April 6, 2023

LCRA Highland Lakes Watershed Ordinance Technical Manual – Porous Pavement Stormwater Credits

This bulletin is provides revised guidance regarding the LCRA Highland Lakes Watershed Ordinance Technical Manual (5th Edition, 2007) requirements for pervious and porous pavement and pavers found in Section 4.3.1. This guidance may be used in lieu of the 2007 manual guidance. Designers will also need to meet relevant criteria found in Sections 2, 4 and 5 of the Technical Manual.

Stormwater Credits

The stormwater basin sizing criteria in Section 2.3 of the technical manual provides an incentive to reduce impervious cover at development sites, since significant reductions in impervious cover will result in smaller and more economical water quality basins.

Impervious cover includes all surfaces that reduce the amount of infiltration of water into the earth, including paved and unpaved roadways, driveways, parking areas rooftops, and similar areas. For lakeside properties, exclude areas below the "elevation when full" for that lake from impervious cover computations.

These optional credits may be used by designers to gain compliance with the Alternate Standards or reduce water quality basin size. Due to local codes, soil conditions, and topography, some of these site design features may be restricted. In single-family subdivisions, stormwater credits will most likely be accrued on single-family lots, however if conditions are appropriate, roadways may also utilize the credit. Since these credits will be typically constructed by homebuilders, and not the subdivision developer, easements, deed restrictions, or other articles approved by LCRA are required to be established through the permitting process to ensure the proper installation, maintenance and survivability of these best management practices (BMPs). Designers and developers are encouraged to consult with LCRA early in the permitting process to ensure orderly efficient implementation of the credits.

Table 2-10 Stormwater Credits

Stormwater Credits	Alternate Standards Application	Water Quality Volume Application
Pervious pavement and pavers	Reduce paved area impervious cover (IC) by 90% for porous pavement and permeable interlocking concrete pavers over gravel med Reduction for other pavers and gravel-based surfaces based on void space and depth of p media.	Reduce paved area IC by 90% for porous pavement, and permeable interlocking concrete pavers over gravel media Reduction for other pavers and gravel-based surfaces based on void space and depth of porous media
Rainwater harvesting (cisterns or tanks)	Reduce roof top IC up to 75%	Reduce roof top IC based on tank volume ratio to catchment area

Soil amendment	Reduce IC by 2%	Reduce drainage area IC by 2% to water quality basin
Conservation landscaping	Reduce IC by 5%	Reduce drainage area IC by 5% to water quality basin
Disconnection of roof-top runoff*	Deduction of rooftop IC based on flow length and/or lot rainwater storage or infiltration	Deduction of rooftop IC based on flow length and/or on-lot rainwater storage or infiltration
Natural area Preservation	Include natural area in development cluster impervious cover calculation	Natural area is subtracted from drainage basin area

*Credit available for residential projects only

See below for calculation procedures for each stormwater credit.

Pervious (Porous) Pavement/Pavers Credit

Pervious pavement/pavers credit definition

A credit is given when pervious pavement, paver blocks or coarse gravel are designed to allow rainfall to pass through the pavement, thereby reducing runoff from the site, promoting groundwater recharge and filtration of stormwater pollutants. This practice may be used for driveways, streets, sidewalks and parking lots to reduce the effective impervious cover within a development project. When constructed per the guidance in the technical manual, a factor dependent upon the pavement type and gravel base depth is applied to reduce the impervious cover. This credit can be used to gain compliance with the Alternate Standards or reduce the BMP volume. The credit is calculated per the equations below. Design and construction details can be found in this bulletin.

Pervious pavement and paver systems consist of a concrete pavement, concrete paver or gravel surface placed over an aggregate base that temporarily stores water prior to infiltration or drainage to a controlled outlet. Attenuation of flow is provided by the storage within the underlying base material, together with appropriate flow controls. An underlying geotextile layer may permit groundwater recharge where sufficient soil depth exists. Alternatively, where infiltration is inappropriate (e.g., if the groundwater vulnerability is high, or the soil type is unsuitable), the installation can be constructed with an underdrain.

Types of pavement and paver systems:

Permeable concrete - Permeable concrete consists of concrete that is made without the fine (sand) fraction. Permeable concrete typically includes proprietary additives used to offset the strength reduction that results from removing the sand component from the mix. These additives can result in a mix that it is of comparable strength to a standard concrete mix. The lack of sand fraction also has the effect of substantially shortening the time for the concrete to setup and may make it difficult to get a consistent texture. It is incumbent on the pavement engineer to understand the properties of the component materials and to ensure the design includes specific specifications to ensure successful application. Coordination with the materials suppliers and contractor experience are essential in minimizing potential problems.

Permeable interlocking pavers – Permeable interlocking concrete pavements (PICP) are concrete block pavers that create voids on the corners and perimeter of the pavers. Specifications should follow ASTM C936.

Pervious pavers – Pervious pavers consist of concrete grid pavers (CGP), which are manufactured with voids within the blocks. The pavers also may be installed with void between pavers. A credit is based on the surface area within the paver that is available for infiltration. These systems may require more frequent maintenance to maintain infiltration capacity due to compaction and/or sealing of the infiltration surface. Specifications should follow ASTM C1319.

Gravel with cellular confinement – This pavement type consists of clean gravel aggregate placed within a cellular confinement, typically a plastic lattice or plastic reinforcing grids (PRG) that add structural support to the soil and reduce compaction to maintain permeability. The gravel-filled grids are placed over an aggregate base that temporarily stores water prior to infiltration or drainage to a controlled outlet.

Gravel surfaces – Gravel surfaces are gravel parking and driveway surfaces constructed of coarse washed aggregate created void space that is available for interception and storage of runoff.

The pervious pavement/pavers credit is computed per the following:

$$\mathbf{A_r = A_p * R}$$

Where: A_r = Allowable reduction in impervious cover
A_p = Area of pervious pavement
R = reduction factor

Pervious Pavement/Paver Type	**Minimum Gravel Base Thickness**	**Maximum Reduction Factor**
Permeable concrete with gravel base	8 in.	0.90
Permeable interlocking pavers with gravel base	8 in.	0.90
Pervious pavers (grid type)*	8 in.	0.75
Gravel with cellular confinement	8 in.	0.90
Gravel, minimum 3/8” size, washed	3 in.	0.50

*The credit for grid type pervious pavers is computed per the following:

$$\mathbf{A_r = A_p * \%_0 * 0.75}$$

Where: A_r = Allowable reduction in impervious cover
A_p = Area of pervious pavers
$\%_0$ = Percent open space of the paver system

Restrictions on the credit

The pervious pavement/pavers credit is subject to the following restrictions:

- Pervious pavement/pavers must satisfy the design and installation requirements in this section. Manufactured pervious pavers and gravel confinement systems must satisfy manufacturer's specifications.
- A pavement/paver maintenance plan must be approved by LCRA before issuance of a development permit.
- The contractor must contact LCRA 48 hours prior to the placement of the pervious pavement for inspection of subgrade, flow barriers, aggregate size/quality, paver type, etc.
- Pervious pavement/pavers may be used for light vehicle loads in parking lots or for sidewalks in the Highland Lakes watershed. Some paver and pavement systems may be capable of supporting heavier loads with appropriate engineered design and may be approved subject to review of supporting documentation.
- Permeable pavement and paver areas should be constructed so that runoff from adjacent areas, such as landscaping and rooftops, is directed away from the permeable pavement.
- The credit is not available if infiltration or treatment of the intercepted runoff cannot be achieved. A minimum infiltration rate of 0.52 inches per hour is required.
- Sites with steep slopes or shallow soils may not be suitable for this credit.
- Impervious cover credit is limited to slopes of less than 10%.
- Installation of pervious pavement or pavers on slopes over 2% requires lateral flow barriers and/or cut-offs in the aggregate base layer.
- If an underdrain is proposed, effluent from an underdrain system must be treated with vegetated strips, infiltration or structural BMP system. Details and specification for underdrains, base and subgrade are included in this bulletin
- Infiltration testing must be performed with a double ring infiltrometer in one representative location for each 5,000 ft^2 of pavement. Infiltration testing is not required for gravel surfaces (without confinement).

Example calculation: the required water quality volume before the credit for a 10 acre site with 30 single family lots would be:

Impervious cover = 3 acres = 30%
1-year runoff volume = 0.59 inches
Water quality volume = (0.59 inches) * (10 acres) * (43,560/12) = 21,417 cubic feet

Applying the credit: each single-family lot has a driveway length of 35 feet and a width of 16 feet for a total driveway area of 560 square feet. The designer chooses to use permeable interlocking pavers with gravel base for each driveway. Thus, the driveway area impervious cover is reduced by 90%.

Driveway area = 560 square feet

A_r = Allowable reduction in impervious cover per house = (560) * (0.90) = 504 square feet
Impervious cover with credit = (3 acres) – ((30 lots) * (504 sq. ft))/43,560 = 2.65 acres
Effective impervious cover = 27%
1-year runoff volume = 0.54 inches
Water quality volume = (0.54 inches) * (10 acres) * (43,560/12) = 19,602 cubic feet.

The BMP water quality volume is reduced by 8% in this example.

Permeable Concrete Design Criteria

There are two possible configurations of permeable concrete: with and without an underdrain. This type of system does not require an impermeable liner and should be designed and constructed to retain as much of the sites predevelopment infiltration capability as possible. Systems constructed with an underdrain should include a layer of sand to filter the stormwater prior to surface discharge. Discharge from an underdrain system must occur in a sheet flow manner or be treated with vegetated strips, structural or infiltration BMP systems.

Permeable concrete systems without an underdrain treat stormwater runoff via filtration assuming adequate infiltration capacity of underlying soils.

(1) *Materials*:

i. *Cement*: Portland Cement Type I or II conforming to ASTM C 150 or Portland Cement Type I P or IS conforming to ASTM C 595.

ii. *Aggregate*: Use Texas Department of Transportation (TxDOT) grade No. 8 coarse aggregate (3/8 to No. 16) per ASTM C 33; or No. 89 coarse aggregate (3/8 to No. 50) per ASTM D 448.

iii. *Admixtures*: Optional.

iv. *Water*: Potable or should comply with TxDOT Standard Specifications.

v. *Base material*: The design of the water quality functions of the pavement system depends on adequate storage volume within the base material. The gravel layers should consist of clean, durable, uniformly-graded rock meeting the ASTM C-33 specifications for No. 4 aggregate. The sand layer in systems with an underdrain should meet ASTM C-33 specifications for fine aggregate.

(2) *Proportions*:

i. *Cement content*: For pavements subject to vehicular traffic loading, the total cementitious material shall not be less than 564 pounds per cubic yard.

ii. *Aggregate content*: The volume of aggregate per cubic yard shall be equal to 27 cubic feet when calculated as a function of the unit weight determined in accordance with ASTM C 29 jigging procedure.

iii. *Admixture*: Optional for strength.

iv. *Mix water*: Mix water quantity must be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. (Mix water quantity yielding a cement paste with a dull-dry appearance has insufficient water for hydration.)

Insufficient water results in inconsistency in the mix and poor aggregate bond strength. High water content results in the paste sealing the void system primarily at the bottom and poor aggregate surface bond.

(3) *Recommendations for permeable concrete with underdrain and surface discharge*:

i. *Base material*: Should consist of the materials and configuration shown in Figure 4.19 (a). The thickness of the concrete should be sufficient to bear expected loads.

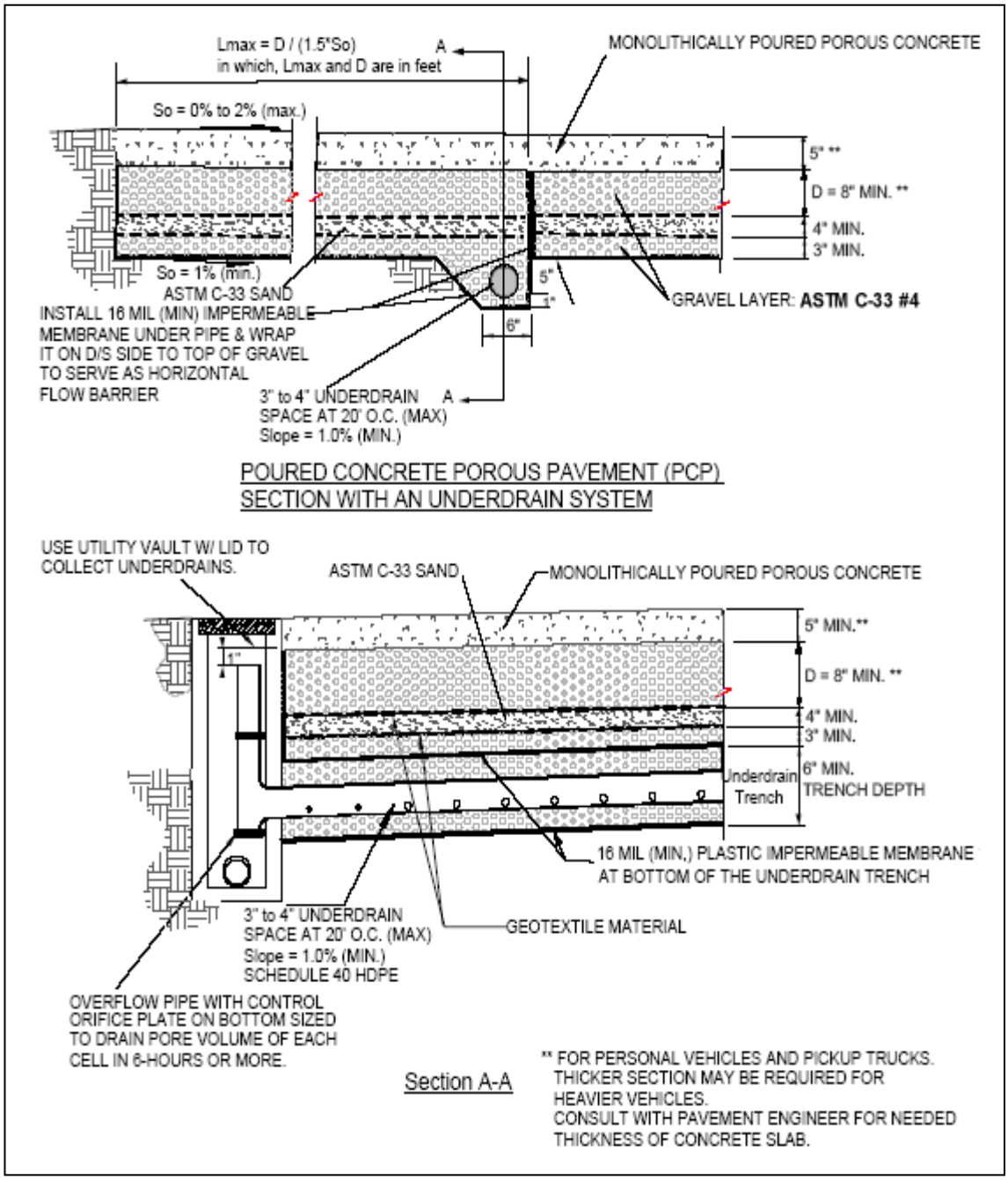
ii. *Lateral flow barriers*: Lateral flow barriers must be installed normal to the direction of flow to prevent flow of water downstream and then surfacing at the toe of the permeable pavement installation. The maximum distance (L_{max}) between cutoff barriers should not exceed that shown in Figure 4.19 (a). Flow barrier options include Polyethylene (PE) or PVC strips that are at least 16 mils thick or earthen barriers. See Figure 4.19 (b) & (c).

iii. *Geotextile fabric*: The sand and gravel layers should be separated by a layer of non-woven 4 oz. geotextile fabric. The purpose of the fabric is to prevent migration of fine material from the sand layer into the gravel. Geotextile fabric must overlap a minimum of 18 inches.

iv. *Underdrain piping*: The underdrain pipe should consist of 3- to 4-inch diameter Schedule 40 PVC. Perforations should be 3/8 inches in diameter and maximum spacing between perforations should not exceed 6 inches. Alternatively, the underdrain piping described in Section 4.2.1(8) of the technical manual may be used.

v. *Subsoil*: The subsoil must be natural soil without waste, debris or material that might leach chemicals into the subsurface. If fill material is required below the pavement, it must be clean and free of deleterious material. It must meet all geotechnical specifications for structural support.

Figure 4.19 (a): Schematic of Permeable Concrete with Underdrain Installation (after UCFCD, 2004)



(4)

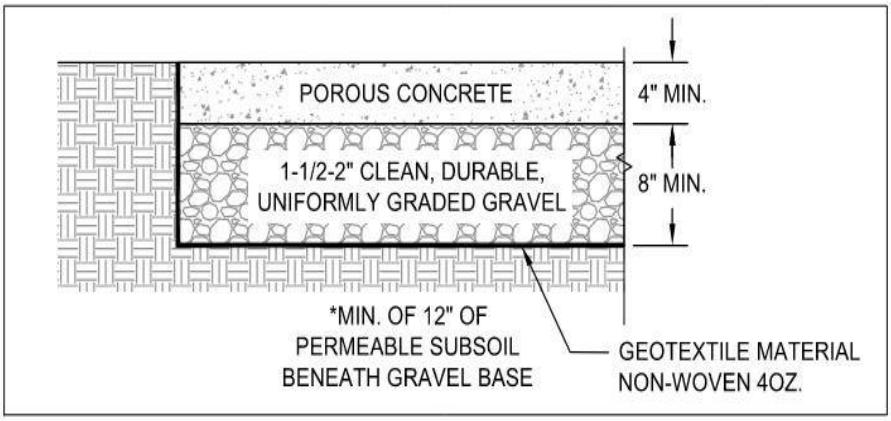
Recommendations for permeable concrete without underdrain:

i. *Base material*: Base material must consist of clean, durable, ASTM C-33 No. 4 aggregate 8 inches thick composed of 1-1/2- to 2-inch clean aggregate (no fines). Slopes over 2% will need to incorporate lateral flow barriers and/or cut-offs in the aggregate base layer.

ii. *Geotextile fabric*: A layer of non-woven 4 oz. geotextile fabric is to be placed on top of the natural subsoil prior to placing base material. The fabric should extend up the natural earth sides and over the top of any adjacent berm. The purpose of the fabric is to prevent migration of fine material from the subsoil into the gravel.

iii. *Subsoil*: Soil exploration should demonstrate a minimum of 12 inches of subsoil below the base material at every sample location. Soil tests must be conducted on the greater of two samples for each identified soil type, or one sample per 5,000 square feet of infiltration area. The subsoil must be natural soil without waste, debris or material that might leach chemicals into the subsurface. If fill material is required below the pavement, it must be clean and free of deleterious material and have a texture comparable to natural soil at the site. Rocky soils are acceptable; however, the coarse material (diameter greater than 0.5 inches) should not account for more than 30% of the soil volume of either soil or fill material.

The subgrade must not be compacted or subjected to construction vehicle traffic prior to the placement of base. Subgrade work must be sequenced to minimize passes of construction vehicles in the beds themselves. If the excavated subgrade is exposed to rainfall runoff, it may accumulate fines. These must be removed prior to geotextile fabric and base placement. Grading should not occur during wet soil conditions to minimize smearing and sealing of the soil surface. If such sealing occurs, the surface must be scarified to restore natural texture and permeability.



MATERIALS:

i. *CEMENT*: PORTLAND CEMENT TYPE I OR II CONFORMING TO ASTM C 150 OR PORTLAND CEMENT TYPE IP OR IS CONFORMING TO ASTM C 595;
ii. *AGGREGATE*: USE TEXAS DEPARTMENT OF TRANSPORTATION (TxDOT) GRADE NO.8 COARSE AGGREGATE (3/8 TO NO.16) PER ASTM C 33; OR NO.89 COARSE AGGREGATE (3/8 TO NO.50) PER ASTM D 448;
iii. *ADMIXTURES*: OPTIONAL;
iv. *WATER*: POTABLE OR SHOULD COMPLY WITH TxDOT STANDARD SPECIFICATIONS; AND
v. *GEOTEXTILE FABRIC*: NON-WOVEN 4OZ.

PROPORTIONS:

i. *CEMENT CONTENT*: FOR PAVEMENT SUBJECT TO VEHICULAR TRAFFIC LOADING, THE TOTAL CEMENTITIOUS MATERIAL SHALL BE NO LESS THAN 564 LBS. PER CUBIC YARD;
ii. *AGGREGATE CONTENT*: THE VOLUME OF AGGREGATE PER CUBIC YARD SHALL BE EQUAL TO 27 CUBIC FEET WHEN CALCULATED AS A FUNCTION OF THE UNIT WEIGHT DETERMINED IN ACCORDANCE WITH ASTM C 29 JIGGING PROCEDURE;
iii. *ADMIXTURE*: OPTIONAL FOR STRENGTH; AND
iv. *MIX WATER*: MIX WATER QUANTITY SHALL BE SUCH THAT THE CEMENT PASTE DISPLAYS A WET METALLIC SHEEN WITHOUT CAUSING THE PASTE TO FLOW FROM THE AGGREGATE. (MIX WATER QUANTITY YIELDING A CEMENT PASTE WITH A DULL-DRY APPEARANCE HAS INSUFFICIENT WATER FOR HYDRATION.)

INSUFFICIENT WATER RESULTS IN INCONSISTENCY IN THE MIX AND POOR AGGREGATE BOND STRENGTH. HIGH WATER CONTENT RESULTS IN THE PASTE SEALING THE VOID SYSTEM PRIMARILY AT THE BOTTOM AND POOR AGGREGATE SURFACE BOND.

GENERAL REQUIREMENTS:

i. DRIVEWAY SLOPE MUST BE LESS THAN 2%;
ii. SUBSOIL: 12" OF SUITABLE SUBSOIL IN TERMS OF SUPPORT AND INFILTRATION REQUIRED. A MINIMUM INFILTRATION RATE OF 0.52 IN/HR IS REQUIRED. SOILS WITH AN INFILTRATION RATE BETWEEN 0.27 AND 0.52 IN/HR HAVE MARGINAL INFILTRATION CAPACITY AND MAY NOT BE SUITABLE FOR ABSORBING RUNOFF. SAND, LOAMY SAND, AND SANDY LOAM ARE GENERALLY CONSIDERED SUITABLE FOR INFILTRATION AND SUPPORT.

INSTALLATION

i. SUBGRADE: THE SUBGRADE MUST NOT BE COMPACTED OR SUBJECTED TO CONSTRUCTION VEHICLE TRAFFIC OR SEDIMENT PRIOR TO THE PLACEMENT OF BASE. SUBGRADE WORK MUST BE SEQUENCED TO MINIMIZE PASSES OF CONSTRUCTION VEHICLES IN THE BEDS THEMSELVES. IF THE EXCAVATED SUBGRADE IS EXPOSED TO RAINFALL RUNOFF, IT MAY ACCUMULATE FINES. GRADING SHOULD NOT OCCUR DURING WET SOIL CONDITIONS TO MINIMIZE SMEARING AND SEALING OF THE SOIL SURFACE. IF SUCH SEALING OCCURS, THE SURFACE MUST BE SCARIFIED TO RESTORE NATURAL TEXTURE AND PERMEABILITY;
ii. GEOTEXTILE FABRIC: A LAYER OF NON-WOVEN 4OZ. GEOTEXTILE FABRIC IS TO BE PLACED ON TOP OF THE NATURAL SUBSOIL PRIOR TO PLACING BASE MATERIAL. THE FABRIC SHOULD EXTEND UP TO THE NATURAL EARTH SIDES AND OVER THE TOP OF ANY ADJACENT BERM. THE PURPOSE OF THE FABRIC IS TO PREVENT MIGRATION OF FINE MATERIAL FROM THE SUBSOIL INTO THE GRAVEL;
iii. BASE MATERIAL: THE BASE MATERIAL SHOULD BE COMPACTED TO A THICKNESS OF 8" WITH A STATIC ROLLER RATHER THAN A VIBRATORY ROLLER;
iv. POROUS CONCRETE: USE CERTIFIED POROUS CONCRETE INSTALLER FOR INSTALLATION.

MAINTENANCE

i. SUBJECT TO ANNUAL INSPECTIONS BY LCRA OR PROPERTY ASSOCIATION; AND
ii. VACUUMING AND POWER WASHING PER MANUFACTURE'S SPECIFICATIONS.

LOWER COLORADO RIVER AUTHORITY		
POROUS CONCRETE FOR RESIDENTIAL DRIVEWAY DETAIL	DATE: 05-2007	SHEET: 1 OF 1

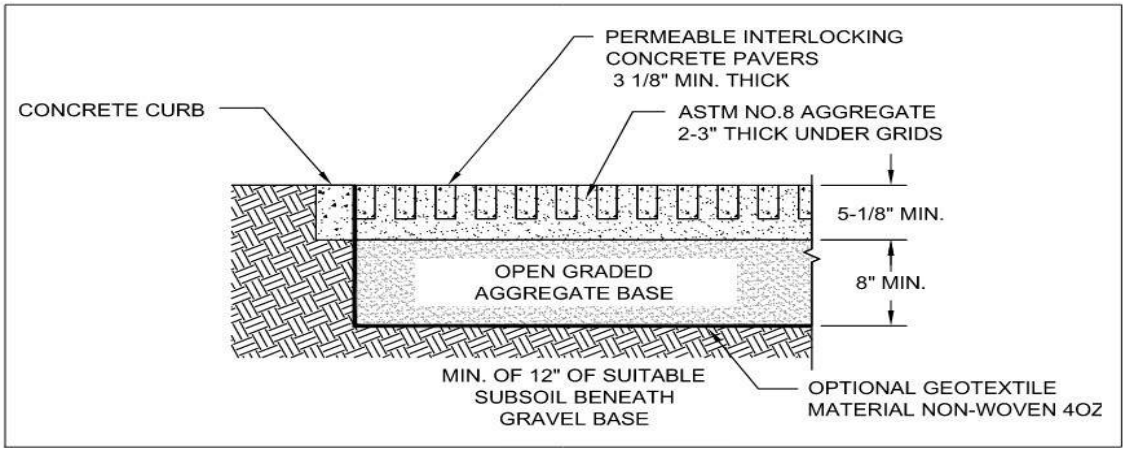
Permeable Interlocking Concrete Pavers (PICP) Design Criteria

Design of PICP should follow Interlocking Concrete Pavement Institute (ICPI) or equivalent design procedures, specifications and maintenance guidance. Proposals for use of PICP to receive impervious cover credits requires a technical review of submittals, including a site plan, site-specific installation details, product specifications and laboratory or field infiltration testing data indicating the system can achieve a 55 inches per hour infiltration rate.

PICP must use open aggregate (No. 8 is preferred or No. 9) for the joint infill and choke layer and a minimum of an 8-inch depth of open-graded No. 57 (1/2 inch to 1 ½ inches) or No. 4 (1 ½ inches to 2 inches) aggregate base. Slopes over 2% will need to incorporate lateral flow barriers and/or cut-offs in the aggregate base layer. Impervious cover credit may be limited on slopes of more than 10%. If an underdrain is proposed, effluent from an underdrain system must be treated with vegetated strips, infiltration or structural BMP system. Refer to the permeable concrete section above for underdrain, geotextile and subsoil requirements.

Field testing must demonstrate an initial infiltration of at least 55 inches per hour immediately following installation.

The owner will need to maintain the pavers to maintain a long-term infiltration rate of 10 inches per hour, which will become a requirement under the BMP Maintenance Permit.



MATERIALS:

i. GEOTEXTILE MATERIAL: NON-WOVEN 4 OZ;
ii. OPEN-GRADED AGGREGATE BASE: VOID SPACE BETWEEN 30-40%. ASTM NO.57 OR NO. 4 CRUSHED STONE AGGREGATE IS SUITABLE AS A BASE AND STORAGE MEDIUM FOR RUNOFF;
iii. RECEIVING AGGREGATE: ASTM NO.8 AGGREGATE PREFERRED, NO. 9 OPTIONAL; AND
iv. CONCRETE GRID PAVERS: ASTM C 936, STANDARD SPECIFICATION FOR CONCRETE GRID PAVING UNITS.

GENERAL REQUIREMENTS:

i. DRIVEWAY SLOPE MUST BE LESS THAN 10%. LATERAL FLOW BARRIERS REQUIRED FOR SLOPES GREATER THAN 2% (SEE PLANS FOR SPACING AND DETAILS);
ii. SUBSOIL: 12" OF SUITABLE SUBSOIL IN TERMS OF SUPPORT AND INFILTRATION REQUIRED. A MINIMUM INFILTRATION RATE OF 0.52 IN/HR IS REQUIRED. SOILS WITH AN INFILTRATION RATE BETWEEN 0.27 AND 0.52 IN/HR HAVE MARGINAL INFILTRATION CAPACITY AND MAY NOT BE SUITABLE FOR ABSORBING RUNOFF. SAND, LOAMY SAND, AND SANDY LOAM ARE GENERALLY CONSIDERED SUITABLE FOR INFILTRATION AND SUPPORT.

INSTALLATION:

i. SUBGRADE: THE SUBGRADE MUST NOT BE COMPACTED OR SUBJECTED TO CONSTRUCTION VEHICLE TRAFFIC OR SEDIMENT PRIOR TO THE PLACEMENT OF BASE. SUBGRADE WORK MUST BE SEQUENCED TO MINIMIZE PASSES OF CONSTRUCTION VEHICLES IN THE BEDS THEMSELVES. IF THE EXCAVATED SUBGRADE IS EXPOSED TO RAINFALL RUNOFF, IT MAY ACCUMULATE FINES. GRADING SHOULD NOT OCCUR DURING WET SOIL CONDITIONS TO MINIMIZE SMEARING AND SEALING OF THE SOIL SURFACE. IF SUCH SEALING OCCURS, THE SURFACE MUST BE SCARIFIED TO RESTORE NATURAL TEXTURE AND PERMEABILITY;
ii. GEOTEXTILE FABRIC: A LAYER OF NON-WOVEN 4OZ. GEOTEXTILE FABRIC IS TO BE PLACED ON TOP OF THE NATURAL SUBSOIL PRIOR TO PLACING BASE MATERIAL. THE FABRIC SHOULD EXTEND UP TO THE NATURAL EARTH SIDES AND OVER THE TOP OF ANY ADJACENT BERM. THE PURPOSE OF THE FABRIC IS TO PREVENT MIGRATION OF FINE MATERIAL FROM THE SUBSOIL INTO THE GRAVEL;
iii. BASE MATERIAL: THE BASE MATERIAL SHOULD BE COMPACTED TO A THICKNESS OF 8" WITH A STATIC ROLLER RATHER THAN A VIBRATORY ROLLER AND THEN CHOKED WITH A 2-3" THICK LAYER OF ASTM NO.8 CRUSHED STONE. THIS LAYER SHOULD BE ROLLED LEVEL AS WELL, AND A THIN, LOOSE LAYER OF NO.8 STONE SCREEDED EVENLY ACROSS THE SURFACE TO RECEIVE THE PAVING UNITS; AND
iv. CONCRETE GRID PAVERS: THE GRIDS ARE PLACED AND COMPACTED INTO THE LOOSE SURFACE OF THE NO.8 MATERIAL. THE OPENINGS ARE THEN FILLED WITH THE NO.8 MATERIAL AND THE PAVING UNITS ARE COMPACTED AGAIN. ADDITIONAL MANUFACTURE'S REQUIREMENTS MAY APPLY.

MAINTENANCE

i. SUBJECT TO ANNUAL INSPECTIONS BY LCRA OR PROPERTY ASSOCIATION.

LOWER COLORADO RIVER AUTHORITY		
PERMEABLE INTERLOCKING PAVERS FOR RESIDENTIAL DRIVEWAY DETAIL	DATE: 05-2014	SHEET: 1 OF 1

Gravel with Cellular Confinement Design Criteria

Design of gravel pavement systems should follow manufacturers design procedures, specifications and maintenance guidance. Proposals for use of gravel pavement systems to receive impervious cover credits requires a technical review of submittals, including a site plan, site-specific installation details, product specifications and laboratory or field infiltration testing data indicating the system can achieve a 55 inch per hour infiltration rate.

Aggregate used for base material and infill must consist of clean durable gravel aggregate of uniform size. A minimum gravel base thickness of 8 inches is required to receive the maximum reduction factor of 0.9. Shallower base thicknesses may be eligible for a reduced credit. Slopes over 2% will need to incorporate lateral flow barriers and/or cut-offs in the aggregate base layer. Impervious cover credit may be limited on slopes of more than 10%. If an underdrain is proposed, effluent from an underdrain system must be treated with vegetated strips, infiltration or structural BMP system. Refer to the permeable concrete section above for underdrain, geotextile and subsoil requirements.

Field testing shall demonstrate an initial infiltration rate of at least 55 inches per hour immediately following installation.

The owner will need to maintain the system to maintain a long-term infiltration rate of 10 inches per hour, which will become a requirement under the BMP Maintenance Permit.

Gravel Surface (Without Confinement) Design Criteria

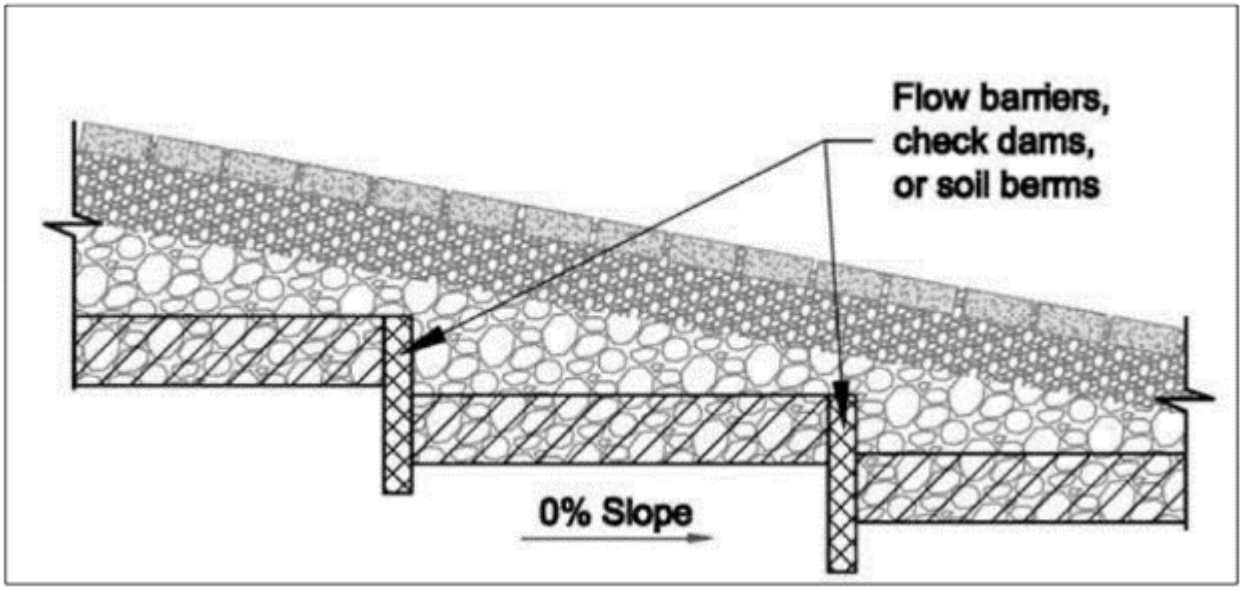
Proposals for use of gravel surfaces for impervious cover credit are limited to slopes of less than 5%. A minimum depth of 3 inches of washed, durable gravel with a minimum diameter of 3/8 inch is required. The credit is limited to areas where rain will fall onto the gravel surface and where flow will not be concentrated. Runoff from adjacent areas may not enter the gravel surface area.

The owner will need to maintain the surface to maintain gravel depth and void space in the gravel layer.

Additional Design Details

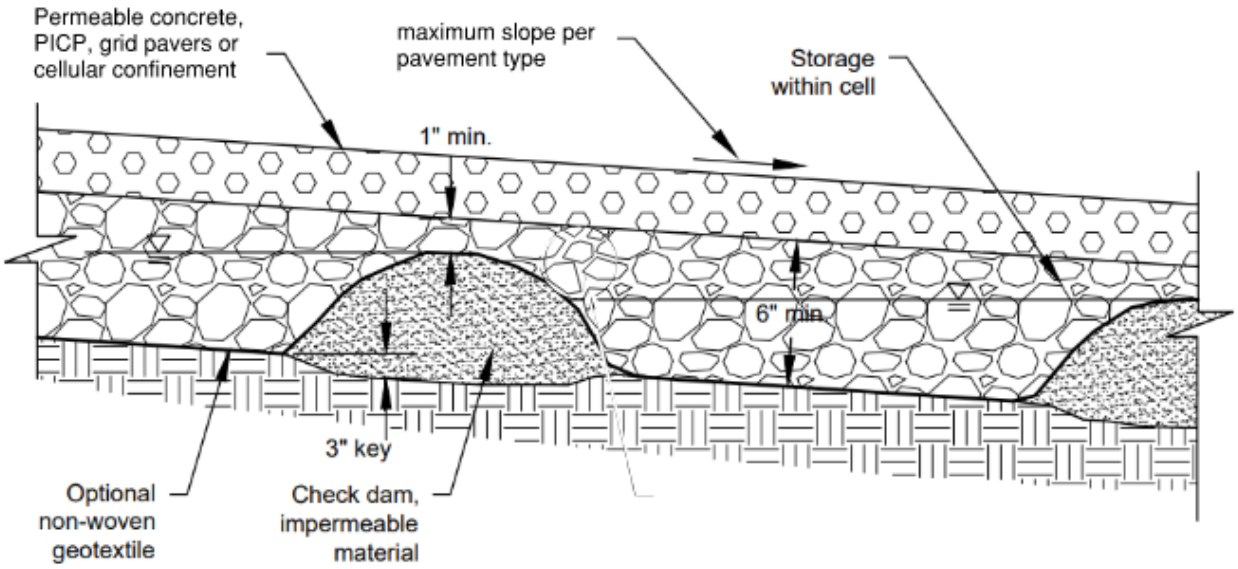
Pavement Bottom Slope – For unlined designs, the bottom slope of a permeable pavement installation should be as flat as possible (i.e., 0% longitudinal and lateral slopes) to enable even distribution and infiltration of stormwater. On sloped sites, internal check dams or berms, as shown in the Figure 4.19 (b) and (c), can be incorporated into the subsurface to encourage infiltration. In this type of design, the depth of the infiltration sump would be the depth behind the check dams. The depth and spacing of the barriers are dependent upon the underlying slope and the infiltration rate, as any water retained by the flow barriers must infiltrate within 48 hours. If an underdrain will be used in conjunction with the flow barriers, it can be installed over the top of the barriers, or parallel to the barriers with an underdrain in each cell.

Figure 4.19 (b): Lateral Flow Barrier example (after Stormwater Guidebook_Permeable Pavement Systems.pdf (dc.gov))



Note: refer to bulletin for dimensions, material specifications and design criteria

Figure 4.19 (c): Lateral Flow Barrier – Earthen Check Dam example (after Washington State Department of Ecology; Figure V-5.3.6)



Note: refer to bulletin for dimensions, material specifications and design criteria