

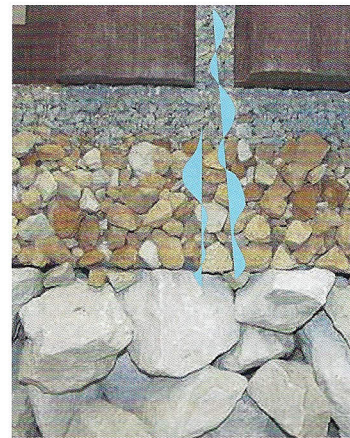
# PERMEABLE INTERLOCKING CONCRETE PAVEMENT (PICP) RESIDENTIAL AND COMMERCIAL DEVELOPERS FACT SHEET

## Stormwater Benefits

- Reduces or eliminates stormwater detention and retention ponds, storm sewers, drainage appurtenances and related costs
- Increased income potential from increased lot utilization due to reduced or eliminated stormwater basins
- Pavement surface increases curb appeal.
- Provides 100% permeable surface by runoff passing through small, open-graded aggregate-filled openings between solid high-strength, durable concrete pavers
- Helps meet local, state and provincial stormwater drainage design criteria and provides compliance with U.S. National Pollutant Discharge Elimination System (NPDES) regulations
- Meets U.S. Environmental Protection Agency stormwater performance criteria as a structural best management practice (BMP) while providing parking, road and pedestrian surfaces
- LEED® point eligible for Sustainable Sites, Water Efficiency, Materials & Resources and/or Innovative Design; Contributes to Green Globe points
- May be used on sloped sites with proper design



**Permeable interlocking concrete pavement at this fast food restaurant in Baltimore, MD treats stormwater before entering the Chesapeake Bay.**



- ← 3 1/8 in. (80 mm) thick pavers with permeable joints
- ← Open-graded bedding course
- ← Open-graded base course (OGB)
- ← Open-graded subbase on non-compacted soil subgrade

**Permeable interlocking concrete pavement (PICP) with base and subbase for infiltration and storage**



**PICP driveway in NC creates an attractive and environmentally responsive entrance.**

## Environmental Quality Improvement

PICP fits "Green" or sustainable development approaches.

PICP may be combined with other LID tools such as rain gardens and vegetated swales.

Permeable pavements remove the majority of pollutants (zinc, copper, phosphorus and suspended sediments) by reducing runoff, slowing the flow of water and filtering.

## APPLICATION OPPORTUNITIES

- **Urban:** Office plazas, sidewalk replacement, street tree planting areas, parking lots, parks and outdoor seating areas
- **Suburban:** Parking lots, parks, driveways, parking bays on roadways, subdivision roads and sidewalks
- **Redevelopment Sites:** Parking areas, plazas and public spaces and sidewalks



# APPLICATION EXAMPLES

## SUBURBAN



**With no detention pond, layout conserves trees while 15,000 sf (1500 m<sup>2</sup>) PICP in the cul-de-sac returns rainfall to the water table in Glen Brook Green subdivision in Waterford, CT.**



**39,000 sf (3900 m<sup>2</sup>) PICP street in Autumn Trails, Moline, IL eliminated the need for storm sewer inlets and pipes.**

### Project profile: Autumn Trails , Moline, IL by Alternative Energy Builders

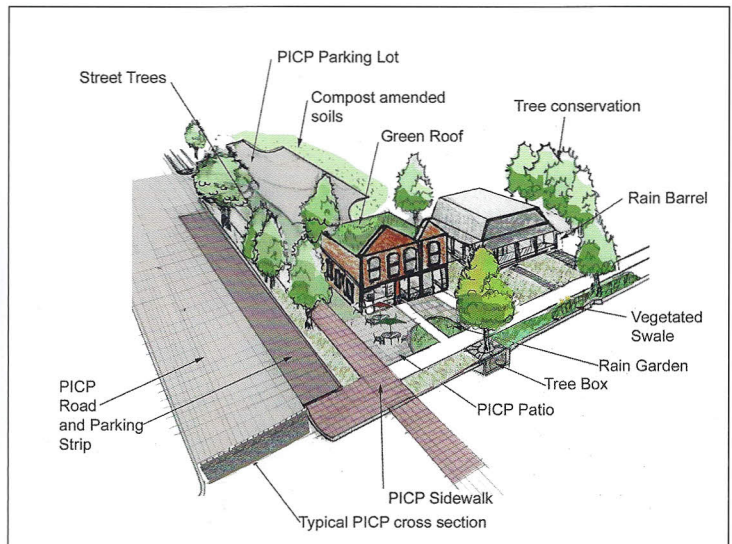
Water efficiency was achieved outside through rain barrels and runoff was prevented using PICP; more buildable land was available due to no stormwater detention structures. The cost comparison below indicates that PICP with no storm sewers can be cost-competitive with conventional pavements.

### Dollar Cost Comparison of Pavement Systems for Autumn Trails, Moline, IL

| Item (2006 prices)                              | PICP            | Concrete         | Asphalt        |
|---|-----------------|------------------|----------------|
| Paving/sf (/m <sup>2</sup> )                    | 2.25 (24.21)    | 8.00 (86.08)     | 3.00 (32.28)   |
| Excavating/sf (/m <sup>2</sup> )                | 1.00 (10.76)    | 1.00 (10.76)     | 1.00 (10.76)   |
| Stone/sf (/m <sup>2</sup> )                     | 2.00 (21.52)    | 1.50 (16.14)     | 1.50 (16.14)   |
| Installation/sf (/m <sup>2</sup> )              | 4.00 (43.04)    | (in paving cost) | 1.50 (16.14)   |
| Curbs/sf (/m <sup>2</sup> )                     | 1.50 (16.14)    | 1.50 (16.14)     | 1.50 (16.14)   |
| Maintenance/sf (/m <sup>2</sup> )               | 0.20 (2.15)     | 0                | Not known      |
| Replacement/sf (/m <sup>2</sup> )               | None            | None             | Every 12 years |
| Detention/Retention required                    | None            | Yes              | Yes            |
| Storm Sewer System/sf paving (/m <sup>2</sup> ) | None            | 3.00 (32.28)     | 3.00 (32.28)   |
| Total/sf (Total/m <sup>2</sup> )                | 10.95 (117.82 ) | 15.00 (161.40)   | 11.50 (123.74) |

## Permeable Interlocking Concrete Pavement: Stormwater BMP that Meets Low Impact Development Goals

- Increases building opportunities
- Reduces demand on sewer system
- Conserves on-site space: roads, parking, stormwater infiltration and retention all combined into the same space creating more green space
- Preserves wooded areas that would otherwise be cleared for stormwater detention or retention ponds
- Increases site infiltration that helps maintain pre-development runoff volumes, peak flows and watershed timing
- Promotes tree survival and growth
- Contributes to urban heat island reduction through evaporation and reflective, light colored concrete pavers
- Highly visible, cost-effective exemplary demonstration of a cornerstone LID technique for public and private development.

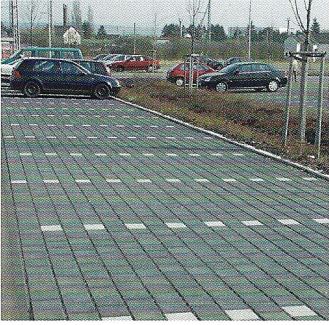


**PICP locations in a sustainable approach to site development**



# COMMERCIAL

**PICP typical cost: \$7-\$12/SF (\$75- \$130/m<sup>2</sup>) costs for grading, clearing and pipes are reduced**



**Light colored pavers marked parking.**



**Stormwater treated in drive and parking space areas in Vancouver, BC shopping center.**



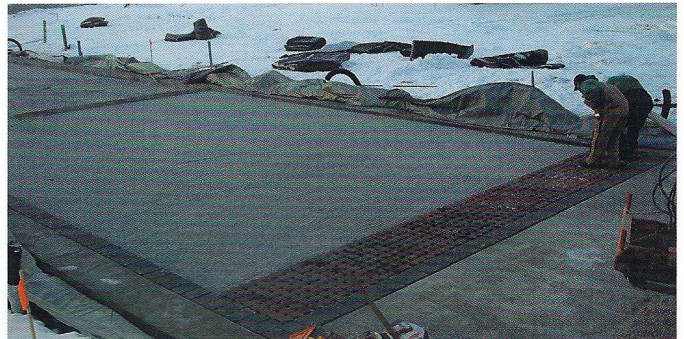
**Base construction uses locally available materials.**



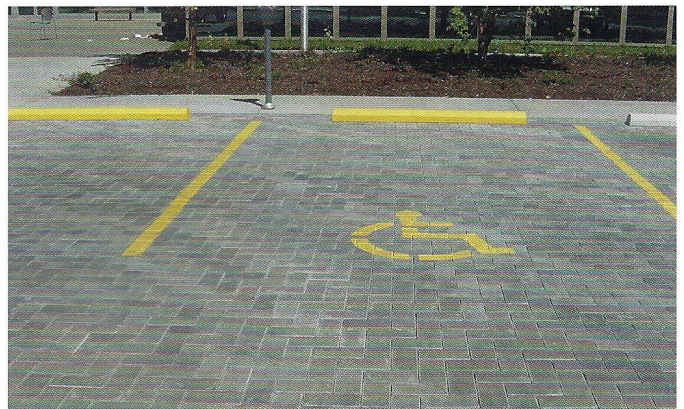
**Mechanical installation speeds construction.**



**Aggregate base and subbase are spread and compacted; pavers are delivered ready to install. After placement, joints and/or openings are filled with small aggregate and pavers compacted at this Walmart in Rehobeth Beach, DE.**



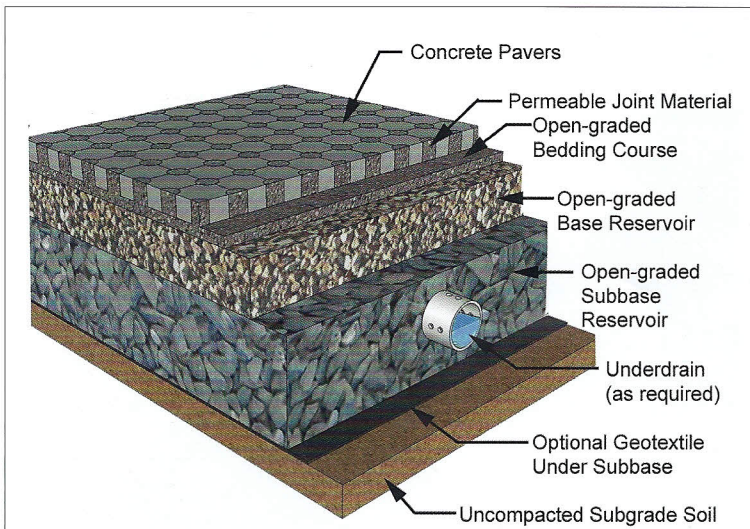
**Installation can occur in freezing temperatures over unfrozen subgrade, shown here in Moline, IL**



**PICP complies with ADA, as shown in this university parking lot in Vancouver, BC.**

## Construction Checklist

- No compaction of soil subgrade – excavate and trim native soil
- Geotextile, drainage pipes and overflow vary with design
- Ensure no sediment and mud on aggregates from equipment
- Install and compact aggregate subbase and base with typical paving equipment
- Specialty equipment used for screeding bedding layer and for mechanical paver installation
- Mechanical installation equipment accelerates construction; typical 5,000 sf (500 m<sup>2</sup>)/machine/day
- Concrete pavers, non-frozen bedding, and base/subbase installable in freezing temperatures over non-frozen soil subgrade
- Paver joints filled with open-graded aggregate and compacted
- No curing time – ready to use upon installation; modular construction allows for project phasing
- Specify ICPI certified installers with PICP construction experience, inspection and detailing skills.



**Typical PICP cross section**



# PERFORMANCE

## Volume Reduction

Meets or exceeds runoff local volume reduction standards via base reservoir storage

Well maintained PICP can reduce runoff volumes from intense rain events typically between 70% and 90%; flooding less likely.

Reduced stormwater runoff volumes generate cost savings in infrastructure sizing and construction.

## Peak Flow Reduction

Reductions in peak flow may reduce stormwater utility fees.

Permeable pavement can reduce peak flow by as much as 100%, producing runoff rates nearer to pre-development conditions.

## Additional Benefits

- ADA compliant
- Concrete pavers are available in various shapes and colors from local ICPI members; colored pavers mark lanes and parking spaces.
- Simplifies surface and subsurface repairs by reinstating the same paving units; no unsightly patches or weakened pavement from utility cuts.

## Regulations

PICP systems are designed to meet local, state and national stormwater regulations. Air quality and urban heat island regulations may also be addressed through the use of PICP as PICP installations are cooler than asphalt.

## FAQs

**Can PICP save money on project costs?** Yes. When total project costs are factored, PICP may be cheaper than other paving solutions due to multiple benefits from PICP. One example is gaining stormwater management infrastructure with the money spent on paving.

**Can PICP be used on clay soils?** Yes. Even in clay soils, PICP reduces runoff and helps to capture rainfall events "first flush" and reduce pollution.

**Can PICP be used to replace every kind of pavement?** PICP is best suited for use in areas of low speed traffic such as parking lots, residential streets, driveways, patios, plazas, sidewalks and parking lanes. Nevertheless, PICP has been successfully used even under heavy commercial loads.

**Will PICP enhance property values?** The data from installed PICP projects indicates that PICP meets multiple criteria for project success including enhancing property values.

## REFERENCES

Ferguson, B. K. *Porous Pavements*. Boca Raton, FL: CRC Press, 2005.

Smith, David R. *Permeable Interlocking Concrete Pavements: Selection • Design • Construction • Maintenance*, Washington, DC: ICPI 3rd ed., 2006. [www.icpi.org](http://www.icpi.org).

For more information pertaining to permeable interlocking concrete pavement, please visit the Interlocking Concrete Pavement Institute ([icpi.org](http://icpi.org)) or the Low Impact Development Center ([lowimpactdevelopment.org](http://lowimpactdevelopment.org)).

**Other Fact Sheets Available for Municipal Officials, Design Professionals and Schools/Universities**



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