Appendix A: Crash Maps Report

Toole Design has prepared the following High Injury Network (HIN) and Sliding Windows Analysis maps for the Northwest Arkansas (NWA) Region as part of the Regional Vision Zero Action Plan. The following memo describes our crash data sources, methodologies, and thresholds for development of the maps created.

Crash Data Sources

Maps are based on Arkansas Department of Transportation (ADOT) Arkansas Crash Analysis Tool (ACAT) and the Missouri Department of Transportation (MDOT)Statewide Traffic Accident Records System (STARS) for all recorded crashes between 2017-2021.[1] [2]

Killed and Seriously Injured Crash Maps

The Safe System Approach focuses identifying and addressing the factors that lead to fatal or suspected serious injury (KA) crashes, similar conditions where they could occur, or proactive and system-wide safety solutions before a crash occurs. This report includes maps highlighting where KA crashes have occurred for each mode as well as non-KA crash locations. Areas with high concentrations of KA crashes will become the basis of the HIN.

1 https://experience.arcgis.com/experience/1911f992cabc484a98f64e7c36c2b262/

2 https://www.mshp.dps.missouri.gov/MSHPWeb/SAC/stars_index.html

Figure 1: Pedestrian Crash Map

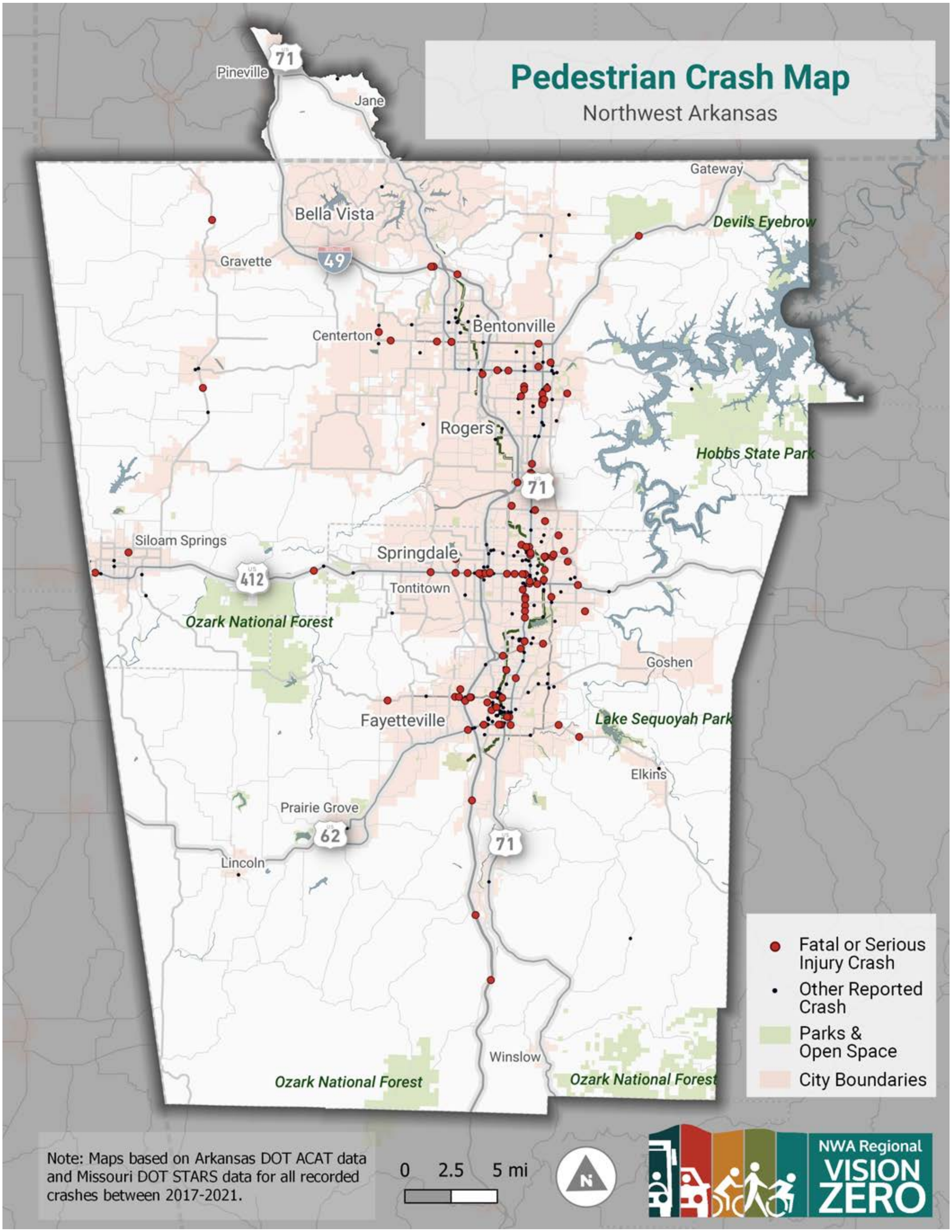


Figure 2: Figure 2: Bicycle Crash Map

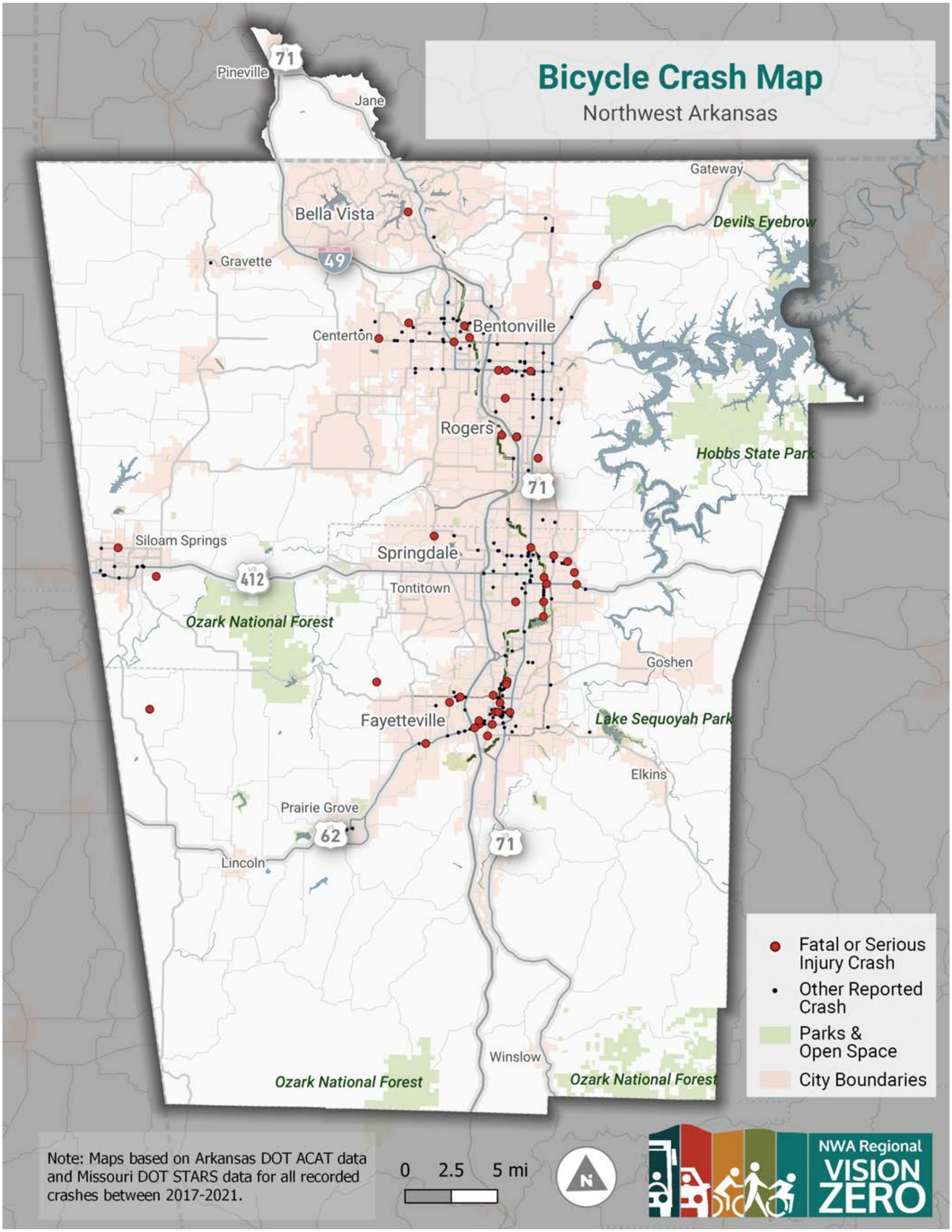


Figure 3: Motorcycle Crash Map

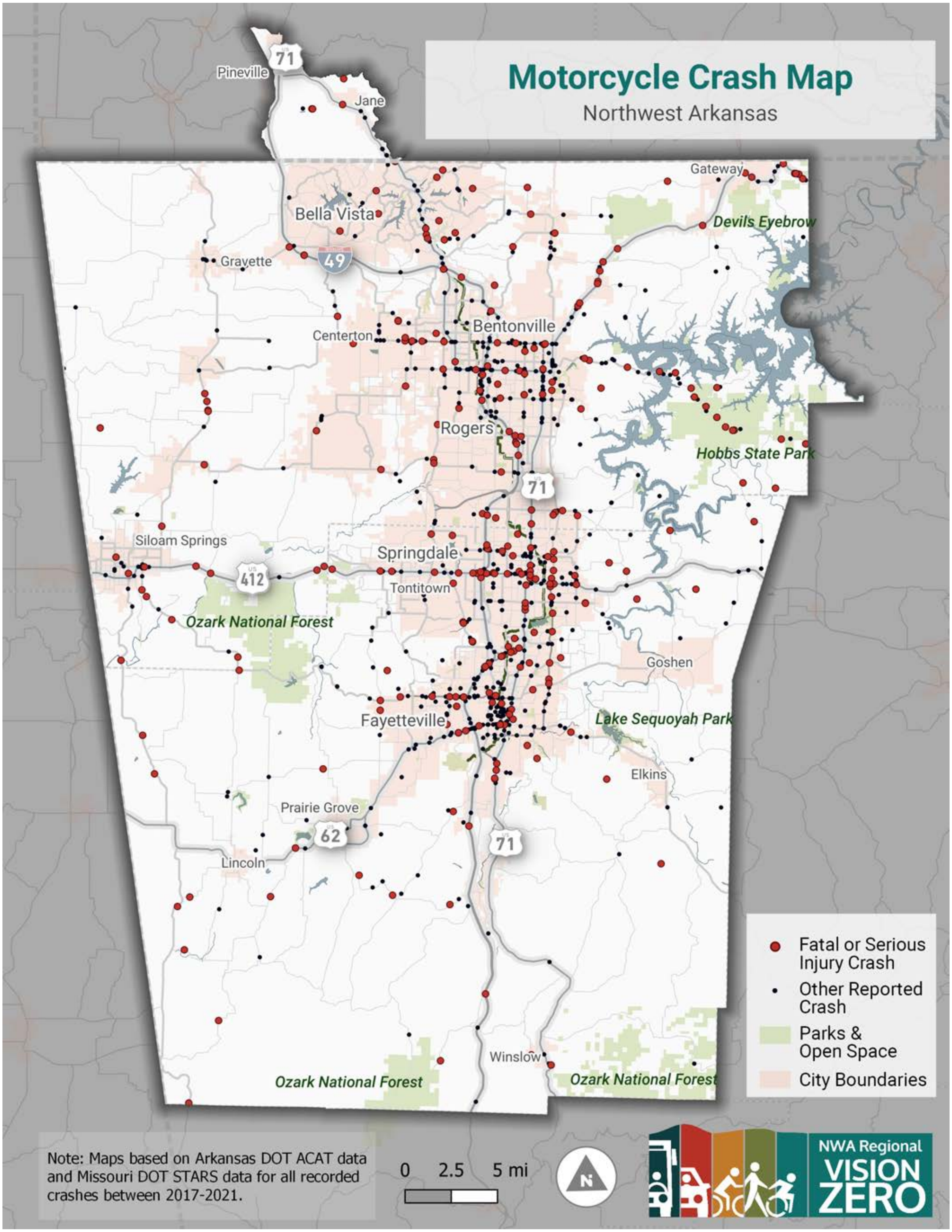


Figure 4: Motor Vehicle Crash Map

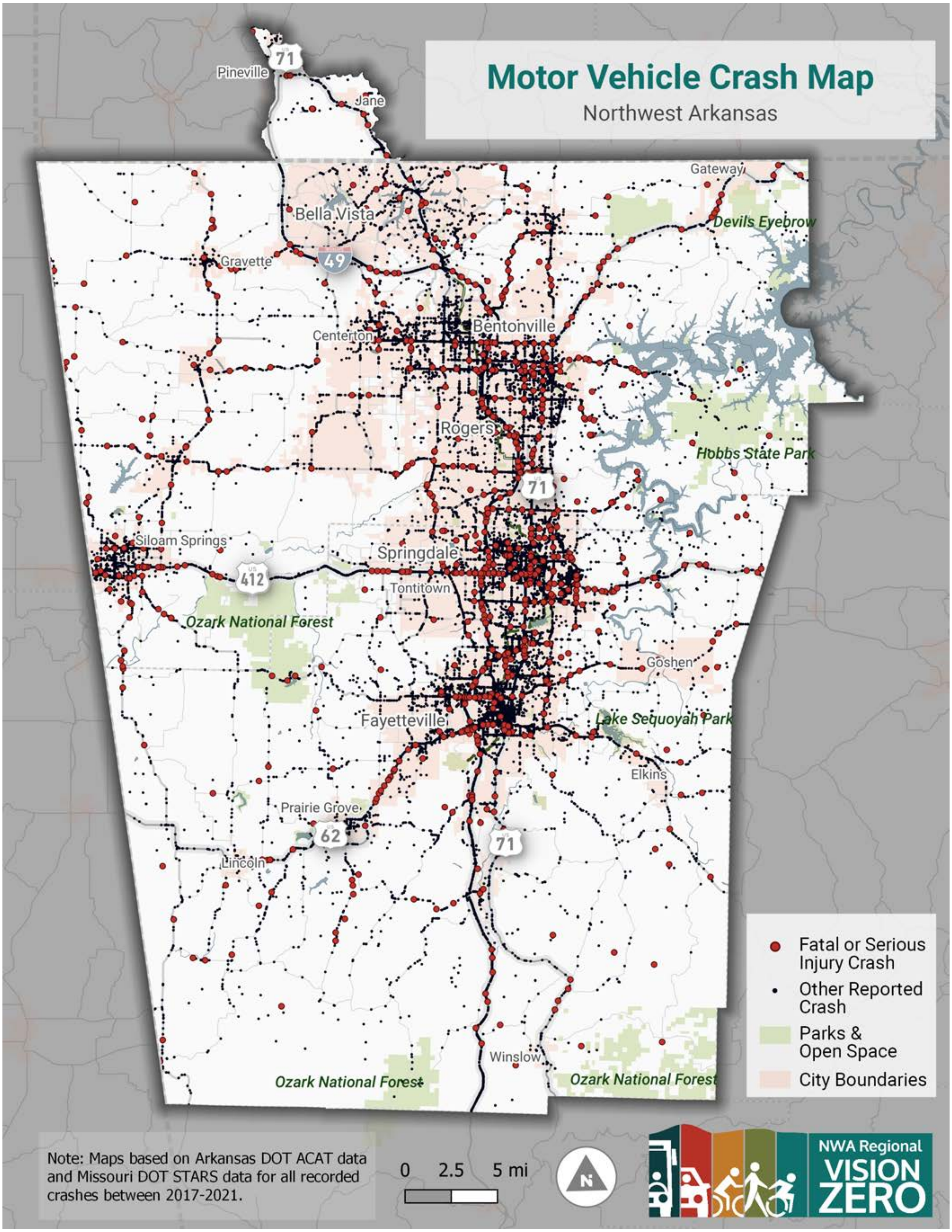
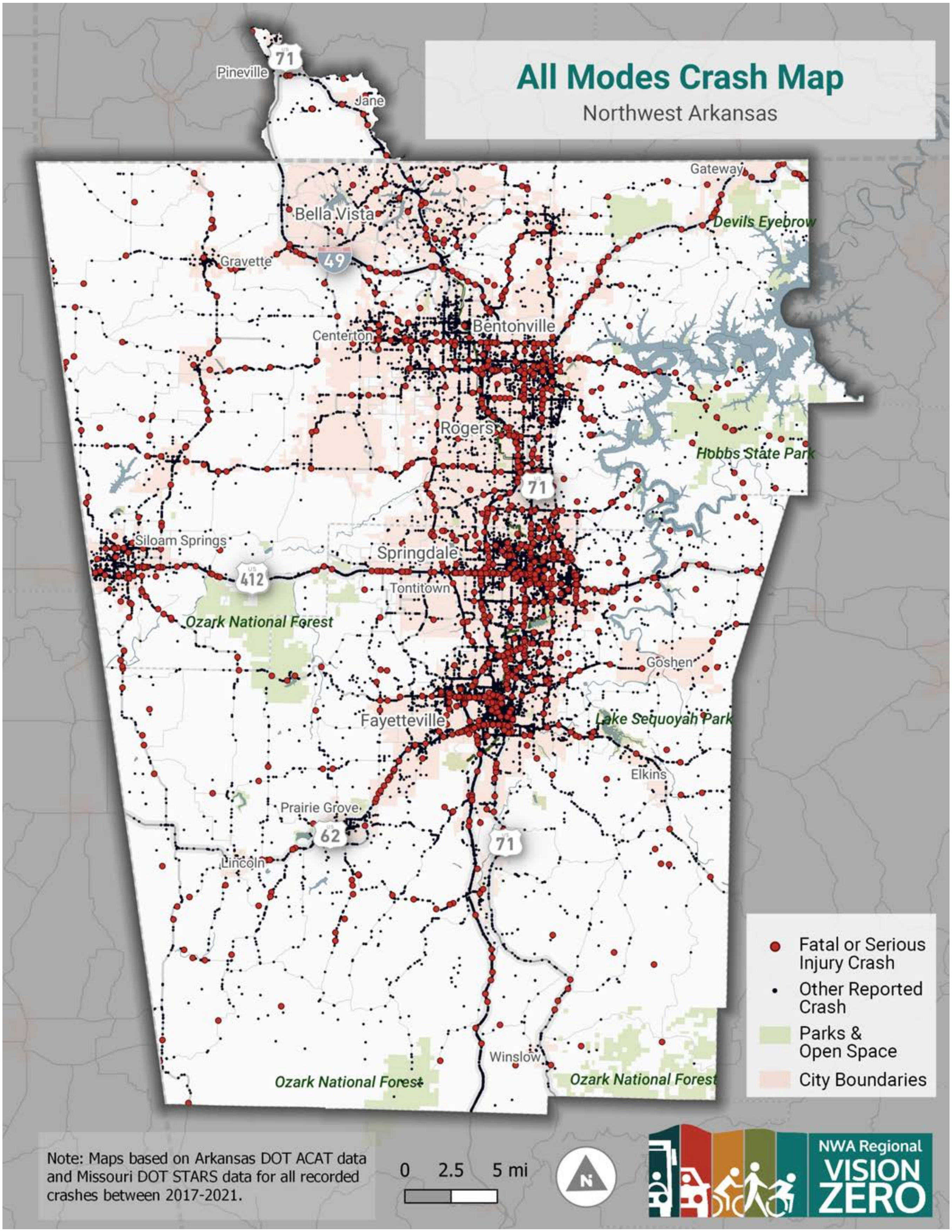


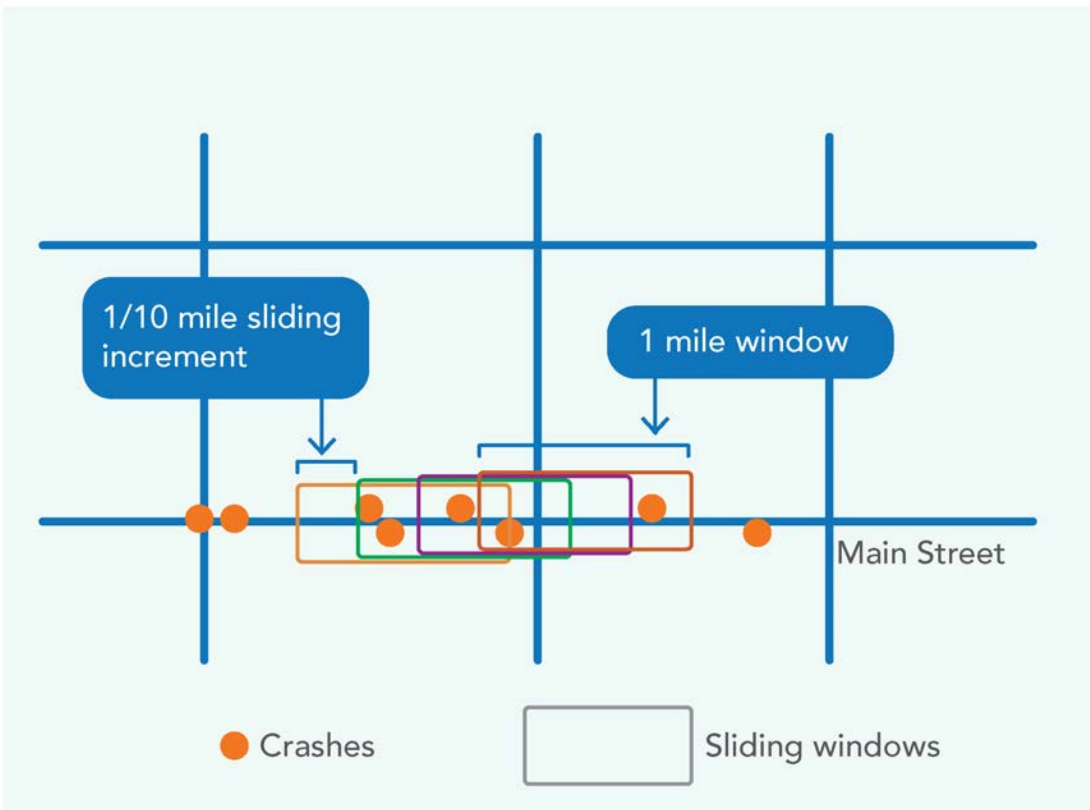
Figure 5: All Modes Crash Map



Sliding Windows Analysis Methodology

A sliding window analysis helps understand crashes throughout a transportation network and identify segments with the highest crash density and crash severity. For the NWA Region, the analysis was done by determining the number and severity of crashes in a **one-mile window** on a roadway and shifting that window along the roadway 1/10 of a mile at a time. In this approach, a virtual "window" is moved along each corridor, counting the number of crashes by density and severity by mode that occurred within each successive one-mile segment. The one-mile moving window slides along a corridor scoring crashes, only stopping for a road name or functional road classification change. Both intersection and segment crashes were included in this evaluation, as the focus is on overall corridor conditions. An example of a Sliding Windows analysis is shown below.

Figure 6: Example of the Sliding Windows analysis. Source: Toole Design.



The Sliding Windows score is calculated by multiplying the number of Fatal Injury/Fatal (K/1) and Suspected Serious Injury/ Disabling (A/2) crashes by 3 and multiplying the number of Suspected Minor Injury/ Evident-Not Disabling crashes (B/3) by 1, and not including Possible Injury/ Probable-Not Apparent (C/4), and No Apparent Injury/ None Apparent (O/5) crashes. Once the weights are established and applied to the crashes, the number of crashes is aggregated along a corridor while incorporating the crash severity weighting. Lower injury crashes (C/4 and O/5) crashes were excluded from the motor vehicle Sliding Windows analysis but included for bicycle, pedestrian, and motorcycle Sliding Windows due to the potential for a crash to result in an injury when a vulnerable roadway user is involved. Each segment is scored based on this methodology and those Sliding Windows scores are shown in the Sliding Windows maps for pedestrian, bicyclists, motorcyclists, and motor vehicles accordingly. For instance, with KA crashes weighted at three times minor injury crashes, a corridor with two KA crashes will have the same weighted total as a corridor with six minor injury crashes.

Figure 7: Pedestrian Sliding Windows Analysis

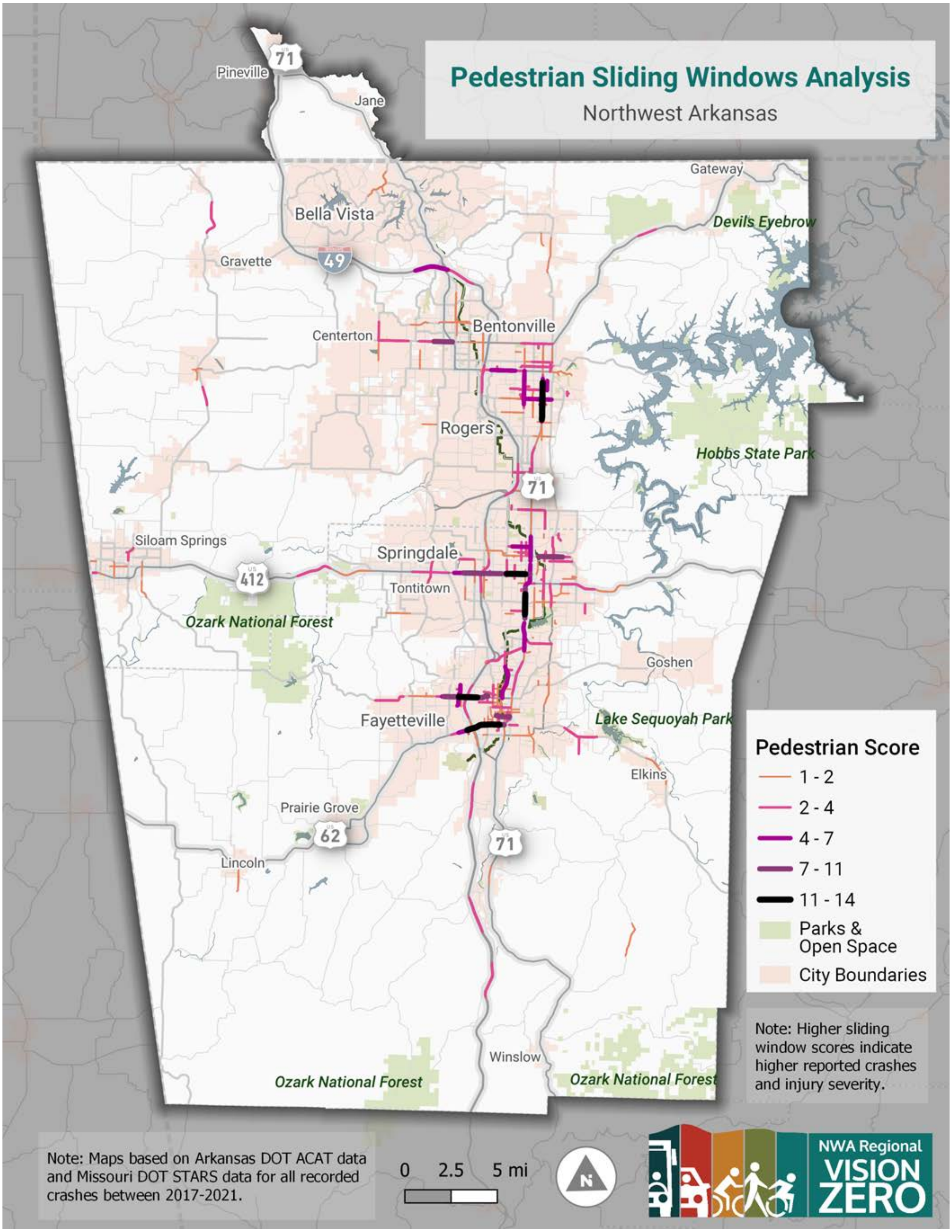


Figure 8: Bicycle Sliding Windows Analysis

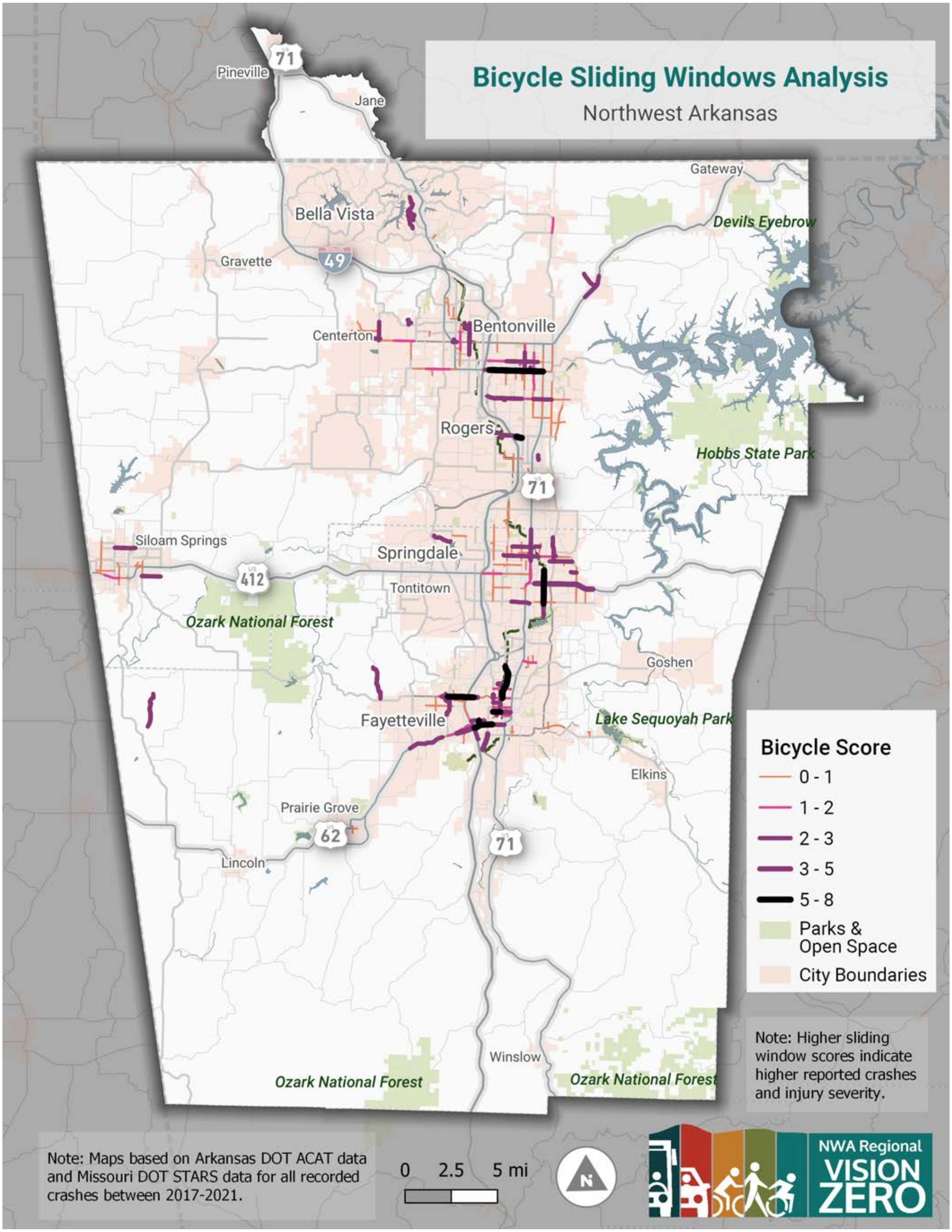


Figure 9: Motorcycle Sliding Window Analysis

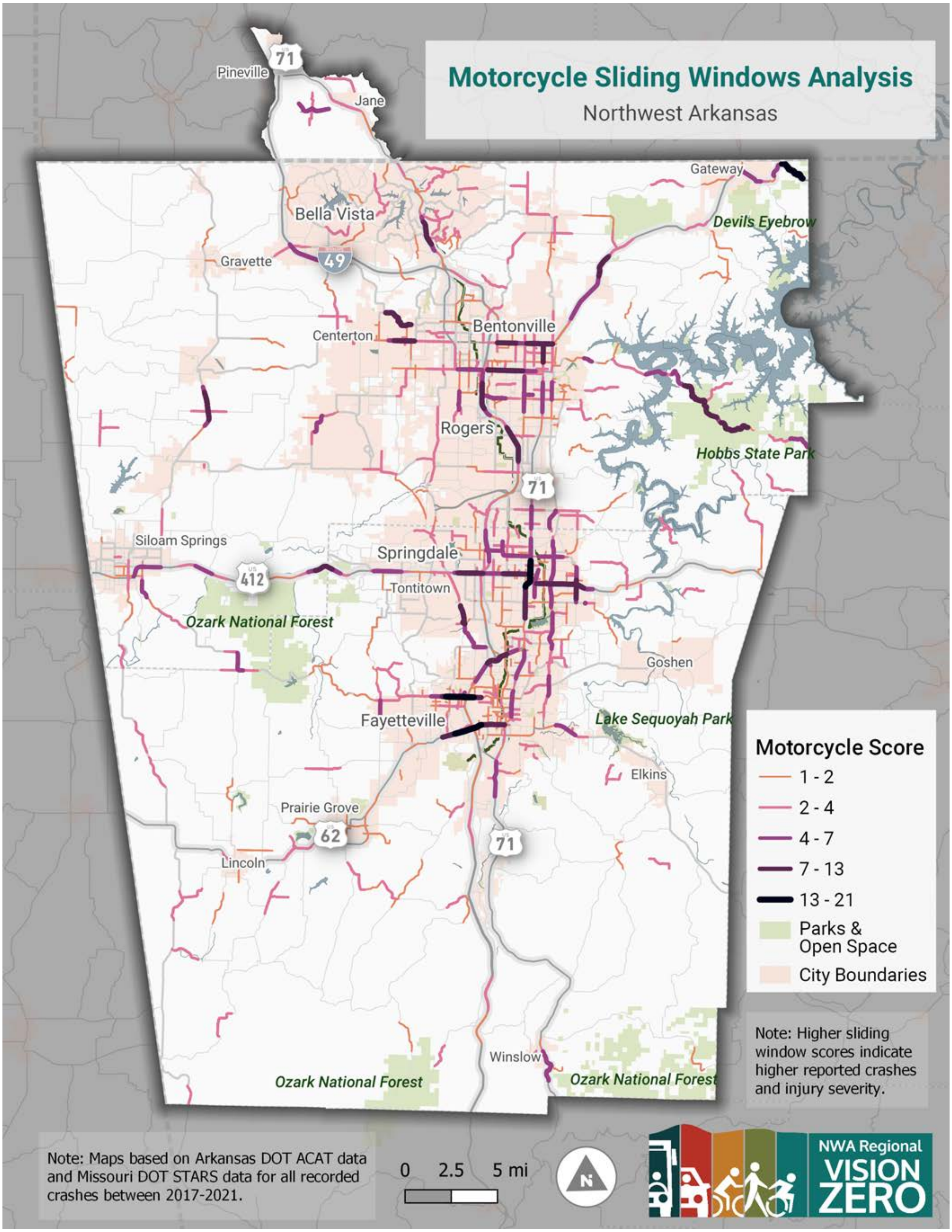
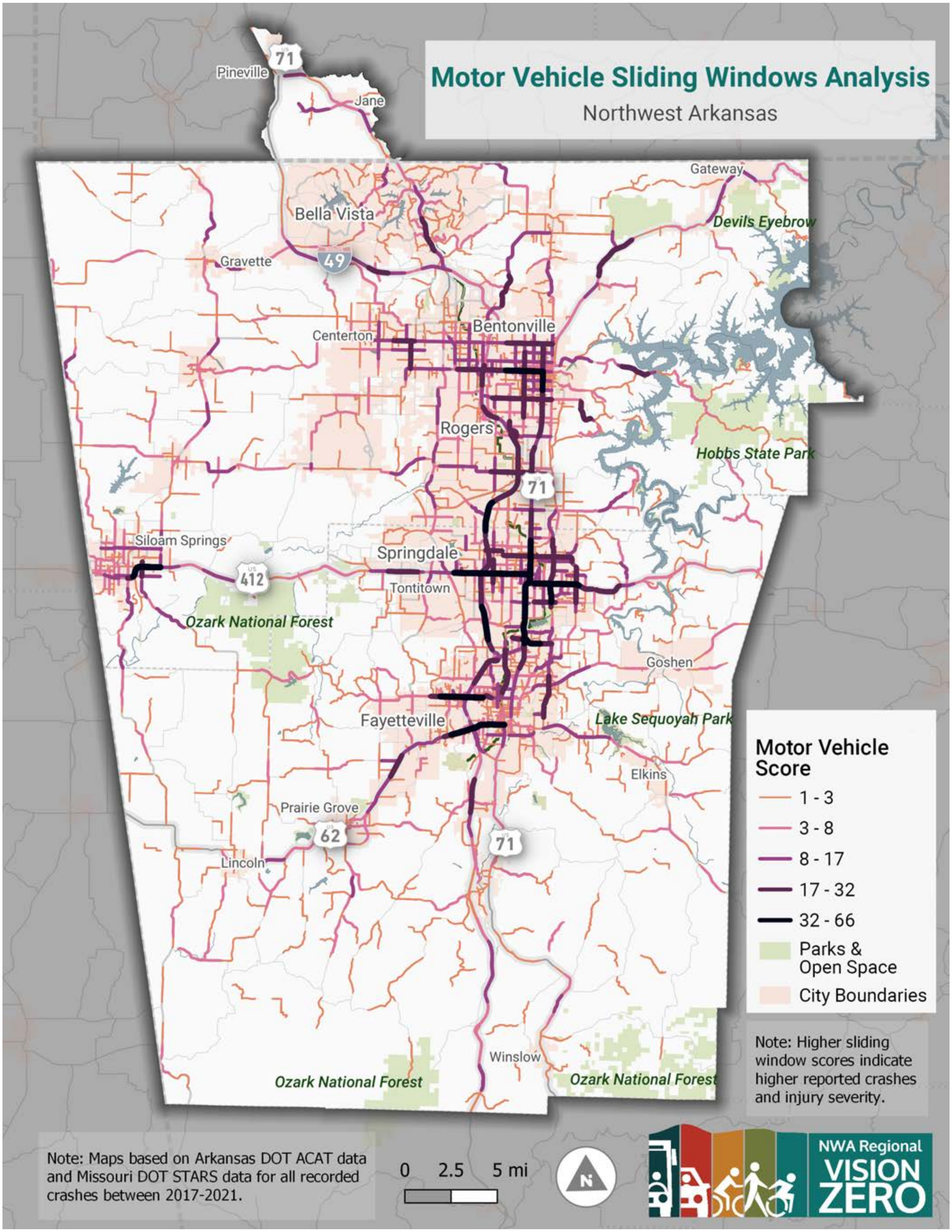


Figure 10: Motor Vehicle Sliding Windows Analysis



Development of High Injury Network

The development of a HIN is a key element of a safety plan to help prioritize where historic crashes have occurred at the greatest density and severity. The HIN development process involves developing crash density estimates along street corridors throughout the region, weighing them by crash severity, and then identifying the highest crash risk sections for each mode individually from the Sliding Windows analysis. HIN corridors are identified by applying a one-mile moving window aggregation to the street network.

High Injury Network Process

Development of the HIN should emphasize that the key goal of Vision Zero is elimination of fatal and serious injury crashes, and therefore the more severe crashes count for more in the analysis but still including lesser injury crashes in the analysis. The combination of crash injury severity and the density of all crashes from the Sliding Windows analysis is how the HIN maps, for each mode and all modes combined, were developed using the following steps:

1. Map the Sliding Windows analysis results for each mode (pedestrian, bicycle, motorcycle, and motor vehicle) individually
2. For each mode, determine the threshold of the Sliding Windows output required to be included in the HIN. This step eliminates streets that have a lower crash density thereby prioritizing streets that have higher crash severities and frequencies.
3. Review false-positive segments that have a high crash score due to a single intersection crash but do not have any other crashes along the corridor.

High Injury Network Thresholds

The goal of setting higher HIN Sliding Windows score threshold is to settle on the Sliding Windows score for each mode independently that will identify key corridors where safety risk is highest based on crash density and injury severity to help agencies prioritize where safety improvements should be made first. A segment that meets or exceeds the Sliding Windows scores for each mode that included in the HIN for the NWA region are listed below:

- **Pedestrian: 4**
- **Bicycle: 4**
- **Motorcycle: 7**
- **Motor Vehicle: 15**

The weighted crash score thresholds for areas included in the HIN do not exactly follow the weighted crash score ranges from the Sliding Windows, as the HIN is a compilation of the highest weighted crash scores.

Manual Refinements

The HIN development process relies on historical crash data, which is imperfect and incomplete because not every crash is reported. As such, this process is both and art and a science. Key areas to manually review in the HIN revision process include areas where a street name or functional road classification changes, but the crash density or injury severity risk seem higher or lower. Manual refinements to the HIN maps should be minimized and really account for key context changes that cannot be captured in a data driven process. For example, an area where the Sliding Window continues but the road context changes drastically.

The following corridor extents were manually adjusted based on review by the project team to account for unique street contexts the automated Sliding Windows Analysis did not account for. The following corridors were manually adjusted based on the following reasons:

1. Segment along West Huntsville Avenue originally terminated at the end of the curve. This segment was manually extended through the White Road curve to fill a small gap between high crash areas.
2. Segment along West Don Tyson Parkway has been manually extended through the curve to account for the existing divided roadway.
3. Segment along East Wagon Wheel Road was manually extended through the ramp entrance to I-49. This extension increased the overall motor vehicle Sliding Window score above the threshold of 15.
4. Segment along South 26th Street was manually shortened to remove the portion of the segment north of West Laurel Avenue where few crashes have occurred and no KSI crashes.
5. Segment along West Hudson Road was manually added to the HIN due to the number of crashes and contiguity with segments of Highway 62 that are on the HIN.

Figure 11: All Modes High Injury Network

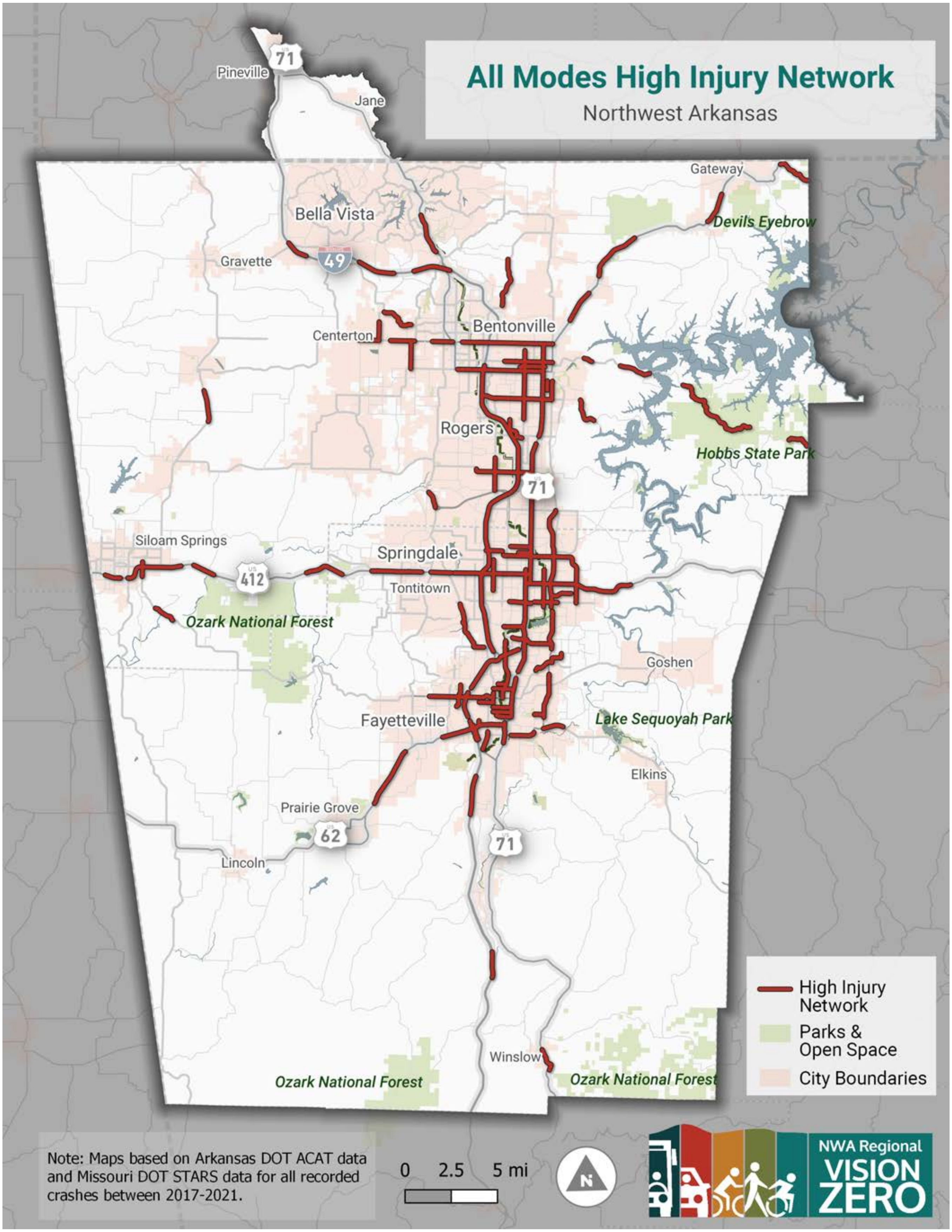


Figure 12: Pedestrian High Injury Network

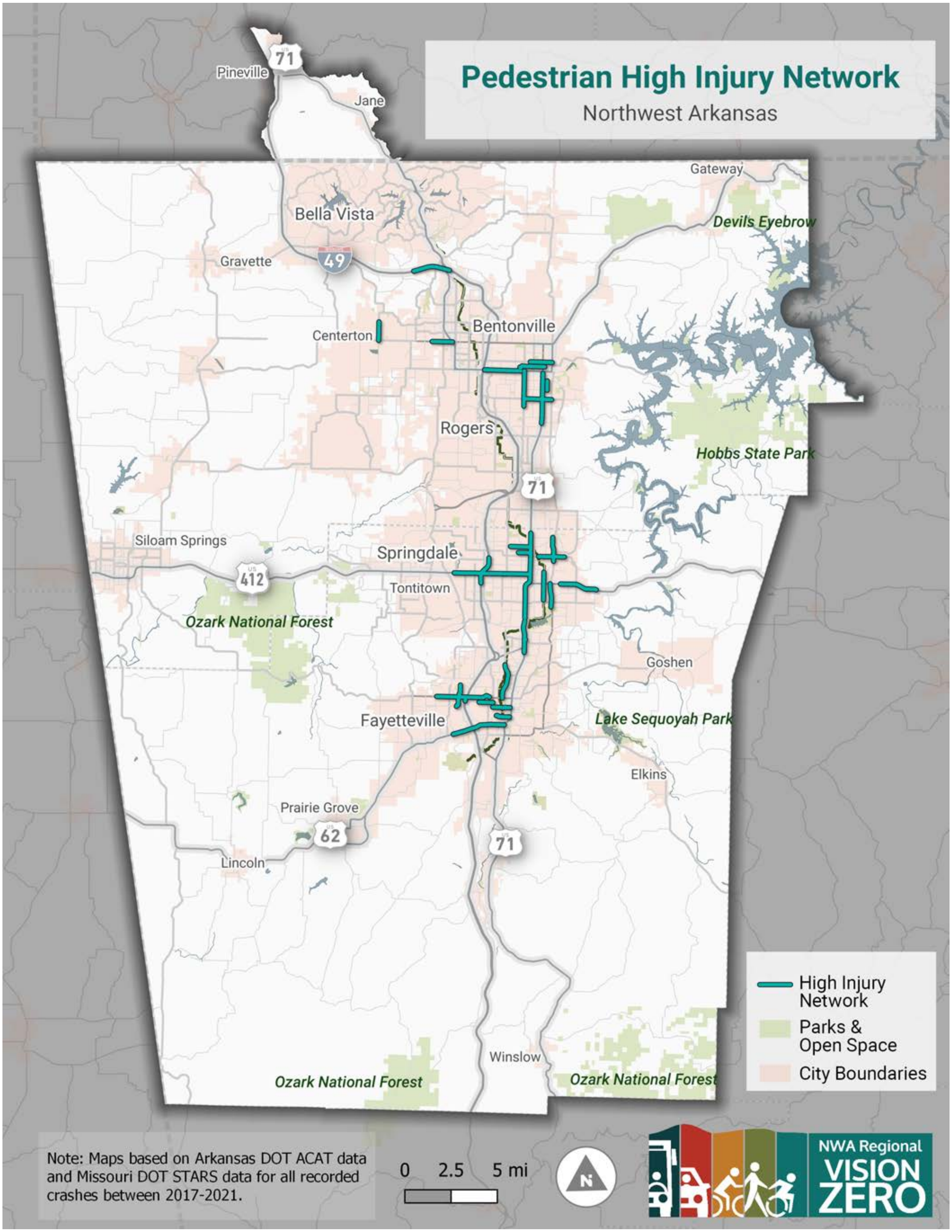


Figure 13: Bicycle High Injury Network

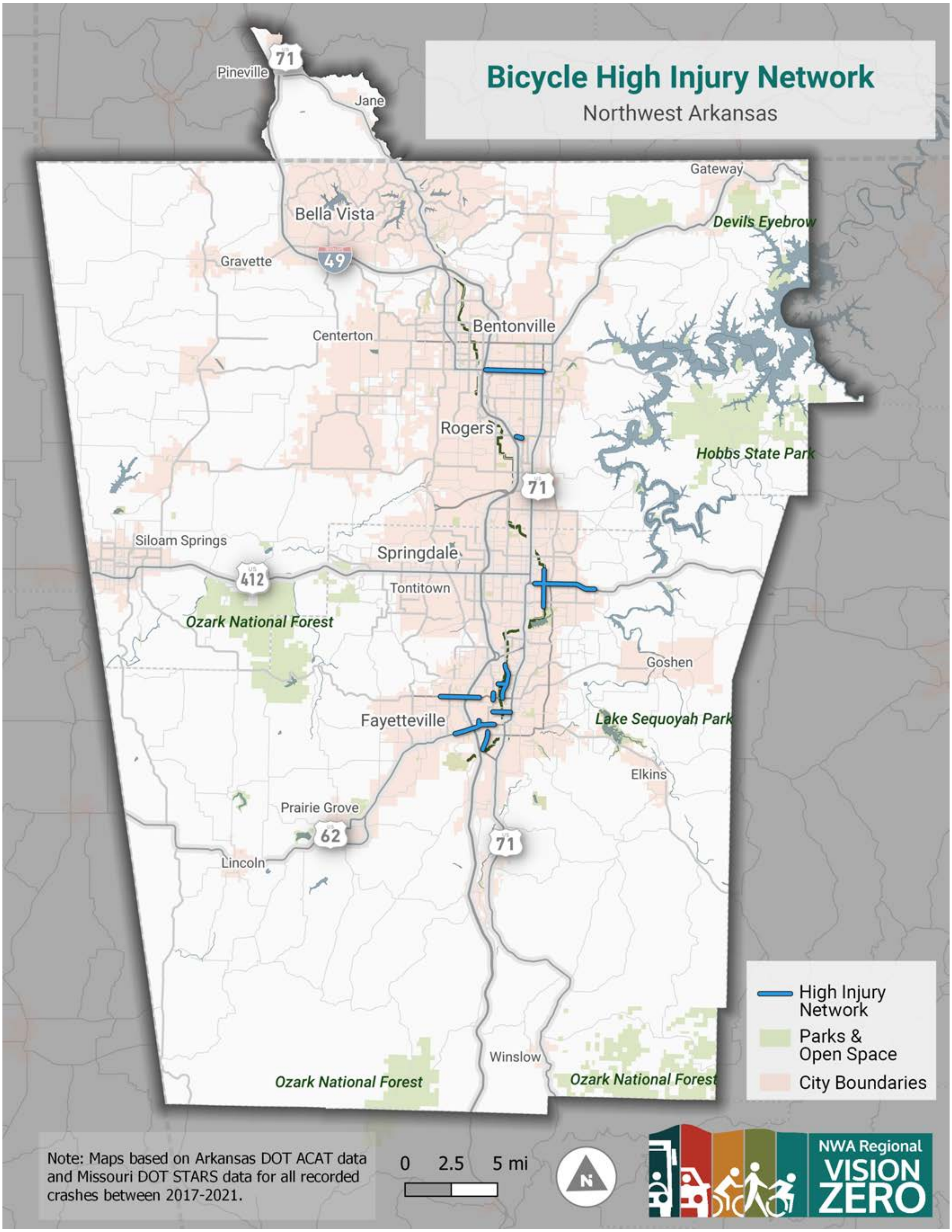


Figure 14: Motorcycle High Injury Network

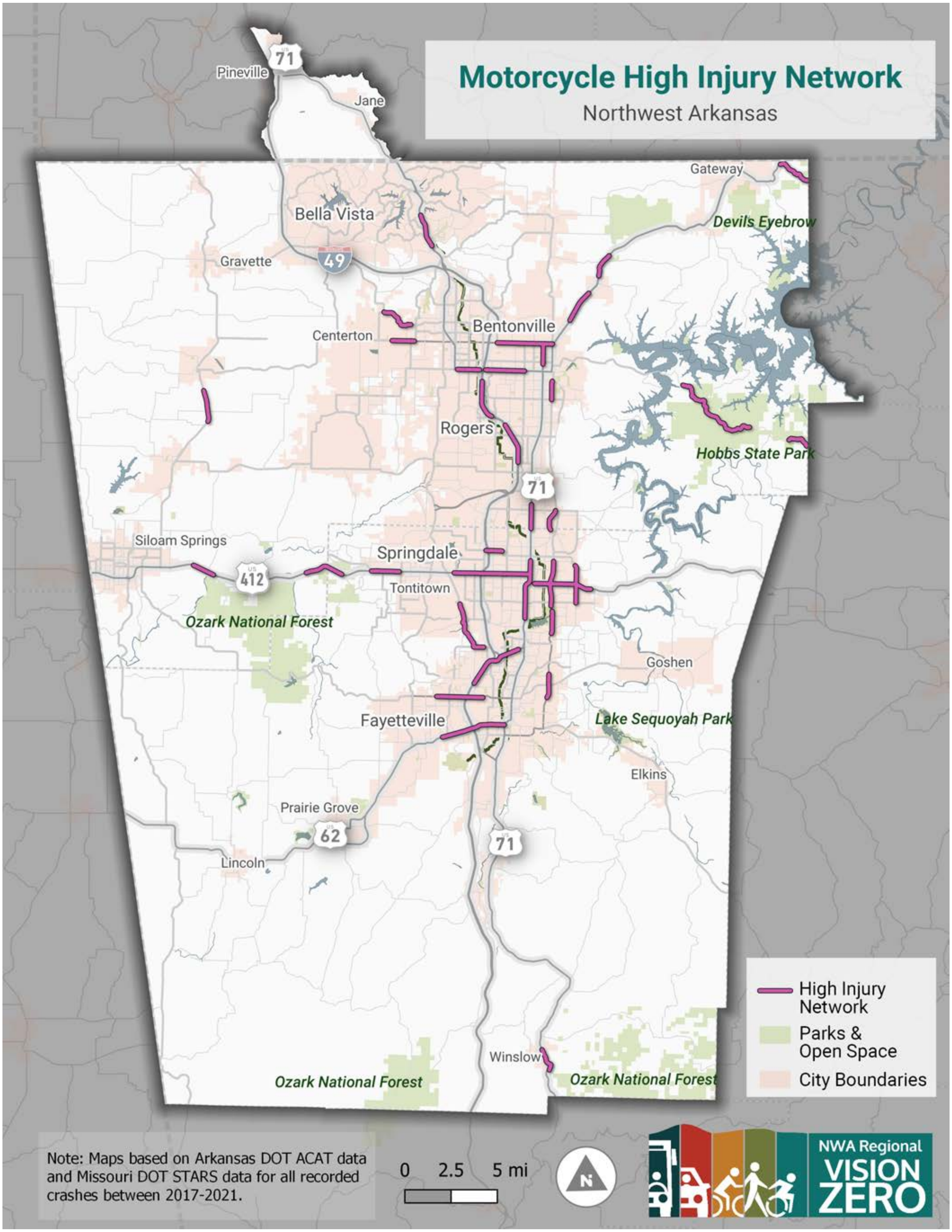
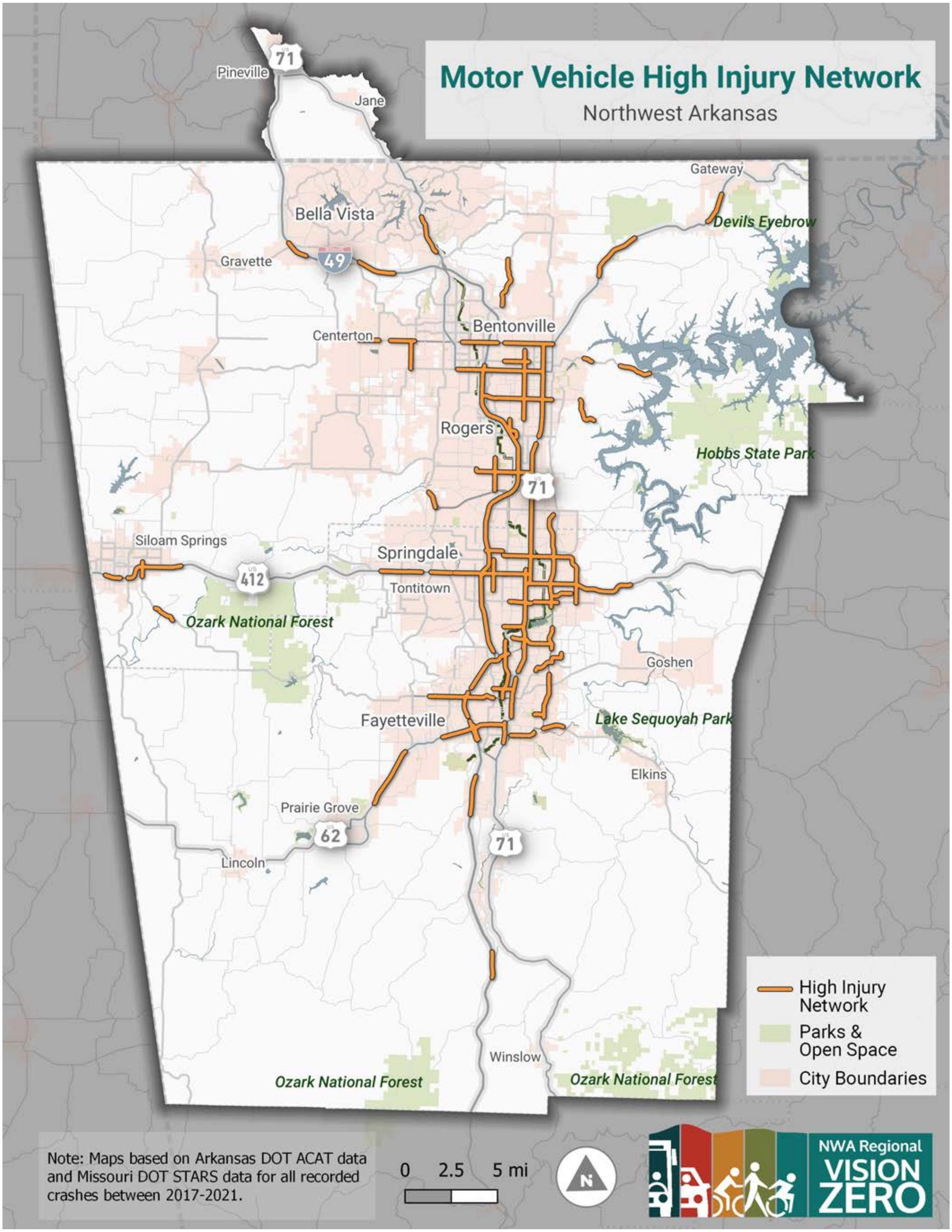


Figure 15: Motor Vehicle High Injury Network

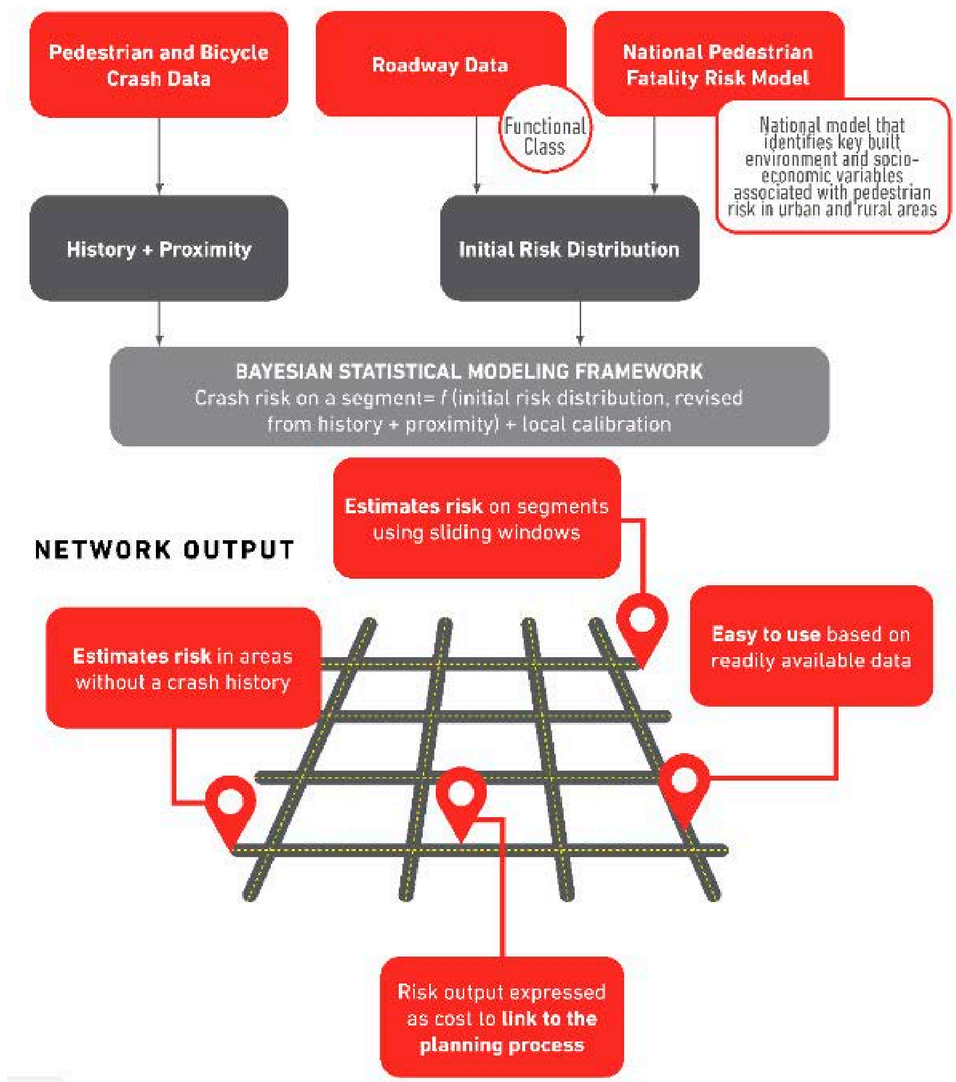


Safer Streets Priority Finder (SSPF) Tool

SSPF Tool Background

Toole Design, in collaboration with the City of New Orleans, University of New Orleans Transportation Institute, and New Orleans Regional Transit Authority, developed the SSPF tool.[3] The SSPF Tool is a free, interactive, open-source resource available at the national scale that can help transportation practitioners identify a street network that is similar to a HIN for bicyclists and pedestrians. The network goes further than a typical HIN by not only taking into consideration areas where a disproportionate share of fatal and serious injury crashes have already occurred, but also areas that have factors present that are likely to contribute to future risk.

Figure 16: Safer Streets Priority Finder Tool Methodology. Source: Toole Design Group.



3 https://www.saferstreetspriorityfinder.com/tool/

The SSPF produces two main outputs:

- **Sliding Windows Analysis:** How the HIN maps were developed for this report in the previous section.
- **Safer Street Model:** Estimated future societal costs forbicycle and pedestrian crashes only.

The following sections will provide high level summaries for each analytical methodology and the results from each analysis. For more detailed information on the methodologies for each analysis, please see SSPF Technical Report.

Safer Streets Model

The Safer Streets Model brings the segmented road network window segments, produced in the Sliding Windows Analysis, into a Bayesian statistical framework to estimate crash risk throughout the system. This framework incorporates external information about how many crashes might be expected, called a Bayesian prior, alongside the crash history.

The model estimates crash risk rates per mile for each road segment for pedestrian and bicyclists based on injury severity. These values are then converted to societal crash cost estimates based on the costs assigned to each crash severity.[4]

The Safer Streets Model is only available to model bicycle and pedestrian crashes. The model cannot estimate or model future motor vehicle or motorcycle crashes at this time.

Key Output

Corridors with highest potential risk for bicycle and pedestrian crashes to occur in the future using both historical crash data and a statistical crash cost model based on functional road classification. The values used to assign corridors were:

- **One-year costs for pedestrians: $100,000**
- **One-year costs for bicyclists: $25,000**
- **Pedestrian Safer Streets Model Rankings**
  - o **High: $600,000 +**
  - o **Moderate-High: $20,0000 - $60,0000**
  - o **Moderate: $50,000 - $20,0000**
  - o **Moderate-Low: $25,000 - $50,000**
  - o **Low: $0 - $25,000**
- **Bicycle Safer Streets Model Rankings**
  - o **High: $30,000 +**
  - o **Moderate-High: $15,000 - $30,000**
  - o **Moderate: $5,000 - $15,000**
  - o **Moderate-Low: $2,500 - $5,000**
  - o **Low: $0 - $2,500**

4 https://safety.fhwa.dot.gov/hsip/docs/fhwasa17071.pdf

Figure 17: Pedestrian Safer Streets Model

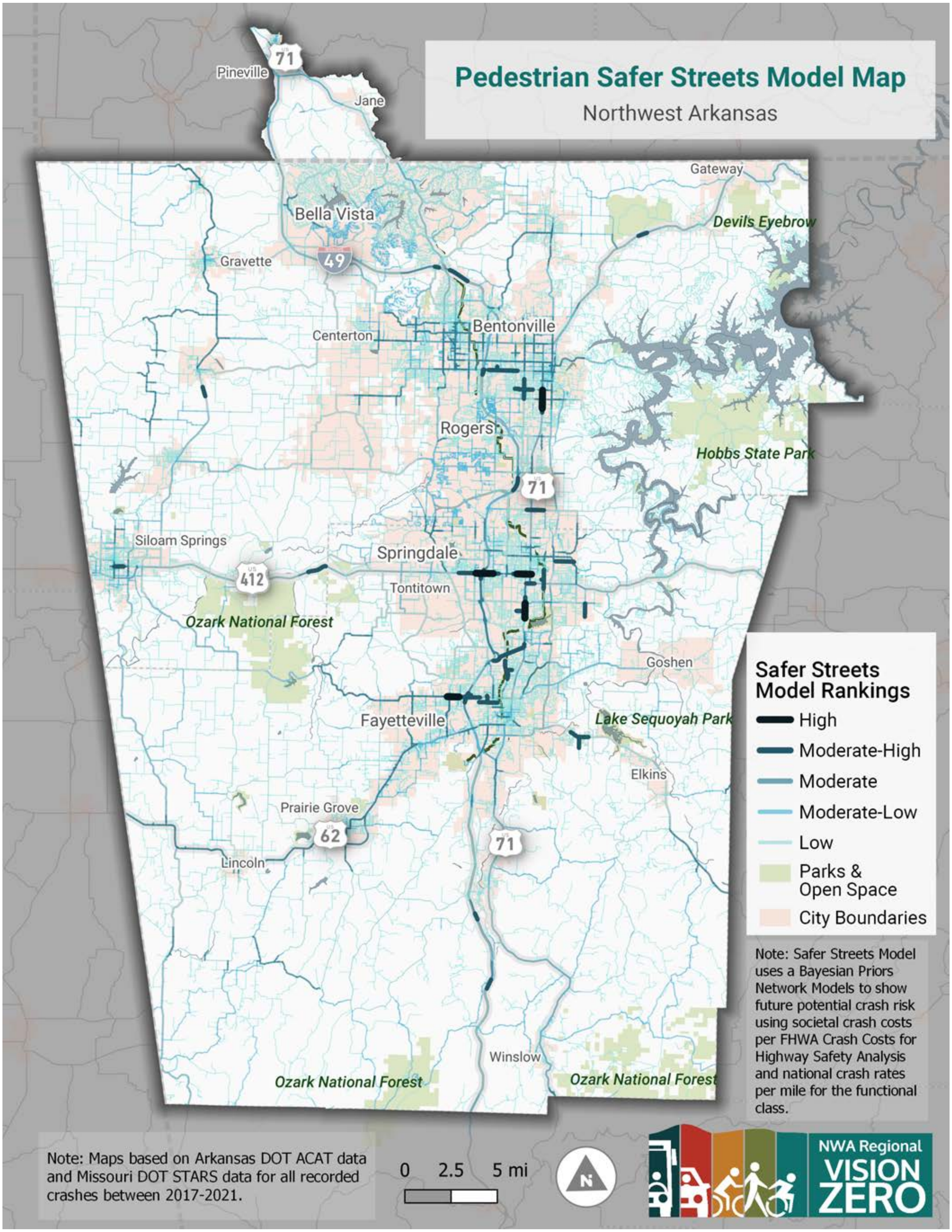
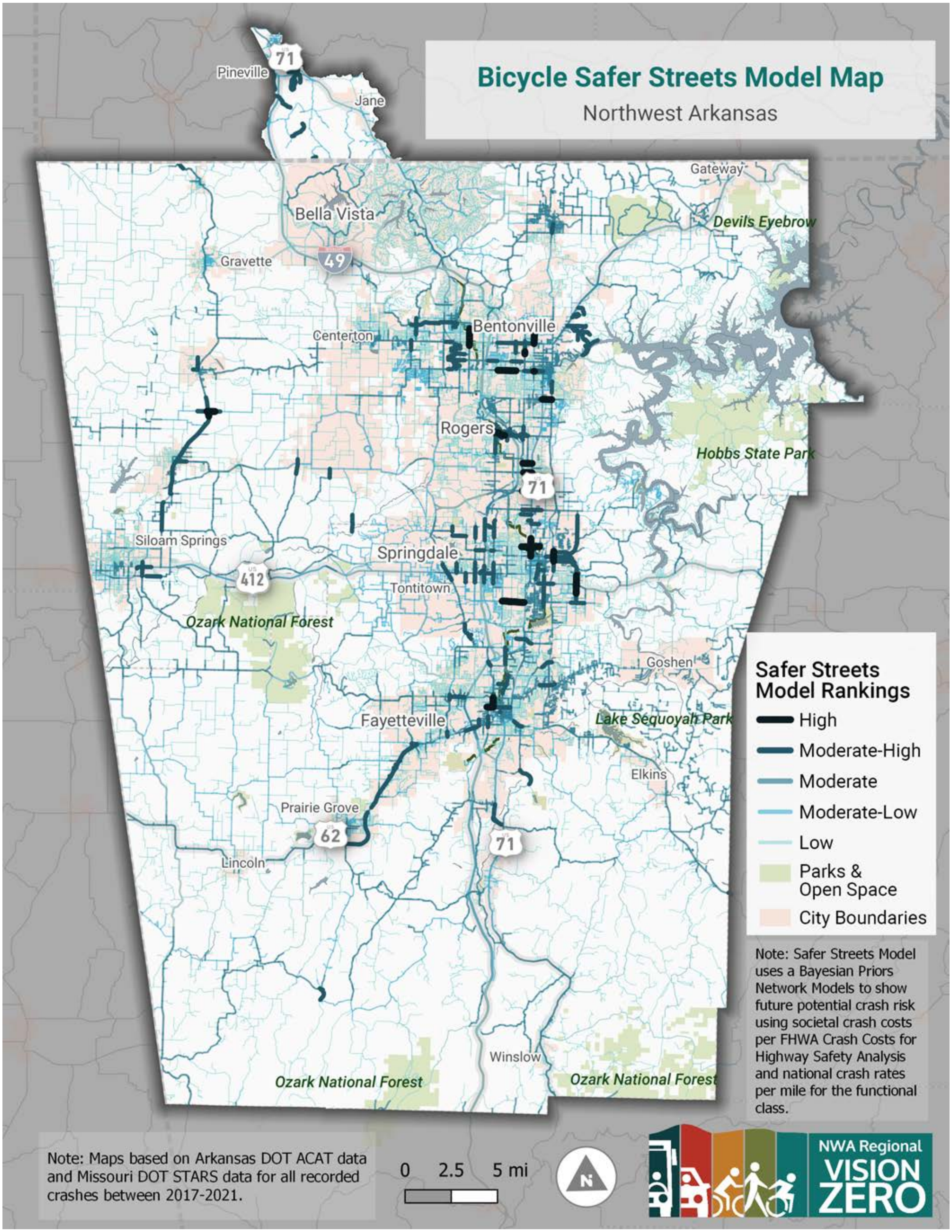


Figure 18: Bicycle Safer Streets Model



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