

Forensic evaluation of pavement failure Using GPR and UAV technology

Vahid Ganji, Ph.D., P.E.

Pavement Department Manager, Michael Baker International

Robert Blight

Supervising Engineer, NJDOT

Megan Kelly

FAA Certified UAV Specialist, Michael Baker International, Inc.

Pavement Evaluation 2019 Conference

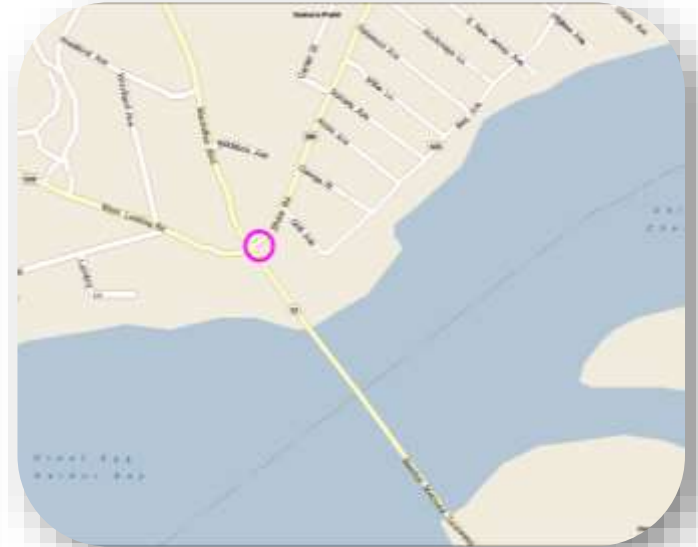
September 18,
2019

Presentation Outline

- Introduction
- Field Testing
- Recommendations
- Conclusions

Introduction

- The ramp from Route 52 WB to North Shore Road in City of Somers Point, NJ exhibited pavement failures that required frequent patching.
- The ramp was constructed between 2011 and 2012 as part of a project to eliminate the traffic circle at this location and premature failures were unexpected.



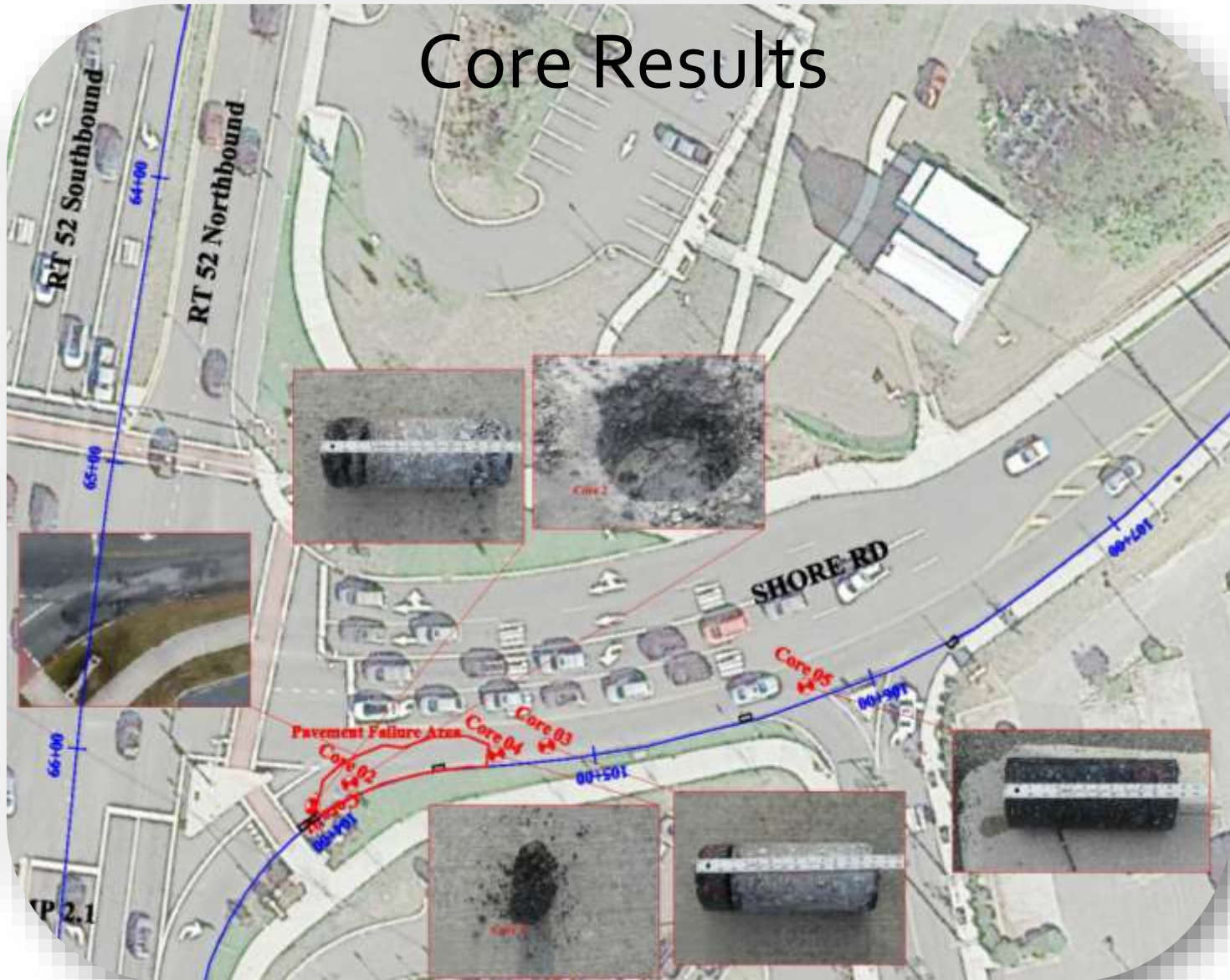
Field Testing

- Pavement Coring & Dynamic Cone Penetration (DCP) Testing
- GPR (Ground Penetration Radar)
- Visual Survey
- UAV Survey (Unmanned Aerial Vehicle)

GPR & Pavement Coring

- Five (5) core samples were extracted from the pavement.
- DCP testing was conducted for three (3) of the cores.
- Based on the core and GPR results, the pavement AC thickness varies from 9" to 14" (average 10").
- The aggregate base layer appears to have been stabilized and DCP could not penetrate indicating California Bearing Ratio (CBR) values more than 100%.
- The relatively thick pavement, strong aggregate base layer, and light traffic indicate that the pavement is structurally adequate. Hence, the cause of the pavement failure is not the structural capacity of the pavement.

Core Results



Core Results

- The core results indicated **significant stripping** of the Hot Mix Asphalt (HMA) surface course in the failed area due to prolonged presence of stagnant water on pavement.

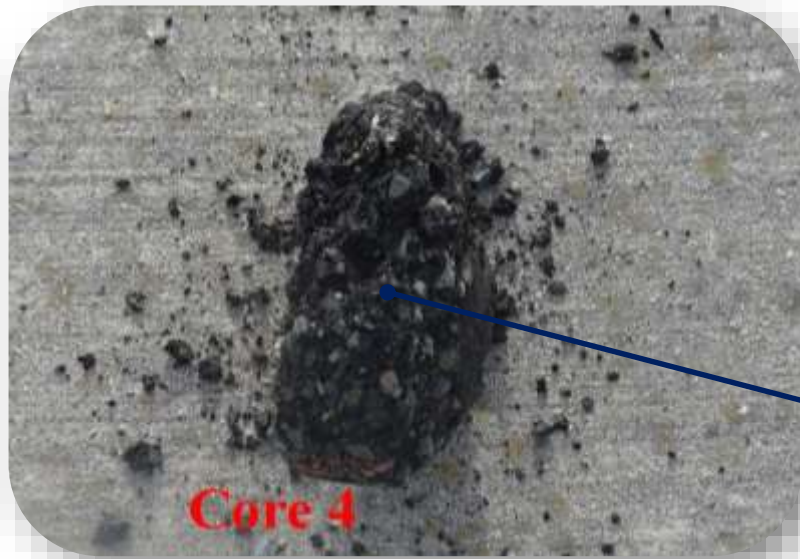
Core 1 (Failed area)

HMA Stripping in
Surface Course



Core Results

Core 2 (Failed Area; **Severe HMA Stripping**)



Core 4 (Failed Area)

HMA Stripping in
Surface Course

Core Results

- The HMA stripping was **less severe** further from the failed area.
- Failed pavement area has been subjected to **prolonged presence of stagnant water** that intensifies HMA stripping.

Core 3 (Slight HMA Stripping)

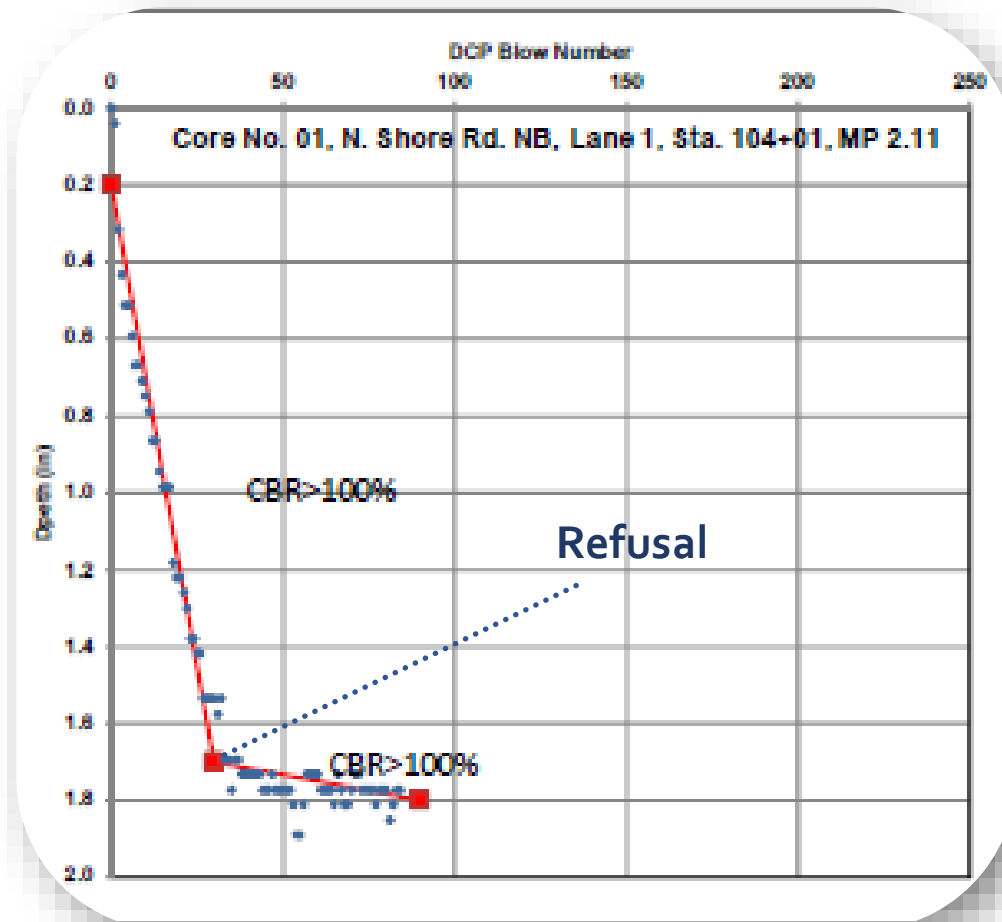


Core 5 (No HMA Stripping)



DCP Results

- DCP Testing Indicated a Strong Pavement Base (CBR>100%)

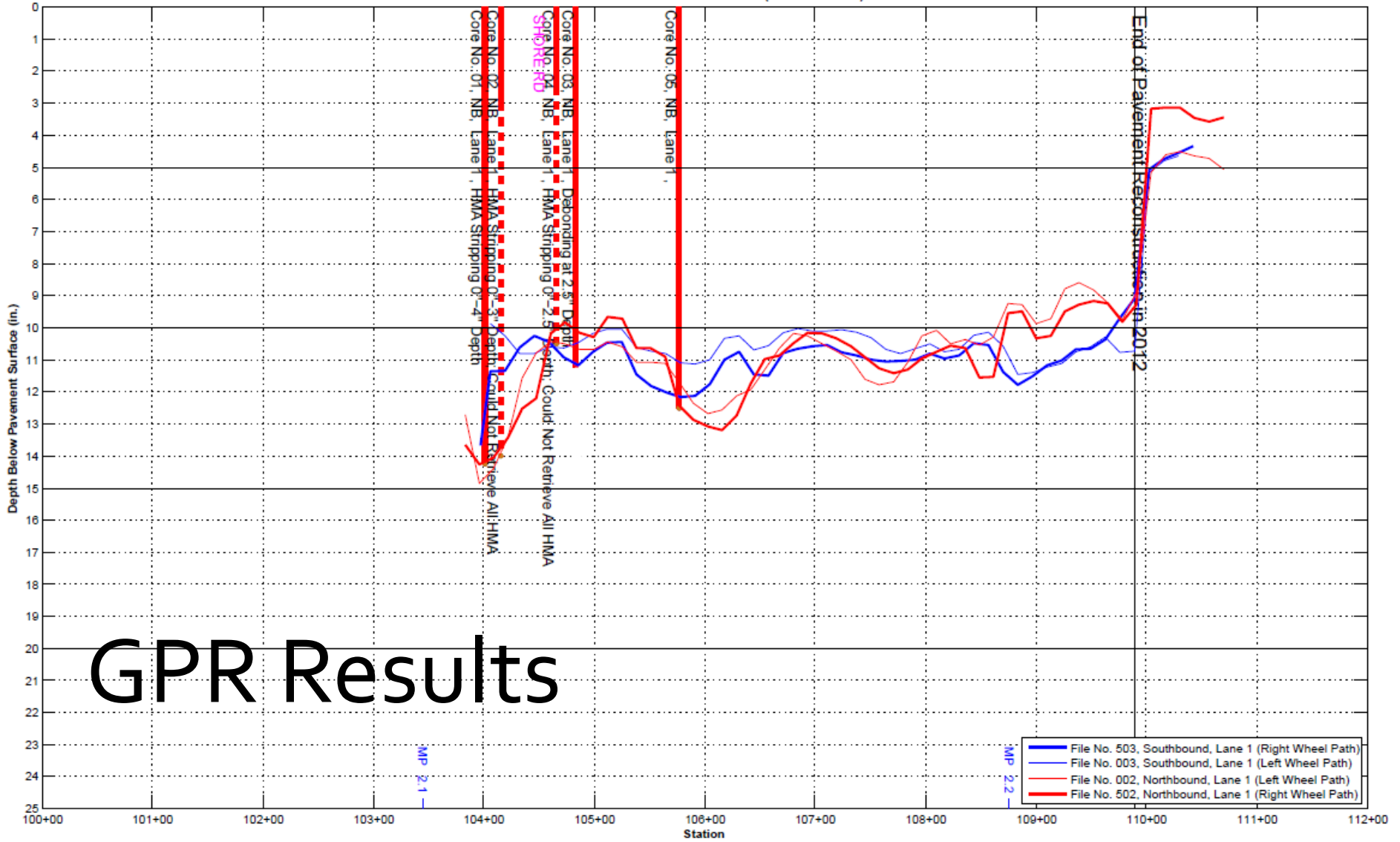


GPR Results

- GPR testing was conducted using two GSSI 2 GHz air-coupled antennas.



HMA Thickness for Route 52 MP 2.11 (Both Directions)



GPR Results

Visual Field Survey

- considerable amount of deposited aggregates observed along the northbound curb on North Shore Road.



- The increasing aggregate deposits are indicative of reduced water velocity (due to decreased slope).

Visual Field Survey

- A review of the pavement surface condition within the project area indicated that the pavement surface course placed circa 2012 shows **signs of raveling** and loss of aggregate, which can be the source of quarry processed aggregates along the curb.



UAV Survey

- UAV survey was done on 2/22/2019. The traffic was stopped from the survey area for 3 minutes to fly the UAV and collect the aerial photos.
- The 3-D point cloud mapping can be viewed at the address below using Google Chrome [here](#)



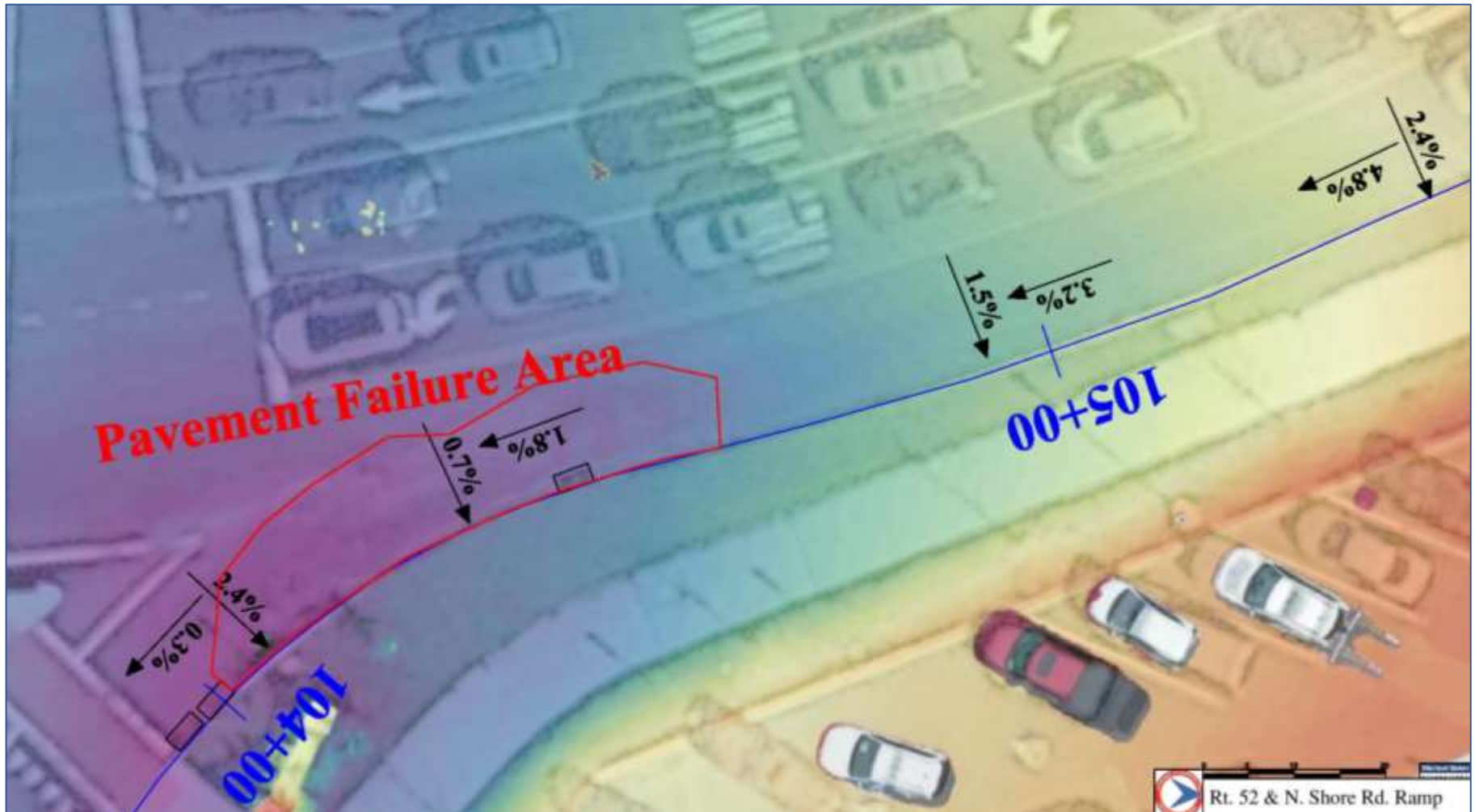
UAV Survey

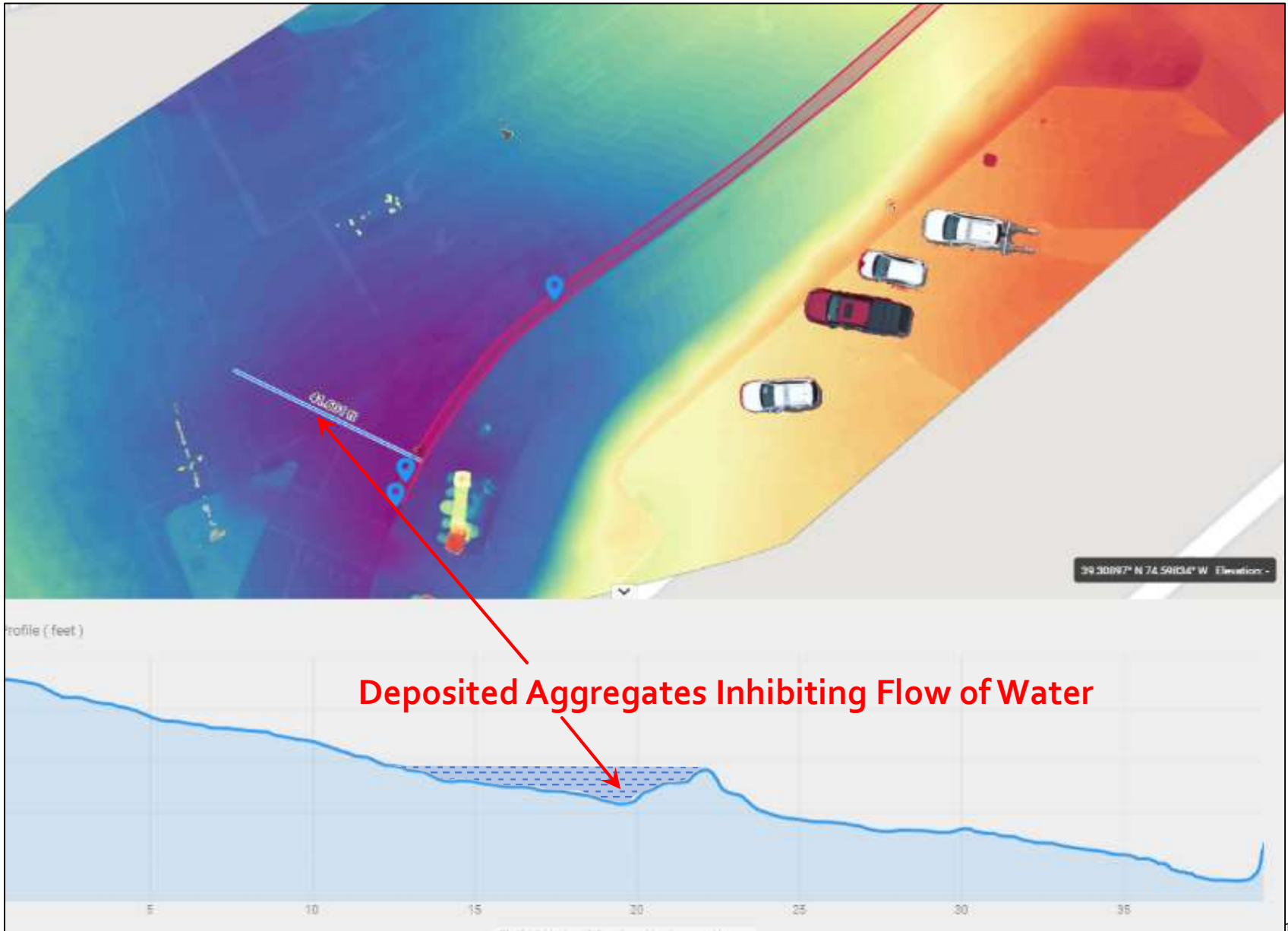


UAV Survey: Point Cloud Imagery



UAV Survey: Slope Measurement

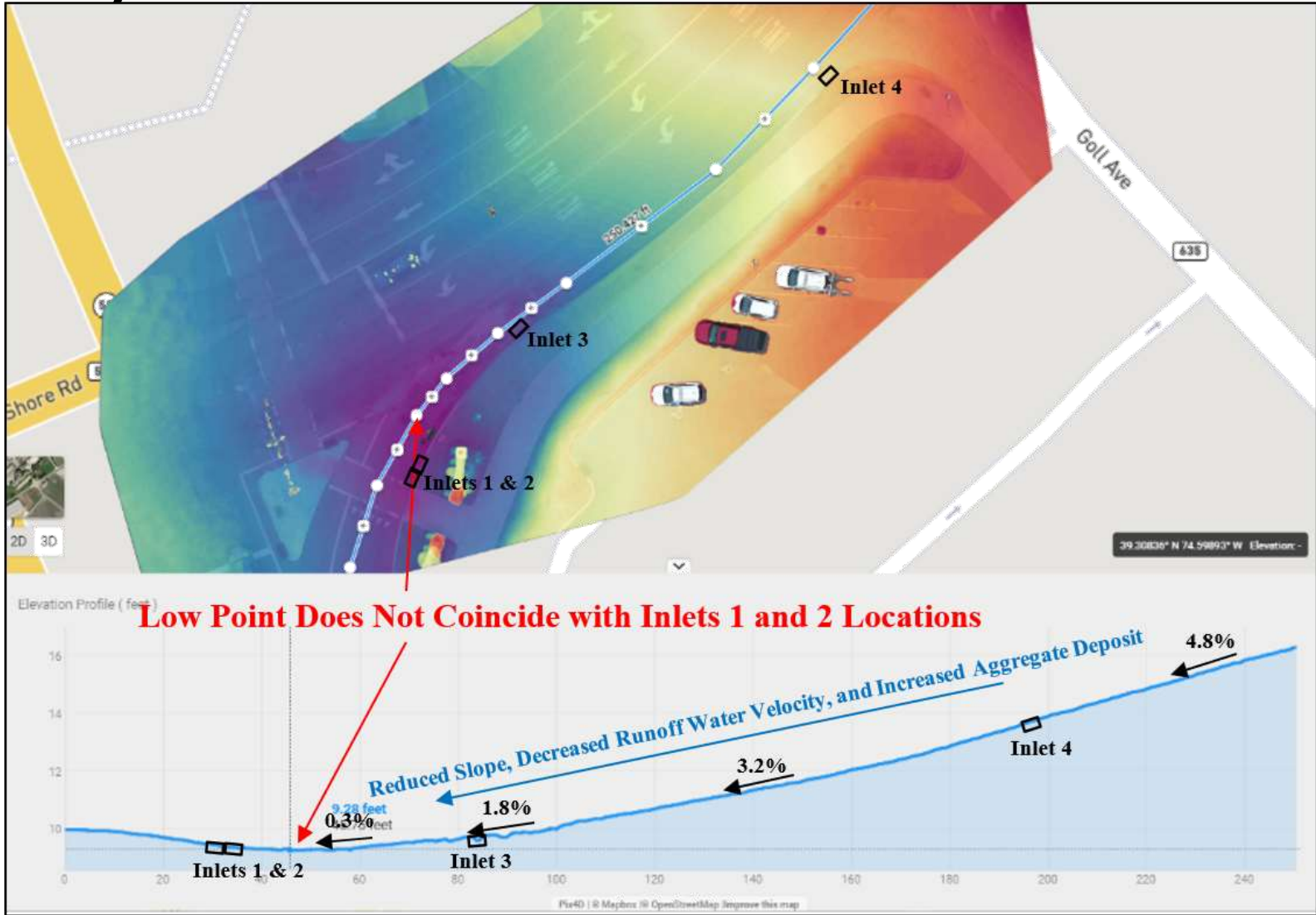




Analysis

- A visual survey of the project area indicated that the pavement failure area is at a low point receiving surface runoff water from the N. Shore Road Sta. 104+00 to Sta. 107+70.
- There are four inlets to catch the surface runoff water. Due to the relatively steep slope north of Sta. 104+46, it is expected that majority of the water is to be captured by Inlets 1 and 2 near the low point of the roadway.
- Inlets 1 and 2 do not seem to coincide with the low point of the roadway (next slide). The low point is approximately 15' north of the inlets

Analysis



Analysis

Inlets 1 and 2 Do Not Coincide with Low Point of Road

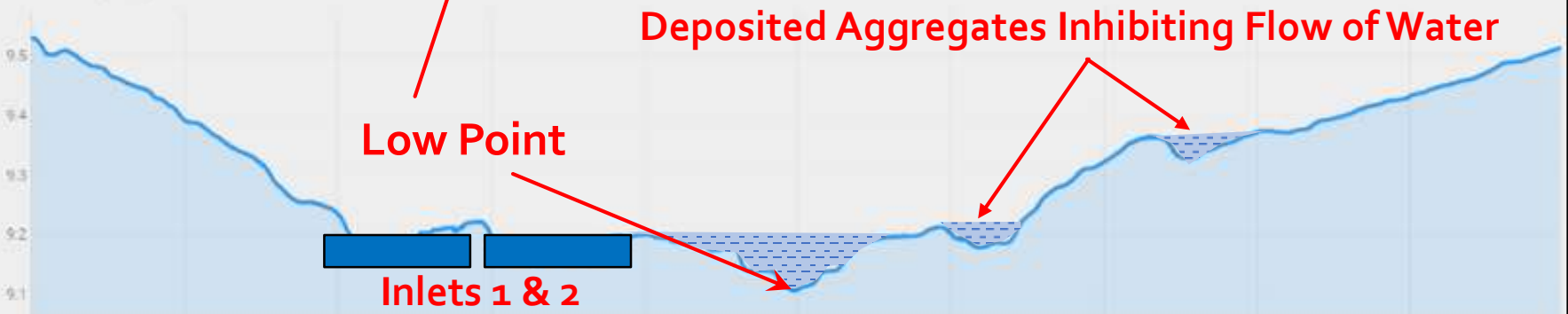
Approximate
Location of
Low Point of
Road



Inlets 1 & 2



Elevation Profile (feet)



Low Point

Inlets 1 & 2

Deposited Aggregates Inhibiting Flow of Water

Conclusions

- The cause of pavement failure at the ramp from Route 52 to North Shore Road is a combination of:
 - Surface course prone to raveling
 - Stagnant water on the pavement due to the roadway geometry
 - Aggregate deposits
- The pavement does not have structural issues.

Short-Term Recommendations

- Seal coat the pavement that was placed circa 2012 between Stations 103+90 to 109+90 (600') to delay further raveling and loss of aggregates.
- Remove the surface course in the failed pavement area to a depth of 4" and replace with a binder rich mix that can resist HMA stripping better. Use of anti-stripping agents in the mix may be considered.
- Regularly remove the deposited aggregates to allow for free flow of surface run-off water and avoid ponding potential.

Long-Term Recommendations

- Mill 3" of the pavement from the intersection of Route 52 to Sta. 109+90 to remove the raveled surface course and overlay with a binder rich surface course resistant to HMA stripping. Use of anti-stripping agents may be considered.
- Survey the area and study drainage issues.
- Use of concrete curb and gutter may be considered to better channel the surface run-off water into the inlets.

THANK YOU!
Questions

