PrI to IRI

The Nevada Experience

Presented by:

Steven Hale, P.E.
Assistant Construction Engineer

69th Annual Asphalt Paving Conference
Kansas University School of Engineering
December 4th, 2025

Outline

- Roadways maintained by the Nevada Department of Transportation (NDOT)
- Smoothness specifications for construction acceptance prior to January of 2016 using Profile Index (PrI)
- Why the switch from PrI to International Roughness Index (IRI) smoothness specifications for construction acceptance
- Development and implementation of IRI smoothness specifications for construction acceptance

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Outline

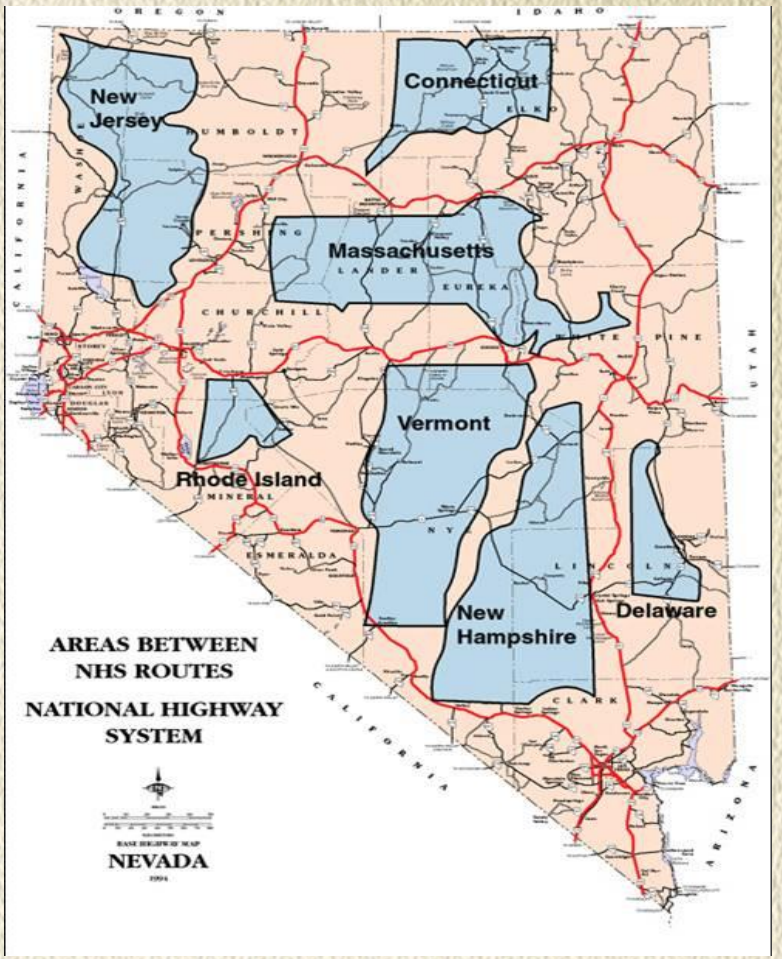
- Current smoothness specifications for construction acceptance using IRI
- NDOT profiler certification program
- NDOT's participation in the 2024 Illinois Profiler Certification Experiment
- Lessons learned
- What the future holds

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Roadways Maintained by NDOT

- Interstate (NHS)
  - 635 centerline miles
- NHS Routes (except Interstates)
  - 1,802 centerline miles
- Other Routes
  - 2,969 centerline miles



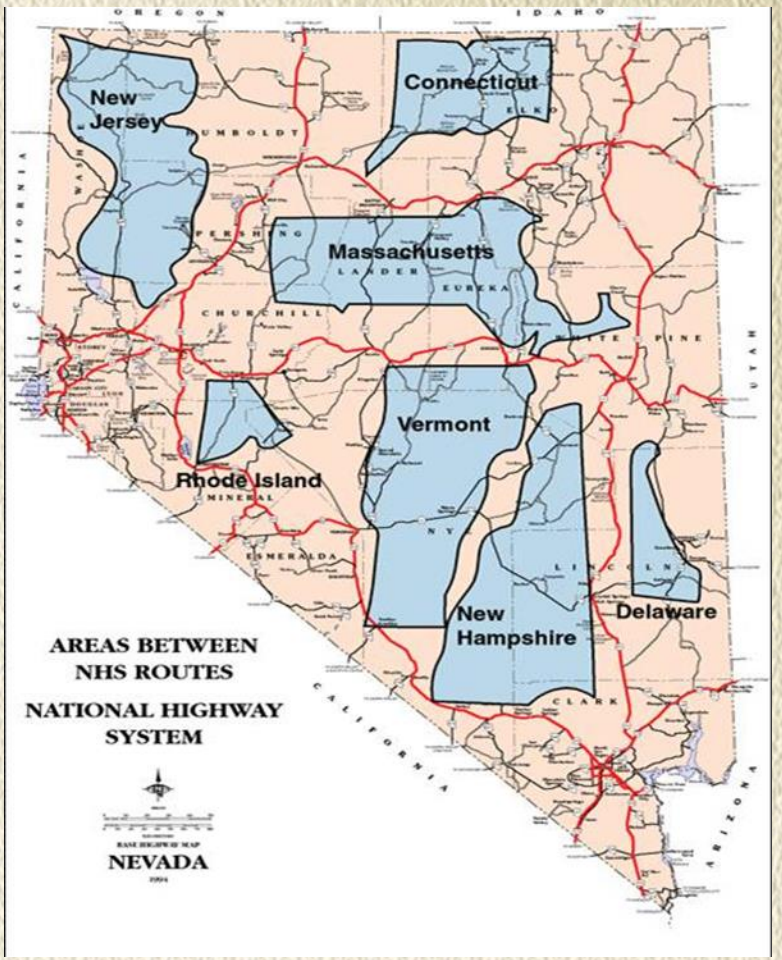
KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Roadways Maintained by NDOT

Total Centerline Miles Maintained

5,406



KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Smoothness Specifications for Construction Acceptance Prior to 2016 Using Prl

- Straightedge measurement
  - NDOT personnel performed measurement
  - Twelve-foot straightedge was used
  - Measurements taken both parallel and perpendicular to centerline
  - Roadway surface to not vary by more than 1/4 in. (1/8 in. for PCCP)

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Smoothness Specifications for Construction Acceptance Prior to 2016 Using PrI

- Profilograph measurement
  - Contractor provided California type profilograph
  - Contractor performed testing
  - Other types of profilographs could be used
  - NDOT oversaw testing and evaluated results

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Smoothness Specifications for Construction Acceptance Prior to 2016 Using PrI

- NDOT specified three different smoothness types
  - Type A (5 in./mi; 0.5 in./0.1 mi)
  - Type B (7 in./mi; 0.7 in./0.1 mi)
  - Type C (10 in./mi; 1.0 in./0.1 mi)

* Only Type A smoothness used for PCCP

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Smoothness Specifications for Construction Acceptance Prior to 2016 Using PrI

- "Must Grind" specification
  - Corrective measures for dense-graded HMA and PCCP
  - Corrective measures for an Open-Graded Friction Course (OGFC)

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Bridge Deck Smoothness Specification for Construction Acceptance Prior to 2016

- **Straightedge measurement**
  - NDOT personnel performed measurement
  - A 12 ft straightedge was used
  - Roadway surface to not vary by more than 1/8 in. (Without overlay)
  - Roadway surface to not vary by more than 1/3 in. (With an overlay > 1 in. thickness)

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Bridge Deck Smoothness Specification for Construction Acceptance Prior to 2016

- Profilograph measurement
  - Only concerned with “Must Grinds”
- “Must Grind” specification
  - Corrective measures for bridge deck

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Why the Switch from PrI to IRI Smoothness Specifications for Construction Acceptance

- Smoothness data for NDOT's Pavement Management System (PMS) is measured in IRI
  - Cradle to grave since apples-to-apples comparison
- Efficiency
- Safety
- More accurate representation

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Why the Switch from PrI to IRI Smoothness Specifications for Construction Acceptance

- Following industry standard
  - Forty-seven states utilize IRI type smoothness specifications for Hot Mix Asphalt (HMA)
  - Thirty-one states utilize IRI type smoothness specifications for Portland Cement Concrete Pavement (PCCP)

roadprofile.com/library/smoothness-specifications/

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Development and Implementation of IRI Smoothness Specifications for Construction Acceptance

- Researched other states already using IRI type smoothness specifications for construction acceptance
- Reached out to the American Concrete Paving Association (ACPA) for industry standards related to IRI smoothness specifications for construction acceptance of PCCP

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Development and Implementation of IRI Smoothness Specifications for Construction Acceptance

- Performed comparisons using an NDOT lightweight profiler to establish baseline IRI values
- Included industry and the contracting community to review and provide comments to smoothness specifications for construction acceptance

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Development and Implementation of IRI Smoothness Specifications for Construction Acceptance

- Continually updating smoothness specifications based upon technological innovation and/or experiences occurring in the field

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

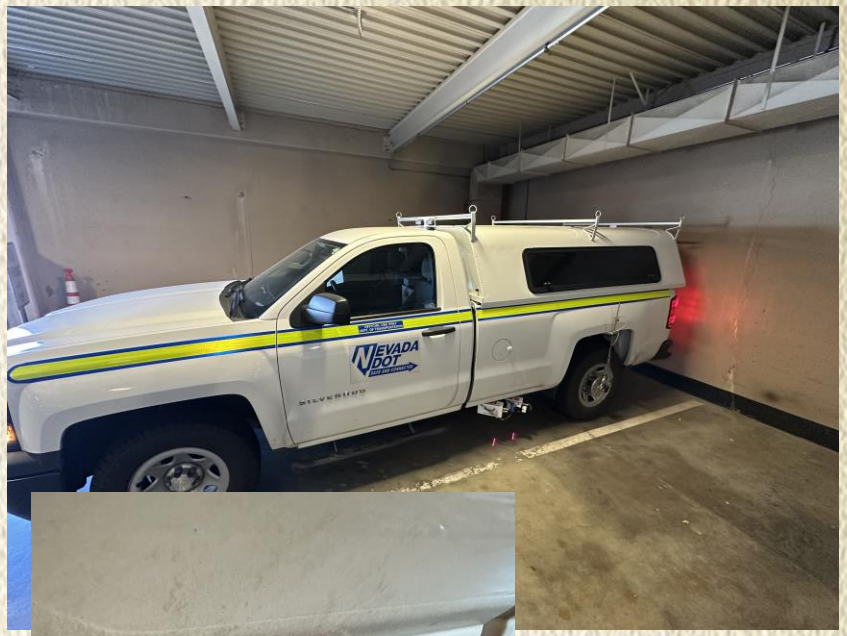
- Contractor's results still used in the construction acceptance process
- Straightedge requirements remain unchanged
- Operator and equipment requires certification
  - NDOT certified or approved equal

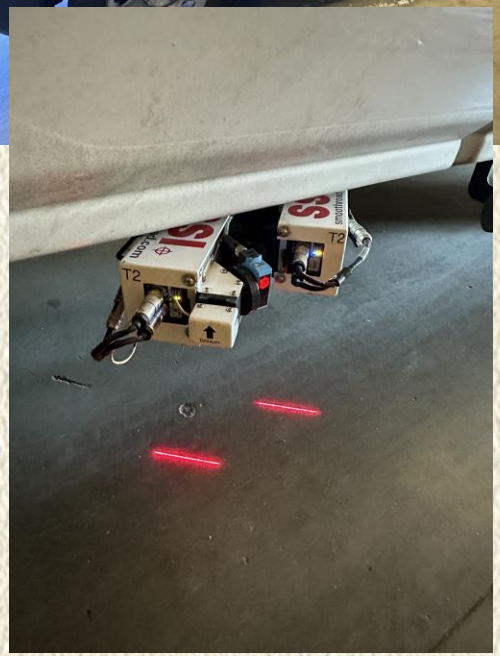
KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- Verification testing performed by NDOT QA personnel
  - Three high speed Stop-And-Go (SAG) inertial profiling systems (one for each district)
  - Perform verification testing at 10% (min.) of the contractor's acceptance testing



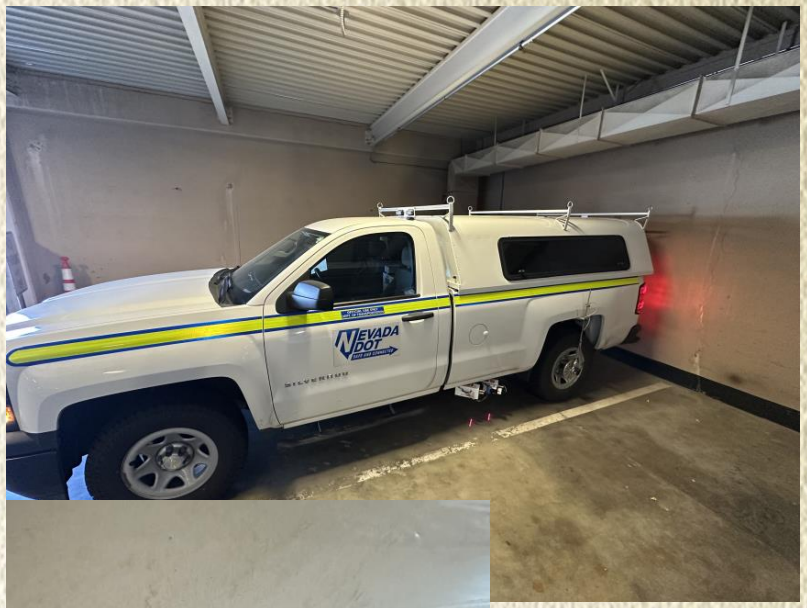


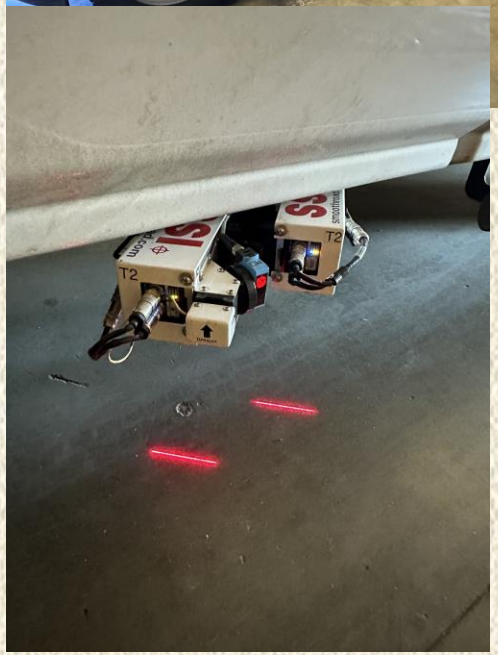
KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- Verification testing performed by NDOT QA personnel
  - Contractor's overall MRI (Mean Roughness Index) results and NDOT's overall MRI results must be within 10% of each other





KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- NDOT specifies four different smoothness types for HMA

	MRI	IRI
Type A	(50 in./mi)	(150 in./mi)
Type B	(60 in./mi)	(160 in./mi)
Type C	(80 in./mi)	(180 in./mi)
Type D	(100 in./mi)	(200 in./mi)

- For PCCP, the specified MRI value is 60 in./mi, and the IRI (Localized Roughness) value is 175 in./mi

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- **Final HMA surface**
  - **Contractor not allowed to grind final surface**
    - ❖ **Liquidated damages of $2,500.00 will be assessed for each defect (MRI, IRI, and straightedge) within each one-tenth mile section exceeding the pavement smoothness type and straightedge requirements. The cumulative amount of liquidated damages for each travel lane within each one-tenth mile section shall not exceed $20,000.00.**

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- NDOT specifies a ride incentive/disincentive on the final surface of interstate routes
- Final surface of HMA
  - Maximum incentive is $1,000.00 per tenth of a mile
    - ❖Incentive is based upon the initial measured MRI
    - ❖Tenth of a mile section has an MRI ≤ 44.999 in./mi
    - ❖No areas of Localized Roughness > 150.000 in./mi
    - ❖No defects in excess of 0.25 in. as measured with a straightedge

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- **Final surface of HMA**
  - **Maximum disincentive is $1,000.00 per tenth of a mile**
    - **If any 0.100 mile lot sections have Areas of Localized Roughness of > 150.000 inches per mile or defects in excess of 0.25 inch as measured with the straightedge, liquidated damages of $2,500.00 will be assessed for each such defect. The cumulative amount of liquidated damages and the negative Ride Pay Adjustment for each lot shall not exceed $20,000.00.**

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- **Final surface of HMA**
  - **Maximum disincentive is $1,000.00 per tenth of a mile**
    - ❖ **Removing and replacing the OGFC may be required if the calculated amount exceeds the maximum cumulative amount of $20,000.00 in liquidated damages and the negative Ride Pay Adjustment for each ride quality lot**

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- **Final surface of PCCP**
  - Maximum incentive is $1,600.00 per tenth of a mile
    - ❖ Incentive is based upon the initial measured MRI
    - ❖ Tenth of a mile section has an MRI ≤ 59.999 in./mi
    - ❖ No areas of Localized Roughness > 175.000 in./mi
    - ❖ No defects in excess of 0.25 in. as measured with a straightedge

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Current Smoothness Specifications (IRI) for Construction Acceptance

- **Final surface of PCCP**
  - **Maximum disincentive is $1,600.00 per tenth of a mile**
    - ❖ **Tenth mile sections with an MRI of 76.000 to 95.999 in./mi require correction to reduce and/or eliminate disincentive**
    - ❖ **Tenth mile sections with an MRI ≥ 96.000 in./mi must be corrected by the contractor**
    - ❖ **Tenth mile sections containing Areas of Localized Roughness > 175.000 in./mi or defects in excess of 0.25 in./mi as measured with a straightedge must be corrected by the contractor**

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Bridge Deck Smoothness Specifications (IRI) for Construction Acceptance

- Straightedge measurement
  - NDOT personnel perform measurement
  - A 12 ft straightedge is used
  - Roadway surface shall not vary by more than 1/4 in.

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Bridge Deck Smoothness Specifications (IRI) for Construction Acceptance

- 502.03.16 Finish of Horizontal Surfaces
  - Test the finished concrete surfaces as well as pavement within 50 feet of the leading edge and within 50 feet of the trailing edge of the bridge deck (including approach slabs) by means of an inertial profiler or multipurpose surface profiler according to Test Method No. Nev. T448 Section II. The maximum allowable IRI for localized roughness is 175.000 inches/mile. Locate and correct areas exceeding profile requirements by grinding.

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT Profiler Certification Program

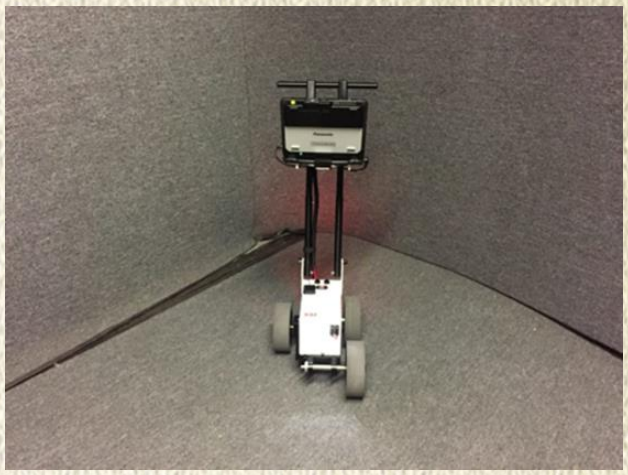
- Program is administered by the Quality Assurance section of the Construction Division
- Certification consists of a written exam and a performance verification of the proposed operator and equipment
  - Written exam required every 5 years
  - Performance verification required every year
- Recently included SAG certification mirroring AASHTO R56

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT Profiler Certification Program

- Two certification sites (North and South)
  - Frontage road along US 395 between Carson City and Reno
  - Frontage road along US 93 north of Las Vegas
  - Either an International Cybernetics Company (ICC) SurPro 5000 or a Surface Systems and Instruments (SSI) CS8800 walking profiler is used to establish a baseline profile along the certification track

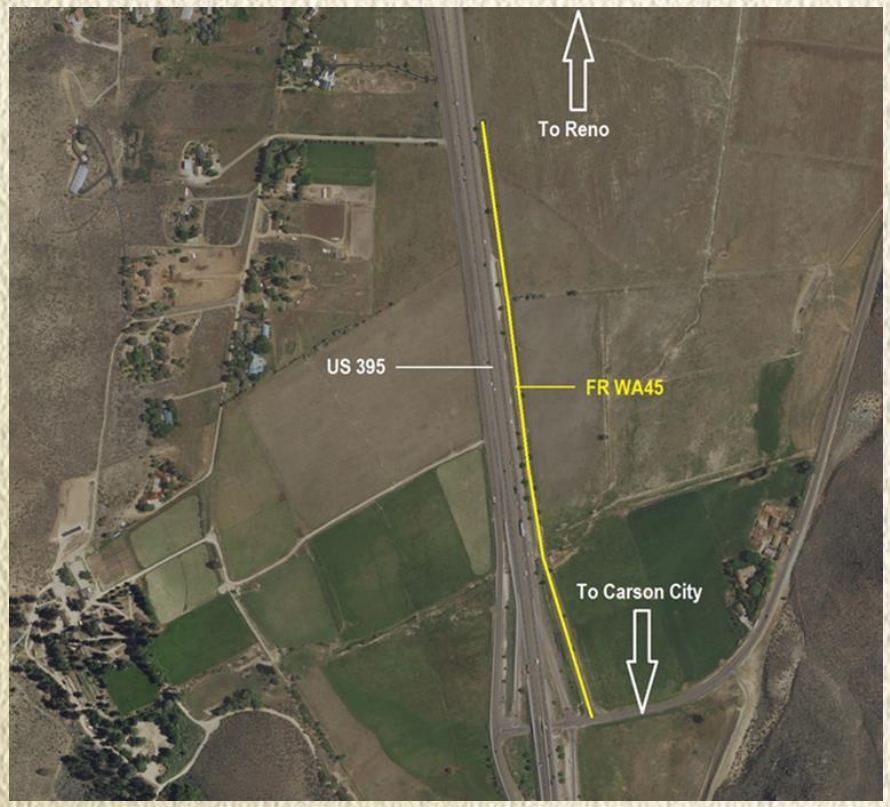


KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT Profiler Certification Program

North Track

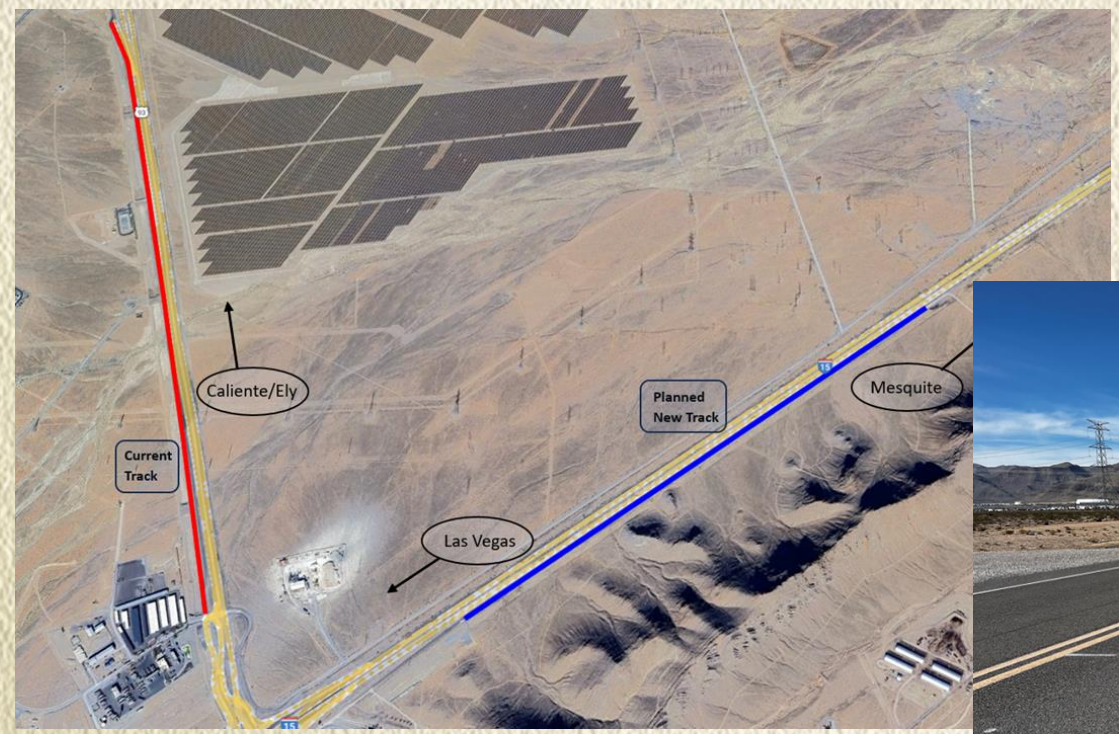


KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT Profiler Certification Program

South Track



KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT's Participation in the 2024 Illinois Profiler Certification Experiment

- Funded by Transportation Pooled Fund
  - TPF-5(537)
- Experiment performed at the Illinois Certification and Research Track (ICART)

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT's Participation in the 2024 Illinois Profiler Certification Experiment

- Experiment conducted on six test sections with different material and surface texture types
- Underlying research was to refine, demonstrate, and document procedures for regional profiler certification

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT's Participation in the 2024 Illinois Profiler Certification Experiment

- Experiment included accuracy and repeatability testing on the following:
  - Conventional high-speed inertial profilers
  - Lightweight inertial profilers
  - Novel road profilers
  - Potential reference profilers
  - SAG high-speed profilers
- The Federal Highway Administration (FHWA) Benchmark Profiler collected reference measurements with additional monitoring by the FHWA Urban and Low-Speed Profiler

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

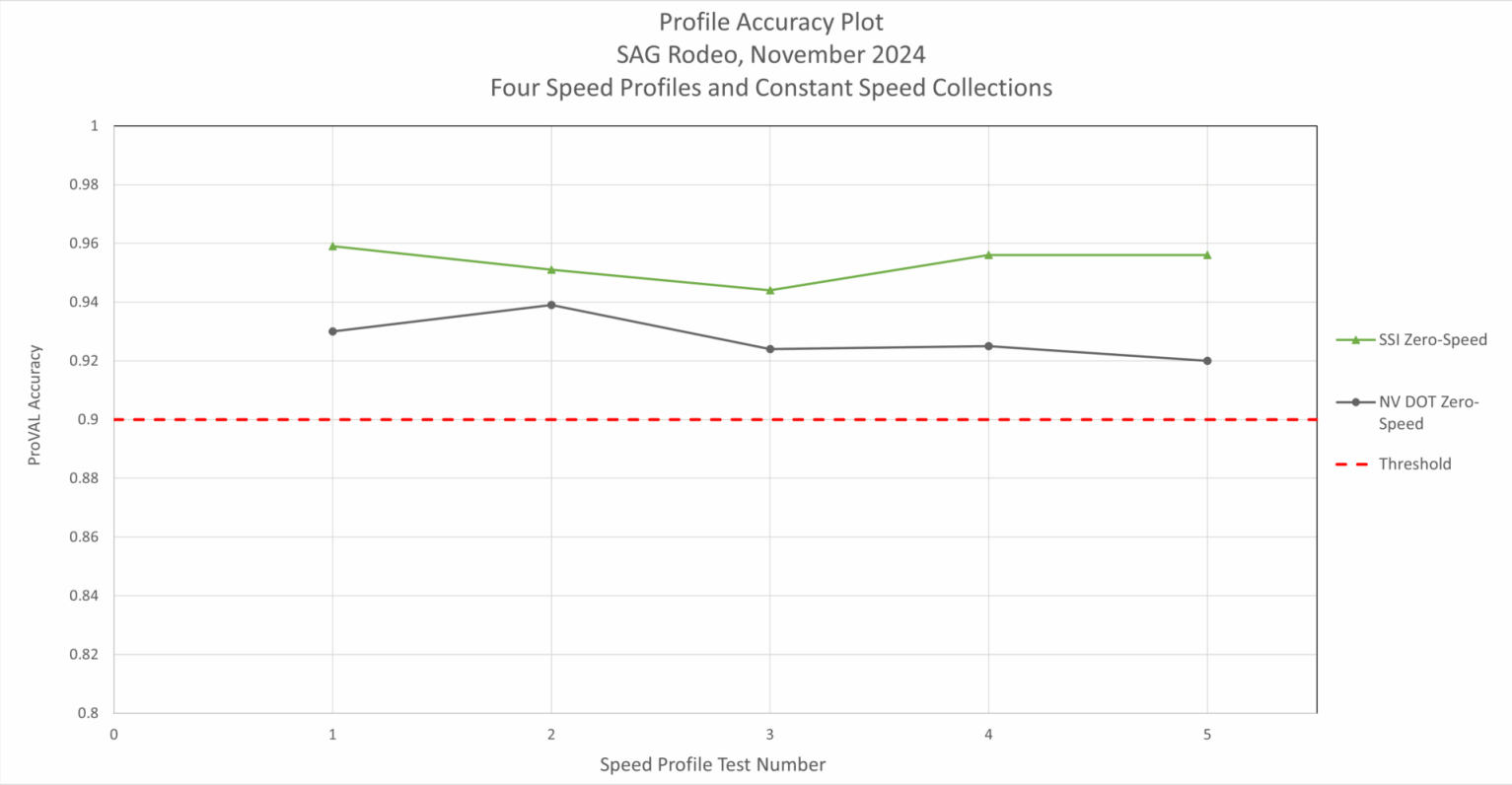
NDOT's Participation in the 2024 Illinois Profiler Certification Experiment

- Nine SAG profilers from different vendors and state agencies participated in the experiment
- Of the nine SAG profilers, only two participating devices achieved the minimum accuracy (90%) and repeatability (92%) scores required to certify under American Association of State Highway and Transportation Officials (AASHTO) R56
  - SSI
  - NDOT

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

NDOT's Participation in the 2024 Illinois Profiler Certification Experiment



www.smoothroad.com/company/news/ssi-zero-speed-profiler-confirms-compliance-at-icart/

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Lessons Learned

- When developing specifications, early involvement by industry is key
- When developing specifications, make a concerted effort to work with seasoned internal staff who may be cautious of changes.
  - Be available to answer their questions and respond to their concerns.
- Be flexible with the ride specifications
  - Project specific
- Continually review specifications and update accordingly

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

Lessons Learned

- Do not be afraid to reach out to other states for assistance with specifications/test methods/certification program
- Do not make certification tracks too smooth
  - Much more difficult to pass the 90% accuracy requirement

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

What the Future Holds

- Continued participation in TPF-5(537) Improving the Quality of Highway Profile Measurement led by Illinois DOT
- Continue working with CalTrans to establish reciprocity for SAG inertial profiler certification

pooledfund.org/Details/Study/771

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

What the Future Holds

- Resurfacing of Northern Nevada certification track
- Relocation of the Southern Nevada certification track.
  - Current location is experiencing new development
    - ❖Concerns with traffic

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

SAVE THE DATE

RPUG 2026

APRIL 28 – MAY 1, 2026

PITTSBURGH, PA

Sheraton Pittsburgh Hotel at Station Square

KU THE UNIVERSITY OF KANSAS School of Engineering

NEVADA DOT SAFE AND CONNECTED

KU
THE UNIVERSITY OF KANSAS
School of Engineering

NEVADA DOT
SAFE AND CONNECTED

KU
THE UNIVERSITY OF KANSAS
School of Engineering

NEVADA DOT
SAFE AND CONNECTED