

INVESTIGATING EVACUATION FLOW OF RURAL AREAS: A CASE STUDY OF THE TRAIN DERAILMENT IN CASSELTON, NORTH DAKOTA

Vu Dang, M.T.U.S., B.S.C.E., Ph.D. Student

Abstract: Reliance on rail transportation has increased over the last few years due to the oil boom in the Bakken region. The carriers utilize the existing DOT-111A train cars to transport these goods to other regions of the country. However, the existing fleets were designed for capacity, not strength; a single puncture and given the right scenario can be disastrous. This case study hopes to evaluate the theoretical evacuated traffic flow caused by the train derailment-related accidents.

APPROXIMATE TIME OF DAY	DATE	DESCRIPTION
2:11 PM	12/30/2013	Train derailment between WB grain and EB crude oil trains. Code Red Alert sent out for 2-mile "remain indoor" warning.
4:30 PM	12/30/2013	Shelters and an Incident Command Center (ICC) were set up at the Casselton Public School. No-fly zone established. 10-mile radius "remain indoor" warning advised.
5:45 PM	12/30/2013	Voluntary evacuation for parts of the city.
6:30 PM	12/30/2013	Shelters were set up at Discovery Middle in south Fargo; 17 people stayed overnight.
7:24 PM	12/30/2013	Mandated evacuation order for entire city and the townships of Durbin and Everest, south and east of the Casselton (5-mile evacuation).
EVENING	12/30/2013	Additional shelter was set up at Casselton Library for about 50 people.
8:56 PM	12/30/2013	BNSF HAZMAT Team arrives from Texas to perform recovery process.
11:30 PM	12/30/2013	Approximately 65% of residents have evacuated the area.
3:00 PM	12/31/2013	Evacuation order lifted.
-	01/01/2014 - 01/04/2014	NTSB conducted interviews for train crews and first responders.

DATA

- U.S. Census Bureau Socioeconomic Data,
 - 2008-2012 ACS 5-Year Estimates,
 - 2012 Population Estimates
- GIS data provided by,
 - Kevin Mayer of Casselton Public Works,
 - Cass County Government,
 - Esri
- Other data, i.e. quantitative values of importance,
 - NTSB,
 - Dave Rogness, Cass County Emergency Manager

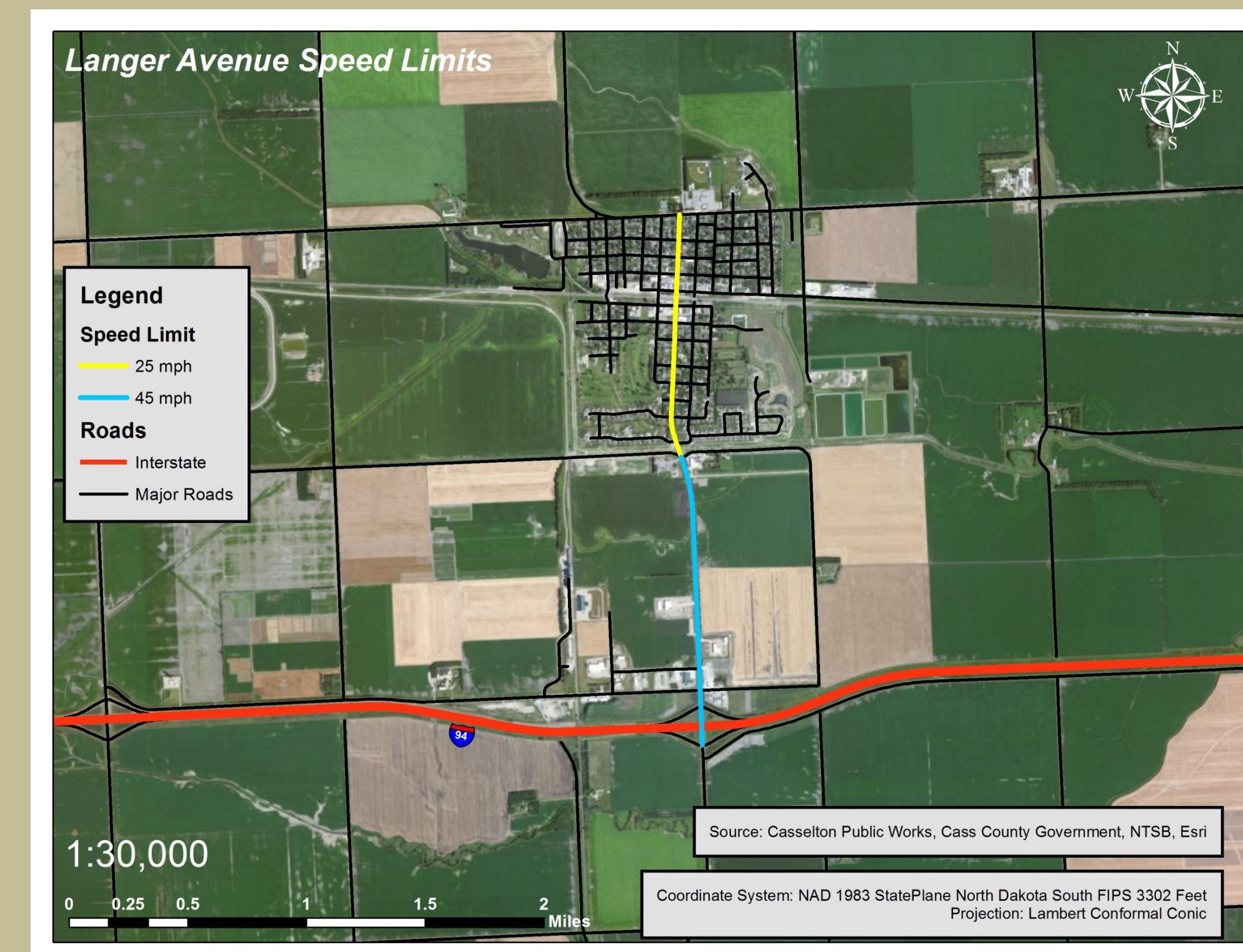
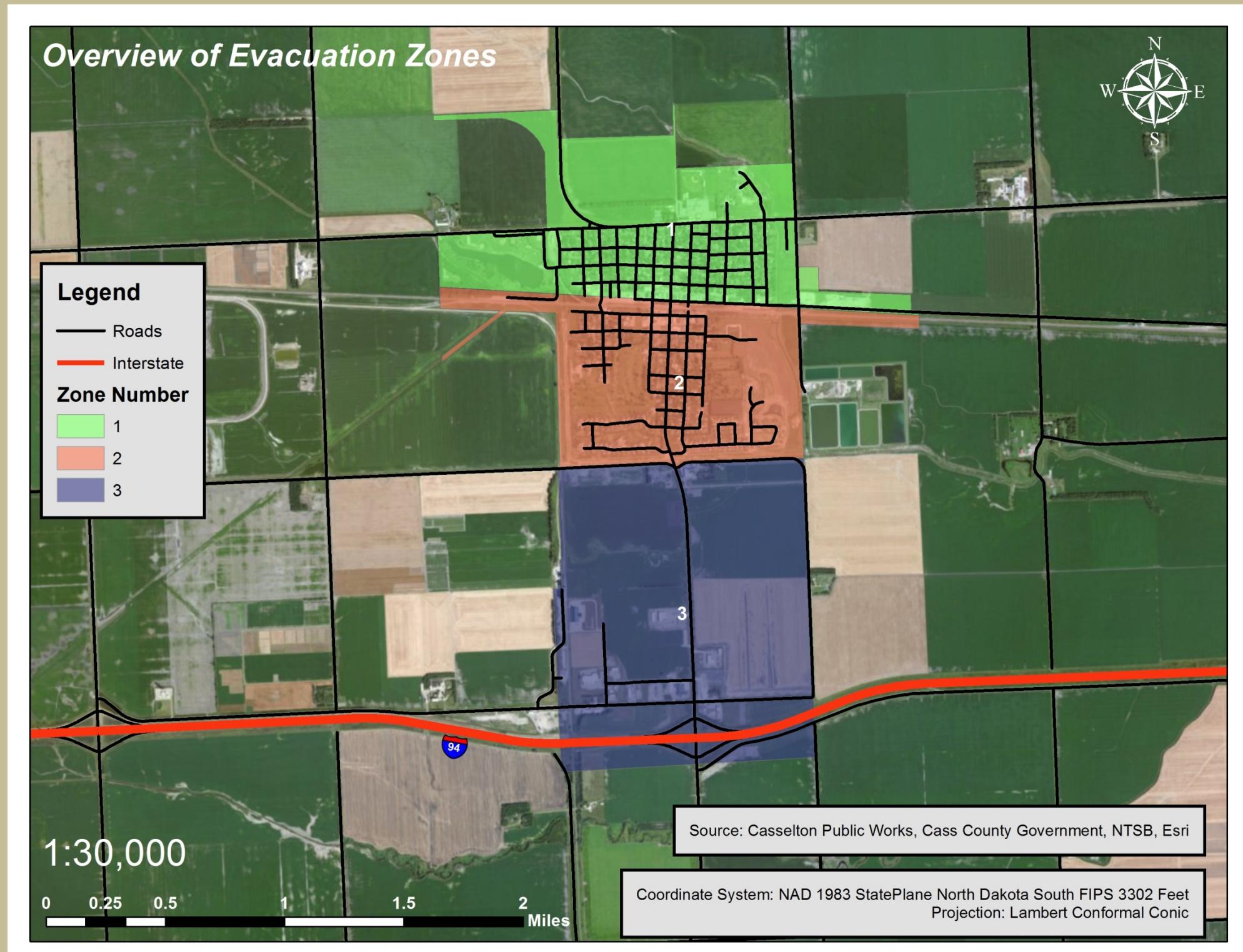
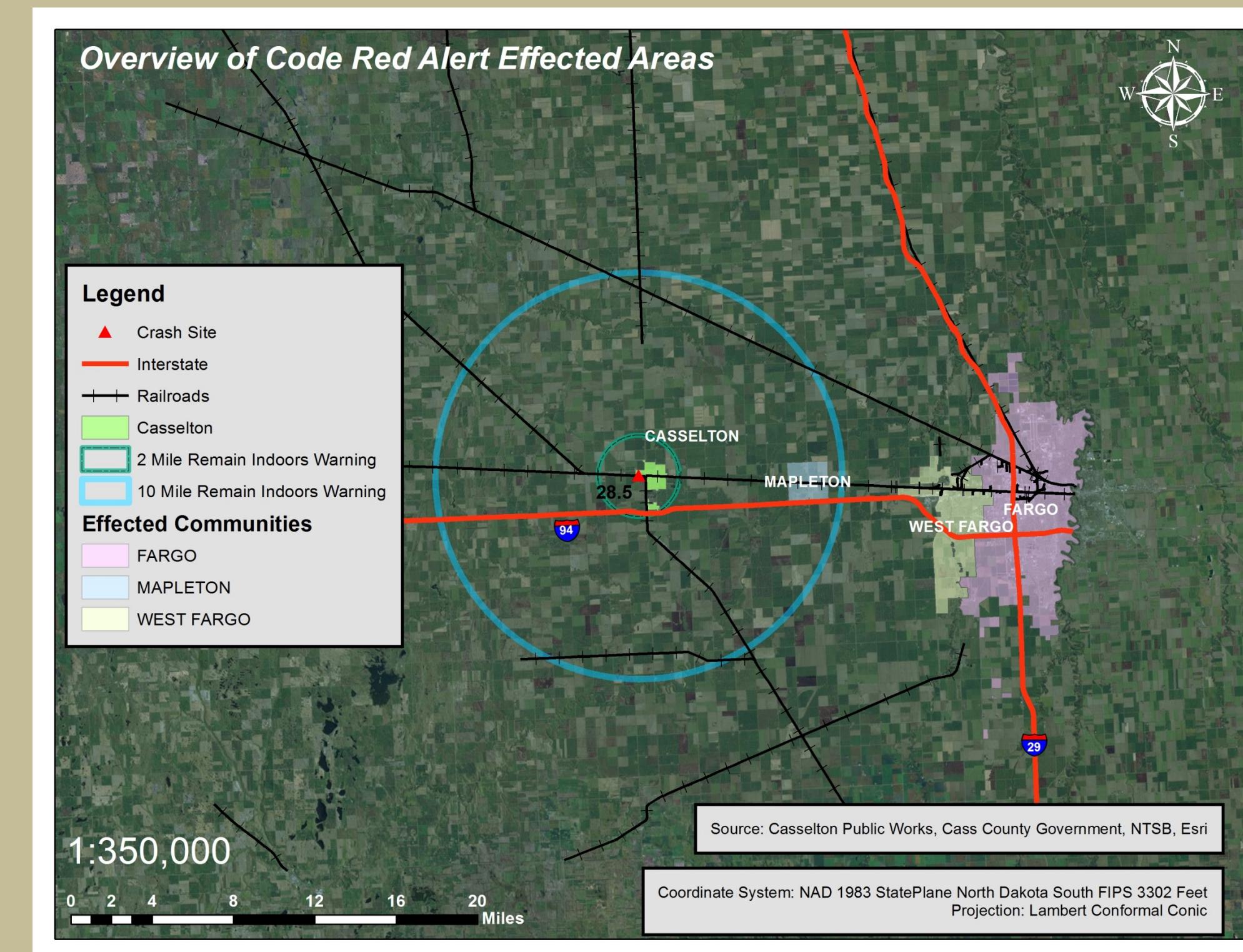
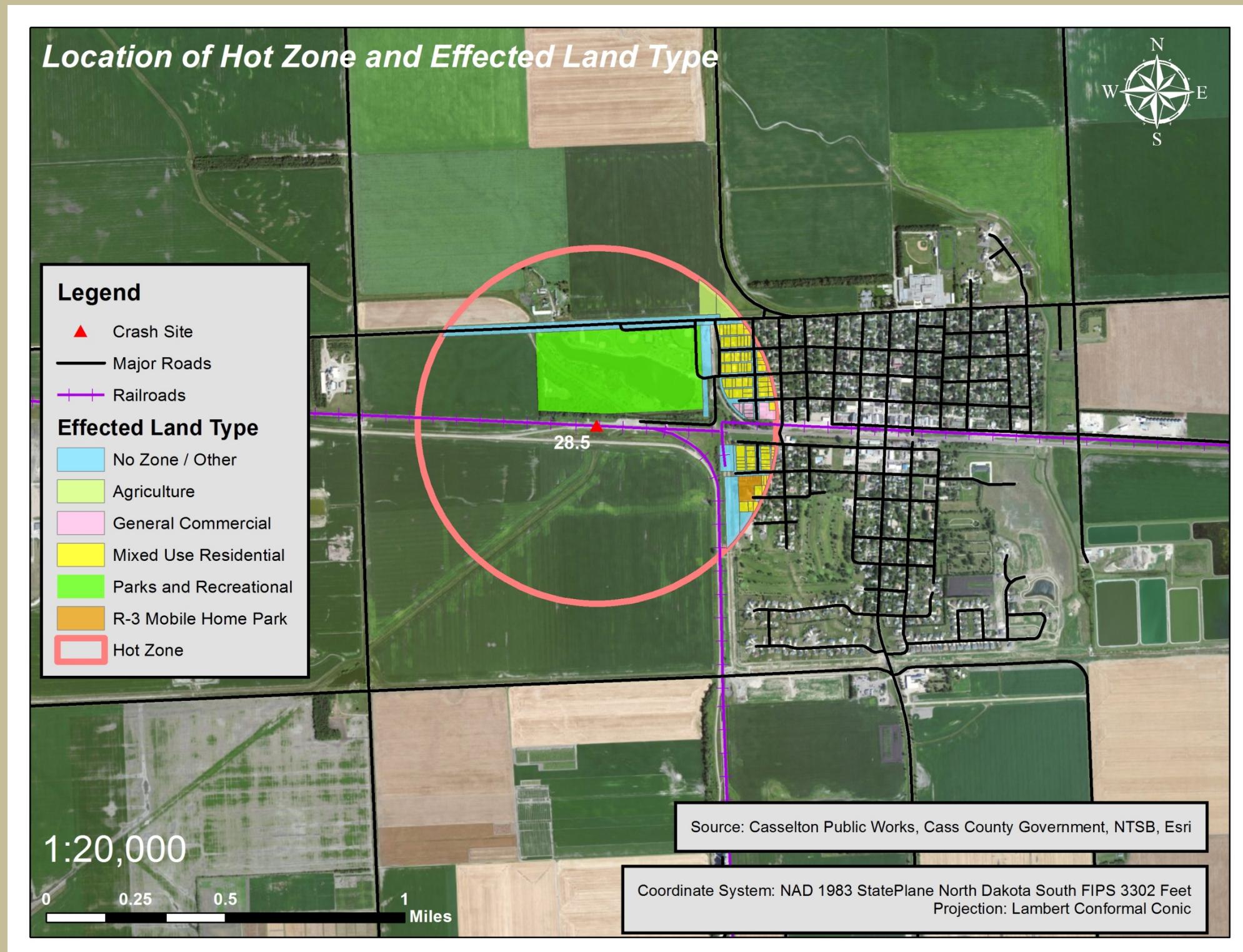
GIS METHODOLOGY

- Parcel data join with zonal data to provide affected households and businesses (Step A)
- 0.5 mile buffer applied to heat zone,
- 2-mile buffer applied for "remain indoors" warning,
- 10-mile buffer applied for Code Red Alert effected areas,
- 5-mile buffer applied for recommended evacuation,
- Simple python script used for evacuation due to wind factor using Arcpy,

TRAFFIC FLOW METHODOLOGY

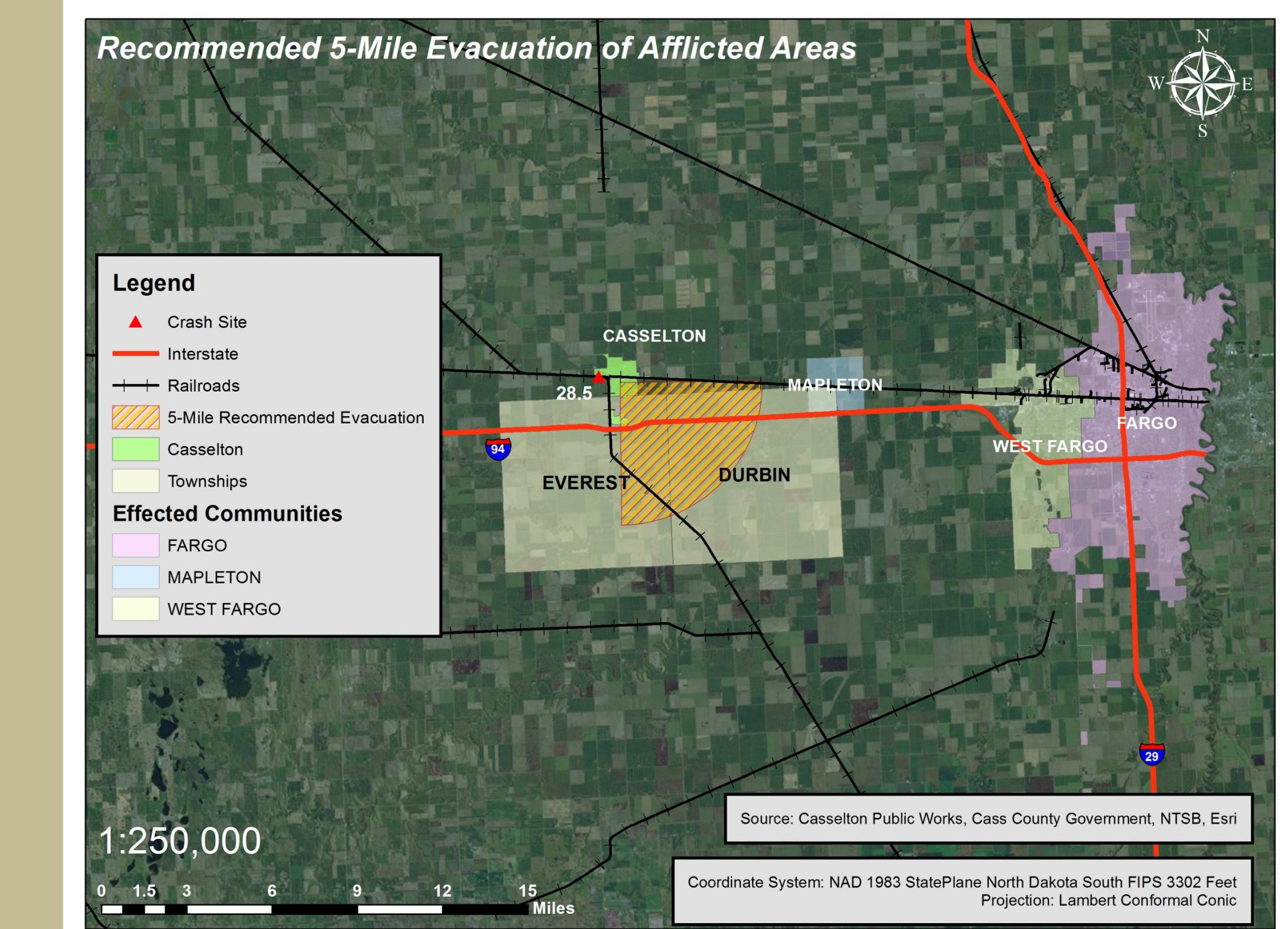
- 3 zones,
- Theoretical evacuation flow factors:
 - Speed limits,
 - Distributive ratios of speed and distance of line segments,
 - Rate of evacuation given by local news media and sheriff department,
 - Road geometry,
 - 17 people used shelters,
 - Evacuation process was roughly 3.5 hours,
- Destination factors during evacuations given by Paz de Araujo and colleagues,
 - 0.60 = families or friends,
 - 0.15 = shelters,
 - 0.15 = hotels,
 - 0.10 = out of county

GIS MAPPING



CONCLUSIONS

- Existing DOT-111A tank car fleet is in deplorable condition to transport hazardous materials,
 - AAR, PHMSA, USDOT, railroad companies, and train car owners need to work together to improve conditions.
- NTSB currently investigating cause of accident,
- Due to the geography, population size, evacuation time and casualties were at a minimum. No loss of life. Evacuation successful thanks in part to effective communications between residents, officials, and emergency responders.
- Similar happen to Fargo would prove to be more disastrous and fatal.



FINDINGS AND RESULTS

- **EVACUATION BY ZONE (persons per hour):**
 - Most occupied was **Zone 3** with **245**,
 - Least occupied was **Zone 1** with **65**,
- **EVACUATION BY DESTINATION (1,581 voluntarily evacuated):**
 - **313 people** likely stayed at hotel in Fargo and West Fargo,
 - **234 people** likely traveled out of county,
 - **1,017 people** likely went to families or friends,
 - **17 people** confirmed went to shelters,