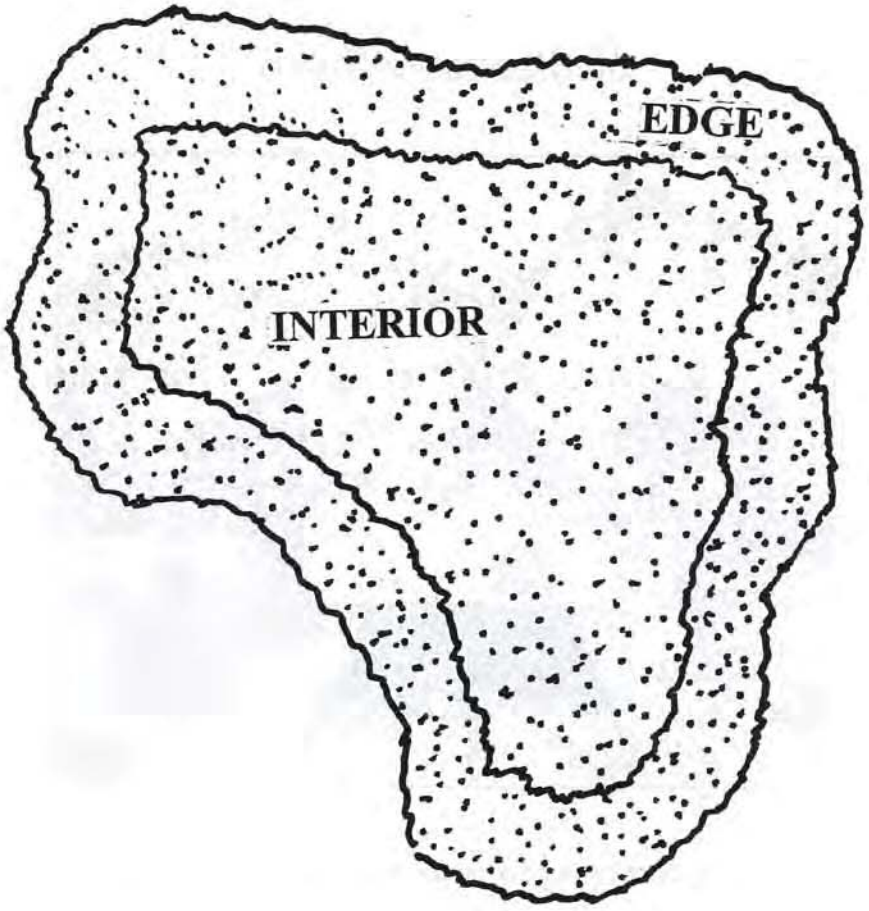
Figure 3C. Maintain forest habitat to edge of roads and driveways and maintain canopy closure over roads, where possible.

DETERMINATION OF INTERIOR HABITAT LOSS

It will often be necessary to calculate the amount of forest interior on a site before development and after development. The following paragraph explains how to do this.

Direct habitat loss refers to the actual acreage of forest area that is cut or cleared. Interior habitat loss on a parcel refers to acres of forest interior that are cut or converted to edge. To determine the interior habitat of a parcel, the forested edge of 300 feet is subtracted from the total contiguous forest. The area left is forest interior provided it is at least ten acres in size. When the FIDS ***Guidelines*** (outlined above) are followed the amount of interior habitat loss will be minimized. When evaluating site design options for a particular property, potential impacts to interior habitat after development are compared to predevelopment interior habitat. The site plan that results in the least amount of interior habitat impacts is generally the better one. Figure 4 shows a schematic of a contiguous forest tract with edge habitat and interior habitat identified.

Figure 4. Edge vs. Interior



MITIGATION

The Criteria direct local jurisdictions to protect and conserve those forested areas necessary to support FIDS by developing a *management program* which has as its objective conserving the wildlife that inhabit or use the forested areas (COMAR 27.01.09.04). This provision requires the conservation and protection of all FIDS habitat, even that located on grandfathered lots. The primary objective of FIDS habitat conservation and protection is to preserve or retain the maximum amount of contiguous, undisturbed forest habitat, particularly the portion of forest that is interior habitat. This protection strategy requires that most existing FIDS habitat be preserved on-site. This can best be achieved by following the ***Site Design Guidelines***; however, there are situations where FIDS habitat impacts occur even when the ***Guidelines*** are followed. Therefore, in order to meet the conservation and protection requirement, local jurisdictions should include in their management programs mitigation requirements that must be met whenever FIDS habitat is impacted.

Mitigation that results in the conservation and protection of FIDS habitat can be achieved in a number of ways. FIDS mitigation can, in many cases, be achieved on-site concurrently with general forest replacement requirements (reforestation) if the reforestation area expands or creates new FIDS habitat. Off-site mitigation should only be considered when no effective, long-term on-site habitat protection is possible. This determination should be made by the local jurisdiction with the input of DNR and the Critical Area Commission staff. The use of off-site mitigation, if well directed, may provide for the creation/protection of large, potentially high quality forests. This method of FIDS protection is similar to the concept of a "no net loss" made popular by wetland protection programs where impacts must first be avoided and only when avoidance is not possible, new habitat is created to replace wetlands lost.

For example, a large subdivision may be proposed on a site that contains forest that has been identified as FIDS habitat. Even if development is proposed predominantly in the nonforested areas of the site, some impacts to the forest edge may occur. While the ***Site Design Guidelines*** have been followed by avoiding direct impacts to the forest interior, there are still FIDS habitat impacts. These impacts should be mitigated by creating FIDS habitat on- or off-site.

In another example, there may be no options for avoiding impacts when developing a small forested grandfathered lot with a single-family dwelling. If it is determined that there are no alternative development scenarios where FIDS habitat impacts could be avoided, off-site mitigation may provide a better long-term FIDS habitat protection strategy.

As an alternative to requiring small property owners to find their own sites for FIDS mitigation, local jurisdictions may adopt a fee-in-lieu program under which the local jurisdiction would take responsibility for implementing the mitigation. A local government may be better equipped to ensure successful restoration and protection of a mitigation area as well as to help landowners of smaller properties meet requirements. The opportunity for creating and maintaining large forested habitat areas may be greater when a number of smaller projects are combined; however, it is recommended that in the case of impacts due to larger projects (e.g., new subdivision,

commercial development) the landowner or developer should be held responsible for locating the mitigation site.

How much mitigation should be required?

When FIDS habitat is impacted, the amount of FIDS mitigation required is based on the following:

1. A determination of whether or not the ***Guidelines*** are followed; * **

2. The number of acres of FIDS habitat that is directly cut; and

3. The number of acres of interior habitat loss (cut or converted to edge).

If it is determined that the ***Guidelines*** were followed, the amount of FIDS mitigation should equal **the number of acres of *direct forest habitat loss*.**

If it is determined that the ***Guidelines*** were not followed, the amount of FIDS mitigation should equal **the number of acres of *direct forest habitat loss*, plus, two times the number of acres of *interior habitat loss* (FIDS habitat cut or converted to edge).**

** Factors that may be taken into account when determining if the **Guidelines** can be followed include the size of the parcel, whether or not the parcel is grandfathered and site constraints that may limit development designs.*

*** One means to help evaluate whether an adequate attempt has been made to apply the **Guideline**s is to determine if a minimum of 80% of predevelopment forest interior will remain as viable habitat after development. This method should not be the only criteria that is considered. An attempt should always be made to apply all the **Guidelines** to every project.*

The following steps are proposed as a method to determine the amount of interior habitat lost or impacted under a proposed development scenario.

1. Identify and calculate the acreage of all FIDS habitat on the parcel, taking into account all contiguous forest areas on and off the property. (See section on how to determine if FIDS habitat is present.)

2. Identify and calculate the pre-development acres of forest interior by delineating the 300-foot wide forested edge and measuring the acreage of remaining interior habitat. (See Figure 6.)

3 Calculate the area of forest cut in the interior and edge of FIDS habitat. This area is considered the ***direct forest habitat loss.***

4. Determine the post-development forest cover and remaining interior habitat by

delineating the proposed new edge habitat after development (300-foot wide forested edge) and measuring the acres of interior habitat that remain. Edge habitat is created whenever there is a minimum 30-foot wide break in the forest canopy (e.g., a road or lawn).

5. Subtract the post-development interior from the pre-development interior. This area is considered the ***interior forest habitat loss***.

Appendix D is a FIDS Conservation Worksheet to use in helping to evaluate how well the Guidelines have been followed and to help with the calculation of any mitigation.

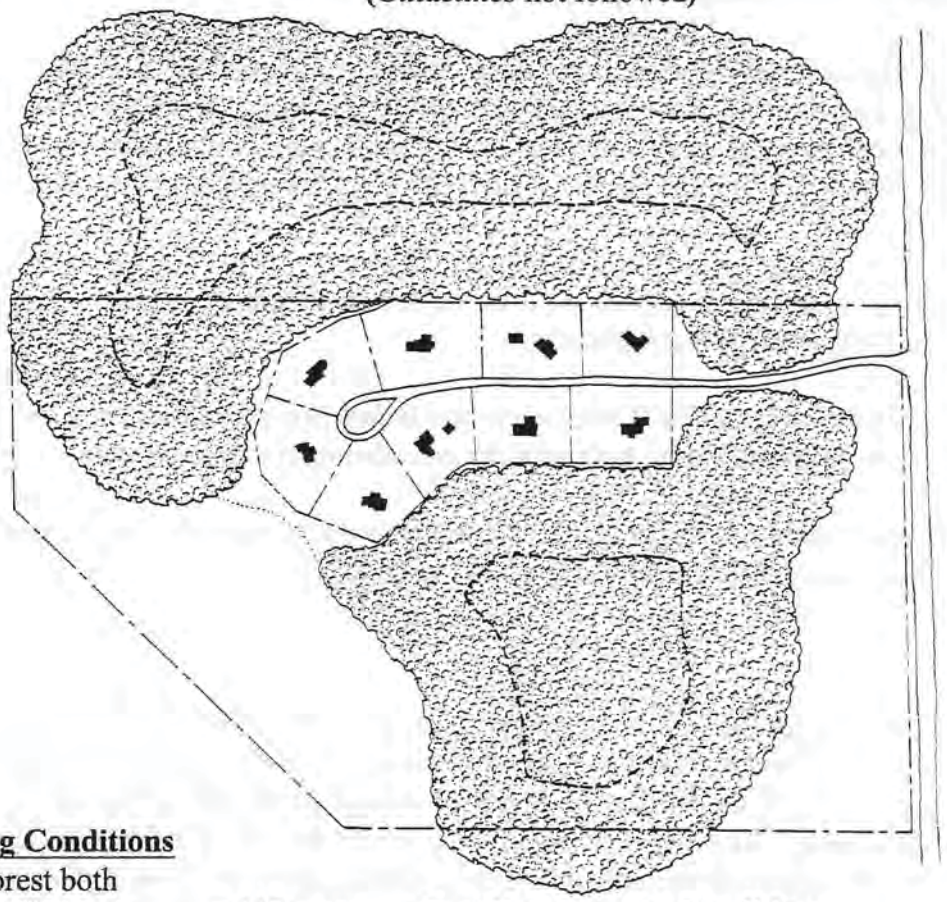
The following example demonstrates how two site designs with the same number of acres cleared can result in widely different levels of interior impacts.

Example:

Consider a 96-acre site purchased for development. The site is 70% forested with agricultural fields on the southwestern and the eastern edges of the parcel. The forest on the property is connected to a larger forest to the north. The entire forest both on and off the parcel is functioning as FIDS habitat. The owner proposes to build nine houses. He directs his consultant to design two different layouts for the nine lots. The consultant prepares two site plans and calculates the amount of direct and interior loss of FIDS habitat after development using the method described above. (See Figures 5A and 5B.)

Figure 5A

DEVELOPMENT SCENARIO 1
(***Guidelines*** not followed)



Existing Conditions

Total forest both on and off parcel = 112 acres

Parcel size = 96 acres

Forest on parcel prior to development = 67 acres

FIDS habitat on parcel prior to development = 67 acres

Forest interior prior to development = 38 acres

Post Development Conditions

Total forest to be = 21 acres

Total forest to remain on parcel = 46 acres

Forest in northern corner of parcel =10acres

Forest in southern portion of parcel = 36 acres

Total FIDS habitat to remain on parcel = 10 acres

(Forest fragment in southern portion of parcel is less than 50 acres, too small to support FID; northern portion of the forest is part of a forest tract that is larger than 50 acres with greater than 10 acres of interior.)

Interior forest to remain on parcel = 1 acre

FIDS Mitigation (***Guidelines*** not followed)

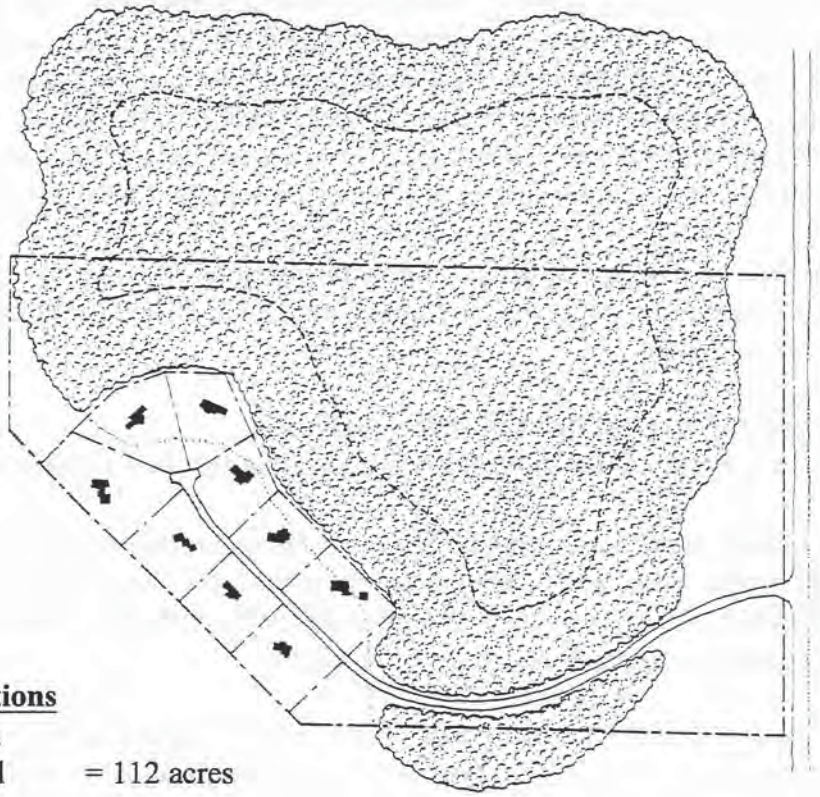
Direct FIDS forest loss = 21 acres

Interior forest loss = 37 acres

Mitigation = Direct FIDS forest loss + 2(interior forest loss) = 21 acres + 2(37) = 95 acre

Figure 5B.

DEVELOPMENT SCENARIO 2
(***Guidelines*** followed)



Existing Conditions

Total forest both on and off parcel = 112 acres

Parcel size = 96 acres

Forest on parcel prior to development = 67 acres

FIDS habitat on parcel prior to development = 67 acres

Forest interior prior to development = 38 acres

Post Development Conditions

Total forest to be cut = 10 acres

Total forest to remain on parcel = 57

Total FIDS habitat to remain on parcel = 55 acres
(A small portion of the forest to be left in the southern part of the site will be isolated from the rest of the forest and too small to function as FIDS habitat.)

Total interior to remain = 27 acres

FIDS Mitigation (***Guidelines*** followed)

Direct FIDS habitat loss = 10 acres
Interior forest loss = 11 acres
Mitigation = Direct FIDS habitat loss = 10 acres

The goal of mitigation is to provide long-term FIDS habitat; therefore, FIDS mitigation sites should contain or result in, through reforestation, a contiguous area of at least 100 acres with a minimum of 20 acres of interior. In those situations where it is not possible to find an appropriate area of 100 acres it may be possible to reduce the minimum size to 50 acres if the reforestation guidelines on the following page are followed. The minimum contiguous forested area does not have to be contained in one parcel. There should be a reasonable expectation that a mitigation area will remain undeveloped and forested in perpetuity. (For assistance in finding appropriate mitigation sites see Appendix E, Resources for Locating Mitigation Sites.)

Once the areas of ***direct forest habitat loss*** and ***interior forest habitat loss*** have been calculated and the required acreage of mitigation is determined, mitigation for the FIDS forest habitat losses may be either in the form of:

> ***Creation*** **of FIDS habitat through reforestation, or**
> ***Protection*** **of existing FIDS habitat once mitigation for direct losses have been met**

For ***direct forest habitat*** impacts, all mitigation must result in the creation of new FIDS habitat.** Again, simple forest replacement proposed to meet the basic Critical Area reforestation requirements can satisfy the FIDS mitigation **only** if the reforestation area creates a new area of FIDS habitat or expands an existing habitat area.

***There may be some flexibility in dealing with grandfathered lots of 1 acre or less when a jurisdiction can demonstrate that other programs within the jurisdiction provide protection and creation of forests that will function as FIDS habitat. Examples of such programs include:*

- *using money from other mitigation fee-in-lieu funds to create FIDS habitat*
- *protecting forest lands through conservation programs such as Rural Legacy*
- *protecting forests outside of the Critical Area*

Once mitigation for the direct forest habitat impact has been satisfied, mitigation for the ***interior forest habitat*** impact may be achieved either by creation of FIDS habitat (reforestation) or protection of existing FIDS habitat. However, when the protection option is chosen, the protected acres are given only half credit toward the required mitigation acres. Reforestation is given full credit toward meeting the interior forest habitat mitigation requirements while protection is only given one-half credit due to the fact that all forests in the Critical Area are afforded some protection under the Critical Area Criteria. While the long-term viability of existing FIDS habitat is improved with permanent protection, new habitat areas must be created to maintain and increase the area of viable FIDS habitat in the Critical Area.

Creation of FIDS habitat through reforestation

Reforestation to create FIDS habitat refers to the reestablishment of locally native forest on a currently nonforested site that will create a forest large enough to function as FIDS habitat. Reforestation through natural succession or planting is given full credit toward FIDS mitigation requirements. For example, if the total mitigation required for impacts to FIDS habitat is ten acres, then reforestation of ten acres of FIDS habitat would fulfill the FIDS mitigation requirement.

If mitigation creates new FIDS habitat through planting or natural regeneration, this mitigation may count toward the basic Critical Area forest replacement requirements; however, forest replacement may not count toward FIDS mitigation unless it creates FIDS habitat.

FIDS Reforestation Guidelines

1. Reforestation should be designed to maximize the area of interior habitat (see Figure 6).

2. Fill in gaps or openings in existing forested areas. Reforest nonforested peninsulas (see Figure 6).

3. Establish or extend a riparian forest buffer to provide a minimum buffer width of at least 300 feet. This reforestation should be part of a forest tract at least 50 acres in size (see Figure 6).

4. All mitigation, with the possible exception of that along a riparian area, should result in the establishment of a minimum forest tract size of 100 acres of which 20 acres is forest interior.*

5. Use natural succession and/or plantings of locally native tree and shrub species to create new habitat. Appropriate action, including the control of invasive species, should be taken to help ensure that the original forest type is replaced.

6. When enlarging forest patches, create shapes such as circles or squares which minimize edge and provide interior habitat.

7. Connect forest fragments to other forest or forest fragments with a corridor at least 300 feet in width.

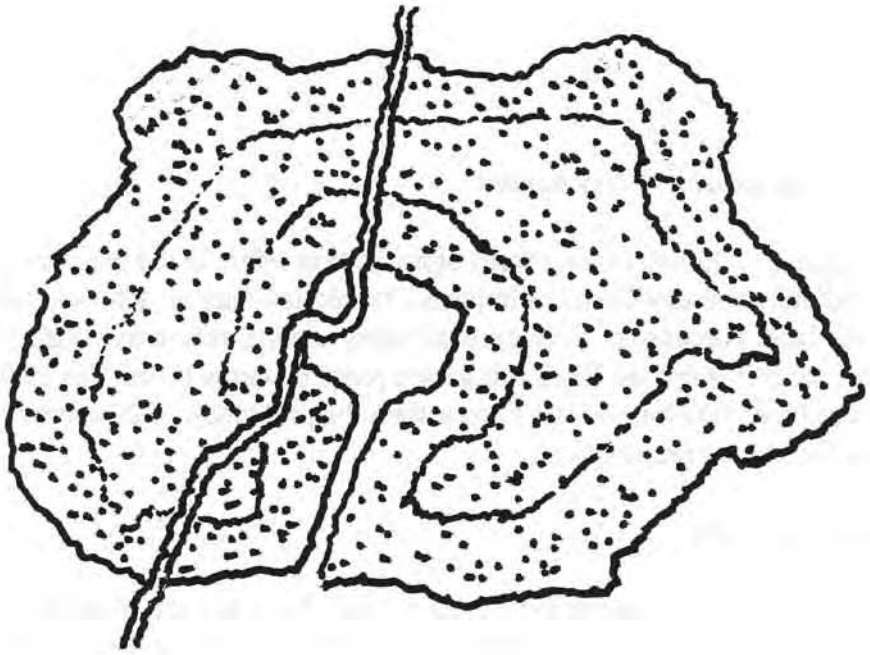
8. The reforestation area should be comprised predominantly of hardwood. If planting, plans should be designed so that at the time of canopy closure at least 75% of the canopy tree species are locally native hardwoods.

9. All mitigation sites must be permanently protected through a conservation easement or

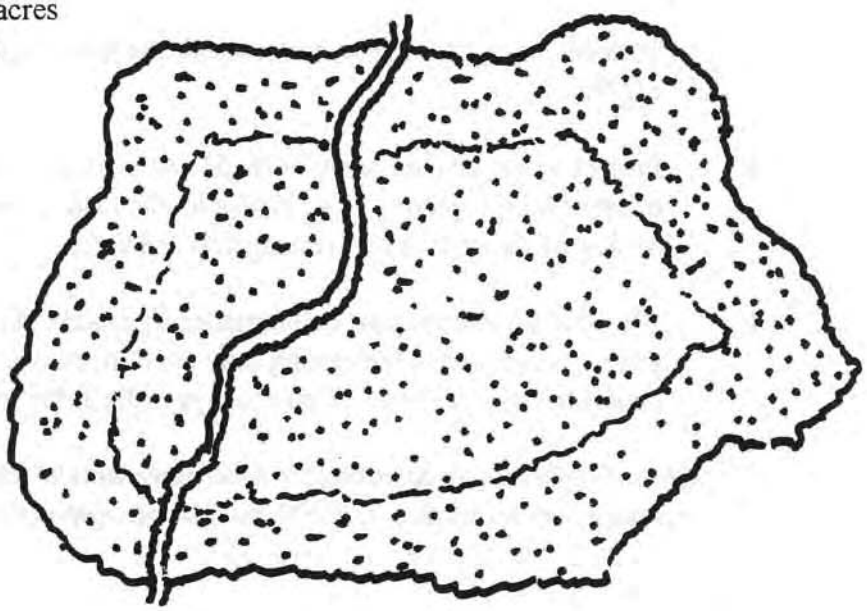
other legal mechanism (See Appendix F). No development may occur in these areas. Some timber harvesting may occur provided Critical Area timber harvest guidelines are followed.

** It may be possible to have a mitigation area less than 100 acres when a 50-100 acre mitigation site: -is adjacent to a major river corridor (e.g., Potomac, Choptank, Chester) or along the Bay especially along the tips of peninsulas----these landscape features provide FIDS breeding habitat and tend to be important migratory stopover areas for FIDS and other landbirds; - is located in a heavily forested landscape (>75% forest within 10km) and large forest tracts (>500 acres) are nearby (within 500 m); - contains old growth forest, unique natural communities and/or rare, threatened or endangered species;*

Robert Savannah, U.S. Fish and Wildlife Service



Forest tract before reforestation: 117 acres
Interior before reforestation: 40 acres



Reforestation acreage: 9 acres
Forest tract after reforestation: 66 acres
Interior after reforestation: 126 acres (This is a 61% increase in interior, with only an 8% increase in total forest tract size.)

Figure 6. Target mitigation to fill openings in existing forest and to extend or fill in gaps along riparian areas.

Protection of existing FIDS habitat as a form of mitigation refers to the permanent protection of existing forest habitat from development impacts. Protection may be achieved through the acquisition of the land, purchase of development rights and protection by conservation easements. Half credit toward the FIDS mitigation requirement is given. For example, if the mitigation required for FIDS habitat is 10 acres, then the protection of 20 acres of FIDS habitat would fulfill the mitigation requirement.

FIDS Protection Guidelines

1. All mitigation should result in the establishment of a minimum forest tract size of 100 acres of which 20 acres is forest interior. Generally, the larger the size of a forest tract, the greater the value for FIDS.

2. In most cases, the older a forest stand, the more valuable it is for the greatest number of FIDS.

3. Protect forest land adjacent to lands that are currently protected or are managed with a conservation objective (e.g., public lands, lands protected through land trusts, wetlands, habitat of threatened and endangered species.)

4. All mitigation sites must be permanently protected. No development may occur in these areas. Some timber harvesting may occur provided Critical Area timber harvest guidelines are followed. Refer to Appendix E for information on conservation easements.

For a list of information to submit to local government when proposing a mitigation site for either creation or protection of FIDS habitat see Appendix G.

Conclusion

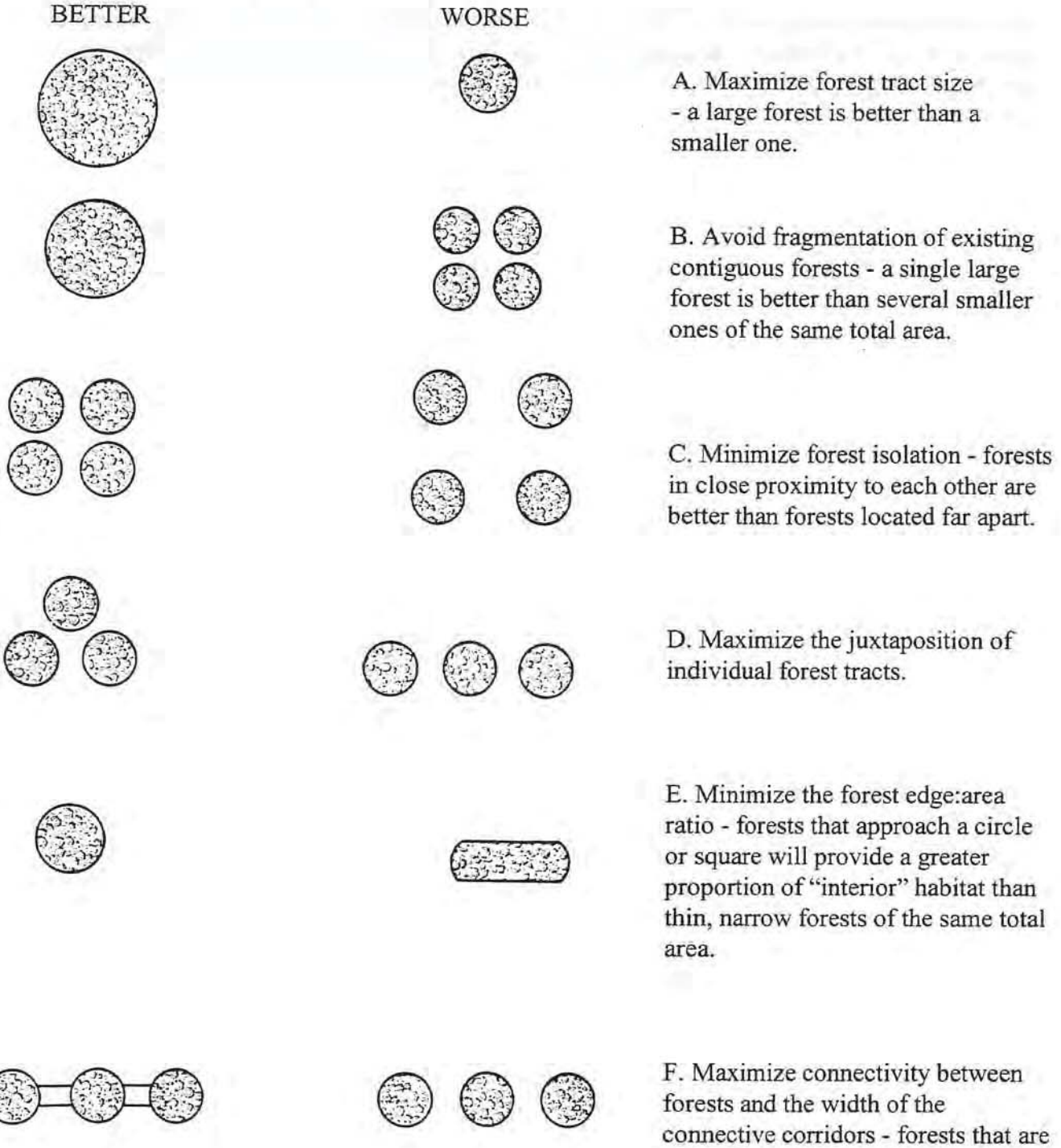
Mitigation is just one part of an overall conservation strategy for FIDS in the Critical Area. The most effective FIDS conservation begins with avoiding development impacts to FIDS habitat through long-term land use planning and implementation of ***Site Design Guidelines***. In a hierarchy of protection strategies for FIDS, mitigation is a last resort, to be used only after land planning and site design options have been exhausted.

Conservation of FIDS habitat should be considered in other existing voluntary and regulatory programs. Many land trusts, local and state government, and incentive programs are currently protecting forests that can serve as core tracts to add on to within a county or a region. FIDS conservation can, in many cases, be dovetailed with wetland protection and mitigation, threatened and endangered species protection and Forest Conservation Act requirements.

Cooperation across jurisdictional boundaries and between public and private interests will also greatly increase the effectiveness of FIDS conservation throughout the region.

The design principles represented in Figure 7 summarize landscape level conservation principles that apply to FIDS at both the large and small scale. It is important to keep these principles in mind when considering either the protection of existing habitat and/or mitigation for habitat impacts.

Figure 7. A schematic of preserve design principles as they apply to forest interior dwelling bird (FID) conservation; from Diamond (1975).



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APPENDIX A

DEFINITIONS OF BREEDING STATUS CATEGORIES AND CODES.

There are 3 breeding categories: POSSIBLE, PROBABLE and CONFIRMED. Different codes exist within categories. The correct use of the categories and codes is essential for documenting breeding evidence.

POSSIBLE (always a 1-letter code)

O - Species observed at a site, but not in breeding habitat. This code is primarily for birds that are not believed to breed at the site. Flyovers and any species outside of "Safe Dates" (Table 1, page 10) with no further breeding evidence should be recorded as 'O'.

X - Species heard or seen in breeding habitat within Safe Dates. Be very cautious during migration periods.

PROBABLE (always a 1-letter code)

A - Agitated behavior or anxiety calls from adult. Parent birds respond to threats with distress calls or by attacking intruders. This does not include responses to "pishing" or tape playing of recorded calls.

P - Pair observed in suitable breeding habitat within safe dates. Use this code with caution.

T - Territorial behavior or singing male present at same location on at least 2 different days. Territoriality can be presumed from defensive encounters between individuals of the same species, or by observing a male singing from a variety of perches within a small area.

C - Courtship or copulation observed. This includes displays, courtship feeding, and birds mating.

N - Visiting probable nest site. This code applies when a bird is observed visiting a probable nest site repeatedly, but no further evidence is seen.

B - Nest building by wrens or excavation by woodpeckers. Both groups build dummy or roosting nests at the same time they are building a real one, but an unmated male will exhibit the same behavior.

CONFIRMED (always a 2-letter code)

NB - Nest building (except wrens and woodpeckers) or adult carrying nesting material. Be cautious with this code since carrying sticks is part of the courtship ritual (Code 'C') for some species.

D - Distraction display; including injury feigning. Agitated behavior (Code 'A') can be mistaken for a distraction display.

UN - Used nest found. Use extreme caution. Nests are difficult to identify. If unsure, forget it - removing or collecting a nest is illegal without a permit.

FL - Recently fledged young or downy young. This includes dependent young. Be cautious of species that range widely soon after fledging. Don't forget to look for dead fledglings or nestlings along roads.

FS - Adult bird seen carrying fecal sac. Excreted feces of nestlings are contained in a membranous sac and often carried away from the nest by the parents.

FY - Adult carrying food for young. Be cautious since some species feed young long after wandering from a nest site or carry food for a long distance. Many also engage in courtship feeding (Code 'C').

ON - Occupied nest. Presumed by activity of parents; entering nest hole and staying, parents exchanging incubation responsibilities, etc. Primarily intended for hole nesters and nests too inaccessible to see the contents.

NE - Nest with eggs or eggshells or ground. Identify these very carefully.

NY - Nest with young seen or heard.

Examples to use as guidelines; from the "Maryland and DC Breeding Bird Atlas Project Handbook"

1. Woodpecker drumming: POSSIBLE - X within Safe Dates; PROBABLE - T if same place 2 different days. This refers to territorial drumming not feeding.

2. Duck summers on pond without suitable adjacent marshes: POSSIBLE - O.

3. Woodcock nuptial flights for 3 weeks: PROBABLE - T (POSSIBLE - X if observed only once); PROBABLE - C if courtship and display to female observed.

4. Gulls frequenting dumps, plowed fields, parking lots throughout summer in unsuitable nesting habitat: POSSIBLE - O.

5. Song Sparrow seen carrying nesting material: CONFIRMED - NB.

6. Wood Thrush seen on nest for extended period of time, but too high to see contents: CONFIRMED - ON.

7. Great Blue Heron feeding along a river away from any known nesting area: POSSIBLE - O. Watch such a bird closely. It could lead to a colony.

8. Second year American Redstart singing abnormal song in a hedgerow in early June: POSSIBLE - O.

9. Male House Wren sings all summer and stuffs nest boxes with sticks; no evidence of a mate: PROBABLE - B.

10. Male and female Scarlet Tanagers observed together several times in the same area, but no nest or young ever seen: PROBABLE - P.

APPENDIX B

FLEXIBLE ORDINANCE LANGUAGE AND DEVELOPMENT STANDARDS

Adapted from the *Model Development Principles*, 1998.
(Center for Watershed Protection, Website: www.cwp.org)

The following model development principles provide site design guidance for economically viable, yet environmentally sensitive development. The goal of using the principles is to provide planners, developers and local officials with benchmarks to investigate where existing ordinances may be modified to reduce impervious cover, conserve natural areas (e.g., forest and FIDS habitat) and prevent stormwater pollution. These development principles identify areas where existing codes and standards can be changed to better protect forest, streams and wetlands at the local level.

Residential Streets and Parking Lots (Habitat for Cars)

1. Design residential streets for the minimum required pavement width needed to support travel lanes; on-street parking; and emergency, maintenance and service vehicle access. These widths should be based on traffic volume.

2. Reduce the total length of residential streets by examining alternative street layouts to determine the best option for increasing number of homes per unit length.

3. Wherever possible, residential street right-of-way widths should reflect the minimum required to accommodate the travel-way, the sidewalk and vegetated open channels. Utilities and storm drains should be located within the pavement section of the right-of-way, wherever feasible.

4. Minimize the number of residential street cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. The radius of cul-de-sacs should be the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds should be considered.

5. Where density, topography, soils and slope permit, vegetated channels should be used in the street right-of-way to convey and treat stormwater runoff.

6. The required parking ratio governing a particular land use or activity should be enforced as both a maximum and a minimum in order to curb excess parking space.

7. Parking codes should be revised to lower parking requirements where mass transit is available or enforceable shared parking arrangements are made.

8. Reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes and using pervious materials in the spillover parking areas.

9. Provide meaningful incentives to encourage structured and shared parking to make it more economically viable.

10. Wherever possible, provide stormwater treatment for parking lot runoff using bioretention areas, filter strips and/or other practices that can be integrated into required landscaping areas and traffic islands.

11. Advocate open space development that incorporates smaller lot sizes to minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space and promote watershed protection.

12. Relax side yard setbacks and allow narrower frontages to reduce total road length in the community and overall site imperviousness. Relax front setback requirements to minimize driveway lengths and reduce overall lot imperviousness.

13. Promote more flexible design standards for residential subdivision sidewalks.

14. Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.

15. Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing both natural and recreational open space.

16. Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system.

17. Create a variable width, naturally vegetated buffer system along all perennial streams that also encompasses critical environmental features such as the 100-year floodplain, steep slopes and freshwater wetlands.

18. The riparian stream buffer should be preserved or restored with native vegetation that can be maintained throughout the plan review, delineation, construction and occupancy stages of development.

19. Clearing and grading of forests and native vegetation at a site should be limited to the minimum amount needed to build lots, allow access and provide fire protection. A fixed portion of any community open space should be managed as protected green space in a consolidated manner.

20. Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas and promoting the use of native plants. Wherever practical, manage community open space, street rights-of-way, parking lot islands and other landscaped areas to promote natural vegetation.

21. Incentives and flexibility in the form of density compensation, buffer averaging, property tax reduction, stormwater credits and by-right open space development should be encouraged to promote conservation of stream buffers, forests, meadows and other areas of environmental value. In addition, off-site mitigation consistent with locally adopted watershed plans should be encouraged.

22. New stormwater outfall should not discharge unmanaged stormwater into jurisdictional wetlands, sole-source aquifers, or other waterbodies.

APPENDIX C

SITE DESIGN GUIDELINES

The *Site Design Guidelines* provide guidance on how to achieve the greatest possible protection and conservation of FIDS habitat when development is proposed. The guidelines are recommended to be followed in order to minimize the impacts to interior forest habitat.

1. Restrict development to nonforested areas.

2. If forest loss or disturbance is unavoidable, concentrate or restrict development to the following areas:

    a. the perimeter of the forest (i.e., within 300 feet of the existing forest edge)
    b. thin strips of upland forest less than 300 feet wide
    c. small, isolated forests less than 50 acres in size
    d. portions of the forest with low quality FIDS habitat, (e.g., areas that are already heavily fragmented, relatively young, exhibit low structural diversity, etc.).

3. Maximize the amount of forest "interior" (forest area > 300 feet from the forest edge) within each forest tract (i.e., minimize the forest edge:area ratio). Circular forest tracts are ideal and square tracts are better than rectangular or long, linear forests.

4. Minimize forest isolation. Generally, forests that are adjacent, close to, or connected to other forests provide higher quality FIDS habitat than more isolated forests.

5. Limit forest removal to the "footprint" of houses and to that which is necessary for the placement of roads and driveways.

6. Minimize the number and length of driveways and roads.

7. Roads and driveways should be as narrow as possible; preferably less than 25 feet in width and 15 feet in width, respectively.

8. Maintain forest canopy closure over roads and driveways.

9. Maintain forest habitat up to the edges of roads and driveways; do not create or maintain mowed grassy berms.

10. Maintain or create wildlife corridors.

11. Do not remove or disturb forest habitat during April-August, the breeding season for most FIDS. This seasonal restriction may be expanded to February-August if certain early nesting FIDS (e.g., Barred Owl) are present.

12. Landscape homes with native trees, shrubs and other plants and/or encourage homeowners to do so.

13. Encourage homeowners to keep pet cats indoors or, if taken outside, kept on a leash or inside a fenced area.

14. In forested areas reserved from development, promote the development of a diverse forest understory by removing livestock from forested areas and controlling white-tailed deer populations. Do not mow the forest understory or remove woody debris and snags.

15. Afforestation efforts should target a) riparian or streamside areas that lack woody vegetative buffers, b) forested riparian areas less than 300 feet wide, and c) gaps or peninsulas of nonforested habitat within or adjacent to existing FIDS habitat.

APPENDIX D

FIDS CONSERVATION WORKSHEET

Parcel size _____ total acreage

_____ Critical Area acreage

Existing

Forest cover _____ total contiguous acreage
Forest cover _____ total acres CA
FIDS habitat* _____ total acres CA
FIDS interior _____ acres CA

Calculate interior by subtracting out a 300 ft. edge.**

If available: _____ acreage of contiguous forest area both in and out of the CA within a 3-mile radius.

Post development

Forest cover _____ total acres CA
FIDS habitat _____ total acres CA
Interior habitat remaining _____ acres CA
Interior acreage

***How to Identify FIDS Habitat**

Assume FIDS habitat is present if a forest meets either of the following minimum conditions:

Forests at least 50 acres in size with 10 or more acres of forest interior (see below to calculate interior) habitat. The majority of the forest tracts should be dominated by pole-sized or larger trees (5 inches or more in diameter at breast height), or have a closed canopy; or

Riparian forests at least 50 acres in size with an average total width of at least 300 feet. The stream within the riparian forest should be perennial, based on field surveys or as indicated on the most recent 7.5 minute USGS topographic maps. The majority of the forest tracts should be dominated by pole-sized or larger trees, or have a closed canopy.

In lieu of using the above criteria for determining if FIDS habitat is present, a FIDS survey may be done by a qualified FIDS observer. See page 12 of the Guidance Document for the procedures to be followed. You may contact the Maryland Department of Natural Resources, Forest Wildlife Divisions or the Critical Area Commission for a list of qualified observers.

****How to Measure the amount of forest interior and forest edge**

To determine the amount of interior in a forest, the edge of 300 feet is subtracted from the total contiguous forest. The area left is forest interior provided it is at least ten acres in size.

When measuring forest edge, do not include natural forest edges such as those adjacent to open water, nonforested wetlands and streams. Riparian forests of 300 feet or greater are considered interior habitat when calculating FIDS habitat in the Critical Area provided that they have a minimum of 50 contiguous acres or are connected to a forest that has been determined to be FIDS habitat.

Please answer the following questions regarding the FIDS *Site Design Guidelines* and how they were applied to the project.

1. Has development (e.g., house, septic reserve areas, driveway) been restricted to nonforested areas? Yes____No____

   If no, explain

   _____

   _____

2. If development has not been restricted to nonforested areas, has development been restricted to:

   a. perimeter of the forest within 300 feet of the forest edge? Yes____No____
   b. thin strips of upland forest less than 300 feet wide? Yes____No____
   c. isolated forests less than 50 acres in size? Yes____No____
   d. portions of the forest with low quality FIDS habitat, (e.g., areas that are heavily fragmented, relatively young, exhibit low structural diversity, etc.)? Yes____No____

3. Have new lots been restricted to existing nonforested areas and/or forests as described in #2 above? Yes____No____

   If no, please explain how property owners will be prevented

   from clearing in the FIDS habitat on their property (i.e., protective covenants/easements)?

   _____

   _____

4. Will forest removal be limited to the footprint of the house and

that which will be necessary for the placement of roads and driveways? Yes____No____

5. Have the number and lengths of roads been minimized? Yes____No____

6. Have the width of roads and driveways been reduced to 25 feet and 15 feet respectively? Yes____No____

If no, explain

_____

_____

_____

7. Will the forest canopy be maintained over roads and driveways? Yes____No____

8. Will the forest canopy be maintained up to the edge of roads and driveways? Yes____No____

9. Will at least 80% of the forest interior be maintained after development? Yes____No____

If no, indicate percentage of forest interior that will be maintained? _____%

10. Are there special conditions on the site that limit where houses and other development activities may be located such as wetlands, steep slopes, etc.? If so, please identify and explain.

_____

_____

_____

11. Do you believe that the ***Site Design Guidelines*** have been followed and that FIDS habitat has been conserved on this site? Yes____No____

MITIGATION REQUIREMENTS

If the *Site Design Guidelines* <u>have</u> been followed the required mitigation will be the creation of FIDS habitat equal to the acreage being directly cut or disturbed. **(**See pages 27 - 28 for specific mitigation options and criteria.)

Enter acreage of FIDS habitat that is being directly impacted _____acres.

THIS IS YOUR MITIGATION REQUIREMENT WHEN THE SITE DESIGN GUIDELINES ARE FOLLOWED.

If the *Site Design Guidelines* <u>have not</u> been followed complete the following.

A. Pre-development FIDS habitat _____ **acres.**
B. Post development FIDS habitat _____ **acres.**
C. Pre-development FIDS habitat interior _____ **acres.**
D. Post development FIDS habitat interior _____ **acres.**
E. FIDS habitat being directly impacted _____ **acres.**
(Subtract B from A)
F. Interior lost due to development _____ **acres.**
(Subtract D from C)
G. Multiply F. times two (2) _____acres and add to E. = _____ acres.

THIS IS YOUR MITIGATION REQUIREMENT WHEN THE DEVELOPMENT GUIDELINES HAVE NOT BEEN MET.

APPENDIX E

RESOURCES FOR LOCATING MITIGATION SITES

In order to assist local jurisdictions in the implementation of the FIDS guidance and the recommendation that forest habitat mitigation be required whenever impacts to FIDS habitat take place onsite, the following State and local programs are outlined. Each of the following programs may be used by local governments, planning staff, landowners and developers to identify appropriate mitigation sites for FIDS habitat planting and protection of existing FIDS habitat. The State Critical Area staff are available to assist in the identification of the most appropriate program for meeting mitigation requirements.

The Green Infrastructure Network (MD Department of Natural Resources):

Using Geographic Information Systems principles and landscape ecology, DNR has mapped an interconnected network of natural lands across the State described as "hubs" and "corridors" that are prioritized for conservation and restoration activities based on their ecological significance (e.g., large contiguous areas of forest, sensitive species, important wetlands or stream, etc.) and the level of threat (e.g., protection status, development pressures, etc.). The goal of the Green Infrastructure Assessment is to help identify an ecologically sound open space network and ultimately, to incorporate this valuable network into State and local land conservation planning efforts.

Green Infrastructure areas have been identified on public and private lands throughout the State through a series of maps and a database developed by DNR. Because only limited Statewide data is available to define this network, the help of local governments, land trusts, citizens and scientific experts is needed in this cooperative endeavor to further refine and identify the Green Infrastructure land network and effectively incorporate this information into State and local planning efforts.

The purpose of the Green Infrastructure land network is to create a coordinated Statewide approach to land conservation and restoration that will identify and protect lands with important ecological and biodiversity characteristics; address problems of forest fragmentation, habitat degradation and water quality; maximize the influence and effectiveness of public and private land conservation investment; promote shared responsibility for land conservation between public and private sectors and guide and encourage compatible uses and land management practices.

In addition, the Green Infrastructure land network could be used by local governments or developers to identify areas where FIDS mitigation, either habitat creation or protection, will achieve the goal of creating or enhancing viable FIDS habitat and be the most valuable. When refined on the local level, the Green Infrastructure Assessment may be useful in assessing the

potential natural resource related impacts of a proposed development and in identifying opportunities for natural resources and habitat enhancement activities.

APPENDIX F

CONSERVATION EASEMENTS

For the purpose of protecting and maintaining FIDS habitat, conservation easements should meet the following minimum conditions:

* The agreement should be between the property owner (grantor) and the local government and/or a land conservancy group (grantees).
* Restrictions on the property include the loss of development rights for the construction of houses and other structures.
* New agricultural activities are prohibited, (i.e., clearing, draining, construction).
* Any harvesting of timber must be done under an approved Timber Harvest Management Plan that would include a review for impacts to FIDS habitat.
* Recreational activities may be allowed provided they do not alter the character of the forest and do not cause undue disturbance during the breeding season.
* The easement shall be created in perpetuity.

Conservation easements should be held by either a local government agency and/or a local land trust that is willing and able to monitor compliance with agreements. An ideal situation is for both a local government agency and local land trust to jointly hold an easement on a property and be responsible for its enforcement. Often local land trusts are better set up than government agencies to monitor the easements for which they are responsible. There are approximately 40 local land trusts in Maryland.

The hub and corridor information and maps that have been developed at the State and regional level will be available to local governments and can be used to identify target areas that may be best suitable for targeting FIDS mitigation.

Contact:
Ms. Teresa Moore, Executive Director
Maryland Greenways Commission
Chesapeake Coastal and Watershed Service
Tawes State Office Building, E-2
Annapolis, MD 21401
(410) 260-8780
FAX (410) 260-8709

Rural Legacy

The mission of the Rural Legacy Program is to protect regions rich in a multiple of agricultural, forestry, natural and cultural resources that, if conserved, will promote resource-based economies, protect green belts and greenways and maintain the fabric of rural life. The Rural Legacy Program provides the focus and funding necessary to protect large contiguous tracts of land and other strategic areas from sprawl development and enhance natural resources, agricultural, forestry and environmental protection through cooperative efforts among State and local governments and land trusts. Protection is provided through the acquisition of easements and fee estates from willing landowners and the supporting activities of Rural Legacy Sponsors and governments.

Application for Rural Legacy Program grants may be made by a Sponsor (defined as one or more local governments, or land trusts endorsed by local governments) to the Rural Legacy Board. The applications include a description of the area, an identification of existing, protected lands and the anticipated level of initial landowner participation in the program, a Rural Legacy Plan complying with the Rural Legacy criteria and a proposed grant amount.

Contact:
Rural Legacy Program
Department of Natural Resources
Program Open Space
Tawes State Office Building, E-4
Annapolis, MD 21401
(410) 260-8403

Critical Area Forest/FIDS Mitigation and the Conservation Reserve Enhancement Program (CREP):

In some counties, fee-in-lieu monies could be used to plant trees and purchase easements in conjunction with the U.S. Department of Agriculture Conservation Reserve Enhancement Program (CREP). CREP is a nationwide program that promotes the planting of streamside buffers and the restoration of wetlands on agricultural land by offering financial incentives to landowners who voluntarily remove land from agricultural production for a period of 10-15 years. A recent component of this program is also the purchase of perpetual easements on qualifying lands. This is where the greatest potential exists for CREP and the Critical Area Program to combine forces to create and protect FIDS habitat. CREP will only pay for the first 150 feet adjacent to a waterbody. An area planted with Critical Area monies would be located landward of the 150-foot CREP forested buffer.

Planting Forested Buffers

The benefits offered to property owners would match the CREP bonus payments and cost-share. An area planted with Critical Area monies would be located landward of the 150-foot CREP forested buffer. Both the CREP and the Critical Area portions would be put in a perpetual

easement to be held and enforced by the local Soil Conservation District (SCD), local land trust, or DNR. The benefits to the local Critical Area Programs include:

- The identification of forest/FIDS mitigation sites in the Critical Area to fulfill mitigation requirements and ensure no net loss of forest.
- Monitoring and enforcement of the mitigation sites would be in the hands of the Soil Conservation District, land trusts, or DNR, taking some burden off of the counties and helping to ensure that the trees are planted and survive.

Purchase of Easements on Existing Forest

Fees-in-lieu above the 1:1 mitigation ratio can be used for creative projects that help to restore/protect habitat and water quality. The monies could be used to purchase easements on forested areas in the Critical Area that are contiguous or near a CREP easement site.

Process

Some county planners are looking for ways to spend fee-in-lieu money. Local landowners may be interested in planting more acreage than is provided under CREP. In order to merge these two interests, local planners need to maintain communication with the Soil Conservation District and local land trusts so that interested landowners can take advantage of this additional funding source.

In some jurisdictions, county planners are looking for ways to spend fee-in-lieu and forest mitigation money. Local landowners may be interested in planting more acreage than is provided under CREP. In order to merge these two interests, local planners can be contacted to see whether there is any money available for interested landowners.

1. Landowner contacts local NRCS/SCD office or works with a local land trust regarding CREP contract and easement.

2. Landowners interested in obtaining this additional funding should contact their county Critical Area planner to find out if there are any funds available.

3. If money is available and the landowner decides to utilize Critical Area money for tree planting and an easement, then the landowner would go through the normal easement process (negotiate easement lines with DNR staff, submit easement applicant via local partner, receive bonus payment from the Board of Public Works in conjunction with a check from the local government for tree planting and easement, easement is executed and recorded).

4. Long-term monitoring and stewardship would be handled by DNR and a local partner (land trust, SCD).

Payments

For a county to combine FIDS mitigation with CREP, the fee-in-lieu amount charged to those property owners that cannot mitigate on-site would have to be comparable to the rates paid out by the CREP program. CREP pays up to 100% of the cost of tree buffers in addition to a bonus payment for every acre of trees restored and placed under a permanent easement. The bonus payment ranges, based on the county, from $693 to $2,716 per acre.

To learn more about the CREP program, landowners should contact their local NRCS office. To learn more about the easement, contact Jeff Horan, Deputy Director of Forest, Wildlife and Heritage at DNR.

State Highway Administration

A local government or a project applicant can contact the Maryland State Highway Administration (SHA) to see if they have information on sites within a particular watershed or county. They often will have property owner information for potential mitigation sites and knowledge on whether an owner is interested in selling or not. They will also sell any extra acreage from their own mitigation (usually wetland) sites, resulting from SHA project impacts. These sites will not always be forested, but in many cases they are.

Contact:
Todd Nichols
Phone: 410-545-8628
FAX: 410-209-5003
E-mail: tnichols@SHA.state.md.us

Maryland Land Trusts:

There are a number of active land trusts throughout the State of Maryland whose goals and objectives include permanent protection of natural resources areas through the use of land conservation tools such as conservation easements and land purchase. The following list of Maryland Local Land Trusts in the State is updated regularly by the Maryland Environmental Trust.

Contact:
Nick Williams
Maryland Environmental Trust
100 Community Place, First Floor
Crownsville, MD 20132
(410) 514-7907
FAX: (410) 514-7919

What is a land trust?

A land trust is nonprofit organization devoted to land preservation. It can be private, nonprofit or public, like MET. Nationwide, land trusts assist conservation-minded property owners to preserve natural areas, farms, forests and scenic openspace without giving up ownership. Property owners that work with land trusts to protect their land have made a voluntary decision to preserve the beauty of their land, forever.

Your Local Land Trusts

In 1988, the Maryland Environmental Trust (MET) developed the Local Land Trust Assistance Program to assist citizen groups in formation and operation of land trusts by offering training, technical assistance, administrative and project grants and membership in the Maryland Land Trust Alliance. Today, the program works with over 40 private nonprofit land trusts. These land trusts can hold conservation easements independently or jointly with MET (currently 40,000 acres are co-held between a local land trust and MET). In addition, some of these land trusts acquire and manage land.

Many people want to have their conservation easements co-held by a local land trust. See below for list. MET can advise you as to which organizations work in your area.

MARYLAND LOCAL LAND TRUSTS

Organization	Address	Daytime Phone
Accokeek Foundation	3400 Bryant Point Road Accokeek, MD 20627	(301) 283-2113
American Chestnut Land Trust	Box 204 Port Republic, MD 20676	(410) 586-1570
Annapolis Conservancy Board	160 Duke of Gloucester St. Annapolis, MD 21401 20627	(410) 263-7949
Bay Ridge Trust	9 Lawrence Avenue Annapolis, MD 21403	(410) 626-0342
Broad Creek Conservancy	1201 Swan Harbor Circle Broad Creek, MD 20744	(301) 292-6318
Calvert Farmland Trust	P.O. Box 3448 Prince Frederick, MD 20678	(410) 414-5070
Carroll County Land Trust	P.O. Box 2137 Westminster, MD 21157	(410) 848-9172
Caves Valley Land Trust	2522 Caves Road Owings Mills, MD 21117	(410) 244-7656

Cecil Land Trust	2522 135 East Main St. Elkton, MD 21921	(410) 392-9667
Central Maryland Heritage League	P.O. Box 721, Middletown, MD 21769	(301) 371-7090
Chesapeake Habitat Restoration Trust	13630 Georgia Avenue Silver Spring, MD 20906	(410) 991-7011
Conservancy for Charles County	1170 Overlook Accokeek, MD 20607	(301) 283-2410
Cove Point Natural Heritage Trust	18-T Ridge Road, Greenbelt, MD 20770	(301) 345-6390
Eastern Shore Land Conservancy	P.O. Box 169 Queenstown, MD 21658	(410) 827-9756
Franklintown Land Trust	5100 Maple Park Avenue Baltimore, MD 21207	(410) 448-0779
Greater Sandy Spring Green Space	20120 New Hampshire Ave Brinklow, MD 20862	(301) 774-6135
Gunpowder Valley Conservancy	16940 York Road, Suite 201, Monkton, MD 21111	(410) 329-8074
Harford Land Trust	P.O. Box 385 Churchville, MD 21028	(410) 836-2103
Harpers Ferry Conservancy	P.O. Box 1350 Harpers Ferry, WV 25425	(304) 535-9961
Howard County Conservancy	P.O. Box 175 Woodstock, MD 21163-0175	(410) 465-8877
Kensington Land Trust	P.O. Box 602 Kensington, MD 20895	(301) 933-8756
Land Preservation Trust	Exec. Plaza 1 11350 McCormick Rd Hunt Valley, MD 21031	(410) 771-9900x106
Long Green Valley Conservancy	12815 Kanes Road Glen Arm, MD 21057	(410) 592-2381
Lower Shore Land Trust	213 Downtown Plaza, City Center, Suite 305 Salisbury, MD 21801	(410) 341-6575

Magothy River Land Trust	P.O. Box 126 Severna Park, MD 21146	(410) 233-1660
Manor Conservancy	P.O. Box 448 Monkton, MD 21111	(410) 659-1315
Maryland Mountain Trust	P.O. Box 604 Grantsville, MD 21536	(301) 334-3963
Monocacy Watershed Conservancy	P.O. Box 4253 Frederick, MD 21705	(301) 663-9303
Mt. Washington Preservation Trust	1807 South Road Baltimore, MD 21209	(410) 466-4270
North County Land Trust	7605 Bay St. Pasadena, MD 21122	(202) 261-1614
Patuxent Watershed Land Trust	8508 Timber Pine Court Ellicott City, MD 21043	(410) 418-5222
Patuxent Tidewater Land Trust	P.O. Box 1955 Leonardtown, MD 20650	(301) 475-1795
Potomac Conservancy	1730 North Lynn St, Ste 403 Arlington, Virginia 22209	(703) 276-2777
Prettyboy Watershed Preservation Society	4318 Beckeysville Road Hampstead, MD 21074	(410) 239-3524
Rockburn Land Trust	6560 Belmont Woods Road Elkridge, MD 21227	(410) 467-7774
Save Historic Antietam Foundation	P.O. Box 550 Sharpsburg, MD 21782	(301) 790-2800x298
Severn River Land Trust	P.O. Box 2008 Annapolis, MD 21404	(410) 424-4000
South County Conservation Trust	P.O. Box 82 Churchton, MD 20733	(410) 867-1756
South Mountain Heritage Society	P.O. Box 509 Burkittsville, MD 21718	(301) 834-7851
Stronghold Corporation	Dickerson, MD 20842	(301) 874-2024

Tree-Land Foundation	P.O. Box 535 Myersville, MD 21773	(301) 663-1122
Western Shore Conservancy FPNA	2808 Church Road Bowie, MD 20721	(301) 390-0797
Wildlife Land Trust/CWS	17308 Queen Anne's Bridge Rd. Bowie, MD 20716	(301) 390-7010
Woodland Committee Land Trust	2403 W Rogers Avenue Baltimore, MD 21209	(410) 367-8855

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INFORMATION REQUIRED FOR MITIGATION SITE DEVELOPMENT PLAN

1. A brief description of mitigation requirements based on the associated development project and how the mitigation plan will meet these requirements.

2. A brief description of the FIDS habitat that is being impacted including acreage, amount of interior lost, dominant tree and shrub species and aquatic and/or other features that help define habitat characteristics.

3. Include a site location map depicting the geographic relationship between the impact site and proposed mitigation site and a vicinity map with enough detail to locate the site for monitoring purposes.

4. Describe the existing land use and ownership, adjacent land use and position in the landscape in relation to other forest tracts.

5. Describe the proposed plant communities that will be created/protected. If creating FIDS habitat, indicate if natural regeneration or plantings will be used.

6. If natural regeneration is proposed, describe the likely seed source, any site or soil preparation that will be undertaken, control measures for invasive species, measures to protect from wildlife grazers, etc.

7. If planting, provide a list of trees and shrubs to be planted, planting densities, control measures for invasive species, measures to protect from wildlife grazers and soil and/or site preparations, watering regime, etc.

8. Provide assurance of the legal right to use the proposed property for mitigation (e.g., letter of intent, option to purchase, etc.).

9. Indicate who will be responsible for monitoring and a description of information that will be provided in the monitoring reports.

Appendix

Critical Area u er Re ulations

itle 2 CRI ICA AREA C I I N R E C E APEA E AND A AN IC C A A A

ubtitle 01 CRI ERIA R CA CRI ICA AREA PR RA DE E P EN

Authorit Natural Resources Article 1 0 Annotated Code o ar land

1 u er

A. n this Appendi , the following terms have the meanings indicated.

B. Terms Defined.

( ) Accessory structure means a structure that is detached from the principal structure, located on the same lot and customarily incidental and subordinate to a principal structure.

(2) Addition means construction that increases the si e of a structure.

( ) Buffer Management Plan means a narrative, graphic description, or plan of the Buffer that is necessary when an applicant proposes a development activity that will affect a portion of the Buffer, affect Buffer vegetation, or require the establishment of a portion of the Buffer in vegetation. Buffer Management Plan includes a major Buffer Management Plan, a minor Buffer Management Plan, or a Simplified Buffer Management Plan.

( ) Caliper means the diameter of a tree measured at 2 inches above the root collar.

( ) Canopy tree means a tree that, when mature, reaches a height of at least feet.

( ) inancial assurance means a performance bond, letter of credit, cash deposit, insurance policy, or other instrument of security acceptable to a local jurisdiction.

( ) n-kind replacement means the removal of a structure and the construction of another structure that is smaller than or identical to the original structure in use, footprint area, width, and length.

( ) nvasive species means a type of plant that is non-native to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health.

( ) andward edge means the limit of a site feature that is farthest away from a tidal water, tidal wetland, or tributary stream.

(0) arge shrub means a shrub that, when mature, reaches a height of at least si feet.

( ) Major buffer management plan means a plan and supporting documentation required under Section . of this Appendi .

(2) Minor buffer management plan means a plan and supporting documentation required under Section . of this Appendi .

( ) Native plant means a species that is indigenous to the physiographic area in

Maryland where the planting is proposed.

( ) Natural regeneration means the natural establishment of trees and other vegetation with at least 00 free-to-grow seedlings per acre, which are capable of reaching a height of at least 20 feet at maturity.

( ) Simplified buffer management plan means a plan required for an application under Section .H of this Appendi .

( ) Structure means building or construction materials, or a combination of those materials, that are purposely assembled or joined together on or over land or water, including a temporary or permanent fi ed or floating pier, piling, deck, walkway, dwelling, building, boathouse, platform, ga ebo, and a shelter for the purpose of marine access, navigation, working, eating, sleeping, or recreating.

( ) Substantial alteration means any repair, reconstruction, replacement, or improvement of a principal structure, where the proposed total footprint is at least 0 percent greater than that of the e isting principal structure.

( ) nderstory tree means a tree that, when mature, reaches a height between 2 and feet.

( ) pland boundary means the landward edge of a tidal wetland or a nontidal wetland.

C. Policies. n developing their Critical Area programs, local jurisdictions shall use the following policies with regard to the buffer

( ) Provide for the removal or reduction of sediments, nutrients, and potentially harmful or to ic substances in runoff entering the Bay and its tributaries

(2) Minimi e the adverse effects of human activities on wetlands, shorelines, stream banks, tidal waters, and aquatic resources

( ) Maintain an area of transitional habitat between aquatic and upland communities

( ) Maintain the natural environment of streams and

( ) Protect riparian wildlife habitat.

D. Authority of Secretary Scope Alternative Procedures and Requirements.

( ) The provisions stated herein may not be construed to limit the authority of the Secretary of Agriculture under Agriculture Article, Title , Subtitle , Annotated Code of Maryland.

(2) The provisions of Sections 2- of this Appendi do not apply to an area of the buffer that is designated as a modified buffer area under Section of this Appendi .

( ) A local jurisdiction may adopt alternative procedures and requirements for the provisions stated herein, if

(a) The alternative procedures and requirements are at least as effective as the Critical Area program under Natural Resources Article, Title , Subtitle , Annotated Code of Maryland, regulations adopted under the authority of that subtitle, and any additional requirements of the local program and

(b) The Commission has approved those alternative procedures and requirements.

E. Buffer Standards.

( ) A local jurisdiction may authori e disturbance in the buffer for

(a) A new development activity or a redevelopment activity

(i) Associated with a water-dependent facility under C MAR 2 .0 .0

(ii) ocated in an approved modified buffer area under Section of this Appendi or

(iii) n accordance with E.( ) of this Section or

(b) n accordance with C MAR 2 .2 .02, a shore erosion control measure under C MAR 2 .0 .0 .

(2) E cept as authori ed under E.( ) of this Section, a local jurisdiction may not authori e disturbance in the buffer.

( ) E cept for the minimum buffer widths under E.( ) through ( ) of this Section, a local jurisdiction shall establish a buffer of at least 00 feet landward from

(a) The mean high water line of tidal waters

(b) The edge of each bank of a tributary stream and

(c) The upland boundary of a tidal wetland.

( ) or purposes related to the calculation of the minimum buffer widths under E.( ) through ( ) of this Section, a local jurisdiction shall measure landward from the points specified under E.( ) and ( ) of this Section.

( ) n accordance with E.( ) of this Section, e cept as provided under E.( ) of this Section, if a local jurisdiction grants final local approval for a subdivision or a site plan in the Resource Conservation Area on or after uly , 200 , the local jurisdiction shall establish

(a) An e panded buffer in accordance with E.( ) and ( ) of this Section and

(b) A buffer of at least 200 feet from tidal waters or a tidal wetland.

( ) The provisions of E.( )(b) of this Section do not apply if

(a) The application for subdivision or site plan approval was submitted before uly , 200 , and legally recorded by uly , 20 0

(b) The application involves the use of growth allocation or

(c) A local program procedure approved by the Commission provides for the reduction of the strict application of the minimum 200-foot buffer under E.( )(b) of this Section if that minimum would preclude a subdivision of the property at a density of one dwelling unit per 20 acres or an intra-family transfer authori ed under Natural Resources Article, - 0 .2, Annotated Code of Maryland.

( ) f a buffer is contiguous to a steep slope, a nontidal wetland, a nontidal wetland of special State concern under C MAR 2 .2 .0 .0 , a hydric soil, or a highly erodible soil, a local jurisdiction shall e pand the minimum buffer required under E.( ) or ( ) of this Section and shall calculate the e tent of that e pansion in accordance with the following requirements

(a) A steep slope at a rate of feet for every percent of slope or to the top of the slope, whichever is greater

(b) A nontidal wetland to the upland boundary of its -foot Buffer

(c) A nontidal wetland of special State concern to include the wetland and its regulated 00-foot buffer and

(d) Hydric soils or highly erodible soils to the lesser of

(i) The landward edge of the hydric or highly erodible soils or

(ii) 200 feet beyond the 00-foot Buffer, for a total of 00 feet.

( ) f a buffer is contiguous to a highly erodible soil on a slope less than or a hydric soil and is located on a lot or parcel that was created before anuary , 20 0, a local jurisdiction may authori e a development activity in the e panded buffer, if

(a) The location of the development activity is in the e panded portion of the buffer for a highly erodible soil on a slope less than percent or a hydric soil, but not the 00-foot buffer

(b) The buffer for a highly erodible soil on a slope less than percent or a hydric soil occupies at least percent of the lot or parcel and

(c) Mitigation occurs at a 2 ratio based on the lot coverage of the proposed development activity that is in the e panded buffer.

2 u er Establishment

A. Applicability.

( ) The requirements of this Section are applicable to

(a) A development or redevelopment activity that occurs on a lot or parcel that includes a buffer to tidal waters, a tidal wetland, or a tributary stream if that development or redevelopment activity is located outside the buffer or

(b) The approval of a new subdivision that includes a buffer to tidal waters, a tidal wetland, or a tributary stream.

(2) The requirements of this Section are not applicable to

(a) An in-kind replacement of a principal structure or

(b) and that remains in agricultural use after subdivision in accordance with a buffer management plan under Section of this Appendi .

B. A local jurisdiction shall require an applicant to establish the buffer in vegetation in accordance with C of this Section as well as the Standards set forth in the Mitigation and Planting Section. A buffer management plan shall also be provided as described in Section of this Appendi when an applicant applies for

( ) Approval of a new subdivision or a new lot

(2) Conversion from one land use to another land use on a lot or a parcel or

( ) Development on a lot or a parcel created before anuary , 20 0.

C. At the time of application, if the buffer is not fully forested or is not fully established in woody or wetland vegetation, an applicant shall establish the buffer to the e tent required in the following table

Development Category	ot Created Before ocal Program Adoption	ot Created After ocal Program Adoption
New development on a vacant lot	Establish the buffer based on total lot coverage	ully establish the buffer
New subdivision or new lot	ully establish the buffer	
New lot with an e isting dwelling unit	Establish the buffer based on total lot coverage	
Conversion of a land use on a parcel or lot to another land use	ully establish the buffer	
Addition or accessory structure	Establish the buffer based on net increase in lot coverage	
Substantial alteration	Establish the buffer based on total lot coverage	

D. Natural regeneration is not permitted as a means to establish the buffer, nor is it permitted as a means to mitigate for any disturbance to the buffer.

iti ation and Plantin tandards

A. Applicability. The requirements of this Section are applicable to a development or redevelopment activity that occurs on a lot or parcel that includes a buffer to tidal waters, a tidal wetland, or a tributary stream when that development or redevelopment activity is located inside the buffer.

B. As applicable to a site, a local jurisdiction shall require that a buffer management plan in accordance with Section of this Appendi to satisfy the planting and mitigation standards of this Section and satisfy the buffer establishment standards required under Section 2 of this Appendi so as to

( ) Prohibit the installation or cultivation of new lawn or turf on-site in the buffer

(2) Ensure the planting of native species in compliance with the amounts specified under C, , and H of this Section

( ) Ensure coverage of the buffer with mulch or ground cover or both until buffer plantings are established

( ) Ensure planting is evenly distributed throughout the entire buffer and

( ) Provide optimum habitat and water quality benefits.

C. As applicable to a site, a local jurisdiction shall calculate the cumulative amount of buffer mitigation required in accordance with the following standards

( ) or a development activity within the buffer, mitigation shall be based on the limits of disturbance and calculated in accordance with the ratios under of this Section

(2) The removal of a healthy tree having a caliper of at least inch as measured at . feet above the ground surface shall be replaced at a ratio of 00 square feet for every inch of caliper

( ) The removal of any shrub shall be replaced with a native shrub species purchased in a -gallon container or larger and

( ) The removal of a dead, diseased, or dying tree shall be replaced with a native tree species having a height of at least feet tall and a -inch caliper or greater.

D. Priority mitigation areas and offsets must be considered by the applicant prior to requesting fee-in-lieu. Prior to accepting fee-in-lieu, the Department of Planning and oning shall receive an e planation from the applicant demonstrating how the priority mitigation options, listed below, were considered for implementation, and why those options are not feasible. The following mitigation options are available for Buffer disturbance and are listed in order of priority

( ) n site - Plant the required amount of mitigation as native forest vegetation in the 00-foot Buffer

(2) ff site - Plant the required amount of mitigation at another Buffer site in the Critical Area, as approved by the Department or

( ) Applicants who cannot fully comply with the planting requirements in D.( ) and (2) above may use offsets to meet the mitigation requirement. ffsets include

(a) The removal of an equivalent area of e isting impervious surface in the Buffer

(b) etland creation or restoration

(c) Shoreline restoration or enhancement

(d) The installation of Best Management Practices for stormwater management or

(e) ther measures that improve the water quality or HPA habitat on site or elsewhere in the Critical Area or NRD, as approved by the Department.

. f it is not possible to comply with the above mitigation options within the Critical Area, plantings and or other habitat and water quality improvements should occur within the affected watershed, especially near streams, wetlands, forests, forest retention areas, and the NRD.

. n accordance with the applicable activity, a local jurisdiction shall require the following ratios of mitigation

Activity	Mitigation Ratio
Shore erosion control	
Riparian water access	2
Development or redevelopment of water-dependent facilities	2
ariance	
iolation	

H. A local jurisdiction may authori e the combination of the planting and mitigation standards found in and of this Section in accordance with the following table

Requirement	Amount	ptions
Establishment	ess than acre	andscaping stock according to of this Section for the entire area
	acre to acre	At least 0 percent of area in landscaping stock according to of this Section, the remainder according to of this Section
	acre to acres	At least 2 percent of area in landscaping stock according to of this Section, the remainder according to of this Section
	reater than acres	At least 0 percent of area in landscaping stock according to of this Section, the remainder according to of this Section
Mitigation	ess than acre	andscaping stock according to of this Section for the entire area
	acre or greater	At least 0 percent of area in landscaping stock according to of this Section, the remainder according to of this Section

. A local jurisdiction shall apply the following planting credits for the type and si e of the vegetation proposed

egetation Type	Minimum Si e Eligible for Credit	Ma imum Credit Allowed (Square eet)
Canopy tree	2-inch caliper and feet high	200
Canopy tree	-inch caliper and feet high	00
nderstory tree	-inch caliper and feet high	
arge shrub	gallon container	0
Herbaceous perennial	quart	2
Planting Cluster	canopy tree and large shrubs	00
Planting Cluster 2	2 understory trees and large shrubs	0

These options are only available for buffer establishment and buffer mitigation of less than acre.

. All landscaping stock planted in accordance with shall be 00 percent guaranteed for at least 2 years after planting is completed.

. A local jurisdiction may use the following table to allow fle ible stocking si e when authori ed under H of this Section

Stock Si e of Trees nly	Required Number of Stems Per Acre	Survivability Requirement	Minimum inancial Assurance Period After Planting
Bare-root seedling or whip	00	0 percent	years
2-inch to -inch container grown trees	0	percent	2 years
More than -inch container grown trees	0	0 percent	2 years

. A local jurisdiction may not

( ) Authori e a variance to the planting and mitigation standards under this Section or

(2) ssue a final use and occupancy permit for an application under Section 2.B.(2) of this Appendi unless the applicant

(a) Completes the planting required under an approved buffer management plan or

(b) Pending completion of the planting required under an approved buffer management plan during the ne t planting season, provides financial assurance to cover the costs for

(i) Materials and installation and

(ii) n the case of a mitigation or establishment requirement that is at least ,000 square feet, long-term survivability in accordance with the requirements of Section . .(2)(d) of this Appendi .

M. Before recordation of a final subdivision, an applicant shall

( ) Post permanent signs delineating the upland boundary of the buffer at a ratio of at least one sign per lot or per 200 linear feet of shoreline, whichever is applicable and

(2) Design each sign required under M.( ) of this Section so that it

(a) s at least inches in width and inches in height

(b) s placed at a height of . feet, but not attached to a tree and

(c) Clearly states Critical Area Buffer No clearing or disturbance permitted .

N. Concurrent with the recordation of a final plat, an applicant shall record a protective measure in a buffer management plan in accordance with Section of this Appendi .

. A local jurisdiction may not approve a final subdivision application until the jurisdiction has reviewed and approved the buffer management plan.

u er ana ement Plans

A. The provisions of this Section do not apply to maintenance of an e isting grass lawn in the buffer.

B. A local jurisdiction shall require an applicant proposing a development activity to submit a buffer management plan if

( ) The establishment of the buffer is required in accordance with Section 2 of this Appendi or

(2) Disturbance to the buffer will result from the issuance of a

(a) ariance

(b) Subdivision approval

(c) Site plan approval

(d) Shore erosion control permit as required under C MAR 2 .2 .02

(e) Building permit or oning certificate

(f) rading permit or

(g) Special e ception.

C. n accordance with the requirements under Sections 2 and of this Appendi , a local jurisdiction shall require an applicant to submit a

( ) Simplified buffer management plan

(2) Minor buffer management plan or

( ) Major buffer management plan.

D. A local jurisdiction may not approve a buffer management plan unless

( ) The plan clearly indicates that all planting standards under Section of this Appendi will be met and

(2) Appropriate measures are in place for the long-term protection and maintenance of all buffer areas established under this Section.

E. A local jurisdiction may not issue a permit for a development activity under Section 2 or of this Appendi unless the local jurisdiction has approved the buffer management plan submitted under C of this Section.

. f an applicant fails to implement a buffer management plan, that failure shall constitute a violation of the local Critical Area program.

. A local jurisdiction may not issue a permit on a property that is the subject of a violation under of this Section.

H. Simplified Buffer Management Plan.

( ) Before the performance of an activity in the buffer, a local jurisdiction shall require the applicant to submit a simplified buffer management plan (blank form supplied at the end of this Appendi) as part of the application associated with any of the following activities

(a) Providing access to a private pier or shoreline that is up to feet wide

(b) Manually removing invasive or no ious vegetation

(c) illing to maintain an e isting grass lawn or

(d) Cutting a tree that is in danger of falling and causing damage to a dwelling or other structure, causing blockage to a stream, or accelerating shore erosion.

(2) A simplified buffer management plan shall include the following information

(a) A brief narrative describing the proposed activity, including the anticipated start date and method to be used

(b) The proposed mitigation

(c) n the case of the removal of invasive or no ious species, the revegetation of the area in accordance with Section .B.( ) and ( ) of this Appendi

(d) The proposed planting date and

(e) The signature of the party responsible for the proposed activity and for ensuring the survival of the planting.

. Minor Buffer Management Plan.

( ) A local jurisdiction shall require an applicant to submit a minor buffer management plan for

(a) Establishment of less than ,000 square feet of the buffer for an application listed under Section 2 of this Appendi or

(b) A requested disturbance that requires less than ,000 square feet of mitigation for an application listed under Section of this Appendi .

(2) A minor buffer management plan shall include

(a) A plan that shows the proposed limit of disturbance, the total number and si e of trees to be removed, if applicable, and the arrangement of the planting to be done

(b) A landscape schedule that shows the proposed species type, the quantity of plants, the si e of plants to be installed, and the planting date

(c) A maintenance plan for the control of invasive species, pests, and predation that shows invasive species and pest control practices, the provision of at least 2 years of monitoring, and a reinforcement planting provision if survival rates fall below the standards described in Section . and of this Appendi

(d) An inspection agreement that grants permission to the local jurisdiction to inspect the plantings at appropriate times

(e) f buffer establishment is required under Section 2 of this Appendi , the information on which calculation of the amount of buffer to be planted was based

(f) f buffer mitigation is required under Section of this Appendi , the information on which calculation of the amount of the buffer to be planted was based and

(g) The signature of the party responsible for the proposed activity and for ensuring the survival of the planting.

. Major Buffer Management Plan.

( ) A local jurisdiction shall require an applicant to submit a major buffer management plan for

(a) Establishment of at least ,000 square feet of the buffer for an application listed under Section 2 of this Appendi or

(b) A requested disturbance that requires at least ,000 square feet of mitigation for an application listed under Section of this Appendi .

(2) A major buffer management plan shall include

(a) A plan that shows the proposed limit of disturbance, the total number and si e of trees to be removed, if applicable, and the arrangement of the planting to be done

(b) A landscape schedule that shows the proposed species type, the quantity of plants, the si e of plants to be installed, and the planting date

(c) A maintenance plan for the control of invasive species, pests, and predation that shows invasive species and pest control practices, the provisions of at least 2 years of monitoring, and a reinforcement planting provision if survival rates fall below the standards in Section . and of this Appendi

(d) A long-term protection plan that includes evidence of financial assurance that adequately covers the planting and survivability requirement, a provision for at least 2 years of monitoring as required in Section . and of this Appendi , and if planting, an anticipated planting date before construction or the sale of the lot

(e) An inspection agreement that grants permission to the local jurisdiction to inspect the plantings at appropriate times

(f) f buffer establishment is required under Section 2 of this Appendi , the information on which calculation of the amount of buffer to be planted was based

(g) f buffer mitigation is required under Section of this Appendi , the information on which calculation of the amount of the buffer to be planted was based and

(h) The signature of the party responsible for the proposed activity and for the survival of the planting.

( ) or a major buffer management plan

(a) A single species may not e ceed 20 percent of the total planting requirement and

(b) Shrubs may not e ceed 0 percent of the total planting requirement.

ee In ieu o u er iti ation

A. f an applicant can demonstrate to the Director of Planning and oning that the priority mitigation options as listed in Section D of the Mitigation and Planting Standards are not

feasible, a payment of .00 per square foot of mitigation will be accepted in lieu of the plantings to be replaced. ee-in-lieu shall otherwise not be accepted by the County.

B. A local jurisdiction shall

( ) Calculate the square footage of mitigation due in accordance with Section of this Appendi

(2) Establish a special fund, which may not revert to the jurisdiction s general fund, for the collection of the fee in lieu of buffer mitigation and

( ) se the funds in the following ways, as listed by order of priority

(a) n the CBCA by means of

(i) Planting in the Buffer to fully establish native habitat along waterbodies

(ii) Creating or enhancing native habitat including forest, meadow, or wetland, giving preference to sensitive environmental areas where R T E species are known or suspected and to the County s mapped reen nfrastructure Network

(iii) Removing e isting lot coverage or

(iv) nstalling Best Management Practices for stormwater management.

(b) ther measures that improve water quality or habitat in the Critical Area or

(c) f the previous options listed in (a) and (b) are not feasible to implement within the CBCA, then those same options in the same order of priority may be implemented outside of the CBCA within the same watershed.

C. A local jurisdiction may utili e a lesser fee in lieu of buffer mitigation that is based on an alternative to the amount required under B of this Section if

( ) The jurisdiction demonstrates that its proposed alternative will ensure the receipt of funds sufficient to administer a financially sound fee in lieu of buffer mitigation program, based on the following costs in that jurisdiction

(a) Planting materials

(b) abor

(c) and acquisition, either by fee simple or by easement

(d) Planting maintenance and

(e) Monitoring and administration of the special account and

(2) The Commission approves the lesser alternative proposed.

D. Each year, the local jurisdiction shall report to the Commission regarding their implementation of the fee-in-lieu program over the course of the previous calendar year

A ricultural Activities

A. The buffer is not required for agricultural drainage ditches if the adjacent agricultural land has in place best management practices as required in C MAR 2 .0 .0 .

B. Agricultural activities are permitted in the buffer, if, as a minimum best management practice, a 2 -foot vegetated filter strip measured landward from the mean high water line of tidal waters or tributary streams (e cluding drainage ditches), or from the edge of tidal wetlands, whichever is further inland, is established, and further provided that

( ) The filter strip shall be composed of either trees with a dense ground cover, or a thick sod of grass, and shall be so managed as to provide water quality benefits and habitat protection consistent with the policies stated in Section of this Appendi no ious weeds, including ohnson grass, Canada thistle, and multiflora rose, which occur in the filter strip, may be controlled by authori ed means

(2) The filter strip shall be e panded by a distance of feet for every percent of slope, for slopes greater than percent

( ) The 2 -foot vegetated filter strip shall be maintained until such time as the landowner is implementing, under an approved soil conservation and water quality plan, a program of best management practices for the specific purposes of improving water quality and protecting plant and wildlife habitat and provided that the portion of the soil conservation and water quality plan being implemented achieves the water quality and habitat protection objectives of the 2 -foot vegetated filter strip

( ) The best management practices shall include a requirement for the implementation of a grassland and manure management program, where appropriate, and that the feeding or watering of livestock may not be permitted within 0 feet of the mean high water line of tidal water and tributary streams, or from the edge of tidal wetlands, whichever is further inland

( ) Clearing of e isting natural vegetation in the buffer is not allowed and

( ) arming activities, including the gra ing of livestock, do not disturb stream banks, tidal shorelines, or other habitat protection areas as described in this Appendi .

ree Clearin and imber arvestin

Cutting shall not occur in the Buffer or other habitat protection areas described in C MAR 2 .0 .0 .02, .0 , .0 , and .0 .

odi ied u er Areas

Some sections of the Critical Area Buffer have been mapped e empt from certain buffer requirements where it was demonstrated by the local jurisdiction that the e isting pattern of residential, industrial, commercial, or recreational development in the Critical Area prevented the buffer from fulfilling the functions stated in Section of this Appendi . The regulations for these sections of Buffer have been modified to achieve water quality and habitat protection objectives, as outlined in the Harford County oning Code.

Note The mitigation options listed in this Appendi may also be referenced as priority mitigation options when mitigation is required for disturbance outside of the Buffer, but within the CBCA. n such a case, planting installation on or off site should be prioriti ed in the Buffer or in other sensitive environmental areas, but may also be installed elsewhere on site within the CBCA as described in this Appendi .

CRI ICA AREA U ER ANA E EN P AN

The following form should be completed by the property owner, or responsible party, for any disturbance of natural vegetation or construction within the Critical Area Buffer. nce completed, and approved, this form will constitute your Buffer Management Plan and will provide our office with an official record of your proposed Buffer impacts and the way in which you plan to meet any required offsets (mitigation). This Buffer Management Plan will be subject to annual renewal, and is considered e pired after one year from the date signed on this form.

Propert ac round In ormation

Property wner (or Contact) _____

Property wner s Address _____

Property wner s (or Contact s Phone) _____

Project Address (if different) _____

Ta Map Block Parcel Section ot

Proposed u er Disturbance

New development redevelopment (ie new building, home addition, replacement structures)

Shore erosion control

Shore access

Dead or dying tree removal

ther (please e plain)

s the property in a designated Modified Buffer Area (MBA) es No

Are there any special plat notes or restrictions concerning your Buffer (wetlands, habitat protection areas, conservation easements) es No

f yes, please e plain

_____

_____

Please provide a brief e planation of your proposed project in the space below. nclude area and or number of trees cleared as well as the type of equipment that will be used.
hree examples ollow

) 00 square feet partially cleared for shore access with hand tools canopy will be maintained, disturbance will be limited to three saplings and several shrubs and path will consist of wood chips

2) Removal of poison ivy from 2,000 sq. feet area along shore access path method of removal includes hand pulling and chemical spraying of individual plants with an approved herbicide any resulting bare areas will be mulched to prevent soil erosion and to prevent reestablishment of invasives. There will be no removal of trees or shrubs.

) A variance was granted to build a new house on a grandfathered lot in the Buffer. The area permanently impacted in the Buffer will be 000 square feet, including the area of the house and a fifteen-foot clearing around the house. The lot is entirely forested. A bulldo er will be used for site preparation.

Proposed Project _____

_____

_____

ustification _____

_____

_____

ong-term management plans for this area _____

_____

_____

Calculation o iti ation

The following three-step process is used to compute the amount of mitigation needed for impacts to the Buffer. or the purposes of this Buffer Management Plan, mitigation is defined as planting or similar offsets which will help to negate the effect of the Buffer disturbance. To determine the amount of mitigation for your Buffer disturbance you need to determine the following

. Amount of buffer disturbed for clearing, grading, and placement of new structures, etc.
2. Mitigation ratio for the type of Buffer impact
. Mitigation amount calculated by multiplying the area disturbed by the mitigation ratio.

Step - Amount of buffer disturbance

Buffer disturbance is based on either the area disturbed or the number of individual trees that will be cut. t is recommended that when an area to be disturbed more closely resembles a natural forest (i.e. canopy cover with multi-layer understory) or when structures or other impervious surfaces are placed within the Buffer of a MBA, even if no trees are cleared, you should quantify

the disturbance amount in *area cleared*. n the other hand, if your site more closely resembles a park setting (i.e., scattered trees with little or no understory), it is recommended that you count the number of trees removed.

AREA B ER C EARED R D ST RBED S ARE EET
R
N MBER TREES C EARED TREES

Step 2 - Mitigation Ratios

Different types of Buffer management activities require different mitigation ratios. Higher ratios are used for activities that have a greater impact upon the buffer. The purpose of the mitigation is to improve the Buffer functions where possible. The table below provides the mitigation ration for different types of Buffer management activities.

pe o u er Disturbance	iti ation Ratio
New development redevelopment (non-MBA)	
New development redevelopment (MBA)	2
Shore erosion control	
Shore access	2
ther	

Please consult with your local government Critical Area Planner if the purpose of your Buffer disturbance is in the *Other* Category.

iti ation Ratio rom the above table

Step - Mitigation Amount

iti ation Amount (sq. ft. or of trees) (mitigation ratio) s t or trees

u er Plantin Plan

This section is to help you provide more specific details on your mitigation location and plantings.

Plantin ocation

All mitigation should be located within the Critical Area in the following order of preference

. n-site within the Buffer
2. n-site adjacent to e isting Buffer
. n-site within the Critical Area

. ff-site (follow order of preference - above)
. ee-in-lieu payment

Plant pacin s and iti ation Credits or arious i e rees and hrubs o Native e etation

Credit uare eet	Plant i e	Plant pacin
00 sq. ft.	canopy tree (inch diameter . foot height)	0 foot on center
0 sq. ft.	large shrub (- gallon container)	foot on center
00 sq. ft.	Cluster together canopy tree (inch diameter . foot height) and large shrubs (- gallon containers)	Tree 0 foot on center Shrub foot on center

chematic Drawin

Please attach a schematic drawing to scale identifying areas of impact to the Buffer, indicate on plan e isting trees and shrubs if possible, and the proposed location for replanting within the Buffer. Show the location of the Critical Area buffer. ndicate on the drawing the specific types of vegetation which will be removed and the specific types and amount of vegetation which will be used for mitigation.

I certify these statements to be true and accurate and that any trees to be removed are on my property. I hereby grant County/Local Jurisdiction officials permission to enter my property for inspections of this Buffer Management Plan.

Applicant Signature Date

Approval information R CE SE N

This Buffer Management Plan is approved as of by