Runway Condition Assessment Matrix

Minneapolis-St. Paul International Airport's Perspective

John Ostrom

Manager, Airside Operations

2018

Operations

- 407,476 Operations
- 38,037,381 Passengers
- 17 Airlines

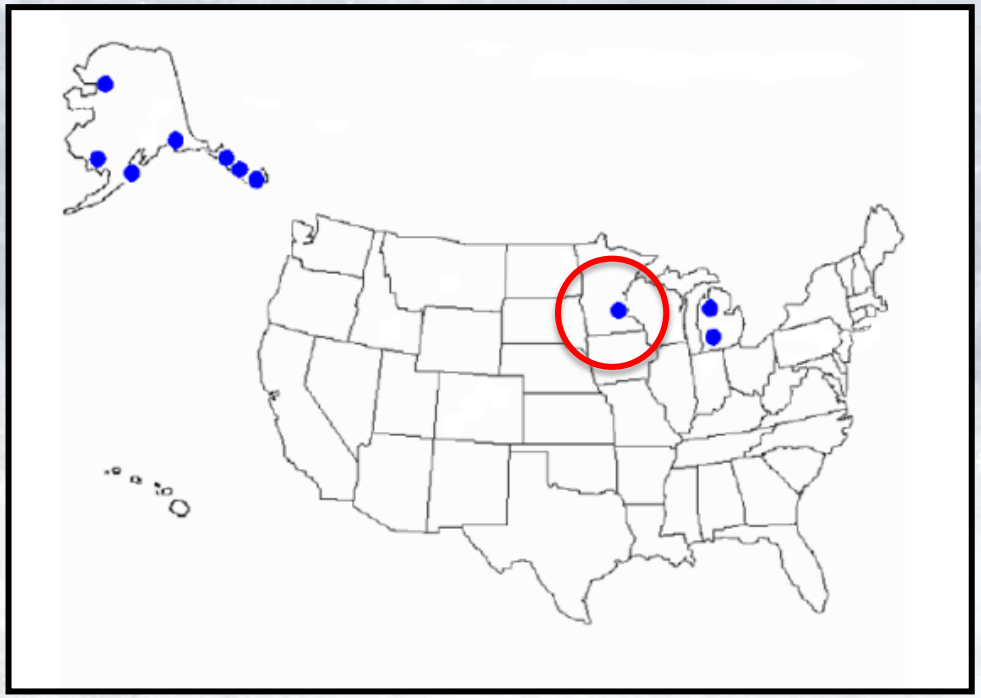
Infrastructure

- 3,000 Acres
- Runways - 4
- Taxiways – 19
- Feeders – 58
- Aprons – 10
- Aircraft Gates - 119

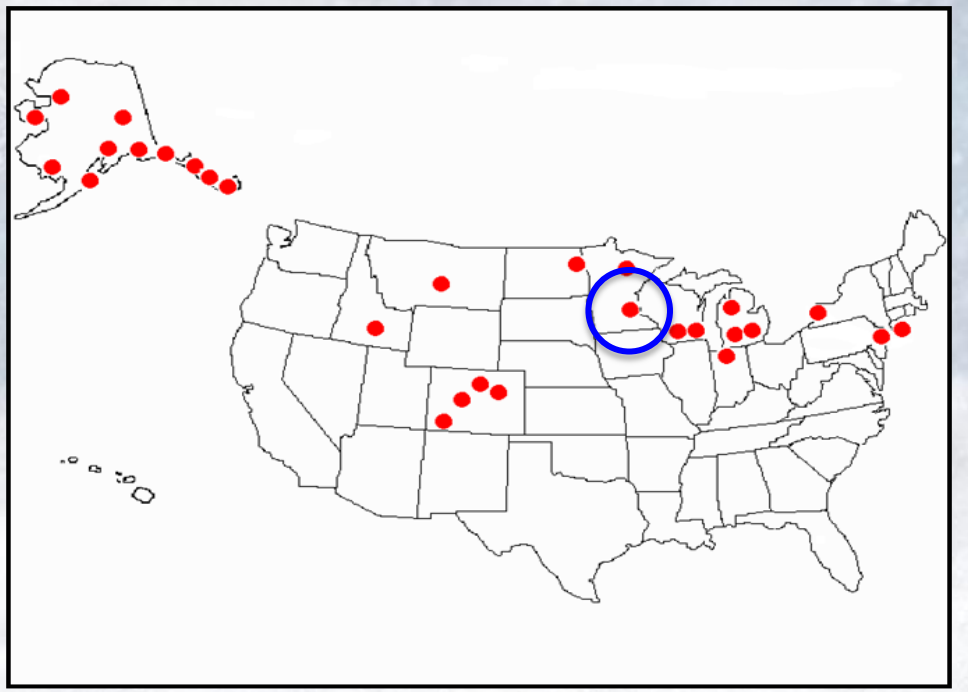
Background/History

Testing/Data Collection 2008-2009 – MSP and TVC

First Validation Winter 2009-2010



Second Validation Winter 2010-2011



Runway Condition Report - Data Collection Sheet

Airport

Runway

Date

Local Time (24 hr)

Initials

Flight #

Is the portion of the Runway that is being maintained MORE THAN 25% covered with a contaminant?

☐ Yes, assign Runway Condition Codes and complete the Matrix Report (blue box)

☐ No, DO NOT assign Runway Condition Codes but complete all other sections of the Matrix Report if any contamination is present (blue box)

"Matrix Report . . . ____ Rwy ____ / / ____ (%) ____ (inch) _____

(Airport) (Rwy #) (Rwy Condition Codes) (% Coverage - 10, 25, 50, 75, or 100%) (Highest Depth only for Slush, Wet Snow or Dry Snow and Standing Water [Water 1/8 " or less report as WET with no depth]) (Contaminant Type [Report in terms in worksheet below, Water 1/8 " or less report as WET])

(Remarks to be transmitted)

" (Date) (Time)

Misc. Data

°C Outside Air Temp

Active Precip? Yes or No

Adjusted Runway Condition Codes

(ONLY If Downgrade or Upgrade Assessments Used)

Requires an explanation in the comments section below

Rwy Treatment Used? Time Applied

☐ Sand ☐ Deicing Chem

Rwy Mu *Before (If Applicable) After*

☐ Decel ☐ CFME

1st Rwy Third

- For Coverage 25% or Less, Enter Code 6
- Circle (or Mark) any contaminant below that covers more than 25% of the Rwy Third. Record the most restrictive code in the box to the right.
- Circle (or Mark) Depth Only for: Water, Slush, Wet Snow, Dry Snow, or Any Snow OVER Compacted Snow

Dry 6 | Wet (Damp) 5 | Frost 4 | Below Min Friction Level Classification - Wet Slippery 3

Water or Slush: GREATER Than 1/8" 2 | 1/8" or LESS 5

Slush: GREATER Than 1/8" 3 | 1/8" or LESS 5

Wet Snow or Dry Snow

Depth: 1/8" or Less | 1/4" | 1/2" | 3/4" | 1" | 2" or More

Dry or Wet Snow OVER Compacted Snow 3

Compacted Snow: -15°C or Colder 4 | Warmer than -15°C 3

Ice 1 | Wet Ice, Water OVER Compacted Snow. Snow OVER Ice 0

2nd Rwy Third

- For Coverage 25% or Less, Enter Code 6
- Circle (or Mark) any contaminant below that covers more than 25% of the Rwy Third. Record the most restrictive code in the box to the right.
- Circle (or Mark) Depth Only for: Water, Slush, Wet Snow, Dry Snow, or Any Snow OVER Compacted Snow

Dry 6 | Wet (Damp) 5 | Frost 4 | Below Min Friction Level Classification - Wet Slippery 3

Water or Slush: GREATER Than 1/8" 2 | 1/8" or LESS 5

Slush: GREATER Than 1/8" 3 | 1/8" or LESS 5

Wet Snow or Dry Snow

Depth: 1/8" or Less | 1/4" | 1/2" | 3/4" | 1" | 2" or More

Dry or Wet Snow OVER Compacted Snow 3

Compacted Snow: -15°C or Colder 4 | Warmer than -15°C 3

Ice 1 | Wet Ice, Water OVER Compacted Snow. Snow OVER Ice 0

3rd Rwy Third

- For Coverage 25% or Less, Enter Code 6
- Circle (or Mark) any contaminant below that covers more than 25% of the Rwy Third. Record the most restrictive code in the box to the right.
- Circle (or Mark) Depth Only for: Water, Slush, Wet Snow, Dry Snow, or Any Snow OVER Compacted Snow

Dry 6 | Wet (Damp) 5 | Frost 4 | Below Min Friction Level Classification - Wet Slippery 3

Water or Slush: GREATER Than 1/8" 2 | 1/8" or LESS 5

Slush: GREATER Than 1/8" 3 | 1/8" or LESS 5

Wet Snow or Dry Snow

Depth: 1/8" or Less | 1/4" | 1/2" | 3/4" | 1" | 2" or More

Dry or Wet Snow OVER Compacted Snow 3

Compacted Snow: -15°C or Colder 4 | Warmer than -15°C 3

Ice 1 | Wet Ice, Water OVER Compacted Snow. Snow OVER Ice 0

Pilot Braking Action Reports: Aircraft Type_____ Braking Action Reported _____ Time of Report_____

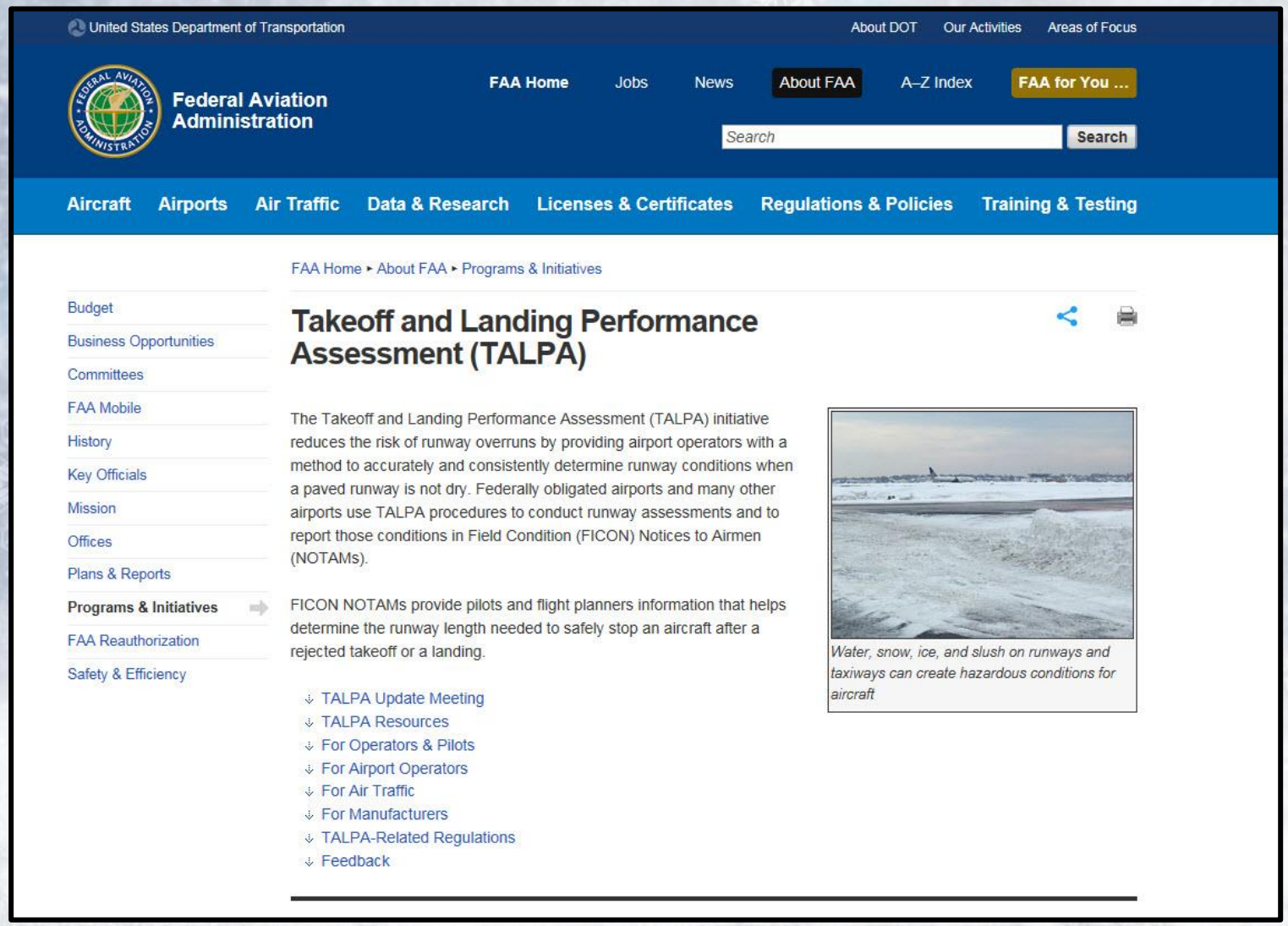
Comments for Evaluation Team on Accuracy and Usability of the Matrix Reporting System _____

Use reverse side if more space is needed.

2010-2011

- Apprehensive
- Overloaded
- Concerned
- Scared

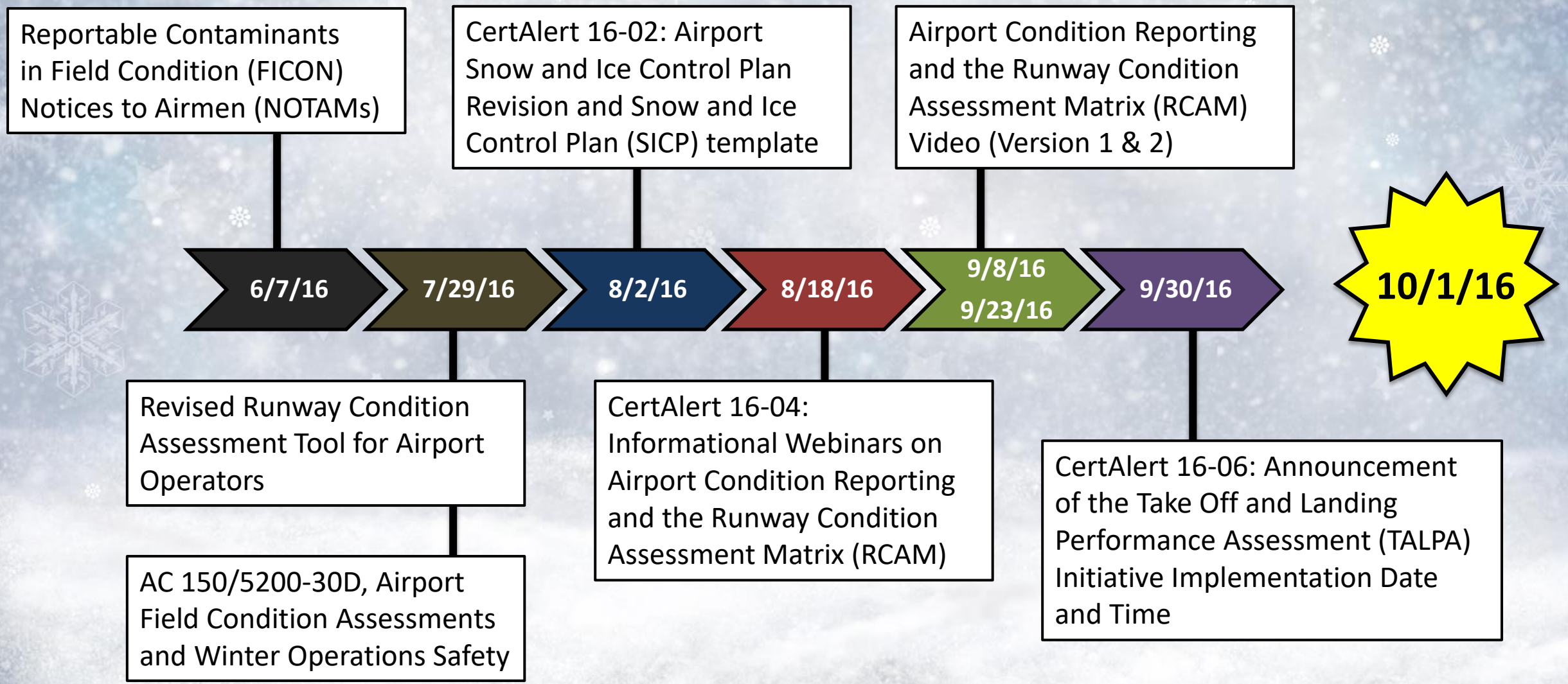
FAA Guidance



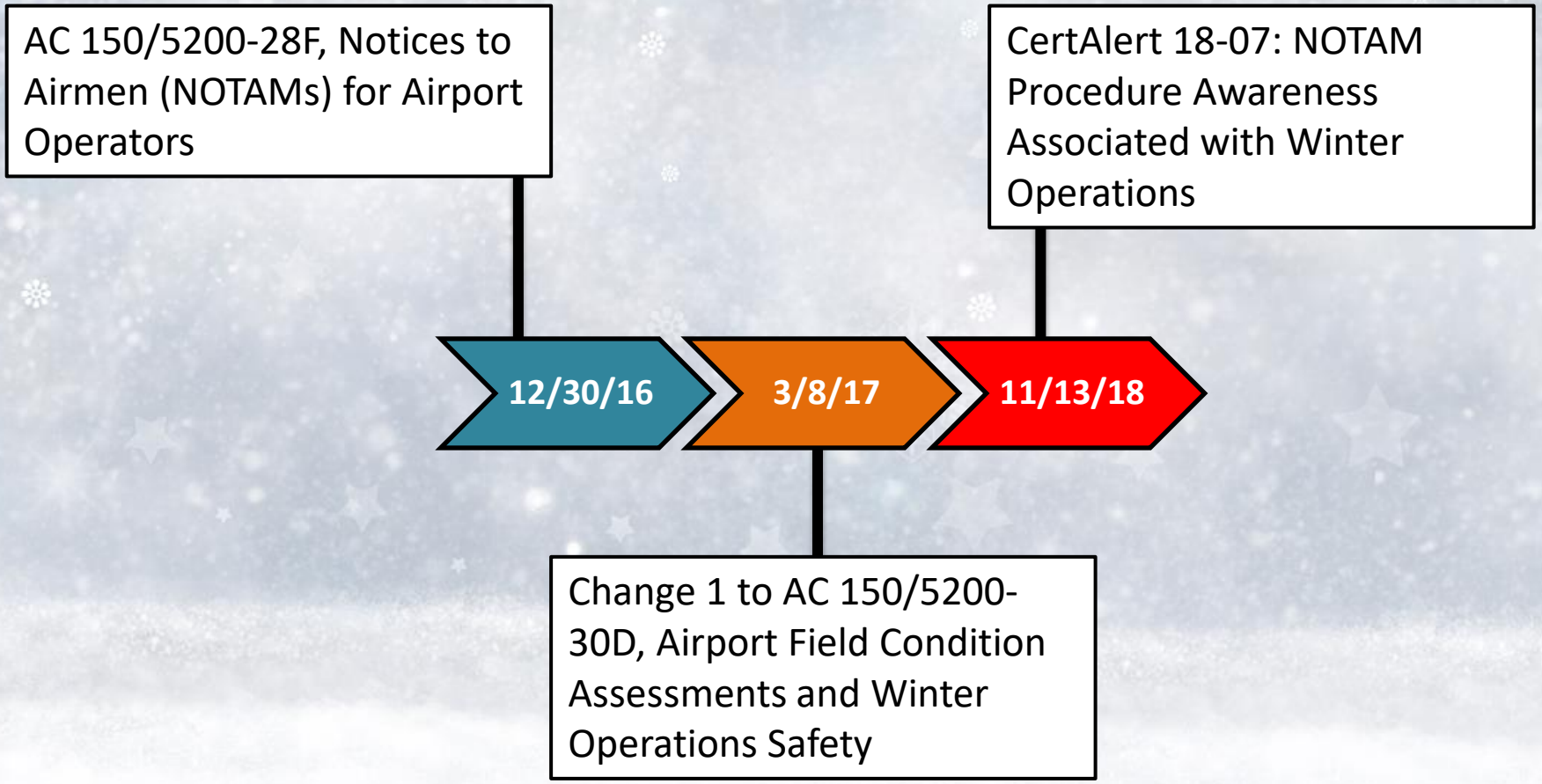
https://www.faa.gov/about/initiatives/talpa

- Operators & Pilots
- Airport Operators
- Air Traffic
- Manufacturers

RCAM Timeline



RCAM Timeline



R Runway

C Condition

A Assessment

M Matrix

Federal Aviation Administration

Assessment Criteria		Downgrade Assessment Criteria		
Runway Condition Description	**Code**	**Mu (μ) [1]**	**Vehicle Deceleration or Directional Control Observation**	**Pilot Reported Braking Action**
• Dry	6		---	---
• Frost • Wet (Includes Damp and 1/8 inch depth or less of water) ***1/8 inch (3mm) depth or less of:*** • Slush • Dry Snow • Wet Snow	5	40 or Higher	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	Good
5° F (-15°C) and Colder outside air temperature: • Compacted Snow	4	39 to 30	Braking deceleration OR directional control is between Good and Medium.	Good to Medium
• Slippery When Wet (wet runway) • Dry Snow or Wet Snow (Any depth) over Compacted Snow ***Greater than 1/8 inch (3mm) depth of:*** • Dry Snow • Wet Snow ***Warmer than 5° F (-15°C) outside air temperature:*** • Compacted Snow	3	29 to 21	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	Medium
Greater than 1/8 (3mm) inch depth of: • Water • Slush	2		Braking deceleration OR directional control is between Medium and Poor.	Medium to Poor
• Ice [2]	1		Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	Poor
• Wet Ice [2] • Slush over Ice • Water over Compacted Snow [2] • Dry Snow or Wet Snow over Ice [2]	0	20 or Lower	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	Nil

[1] The correlation of the Mu (μ) values with runway conditions and condition codes in the Matrix are only approximate ranges for a generic friction measuring device **and are intended to be used only to downgrade a runway condition code; with the exception of circumstances identified in Note 2.** Airport operators should use their best judgment when using friction measuring devices for downgrade assessments, including their experience with the specific measuring devices used.

[2] In some circumstances, these runway surface conditions may not be as slippery as the runway condition code assigned by the Matrix. The airport operator may issue a higher runway condition code (but no higher than code 3) for each third of the runway if the Mu value for that third of the runway is 40 or greater obtained by a properly operated and calibrated friction measuring device, **and all other observations, judgment, and vehicle braking action support the higher runway condition code. The decision to issue a higher runway condition code than would be called for by the Matrix cannot be based on Mu values alone; all available means of assessing runway slipperiness must be used and must support the higher runway condition code.** This ability to raise the reported runway condition code to a code 1, 2, or 3 can only be applied to those runway conditions listed under codes 0 and 1 in the Matrix.

The airport operator must also continually monitor the runway surface as long as the higher code is in effect to ensure that the runway surface condition does not deteriorate below the assigned code. The extent of monitoring must consider all variables that may affect the runway surface condition, including any precipitation conditions, changing temperatures, effects of wind, frequency of runway use, and type of aircraft using the runway. If sand or other approved runway treatments are used to satisfy the requirements for issuing this higher runway condition code, the continued monitoring program must confirm continued effectiveness of the treatment.

Caution: Temperatures near and above freezing (e.g., at 26.6° F (-3°C) and warmer) may cause contaminants to behave more slippery than indicated by the runway condition code given in the Matrix. At these temperatures, airport operators should exercise a heightened level of runway assessment, and should downgrade the runway condition code if appropriate.

2016-2017 Preseason Preparation

- MSP Airport Certification Manual (ACM) Snow and Ice Control Plan (SICP) change by October 1, 2016
- Airlines and ATCT briefings on RCAM
- Airlines expectations and operational impacts
- Staffing matrix changes
  - Runway, Taxiway, NOTAM/FICON Positions

20 Minute Runway Closures

- 15 minutes Plowing
- 5 minutes SFT and SUV

SUV

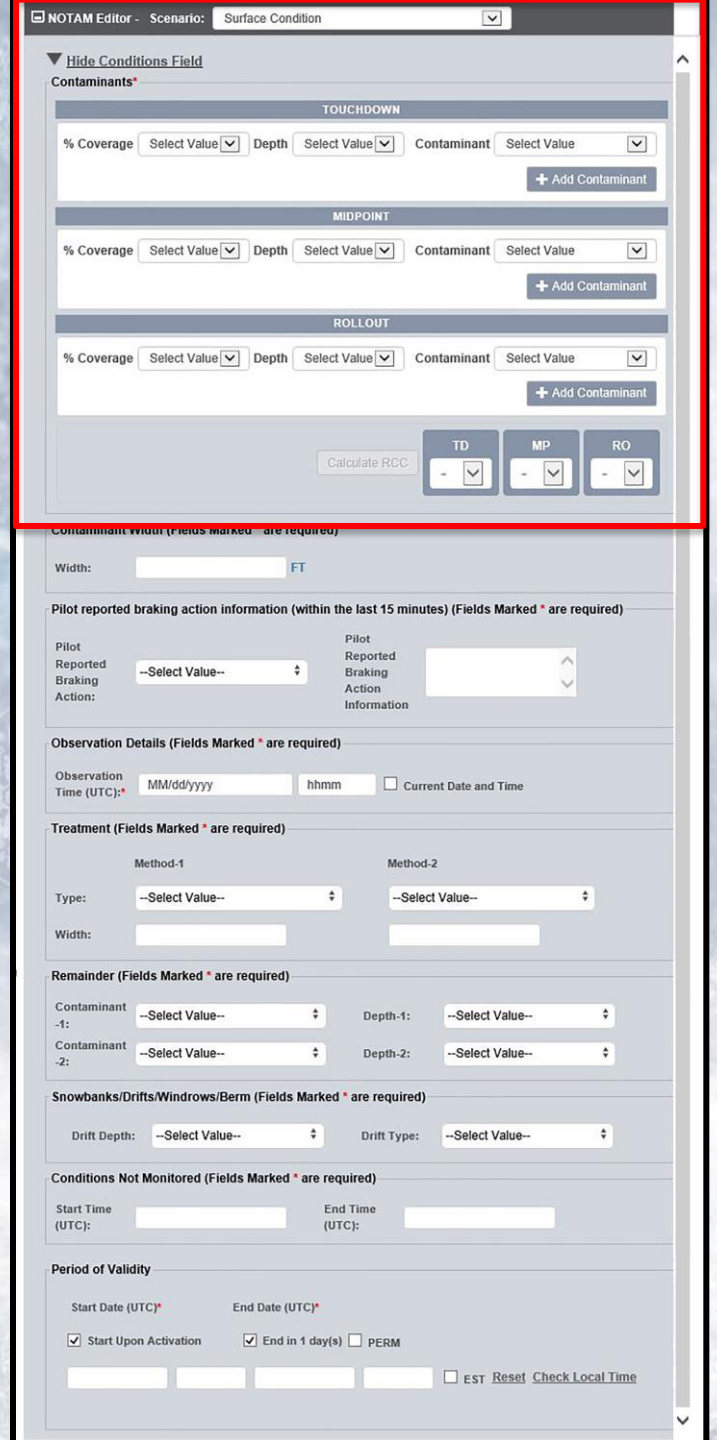
- Contaminant Type
- Contaminant Depth
- % Coverage

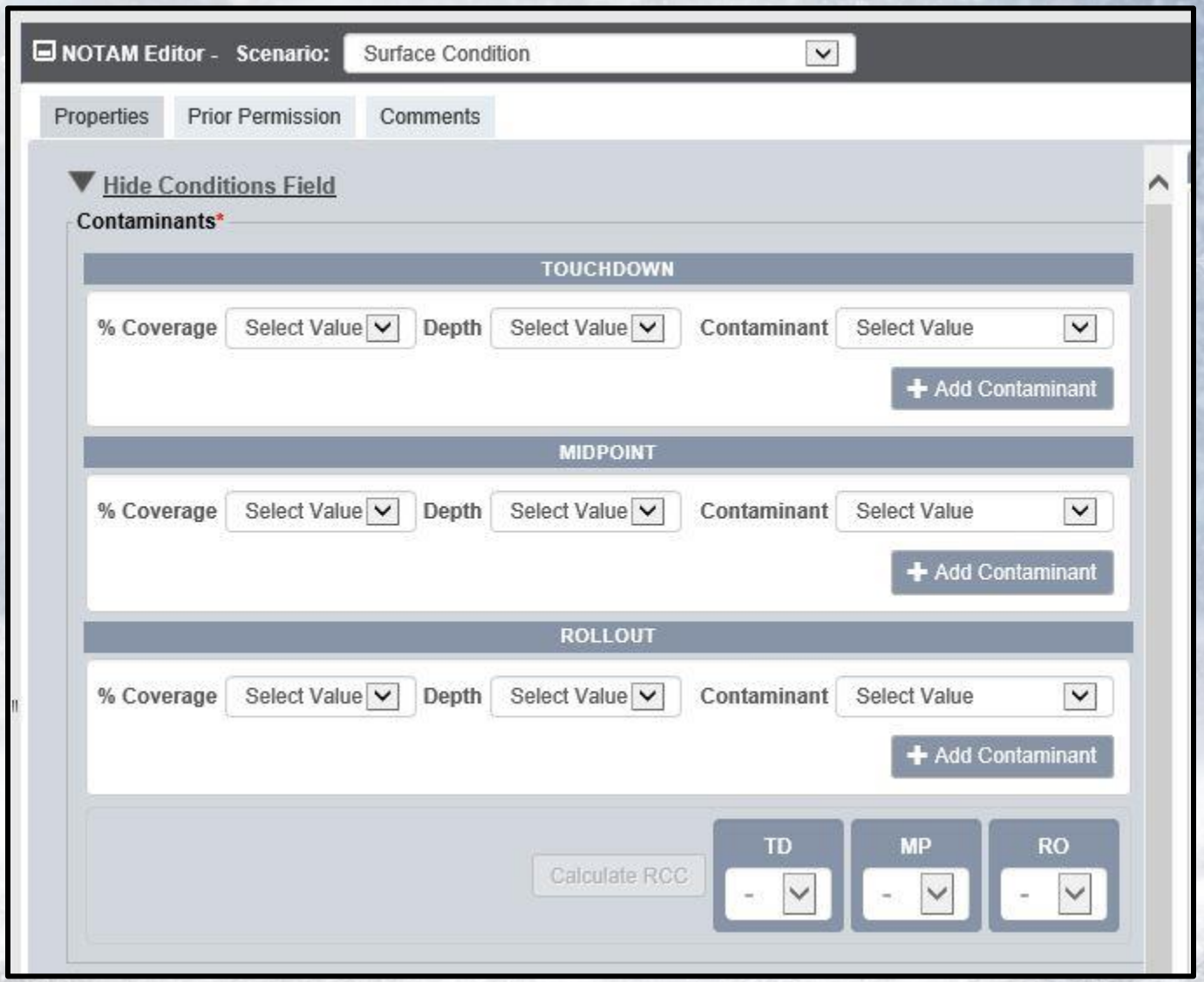
SFT

- Pre-Run Mu values
- Post Run Mu values

All data called in to Ops Center to determine RCCs and then communicated to ATCT when runway is opened.

FAA Digital NOTAM System





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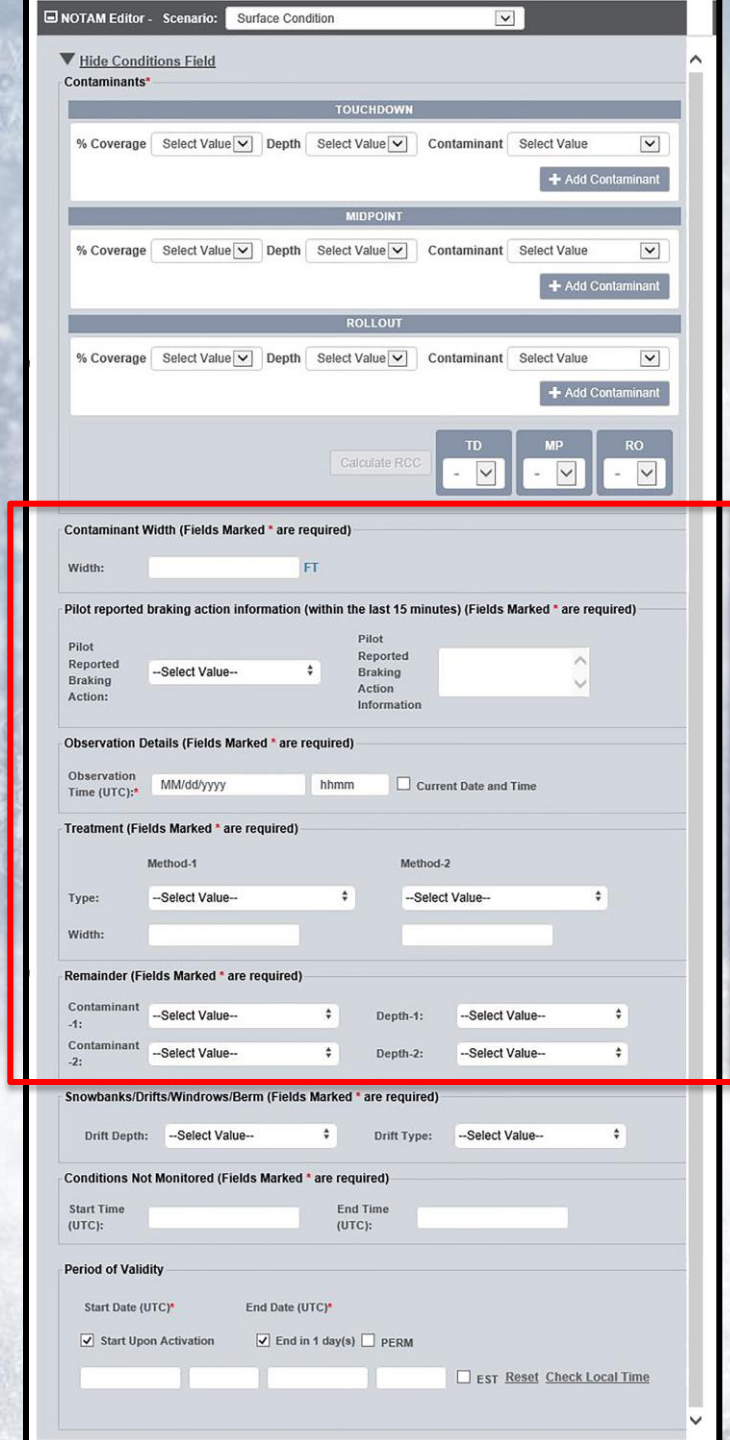
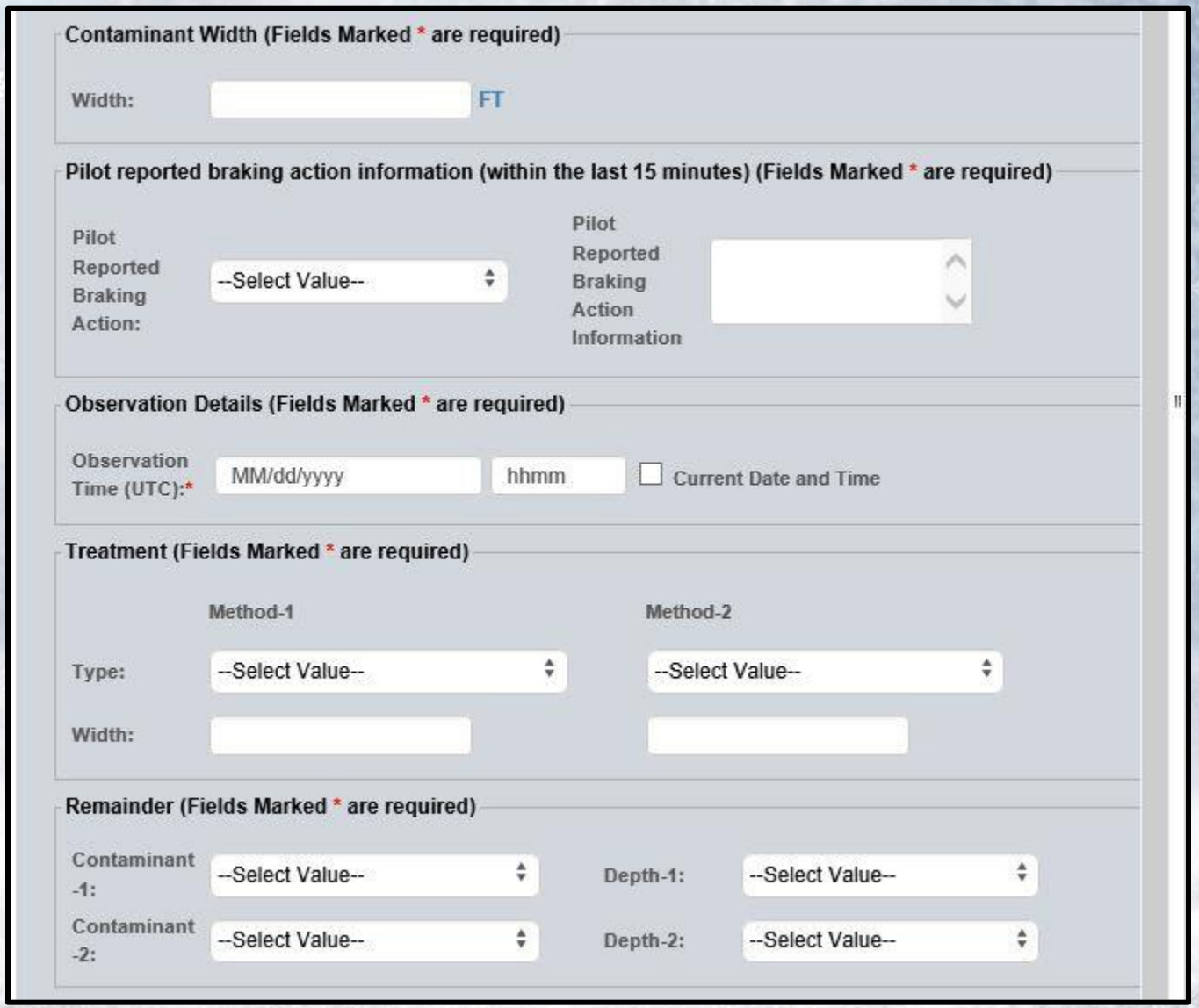




FAA Digital NOTAM System

FAA Digital NOTAM System

Domestic | ICAO | Plain Text

!MSP XX/XXX MSP RWY 12L FICON 3/3/3 100 PCT 6IN DRY SN 1903201932-1903211932

Domestic | ICAO | Plain Text

XX/XXX NOTAMN
Q) ZMP/QMRXX/IV/NBO/A/000/999/4452N09313W005
A) KMSP
B) 1903210115
C) 1903220115
E) 12L FICON 3/3/3 100 PCT 6IN DRY SN .

Domestic | ICAO | Plain Text

Issuing Airport: (MSP) Minneapolis-St Paul Intl/Wold-Chamberlain
NOTAM Number: XX/XXX
Effective Time Frame
Beginning: Wednesday, March 20, 2019 1932 (UTC)
Ending: Thursday, March 21, 2019 1932 (UTC)
Affected Areas
Runway: 12L
Condition: 3/3/3 100 PCT 6IN DRY SN

March 12, 2017

17:22

- Runway 12R opened
- .5 mile visibility, snowing
- Dry Snow
- <1/8”
- 100% Coverage
- RCC = 3/3/3 (downgraded)
- Mu = 28/24/24

17:39

- PIREP BRA M
- PIREP BRA M-P

17:45

- FedEx 728 requested BRA
- ATC Advised BRA M-P
- ATC advised RCC 1

17:55

- FedEx 728 Diverted to MKE

February 19, 2018

ASRS Report

19:15

- Runway 12L inspected
- Dry Snow
- <1/8”
- 100% Coverage
- 2” windrows
- RCC = 5/5/5
- Mu = 29/29/32

19:49

- ATC advised Ops that Skywest 4796 reported Runway 12L BRAP-N
- Runway 12L closed
- Mu 27/27/27
- Dry Snow
- <1/8”
- 100% Coverage
- 2” windrows
- **Would have been 5/5/5**

Skywest 4796

“So far my experience with RCC values has proven them to not be sufficient in evaluating actual runway conditions. More than a year after the implementation I have yet to see an RCC value below 5 on a runway I've used in varying conditions. The reported values during the time of our landing were not an accurate representation of the actual runway conditions.”

Skywest 4796

“The airport had reported 5/5/5 as the RCC for the runway of intended landing. Having taken off earlier, in similar meteorological conditions, and noticing no abnormal conditions on the runway, we could have probably been a little complacent, and should have questioned the actual runway condition based on the new BA reports of medium to poor. However, the significant difference between reported RCC and actual conditions, led us to believe that a safe landing was a reasonable assumption.”

December 31, 2018

ASAP Report

11:40

- Runway 12L inspected
- Wet
- 80% Coverage
- RCC = 5/5/5

14:37

- -SN

15:55

- Delta 588
- Runway 12L BRAM by CRJ
- Upset that RCC didn't match PIREP

16:17

- Runway 12L inspected
- Dry Snow
- < 1/8"
- 50 % / 50% /100%
- RCC = 5/5/5

Delta 588

- “Using the MSP ATIS C we were expecting and briefed runway 30R/12L to have braking conditions of 5 5 5 which is Good. When we contacted MSP Tower they gave us the actual runway conditions which was Medium braking being reported by a CRJ. Medium braking is a big difference from Good braking which was still being reported on the MSP ATIS RCCs. When we landed we had Medium braking which is what ATC Tower gave us and not the Good being reported on the MSP ATIS Runway Condition Codes.”

Runway Plowing

3 Runway Configuration

Runway	Rwy Closed	Rwy Open	Elapsed Time	Snow Rate: 1 inch per hour Snow Accumulation	Snow Rate: .5 inch per hour Snow Accumulation
12R/30L	**0900**	**0920**	0	.125” snow	.125” snow
12L/30R	0925	0945	25 minutes	.54” snow	.27” snow
17/35	0950	1010	50 minutes	.95” snow	.45” snow
12R/30L	**1015**	**1035**	55 minutes	1” snow	.5” snow
12L/30R	1040	1100			
17/35	1105	1125			

Challenges: RCAM and MSP ATCT

- Controllers feel they're getting less information with FICONs
- Controllers converting aircraft braking action PIREPs to RCCs
  - Pilot reports Medium
  - Controller calls it 3/3/3
- Controllers reporting RCCs as aircraft braking action
  - FICON shows 5/5/5
  - Controller calls it Good

Challenges: RCAM and MSP Pilots

- Pilots not understanding that a FICON is a snap shot in time and only valid at the date and time of issuance
- Pilots calling ATCT for clarification of FICON information and for updated FICONs
- Pilots reporting aircraft braking using RCC
  - Braking action 4
- Pilots wanting FICON to show clear and dry (6)

Challenges: RCAM and MSP

- Increased staff by 1 for FICON/NOTAM issuance
- No option for reporting residual glycol or chemical on runway for RCC. Airport reporting it wet, contrary to guidance.
- Fudged contaminant depth reporting after runway closure during active event
- Pilots using only lowest RCC number
- Wet FICONs are killing us

Wet FICONs

Issue

- **Runway 4/22 – Wet**
- **Runway 12L/30R – Wet**
- **Runway 12R/30L – Wet**
- **Runway 17/35 – Wet**
- **Taxiways – Wet**
- **Aprons – Wet**

Cancel

- **Runway 4/22 – Wet**
- **Runway 12L/30R – Wet**
- **Runway 12R/30L – Wet**
- **Runway 17/35 – Wet**
- **Taxiways – Wet**
- **Aprons – Wet**

Issue – Wet (6)
Cancel – Wet (6)

Proposed

Issue – Aerodrome Wet
Cancel – Aerodrome Wet

SAFO: Runway Assessment and Condition Reporting

Effective October 1, 2016

- When an airport condition (FICON) NOTAM includes RwyCCs, it is an indicator that more than 25% of the overall runway coverage or cleared width is contaminated and performance impacts are likely. When a runway is less than 25% contaminated, RwyCCs will not be generated, and performance impacts are less likely.

RCAM Anomalies

- Tried to break the FICON/RCC process
  - 100% Wet / 100% Wet / **25% 10” Slush** = 5/5/**2** *(3,333 ft x 50 ft)*

    MSP MSP RWY 30L FICON 5/5/2 100 PCT WET, 100 PCT WET, 25 PCT 10IN SLUSH 1903270150-1903280150

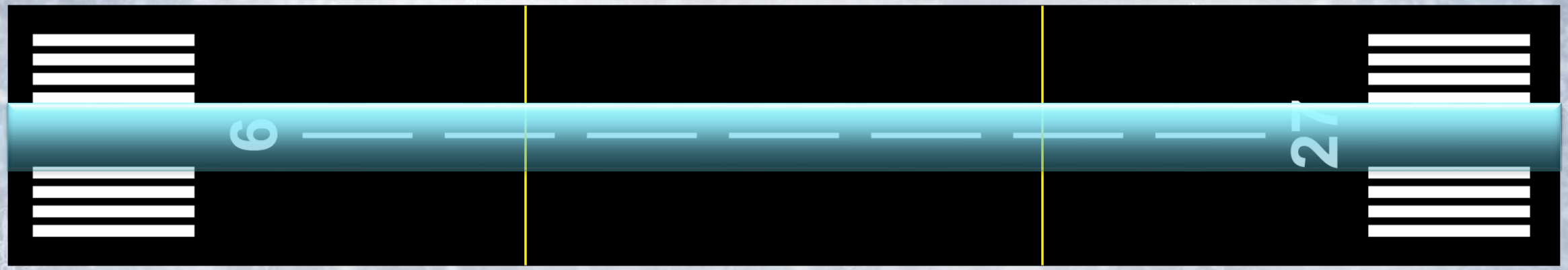
    No Treatment

  - 100% Wet / 100% Wet / **25% 10” Slush and 75% Wet** = 5/5/**5** *(3,333 ft x 50 ft)*

    MSP RWY 30L FICON 5/5/2 100 PCT WET, 100 PCT WET, 25 PCT 10IN SLUSH PLOWED AND SWEPT AND SANDED AND DEICED LIQUID 2IN WINDROWS 1903220225-1903230225

Example 1

Runway = 200’ wide, 10,000’ long



RO

- Contaminant = ICE
- % Coverage = 25

MP

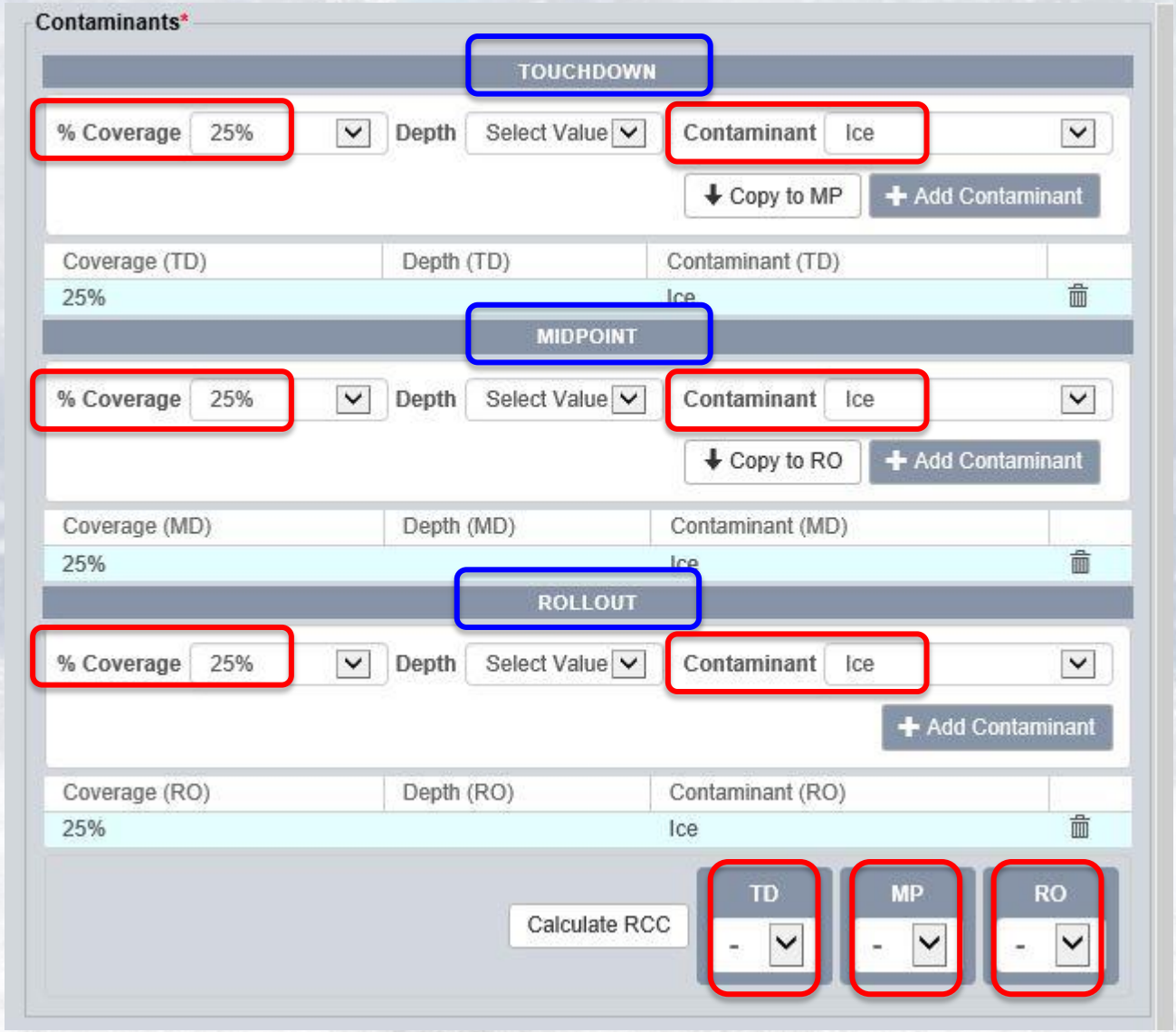
- Contaminant = ICE
- % Coverage = 25

TD

- Contaminant = ICE
- % Coverage = 25

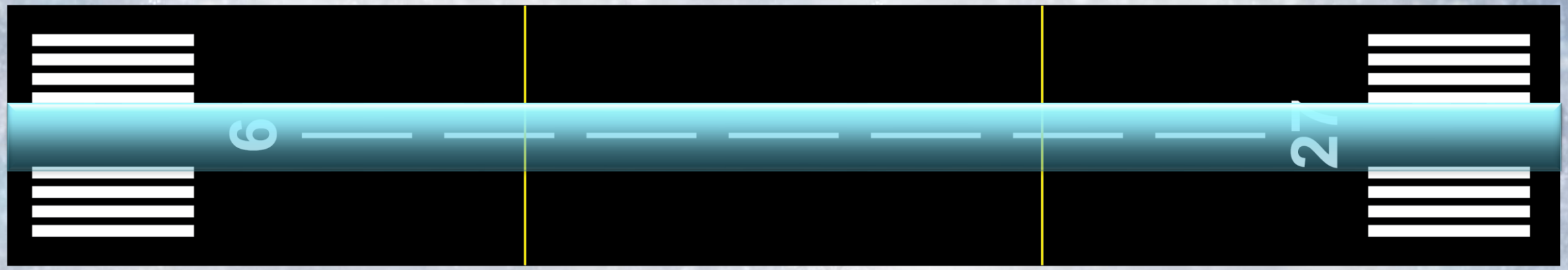
Ice = 50 feet wide, 10,000 feet Long

FICON


Contaminants*
TOUCHDOWN
% Coverage 25%
Depth Select Value
Contaminant Ice
Copy to MP
Add Contaminant
Coverage (TD)
Depth (TD)
Contaminant (TD)
25%
Ice
MIDPOINT
% Coverage 25%
Depth Select Value
Contaminant Ice
Copy to RO
Add Contaminant
Coverage (MD)
Depth (MD)
Contaminant (MD)
25%
Ice
ROLLOUT
% Coverage 25%
Depth Select Value
Contaminant Ice
Add Contaminant
Coverage (RO)
Depth (RO)
Contaminant (RO)
25%
Ice
Calculate RCC
TD
MP
RO
-
-
-

Example 1

Runway = 200’ wide, 10,000’ long



RO

- Contaminant = ICE
- % Coverage = 25

MP

- Contaminant = ICE
- % Coverage = 25

TD

- Contaminant = ICE
- % Coverage = 25

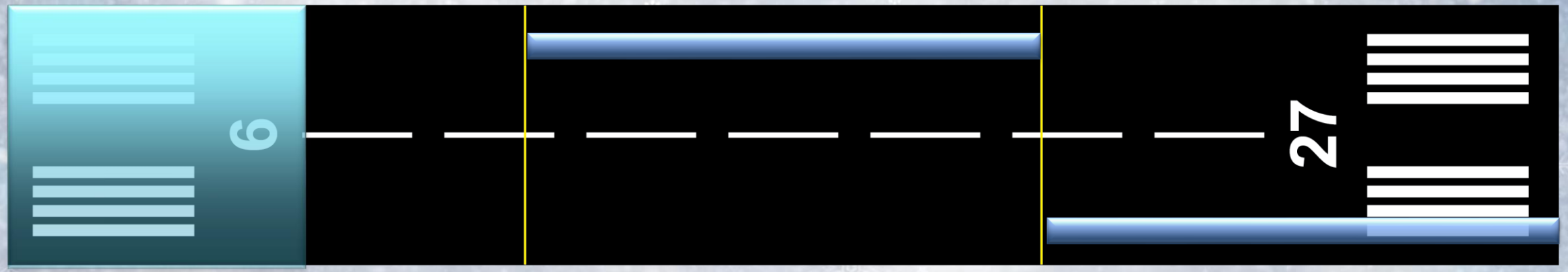
MSP RWY 27 FICON 25 PCT ICE 1903220225-1903230225

NO RWYCC

Ice = 50 feet wide, 10,000 feet Long

Example 2

Runway = 200’ wide, 10,000’ long



RO

- Contaminant = ICE
- % Coverage = 50

MP

- Contaminant = Wet
- % Coverage = <10

TD

- Contaminant = Wet
- % Coverage = <10

!MSP XX/XXX MSP RWY 27 FICON 10 PCT WET, 10 PCT WET, 50 PCT ICE 1903220225-1903230225

NO RWYCC

Ice = 200’ wide, 1,666’ Long

Technology

- Testing and demo with AST's SafeLand and SafeScan systems
- Testing and demo with Vaisala Sensor System
- Runway Friction Prediction Tool - NCAR
  - Sensors = Automation
    - Depth
    - % Coverage
    - Contaminant Type
    - OAT
    - Friction*

Good Progress, With More Work Ahead

Questions