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A Study of Optimal Siting of Hazardous Materials Response Teams in the Commonwealth of Virginia

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Supplementary Notes

Abstract

This report describes an analysis of the optimal placement of hazardous material emergency response teams in the state of Virginia. The report describes a method for determining the optimal placement of response teams in Virginia. The three sites in Virginia that provide the most coverage of the state within a two hour response period are analyzed, and the optimal placement of teams at four sites is analyzed. The conclusion of the report is that four response teams, located throughout the state, can provide emergency response to every location in Virginia.

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A STUDY OF OPTIMAL SITING OF HAZARDOUS MATERIALS RESPONSE TEAMS IN THE COMMONWEALTH OF VIRGINIA

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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INTRODUCTION

In 1986 the Joint Secretarial Task Force on Hazardous Materials studied the Virginia program to prevent and abate hazardous materials incidents. The Committee on Emergency Response, which studied emergency response needs and capabilities in detail, recommended that "a statewide network of regional hazardous materials emergency response teams be established," and that the "response team geographical areas of responsibility be based on terrain, traffic, and other concerns as mutually agreed upon by the state and participating local jurisdictions."[1]

Specifically, the emergency response committee concluded that:

> The potential for hazardous materials accidents (accidents involving hazardous materials) is present in every local jurisdiction of the Commonwealth. The potential is greater in those areas with the largest amount of truck traffic on the highways, major rail facilities, and concentrations of industrial facilities--primarily the larger urban areas. However, in those areas where the potential is less, the consequences of an accident are no less severe and there must be capabilities to respond in these as well as in the areas with the greatest potential for hazardous materials accidents.
>
> Notwithstanding the need to have hazardous materials technical response teams (hazardous materials teams) available throughout the state, there is not a need for a team in every jurisdiction. Hazardous materials emergency technical response does not have to be as immediate as other emergency response as long as local first responders have the capability to do basic hazardous materials response while

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[1] Joint Secretarial Task Force on Hazardous Materials, Final Report of the Hazardous Materials Task Force, Richmond, Va.: November 1986, p. 10.

> technical response is on its way. This capability can be developed by training personnel in hazardous materials Levels I and II courses. Also, the costs of equipping, training and maintaining a hazardous materials team and the number of personnel involved are such that only the larger jurisdictions or groups of smaller jurisdictions can afford to have a hazardous materials team.[2]

Acting on the recommendation of the Task Force, the 1987 Virginia General Assembly passed the Virginia Hazardous Materials Emergency Response Program, amending Title 44 of the Code of Virginia.[3] The Act added Section 44-146.36 to the Code, authorizing the Coordinator of the Department of Emergency Services to enter into agreements with political subdivisions:

> The Coordinator may enter into agreements with political subdivisions to provide hazardous materials emergency response within a specific geographical area of the Commonwealth on a state and political subdivision cost-sharing basis. The cost-sharing agreements shall be negotiated with political subdivisions by the Coordinator.[4]

The law now requires the Department of Emergency Services to create a network of hazardous materials emergency response teams capable of responding to incidents anywhere in the state. The purpose of this study was to determine the optimal placement of those teams.

ASSUMPTIONS OF THE STUDY

An important assumption of the study was that local fire departments would be the primary responders to hazardous materials incidents. In fact the Code of Virginia outlines the responsibilities of localities to coordinate with state agencies in emergency situations. Section 27-15.1 vests the local fire chief with the authority to manage all emergency situations to which the fire department is called. When the department is answering an alarm, extinguishing a fire, and returning to the station, the chief is empowered to maintain order at the fire and its vicinity, direct the action of the firefighters, keep bystanders at a safe distance, and control traffic until the arrival of the police.

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[2] Id., p. 12.

[3] See Code of Virginia, 44-146.34-44-146.40.

[4] Code of Virginia, Sec. 44-146.36.

In 1984, the General Assembly amended Section 27.15.1 to expand the fire chiefs' authority in relation to hazardous materials incidents. The law was amended to read "...at an emergency incident where there is imminent danger or actual occurrence of fire or the uncontrolled release of hazardous materials which threatens life or property," the fire chief is in command. The chief's powers were also amended to include investigations into the origins and cause of the incident. By law the fire chief is clearly intended to be the man in charge at the hazardous material incident site.[5]

The Hazardous Materials Emergency Response Program and the Emergency Services and Disaster Law do not abridge the fire chiefs' authority. Indeed, the Emergency Services and Disaster Law specifically provides that "... nothing in this chapter is to be construed to...affect the jurisdication or responsibilities of fire-fighting forces...."[6]

The time required for the emergency response team to arrive on the scene is greater than the time required for the primary responders, the local fire department, to arrive. From a review of case studies of hazardous materials incidents in Virginia[7] and in other states,[8] it was concluded that the secondary response to incidents was not required until 120 minutes after the incident. One of the assumptions of this study is that a 120 minute response time for technical response teams is adequate.

Another important assumption of the study is that the response time of the teams is dependent on the condition of the highways travelled and the variable speeds that can be travelled on different classes of roads. This study assumed eight classes of roads in the Commonwealth, as described in Figure 1.

In addition, it was assumed that the speeds in Figure 2 could be sustained on particular classes of roads. These assumptions depend on the vehicle being driven at the posted speed limit and having the sirens and flashing lights normally on emergency vehicles.

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5 See, generally, Code of Virginia, Section 44-146.16.

6 Code of Virginia, 44-146.16(4).

7 Bowman, Hazardous Materials Regulation in Virginia, Charlottesville, Va.: February, 1987, p. 35-36.

8 National Fire Protection Association, Hazardous Materials Transportation Accidents, Boston, Ma.: 1978.

CLASSES OF ROADS USED IN METHODOLOGY

Class	Description
1	Any interstate road.
2	Any rural primary road or any primary road with little traffic control.
3	A suburban primary road, a primary road with some traffic control, or a primary road with many horizontal or vertical curves.
4	An urban primary road, a primary road with frequent traffic controls, or a steep primary road.
5	A paved, relatively flat, smooth, and straight secondary road.
6	A paved secondary road with either horizontal or vertical curves, or a rough secondary road.
7	An unpaved, relatively flat and straight secondary road.
8	An unpaved secondary road with either horizontal or vertical curves.

Figure 1

AVERAGE TRAVEL SPEED FOR DIFFERENT CLASSES OF ROADS (mph)

Class	Snow and Ice	Normal Conditions
1	55	55
2	45	55
3	40	50
4	40	45
5	40	45
6	30	35
7	30	35
8	25	35

Figure 2

The assumptions of this analysis are different from the assumptions used by the emergency response committee of the state task force in preparing their final report. The results of their analysis, reproduced as Figure 3, assume uniform road conditions and travel speeds over the road network. As a result, their analysis resulted in response contours characterized by a scalar radius from the site of the team headquarters.

METHODOLOGY

The model of siting maintenance area headquarters developed by David Wyant for the Virginia Department of Transportation [9] is ideally suited for the requirement of determining the optimal placement of response teams in the state.

Wyant's model analyzes travel time, given an assumed speed over the Virginia highway system, by Virginia Department of Transportation residency area. By selecting likely sites for hazardous materials team headquarters and adding the travel times through contiguous residencies, the travel times from various sites throughout the state were generated from the University of Virginia's CDC computer. Plotting the travel times on a map allowed the identification of isochronal (travel time) contours around site locations. The set of site locations that allowed the most geographical coverage within the 120 minute time constraint were deemed to be the optimal set of sites.

RESULTS

The original hypothesis tested in the study was that three sites would allow response teams coverage of the entire state. The three optimal sites in the state were Harrisonburg, Pulaski, and Colonial Heights. But it was determined that neither these three sites nor any other three would suffice to allow coverage of the entire state because

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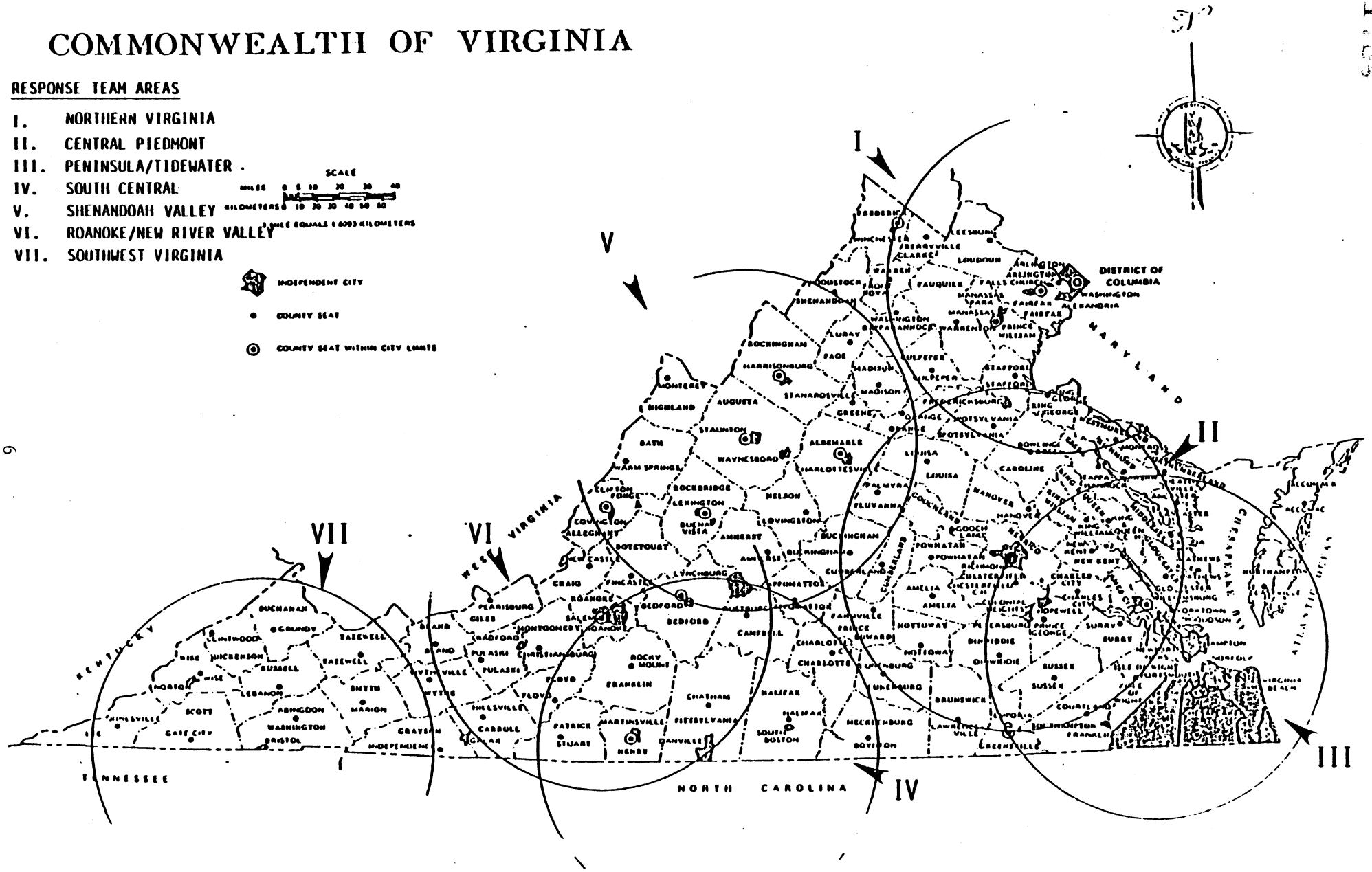
[9] Wyant, Methodology for the Placement of Maintenance Area Headquarters, Charlottesville, Va.: March 1984; Wyant, Methodology for the Placement of Maintenance Area Headquarters, Charlottesville, Va.: April 1985; Wyant, Refinement of the Methodology for Siting Maintenance Area Headquarters, Charlottesville, Va.: May 1985; Wyant, Refinement of a Methodology for Siting Maintenance Area Headquarters, Charlottesville, Va.: June 1986.



PROPOSED GENERAL GEOGRAPHICAL AREAS FOR REGIONAL RESPONSE TEAMS

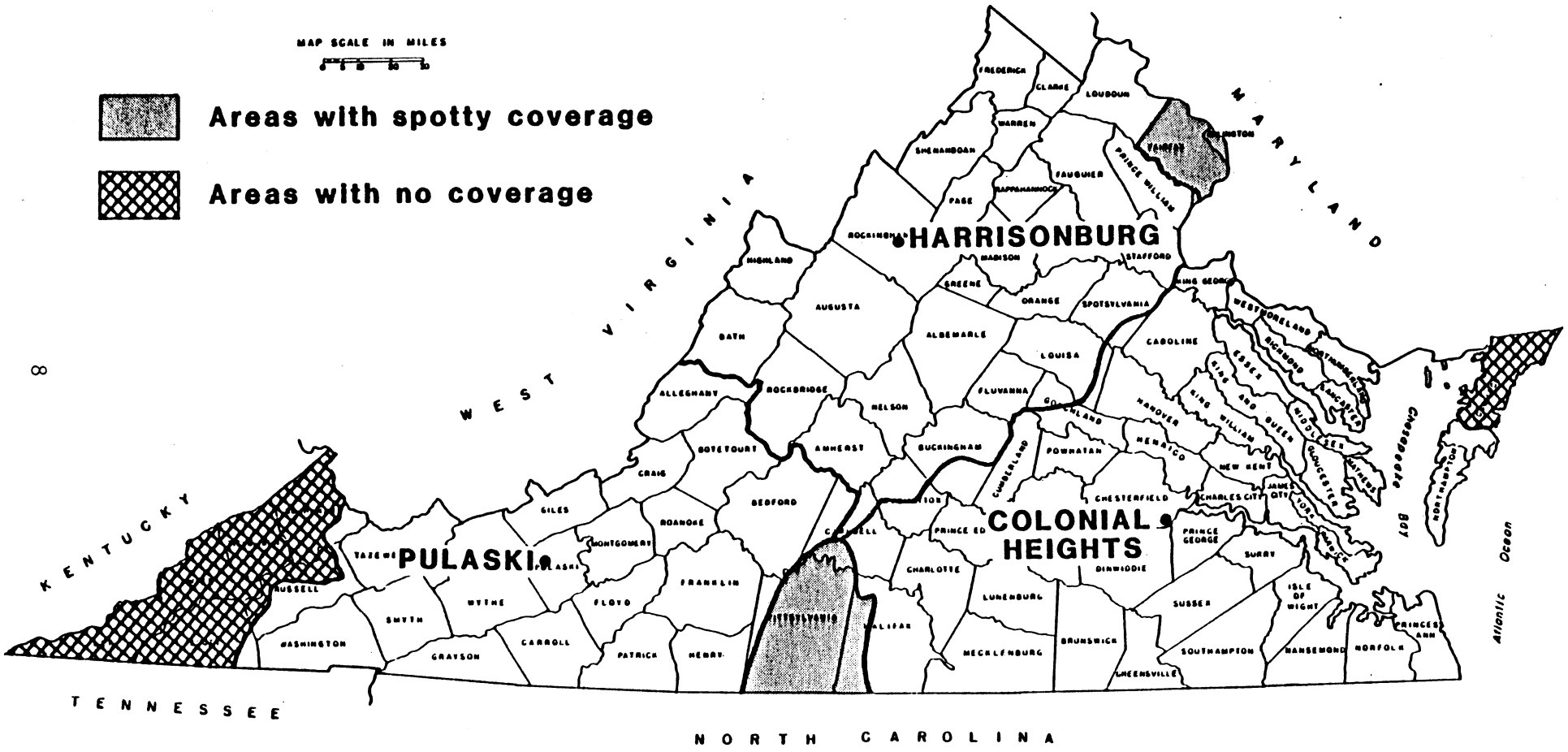
Figure 3.

pockets of the state were left uncovered in Pittsylvania County, southwest Virginia, Fairfax County, and the Eastern Shore. This is illustrated by the isochronal contour map of the state in Figure 4.

Once the three-location hypothesis was disproven, the analysis was repeated to test the amount of coverage available from four locations in the state. There are many sets of four sites in Virginia from which the 120-minute-response criteria can be satisfied. The set of sites illustrated in Figure 5 is an illustration of one such set.

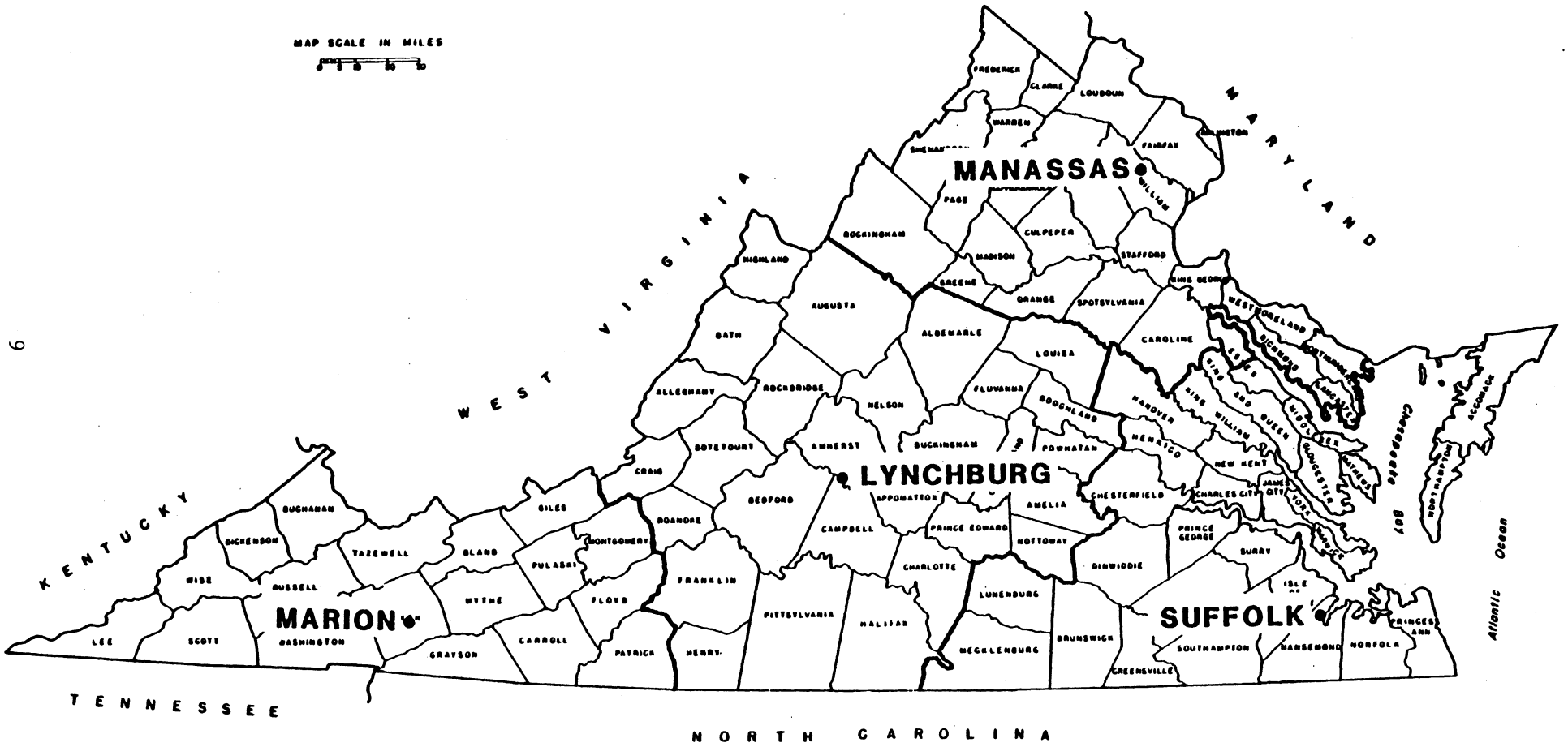
CONCLUSIONS

Legislative action by the General Assembly requires that a network of hazardous material emergency response teams be set up in Virginia. Four teams, sited at optimal locations throughout the state, can provide coverage of all points at which hazardous materials incidents might occur. The placement of the teams using the model described in this study would allow the siting of teams based on the characteristics of the road system; the speed limits on the road network; and the locating of teams to provide quicker response to areas in which hazardous materials incidents are most likely, while providing acceptable coverage to all areas of the state.



OPTIMAL PLACEMENT OF THREE RESPONSE TEAMS

Figure 4.



OPTIMAL PLACEMENT OF FOUR RESPONSE TEAMS

Figure 5.