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UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Maintenance and Winter Operation BMPs for PICP

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Tehrani

Outline

- Clogging and conventional approaches
- Surface Treatments
- New maintenance approaches for PICP
- Winter salting and safety

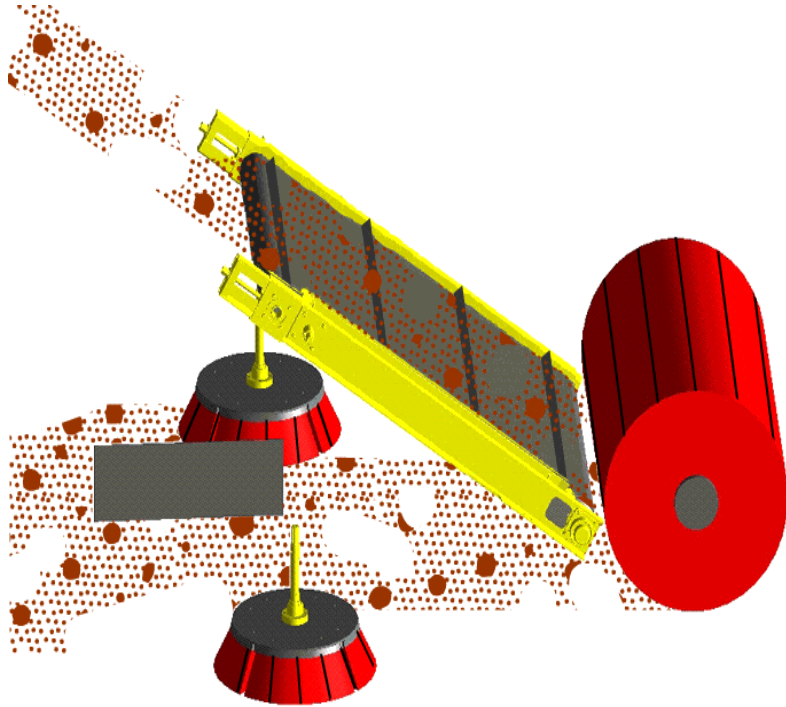




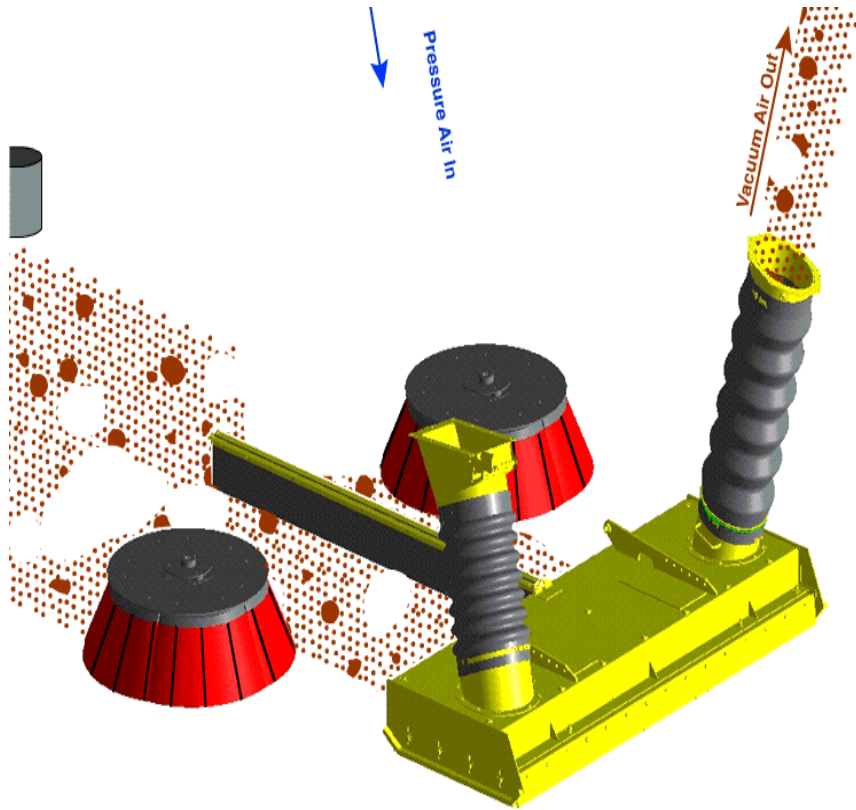
Clogging



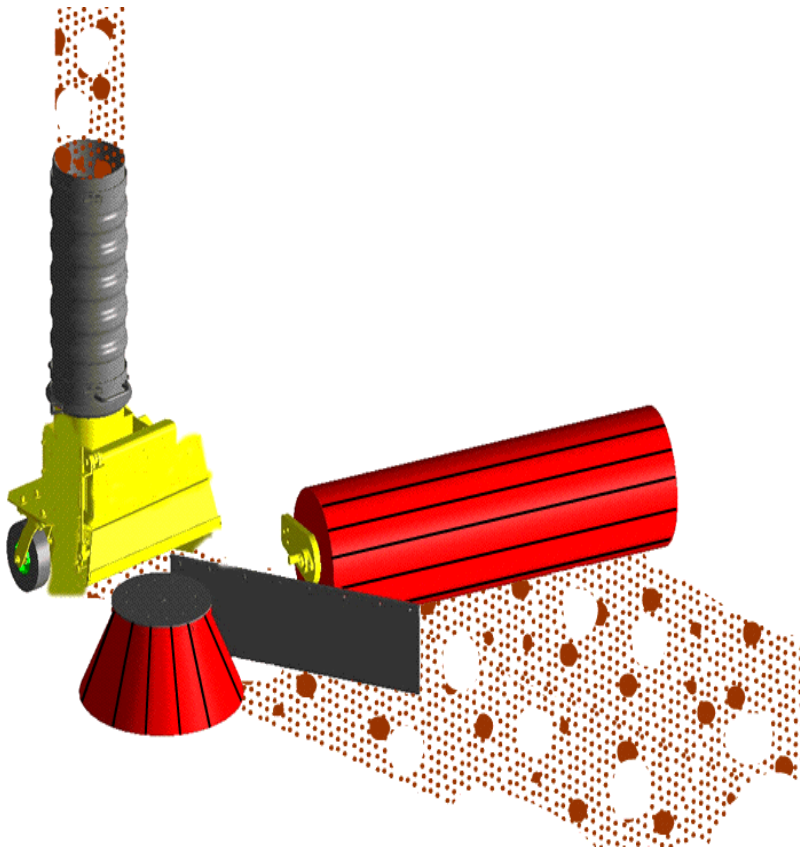
Street Sweeper Options



Mechanical Sweeper



Regenerative Air Sweeper



Vacuum Sweeper

True Vacuum Sweeper



A high-speed photograph of a water splash, showing intricate, crystalline structures of water droplets and air bubbles. The water is a deep teal color, and the background is a soft, out-of-focus grey. The splash is centered on the left side of the frame, with droplets trailing off to the right.

Evaluating Surface Treatment Approaches

TRCA PICP (2009)

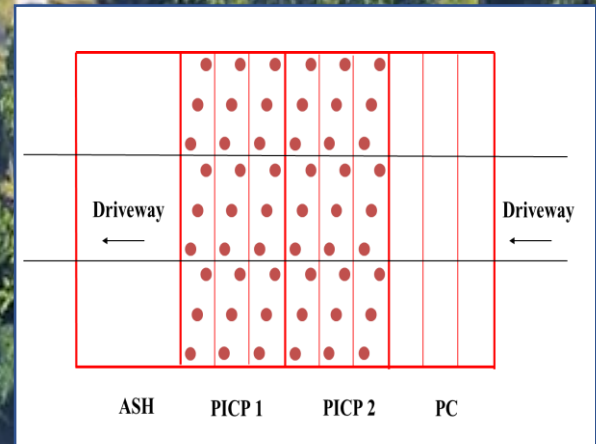
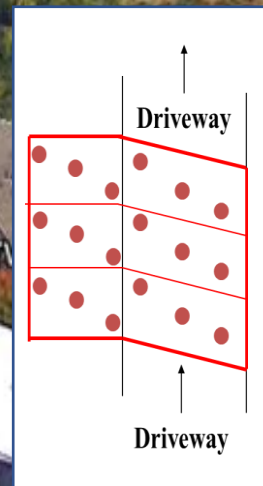


Image © 2015 DigitalGlobe

Google Earth

43°49'53.69" N 79°35'27.69" W elev 671 ft eye alt 1022 ft

CVC PICP (2010 and 2012)



© 2016 Google

Google

12

2004

43°37'24.87" N 79°44'09.31" W elev 590

Maintenance

Surface treatment

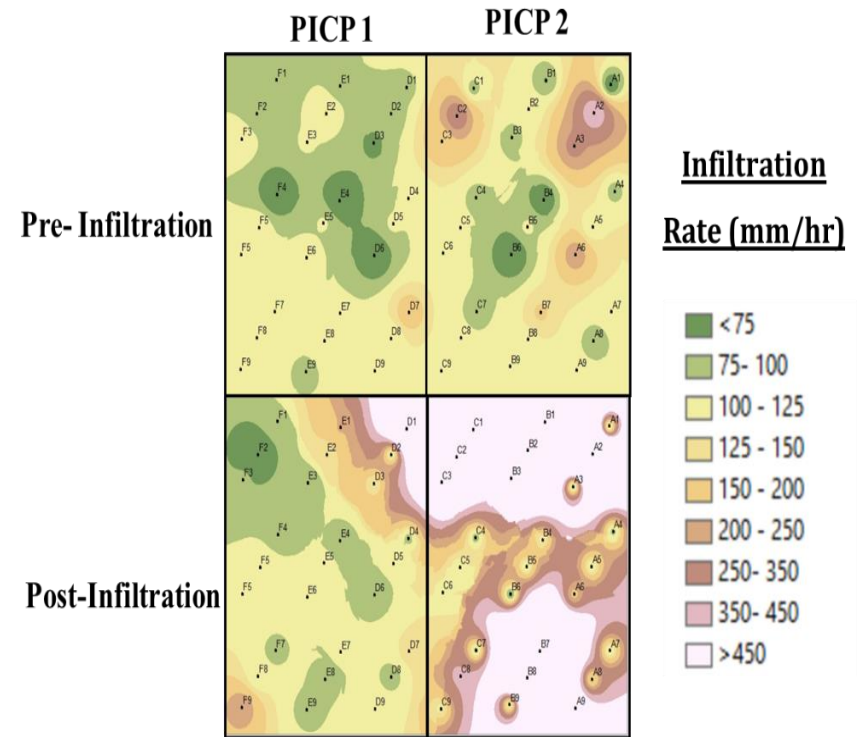
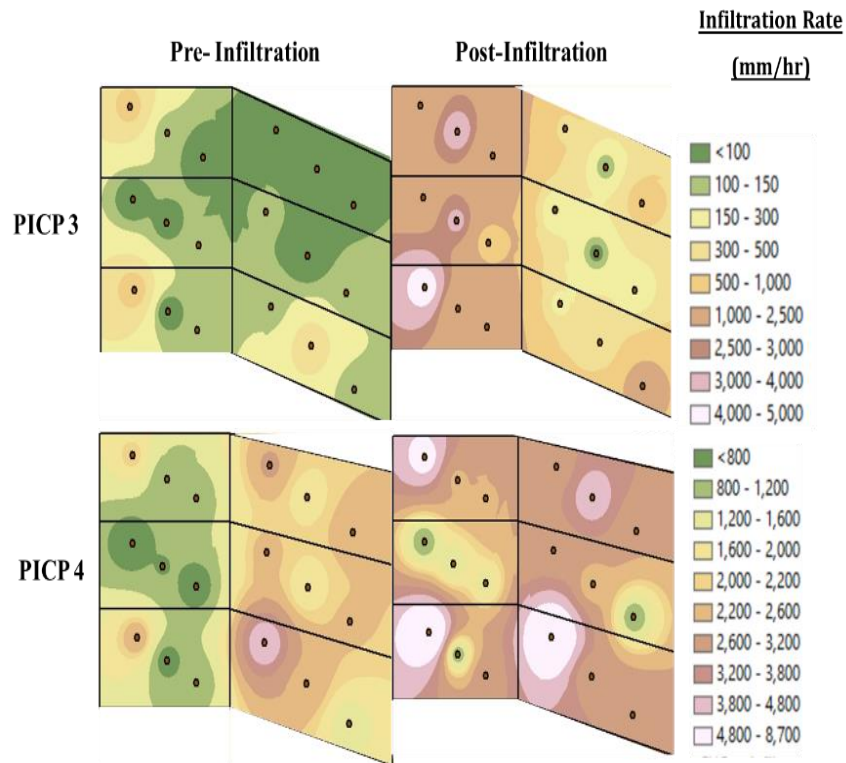


Street-sweeping



Did maintenance improve surface infiltration?

Pre-Maintenance								
Section	Number of tests	# Censored Observations	Percent Censored (%)	Min. Infiltration /MDL (mm/hr)	Max Infiltration (mm/hr)	Median (mm/hr)	Standard Deviation	
PICP1	27	19	70	30	184	61	35	
PICP2	27	16	59	30	449	73	103	
PICP3	18	10	56	30	639	47	200	
PICP4	18	0	0	318	4768	1606	1134	
Post-Maintenance								
PICP1	27	16	59	34	1441	78	266	
PICP2	27	12	44	66	6983	87	1645	
PICP3	18	1	6	73	4912	619	1380	
PICP4	18	0	0	773	8689	2595	2310	



Spatial Variability

A man wearing a high-visibility yellow safety vest over a white t-shirt, dark pants, and brown work boots is using a long-handled power broom to clean a paved surface. He is wearing safety glasses and a watch. In the background, there is a dark SUV parked, some orange traffic cones, and a grassy area with trees.

Was adding
surface treatment
effective?

Location	Impact
PICP 1	Power broom
PICP 2	No impact
PICP 3	No impact
PICP 4	Power broom and Power wash

A high-speed photograph of a water splash, creating a crown-like shape with many droplets in the air. The water has a blueish-green tint. The background is a solid, muted grey-blue.

New Approaches to Maintenance



Issues

- Street-sweeper availability
- Too big
- Inconsistent performance

2017 PICP Test Pad



Maintenance Approaches

- Power Washing
- Cyclone
- Stormwater Utility Vehicle
- Typhoon
- Vacuum-only
- Cohesive Sediment
- Preventative





Winter Operations

Test Site

Conventional Asphalt Plot

- Road Salt → Standard Application Rate (10 lb/1000ft²)

PICP Plot 1

- Road Salt → Standard Application Rate (10 lb/1000ft²)

PICP Plot 2

- Road Salt → Low Application Rate (5 lb/1000ft²)

PICP Plot 3

- Road Salt Pre-Wetted with Beet Juice → Standard Application Rate (10 lb/1000ft²)

PICP Plot 4

- Road Salt Pre-Wetted with Beet Juice → Low Application Rate (5 lb/1000ft²)



De-Icing Materials

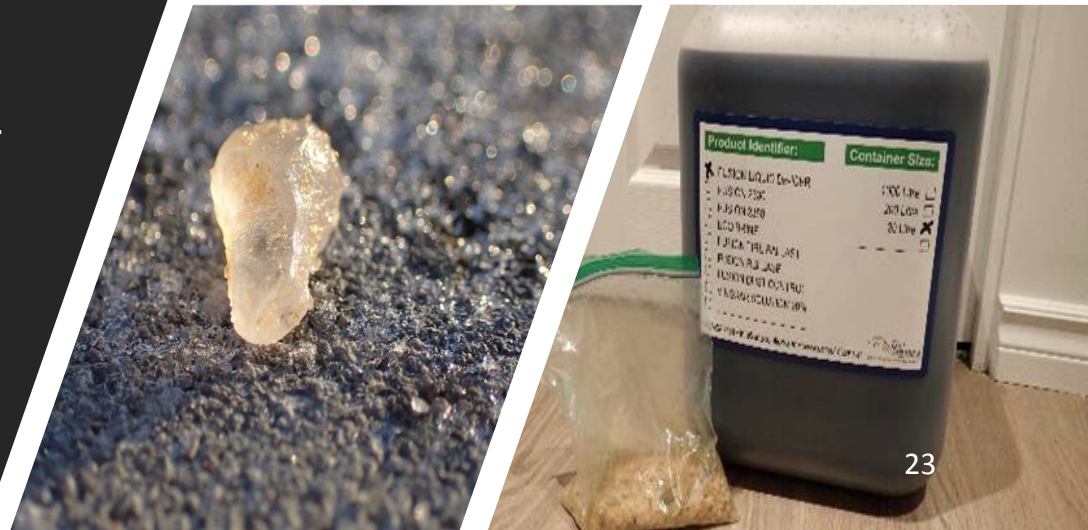
Road Salt:

- Conventional NaCl available from hardware stores



Road Salt Pre-Wetted with Beet Juice

- Using same conventional NaCl from same bag
- Beet juice product is Fusion Liquid De-Icer
- Beet juice mixed at 14 L per metric ton of salt (as recommended by manufacturer)



Slip Test Mark IIIB

Simulates a pedestrian slipping



Slip Alert

Simulates a vehicle skidding



Monitoring Equipment

1. Conductivity Sensors (CT2X)
2. Camera (CCFC)
3. Surface-Mount Thermistor Temperature Sensors (110PV)
4. Infrared Surface Temperature Sensors (Surface Sentinel)
5. Snow Depth Sensor



Salting Test (after 17cm of Snow)

After Shovelling



After Salting



Next Day



Salting Test (after 17cm of Snow)

After Shovelling



After Salting



Next Day



Salting Test (after 17cm of Snow)

After Salting



Next Day



Acknowledgements

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Thanks !

Questions?

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