

James City County - Engineering and Resource Protection

Chesapeake Bay Exception Guidelines & Specifications

PERVIOUS PAVER BLOCK SYSTEMS AS PART OF CHESAPEAKE BAY EXCEPTIONS (RESIDENTIAL APPLICATIONS)

This guideline and specification is intended to be used by applicants, designers, or plan preparer's who intend to utilize pervious paver block systems as a mitigation measure for Bay Act – Chesapeake Bay Exception purposes. It can also be used by the general public to educate themselves about the use, function, and benefits of these types of systems. This information is intended for residential purposes only, not larger scale site plan applications. It only applies to pervious paver block systems used for mitigation purposes and is not meant as a requirement for those who choose to use traditional hardscape surfaces for residential features such as driveways, patios, and walkways. The last page of this packet is required to be filled out and submitted to the County if pervious paver block systems are being used for mitigation purposes for residential Chesapeake Bay Exception applications, especially if placement is proposed within a defined Resource Protection Area (RPA).

Importance of Infiltration - From a regulatory aspect, all of James City County is in a Resource Management Area (RMA). Performance standards of the Chesapeake Bay Act require land disturbance to be limited to only the area necessary for proposed use or development, for existing vegetation to be preserved to the maximum extent possible consistent with the proposed use or development, and impervious cover must be minimized to promote the infiltration of stormwater into the ground.

From a scientific aspect, the effects of land development on the hydrologic water cycle are well documented. In a well vegetated forest or meadow, a significant amount of rainfall is collectively taken up by evaporation, transpiration, absorption, and by the percolation and infiltration of runoff through and into the soil. Water vertically flows through the soil. Some is stored in the soil itself or it continues through until it reaches water tables or, because of topography, it flows laterally through the soil and emerges as springs or seeps. These springs or seeps provide base flow for our local streams and wetlands.

In forest or meadow conditions, a very small amount of rainfall becomes surface runoff. In addition to evaporation and transpiration, natural ground cover and leaf litter provides resistance against soil erosion. Leaf litter and organic matter decompose and become nutrients for adjacent existing vegetation and biological organisms. Clearing the land surface of natural vegetation and/or adding impervious cover (roads, buildings, parking lots, roofs, etc.) impacts the hydrologic cycle in several ways. It removes forest and meadow areas which subsequently result in the loss of the evaporation and transpiration components of the cycle. The soils are now exposed which increases surface erosion. During clearing and grading processes, natural soils are altered in a way by which percolation and infiltration aspects of the soil are reduced.

Also, as natural vegetation is replaced with impervious surfaces, drainage patterns are altered and percolation and infiltration (groundwater recharge) is dramatically decreased and the amount of surface runoff increases. The increase in surface runoff results in higher potential for surface soil erosion, downstream flooding, and erosion in downstream natural receiving waterways. Surface or channel erosion results in sediments being carried downstream to affect other natural waterways such as lakes, rivers and the bay.

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In addition natural forests and meadows and their associated soil profiles have, in a collective ecological fashion, natural pollutant removal mechanisms that are significantly reduced or lost due to land development activities.

General - permeable or pervious paver block systems, or “managed permeable paver systems”, are viewed as a common alternative to traditional types of hardscaping such as concrete, brick, mortar, or asphalt. These systems must be specifically designed, installed and maintained properly in order to obtain distinct mitigation credit for Chesapeake Bay Exception purposes. If not properly designed, installed and maintained appropriately as a pervious or somewhat pervious system, then these systems are considered as aesthetic features and are considered as impervious cover, just like concrete or brick.

Background - pervious paver block systems have been available for many years and have been used primarily as aesthetic treatments for parking areas and low volume roadways. Other traditional uses include applications for overflow parking, emergency access or fire lanes, pedestrian trails, golf cart lanes and boat launch areas. In recent times, these systems have been used more and more for residential home purposes. Residential applications include patios, driveways, sidewalks, walkways, pathways, landings, pool-side perimeters, erosion control, shoreline stabilization, gardening and general landscaping. A typical 10 ft. by 10 ft. or 100 square feet “traditional” concrete or brick patio can generate about 9 cubic feet of runoff volume (about 65 gallons) during a 1-inch rainfall storm event. This is compared to little or no runoff if the same area was forest, meadow or even high lawn grass. There is multitude of manufacturers in the market who offer pervious paver block systems each with different color, style, configurations and material type. Some manufacturer's pitch the term “pervious pavers” when indeed the actual block structure itself is not pervious at all and the joint or foundation structure may or may not be.

Use as a Mitigation Tool - In order for pervious paver block systems to achieve water quality benefits, there must be a properly engineered or designed system that allows for rainfall and surface runoff to penetrate through the paver blocks or joint network into underlying layers of sand or larger stone, such as AASHTO #57 stone. In addition, soils underlying the sand or stone base must have acceptable infiltration characteristics, generally with an infiltration rate at least of one-half ($\frac{1}{2}$) inch per hour. Infiltration is defined as downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or materials (County Soil Survey, 1985).

The infiltration rate of underlying soil must be demonstrated by field or laboratory testing methods or by a qualified geotechnical engineer or soil scientist's determination. Otherwise a perforated under drain system with acceptable outlet (daylight) must be provided. The sand-stone base provides structural support for the paver blocks but also acts as a reservoir to store runoff so that it can be detained and slowly released (infiltrated) into sub soils, if underlying soil conditions allow.

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If soils are not satisfactory, then the system can be carefully designed to serve as a filtering mechanism. A filtering device is where runoff is conveyed through the paver block system, sand-stone layers, and then through an under drain pipe to an acceptable outfall. Acceptable outfalls can include a stabilized vegetated or lawn area, level spreader, or an existing natural or manmade receiving channel consistent with the provisions of Minimum Standard # 19 of the Virginia Erosion and Sediment Control law and regulations. The pipe outfall should have rock outlet protection, or equivalent means, to dissipate velocity and prevent erosion at the end of the pipe.

When working as a filtering type system, there is very little or no infiltration in underlying natural soils, but the designed system (sand, stone, gravel, soil, etc.) traps pollutants associated with stormwater runoff. Supplemental storage facilities can also be used in conjunction with paver blocks such as stone containment (dry wells) or underground rain water harvesting cisterns, chambers or vaults. Some of these systems are pre-manufactured as well.

Pervious Paver System Types and Terminology - The unique shape of regular or interlocking pervious paver block systems leaves drainage openings that typically comprise 10% or more of the paver's surface area. In a designed pervious paver block system, the actual blocks themselves may or may not be of permeable nature; however, the openings in the blocks or the joint system or network serves as the primary method to catch and convey surface runoff from the paver blocks into beneficial stormwater management layers below. Types of pervious paver block systems generally include:

- Permeable or Porous Concrete (PC)
- Permeable or Porous Asphalt (PA)
- Concrete Grid Pavers (CGP)
- Permeable Interlocking Concrete Pavers (PICP)
- Plastic Turf Reinforcing Grids (PTRG)

There are examples of successful use of these types of systems all across James City County for a variety of purposes. Over the last few years, plastic or high-density polyethylene (HDPE) grids have also entered the market place. Some of these are even made with recycled material. These would be considered PTRG type units as they are backfilled with sand, topsoil or a mix of both to promote the growth of vegetation but yet provide erosion resistance and durability for surface uses.

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Pervious Paver System Types and Terminology



Permeable Interlocking
Concrete Pavers (PICP)



Concrete Grid Pavers
(CGP) "Turfstone"



Porous Concrete (PC)



Porous Asphalt (PA)



Plastic Turf Reinforcing
Grids (PTRG)

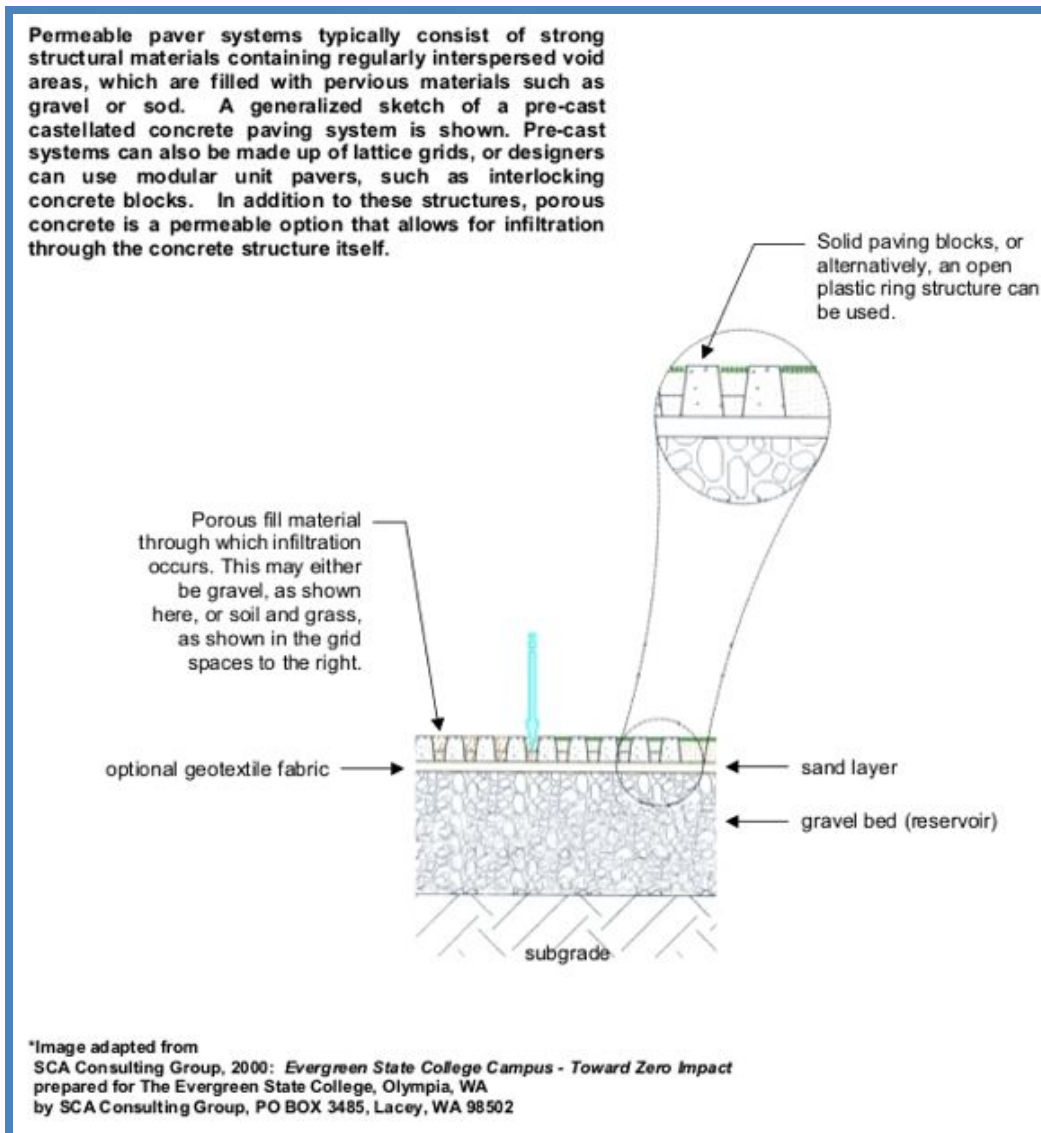
Note: Permeable interlocking concrete pavers (PICP) are the most commonly used type of pervious paver block systems for residential applications. Porous asphalt (PA) is the least commonly used. The County does not endorse or recommend any specific type of pervious paver block system, any particular paver stone, manufacturer, or installation or testing contractor.

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Installation- The following is a general expectation for installation of permeable or pervious paver block systems. Specific information for installation is also most always available from manufacturer's literature for the specific paver being used.

Typical Installation Detail



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Impervious Cover – Properly designed, installed and maintained pervious paver block systems will not receive credit as “pervious” or “managed grass” but will be considered as “impervious cover” for application purposes. However, a properly designed, reviewed, approved, installed and maintained system will be considered as one of several allowed forms of mitigation, following the spirit and intent of the Bay Act program.

In order to be considered as a possible mitigation component, the system must follow all the initial screening and established guidelines and specifications listed below. For initial screening purposes, if the pervious paver block system does not meet the following requirements, then the system cannot be considered for mitigation purposes, regardless of design features provided.

Initial Screening

- An administratively complete Chesapeake Bay Exception (CBE) application must be provided using the County's Sensitive Area Activity Application (SAAA) form. The pervious paver block system must be listed as a proposed mitigation measure on Page 3 of SAAA form.
- A plan view must be provided which shows the location, size and dimensions of the proposed feature. See the SAAA form for additional information for plan requirements.
- The size of the surface footprint shall be the minimum necessary to afford relief.
- The surface materials and/or associated joint system or network are of pervious nature.
- The system must have bedding sand or stone which are permeable in nature, meaning the quality of the material is such that it enables water to move downward through the soil or stone profile to underlying soils.
- Infiltration rate of underlying soil is confirmed, or if not feasible for infiltration, the system has a designed storage area and a dewatering perforated pipe under drain which terminates (ends) at an acceptable outfall.
- No credit for pollutant removal is taken; however, the net effect of use of the system can be considered as an attempt to minimize or reduce impervious cover which is consistent with performance standards of the Chesapeake Bay Preservation ordinance.

Design Specifications - The following are general design requirements associated with pervious paver block systems for residential Chesapeake Bay Exception application purposes. Unless specific specification-detail information is provided by the applicant, designer, or the plan preparer as a supplement to the County's Sensitive Area Activity Application (SAAA) form, these guidelines can be used as default design, installation, and maintenance procedure for application purposes. If this general guideline and specification is used additional specific specification-detail information is not required, but still can be provided if desired.

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The applicant, designer, or plan preparer must adhere to all of the following items for use of pervious paver systems for residential Chesapeake Bay Exception (CBE) application purposes.

1. The system shall be designed to provide for adequate infiltration, runoff storage or filtering capability.
2. Disturbed area runoff, sediment, oils, and greases shall not be allowed to reach the surface layers.
3. Construction techniques shall be used that minimize compaction of subsurface soils within the proposed design footprint.
4. Clean sand or washed stone bases shall be used.
5. No heavy loads shall be introduced to the surface block system.
6. Seasonal water tables must not be within the vicinity of the entire design section.
7. Installation shall follow methods as outlined in this guideline and specification and in accordance with applicable manufacturer's or industry specifications.
8. Final surface grade of the system shall be relatively flat or sloped to drain.
9. Minimum slope of perforated under drain pipe, if required, is 0.5 percent.
10. The system must only handle rainfall that falls directly onto the design surface itself or from reasonable directly adjacent perimeter areas (conveyed in a sheet flow manner).
11. Installation must be performed by appropriately qualified contractors or professionals.
12. Maintenance requirements shall be relayed to and an acceptable level of maintenance shall be performed by the home or property owner.
13. The system must be listed as a proposed mitigation measure on Page 3 of the County's Sensitive Area Activity Application (SAAA) form. This form is required for all Chesapeake Bay Exceptions under the County's Bay Act program. This form is found at <http://www.jccgov.com/environmental/index.html>
14. The "Design Worksheet" as provided on Page 8 of this guideline and specification is required to be fully completed, signed and submitted for review as part of the application process.
15. The provision of any other special conditions as imposed by the Chesapeake Bay Exception review and approval process shall apply.

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PERVIOUS PAVER BLOCK SYSTEM – DESIGN WORKSHEET – RESIDENTIAL (CBE's) **(Must Complete all Items, Sign & Date and Submit)**

1. Proposed Use of Pervious Paver System (ie. patio, etc.): _____

2. Size/Dimensions of System (Area in square feet and length and width dimensions in feet):

Area (s.f.): _____ Length (ft.): _____ Width (ft.): _____

3. Soil Suitability: System subsoils must infiltrate at least one-half (½) inch per hour

- Yes, Confirmed by field or laboratory methods or by qualified geotechnical engineer or soil scientist. Report or statement provided.
- No, Perforated pipe under drain with outlet is provided.

4. Type of pervious paver block system being proposed (check one)

- Permeable Interlocking Concrete Pavers (PICP) - *Note: This is the most commonly used type of system See page 3.*
- Permeable or Porous Concrete (PC)
- Permeable or Porous Asphalt (PA) Other or Additional Information: _____
- Concrete Grid Pavers (CGP) _____
- Plastic Turf Reinforcing Grids (PTRG) _____

5. Thickness of pervious paver block system (from manufacturer): _____ (inches)

6. Material type of pervious paver block system (concrete, etc.): _____

7. Width of proposed joints between paver blocks: _____ (inches)

8. Material type of joint (sand, stone, etc.): _____

9. Type/thickness of bedding stone (List all that apply from surface downward):

- | | | |
|----------------|------------------|----------|
| a. Type: _____ | Thickness: _____ | (inches) |
| b. Type: _____ | Thickness: _____ | (inches) |
| c. Type: _____ | Thickness: _____ | (inches) |
| d. Type: _____ | Thickness: _____ | (inches) |

I, the undersigned, have read and understand the above guidelines and specifications for the use of pervious paver block systems for residential Chesapeake Bay Exception application purposes and agree to abide by the terms and conditions of the guidelines and specifications for all phases of planning, design, installation, construction and maintenance.

Applicant/Applicant's Representative Name (Please print): _____

Applicant/Applicant's Representative Signature: _____

Date: _____ Email or Phone No.: _____