



# Leveraging the Operational & Cost Advantages of Hot In-place Recycling for a Single-Runway, Airfield Pavement Rehabilitation Project at Kelowna International Airport

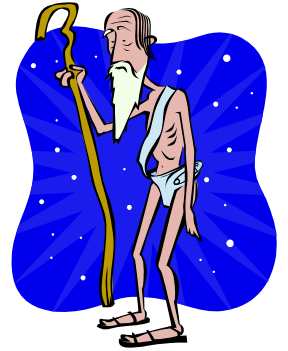
## Project Highlights: From Inception to Completion

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SNC Lavalin Inc. – Airport Group



And so it begins?

...Sorry, but according to the  
**SWIFT** session moderator the  
title is so long, I've used up all of  
my time...



# Presentation Outline

- **Project Background**
  - Site information
  - Runway Construction History
- **Project Evolution**
  - 2011 Project – Scope of Work
  - 2012 Project – Revised Scope of Work
- **Project Execution**
  - The HIR Process
  - Qualities
- **Observations & Conclusions**
- **Discussion & Questions**



## Site Information & Project Background

- **Busiest single-runway airport in Canada**
- **11th busiest airport in Canada**
- **1.4 million passenger movements annually**
- **City population ~110,000, Metro ~180,000**
- **Regularly scheduled flights to & from Calgary, Edmonton, Toronto, Vancouver, Victoria, Los Angeles & Seattle; seasonal service to Las Vegas, Phoenix & Mexico**
- **Typical daily aircraft movements: 64 scheduled passenger flights; 20 to 30 cargo/freight movements**







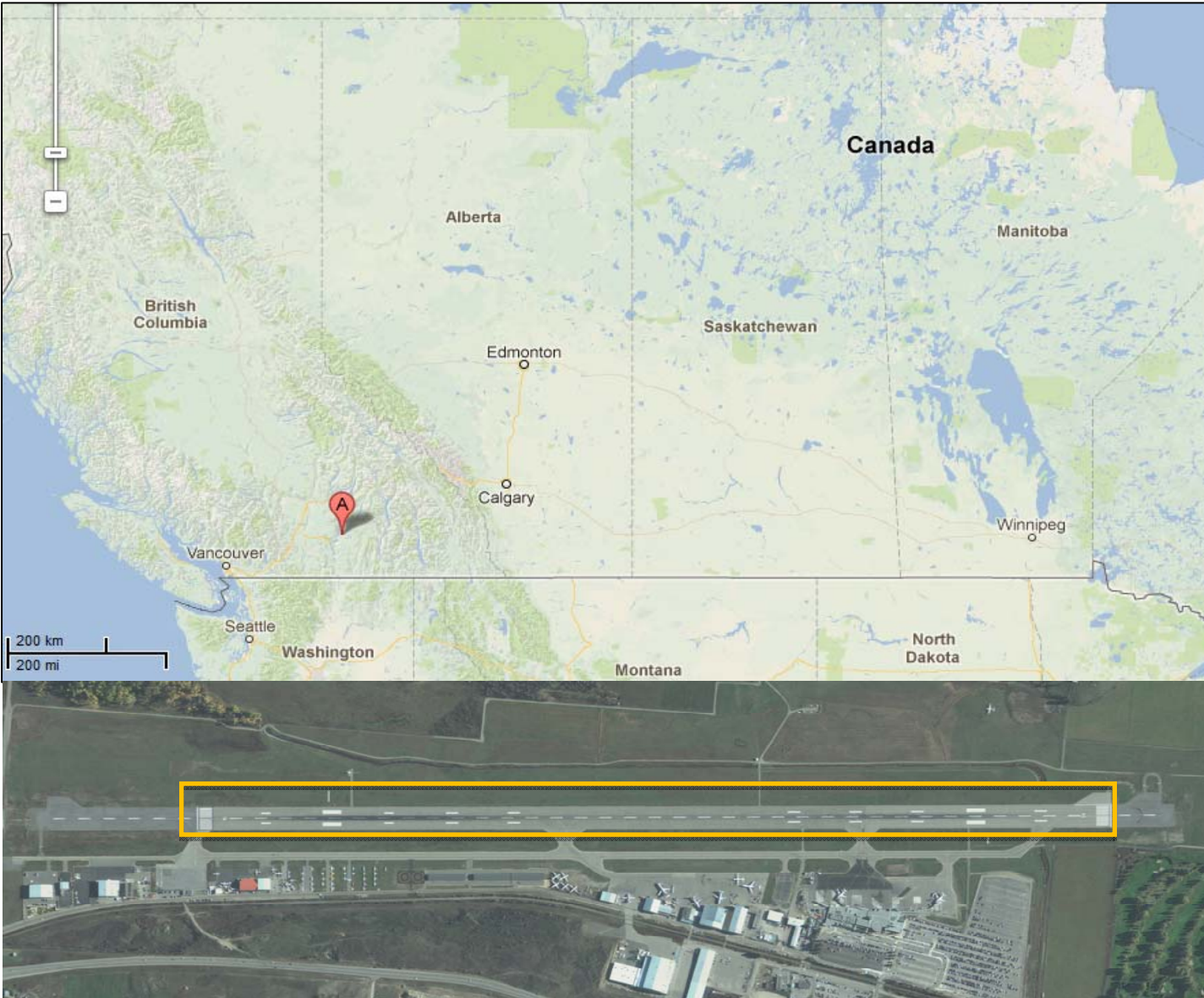
## Project Background & Site Information

- Q **Near Okanagan Lake in southern interior of BC 400 kms northeast of Vancouver**
- Q **Semi-arid climate; dry sunny summers, cold cloudy winters & four distinct seasons**
- Q **Summers hot & sunny, daytime temperatures often >35C, hottest recorded temperature 39C**
- Q **Average 380 mm rain/year; 300.5 hours bright sunshine in July**
- Q **Typically very good climate for paving, minimal risk of weather-related delays**



## Construction History - Runway 16-34

- Q 1957: constructed @ 550 m long, 30 m wide; 130 mm crushed base gravel
- Q 1959: extended to 1,631 m, widened to 61 m & paved with Hot Mix Asphalt (HMA)
  - Q 1959 pavement: 280 mm granular sub-base, 150 mm granular base, 90 mm HMA
- Q 1977: overlaid with 85 mm HMA
- Q 1986: overlaid with 80 to 200 mm HMA (TC/PW&GSC) with hydrated lime anti-strip additive
- Q 1990: extended 600 m south
- Q 2008: extended 450 m north
- Q PCN: 54/F/C/W/T; no tire pressure restriction (>1.0 MPa)





## The “2011” Project

- Q **Project designed by another Consultant: 2010/2011**
- Q **May 2011: Tendered Resurfacing of Runway 16-34, Taxiways A, B and C**
- Q **Scope of Work:**
  1. **Cold-mill 65 mm & inlay 75 mm HMA on keel section (19 m); Hot In-place Recycle to 50 mm (HIR 40 +10 mm added mix) on both outside edges (21 m) all at 2,187 m long**
  2. **Cold-mill & inlay 50 mm HMA on taxiways A, B and C with small portion of full-depth, (complete pavement structure with utility work) taxiway widening (50 m<sup>2</sup>) on taxiway C**





## The “2011 Project” (cont’d)

3. **Milling, removal & reinstallation of 4 runway 16 threshold inset lights & reinstate asphalt**
4. **Install runway pavement sensor, Remote Processing Unit (temperature sensor)**
5. **Optional work: construct Annual Aircraft Parking Area on taxi D; construct asphalt parking area adjacent to Apron I North; construct a (small) concrete slab for pavement sensor unit**
6. **Other important Contractual elements**



## Other Important Aspects of 2011 Tender Documents/Specifications

1. **Available work days/hours:** 00:00 to 05:30, 7 days/week
2. **Pay adjustments for asphalt compaction based on BC MoTI, End Product Specifications (with penalty/bonus)**
3. **Penalty:** \$10,000/hr if runway or taxiways not serviceable by 05:55 daily; \$10,000 penalty at 05:56 & again on the hour for every hour thereafter the runway and/or taxiways are not returned to serviceable condition in morning
4. **Bonus \$10,000/day to max. \$100,000 for completing all work before 05:55, August 10<sup>th</sup>**



## Other Important Aspects of 2011 Tender Documents/Specifications (cont'd)

5. **Penalty costs additional to liquidated damages for late completion. Delay caused by abnormal weather to have no bearing on Bonus/Penalty date**
6. **Runway & taxiway closures limited to a single, 5.5 hr. period/24-hrs day, 7 days per week**
7. **Runway access at 00:00 nightly. Equipment off, surfaces swept clean by 05:30**
8. **Severe penalties for flight delays caused by construction work, including late cleanup, or in the event of weather-related reopening delays**
9. **Notice to Proceed June 3, 2011; Substantial Performance August 31, 2011; Total Performance September 21, 2011**

## 2011 Tender Results

Bidder No. 1	Bidder No. 2
\$6,256,695.00	\$6,593,642.43

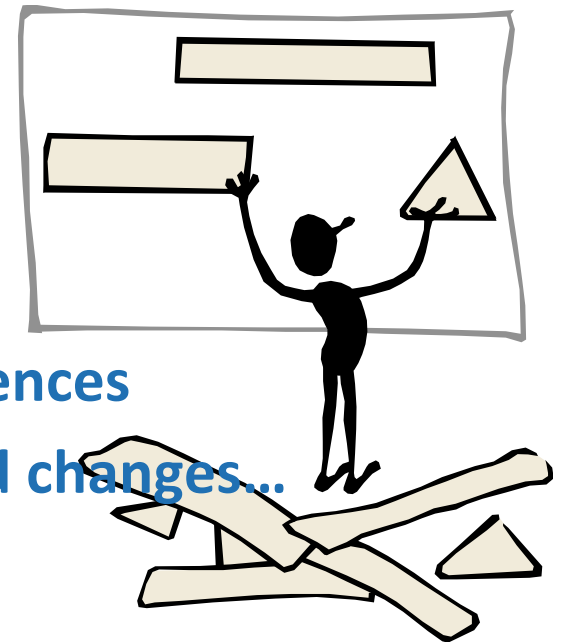
Neither of above include optional work or taxes. Both bidders were Kelowna based; a 3<sup>rd</sup> nearby (Penticton) bidder did not bid project.

Low bid ~ 40% over budget (\$ 4.4 M) tender **cancelled**



## Next Steps ... for 2012 Re-tender

- Q Request for Proposals issued to Consultants, September 2011 (value engineer 2011 project, recommend changes/re-design, re-tender & manage project for 2012)
- Q SNC Lavalin selected September 2011
- Q Reviewed all 2011 documents
- Q Met with local bidders/debriefed
- Q Met with regional non-bidder/debriefed
- Q Assessed options considering past experiences
- Q Based on available budget; recommended changes...





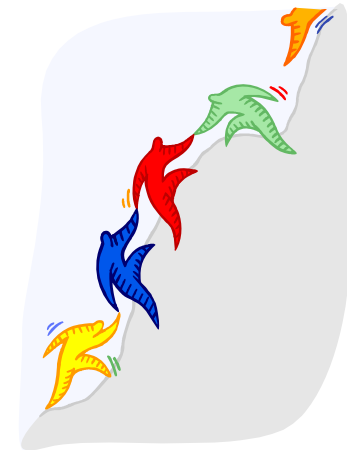
## Next Steps ... for 2012 Re-tender



## Next Steps ... for 2012 Re-tender

### Take a Partnership Approach...

- Q Risk sharing
- Q Remove high \$ penalties
- Q Airport equipment used for final surface sweeping
- Q Airport supplied and placed barriers, X-markers, etc.
- Q Parties to Contract do what they do best – build, versus operate & support
- Q Simplify the scope of work



# Recommendations for 2012 Project

- Meet with stakeholders; negotiate increased duration of nightly work window
- Adopt 'hard' closures; allow only critical Medevacs
- "Package" work to better suit regionally-based contractors/limit subcontractor mark-ups
- Remove taxiway A, B and C work to a separate project/tender separately
- Remove non-essential work scope, including Optional Work, from tender
- Defer taxiway C widening to later date, when scheduled use by larger aircraft is confirmed
- Eliminate penalties/bonuses, including daily & substantial completion delay charges
- Allow weather related contract extension, subject to proof and Terms of Contract; retain liquidated damages for late completion





## Recommendations for 2012 Project (cont'd)

- Tender early in 2012, for optimal market conditions
- Eliminate high operational disruption risk (mill & inlay work on centre 19 m)
- Allow HIR to be applied to entire runway surface (61 m by 2,187 m)
- Increase HIR cut depth from 40 to 50 mm; add 30% (vs. 20%) plant-produced HMA (65 mm total resurfacing treatment depth)
- Include mandatory use of liquid anti-strip additive in the added HMA
- Modify taxiway A, B & C rehabilitation scope as follows:
- Reconstruct failed portion of taxi A to sub-grade; include thickened asphalt layer
- Remove & thicken asphalt layer only on remainder of taxiway A and C (failed)
- Increase mill & inlay depth to 65 mm on remaining taxi A; no change to taxi B (50 mm mill & inlay)
- Work carried out in same date window as runway, same work hours



# Re-Tender of “2012” Projects

## 1.) Runway Project:

- Prepare new runway contract documents, drawings, specifications, PCO (MMCD Gold)
- Tender runway project as stand-alone, full length/width HIR treatment (140,000m<sup>2</sup>) plus 30% added hot mix (50 + 15 mm = 65 mm)
- Asphalt rejuvenator (Cyclogen L) by cash allowance
- Standby time by cash allowance
- Subcontract work limited to survey layout, airside security, line & paint markings
- Advance runway pavement coring by Contractor for HIR mix analysis/design
- Detailed obligations for QMP (and QC Testing)
- QA testing by CoK
- Mix design(s) by contractor
- Hours of work: 23:00 to 05:30, 7 days/week (1 extra hour)
- Public Tender January 2012; award February 2012
- Substantial Completion by September 15, 2012





## Re-Tender of “2012” Projects

### 2.) Taxiway Project:

- Mix design(s) by contractor
- Hours of work: 23:00 to 05:30, 7 days/week (1 extra hour)
- Public Tenders May 2012; awarded June 2012
- Prepared new taxiway contract documents, drawings, specifications, PCO (MMCD Platinum)
- Detailed obligations for QMP (and QC Testing)
- QA testing by CoK

### Scope Changes vs 2011:

- Taxiway A: reconstruct 1,600 m<sup>2</sup> to existing sub grade (failed); Excavate 1,010 mm, replace with 600 mm granular sub base, 300 mm granular base & 110 mm HMA
- Taxiway A: remove 1,800 m<sup>2</sup> including 100 mm existing asphalt pavement & 40 mm granular base; replace with 140 mm HMA (2 lifts)

# Re-Tender of “2012” Project(s)

## Taxiway Project (cont'd)

### Scope changes vs 2011:

- Taxiway A: cold-mill & inlay 1,400 m<sup>2</sup>, taxiway A to 65 mm (vs. 50 mm) depth using HMA
- Taxiway B: cold-mill & inlay to 65 mm (vs. 50 mm) depth using HMA
- Taxiway C: cold-mill & inlay 2,300 m<sup>2</sup> to 50 mm using HMA
- Taxiway C/D: remove 580 m<sup>2</sup>, including 190 mm of existing asphalt pavement (failed): replace with 190 mm of new HMA (3 lifts).



## Bid Results Comparison: “2011” vs. “2012”

Project	Low Bid Cost	Bid 2	Bid 3	Bid 4
Runway & Taxiways 2011	\$ 6,256,695	\$6,593,642	N/A	N/A
Runway only 2012	\$ 2,312,100	\$2,417,105	\$3,560,000	N/A
Taxiway only 2012	\$ 581,120	\$ 727,245	\$ 786,698	\$ 803,127
Combined Project Cost 2012	<u>\$ 2,893,220</u>	Runway low bid: ARC Asphalt Recycling Corp. Taxiway low bid: Peter's Bros. Construction Ltd.		
Difference (savings vs. 2011)	<u>\$ 3,363,475</u>	Notes: Optional work not done. Scope very similar, with some portions increased (offsetting)		

## Past Runway / Taxiway HIR Experiences

- Penticton airport, taxiway A – stand-alone, HIR 1994; runway – HIR with overlay
- Many, many others completed in BC (runways & taxiways), HIR with overlay, (including some secondary runways)



Stand-alone HIR surface – taxiway A at Penticton airport, completed 1994, as at October 2011 (17 years)

## Other Good HIR / Overlay Experiences on Runways in BC, 1988 to 2011 ...

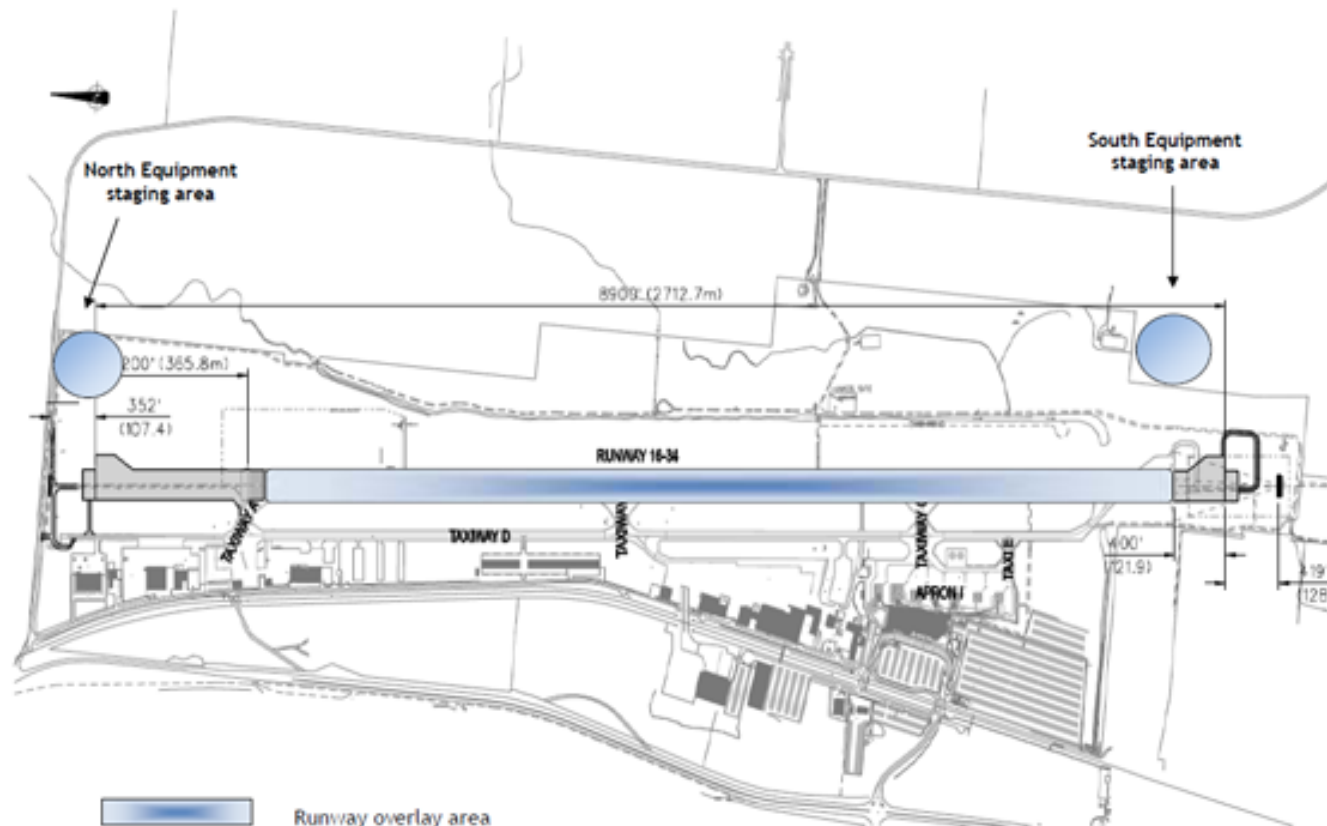




# Project Execution, Kelowna Runway HIR Process



Runway Rehabilitation Project  
June 4 - August 24, 2012  
Between 11:00 pm and 5:30 am



# Project Execution, Kelowna Runway HIR

## Process – Specs

Property (HIR/added HMA combined)	Property Specification – Airfield Pavement
Marshall Stability at 60°C, N, minimum	12,000
Flow Value, mm	2 - 4
Air Voids in (combined) Mixture, %	2.5 - 4.5
Voids in Mineral Aggregate, % minimum	14
Index of Retained Stability, % minimum	75
Tensile Strength Ratio (TSR), % minimum	80

- Combined HIR and Added Mix Asphalt Specification Requirements
- Aggregate gradation slightly coarser than typical surface mix/larger maximum aggregate size (19 mm)
- Softer grade of asphalt binder than required for climate/loading (150-200 Group 'A')
- Asphalt rejuvenator at 0.5 litres/m<sup>2</sup>; liquid anti-strip in added mix at 1.5% of AC weight

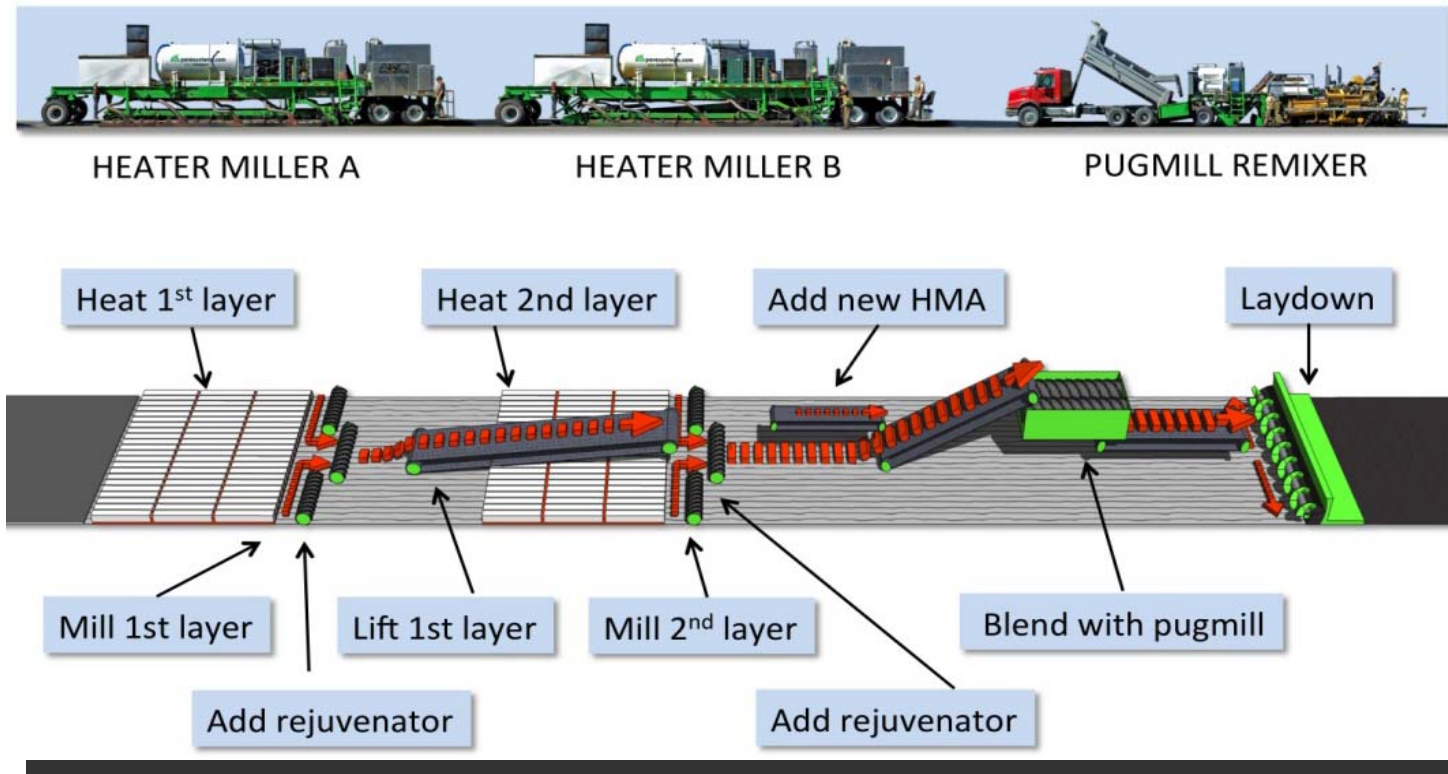
# Project Execution, Kelowna Runway HIR Process



ARC's Ecopaver 400 pre-heater (two versus the usual one)

# Project Execution, Kelowna Runway – the HIR Process

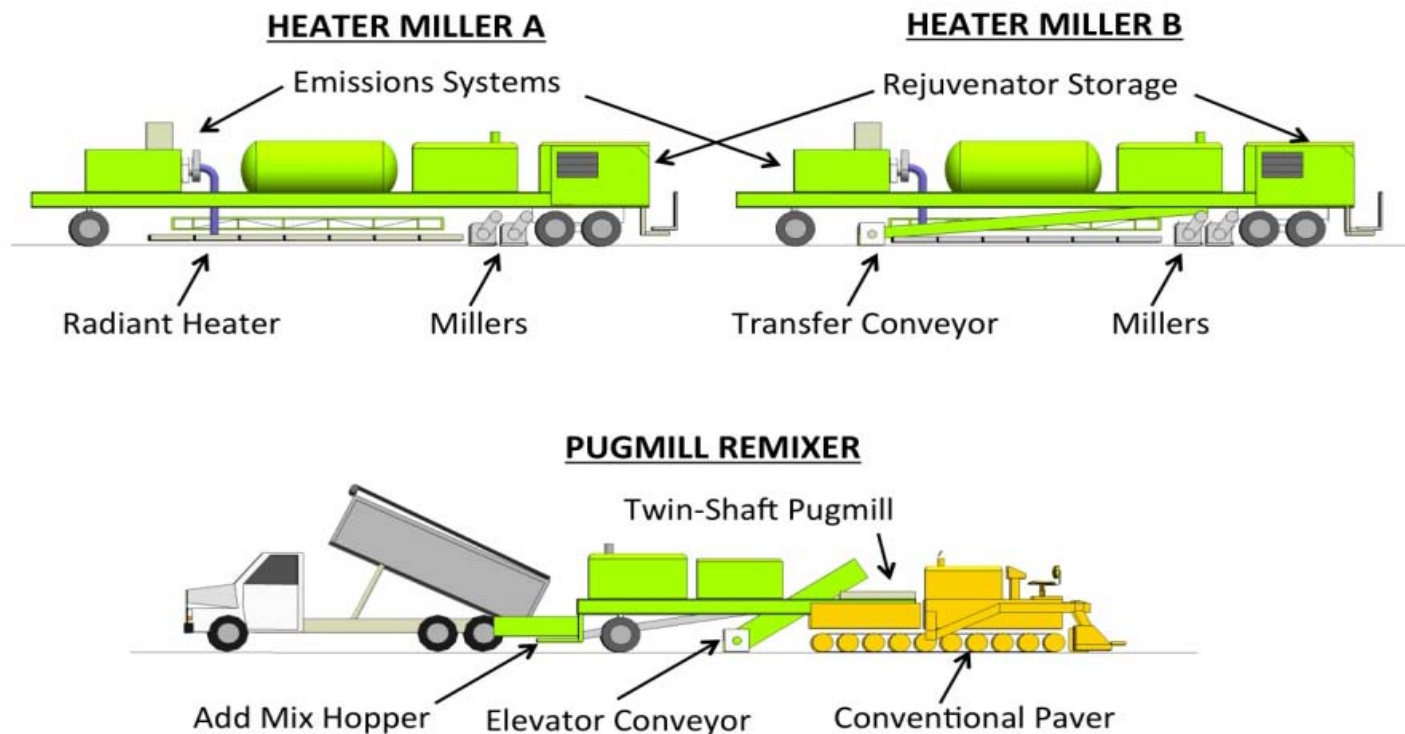
## MULTI-STAGE RECYCLING PROCESS



'Standard' ARC Ecopaver 400 HIR Train Schematic

# Project Execution, Kelowna Runway HIR Process

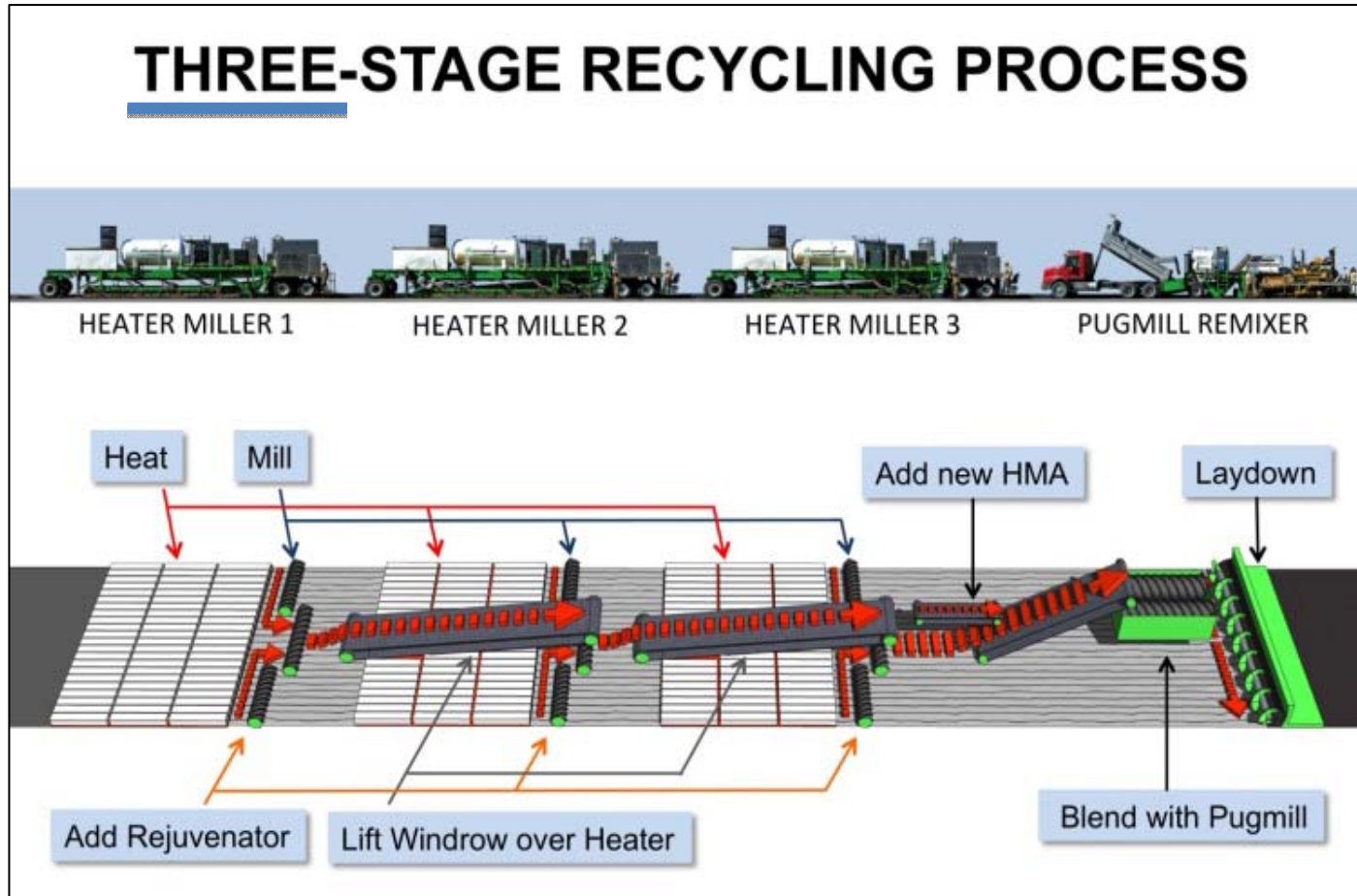
## MULTI-STAGE TRAIN COMPONENTS



Layout and Processing Schematic of Standard' ARC Ecopaver 400 HIR Train



# Project Execution, Kelowna Runway HIR Process



The Kelowna airport 'Modified' ARC HIR Train

# Project Execution, Kelowna Runway HIR Process



ARC Ecopaver 400 (2 stage) working on a BC highway project

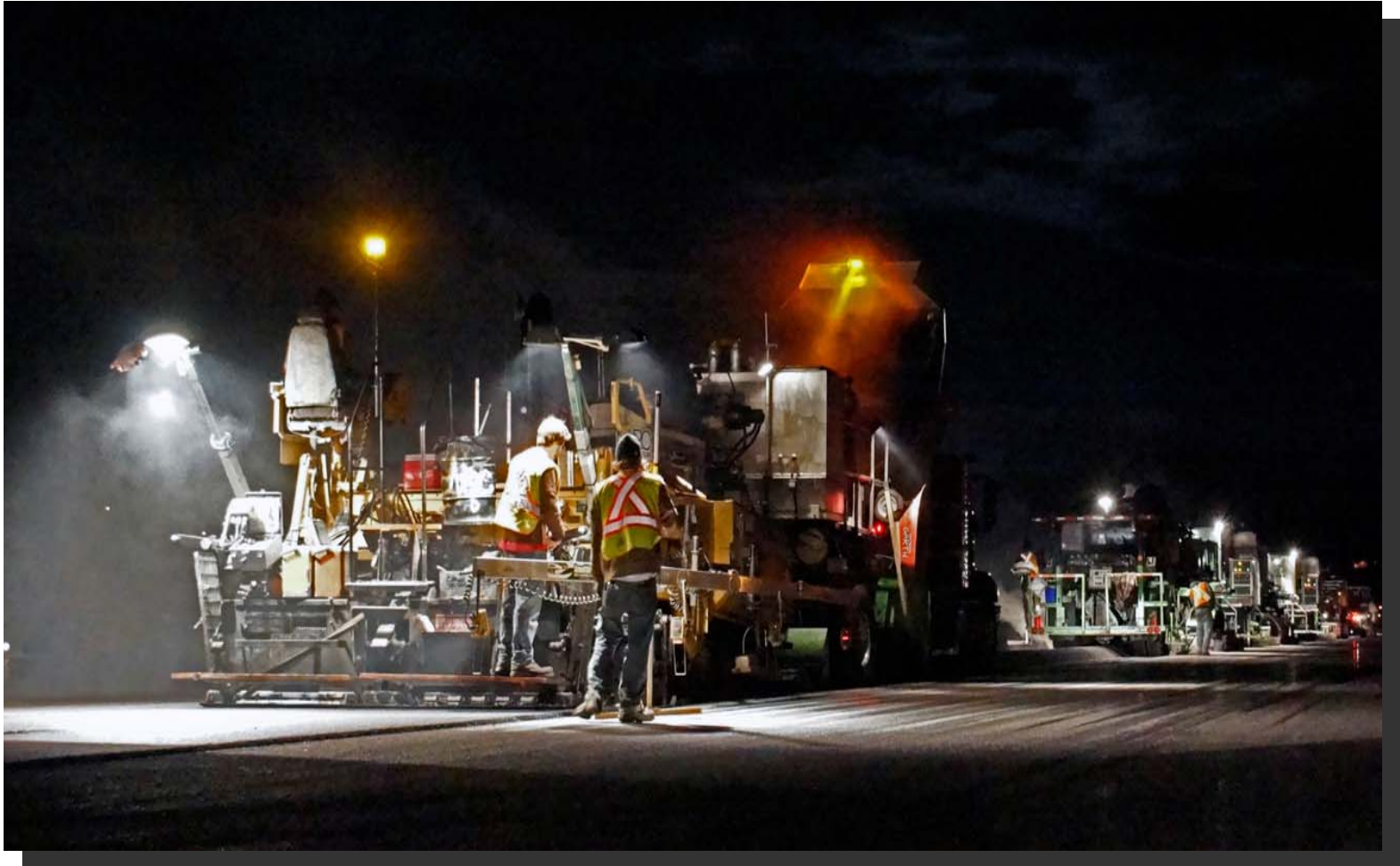


# Project Execution, Kelowna Runway HIR Process



ARC's on site, Terex 150 TPH, Portable Drum Mix Asphalt Plant, ~ 1 km from airport

# Project Execution, Kelowna Runway HIR Process



ARC HIR train from back of paver

# Project Execution, Kelowna Runway HIR Process



ARC HIR train from back of paver

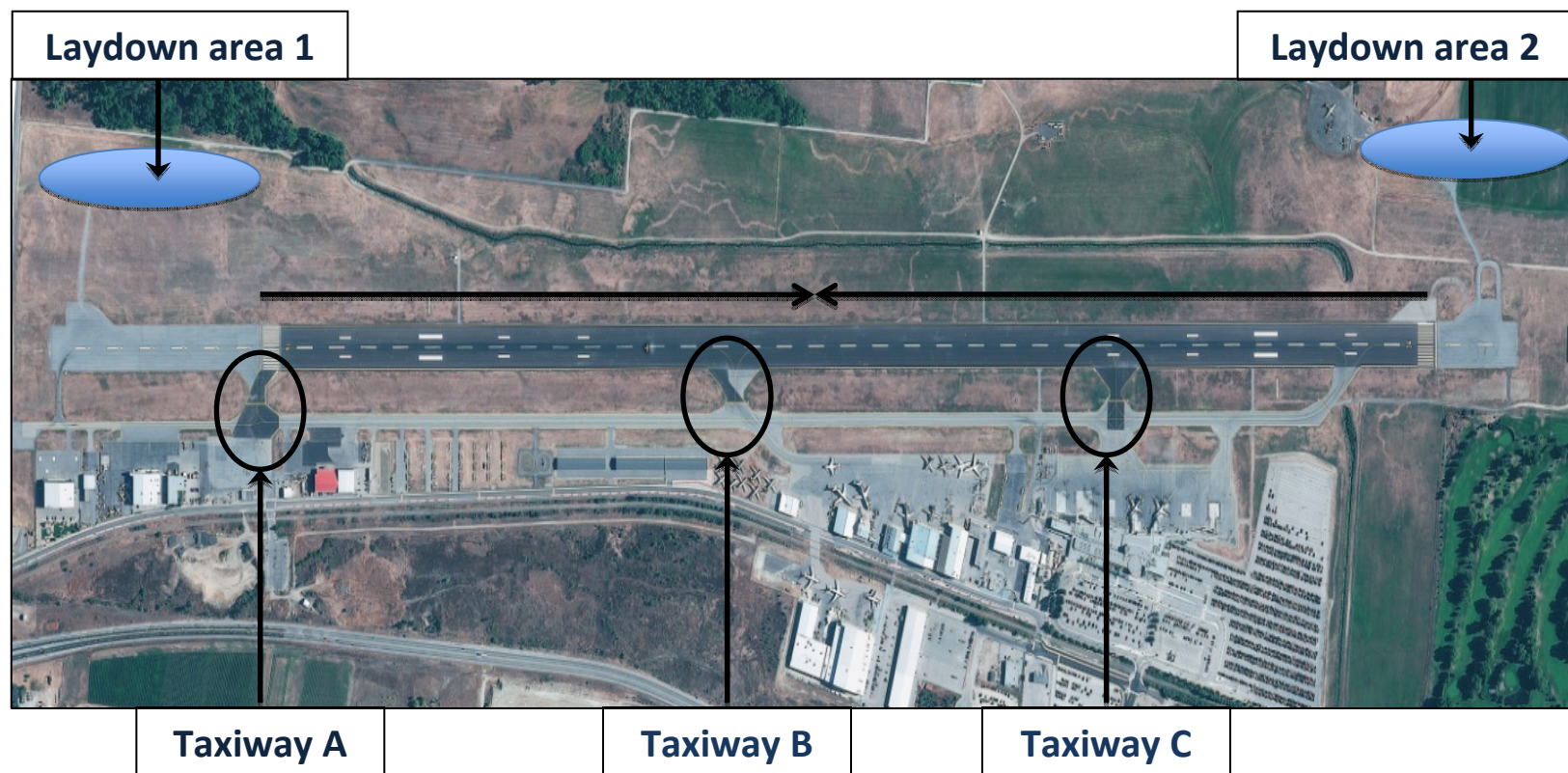


# Project Execution, Kelowna Runway HIR Process

- 1 equipment lay-down area at each end of site
- HIR started June 10
- East edge of runway to centreline, then west edge to centreline
- Cool & wet at start (6.5 days lost during east half, weather & electrical)
- 7 days/week
- 9 passes each side centreline
- Varied widths, with overlaps on each pass
- Average 50-60% runway length / shift (1,100 lineal / shift @ 3.65 m wide)
- 1 transverse joint per pass
- East half: 20 shifts
- West half :15 shifts
- HIR completed: July 19
- Average shift: 1,100 lineal m or 4,015 m<sup>2</sup>/ shift (5 hrs)
- Best shift: ~1,700 lineal metres; 6200 m<sup>2</sup>/5 hrs = 1,240 m<sup>2</sup>/hour)



# Project Execution, Kelowna Runway HIR Process



# Project Execution, Kelowna Runway HIR

## Process – QC Test Qualities

Test Description / Specification Limits	Asphalt Content (% dry aggregate) <b>6.1 ± 0.3</b>	Stability (N) <b>&gt; 12,500</b>	Flow (mm) <b>2-4</b>	Air Voids (%) <b>2.5 - 4.5</b>	Compaction (%) <b>&gt; 98.0</b>
Upper Limit	6.4	N/A	4.0	4.5	N/A
Lower Limit	5.8	12,000	2.0	2.5	98.0
Highest Lot Test	6.5	16,400	4.0	4.9	99.0
Lowest Lot Test	5.3	10,225	2.0	1.4	97.4
Job Lot Average (33 Test Lots)	5.9	12,668	3.5	2.7	98.3

# Project Execution, Kelowna Runway HIR Process - Qualities



Runway (Offset from centreline)	Average Runway		Minimum 100 m	
	Friction Index		Runway Friction Index	
	October 2012	June 2011	October 2012	June 2011
16-34 (3 m)	81	81	74	58
16-34 (6 m)	81	81	74	58
16-34 (15m)	83	95	72	85



## Observations & Conclusions



- Q The runway 16-34 resurfacing project at Kelowna airport, a single-runway site, is believed to constitute the first primary runway surface treated using 'stand-alone' HIR with added mix, in Canada (possibly North America)
- Q The application of HIR for the runway resurfacing offered many benefits to the City of Kelowna airport including:



## Observations & Conclusions

**QReduced operational risk in a short nightly window**

**QLimited need for commercial air-carrier schedule changes**

**QSignificant reduction in runway resurfacing cost**

**QReduction in use of non-renewable resources**

**QReduction in trucking (of resurfacing materials) to/from airport**

**QImproved nearby road & highway traffic safety (less trucking/shorter hauls)**

**QA smooth longitudinal profile (since HIR processing rarely stops forward movement)**

**QNo surface irregularities (abrupt elevation changes) through or at ends of each HIR pass**



## Observations & Conclusions

QIn emergency, equipment quickly removed from runway, the hot surface compacted with no deep reveal or abrupt rise in profile

QContractor was an important element in the success of the project

QOngoing commitment to a safe & high quality project was demonstrated throughout the Work.

QPast experience, integrity, professionalism & high level of skill was evident at all levels

QExtreme care needed in assessing suitability of an airfield pavement to use of HIR process

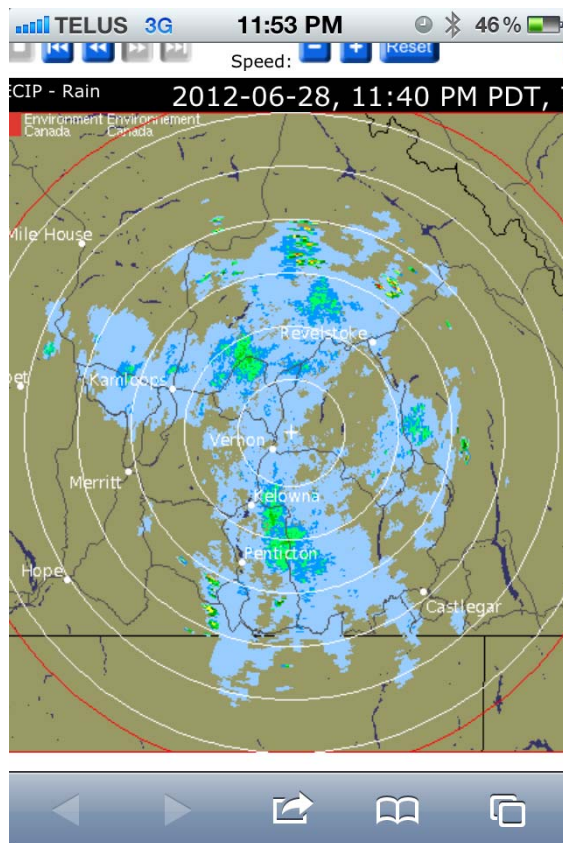
QDue to the length of the 'train', HIR is not well-suited to short runs or confined areas



## Observations & Conclusions

- Q **Both projects were completed** ahead of schedule
- Q **Both projects were completed** under budget
- Q **No operational delays or disruptions**
- Q **Both projects met / exceeded the owners' needs & expectations**
- Q **Pavement maintenance manual developed**
- Q **Aggressive crack/joint sealing (pavement preservation & maintenance) program is being implemented**

# The Importance of New Technology





Questions...?



**Thank-you for your time and attention!**







## WE CARE NOUS VEILLONS

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**WE CARE** about the health and safety of our employees, of those who work under our care, and of the people our projects serve.



**WE CARE** about our employees, their personal growth, career development and general well-being.



**WE CARE** about the communities where we live and work and their sustainable development, and we commit to fulfilling our responsibilities as a global citizen.



**WE CARE** about the environment and about conducting our business in an environmentally responsible manner.



**WE CARE** about the quality of our work.