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Neighborhood Evacuation Model

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U.S. DEPARTMENT OF ENERGY | NNSA

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Problem Description

- In Albuquerque, some neighborhoods have limited options for outbound travel during an emergency (wildfire, natural gas emergency, *etc*.).
- We are interested in the time needed to evacuate such a neighborhood, and options that might shorten this time.
- We selected the Four Hills neighborhood, which has only one egress route and a network of low speed, curved roads.

Modeling Approach

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- Use GIS (Geographic Information Files) data available from the City of Albuquerque to set up the road network and locations of households
  - Use QGIS to edit the GIS data
    (remove drainage and other easements, non-household parcels, etc.)
  - QGIS is an open source GIS tool
- Use NetLogo to model the generation of cars and to move them out of the neighborhood along the road network
- Report on:
  - Households that have not started
  - Cars on the road that have not exited the neighborhood

Modeling Approach

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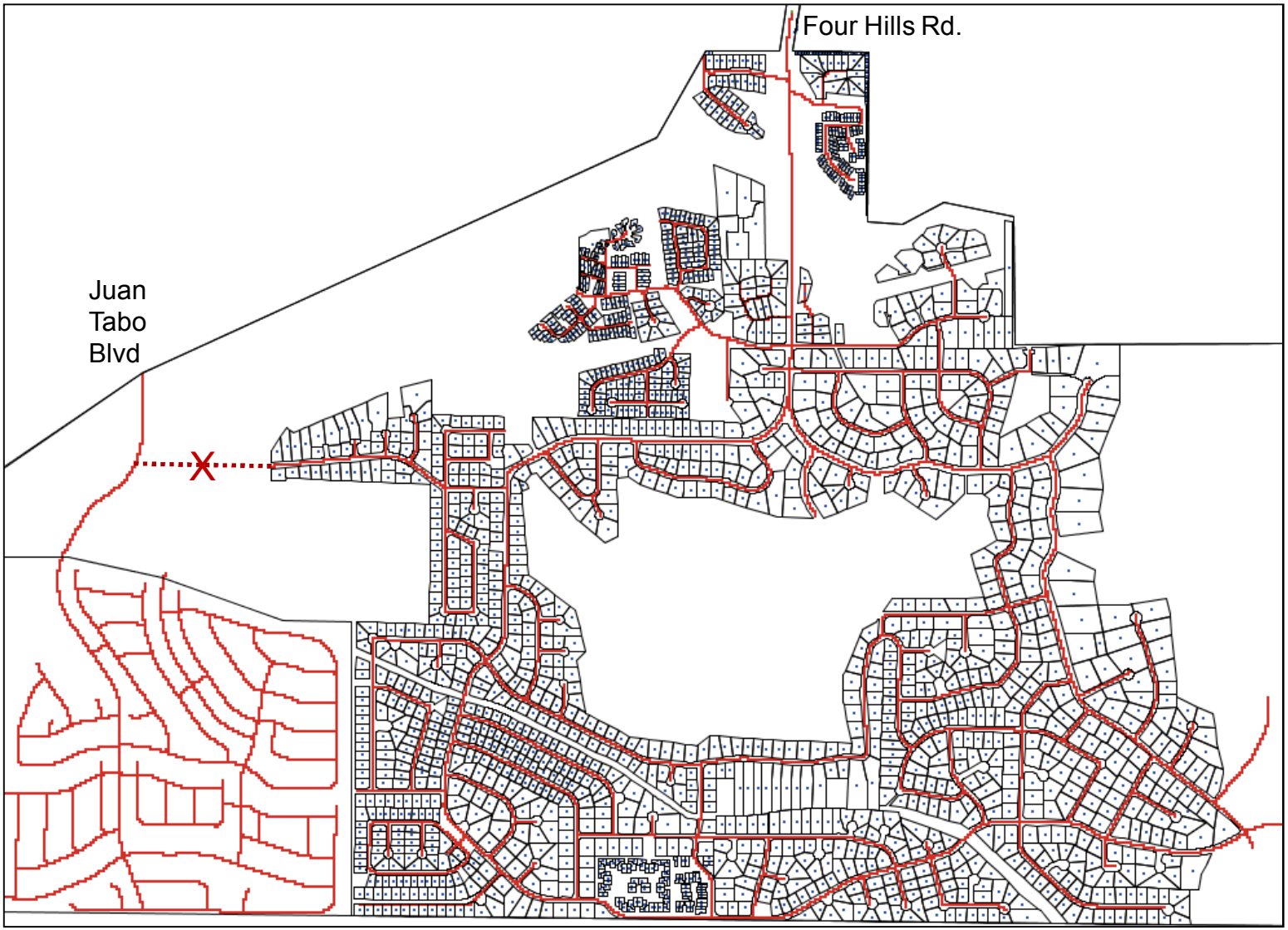
- There are two modeling approaches
  - Identify patches that represent homes and roads, and move turtles from patch to patch
  - Model a graph-theoretic network and move turtles from node-to-node along links
- We used the first approach thinking it would be simpler
  - Inexperience with NetLogo
  - Short time for development and analysis

Four Hills Neighborhood



Four Hills Neighborhood

- There is an alternate exit to Juan Tabo Blvd via a dirt path, but this is blocked by a locked gate.
- There are 1844 households
- Most roads are 2 lanes at 25 MPH
  - Four Hills Rd north of Happy Valley Rd is 4 lanes at 40 MPH
- Some evacuation options:
  - Open up unimproved road on the west side of neighborhood
  - Convert some inbound lanes to outbound travel
  - Evacuate neighbor by sections (e.g., north to south)

Intermediate Simulation Step

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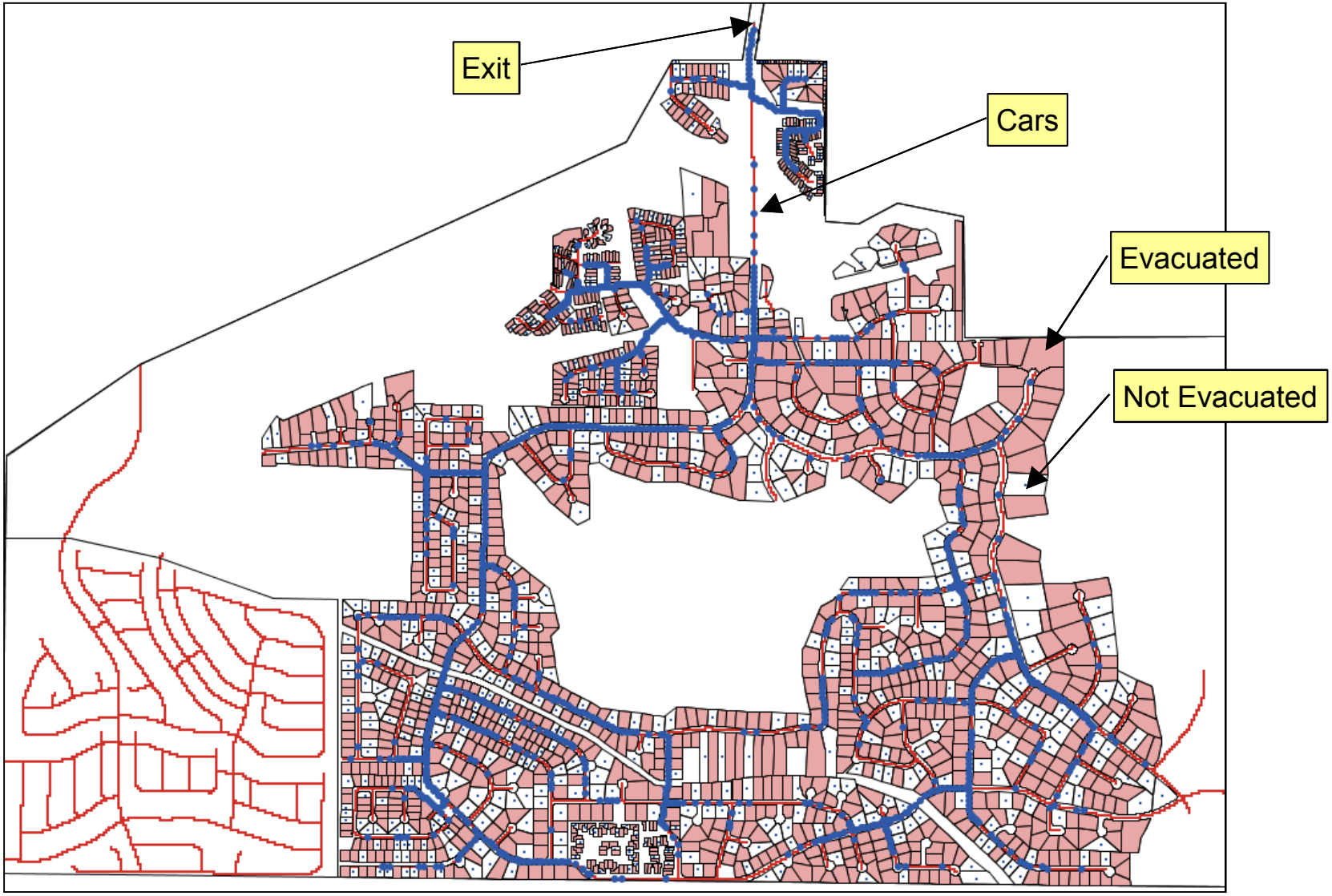

Findings (Partial Success)

- Model runs
  - GIS data edited and processed to associate roads with patches
  - Households located and processed to generate car-like turtles that move on the roads to the exit node along the shortest path
- Car model does not capture behavior
  - Turbulent traffic flow instead of smooth flow
  - No special behavior at intersections
  - Motion is not related to speed limit and number of traffic lanes
- Data reporting is incomplete
  - Counts of households by unevacuated and evacuated status
  - No report of travel time statistics and histogram

Path Ahead

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- With no prior NetLogo experience:
  - It was very hard for us to develop the model
  - We could do better given what we know now
- The graph-theoretic approach would have provided more versatility for modeling behavior and physics