

OPERATION & MAINTENANCE GUIDE

for Belgard Permeable Interlocking Concrete Pavement Systems



BELGARD PERMEABLE PAVERS are produced by Oldcastle Architectural Products Group (APG) plants throughout North America and are manufactured in accordance with ASTM *C936 Standard Specification for Solid Concrete Interlocking Paving Units*, and ASTM C1782 *Standard Specification for Segmental Concrete Paving Slabs* in the United States. In Canada, pavers and slabs are manufactured in accordance with CSA A231.1/ A231.2 *Precast Concrete Paving Slabs/Precast Concrete Pavers*.

Permeable Interlocking Concrete Pavement (PICP), like all types of permeable pavement, is a stormwater control measure that requires periodic inspection and maintenance to ensure long-term performance throughout the design life of the system. The type of maintenance differs from traditional impermeable pavements and maintenance methods can vary based on site-specific conditions.

All permeable pavements will collect sediment and debris which results in a decreasing infiltration rate over time. The rate of decrease depends on the sources of sediment. The surface infiltration rate reduction is gradual over time and most rain events are still infiltrated through the sediment filled joints. Gradual sedimentation captures suspended solids near the surface where routine maintenance can readily remove the sediment.

This document addresses the key inspection and maintenance requirements for Belgard permeable paver systems and does not address other types of permeable pavement systems or the cleaning and maintaining of standard concrete pavers. Belgard recommends that a site-specific Operations & Maintenance (O&M) Manual be developed, based on guidelines presented in this document, for large commercial and municipal projects.

Visit **www.BelgardCommercial.com** for a full collection of resources related to Belgard permeable pavers including typical details, guide specifications, laying patterns, and other reference material.

Oldcastle APG, a part of CRH International, is committed to delivering sustainable products that provide environmental benefits, including concrete products for stormwater management. Belgard permeable pavers are used throughout North America as part of a Low Impact Development strategy to infiltrate stormwater, reduce runoff, and associated flooding. Oldcastle's commitment to a cleaner environment extends beyond the products we manufacture and now includes a variety of post-construction maintenance programs for owners, municipalities, and facility managers. For more information about Oldcastle's commitment to the environment, go to http://www.crh.com/sustainability.



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SITE CONSTRUCTION PROTECTION FOR PICP SYSTEMS

Protecting PICP from excessive sediment buildup during construction is important to long-term performance and effective future maintenance efforts. Most sites build PICP systems first to protect the open-graded aggregates from debris, dirt, etc., and then the PICP is used for site access during construction. During the pre-construction meeting, various trades should review material flow that will impact or stain the paver surface, e.g. concrete trucks, dry wall, masonry, etc. These vehicles may utilize the pavement, but consideration on how washout and debris from these trades will impact the paver surface must be addressed. Excessive mud tracked on the pavers may cause excessive sedimentation in some areas but can be removed with a vacuum street sweeper at the conclusion of construction activities and prior to turning the project over to the owner. In addition, the PICP system can serve as an integral part of the project's Stormwater Pollution Prevention Plan if designated before construction with a plan to maintain and restore the PICP to full surface infiltration capacity. Oldcastle recommends that the PICP can be used by construction traffic if the joint material is removed and replaced upon substantial completion of the project, as necessary due to sedimentation. Surface infiltration testing must be performed and exceed 100 in/hr. unless otherwise specified by the construction documents.

An alternative solution to protect the PICP system would be to excavate to the final subgrade elevation and install the ASTM No. 2 aggregate to the depth shown in the construction documents (the layer can be increased in thickness to reduce the grade change as you enter the permeable paver area, as needed). The ASTM No. 2 aggregate can then be used by construction traffic and as a sediment trap. Once the final road construction can proceed, the top 6 to12 inches of ASTM No. 2 aggregate is excavated and the PICP system is built in its entirety as designed. Once final road construction begins, prohibit construction traffic access over the open-graded aggregate subbase and base materials.





Another alternative solution would employ the use of a sacrificial layer of asphalt over the base (ASTM No. 57 aggregate). This approach would require the eventual removal of the asphalt layer and re-grading the base layer before proceeding with the setting bed layer and paver installation.

Each of these options would allow immediate traffic flow after the permeable pavers have been installed, compacted and joint fill added. Protection of the pavers may or may not be required based on the stage at which they were installed; the projected use by the trades; and needs of the property owner. Plywood, fabric with chips, tarps, and numerous other methods have been used in attempts to provide a protective layer over the paver surface, however, most have proven costly and ineffective.

POST-CONSTRUCTION (PUNCHLIST) INSPECTIONS AND CLOSE-OUT DOCUMENTS

When the PICP construction is complete, the owner or their representative should confirm that the newly built PICP was installed in general conformance with the construction documents. Confirmation that the proper materials and drainage were installed, through site visits and/or photographs, is recommended to ensure the long-term performance of the PICP system.

Example Construction Detail for a PICP System



Project close-out documentation should include all required information listed in the project specifications (inspection test reports, material certifications, etc.). A PICP Inspection should be conducted that includes, at a minimum, the items described below:

Belgard Permeable Paver Post-Construction (Punchlist) Inspection Checklist

- □ The pavers utilized are the type, thickness, and dimensions specified in the construction documents.
- **u** The edge restraint system is installed in general conformance with the construction documents.
- Paver joint openings are filled with the specified aggregate to the bottom of the chamfer of the paver.
- □ The area around the permeable paver perimeter is stabilized and covered with required vegetation or specified surface material
- \Box Final paver surface elevations do not deviate by $\pm \frac{3}{8}$ in. over a 10ft. long straightedge.
- The surface elevation of the pavers is 1/8 in. to 1/4 in. above adjacent utility structures, concrete collars, channels, curbing, or edge restraints within designated ADA routes. Note: Vehicular areas may be 3/8 in. above adjacent structures outside of ADA routes.
- Lippage is not greater than 1/8 in. between adjacent pavers.
- Cracked paver units (if applicable) have been removed and replaced.
- □ The installed surface slope is in general conformance with the construction documents.
- Drains and outfalls (if applicable) related to the PICP system are constructed and functioning in general conformance with the construction documents.
- Observation wells (if applicable) related to the permeable pavement system have been installed in accordance with the construction drawings and have been accessed to confirm the reservoir is draining as designed (based on rain event size).
- □ Surface infiltration testing in accordance with ASTM C1781, Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems, has been conducted within 60 days post-installation, and results exceed 100 inches/hour unless otherwise specified by the construction documents.

Oldcastle recommends that the contractor return to the site along with the owner and/or their representative 6-months after substantial completion to observe the permeable paver system and refill joints where joint infill is ½" or more below the chamfer of the pavers. Designers should include this requirement in the project specificatoins to ensure that it is included in the contractor's bid.

TYPES OF PICP MAINTENANCE ISSUES

The following examples of PICP maintenance issues can provide visual indicators of issues that require corrective actions.

CONDITION OBSERVED: EXCESSIVE PONDING AFTER RAIN EVENTS.



POSSIBLE CAUSE: Sediment build-up in joints from contributory run-on.

CORRECTIVE ACTION: Verify correct joint fill is being used; identify possible sources of excessive run-on that can be mitigated, validate observation based on several rain events. Conduct ASTM C1781 testing and perform restorative maintenance, if needed.

CONDITION OBSERVED: LOSS OF JOINT INFILL.



POSSIBLE CAUSE: Scouring on slopes; improper joint infill used; pumping under traffic; improper sweeping during routine maintenance; and failure to refill joints as needed.

CORRECTIVE ACTION: Verify correct joint fill is being used; replace joint fill material to bottom of the chamfer of the paver.

CONDITION OBSERVED: SURFACE SETTLEMENT: DEPRESSIONS OR RUTS.



POSSIBLE CAUSE: Weak subgrade conditions; improper compacting of subbase/base during construction; excessive loading.

CORRECTIVE ACTION: Verify surface deformation is in excess of $\frac{1}{2}$ inch using a 10-foot straight edge; contact a civil or geotechnical engineer to determine the cause of rutting and follow restorative action plan provided by the engineer (see Structural Repairs section).

CONDITION OBSERVED: DAMAGED PAVERS - CHIPS, CRACKS, SPALLS.





POSSIBLE CAUSE: Differential settlement; excessive loading, lack of joint infill.

CORRECTIVE ACTION: Determine causes of paver damage and correct the underlying conditions prior to replacing pavers (see Structural Repairs section).

CONDITION OBSERVED: EXCESSIVE IN-FIELD JOINT WIDTH (1/2")





POSSIBLE CAUSE: Improper or lack of joint infill; poor edge restraint system; settlement of subgrade, subbase, base, or bedding layer; utility trench failure.

CORRECTIVE ACTION: Re-instate pavers based on severity and frequency; evaluate surface for indications of settlement and address accordingly.

STRUCTURAL REPAIRS

PICP may require structural repairs during the life of the pavement to correct pavement distresses and to maintain an acceptable level of service. The most common distresses that affect the structural performance of PICP include damaged pavers and depressions and rutting. A more comprehensive list of distresses can be found in ASTM E2840 Standard Practice for Pavement Condition Index Surveys for Interlocking Concrete Roads and Parking Lots. While ASTM E2840 is specific to interlocking concrete pavers, most of the information provided is applicable to PICP. For large commercial projects (> 100,000 sf), Belgard recommends calculating a Pavement Condition Index (PCI), adjusted to accommodate PICP, in accordance with ASTM E2840 once every five years to identify areas of distress and to establish a maintenance schedule to assist the Owner in prioritizing maintenance needs and to establish a more accurate long-term maintenance budget.

Damaged Pavers

Damaged pavers include distresses such as cracking, chipping, or spalling. The severity of the distress can vary and will determine what restorative action, if any, is required.

	DAMAGED PAVER SEVERITY LEVELS			
Low	One or two cracks with no separation, chips, or spalls in the pavers.			
Medium	Advanced cracking with no separation, spalling, or chipping in the pavers but pavers are not disintegrated			
High	Pavers are cracked into multiple pieces or are disintegrated from cracks, chips, and/or spalls.			

Damaged pavers that are determined to be Low Severity should remain in place unless the frequency of breakage is greater than 1% of the surface area of the pavement. If this occurs, additional material testing and site investigation is recommended to determine the cause of the breakage. Damaged pavers determined to be in the Medium and High Severity Levels should be removed and replaced as described below.

Place the new replacement pavers to match the existing laying pattern. Compact the pavers in accordance with Belgard's guide specification for PICP. If the newly reinstalled paver is not flush to plus ¹/₈-inch with the surrounding pavers following compaction, it should be removed, and the thickness of the bedding layer should be modified to result in a flush to plus 1/8-inch surface following paver replacement and compaction. Once the desired grades are accomplished, sweep permeable joint aggregate into the joints and compact into place; repeat until the joints are full.

Depressions & Ruts

Depressions are areas of the pavement that have settled within the base, subbase, or subgrade and are typically not load related. Depressions can occur near the edge restraints, utility structures and penetrations, and at utility crossings. Ruts are depressions in the wheel paths of the pavement generally caused by repeated traffic loading and can occur in the base, subbase, and/or subgrade.

DEPRESSIONS & RUTTING SEVERITY LEVELS				
Low	${\it 1}{\it 4}$ to ${\it 1}{\it 2}$ in. depth using a straight edge			
Medium	$\frac{1}{2}$ to 1 in. depth using a straight edge			
High	> 1 in. depth using a straight edge			

For both depressions and ruts, the maximum depth determines the severity. Depressions and ruts of low severity shall typically remain in place but should be monitored during annual inspections for increased severity. Depressions and ruts with medium and high severity shall be evaluated by the engineer of record and the installing contractor to determine if repair is necessary and determine the underlying cause of the issue.

Once the underlying causes are identified, the engineer of record and the installing contractor should formulate a corrective action plan to address both the paver distresses and the underlying causes. The pavement shall be reinstated using the same procedure outlined in the Utility Repairs section of this document.



UTILITY REPAIRS

WINTER CONSIDERATIONS

One advantage of PICP is that the pavers can be easily removed and reinstated for access to underground utilities. This important advantage allows the pavement surface to be utilized immediately after repairs are made.

Should utility repairs be required below the PICP surface, the pavers can be removed by hand using specialty equipment like paver extractors without the use of saw cutting equipment or pneumatic jack hammers. Once the first paver is removed, it is relatively easy to remove the remaining pavers to beyond the extent of excavation. Set the pavers aside for future reinstallation. Undisturbed pavers can be secured with a wood or metal frame as shown in the diagram.

As excavation begins, remove and dispose of the bedding material (ASTM No. 8 Stone) and new aggregate used during reinstallation. The base and subbase, ASTM No. 57 and No. 2 stone respectively, can be reused during reinstallation, but should be carefully removed and stored separately to prevent intermixing. Storage locations for both the base and subbase should be carefully chosen to prevent contamination. Any aggregates that become dirty or contaminated should be discarded and replaced.

Where repairs require excavation into the underlying subgrade soil, Oldcastle recommends using flowable concrete fill (200 to 500 psi) to support the repaired utility. The open graded base cannot adequately fill under pipes or boxes, nor can it be compacted in these places. When pouring the flowable fill, use a plastic sheet or geotextile to prevent the flowable fill from seeping into the ASTM #2 Stone. A minimum 4 in. layer of flowable concrete fill should be used to cover a pipe or box structure.

When reinstalling the aggregates, place and level the subbase stone (ASTM No. 2) in no more than 6-inch lifts and use a plate compactor to compact each lift. The base stone (ASTM No 57) can be placed, leveled, and compacted in one 4-inch lift. The setting bed (ASTM No. 8) shall then be placed and screeded in one 2-inch lift without compaction.

When reinstalling the pavers, place the pavers level with the adjacent pavers, or slightly higher to account for settlement of the underlying materials (based on the depth of excavation). In either scenario, the bedding layer should be 1/8 in. higher so that once the pavers are reinstalled and compacted, they should be the same elevation as the adjacent units. Once the desired grades are accomplished, sweep jointing material into the joints and compact using a minimum 5,000 lbf plate compactor to vibrate the pavers into place. Repeat the process until the joints are full. Belgard can identify an authorized paver contractor to reinstate pavers, if required.





Snow Removal

Snow removal may be accomplished with standard snow removal equipment used for impervious pavements. Whether it is a snow shovel, plow, power broom or blower, the same equipment may be used. Snowplow blades without a rubber tip or shoes may contact pavement but will not damage the pavers as edges are chamfered to reduce chipping. Steel blades or any metal used that abrades the paver may scratch the surface and leave rust marks from steel particles.



When using a snowplow or snowplow box, the utilization of rubber or plastic snow blades with properly adjusted skis/guides will prevent unwanted rust or scrape marks on the permeable paver surface. When using a snowblower, ensure the guides are properly adjusted to keep the rotating impeller from scraping and damaging the permeable paver surface and from displacing joint fill material. Plowed snow should not be piled on the permeable paver surface any sediment build-up.

because winter sediment deposition can accelerate sedimentation. There are electric and liquid glycol melt systems that can be If snow must be piled on the permeable paver surface, a springinstalled beneath Belgard Permeable paving systems that can time restorative cleaning is suggested in select areas to remove reduce or eliminate the need for snow and ice removal. When considering the use of these systems, it is imperative that the guidelines and details established in ICPI's Tech Spec #12 Snow Note: These same practices will prevent unwanted rust, scrape marks, Melting Systems for Interlocking Concrete Pavements be followed. and winter sediment on the surface of asphalt and concrete pavements. Because the snow melt system is below the permeable pavers, it is important to follow the maintenance requirements provided by the snow melt equipment supplier to ensure the long-term functionality of the system.

Deicing Chemicals

The need for deicing chemicals on Belgard PICP systems should be significantly reduced compared to traditional impervious pavements or standard concrete pavers. If needed, use sodium chloride (ie rock salt) without sand. If air temperatures fall below 14 degrees Fahrenheit, calcium chloride may be used in moderation. Any deicing chemical should be used sparingly and in accordance with the manufacturer's application instructions. Never use magnesium chloride or materials containing ammonium nitrate and ammonium sulfate.

The use of sand or cinder mixes for snow or ice removal is not recommended because it can accelerate sedimentation.





A 2020 University of Toronto study on pavement deicing operations quantified some significant winter safety benefits when using PICP. Besides confirming that the use of permeable pavers can eliminate the occurance of snow melt refreezing and black ice formation, snow and ice on PICP can also melt and dry quicker when deicers are used. Most importantly, the research confirmed that a much lower deicing salt application rate is required on PICP compared to impervious asphalt. The study also demonstrated that PICP systems can attenuate and buffer the release of salt back into the environment, an important finding since there is concern about snowmelt and stormwater runoff environmentally damaging lakes and rivers. Contact a Belgard sales representative for a complete copy of Deicing Operations for Permeable Interlocking Concrete Pavements by the University of Toronto, dated April 1, 2020.

Snow & Ice Melt Systems



ANNUAL INSPECTION & ROUTINE MAINTENANCE PROGRAM

The following items are minimum requirements for any annual PICP maintenance program:

An annual inspection is recommended in the spring after snow events have subsided for the year. The purpose of the annual inspection is to assess the functional condition of the permeable pavers as a structural pavement and stormwater control measure. Once the annual inspection is completed, routine maintenance activities should be performed to correct any deficiencies.

- **Q** Replenish paver joints with additional aggregate if the level is more than ½ in. below the bottom of the chamfer at the paver surface.
- □ Inspect vegetation around PICP perimeter for cover & soil stability, repair/replant as needed.
- \Box Inspect and repair all paver surface deformations (depressions/settlement) exceeding $\frac{1}{2}$ in.
- Repair paver heights offset by more than $\frac{1}{4}$ in. above or below adjacent units, or offset by more than 1/8 in. lippage from paver-to-paver.
- Replace cracked paver units of medium and high severity impairing surface structural integrity.
- Check drains and outfalls (if existing) for the free flow of water. Remove any obstructions.
- Check observation wells (if existing) to confirm reservoir is draining (based on last measurable rain event).
- Conduct Routine Maintenance and increase frequency based on sediment loading.



The initial routine maintenance cycle of a permeable pavement should commence 6 months from the PICP installation date, and be repeated every 12 months or more frequently as needed. The objective is to remove debris and sediment from the surface with standard sweeping equipment such as power or manual brooms, blowers, mechanical sweepers or regenerative air vacuums. Examples of routine maintenance equipment are shown on the following page.

The Importance of Maintaining Joint **Fill for Routine and Restorative** Maintenance

While the focus is often on cleaning PICP joints, it is equally important Lawn maintenance personnel should be instructed to blow grass to maintain aggregate in the joints not only for filtering sediment but clippings away from permeable pavement and blow off any grass to maintain paver to paver interlock providing structural stability. clippings, plant debris, or leaves that are deposited on the permeable During the service life of the permeable paver system, joint material pavement during lawn maintenance and landscaping operations. loss occurs through scour, migration, snow plowing, sweeping, and A dry mechanical or regenerative air type sweeper may be used during wheel suction from traffic, etc. It is imperative to replenish joint fill dry periods to remove encrusted sediment, leaves, grass clippings, material as needed with the specified joint material in the construction etc. Vacuum equipment, air blowers or sweeper settings may require documents (typically ASTM No. 8, 89, or 9) by sweeping joints full and adjustments to prevent uptake of aggregate from the paver voids or removing the excess from the surface. joints. Leaf blowers or other standard onsite manual methods that are used for standard pavement maintenance may be employed to remove this surface debris.





The use of water equipped sweepers or water assisted cleaning equipment to remove sediment within the joints or paver openings may be helpful. Excessive water will also create a slurry containing contaminants that may require special off-site disposal.

Restorative Maintenance

In rare cases, excessive sediment loading can occur in PICP surfaces. These conditions are typically in isolated areas within the pavement (often along edges or drive lanes) and are usually due to excessive contributory run-on. Fortunately PICP, unlike other types of porous pavements, provides vertical filter columns (joints with specific aggregate infill) that allow for the capture and extraction of sediment build-up within the paver openings. Restorative maintenance can be done utilizing a number of different methods, although vacuum and high pressure air systems can best remove the entire 3 in. column of joint aggregates.









Sediment collects within the joint or paver openings (voids). As particles attach to the interior infill aggregates, the fine particles bind together. below the surface as shown below. The majority of the particulate or sediment travel is limited to the near surface and typically does not advance more than 1-2 inches below the paver surface and typically does not reach the bedding layer. The ability for PICP to collect sediment near the surface is a key advantage to this type of infiltration system. Maintenance can be easily performed on the near surface joint filters within a PICP system.



Municipal vacuum trucks, high-pressure air jets, and even a shop vac, may be used for restorative maintenance in smaller areas. For some projects, a high-powered pressure washer followed by high-powered vacuum suction such as a Ditch Witch FX30® vacuum excavator can be used for hot spot cleaning. This machinery is typically used for removal of accumulated sediment from catch basins and sumps. It is commonly available for rent in all markets and contractors have found this approach to be efficient for small projects. Restorative maintenance should be attempted in a dry condition and if removal is not achieved, flooding the area with water will help release the sediment under pressure from the vacuum source (water may be effective for restorative maintenance).

The final task in restorative maintenance is to replace openings with joint fill (ASTM No. 8, 89, or 9) specified in the design by sweeping joints full to bottom of the chamfer of the paver surface. Remove excess chip materials from surface and the pavement is ready for use.



Maintenance Research

A 2020 University of Toronto study, *Maintenance Equipment Testing* A 2020 United States Geological Survey study, Assessment of on Accelerated Clogged Permeable Interlocking Concrete Pavements Restorative Maintenance Practices on the Infiltration Capacity of evaluated PICP restoration equipment based on surface infiltration Permeable Pavement Assessment of Restorative Maintenance Practices on the Infiltration Capacity of Permeable Pavement, evaluated different testing before and after cleaning. Five different technologies were investigated: full vacuum sweeper, regenerative air sweeper, dry cleaning methods over a four-year period on three different types of permeable pavement. Researchers also found that all cleaning mechanical sweeper, water pressure washing, and a hybrid high methods improve surface infiltration rates, however, the PICP system pressure air/vac system specifically designed for permeable recovered and responded to cleaning far better than pervious asphalt pavement. The study found that all cleaning technologies significantly or porous concrete. Researchers noted that PICP allows for sediment improve surface infiltration rates. However, the high pressure air-vac hybrid (Typhoon Permeable Joint Excavator along with a to be easily removed from surface openings, unlike fines that clog cast in-place permable pavement. The Typhoon system had the PAVEVAC suction system) had the best and least variable results. highest restored infiltration rates out of four cleaning methods tested, The Typhoon system restoration was 2 to 6 times higher than the other systems and was the only technique able to fully restore which included two different vacuum-assisted street cleaners and manual methods. surface infiltration rates.



Contact a Belgard Sales Representative for copies of the latest maintenance research reports or for information about routine or restorative maintenance contractors in your market.

When is Restorative Maintenance Needed?

Restorative maintenance is sometimes required on older installations not routinely maintained. An indication that restorative maintenance is needed is when rainwater ponds on permeable paver surfaces. In addition, on some land development or phased construction projects, permeable pavers are installed early in the project and often are subjected to significant sediment loading prior to substantial completion or occupancy permit issuance. Project developers, HOAs, and municipal inspectors typically require that the PICP system is restored to full surface infiltration capacity for final acceptance and approval. On these projects subject to sediment loading, Belgard Commercial recommends a restorative maintenance program be implemented to restore the PICP infiltration rate and jointing material.



RESOURCES

The following resources address PICP design and maintenance and may provide additional guidance:

- Permeable Interlocking Concrete Pavements, latest edition a comprehensive design manual that provides specifications and information on construction and maintenance, published by The Interlocking Concrete Pavement Institute (ICPI)
- ASCE 68-18 Permeable Interlocking Concrete Pavement, a design standard providing design methodologies for both structural and hydrologic design of permeable paver systems by the American Society of Civil Engineers (ASCE) through the Transportation and Development Institute (T&DI)
- ASTM E2840 Standard Practice for Pavement Condition Index Surveys for Interlocking Concrete Roads and Parking Lots published by the American Society for Testing Materials (ASTM)

Go to BelgardCommercial.com to download PICP resources including:

- Guide specification
- Typical details
- Project Profiles
- Product Data Sheets (cut sheets)
- Color options
- Installation guidelines
- Inspection & Maintenance checklists

Belgard Commercial offers the following postconstruction services:

- Project-specific O&M Manual Belgard Commercial has developed O&M manual templates for commercial and municipal PICP projects to restore clogged areas with new joint fill and establish surface infiltration rates exceeding 100 inches/hour. Assistance with developing a projectspecific O&M manual can be provided.
- ASTM C 1781 Surface Infiltration Testing Belgard Commercial can provide surface infiltration testing along with a report documenting the methodology and results for municipal and commercial PICP projects.
- Routine PICP Maintenance Program Belgard Commercial can recommend routine maintenance service contractors for commercial and municipal PICP projects. The frequency and cost of this program is quoted on a project-specific basis.
- Restorative PICP Maintenance Belgard Commercial can facilitate restorative maintenance services on an as-needed basis to restore clogged areas with new joint fill and establish surface infiltration rates exceeding 100 inches/hr. Belgard Commercial will ensure that appropriate equipment will be operated by qualified and trained contractors. Projects that elect restorative maintenance will receive results of an ASTM C1781 surface infiltration test upon completion of the scope of work.

- Project-specific details
- Project-specific specifications

 - Concept plans for alternative PICP designs
 - Stormwater Management Plan reviews
 - pavement systems
 - Life-cycle cost analysis comparisons

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Belgard Commercial offers the following post-construction services:

- Input on stormwater conveyance, storage, and water quality strategies
- Cost analysis comparing PICP systems to conventional impervious

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