

# Why Should You Consider a Stormwater Friendly Driveway?

Driveways are an integral part of our residential properties. They afford better access and allow us to park off the street. Stormwater friendly driveways also allow water to soak away into the ground below, where it is filtered by the soil and can recharge groundwater, keep pollutants out of Lake Champlain, and reduce flooding risks. These driveways help conscientious homeowners reduce their individual contributions to the City's stormwater runoff challenges.

Unfortunately, our traditional driveways are often direct conduits for polluted runoff to drain quickly from properties into the street. Rain falling on impermeable, paved surfaces collects oil, deicing salts, fertilizers, and gasoline residue as it runs down the driveway to the street. Driveways also often capture runoff from adjacent rooftops, directing an even larger volume of water out to the road than what falls on the driveway. Runoff from sloped gravel or dirt driveways typically carries a significant amount of sediment. Much of this material stays on our streets, creating hazards for cyclists, while the rest of it clogs up stormwater infrastructure and pollutes Lake Champlain – not to mention the money that property owners pay over and over again to replace their lost driveway material.

## Benefits

- Help improve Lake Champlain water quality by managing rain where it falls and reducing runoff from storms
- Solve or prevent erosion problems on your property, prevent puddles and the nuisance they create, reduce your use of sand and salt or other deicing chemicals, and keep gravel, sediment, and other pollutants out of your street, storm sewers, and Lake Champlain
- Increase the value of your home by beautifying your landscape, while benefiting plants and gardens by recharging the water table on your property



Stormwater friendly driveways like this one in Burlington, where an open concrete paver system was planted with grass, offer multiple benefits for homeowners, local infrastructure, and Lake Champlain.

# Why Should You Consider a Stormwater Friendly Driveway? (cont.)

The cumulative effect of rapid runoff from our homes and driveways can cause localized flooding, or overwhelm the sewer system and cause sewage to backup into basements. Once it gets to a storm drain, runoff is typically discharged to the lake with little or no treatment. Vermont has over a dozen stormwater impaired watersheds, all of which ultimately drain to Lake Champlain. The impact of urban stormwater runoff on the lake's health, aquatic species, and our enjoyment and use is significant.

For these reasons and more, the City of Burlington Stormwater Management Program encourages the implementation of stormwater friendly driveways.



*A ribbon or "Hollywood" driveway, like this one in Burlington, is another stormwater-friendly driveway option.*

Stormwater friendly driveways are attractive and durable. Most types require minimal maintenance, last longer than traditional concrete or asphalt, and allow snow and ice to melt and drain away faster. If you are already planning to replace your driveway, consider making a better long-term choice for your home, your neighborhood, and the Lake.

Zoning restrictions and open space requirements often limit what you can build on your property, depending on the amount and type of manmade surfaces already in place. Choosing a stormwater friendly driveway, however, can reduce the amount of coverage calculated for zoning permit purposes and thus may allow you to construct additional building space elsewhere on your lot. Currently "strip driveways" provide this benefit, but soon other stormwater driveway types may provide up to 50% credit if proposed amendments to zoning regulations are approved in early 2014.

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Visit <http://bit.ly/1hzity2> for available grant opportunities that may help you implement your own stormwater friendly driveway.



# Stormwater Friendly Driveways: Porous Concrete and Asphalt

Porous concrete and asphalt – also called permeable or pervious – are alternative pavement surfaces that contain the same large aggregate material as traditional concrete or asphalt, but little or no sand or other fine fill material. This leaves a system of holes or voids that water can drain through quickly, while maintaining the general appearance and hardness of typical pavement. Porous pavement is installed over a drainage layer of clean, crushed stone and supporting subbase (see the schematic drawing on the next page) that acts as a reservoir to hold, drain, and infiltrate stormwater. Porous pavement surfaces tend to be more textured, providing better traction for vehicles and pedestrians, and both poured-in-place and pre-cast options are available.

**QUICKER SNOWMELT AND DRAINAGE:** The air flow and drainage provided at the surface of the driveway allows snow and ice to melt and drain quickly, reducing the risk of re-freezing and slippery surfaces. Less deicer is needed, lowering winter maintenance costs while keeping chlorides from leaching into ground and surface waters.

**LOW LIFE-CYCLE COST:** While installation costs are typically slightly higher, properly constructed porous pavement is durable, low maintenance, and has a low life cycle cost.

**WATER QUALITY:** Contaminants such as oils can be caught in the void spaces of the porous pavement where they are broken down into smaller and less harmful compounds, and are kept out of your yard, storm drains, and natural waterways. Porous pavement also does not require sealing with potentially toxic sealants.

**WATER QUANTITY:** Porous pavement is typically designed to treat stormwater that falls on the actual paved surface, but it can often accept clean runoff from adjacent impervious areas like rooftops.

**CONSIDERATIONS:** Porous pavement has more void space and is prone to settling under heavy weight, though this should not be an issue in residential applications. Proper installation is critical, so a certified installer or an experienced contractor should be selected. Pavement should be kept clean with regular sweeping, typically once in spring after snowmelt, once in fall after the leaves fall, or occasional vacuuming to keep void spaces clear. Careful sediment control is needed for any uphill areas to avoid clogging pavement. Care should be taken when using deicers—over-application of chlorides can increase raveling of pervious concrete. Consider use of pre-cast permeable concrete slabs to minimize this material's susceptibility to deicers.



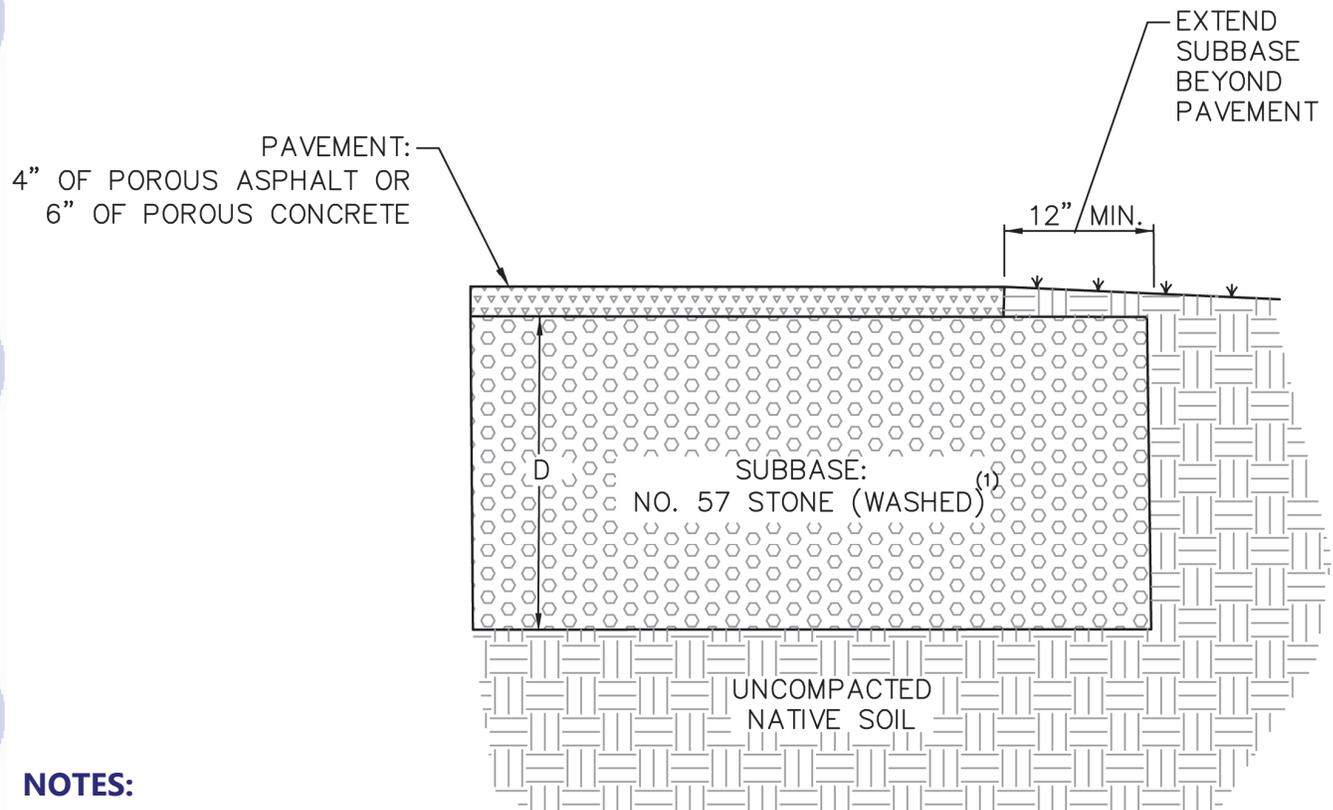
The line between porous and non-porous asphalt. Photo credit: vtwaterquality.org.



A pre-cast permeable concrete parking lot being laid on the UVM campus in Burlington. Photo credit: University of Vermont.



# Porous Concrete and Asphalt: Schematic Drawing (not to scale)



## NOTES:

- (1) Refer to the companion Local Vendors List for locally available products.
- (2) Compact the subbase layer in minimum 6" lifts.
- (3) All aggregates must be washed angular crushed stone. Do not use rounded stone.
- (4) For porous concrete: Allow 28-day cure prior to exposure to freezing, and no deicer use within first 12 months.
- (5) Subbase thickness dimension "D" is 12 inches for sandy, well drained soils, and 16" otherwise. This subbase thickness is for residential driveways only. Locations that experience heavy vehicle loads or have clay soils will require subbase design by a qualified professional. Maximum driveway slope should not exceed 5%.

## ESTIMATED INSTALLATION COSTS:

Porous asphalt and concrete costs start at \$20 per square foot. This cost includes subbase installation, but not demolition of the existing driveway. Costs vary based on soil conditions, size of driveway, and contractor availability.

*The typical cross sections provided herein are conceptual only and are not intended for use as construction documents. Refer to manufacturer for installation and maintenance requirements for all products. Modifications to the typical sections may be necessary based upon soil conditions and site suitability. Contact a qualified professional to verify suitability for each application.*



# Stormwater Friendly Driveways: Solid Pavers and Turf Pavers

Pavers are interlocking blocks of stone, brick, or concrete that can be installed instead of conventional impervious paving. There are two main types of paver systems: impervious block systems that incorporate spaces between to allow infiltration, or systems with larger spaces within blocks filled with clean washed stone, or grass or other suitable vegetation.

Installation of pavers begins with a level base of existing or “native” soil (see schematic drawing on the next page). A washed gravel subbase (e.g., No. 57 stone) may be spread over the soil base to provide a reservoir for holding runoff prior to infiltration. Incorporating a gravel subbase increases the stormwater management benefits of using pavers, and is especially important on less well-drained or clay soils. A bedding course is then placed, leveled, and compacted. The bedding course accommodates minor differences in the pavers and allows the pavers to seat firmly so that they won’t rock and crack. The pavers are laid on the bedding course, and are filled with bedding course or sand/soil material according to the paver manufacturer’s specifications. Open space pavers can be either filled with stone or seeded.

**CURB APPEAL:** Many colors, styles, and patterns are available and pavers have great aesthetic value. Pavers have much the same look as brick driveways, but offer greater water quality benefits. To minimize installation costs, consider using solid pavers and turf pavers together in a ribbon driveway layout (see companion sheet) if suitable for your site.

**EROSION PREVENTION:** Replacing gravel surfaces with pavers can reduce erosion and contaminant transport to storm drains, and can help reduce localized flooding and pooling during storm events.

**WATER QUALITY:** Paver systems filter water as it passes through, and help recharge local groundwater.

**QUICKER SNOWMELT AND DRAINAGE:** Increased drainage and air flow mean snow melts more quickly and drains away, instead of re-freezing and creating slippery conditions. Less deicer is needed, lowering winter maintenance costs while keeping chlorides from leaching into ground and surface waters.

**DURABILITY:** Pavers are better able to move with the freeze-thaw cycle, rather than cracking like typical pavement. Individual pavers can easily be replaced as needed.

**CONSIDERATIONS:** Some site preparation, such as clearing and leveling, is necessary to ensure that the pavers are installed evenly and correctly and won’t “pop”. Care should be taken when applying deicers to vegetated pavers in the winter.



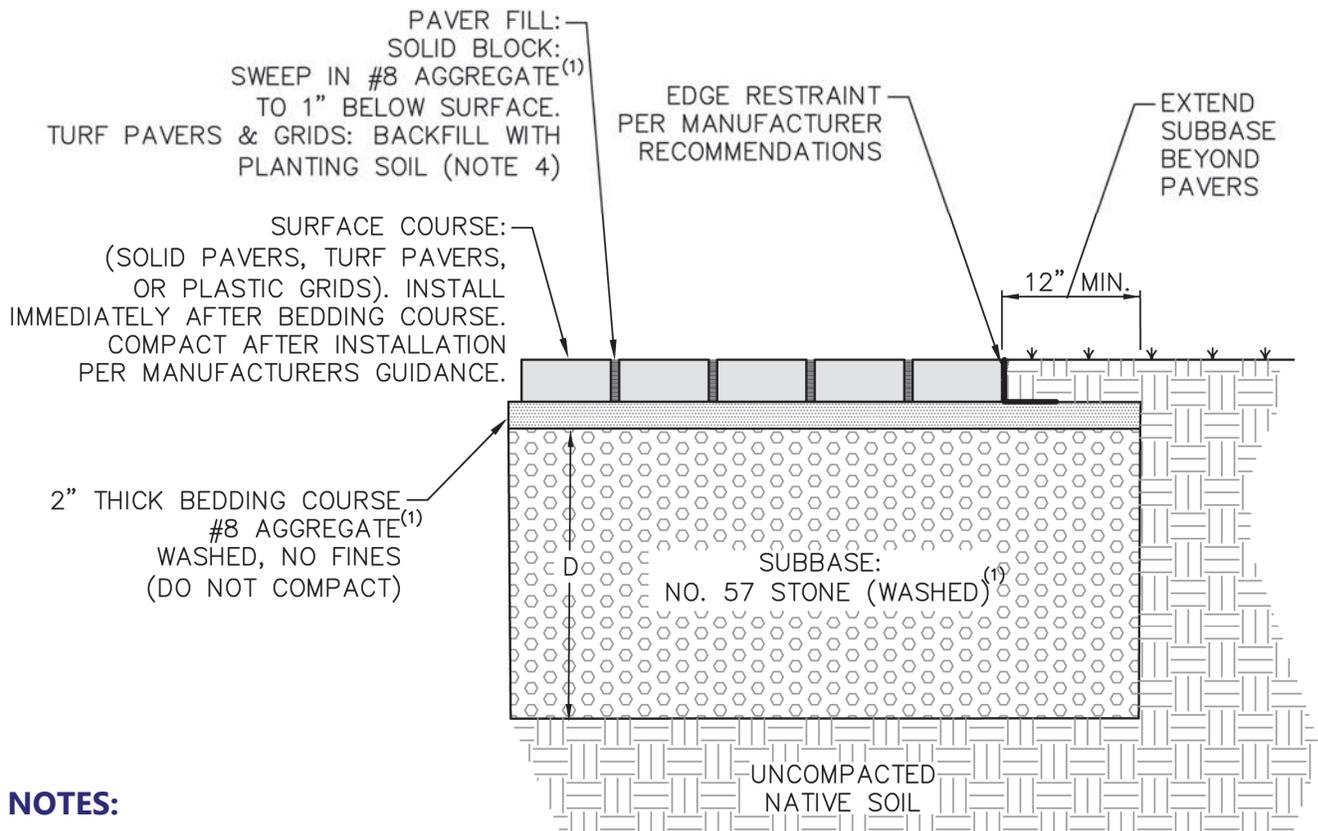
*A concrete paver walkway in Burlington.*



*Concrete paver driveway planted with turf.*



# Solid Pavers and Turf Pavers: Schematic Drawing (not to scale)



## NOTES:

- (1) Refer to the companion Local Vendors List for locally available products.
- (2) Compact subbase material in minimum 6" lifts.
- (3) All aggregates must be washed angular crushed stone. Do not use rounded stone.
- (4) Planting soil mix for turf pavers to be 60:40 concrete sand/soil, or 70:30 concrete sand/compost (blend prior to placement).
- (5) Do not use stone dust or stone screenings within the paving system.
- (6) Subbase thickness dimension "D" is 10" for sandy, well drained soils, and 16" otherwise. This subbase thickness is for residential driveways only. Locations that experience heavy vehicle loads or have clay soils will require subbase design by qualified professional. Maximum driveway slope should not exceed 5%.

## ESTIMATED INSTALLATION COSTS:

Solid and turf paver costs start at \$20 per square foot. This cost includes subbase installation, but not demolition of the existing driveway. Costs vary based on soil conditions, driveway size, and contractor availability.

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# Stormwater Friendly Driveways: Plastic Grid Systems

Plastic grid systems are made up of honeycomb-like grids of closed plastic cells, and are filled with gravel or sand/soil mix and grass after they are installed. These grid systems are primarily constructed from recycled plastic, and they help guard against soil compaction and rutting—thus also protecting water quality.

Installation of a plastic grid system begins with a base of existing or “native” soil (see schematic drawing on the next page). A crushed gravel subbase may be spread over the soil base to provide a reservoir that holds runoff, so that more can soak into the ground. Incorporating a gravel subbase increases the stormwater management benefits of using a plastic grid system, particularly in areas with poorly drained soils. A drainage layer of clean stone and a bedding course are then placed and lightly compacted. The grid is laid on the bedding course and filled with clean sand or sand/soil mix to the depth called for in the manufacturer’s specifications. The cells are then filled with stone or seeded.

## **WATER QUALITY AND EROSION PREVENTION:**

The plastic grids hold gravel and turf in place, prevent erosion, allow water to infiltrate, and provide some stormwater filtration.

**QUICKER SNOWMELT AND DRAINAGE:** Increased drainage and surface texture mean snow melts more quickly and drains away, instead of re-freezing and creating slippery conditions. Plastic grid systems are compatible with snow shoveling and snow blowing since the grass roots are protected below the plastic grid.

**FLEXIBLE SITE DESIGN:** The flexibility of the plastic grid makes it better suited to uneven terrain than solid or turf pavers. Plastic grids can be cut to fit any shape or area. The interlocking panels are quick and easy to install.

**DURABILITY:** Minimal maintenance is needed to ensure that the plastic cells stay properly filled with media and maintain their shape and stability.

**CONSIDERATIONS:** Plastic grid systems are not intended for high-traffic surfaces, or frequent use by heavy weight vehicles where the grids may become worn down or over-compacted. Mowing and otherwise maintaining the turf in your grid system is important to ensure continued high function. Care should be taken when applying deicers in the winter to avoid killing grasses.

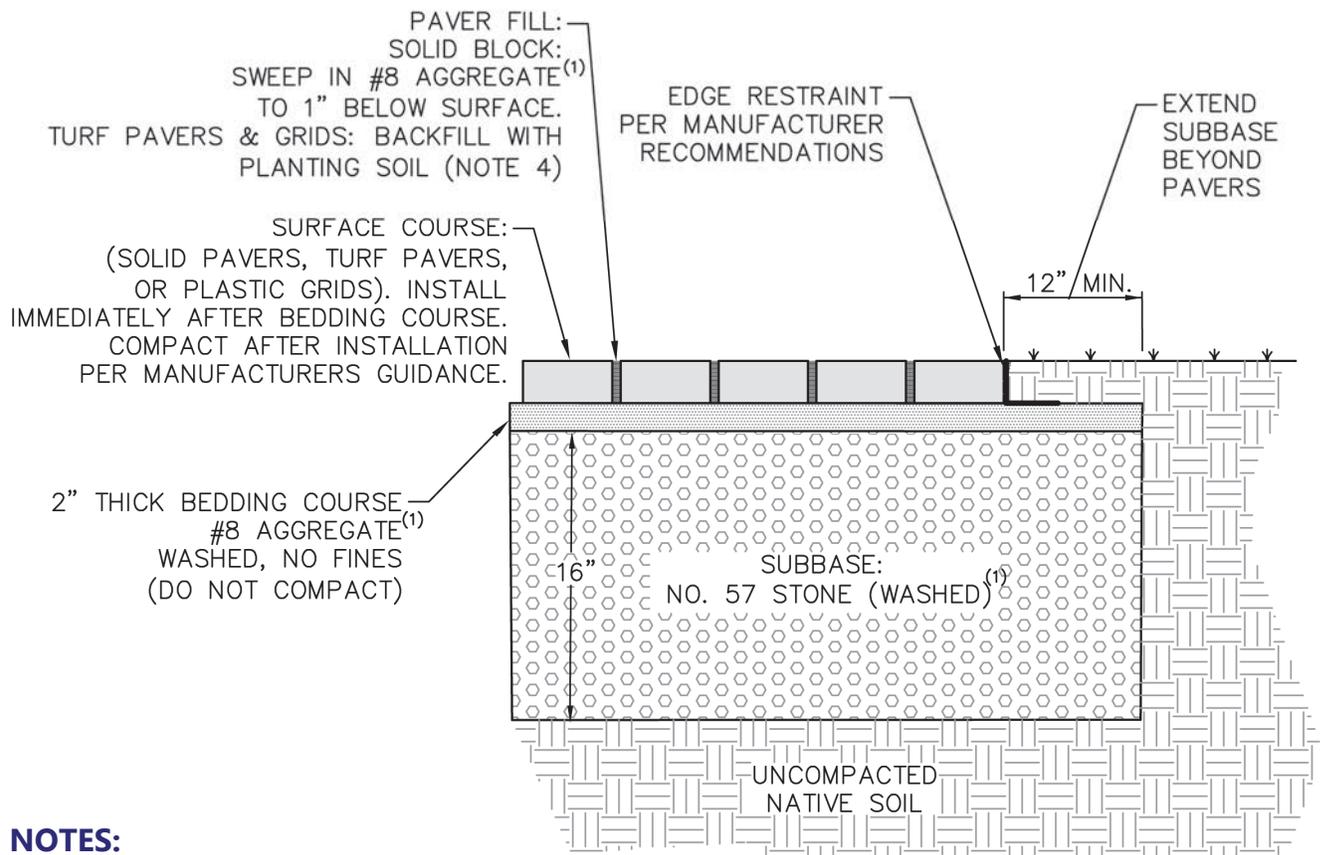


*Schematic of the Invisible Structures Grasspave2 plastic grid system (invisiblestructures.com)*



*Installation of a plastic grid system with gravel fill (groundprotection.co.uk)*

# Plastic Grid Systems: Schematic Drawing (not to scale)



## NOTES:

- (1) Refer to the companion Local Vendors List for locally available products.
- (2) Compact the subbase layer in minimum 6" lifts.
- (3) All aggregates must be washed angular crushed stone. Do not use rounded stone.
- (4) Planting soil mix for turf grassed grid systems to be 60:40 concrete sand/soil, or 70:30 concrete sand/compost (blend prior to placement).
- (5) Subbase thickness dimension "D" is 10" for sandy, well drained soils, and 16" otherwise. This subbase thickness is for residential driveways only. Locations that experience heavy vehicle loads or have soft soils will require subbase design by an engineer. Maximum driveway slope should not exceed 5%.

## ESTIMATED INSTALLATION COSTS:

Plastic grid system installation costs start at \$15 per square foot. This cost includes subbase installation, but not demolition of the existing driveway. Costs vary based on soil conditions, size of driveway, and contractor availability.

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# Stormwater Friendly Driveways: Ribbon Driveways

Ribbon or “Hollywood” driveways became popular in the 1920s and consist of two parallel strips of concrete, mortar-set stone or brick, or solid or turf pavers with an open, unpaved space in between. The strips in a ribbon driveway should be at least two feet wide and located so they are separated five feet on center (see schematic on the following page). The space between the ribbons may be planted with grass or another ground cover, or filled with landscaping rocks or gravel. Ribbon designs are best suited to shorter, straight driveways, and can become impractical where driveways are long or curved.

**LOWER COST:** Ribbon driveways require far less material and installation time than fully paved driveways. Ribbon driveways can be contoured and designed to fit most any space.

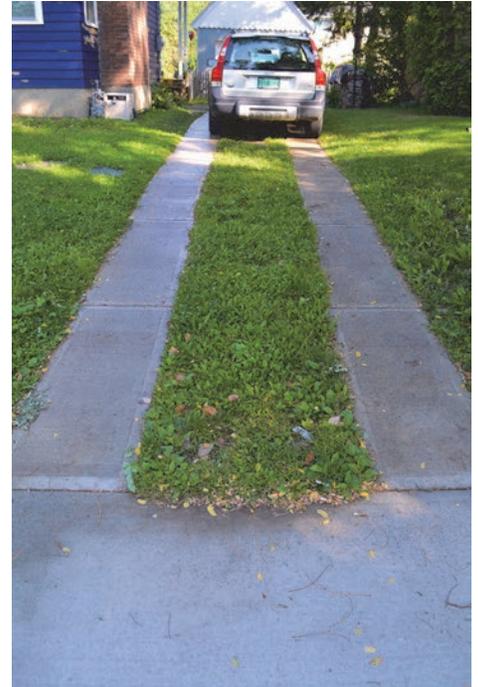
**CURB APPEAL:** Ribbon driveways provide great opportunities for landscaping, with many design and pattern options. Ribbon driveways can be combined with porous pavement, permeable pavers, bricks, or turf pavers. Ribbon driveways can be incorporated into historical restoration or used to add quaint charm and character to your home.

**WATER QUALITY:** Ribbon driveways typically contain 60-70% less impervious surface than a full width driveway, allowing more water to drain into the ground below and reducing runoff.

**DURABILITY:** Ribbon driveways are able to respond more dynamically to frost and thaw cycles than fully paved driveways and are less prone to cracking. If needed, replacement of ribbon driveways is easier, quicker, and less costly.

**CONSIDERATIONS:** Ensure that the ground doesn’t become compacted when tires miss the strips—consider placing small markers to avoid driving off the paved areas. The center open ribbon may need annual maintenance to top off gravel, or keep vegetation healthy after each winter snowplowing season. If ground cover or grass is selected for the open ribbon, parked vehicles must be moved periodically so that a single location is not continuously shaded. Snow-blowers work well with ribbon driveways.

As of December 2013, ribbon driveways are the only layout that receives coverage credit under the zoning regulations, as only the paved strip portion (beyond the required 38 feet of parking space) is counted in calculating lot coverage.



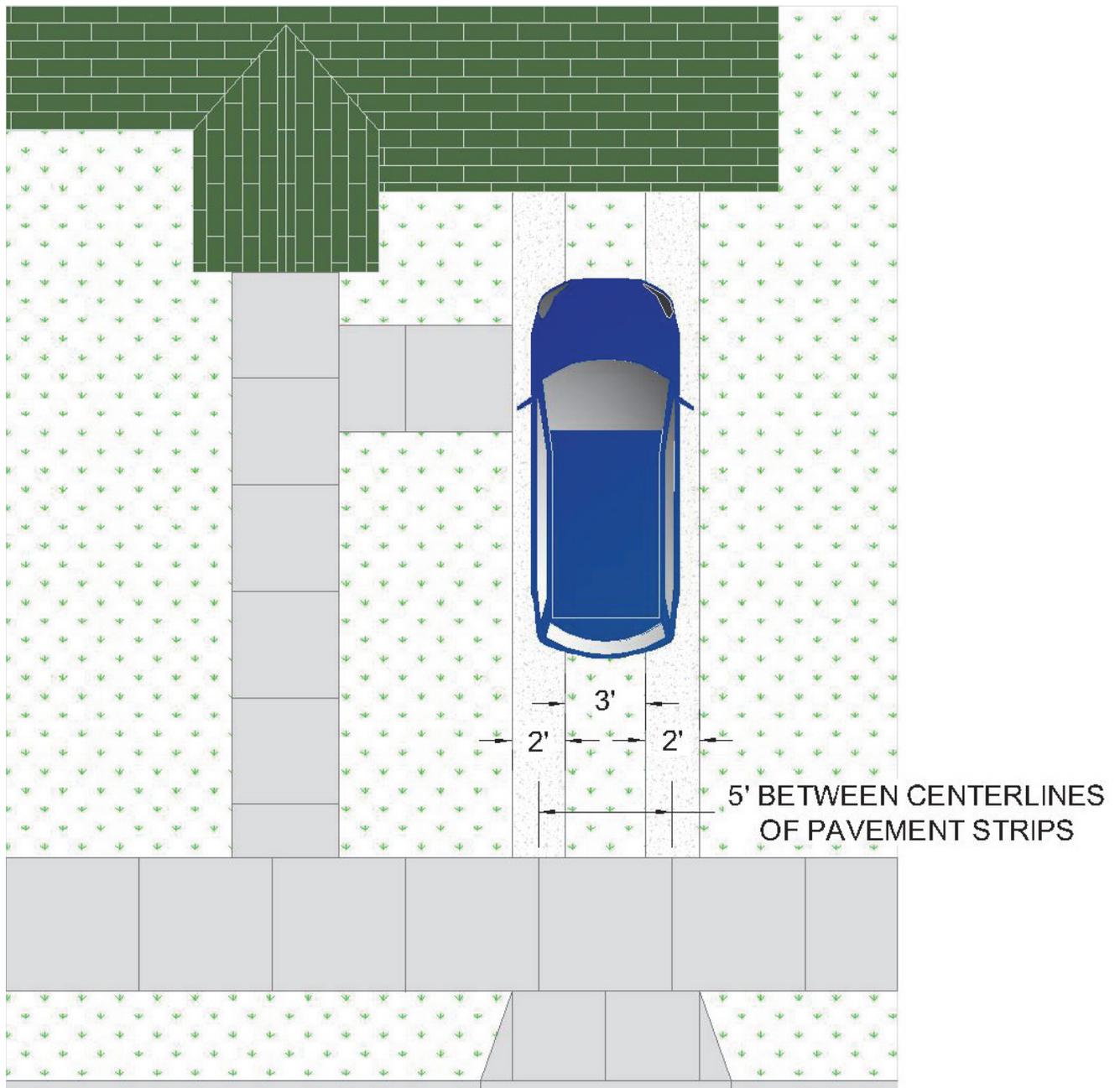
*A concrete ribbon driveway in Burlington.*



*A concrete paver ribbon driveway in Burlington.*



# Ribbon Driveways: Schematic Drawing (not to scale)



## NOTES:

- (1) Refer to the companion Local Vendors List for locally available products.

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# Stormwater Friendly Driveways: Problem Prevention

## Coal-Tar Based Sealants

When asphalt driveways crack, sealants are often touted as a cheap and easy fix. Traditionally, sealants have been made with coal tar, which contains high levels of polycyclic aromatic hydrocarbons (PAHs) that can wash off and pollute air, soil, and water. PAHs are toxic to mammals (including humans), birds, fish, amphibians, and plants—and PAH levels can be 60-80 times higher in particles washed off of coal-tar sealed surfaces as compared to unsealed surfaces.

Asphalt-based seal coats present an option with much lower PAH concentrations (up to 1000 times less) than coal-tar sealants. A 2012 survey found that asphalt-based sealants cost an average of \$20 per five-gallon bucket, about 20% more than coal tar-based sealants. There are other environmentally friendly sealant products available on the market, including Gilsonite-based and acrylic-based products, but they can be much more expensive (\$40+ per five-gallon bucket). Finally, utilizing pavers, a plastic grid system, or other permeable driveway options eliminates the need for sealants.

## Gravel Driveways

While gravel driveways may start off permeable, compaction eventually makes them just as impermeable as regular asphalt. Many driveways slope down to the street, so gravel can migrate into the roadway during significant rain events. When this happens, the homeowner has to replace the gravel, and it can cause problems for bicyclists and other vehicles using the street, stormwater infrastructure, and Lake Champlain.

In some cases the negative impacts of gravel driveways can be mitigated by shaping or crowning the driveway to get water and sediment to shed to the sides. However, the City of Burlington Stormwater Management Program recommends that gravel **not** be used as a driveway surface on slopes greater than 2%. Driveways that discharge sediment to the right-of-way may be cited for violation of the City's Chapter 26 Ordinance on Wastewater, Stormwater, and Pollution Control [26-112(b)(1-2)]. Homeowners with steeper driveways should actively look for alternatives to gravel.

## Coal-Tar Sealant Alternatives

- ENVIROSEAL LAS-320™ asphalt sealer is not petroleum based, and is EPA approved
- AFM DynoSeal Driveway/ Asphalt Sealer
- INTEGRA-SEAL by UNIQUE Paving Materials, asphalt-based, zero VOCs, no PAHs
- Eco-Seal Brand Sealer
- Latex-ite® Blacktop Driveway Sealers
- Black Jack® Asphalt Sealers



*A Burlington gravel driveway without proper slope and drainage. Gravel and oils are washing into the street.*



*A Burlington gravel driveway with clean gravel and no wash-out.*



# Stormwater Friendly Driveways: List of Local Vendors for Materials

## Plastic Grids

Products : NDS Tufftrack, Bodpave 40 & 85

Local Vendor (NDS TuffTrack only): Ferguson Waterworks

429 Troy Avenue

Colchester, VT 05446

Phone : 802-655-3505

## Solid Pavers, Turf Pavers

Product Lines: Unilock, Belgard, Technobloc

Local Vendor: Trowel Trades Supply

206 Hegeman Ave.

Colchester, VT 05446

Phone: 802-655-3166

## Aggregates: #57 stone, #8 stone, and Concrete Sand (ASTM C33 sand)

Whitcomb Quarry (substitute Standard 3/8" stone for #8 stone, request washing, order 10% extra)

61 Whitcomb Street

Colchester, VT 05446

Phone: 802-655-1270

Shelburne Limestone Corporation (substitute 1/8" filler stone for #8 stone, #57 or sand not available)

688 Quarry Road

Shelburne, VT 05482

Phone: 802-985-2334

Hinesburg Sand & Gravel (all products available, specify crushed product)

14818 Route 116

Hinesburg, VT 05461

Phone: 802-482-2342

## Paving Contractors

Porous Asphalt:

S.T. Paving

PO Box 567

Waterbury VT 05676

Phone: 802-244-7861

Porous Concrete:

SD Ireland Companies

193 Industrial Avenue

Williston, VT 05495

Phone: 802-863-6222

Porous Concrete Panels (Precast):

Product Name: Stormcrete

Porous Technologies, LLC

8 Blue Moon Drive

North Yarmouth, ME 04097

Phone: 877-271-9055

