Our Islands Our Future

GUIDE TO GREEN BUILDING in the USVI

DESIGNERS
Field Guide

February 2013

Funded by NOAA's Coral Reef Conservation Program through NOAA Fisheries Caribbean Field Office

Developed by The FHWGroup. Content guided by a steering committee of federal and VI agencies and NGOs

INTRODUCTION

This guide is meant to serve as a practice manual demonstrating the concepts detailed in the accompanying classroom module for designers. The guide follows the layout of the classroom module, moving through green design, selecting best management practices (BMPs), and green landscaping, as well as operation and maintenance of site BMPs.

The guide, along with the classroom module, is meant to be a training tool for practicing the concepts of green design in the field or in a classroom setting to familiarize you with how to incorporate these concepts in the design of your projects.

The guide is divided into three sections – [1] designing with nature, [2] selecting appropriate BMPs, and [3] green landscaping and project operation and maintenance. You can review each of the sections in any order based on your interest.

NOAA CORAL REEF CONSERVATION PROGRAM

Green Design

Design With Nature

Core Green Design Elements

When creating plans for your site, be sure to include the following elements i) natural resource protection; ii) water management; and iii) energy optimization.

Note: *The structural integrity of the building is a very important element of the design. The content included in this field guide does not focus on structural integrity. As part of project design, conduct the relevant reviews to ensure site plans are appropriate based on soil compaction information and that the soils are suitable for proposed project.*

Natural Resource Protection

Photo Credit: Gary Ray

Unstabilized road cut on a steep slope in St. John; will lead to muddy runoff when it rains if exposed soils are not stabilized

Water Management

Photo Credit: Hosana Solomon

Cisterns (one shown above) serve a dual purpose in the VI – they serve as the main potable water source for many and also increase on-site infiltration, reducing stormwater runoff. Appropriate stormwater management measures are also needed to ensure runoff stays on-site.

Energy Optimization

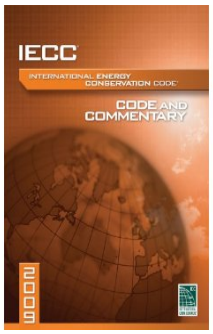


Photo Credit www.energycodes.gov

Ensure basic compliance with the International Energy Conservation Code (IECC)

GREEN DESIGN CHECKLIST

(see also IGBA Green Certification Checklist at **http://igba-stjohn.org/**)

General			Notes
The home is large enough to meet the occupants' requirements, but not so big that it increases energy use for cooling and cleaning.	☐ YES	☐ NO	
Site design minimizes construction and clearing footprints and protects native vegetation.	☐ YES	☐ NO	

Green Strategies – Part I			Notes
Design integrates hurricane protection	☐ YES	☐ NO	
Structures are well-integrated in natural landscape to minimize excavation and hillside cuts and preserve views	☐ YES	☐ NO	
Native/natural vegetation greenbelt considered	☐ YES	☐ NO	
Site design preserves visual privacy	☐ YES	☐ NO	
Native and protected plants and animals are identified and a plan for their protection is implemented as part of site design	☐ YES	☐ NO	
Grading and phasing of construction are linked to erosion and sediment control and stormwater management to protect the environment	☐ YES	☐ NO	
Small equipment used to excavate site for project to protect the environment	☐ YES	☐ NO	
Erosion control, sediment control, and stormwater management integrated over project lifetime -from design and construction to operation and maintenance	☐ YES	☐ NO	
Stormwater drainage and erosion control designed and implemented based on site characteristics	☐ YES	☐ NO	

Green Strategies – Part II			Notes
Driveway and parking area designed to minimize erosion from stormwater runoff	☐ YES	☐ NO	

Materials Use			Notes
Recycled materials or materials with recycled content have been included	☐ YES	☐ NO	
Local materials and suppliers have been included	☐ YES	☐ NO	
Building materials and appliances are durable and low maintenance	☐ YES	☐ NO	
Sustainable lumber has been used	☐ YES	☐ NO	
Materials have been included that moderate indoor temperatures(thermal mass) and improve indoor air quality	☐ YES	☐ NO	
Light and dark colored materials have been included to reflect and absorb heat as appropriate	☐ YES	☐ NO	
Demolition materials from existing structures have been designed for re-use, recycling, or disposing of appropriately	☐ YES	☐ NO	

Passive Design			Notes
Windows are located and sized appropriately to provide natural daylight, reducing the amount of electricity required for lighting the home	☐ YES	☐ NO	
Eaves or other light blocking devices have been incorporated to provide shading, to keep the home cool	☐ YES	☐ NO	
Windows and doors are located to get good natural cross ventilation and to ventilate bathrooms and any other areas that may tend to be damp	☐ YES	☐ NO	
Appropriately designed thermal mass moderates indoor air temperatures	☐ YES	☐ NO	
Ceilings are high enough to accommodate ceiling fans	☐ YES	☐ NO	

Design for Life			Notes
The home is adaptable for future changes in occupant lifestyles and accessible for all	☐ YES	☐ NO	
Indoor air quality has been addressed with the choice of non-toxic materials and finishes	☐ YES	☐ NO	

Energy Use			Notes
Artificial lighting has been minimized and is energy efficient	☐ YES	☐ NO	
Appliances (Refrigerators, TVs, DVDs, computers, etc.) are energy efficient	☐ YES	☐ NO	
A solar water heater is included	☐ YES	☐ NO	
Renewable energy (such as PV solar panels) have been included	☐ YES	☐ NO	

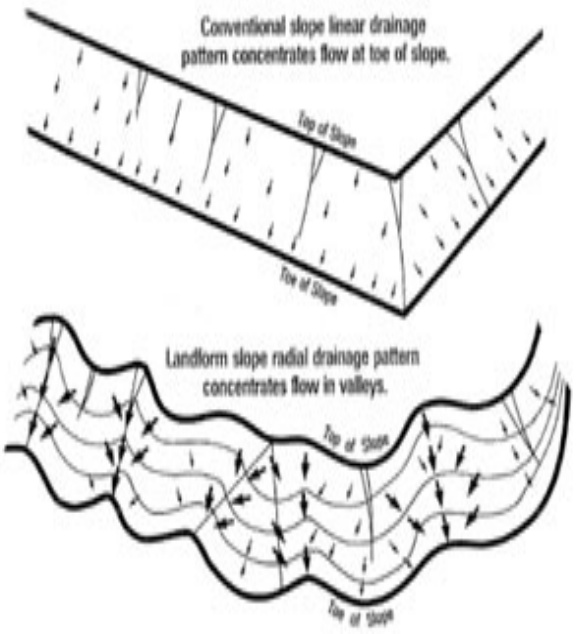
Water Use			Notes
Rain water storage tanks (cisterns) have been included	☐ YES	☐ NO	
Outdoor surfaces and vegetation to retain water have been included	☐ YES	☐ NO	
Low water use toilets have been used	☐ YES	☐ NO	
Grey water recycling systems have been used, including for irrigation, and maintenance schedules for these have been developed	☐ YES	☐ NO	

Incorporate Design Elements in Harmony with Physical Characteristics

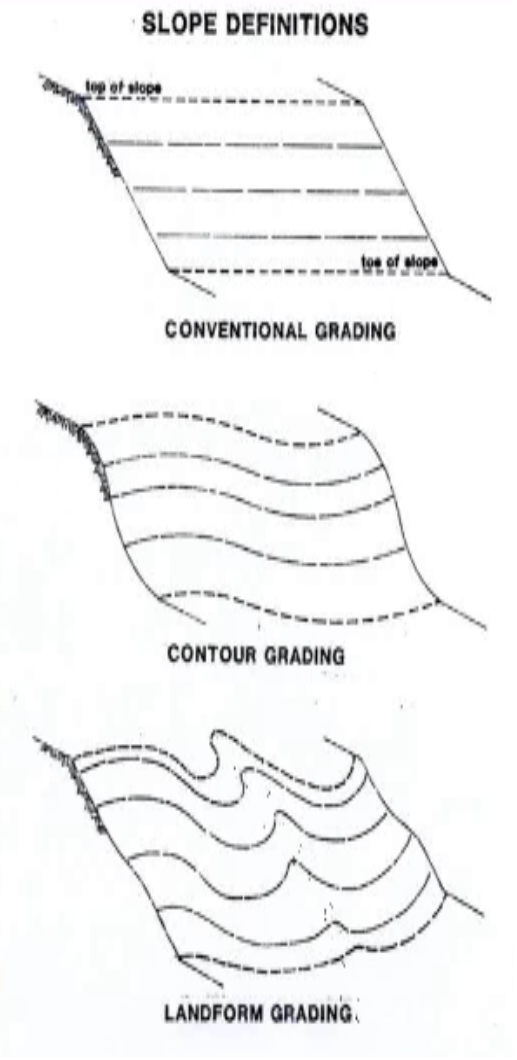
Most natural slopes and land forms have curvilinear shapes, and concave elements are dominant. Design with the slopes on-site and mimic natural slopes in your design when grading is necessary.

Photo Credit (all): www.dot.ca.gov/hq/LandArch/webinars/wmf/LandformGrading.wmv

Landform Grading - Erosion Control from the Beginning



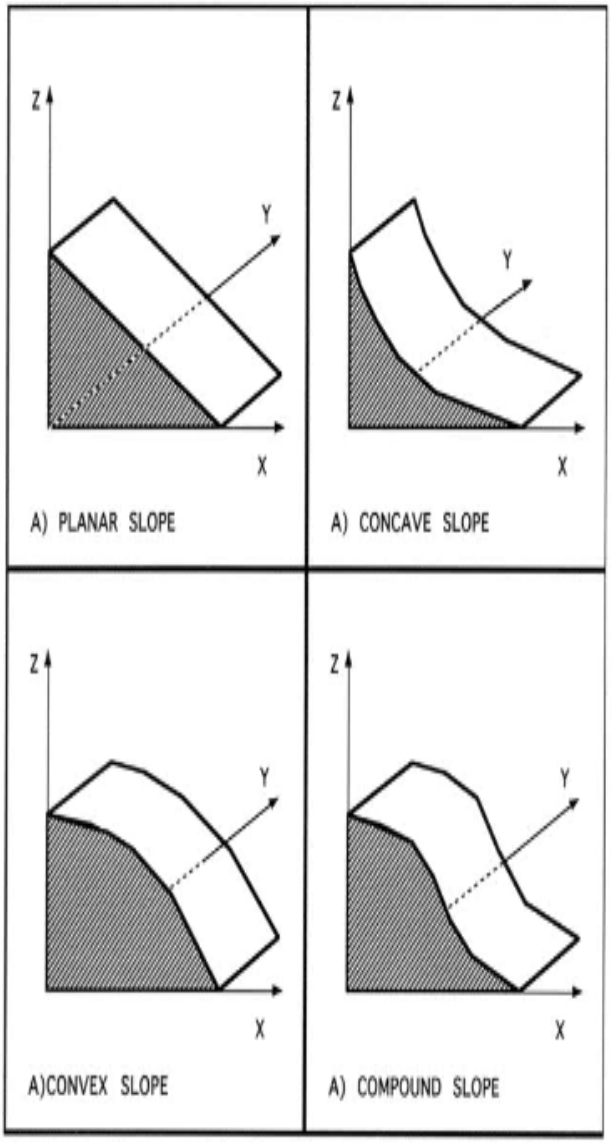
http://www.waterboards.ca.gov/water_issues/programs/nps/encyclopedia/3_2d_const_gradexcv.shtml



Traditional grading alters the pre-existing hydrograph and impedes soil infiltration and soil moisture thus limiting soil biota. Landform grading techniques create radial drainage patterns and concentrate flows in valleys, creating microclimates for the establishment of vegetation, often without the need for constant irrigation (as is the case for vegetated areas on 2:1 slopes).

Landform Grading - Erosion Control from the Beginning

Concave slopes greatly reduce sediment loss.



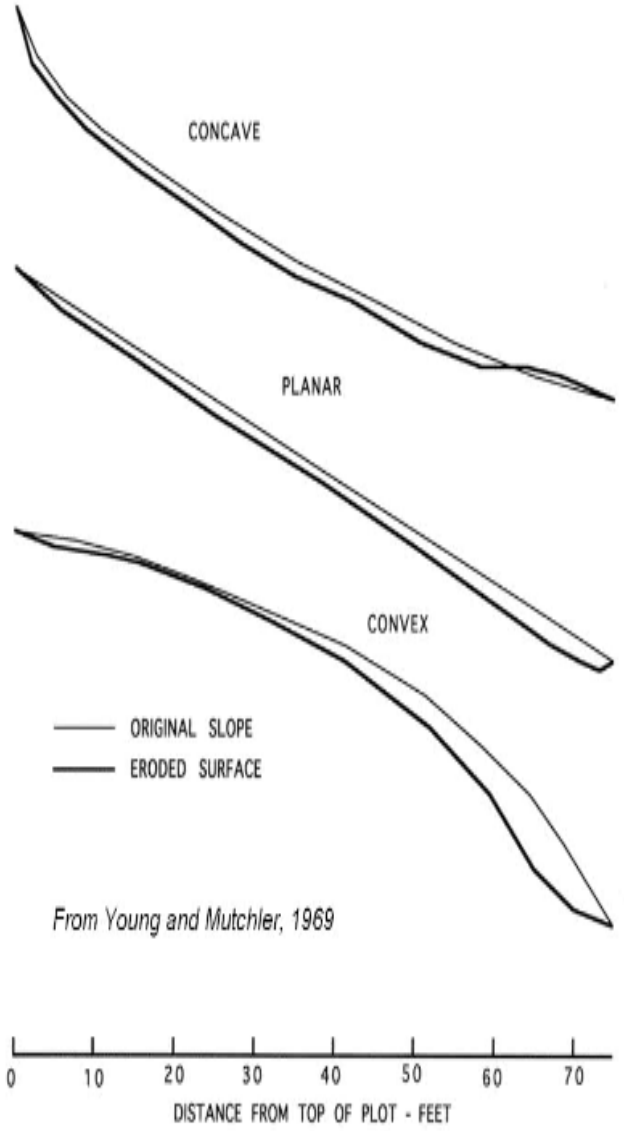


Image Credit – Landforming: An Environmental Approach to Hillside Development, Mine Reclamation and Watershed Restoration(2010)

Landform Grading - Erosion Control from the Beginning

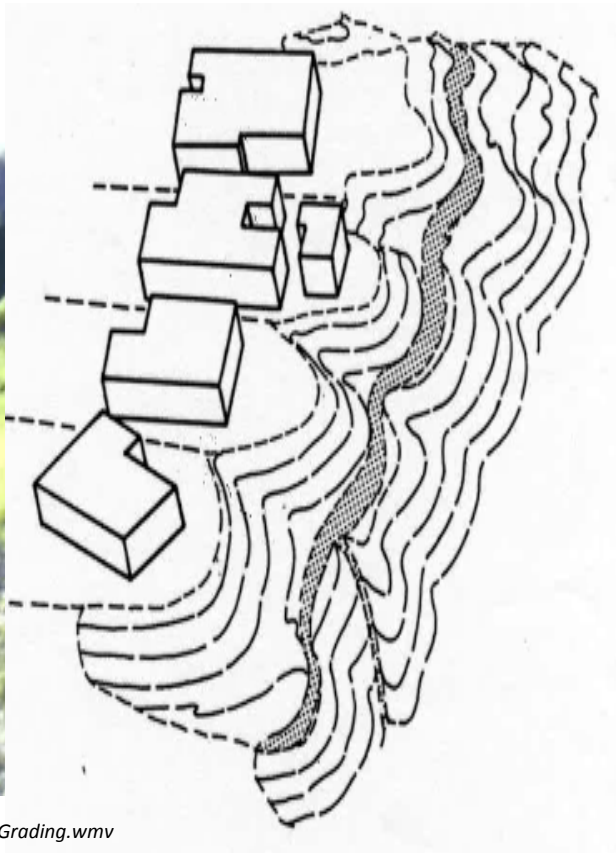


Photo Credit (all): www.dot.ca.gov/hq/LandArch/webinars/wmf/LandformGrading.wmv

The traditional cut-and fill grading approach used throughout the VI produces sharp angles in the landscape which encourage erosion and increase the need to stabilize the site with BMPs after grading is complete. Landform grading reduces the sharp angles specified in the grading plan, and reduces the potential for erosion and loss of valuable topsoil. Landform grading also preserves and/or restores natural drainage features.

Practical Exercise

- Review site assessment information, including soils, slopes, existing waterways, existing vegetation, and any information regarding presence of protected plants or animals

- List ways these resources can be protected in project design

- Compare this information to project plan to determine whether site disturbance has been minimized and resources such as waterways, native vegetation, and protected species have been preserved and incorporated in project design

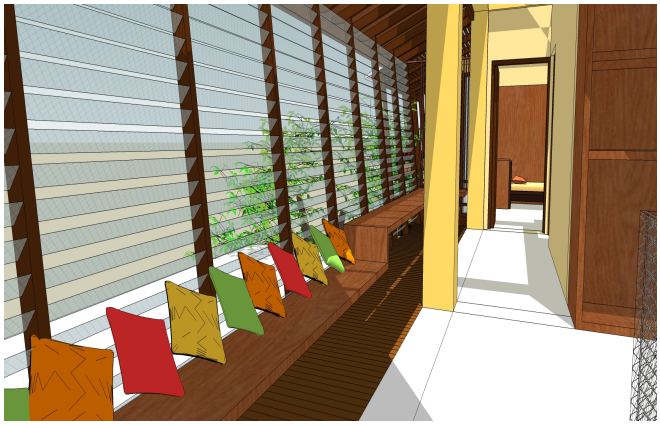
- Review site plans to determine points where, based on cut and fill plans and existing and proposed drainage patterns, transport of runoff and sediment off-site could occur

- List ways this transport can be avoided to keep runoff and contaminants on-site

Energy Efficiency/Optimization

The following items should be considered in your design to ensure the energy efficiency of new residential construction has been optimized : [1] the building envelope, [2] domestic hot water systems, and [3] lighting

1. Tropical Building Envelope



http://tancheesing.files.wordpress.com/2012/09/tropical-space-vs-manicured-space.jpg

http://puebloverde.org/building-in-pueblo-verde

Residential buildings are usually skin-dominated, having smaller internal heat generation as compared to the heat gain/loss through the envelope. The building envelope can contribute up to 73% of the total heat gain/loss in a residence. Building envelope characteristics such as building geometry and orientation, properties of materials, type and quality of construction, and interaction with outdoor conditions impact the heat gain and loss through the envelope.

In the tropics, the building envelope behaves more like a climatic filter rather than a climatic shelter. If the building envelope is designed to be responsive to the climatic conditions, the interior space will then be habitable and comfortable to the inhabitants.

The provision of generous overhang, semi-outdoor spaces, ample shade trees and landscaping, are useful strategies in layering climatic filters and creating pockets of spaces to soften the edge of buildings and soften the impact of tropical weathering.

The choice of materials is critical in determining the thermal performance of buildings. Thermal properties of building materials need to be understood. For example, while the extensive use of glass may allow ample daylight and views, it can also let in excessive heat. The use of a thermal mass wall to absorb excess heat to keep the building cool and the use of reflective roofing materials to reflect sunlight are examples of strategies to climate-proof the building.

Energy Efficiency/Optimization

2. Domestic Hot Water Systems

www.solargreen.net.au

Ensure energy efficient solar water heaters are included and provide at least 70% of the building's water heating needs as required by the 2009 Renewable Energy Act.

3. Lighting

architecturalhousemodels.com

In designs, ensure 50% of lamps in permanent fixtures are high efficacy as required by the 2009 IECC. (Note: It is also important, when projects are located in coastal areas or can be seen from nearshore waters, that lighting is sea turtle friendly to minimize disorientation of these animals in nearshore waters and on nesting beaches.)

Practical Exercise

- Do energy cost calculations for building using electric power grid fed air conditioning versus incorporating green building concepts and using passive cooling and/or solar energy

- Review project plans and site characteristics to assess whether design has taken advantage of:
    - Native vegetation for shading and erosion control
    - Angle of sunlight to minimize need for air conditioning and take advantage of solar energy
    - Dominant wind direction in area to allow for passive cooling through natural ventilation

BMP Selection

Including Appropriate BMPs in Design

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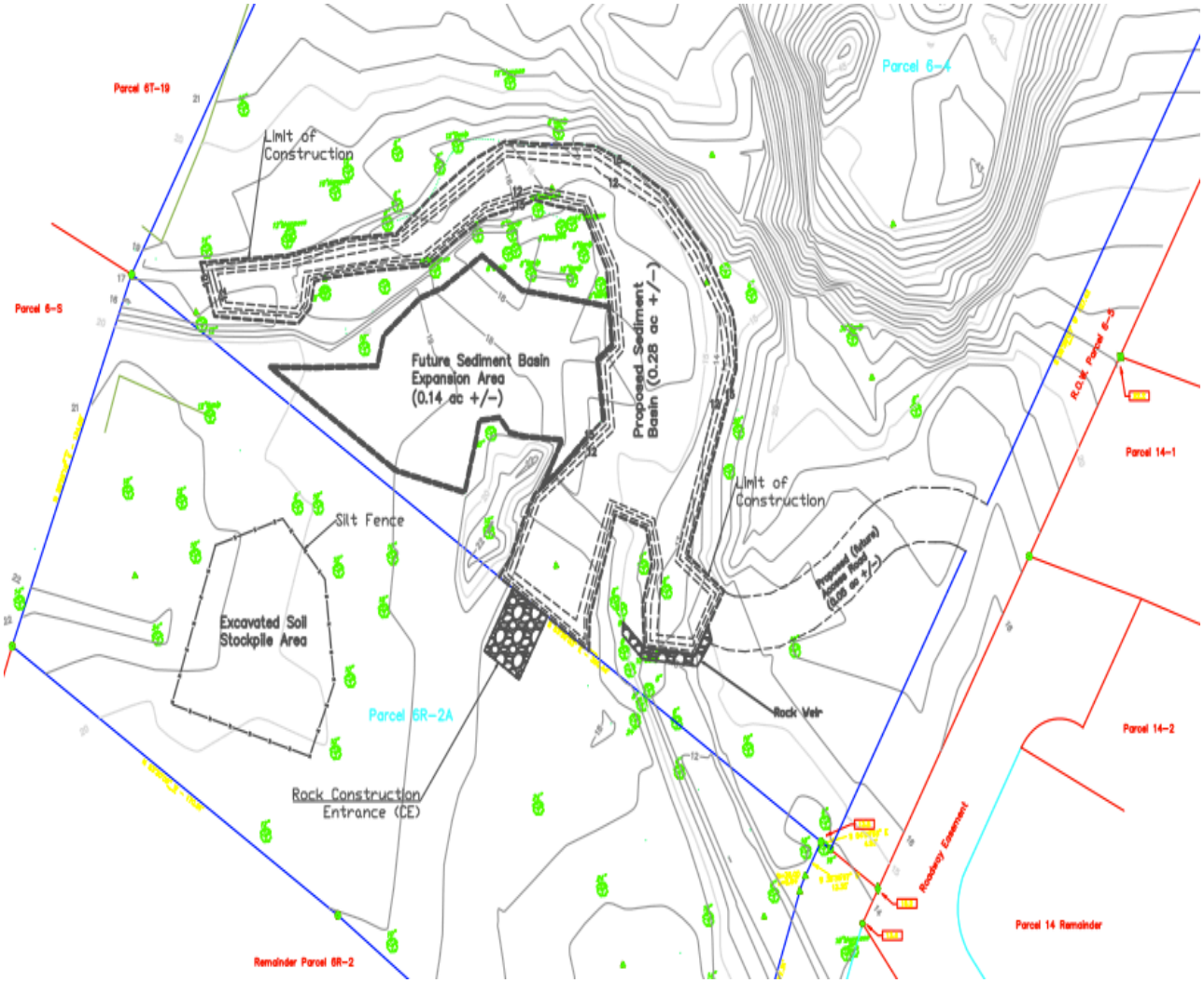
Design erosion and sediment control structures and stormwater controls to mitigate common site hazards such as low vegetative cover, high soil erodibility, intense precipitation, and steep terrain.

TIP #1

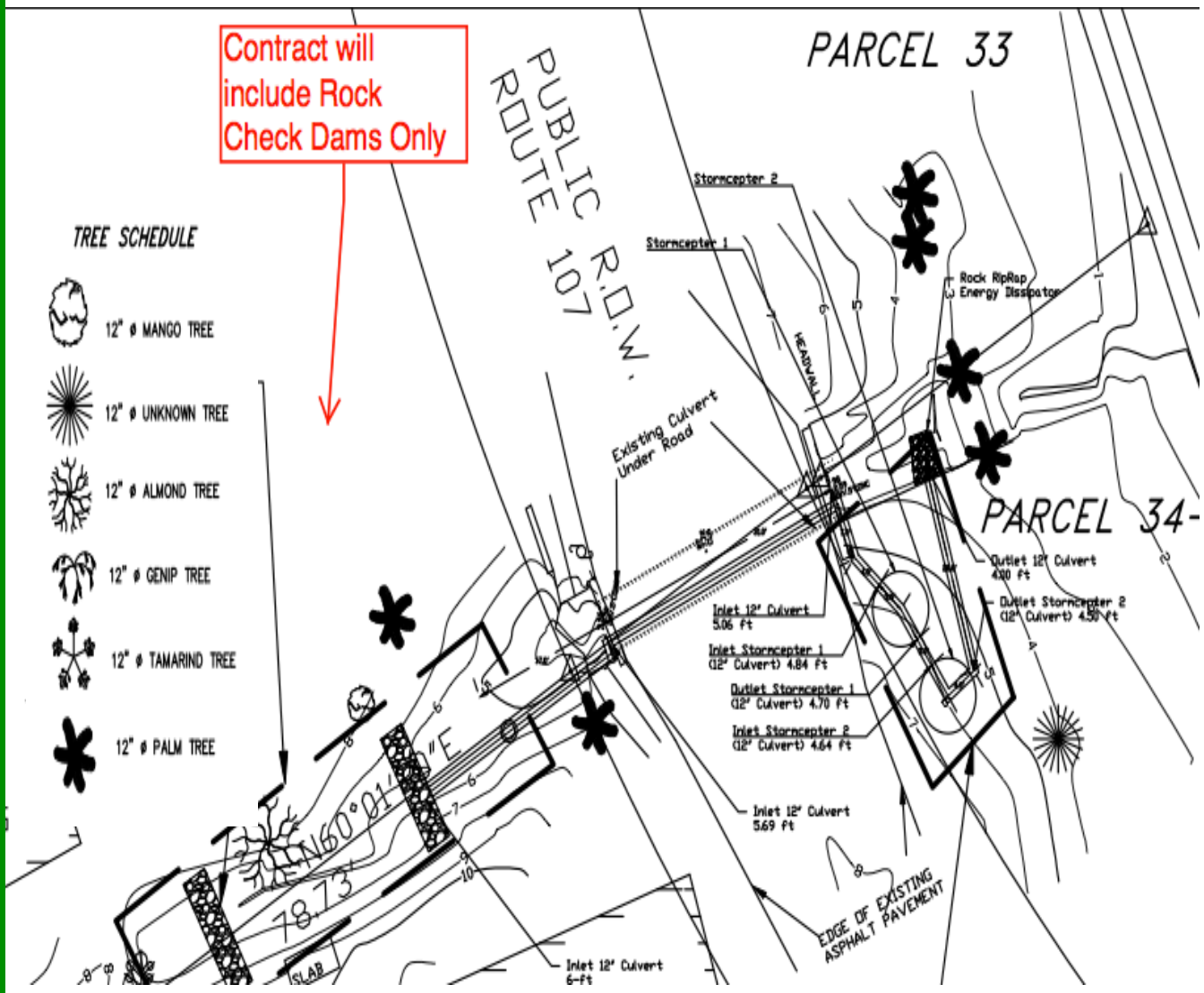
Use site phasing to develop a construction work schedule that strategically coordinates the timing of land disturbing activities to **minimize soil exposure**.

NOAA ARRA USVI Watershed Stabilization Project

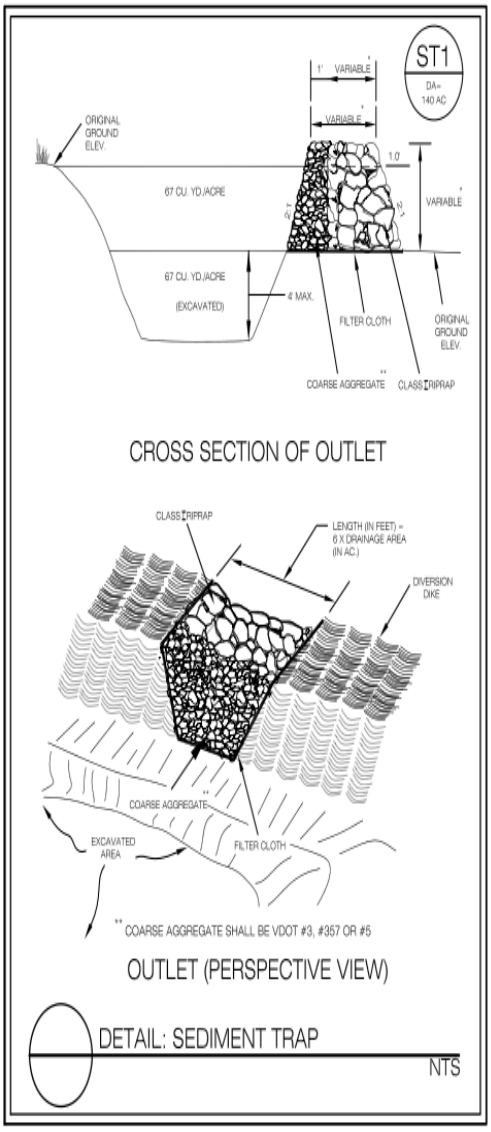


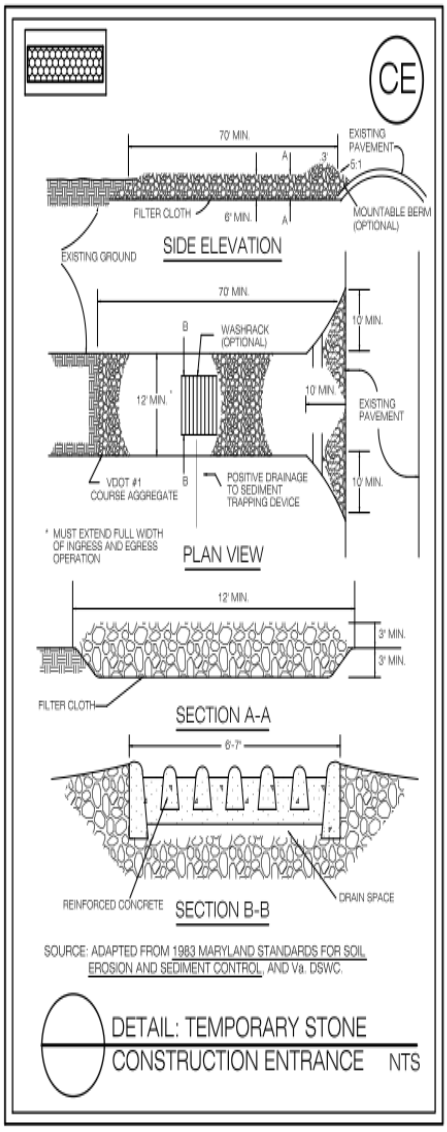
TIP# 2 - Plan for the timely installation of all BMPs **before and during construction** to reduce soil loss and offsite runoff.

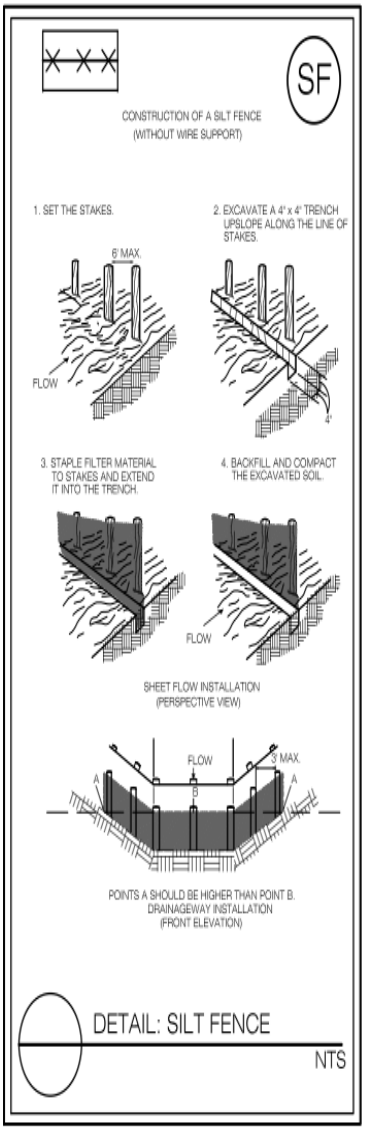
NOAA ARRA USVI Watershed Stabilization Project



SAMPLE BMP PLANS





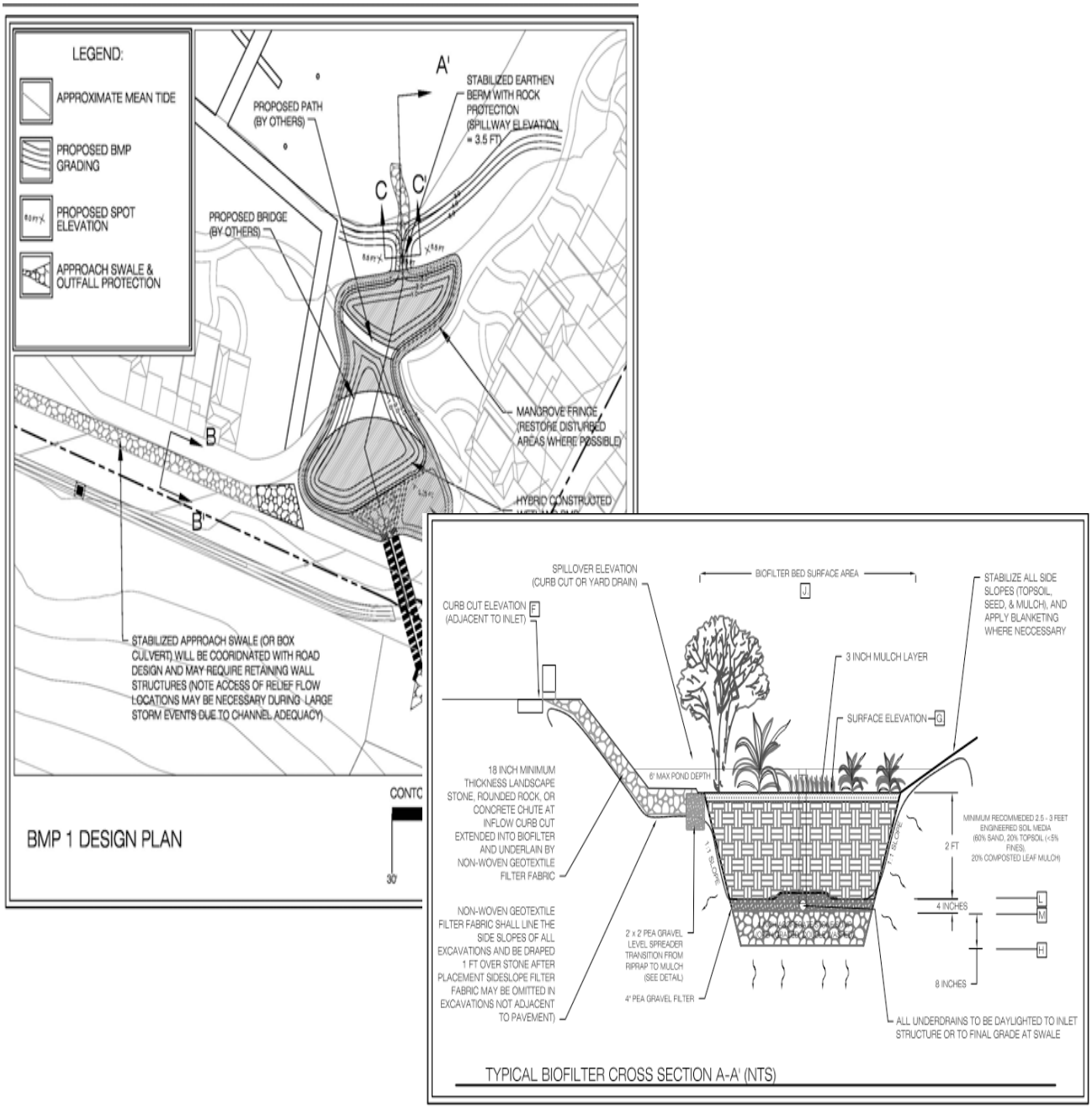


Example of stormwater and sediment BMPs from the proposed Seven Hills Beach Resort & Casino, Robin Bay, St. Croix

Architects: Springline Architects, St Thomas, VI and JCJ Architecture, CT;

Structural Engineer: Dewberry; Environmental Engineers: Williamsburg Environmental Group (WEG); Civil Engineer: Harris Civil Engineers; MEP Engineers: X-nth, Inc., FL; Land Surveyor: Systems Engineering

SAMPLE BMP PLANS



Example of stormwater and sediment BMPs from the proposed Port of Mandahl, Mandahl Bay, St. Thomas

Architect: Springline Architects, St Thomas, VI; Structural Engineer: Connolly Engineering, NY; Environmental Engineers: Williamsburg Environmental Group (WEG); MEP Engineers: Schmidt & Stacy; Land Surveyor: Pate Engineers

Practical Exercise

- Review site plans and verify that plans clearly define required project phasing in terms of when different stages in construction should take place.

- List the erosion and sediment control and stormwater management BMPs that will be used during each of the project phases. Now review the site plans again and verify that this information is clear, as well as whether BMPs are temporary or permanent.

- For each of the BMPs, list the maintenance requirements during construction and over the project lifetime (if permanent). Now review the project plans to determine whether maintenance requirements are clear.

- Review a site plan and evaluate whether, based on soils, slopes, and drainage patterns, the location, number, and types of BMPs will be adequate to contain runoff onsite.

- List additional measures that may be needed or alternate BMPs that could be employed.

Green Landscaping, Operation and Maintenance of BMPs

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Landscaping is part of the final construction stage of the project. However, the plans you design need to incorporate landscaping from the start of the project. This is done by clearly marking areas where native vegetation and greenways, buffers, and water courses are to be maintained on-site with no or minimal disturbance.

The reuse of grey water as part of an irrigation system and the plans for the irrigation system also need to be included in project plans.

Maintenance of landscaping is required, although this is minimal when using native vegetation and irrigating with grey water or rainwater. Be sure the property owner is aware of landscaping maintenance requirements, including maintaining grey water systems.

BMP OPERATION AND MAINTENANCE

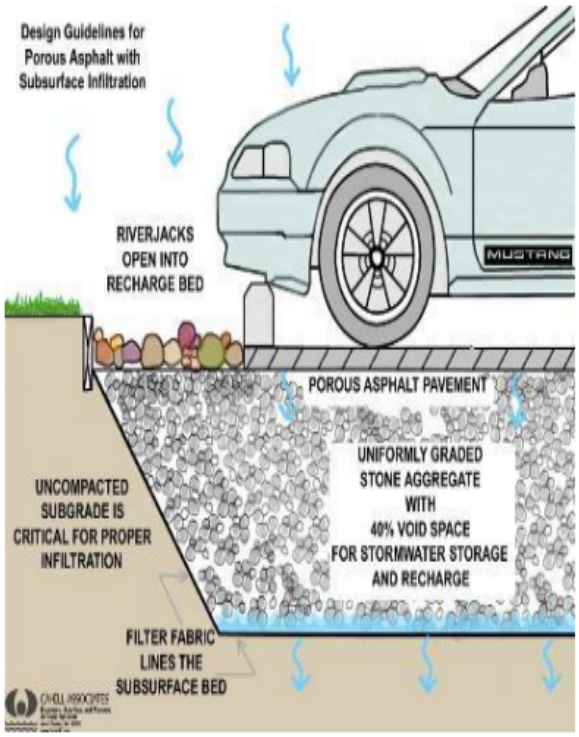
The permanent BMPs for sediment and erosion control and stormwater management need an operation and maintenance plan so they continue working properly.

Maintenance of wastewater systems is also necessary, though minimal when using technologies such as package plants.

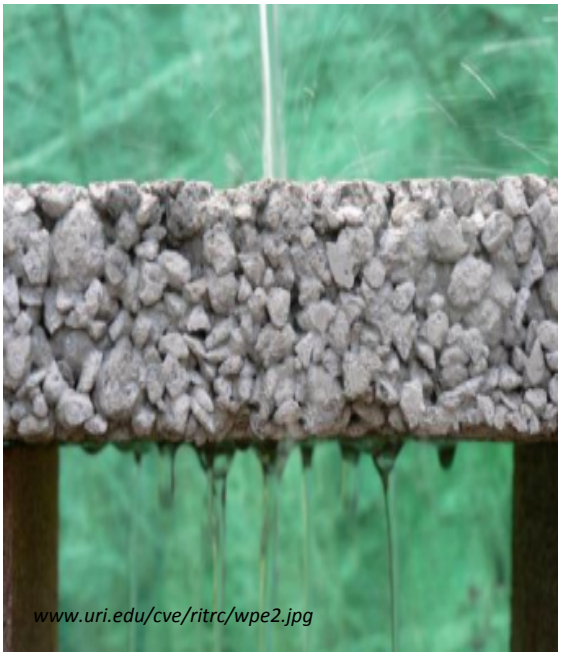
Be sure the property owner is aware of all maintenance requirements and these have been taken into consideration in project design.

Permeable Pavement Options

Does the design match the intended use?



Porous Asphalt - *http://www.mytorontohomeimprovement.com/wp-content/uploads/2008/08/permeable-pavement.JPG*



Pervious concrete (example shown above) *is composed of materials that result in voids when it is dry, thus allowing water to drain through. Installation requires the same type of drainage bed as Porous Asphalt.*

If permeable pavement will be used in a setting that involves vehicles, the pavement surface must be able to support the maximum anticipated traffic load. The structural design process will vary according to the type of pavement selected, and the manufacturer's specific recommendations should be consulted. Porous pavement can be part of a grey water recovery system for irrigating landscaped areas.

Permeable Pavement Options

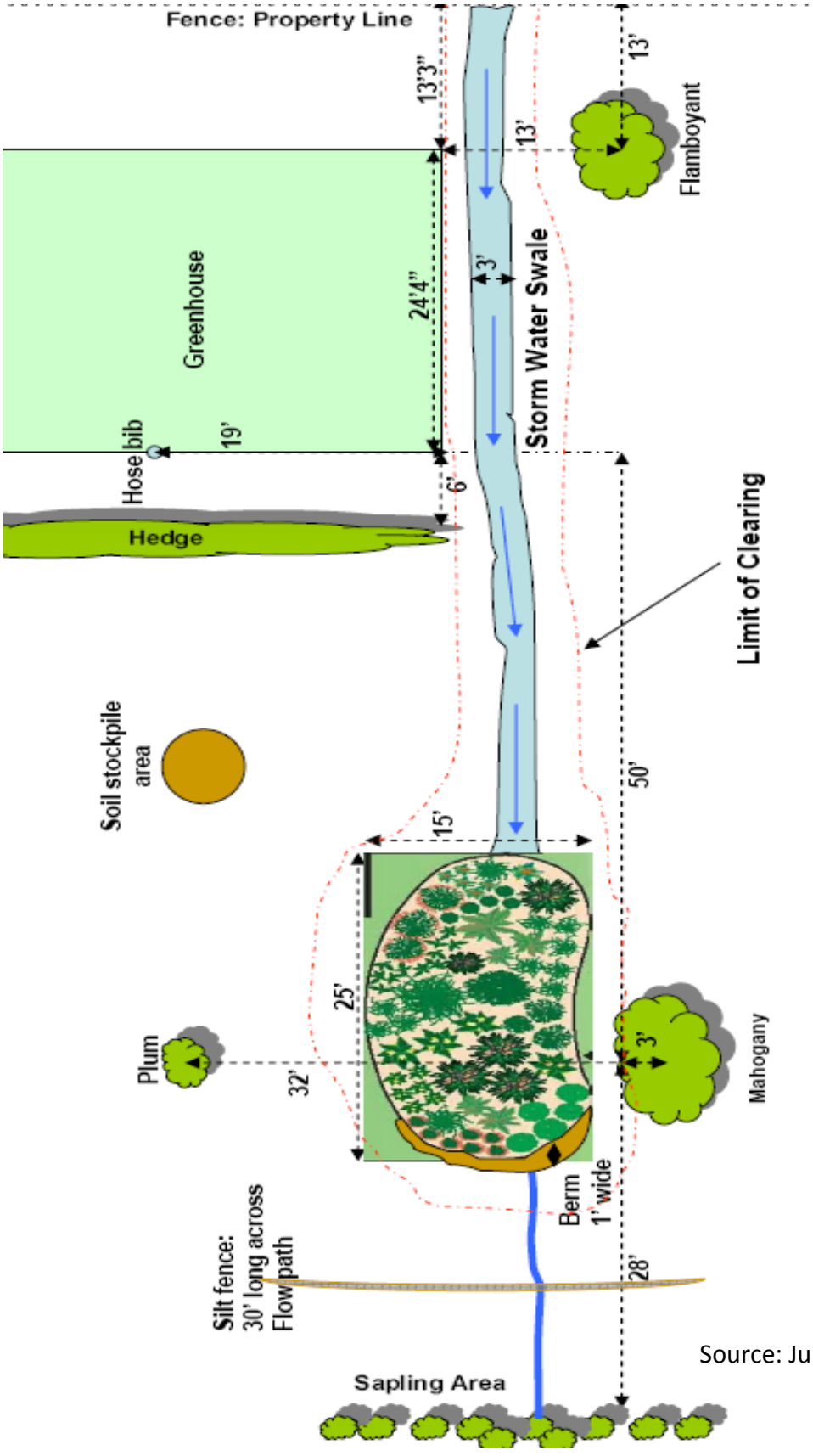
Does the design match the intended use?

While the specific design may vary, all permeable pavements have a similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer and a filter layer or fabric installed on the bottom.

Design Factor	Porous Concrete	Porous Asphalt	Concrete Pavers
Design Permeability	10 feet/day	6 feet/day	2 feet/ day
Pavement thickness	5 to 8 inches	3 to 4 inches	~3 inches
Bedding layer	None	2 inches No. 57 stone	2 inches of No. 8 stone
Reservoir layer	No. 57 stone	No. 2 stone	No. 2 stone 3-4 inches of No.57 stone
Construction Notes	Cast in place, seven day cure, must be covered	Cast in place, 24 hour cure	No cure period; manual or mechanical installation of pre-manufactured units, over 5000 sf/day per machine

Source: ***Virginia DCR Stormwater Design Specification No. 7*** *- http://vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/VASWMBMPSpec7PERMEABLEPAVEMENT.html*

Rain Garden Plan



Source: Julie Wright, NRCS

Use of Local Grasses in Lawns

This list of local grasses found in the US Virgin Islands will help you choose species for landscaping plans that have less water requirements such as Bermuda and Bahia.

Best Management Practices to Control Sediment & Erosion on Construction Sites

Table 8. A tabular comparison of lawn grasses (*USDA-SCS, 1990b*).

Grass	Maintenance Frequency		Soil Type	Tolerance to:		Resistance to:		Establishment		Mower type	Mowing Height (in.)	Insect Problems	Disease Problems
	Mowing	Fertilizer (times/yr)		Shade	Salt	Drought	Wear	Method	Rate				
St. Augustine grass	weekly	3 to 4	Alkaline	Good	Good	Poor	Good	Vegetative	Medium to fast	reel or rotary	1½ - 2½	Chinch bugs Armyworms Mole-crickets	Brown patch Grey leafspot
Centipede grass	bimonthly	1	acid	fair	poor	good	poor	vegetative	medium	reel or rotary	1¼ - 2	Ground pearls Armyworms Spittle bugs Mole-crickets	Brown patch
Zoysia grass	weekly to bimonthly	3 to 4	wide range	good	good	good	good	vegetative	slow	reel	½ - 1¼	Armyworms Billbugs Mole-crickets	Brown patch Dollar spot
Improved bermuda grass	1-3/week	4 to 12	wide range	very poor	fair	poor	good	vegetative	very fast	reel	½ - 1	Armyworms Scale insects Mole-crickets	Dollar spot Brown patch Helminthospo rium
Seeded bermuda grass	1-2/week	4 to 12	wide range	very poor	fair	fair	good	seed or vegetative	very fast	reel or rotary	½ - 1	Armyworms Scale insects Mole-crickets	Dollar spot Brown patch Helminthospo rium
Bahia grass	weekly	1 to 2	acid	fair to good	poor	fair	good	seed or vegetative	medium	rotary	2½ - 3	Armyworms Mole-crickets	Brown patch
Carpet grass	weekly	1	wet, poorly drained, acid	good	poor	very poor	fair	seed or vegetative	medium	rotary	1¼ - 2	Armyworms Mole-crickets	Brown patch

Source: Julie Wright and Edwin Mas, NRCS

This is a stormwater detention basin located at Kingshill Road, Coral Bay, St. John. Sediment needs to be removed or else erosion control function of the basin is lost. →

← Evident sediment built up in retention pond located in Kingshill Road, Coral Bay, St. John. Removal of excess sediment is important to maintain proper function of the pond.

Photo Credit: Horsley Witten Group http://www.horsleywitten.com/

These two pictures show how in Callabash Boom Road (Coral Bay, St. John) homeowners and Department of Public Works make sure culverts are clear. →

←

It is important to inspect all erosion control structures at the close of each workday and after every storm.

Photo Credit: Horsley Witten Group http://www.horsleywitten.com/

Practical Exercise

- Review landscaping plans for a project. Determine whether these are consistent with rest of project plans in terms of areas where vegetation is to be preserved and that project phasing will allow for irrigation system, including use of grey water, to be completed as planned.

- Evaluate water conservation in the landscaping plan. Identify additional measures that could be included in plan to reduce water use or take advantage of grey water.

- Review information on maintenance requirements for projects that are included in project plans. Identify whether all BMPs and systems such as septic, cisterns, etc. have been included in maintenance requirements.

- Draft a maintenance plan to give to project owner based on permanent BMPs and systems such as cisterns, wastewater treatment, etc. that are part of the project.

Acknowledgements

Steering Committee

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www.dpnr.gov.vi
www.solarsystemsvi.com