North Carolina Hazardous Materials Transportation Route Optimization

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Introduction

- 2.2 billion tons of HazMat transported each year in the U.S.
- 15,424 incidents in 2012
- Risk increases in highly populated areas and around critical facilities
- Thoughtful route planning reduces risk

Regulations

- Chemical transport routes not regulated
  - Exception: Certain tunnels
- Radioactive material routes are regulated
- Voluntary compliance helps companies avoid negative publicity

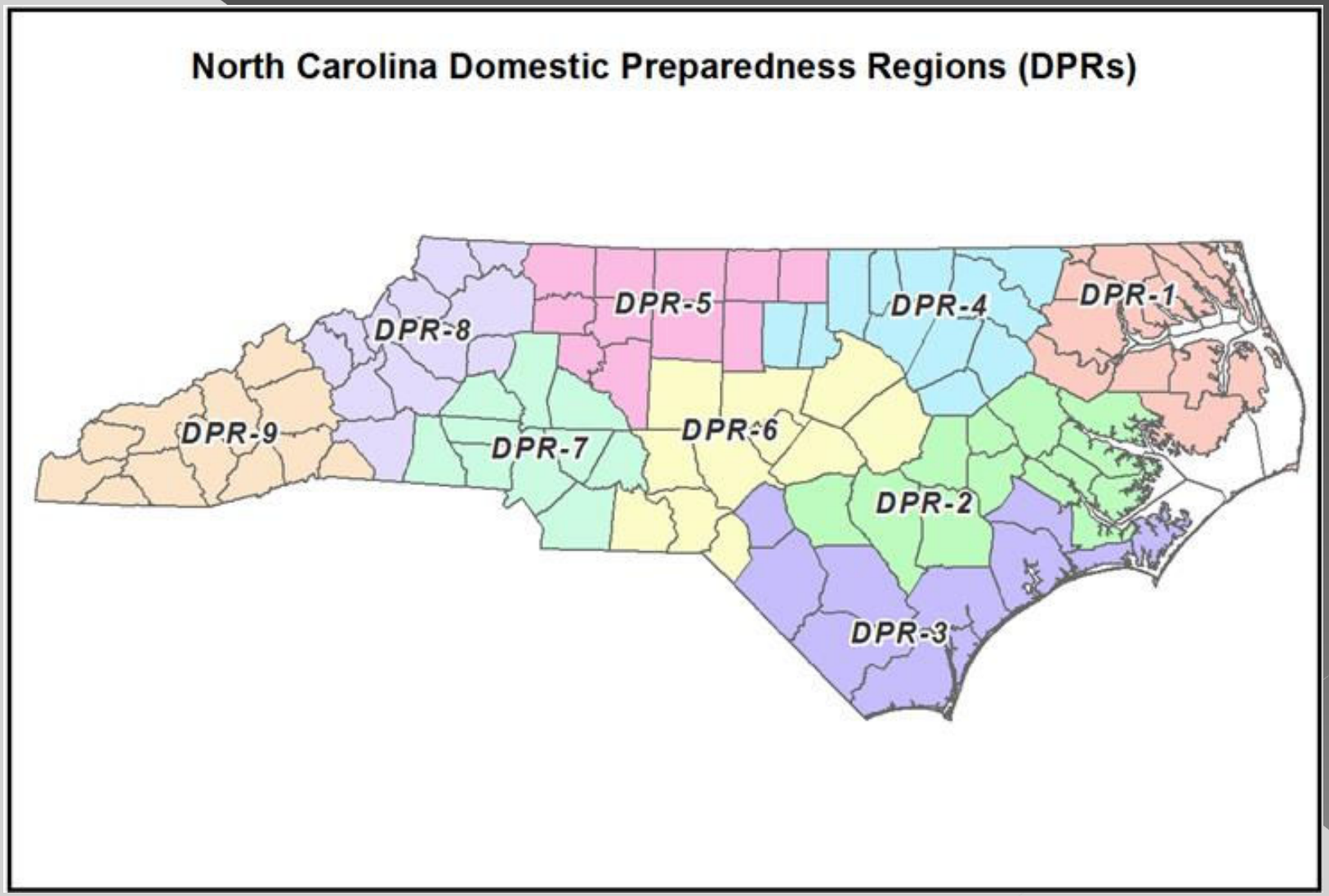
Cost/Benefit

- Route planning must balance economic and safety concerns
- Longer routes add cost
- Shorter routes may increase population exposure risk
- Optimal routes must consider both cost and safety

Project Background

- NCDPS contracted with IEM from 2009-2013 to conduct a statewide hazardous materials study.
- Produced statewide hazard profiles for use by Local Emergency Planning Committees (LEPCs)
- Data collection and hazard identification
- The following background slides describe this study and were used with permission from NCDPS

NC DPRs


North Carolina Domestic Preparedness Regions (DPRs)
DPR-1
DPR-2
DPR-3
DPR-4
DPR-5
DPR-6
DPR-7
DPR-8
DPR-9

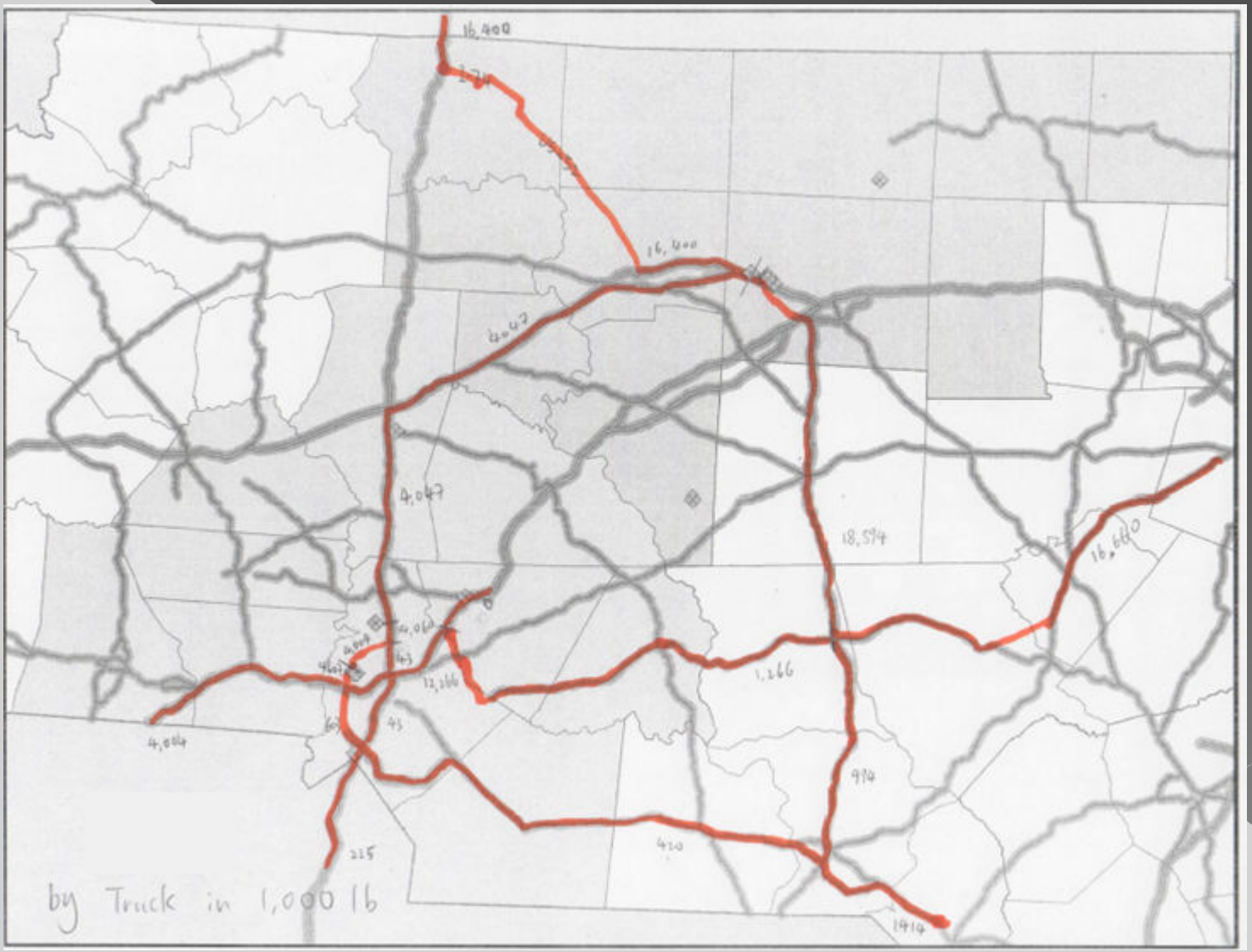
Phased Study Coverage

Phase	Year	DPRs Covered
1	2009	1, 2
2	2010	3
3	2011	4, 6
4	2012	8, 9
5	2013	5, 7

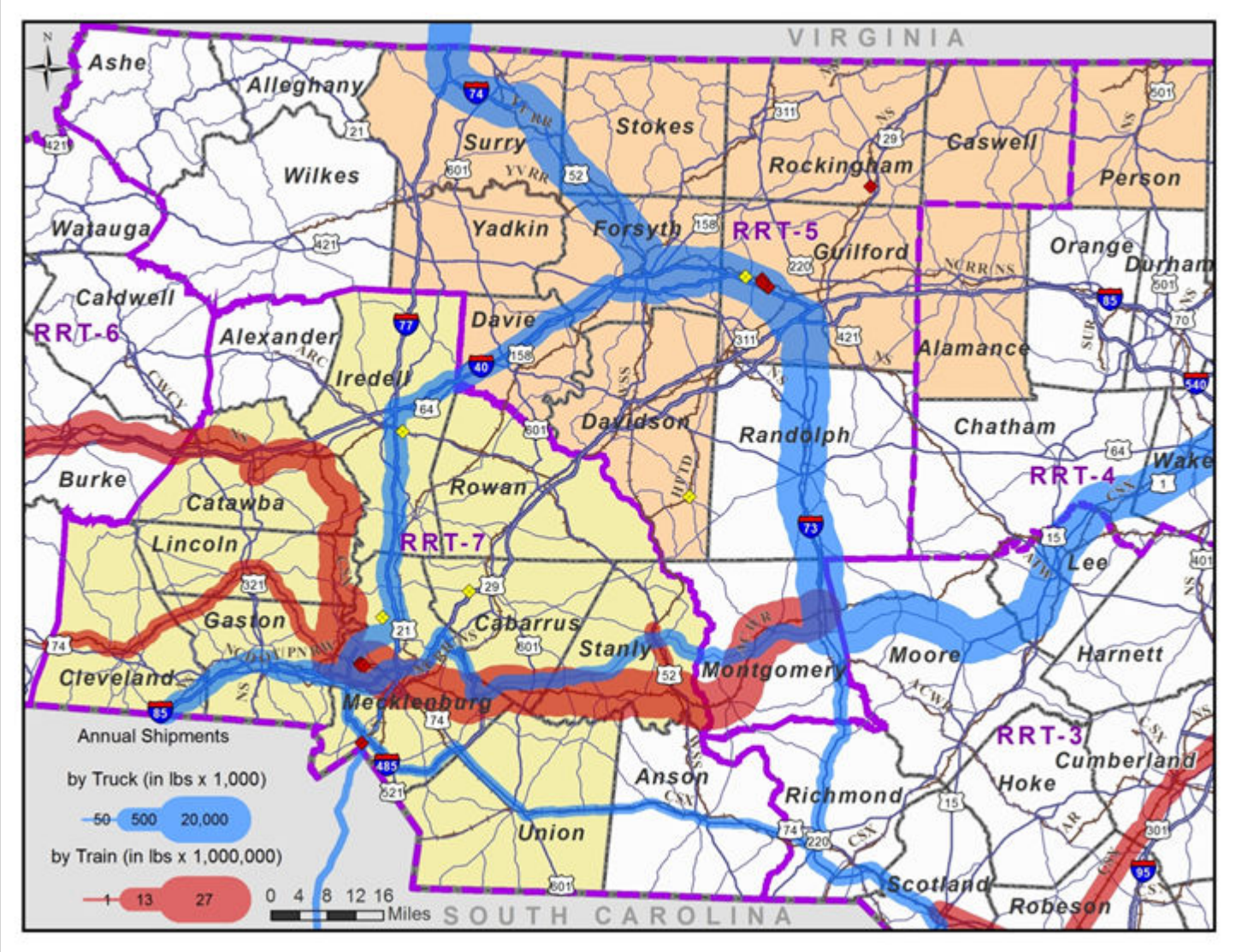
Data Collection Methods

- "Clicker Counts"
  - Intentionally not used for this study because of high costs, limited sample size
  - Limited value
- Collect data directly from manufacturers
  - Produce linear features for aggregated shipment volumes and routes

Sketch Maps


16,400
16,400
4,047
4,047
18,574
16,680
1,266
974
4,004
12,166
225
420
1414
by Truck in 1,000 lb

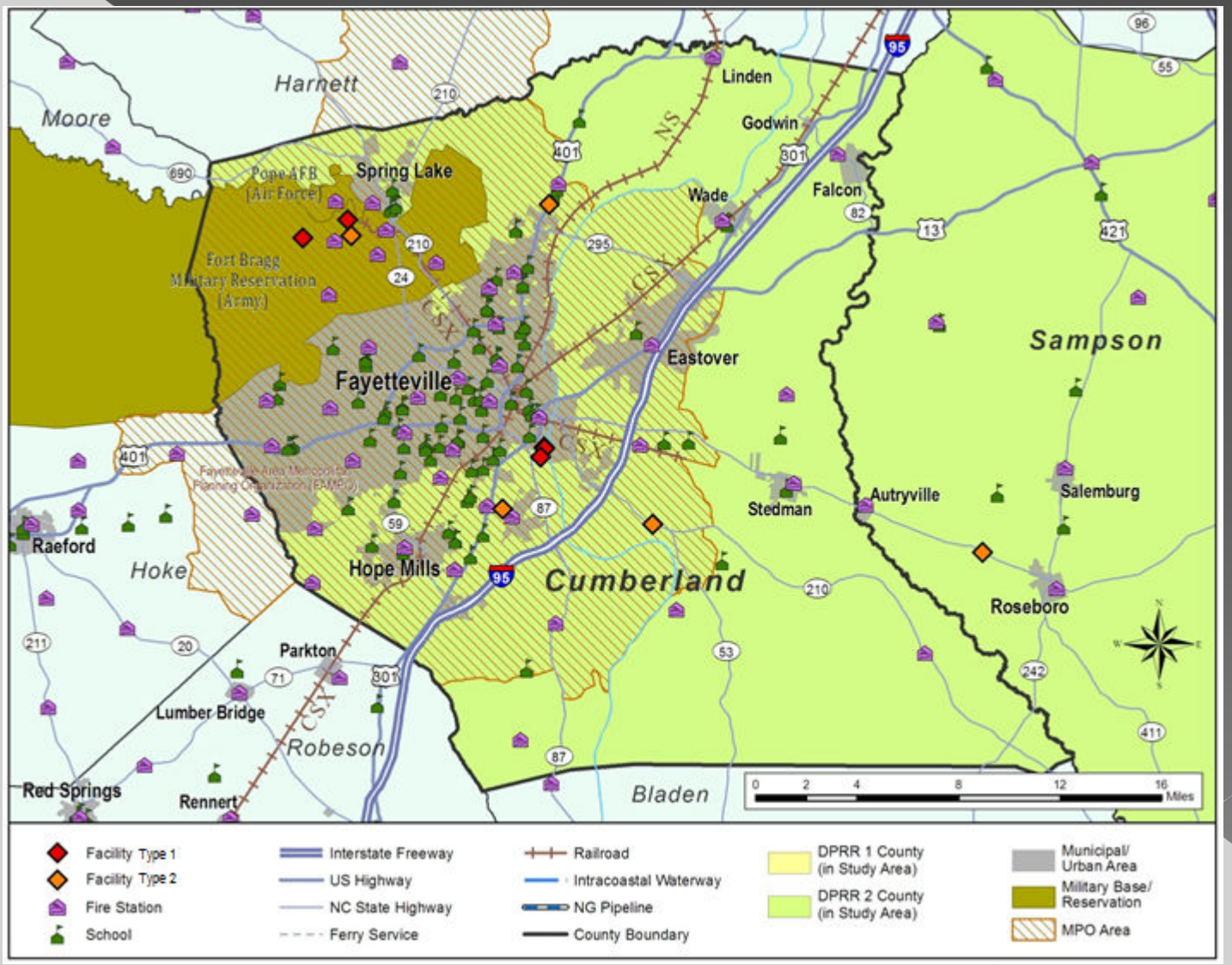
Flow Maps


VIRGINIA
Ashe
Alleghany
Wilkes
Watauga
Surry
Stokes
Yadkin
Forsyth
Rockingham
Caswell
Person
Guilford
Orange
Durham
Caldwell
Alexander
Iredell
Davie
Alamance
Davidson
Randolph
Chatham
Wake
Burke
Catawba
Lincoln
Rowan
Gaston
Cabarrus
Stanly
Montgomery
Moore
Harnett
Lee
Cleveland
Mecklenburg
Anson
Richmond
Union
Cumberland
Hoke
Scotland
Robeson
RRT-3
RRT-4
RRT-5
RRT-6
RRT-7
Annual Shipments
by Truck (in lbs x 1,000)
50
500
20,000
by Train (in lbs x 1,000,000)
1
13
27
0 4 8 12 16
Miles
SOUTH CAROLINA

Study Chemicals for DPRs 5 and 7

Rank	Chemical Name	Uses
1	Chlorine	Water treatment
2	Hydrogen Fluoride	Chemical catalyst
3	Ammonia	Refrigerant, fertilizer
4	Sulfur Dioxide	Water treatment
5	Ethylene Oxide	Disinfectant and production of plastic, antifreeze, and surfactants
6	Formaldehyde	Preservative, plastics and adhesives
7	Toluene Diisocyanate	Curing agent in plastics and coatings
8	Hydrogen Chloride	Production of acid, chemical reagent
9	Butane	Gasoline blending and a fuel gas
10	Vinyl Acetate Monomer	Production of latex and other plastics and adhesives

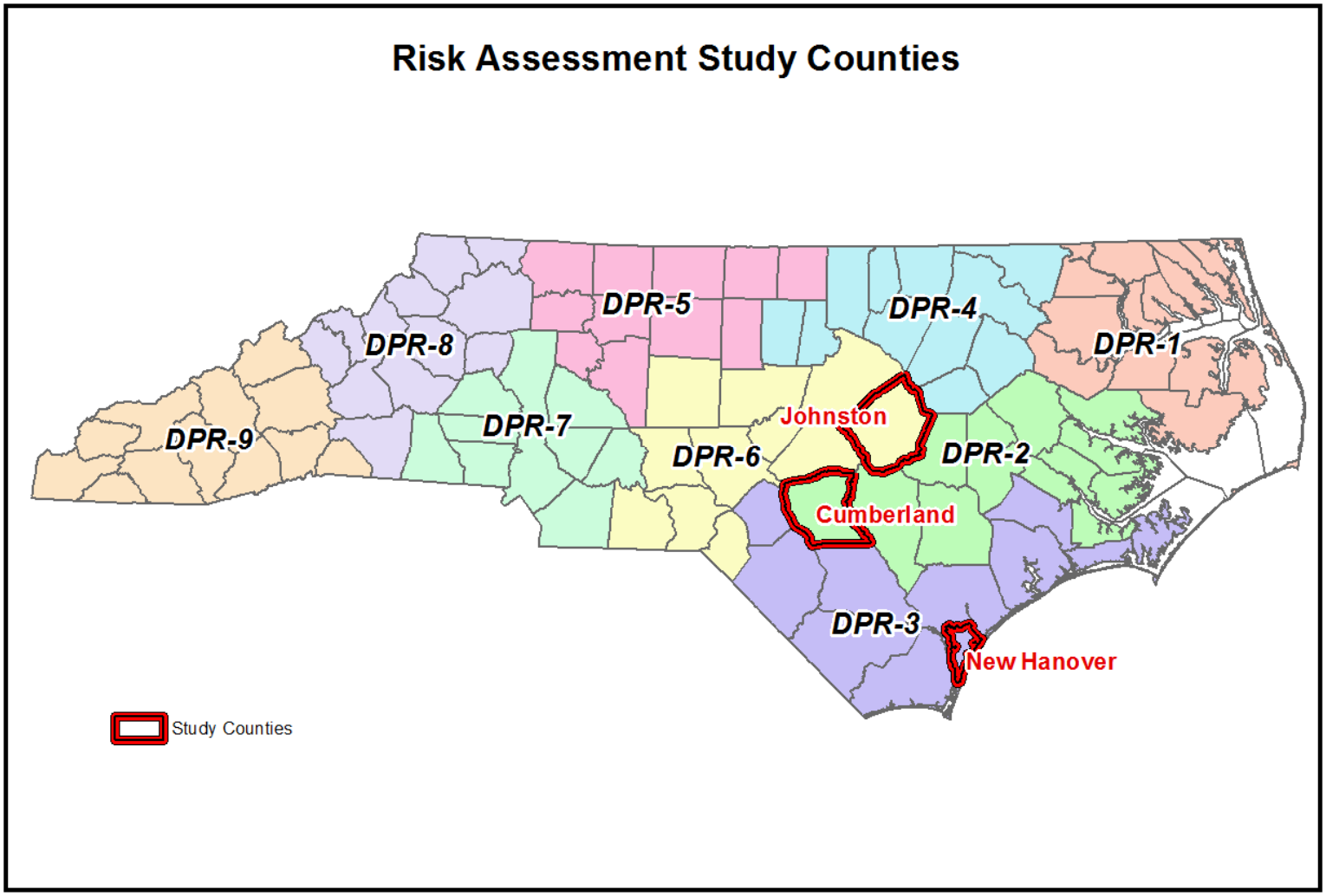
County Profile Maps



Next Phase – Risk Assessment

- NCDPS contracted with IEM in 2013 to conduct a statewide HazMat risk assessment for selected counties.
- Formal risk assessments in major metro areas
- Review hazard mitigation options with local officials
- 2011 Pilot in Wake County (Raleigh area)
- The following background slides describe some of the tasks conducted in Phase 1 for three counties: Cumberland, Johnston, and New Hanover

Study Areas


Risk Assessment Study Counties
DPR-5
DPR-4
DPR-8
DPR-1
Johnston
DPR-9
DPR-7
DPR-6
DPR-2
Cumberland
DPR-3
New Hanover
Study Counties

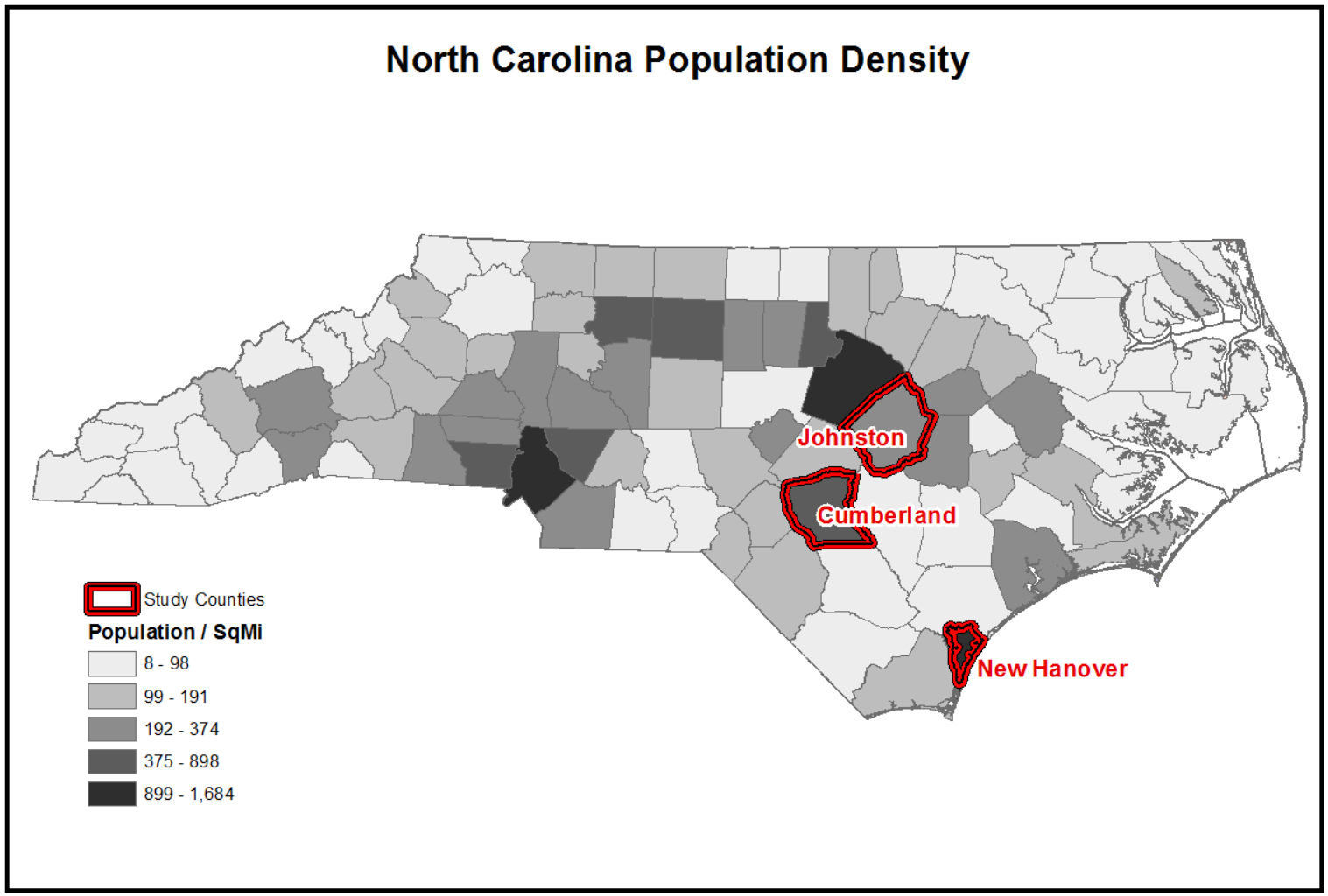
Risk Assessment Objectives

My Capstone Objectives in the context of this study are as follows:

- Examine potential impact of spills on:
  - Populations
  - Critical facilities
- Suggest alternate routes using Network Analyst
  - Use protective action buffers

The following slides describe methods I will use to achieve the Capstone objectives.

Population Density



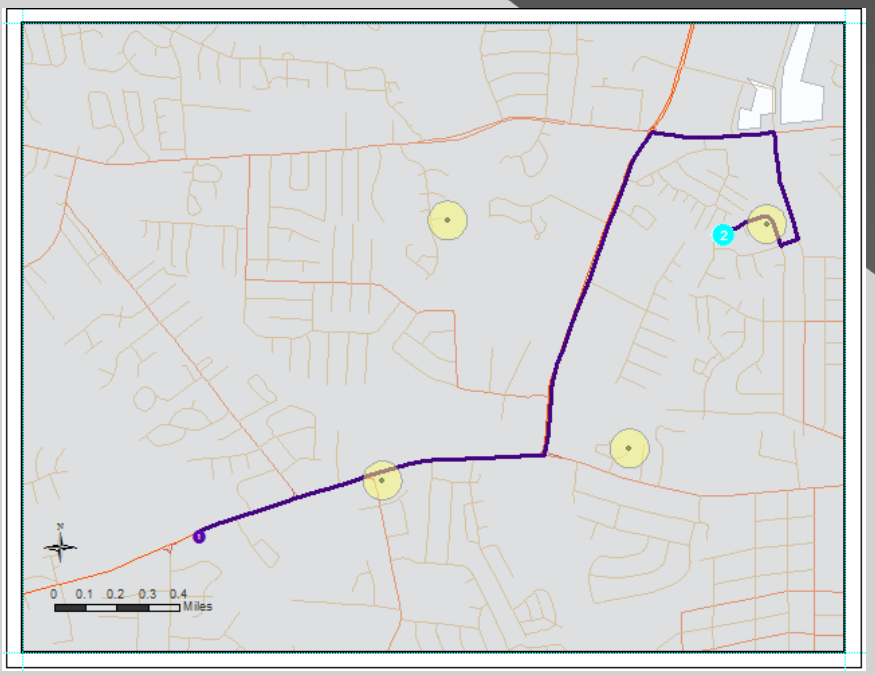
Population at Risk
(Capstone Activity Only)

Step #	Description
1	Buffer each HazMat transport route segment using the appropriate protective action distance for the chemical of concern.
2	Overlay the buffers with the census blocks.
3	Intersect buffers with census blocks.
4	Calculate the proportionate population in the intersecting portions of the census blocks.
5	Add up the population values for all affected blocks within the buffer zone for each road or rail segment.
6	Assign these combined population values to the road/rail segments.

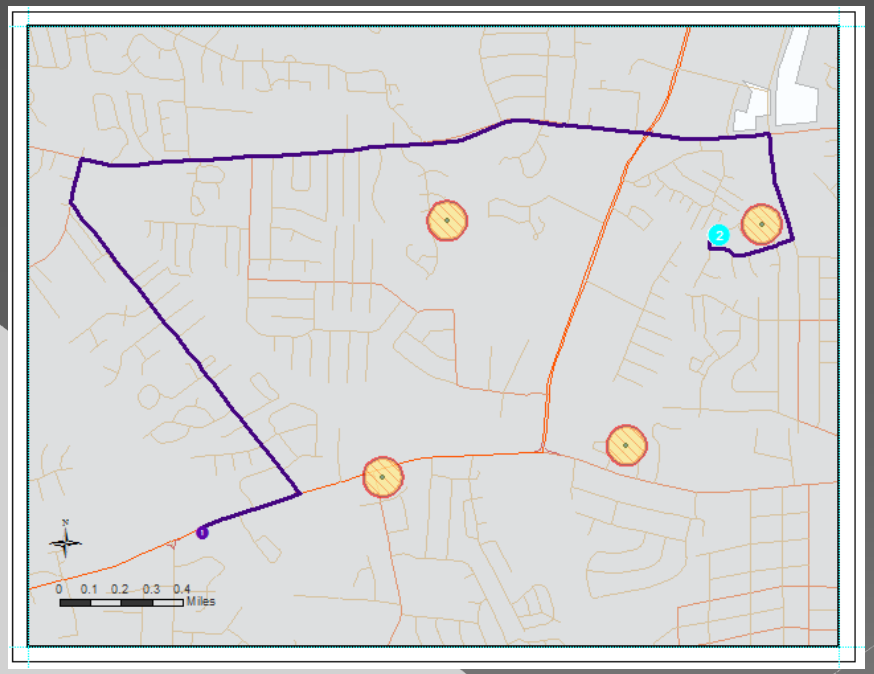
Critical Facilities at Risk
(Capstone Activity Only)

- Plot critical facilities on map
- Overlay transportation corridor buffer zones
- Tally number of facilities that fall within each buffer
- Use facility buffers in network analysis

Route Optimization
(Capstone Activity Only)



Without optimization



With optimization

Anticipated Capstone Results

- Many current routes will not be optimal
- Maps with additional travel time vs. reduced exposure potential
- Potential exposure numbers by city, county, and region
- Useful to LEPCs, responders, emergency planners, and zoning boards

Schedule

- Data collection: May 2014
- Analysis/Development: June-July 2014
- Submit Report: August 2014

Questions?