TABLE OF CONTENTS

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Wake County Public Safety Director John Rukavina and Fire Marshal Ray Echevarria guided the project for the county, and participated in many exchanges of ideas.

Though we received outstanding cooperation, the findings and conclusions are those of the TriData project staff. The main contributors on the project team were —

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EXECUTIVE SUMMARY

Wake County selected TriData Corporation of Arlington, Virginia, to perform an independent assessment of fire and EMS station locations and apparatus requirements out to a planning horizon of 2018. TriData had undertaken two previous comprehensive studies for Wake County—one of the EMS system in 1999 and one for the fire system in 1994.

The study presents criteria and models for making decisions about station locations, and makes a set of specific recommendations for deployments from the present to 2018. The study can be used as a benchmark or starting point for making long-term capital plan decisions. Alternative deployments might be compared with the set presented here. Staffing will be addressed in a separate paper.

OVERVIEW

Methodology – The study was based on information gained during interviews with fire and EMS leaders in Wake County, Wake County staff, first-hand observations, and analysis of the available data. A series of working drafts were used to sharpen the analyses.

The study started with projections of population and the resultant demand for emergency service by traffic analysis zone (TAZ), a level of detail beyond that usually used for such deployment studies. The resulting workloads were compared with the capacity of the fire and EMS units.

The study then addressed service goals for EMS and fire services in terms of response times in urban, suburban, and rural areas, by TAZ. The heart of the study was evaluating various station location scenarios to reduce current service shortfalls in various areas of the county. The evaluation of alternatives was both in terms of the percent of current calls not within desired response times and the percent of road miles not within reach of the desired response times. Geographic Information System (GIS) software was a major analytic tool. The analysis of the reach from various stations was repeated for two milestone years the county has been using for other planning purposes—2010 and 2018 (15 years out). The apparatus fleet was also reviewed.

We proposed a capital improvement plan for stations and apparatus based on the recommended scenarios for changing station locations.

Findings – We recommended relocating four stations and constructing eight new stations over the next decade to improve the ability to meet the Wake County service standards, particularly in growth areas. We also identified seven fire service areas that could be

served as well or better by resources from nearby fire stations if their small service areas can be contracted out. For these seven stations, we outlined a detailed closure process.

The closures of the seven stations are predicated on the county contracting with the nearby fire departments (or their municipalities) to provide coverage for the calls now being handled by those seven stations. In each case the volume of calls that would be assumed by the new fire service providers would increase their existing workloads very little—one call per day to one call per three days. The alternate stations have relatively low workloads and the capacity for delivery of additional emergency service. In exchange for reimbursement for use of this service capacity, which could be provided at a cost lower than current cost to the county, these departments would assume this incremental workload. They would meet (or exceed) the County's service delivery standards.

Overall, the county fire and EMS system has the capacity to absorb more calls than it is currently handling without adding new resources. There are no units that are overloaded by national standards, benchmarks, and good practices. This includes stations in Raleigh and Cary. However, increases in workloads are expected over time. At some point willingness of volunteers to participate will be affected, and that must be taken into account in the County's fire service planning process. A forthcoming comparison study dealing with staffing will address these issues further.

As part of the above changes, a portion of the apparatus fleet would be re-deployed. The frontline fleet does not need to be increased. Some units should be saved as spares as they are retired from frontline duty.

POPULATION GROWTH AND DEMAND

Total emergency service demand (the number of emergency calls) is a function of two factors: the size of the population serviced and the per capita demand. Both population and per capita demand have been increasing.

County and State planning sources project the county population to be 850,000–874,000 in 2010 and 1,029,000–1,072,000 by 2018. The population density will increase in many areas, changing some TAZs from suburban to urban, and some from rural to suburban The change in population density classification will in turn change the service level goals.

Even under the high demand forecast, none of the existing stations or units and none of those proposed to be added would be overloaded by 2018. The implication is that it is more likely that new stations and units will, for the most part only have to be added primarily to meet County response time goals rather than keeping up with added workload.

RESPONSE TIMES AND SERVICE-LEVEL GOALS

Response times include three components: call processing and dispatch time (measured from receipt of call to dispatch), turnout time (measured from paging a station to the time wheels are rolling), and drive time (measured from the station to the scene of the incident).

Wake County's Fire Commission Service Level Committee set service goals in terms of the 90th percentile levels for response times to fire calls. Wake County's franchise agreement with EMS agencies also sets service goals in terms of the 90th percentile level for response times to EMS calls. The standards were set in terms of the "field element," which is turnout time plus drive time. Separate goals were set for urban, suburban, and rural areas. (Urban, suburban, and rural are defined by population density and whether within a city.) The 90th percentile goals for the field element are, respectively, 5 minutes, 7 minutes, and 9 minutes for the first-in units. To that one must add at least a minute for call processing time to get total response time. The study analyses were based on the extent to which the current system and various alternative deployments would meet these goals.

Call Processing – The current call processing times are over two minutes at the 90th percentile, well over NFPA and emergency medical dispatch standards for call-processing time. While a study of the communication center was not directly within the scope of this study, we found that ~~a~~ significant changes in approach will be needed for the Raleigh/Wake Communications Center to get units dispatched within one minute for 90 percent of emergency calls, versus the 2–3 minutes it presently often takes. Improving call-processing time is the single most cost effective way to improve overall response times by 1–2 minutes. Dispatching a unit as soon as it appears to be needed, while the caller is still on the line, is usually the best way to reduce the dispatch time. The new CAD, installed in October 2003, and addition of Locution (technology designed to help reduce call-processing time) to the RWCC in early 2004 should help, but changes in dispatch protocol are also needed.

Turnout – Though harder to change, improved turnout times are needed even more than improved call processing times because current turnout times are most often several minutes in length vs. the desired one-minute turnout time target for 90 percent of emergencies. Wake County has a classic volunteer system with volunteers responding from home, most often driving their personal vehicles to the station to get apparatus, and then driving the apparatus to the scene of the emergency. That adds the volunteer's personal turnout and drive time to the time needed to get the apparatus out the station door. Because it may improve volunteer recruiting and retention and would definitely make a significant improvement in the quality of service, we strongly recommend that

"duty shifts" (like, for example, those utilized by the Fuquay-Varina Fire Department) be instituted for volunteers in all fire departments and EMS/rescue squads that rely on volunteers. This would limit the time a cadre of volunteers must devote to standing by for calls and provide a faster response. A four-person shift made up of "duty shift" volunteers, or a combination of career staff and duty-shift volunteers in each fire station and a two-person shift in each EMS station would greatly improve the probability that a fire or EMS unit would be on the road within one minute of dispatch for 90 percent of emergency calls. It is critical that such volunteer "duty shift" staffing be reliable in a manner comparable to career employee staffing so that turnout and response-time goals can in turn be reliably met.

Full-Response – Besides the first-in unit, there are goals for arrival of a ladder truck and for the full complement of three engines and a ladder for a structure fire. (The number of units assigned for response is as much for delivery of the firefighters anticipated by the nature of the fire as it is for delivery of the resource support that the apparatus brings) The ladder company goals are 8, 10, and 12 minutes for urban, suburban, and rural areas, respectively. With the addition of two new aerial units to the present nine, the goal should be achievable if turnout times can be improved. The goals for the full first alarm response can be met if one engine with four-person staffing (as described above) is ready to go from each of the 39 station locations.

Goal Compliance – As of October 2003, none of the fire departments is meeting the urban service level goals, and only four are meeting suburban goals. Most (all but four) meet rural goals. Those service level goals will be extremely difficult and expensive to meet if dispatch and turnout time are not improved. The drive-time portion of the goals can be improved by better station locations—but not enough to offset the currently high dispatch and turnout times without the prohibitive expense of adding many more new stations.

STATION LOCATIONS

We examined a variety of fire and EMS station location scenarios to improve the percent of the road miles that could be reached within the service goal targets and percent of actual calls in 2002. We considered impacts of expected growth and planned changes in major roads. The analysis of each scenario was undertaken using Geographic Information System (GIS) software.

THE RECOMMENDED SET OF FIRE STATION CHANGES AND SUGGESTED YEAR OF IMPLEMENTATION ARE SHOWN IN

Table 37 below. The stations recommended for closure analysis are so recommended for reasons of efficiency. The recommended relocations and new stations are mainly to improve response times. The timing of relocations and new-station construction has some

flexibility as does the order of implementation because, for purposes of fire response, growth is expected to be gradual and widely spread across the entire geographic area of Wake County.

The good news is that by re-deploying apparatus and personnel from existing stations, the total number of front-line apparatus and personnel do not need to change, even 10 years out. Of course that requires the cooperation of all the fire and EMS departments and personnel in working toward a more efficient and effective seamless system in which planning stations and purchasing, replacing and deploying apparatus are done on a countywide basis. The incorporated towns and cities must cooperate, too, entering into fair agreements on cost-sharing of resources where appropriate.

TABLE 1: RECOMMENDED IMPLEMENTATION TIMETABLE FOR COUNTYWIDE STATION IMPROVEMENTS

Recommendation	Implementation Timeframe	Consideration	Type of Action
Relocate HSDPS Station 2 to 10200 block of Holly Springs Road	Complete relocation by end of FY 2004	Construction of HSDPS Station 2 is underway. This relocation will occur upon completion of the station sometime in 2004.	Relocation
Initiate closure process for Falls Station 1	Begin detailed closure analysis and transition process in FY 2005	Replace fire service from Falls Station 1 with fire service from City of Raleigh. Initiate contract negotiations with City of Raleigh.	Station closure; replace service by contract.
Initiate closure process for WWFD Station 1	Begin detailed closure analysis and transition process in FY 2005	Replace fire service from WWFD Station 1 with fire service from City of Raleigh. Initiate contract negotiations with City of Raleigh.	Station closure; replace service by contract.
Initiate closure process for WWFD Station 2	Begin detailed closure analysis and transition process in FY 2005	Replace fire service from WWFD Station 2 with fire service from Town of Cary. Initiate contract negotiations with Town of Cary.	Station closure; replace service by contract.
Initiate closure process for W-NHFD Station 1	Begin detailed closure analysis and transition process in FY 2005	Replace fire service from WNHFD Station 1 with fire service from City of Raleigh. Initiate contract negotiations with City of Raleigh.	Station closure; replace service by contract.
Initiate closure process for EWFD Station 2	Begin detailed closure analysis and transition process in FY 2005	Replace fire service from EWFD Station 2 with fire service from Town of Knightdale. Initiate contract negotiations with Town of Knightdale.	Station closure; replace service by contract.
Initiate closure process for Bayleaf Station 3 (as a fire station)	Begin detailed closure analysis and transition process in FY 2005	Its service areas are donut holes within Raleigh. Replace with fire service contracted with City of Raleigh. (We recom-mend continuing to use the station as an EMS station.)	Station-use change: replace fire service by contract; use for EMS.
Initiate closure process for MFD Station 3 when CFD	Begin detailed closure analysis and transition	Replace fire service from MFD Station 3 with fire service from Town of Cary. Initiate contract	Station closure; replace service by contract.

Recommendation	Implementation Timeframe	Consideration	Type of Action
Station 7 open next door.	process in FY 2005	negotiations with Town of Cary.	
Build a new KDPS station near 2128 Mingo Bluff Boulevard in Knightdale	Begin design work in FY 2005; open new station by end of FY 2006.	Needed to meet current service deficiency in the west of Knightdale.	New Station
Relocate KDPS to a new station at Laurens Way and McKnight Drive	Begin design work in FY 2005, open new station by end of FY 2006.	The KDPS station is inadequate for use as a fire station. Construction of a new station in Knightdale should begin as soon as possible so the relocation can occur.	Relocation
Build a new Garner station at Greenfield Parkway and "Unnamed Road" (near Route 70) in Garner	Begin design work in FY 2005; open new station by end of FY 2006.	Needed to meet current service deficiency in the east of Garner.	New Station
Build a new AFD station at Kelly Road and Olive Chapel Road	Begin design work in FY 2005; open new station by end of FY 2006	Needed to meet current and short-term future service deficiency in the west of Apex.	New Station
Build a new fire station at Main Street and Harris Road in Wake Forest	Begin design work in FY 2006; open new station by end of FY 2007	Needed to meet current and short-term future service deficiency in the north of Wake Forest.	New Station
Build a new fire station with co-located EMS station at Durant Road and Koupela Road	Begin design work in FY 2005; open new station be end of FY 2006	Needed to provide a permanent home for relocated EMS 15, when demand warrants a changing the unit from peak-load to full-time status.	New Station
Relocate Garner Station 1 to Benson Road and Route 70	Begin design work in FY 2007; open new station be end of FY 2008	A current service deficiency in the center of Garner argues for moving Garner Station 1 sooner rather than later. Construction starting in 2008 would ensure that the station was operating before 2010, when the downtown service gap will be evident.	Relocation
Build a new fire station at Thomson Mill Road and Elmo Road	Begin design work in FY 2008; open new station by end of FY 2009	Needed to meet a future service deficiency in the west of Wake Forest.	New Station
Hilltop Needmore Road and Sunset Lake Road	Begin design work in FY 2009; open new station by end of FY 2010	Needed to meet current and future service deficiency in the north of Fuquay-Varina.	New Station
Relocate AFD Station 1 to East Williams Street and Lufkin Road	Begin design work in FY 2009; open new station by end of 2010.	The Apex Fire Department is contractually obligated to keep AFD Station 1 open for another seven years. The Department should explore whether this provision of the contract could be waived by mutual agreement to allow the relocation to occur in a more	Relocation

Recommendation	Implementation Timeframe	Consideration	Type of Action
		reasonable timeframe.	
Build new EWFD Station 2 in the 3200 block of Smithfield Road	Begin design work in FY 2009; open new station be end of FY 2010	Needed to meet future service demand in this area.	New Station

EMS DEPLOYMENT

The EMS units are operated under a countywide system that serves both the incorporated and unincorporated areas of the county. This EMS system is closer to a seamless, countywide system than is the current fire service system.

The recommendations for EMS include "unclustering" of the EMS units, spreading them out across more locations to obtain better response times, and establishing reliable staffing as an EMS system benchmark. The scenario for improving response times would include the following actions:

- Relocate Cary EMS from its central station to Swift Creek Fire Station 1.
- Relocate EMS 6 to Raleigh Fire Station 23.
- Relocate EMS 15 to the projected new EMS/fire station on Durant Road and Koupela Road or to a new medical care facility proposed for that area by WakeMed.
- Move EMS 12 to be co-located with fire units at Stony Hill Station 1.
- Relocate Wendell EMS to be co-located with Wendell Fire Station 2.
- Relocate one of the three staffed units from the Garner EMS headquarters station to Garner Fire Station 2, and a second unit to a new fire station at Benson Road and Route 70.
- Relocate a second-duty EMS unit with low utilization to the Wake EMS Station5/Wake-New Hope Fire Station 1 area, where calls for service have expanded dramatically over the past three years.
- Close EMS Station 1 and relocate its three units relocated to
  - A new station in the 400 block of Peace Street
  - Raleigh Station 2
  - The former Wake-New Hope Station 1
- Consider relocating Knightdale and Zebulon second duty units to other stations where the most first-due calls are missed (when data is available to do the analysis).

Rural Water Supply Deployment – There are currently about 80 rural water supply units (tankers and tanker/pumpers) deployed across the county. Most fire stations currently house at least one (and sometimes two or more) rural water supply unit(s).

We recommend basing rural water supply units in 34 stations. If the recommended station closures proceed, at least five water supply units can be reassigned from those stations to stations that do not have a rural water supply unit and are in an area that would benefit from one. The redistribution proposed would send one water supply unit to each of the following locations:

- New Apex station at Kelly Road and Olive Chapel Road
- New Fuquay-Varina station on Hilltop Needmore Road
- New Garner station at Greenfield Parkway and "Unnamed Road"
- New Knightdale DPS station on Mingo Bluff Boulevard
- Planned Raleigh Station 30 at Buffalo Road and I-540 (once it is completed)

If the recommended station closures do not proceed, new water supply units will need to be purchased for these five locations.

FIRE APPARATUS

The optimum system of fire apparatus from a cost-effectiveness perspective would be one front-line engine staffed with four people at each of 39 stations (excluding Raleigh and Cary), 11 stations each with one aerial, and 34 stations with at least one tanker or tanker/pumper.

However, the ability to use this optimum deployment plan depends on achieving call-processing performance of one minute or less 90 percent of the time, and firefighter turnout time performance of one minute or less 90 percent of the time. Until those benchmarks are met, most of the current apparatus fleet, with some redeployments and build-up of a pool of spares, will be required to meet needs. Most stations now have more than one front-line fire truck that can pump water, with the second truck (if not the first) often being a pumper/tanker that can serve a dual role. We recommend that this arrangement continue until there is high reliability in consistent call processing and turnout times that meet national benchmark standards, and the data to prove the reliability of adequate responses from supporting stations.

Spares – There have been few fire trucks specifically identified in Wake County's fire service area as "spare" apparatus, that is, standing by for use in case the front line trucks are out for maintenance, and available for use in the event of major emergency. We recommend that, as units near the end of their front line assignment period, they be considered for assignment to a new, official contingent of spares for use as backups by all

of Wake County's fire services. This contingent of spares should equal at least 25 percent of the number of front line apparatus, which would meet long-standing, proven NFPA standards.

Specifications – The ambulance fleet seems to be headed in the right direction, with movement toward a sound, cost-effective replacement policy and the use of medium-duty chassis. We recommend collecting data to compute the cost per mile of the latest generation of ambulances, and compare them with the costs per mile of new, heavier duty chassis; other comparable jurisdictions have found the heavy-duty chassis to be most cost-effective (though that may or may not prove to be the case for the county).

We recommend that, in consultation with fire and EMS leaders, the county develop standard specifications and service-life standards for purchase and replacement of all fire and EMS apparatus on a countywide basis to be more cost-effective than the current practice of one-unit-at-a-time replacements. The specifications should be performance-based. (Suggested minimum specifications are provided in the text.) This will increase flexibility of acquiring, using and replacing vehicles countywide, and in maintaining a reliable and consistent spare vehicle fleet.

We recommend that the county purchase standard fire vehicles with commercial chassis (vs. custom units) for engines, tankers, heavy-rescues and hazmat units. Ladder units or quints should be custom ordered. Quints—a combination of an engine and a ladder—should be considered to replace pure ladder units to provide more flexible use with the same staffing.

We recommend that the County use its recent "lease-purchase" of ambulances as a model for procurement and assignment of fire and EMS vehicles in the future. The county would purchase all the apparatus in groups and lease them back to individual departments, appropriating the "lease payment" funds to fire and EMS departments that do not have reserves available for contribution to an apparatus-replacement program, and then banking the "lease payments" in a multi-year capital improvement fund for replacement of the vehicles at the end of their useful service lives.

We recommend development of countywide fire vehicle maintenance standards, similar to those developed for the ambulance "lease-purchase" program initiated last year. In particular, preventive maintenance should be standardized. The lease-purchase agreement can be a mechanism for achieving maintenance standardization.

Individual vehicles should be evaluated as to their need for replacement. For example, fire pumpers generally can be expected to have a life of about 12 years, with an additional three years or more as a spare, but in practice, the useful life can vary up or

down by a year or two. Examples of criteria for making the vehicle-by-vehicle decision are included in the text.

The County should ensure that the apparatus replacement program is part of the capital improvement program, and is supported by adequate funding.

COST ALLOCATION MODELS

Two general classes of cost allocation methodology were considered. The first is for contracting out service to an existing municipal station to serve an unincorporated area. The second is for cost sharing of jointly constructed or operated stations.

Regarding the first situation: when a municipality is asked to provide a service beyond its borders to unincorporated areas, at the minimum its incremental cost should be met. The ultimate formula should result in reduced costs for the service currently provided by the county, and also benefit the provider jurisdiction with some revenues for use of its spare capacity. Examples of how to compute incremental costs are included in the text.

There are several formulas for allocating costs for a station that serves two jurisdictions. The allocation can be based on the number of calls in each jurisdiction and such factors as the value protected, the population protected, or both. The county should provide any special resources such as water tankers that are needed for calls in the county but not in the municipalities. Some specific alternative formulas are given in the text. Cost of apparatus and personnel can be shared as well as the cost of the station.

DATA PROBLEMS

This study was hindered by a lack of adequate data both in terms of comprehensiveness and level of detail. We make recommendations throughout the report on data that are needed. The new CAD will significantly improve data on response times and types of calls. Another need is for the costs of maintenance of each fire and EMS vehicle, so that decisions can be made about each vehicle's useful life. These data are also required for the fire and EMS fleets to evaluate the cost effectiveness of various types of vehicles. Without that data, cost to operate per mile cannot be computed.

Another major gap is data on the number of volunteer firefighters responding on each vehicle and the response times for each call—especially turnout time. This is needed to determine the number of firefighters who arrive at the scene within the response time benchmarks proposed by the service level committee. Collection methods for this data should be developed and implemented on a countywide basis as soon as possible.

AS A FINAL WORD …

The ICMA and the IAFC note that the purpose of their new fire department accreditation system is to "assist [local fire departments] in becoming goal-oriented, forward-looking, well-organized, and properly equipped and trained, and provide a methodology for continually evaluating and improving services." The TriData study was intended to help meet similar goals.

Wake County Fire and EMS are fortunate to have leaders that are asking the right questions, even when some of the answers are painful to hear or are beyond the state of the art to answer. TriData has worked with approximately a hundred local governments across the nation, many of which operate similar combination county departments. Wake County leadership is on the leading edge, particularly in regard to nearest-unit, "boundary-less" response. It is our hope that this report will stimulate further thinking, and assist in moving fire and EMS systems that have proved their effectiveness toward a more highly integrated, more effective and efficient level of service in the future.

I. INTRODUCTION

For the past ten years, Wake County has experienced explosive growth both in population and in commercial and residential development to accommodate that population. This has led to a significant increase in demand for fire and emergency medical services (EMS) in the County. This growth, coupled with acknowledged problems of an aging set of fire and EMS stations across the county, creates the need for development of a comprehensive long-range capital plan and deployment plan for Wake County's fire and EMS services[1].

The County hired a consultant, TriData, a division of System Planning Corporation of Arlington, Virginia, to prepare an analysis of where fire and EMS stations should be located in the near- and long- term defined respectively as from now to seven years in the future (FY2010), and from eight to 15 years in the future (FY2018). The scope of work also entailed examining the staffing and apparatus deployment at the various stations. This is critically important because one cannot simply consider location of stations when assessing the ability of an emergency response system to deliver service at desired levels.

TriData has undertaken two previous studies for Wake County, a 1994 report on the organization and deployment of fire services in the county and a 1999 report on the organization and deployment of EMS. Both of these earlier reports concerned the overall approach to delivery of service and contained recommendations that focused on core operational philosophies and strategic direction. This latest study (2003) assesses whether resources were adequately deployed to meet mission requirements.

System History

To understand the current Wake County fire and EMS system one must first understand its roots. The Wake County system reflects service delivery methods and philosophies that were appropriate when the county could be described as mostly rural with one large urban center (Raleigh) and several small towns.

At that time, ambulance services were run out of funeral homes (when they existed) and fire suppression was performed by volunteer firemen[2] who responded from work or from home when called. The only paid firemen were in the City of Raleigh. Fire departments' call volumes were low, and employers generally did not mind when someone left work or was late because they knew that the only form of fire protection depended on neighbors assisting each other. Fire stations were generally located in towns because that is where most of the volunteers lived, and where most of the structures to be protected were

[1] Stations were not evaluated in this study from an engineering point of view, but we did observe their condition and heard from many firefighters about the problems with the structures.
[2] At the time, firefighting was an exclusively male domain.

located. Many volunteers lived in or near the towns, and could therefore respond quickly. Fire departments were supported by local fire tax revenues and to some extent community fundraising. Accordingly, the areas with the highest tax rolls had the best equipment and the ability to build more and better fire stations. Many fire departments were (and remain) territorial because more territory generally meant more funding and more activity.

Beginning in approximately 1970, efforts of the insurance industry (through the Insurance Services Office, or ISO) to reduce losses through a better organized system of fire suppression led to a system for rating public fire protection. One of the ISO standards was the five-mile response district; i.e., the ISO deemed insured properties within five miles of a fire station to be better protected that those more than five miles away. The ISO would rate fire departments based on a number of factors such dispatch facilities and processes; fire department locations, training, equipment, and staffing; and water supply. Insurance companies offered lower rates to property owners protected by better-rated fire departments.[3]

Most of the current fire station locations in Wake County were established as a result of the pressures on a fire department to maintain its territory and the need to cover most of the structures in its district within the ISO-recommended five miles of a fire station.

Beginning in the mid-1970s, EMS became recognized as the third essential public safety service. By the 1980s, public expectations for and utilization of EMS had grown to such an extent that it became necessary to build EMS stations and create EMS agencies in areas that had never had such services before. Over the ensuing years, EMS calls have quickly overtaken fire calls. TriData's 1994 study recommended requiring all fire departments to participate in the delivery of medical first response services to improve EMS response time. That goal was achieved in June 2000.

As the incorporated cities and towns of Wake County have grown through annexation and development, there has been a corresponding need for new fire and EMS stations in some areas that have before not needed protection and some areas once protected by volunteer departments are now being protected by growing municipal departments. This has led to a decreased call volume for many departments, a trend noted in the 1994

[3] The ISO Public Protection Classification (PPC) system ranges from "10" (does not meet ISO minimum standards) to "1" (meets strictest ISO standards, the best possible grade). As of the first TriData report in 1994, most fire departments in Wake County had a PPC rating of "6/9S" (meaning that the departments provided Class 6 in areas within 1,000 feet of a permanent water supply and Class 9 elsewhere; the "S" stands for "meeting North Carolina standards). In North Carolina, 38 percent of all fire districts have an ISO PPC rating of "9." For reference, out of more than 45,000 rated fire districts in the United States, only 42 have attained an ISO PPC rating of "1," including only one department in North Carolina. (Source: ISO website)

TriData report that has continued to the extent that some departments have merged with other departments.

The current fire system is rooted in past service delivery methods and tailored to local preferences. Individual fire departments have staked out territories that define what apparatus is dispatched, what procedures are used, and who is in charge. The lines between these fire districts have been viewed as absolute. A more distant fire department will often be dispatched to an emergency even though another department is closer, simply because the incident occurred in the fire district of the more distant department. This parochial approach is antiquated and many fire service agencies have moved away from it nationally. In Wake County, it has led to a less-than-rational distribution of stations, equipment, and personnel. As noted in the 1994 TriData report, "Equipment and stations have been added without an overall plan to coordinate services among the fire departments, resulting in less-than-efficient station placement."[4] In an effort to coordinate fire service delivery, the Wake County Board of Commissioners (WCBC) has required that it approve all new fire station locations and major station renovations. It plans to use this report to guide the County in pursuing the coordination of services among departments and in developing a long-term capital improvement plan (CIP) for station locations, and a multi-year, on-going capital expenditure plan for fire apparatus. These are steps in the right direction; however, more can be done.

In contrast to the fire system, the EMS system in Wake County is virtually seamless. Most service is provided by a central County EMS Department. Several volunteer EMS corporations are contracted to provide service in their area, but are integrated into the County EMS system. The fire departments are often first responders to EMS calls and so the fire and EMS systems must be addressed and planned for together.

This report attempts to outline how the system of fire and life protection (EMS) should look in the future, from the standpoints of geographic location, and the equipment and the personnel distribution. Optimization of the system is dependent on eliminating the concept of "fire districts" (or EMS districts) and in its place adopting the concept of a "seamless" response system. Wake County's Model EMS System plan already incorporates provisions for "nearest unit" response. The plan was supported unanimously by Wake County EMS delivery agencies. To do the same for fire requires moving to a dispatch protocol in which fire units or stations too, are dispatched based on proximity to an incident, not which side of some arbitrary line the incident falls.

Fortunately, modern computer-assisted dispatch (CAD) systems are designed to operate using "closest unit dispatch" or "proximity-based dispatch" concepts. Wake County has acquired such a new CAD system for use in the Raleigh/Wake Communication Center

[4] TriData Corporation, "Comprehensive Review of Wake County Fire Protection," 1994, pp. 2-41.

(RWCC). This CAD system is being structured around nearest-unit response, regardless of political boundaries, in County service areas—a very important step forward. Also included in Wake County's CAD system design is capture and assembly of emergency-response data, which will greatly improve the information required to monitor fire and EMS event data in the future. It is expected to replace the current CAD system by the end of October 2003.

The analyses contained in this report are all based on proximity-based dispatch—sending the nearest unit. We did not use the term "closest *station* dispatch" because not all stations should be considered "staffed" 24/7. Also, the closest unit may not be in a station at the time a call comes in for service. Simply locating a station in a given place and positioning equipment in that station does not improve fire or life safety. The apparatus in a station must be able to leave that station in relatively short order; the standard is one minute or less for 90 percent of calls. This means that volunteers must live sufficiently close to unstaffed stations. In computing response times, we did not include stations where volunteers did not live sufficiently close to unstaffed stations to respond promptly.

Data Shortcomings

This study was based on the data that was available. While there were many data shortcomings, the "big picture" and trends were reasonably clear. The level of data problems that were identified does not significantly affect the recommendations. That said, fire and EMS data collection needs to be improved for better management, planning, and providing information to the public.

Despite a mandatory requirement for fire departments to submit incident reports, not every department is reporting all incidents, and not all are reporting them in sufficient detail. Even the most basic data such as how many calls a fire department responded to was incomplete. This leads to underestimating trends and hence needs for the future, so it is important to get right. The new CAD system will undoubtedly contribute toward improving the quality and completeness of the data. It would be highly desirable to get 100 percent reporting by all Wake County fire and EMS units, including in the towns, cities, and the County, on each call, including the number of units by type of unit, and the number of people on the responding unit. As in most communities, no one penalizes departments or individuals for not reporting. No one says you cannot continue to be a fire officer if you do not submit the required data. But as will be noted in various places throughout the report, better management decisions can be made if the comprehensiveness and quality of the data were improved. We give specific suggestions about data throughout the report.

***Recommendation** 1: **The completion and quality of fire and EMS data should be improved countywide, for each department**.* Having better data will allow for better management and better planning of fire and EMS services.

Organization of This Report

The next chapter, Chapter II "Population and Demand Projections," discusses the recent trends in fire and EMS demand, and projections of demand through 2018.

Chapter III deals with "Level of Service Targets," especially the response time targets for urban, suburban, and rural areas.

Chapter IV, Station Location, considers alternative fire and EMS station location scenarios for each of four quadrants of the County. The capital plan for stations is in Chapter VI.

Chapter V, Vehicle Issues, considers fire and EMS apparatus, including their specifications, procurement, maintenance, and replacement. A capital plan is included for this. Chapter IV addresses location and number of units, too.

Chapter VI provides an implementation timeline and capital improvement plan for fire and EMS station construction and renovations and apparatus replacement.

Chapter VII details cost allocation methodologies for contracting with municipal fire departments for the provision of fire suppression services.

Chapter VII is a listing of all the explicit recommendations in the report.

Appendix A provides information about each fire department, based on data received and interviews held with each department.

Appendix B has the annual data received on incidents per department that was used to make projections; the corrected version is in Chapter III.

Staffing needs will be addressed in a separate report. [This was an add-on task to the original study scope, and was done after the rest].

II. DEMAND AND POPULATION PROJECTIONS

Fire and EMS station location analysis is a planning effort that addresses both present and future configurations of response resources. The analysis is first concerned with whether the present station distribution is appropriate to meet current demands for service within established service level targets or performance goals. Second, the analysis addresses planning permanent and semi-permanent facilities in areas where there is little or no demand at present, which there will likely be demand in the future. This second piece is the harder of the two because it requires not only projecting where people will live and work, but also the overall demand for service.

To estimate demand, three types of information are required: population growth, geographic distribution of population, and per capita system usage. The County and State planning professionals routinely estimate current and future populations as well as trends in geographic distribution of population. They usually have the most reliable information on growth because they are involved in the reviews of plans for future development. The demand projections relied on those estimates. We also considered the knowledge of local emergency services professionals about the demand in the areas they protect.

In estimating overall call volume, the number of emergency calls can be computed as a function of the size of the population and the demand per capita (total calls = population x calls per capita). This projection is preferably done by fire district (or even smaller areas such as Traffic Analysis Zones or TAZs, which was used here).

Projections are estimates. The methodologies used in this report have been used in many prior fire service planning studies. (They will be described below.) While the forecasts cannot be viewed as exact predictions of how many people will live in a given part of the County or what their usage of the emergency services will be, they should produce a reasonably accurate picture for the purposes of planning station locations, apparatus, and staffing. Planning does not require knowing exact numbers and locations of new development; approximations usually suffice. Many communities have successfully based station locations on these methodologies (e.g., Arlington County, VA; Colorado Springs, CO; Jacksonville, FL to name a few). Nevertheless, planning such critical services should be periodically revisited based on updated projections, because growth patterns do not always follow predictions.

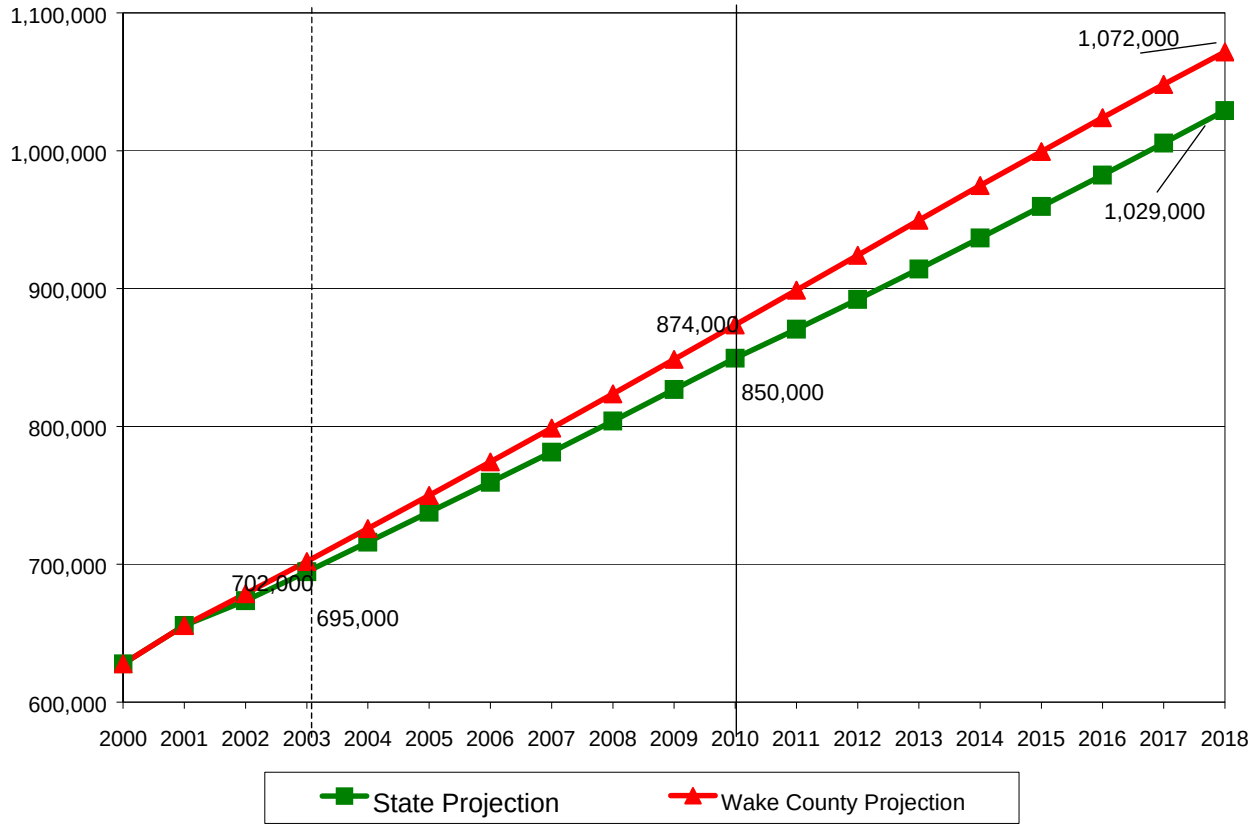
Recommendation 2: Update the demand projections annually, and compare them to unit workloads and planned station locations. This study can be used as a guide on the types of analyses to be done. The results should be incorporated into updating the County's Capital Improvements Plan.

Overall Population Growth

Population estimates published by the North Carolina Office of State Planning and by the Wake County Planning Office and Informed Decisions, Inc., were used as the basis for estimating Wake County's population over the 15-year planning period of this study. These data are depicted in Figure 1. The two projections have a relatively small difference through 2018.

The high population estimate (Wake County Planning Office data) and the low estimate (State Planning Office data) form a projection "envelope." Barring unforeseen changes in the factors that affect growth in Wake County, the actual population at any point in the next 15 years will likely fall somewhere between the two estimates. These estimates form the basis upon which growth was projected by region of the County and from which demand for service was estimated. As will be seen, we use both the high and low estimates to form an envelope of projected demand.

FIGURE 1: PROJECTED WAKE COUNTY POPULATION GROWTH (2004-2018)



Are these calendar years? If so, clearly state calendar years. (Phil Stout)

Source: NC Office of State Planning and Wake County Planning Office

Growth by Geographic Area

The prime objective of fire and EMS station location planning is the minimization of response time through strategic placement of resources in a way that will meet the agreed upon response time goals at an acceptable cost. To effectively locate emergency response resources, one needs to determine how many calls will occur, and *where* they are likely to occur.

It is not enough simply to project the overall population (which will give a reasonably good estimate of overall system demand). One must know where people are living and working because it is in those locations that most emergency incidents occur.

Detailed projections of Wake County population density by "traffic analysis zone"[5] (TAZ) were prepared by the Triangle Regional Modeling Team of the Triangle J Council of Governments. Population density projections for the present, 2010, and 2018 (the near- and long-term endpoints for this study) were interpolated using the Triangle J data. Figure 2 shows current population density by TAZ while Figure 3 and Figure 4 show the population density estimated for the near-term (2010) and the long-term (2018).

In these maps and in defining service demand goals, the County TAZs were defined as urban, suburban, or rural. An *urban TAZ* was defined as either completely inside current corporate limits or a TAZ with a population density of 2,000 people or more per square mile. A *suburban TAZ* has a population of 1,000 to 1,999 people per square mile or is partially within current corporate limits. A *rural TAZ* has a population density under 1,000 people per square mile and is not at all within current corporate limits.[6]

Comparing Figure 3 and Figure 4 with Figure 2, there are some changes in population density expected over that time period, with the majority of the County in suburban or urban by 2018, but the changes are not radical. The implications will be discussed in detail in a later chapter, where different response time goals are considered for urban, suburban, and rural TAZs.

[5] A traffic analysis zone (TAZ) is a common unit of analysis employed by planning offices throughout the United States. Although TAZs don't have intuitive meaning, they provide a good analytical platform because they are relatively stable over time, they are mutually exclusive, and they are exhaustive (meaning they are designed to completely cover a given geographic region).

[6] The reason that population density was not the sole determinant of urban or suburban areas was that some business areas in Raleigh would be defined as rural if only population density were considered. The US Census uses a combination of density and location relative to pre-defined corporate boundaries. As the corporate boundaries expand in Wake County, more areas may be defined as urban than are shown in the maps here.

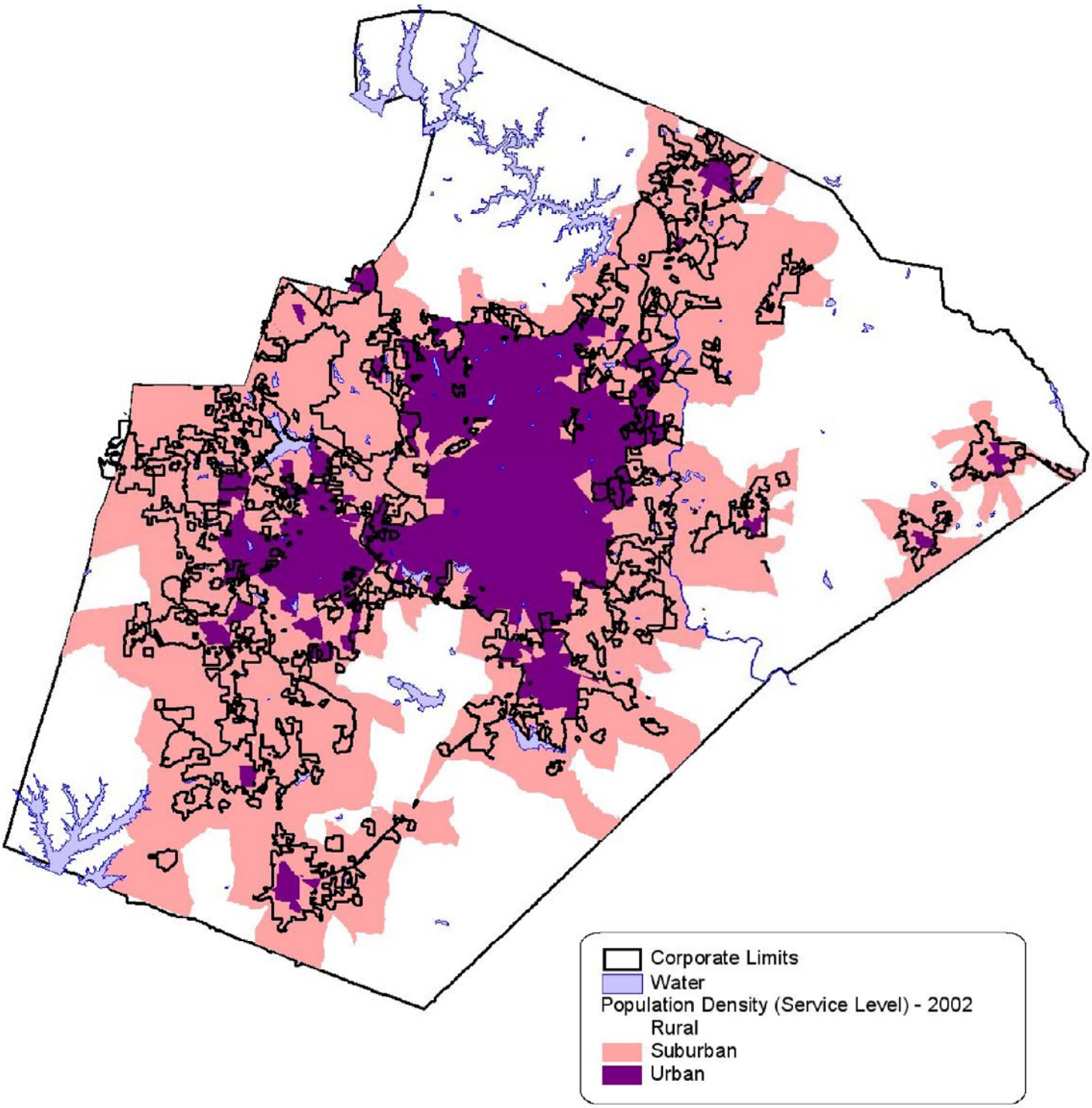
The maps of population growth are one of the starting points for assessing future needs for fire and emergency medical services. (The other is data on the trend in demand per capita.) In making recommendations about the needed future response capacity of the fire and EMS system, we considered the likelihood that an area would experience near- or long-term growth and, therefore, additional demand for service.

In general, there is a linear relationship between the number of people in a given area and the fire or EMS call volume. The more population, the more calls. But that is true only if the per-capita demand rate stays the same over time. The rate of calls per capita is affected by the demographic profile of the population; e.g., the more elderly and more low income the population, the greater the call volume is likely to be.[7] The breadth, intensity, and quality of public fire and injury prevention education, and a host of other factors, including built-in fire protection, product safety, topography, commuting patterns, and weather, also affect the per capita call rate. The call volume also can be influenced by the cost of medical care and local public policy concerning the use of EMS for medical care that is not of an emergency nature. For example, people may use EMS more to avoid paying higher costs of personal medical care. Some jurisdictions (notably Washington, DC) have had sharp increases in per capita demand after a mayor (Marion Barry) in effect told the public they could call on EMS whenever they had medical problems.

The calls per capita may be different for fires and EMS. In general, structure fires are declining per capita and EMS calls are increasing.

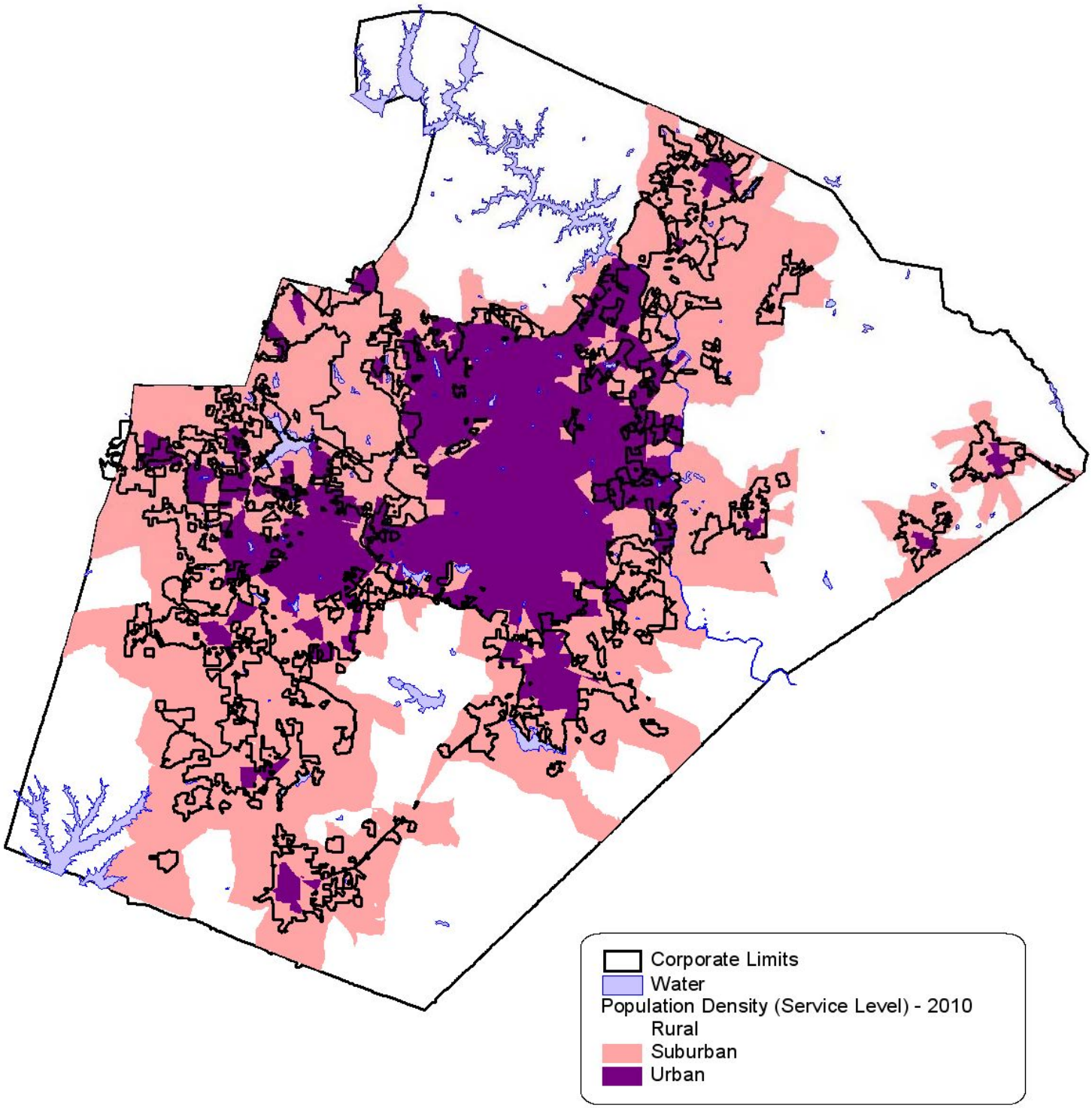
[7] Because demand growth is not expected to overload stations, it was not cost-effective to be overly precise in the demand model at present. Future studies might consider doing the demand analysis with more detailed consideration of changing demographics, especially if the population ages significantly.

FIGURE 2: CURRENT POPULATION DENSITY BY TRAFFIC ANALYSIS ZONE (2002)



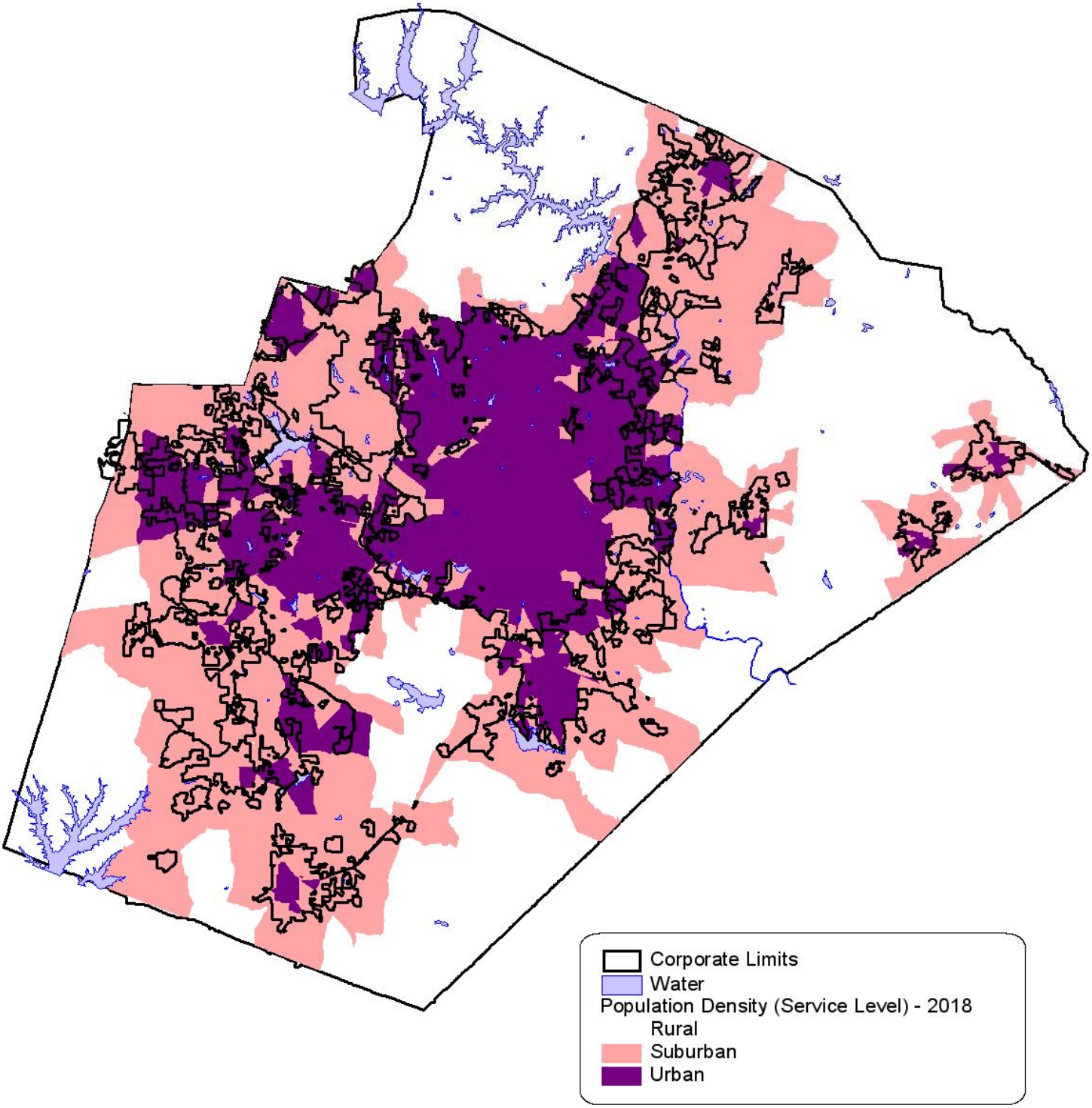
Source: Triangle Regional Modeling Team of the Triangle J Council of Governments

FIGURE 3: PROJECTED POPULATION DENSITY BY TRAFFIC ANALYSIS ZONE (2010)



Source: Triangle Regional Modeling Team of the Triangle J Council of Governments

FIGURE 4: PROJECTED POPULATION DENSITY BY TRAFFIC ANALYSIS ZONE (2018)



Source: Triangle Regional Modeling Team of the Triangle J Council of Governments

Demand Estimates

Using the population projections described above, we projected overall countywide call volume as a function of population and per-capita demand. These projections were then disaggregated by TAZ to estimate local demand for service.

To arrive at a lower bound for estimated demand, it was assumed that the average per-capita demand for the last three years (the best available data) would remain constant. The per-capita demand figures were then multiplied by the population estimate for each future year using the Wake County Planning Office data, which provided the high population estimates (Figure 1). However, in many cases per capita demand has been shown to increase over time. This is often attributed to aging of the population or an increase in the community's awareness of services. Thus, the estimated demand produced by the above method is probably lower than actual demand.[8]

The upper bound for estimated demand was produced by assuming that the average annual change in per-capita demand over the past nine years would continue over the next five years and then level out. At some point, demand per capita is expected to level out, but one does not know when. It varies as a function of many factors, such as aging of the population, local dispatch policy, and public education to prevent fires and injuries. Some communities keep rising and others level off. Most are still rising for EMS calls, dropping or keeping level for fire calls, and increasing for false alarms because of increased numbers of automatic fire detection systems. Since this method tends to overestimate demand, multiplying it by the low population projection was used as a corrective factor. One could use the worst-case demand per capita projection and the higher population projections, but that probably exaggerates the estimate.

[8] If one uses the lowest population estimate and the lowest per-capita demand, one is assuming that the best cases of each will coincide. Likewise, if one assumes the maximum population growth and continual population per-capita growth, it assumes lining up the worst cases. Neither is likely statistically. However, one must keep reviewing the situation year by year to see if adjustments to the growth plans are needed.

TABLE 2: HISTORIC FIRE DEPARTMENT CALL VOLUME – REVISED[9]

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03
Apex	652	860	1,241	1,205	439	188	1,762	1,849	1,660
Bayleaf	360	456	480	456	516	540	580	607	860
Cary	2,609	2,990	3,894	3,534	3,670	3,785	4,470	4,634	4,881
Durham Highway	493	490	659	645	701	438	712	628	619
Eastern Wake	493	970	913	884	1,280	1,330	1,536	1,436	1,089
Fairview	513	577	824	717	725	749	822	831	743
Falls	160	186	211	205	194	228	295	328	368
Fuquay	450	555	819	691	630	1,873	2,110	2,327	2,469
Garner	870	997	1,406	1,346	942	2,479	2,337	3,371	3,575
Holly Springs	125	107	471	472	152	517	559	554	656
Hopkins	114	157	223	228	281	283	322	313	349
Knightdale DPS	-	-	-	-	-	-	-	-	608
Morrisville	396	446	582	638	779	793	850	865	873
Raleigh	6,758	18,765	18,319	18,720	20,485	21,820	21,664	22,274	24,000
Rolesville	177	218	354	296	300	380	531	628	719
Six Forks	170	192	176	244	226	238	301	301	Closed
Stony Hill	172	173	225	185	223	277	372	353	357
Swift Creek	338	497	605	472	452	322	422	475	416
Wake Forest	348	463	447	451	519	498	520	1,278	1,600
Wake-New Hope	1,092	1,078	1,176	1,070	1,335	785	1,128	1,225	1,068
Wendell	367	400	594	601	651	1,065	1,089	1,213	1,260
Western Wake	406	654	876	510	628	553	550	550	512
Zebulon	126	142	216	213	206	591	579	576	657
Total (less Raleigh)	**10,431**	**12,608**	**16,392**	**15,063**	**14,849**	**17,912**	**21,847**	**24,342**	**25,339**
Grand Total	**17,189**	**31,373**	**34,711**	**33,783**	**35,334**	**39,732**	**43,511**	**46,616**	**49,339**
Per Capita (less Raleigh)	**0.0199**	**0.0239**	**0.0298**	**0.0261**	**0.0248**	**0.0286**	**0.0337**	**0.0362**	**0.0363**

Source: Wake County Department of Public Safety. This includes all calls the fire departments went on, including EMS. There was a change in dispatch policy which led to sending fire units on EMS calls in the past few years, causing sharp jumps in total calls in some departments.

Because of the highly variable pattern in demand for fire department services over the last nine years of available data (Table 2), in large part because of the change in policy that makes fire departments the first responders for many EMS calls, we used the per-capita growth percentage for EMS demand as a surrogate for the percentage for annual per-capita demand increase for fire departments, in the high demand projection. This is a reasonable assumption because EMS calls represent a majority of the current fire service call volume (52–55 percent in recent years), and the portion rising fastest. Fire departments have had jumps in their call volumes as they start to respond to EMS calls,

[9] The data here is a revised set provided toward the end of this project. The data used to make projections is given in Appendix B. The difference in the trend is small, but suggestive of demand being closer to the upper bound in the projections then a mid-point.

and that is not reflective of change in demand as much as changes in response policy. Figure 5 shows the resultant projections of high and low demand for fire department-related calls for the next 15 years.

The data upon which the projections were made for fire departments include both fire-related and medical first responder responses. The data could not be disaggregated by type of call until the last three years, too few to project by type of call separately.[10] The data represents total fire department calls for service, not just calls for fires; the fire calls are substantially fewer.

The same methodology was employed for the high and low EMS projections as was used in the fire service demand projections. Figure 6 shows the projected demand for EMS calls for the next 20 years.

The projected increase in fire service calls is 4,800–7,000 calls by 2010, and 11,000–16,000 by 2018. The projected increase in EMS calls is much greater, 11,000–24,000 calls by 2010, and 27,000–52,000 by 2018. That is, the number of EMS calls may double over the planning horizon of the study. So much of the additional workload in the future will consist of responding to EMS calls, similar to the pattern emerging almost everywhere in the U.S., because built-in fire protection, smoke detectors, and other measures are working to reduce fires, while the aging of the population and high medical costs tend to drive EMS calls up.

A straight line extrapolation through the actual data for FY00 to FY03 would give a much higher rate of increase than we projected, but almost assuredly would be wrong. The sharp increase in those years was due primarily to getting more fire units to respond to EMS calls in addition to rescue units. Once fire units all follow that policy, the increase in demand should mainly track the increase in EMS calls.

The numbers in Figure 6 for EMS demand are much higher than the number of fire service calls because the EMS demand includes EMS calls for the whole County, including Raleigh (EMS is a countywide integrated system). The fire department numbers exclude Raleigh though they do include EMS calls responded to by fire departments outside Raleigh.

[10] It would be desirable to report number of calls per fire department by type of call so that the composition of the trend can be viewed to better understand demand and make better projections. Future studies will be able to project fires, EMS calls, false alarms, and other calls separately. They do *not* tend to trend in the same direction, based on many other studies we have undertaken.

FIGURE 5: FIRE SERVICE DEMAND PROJECTIONS (FY2004 – FY2018), EXCLUDING RALEIGH

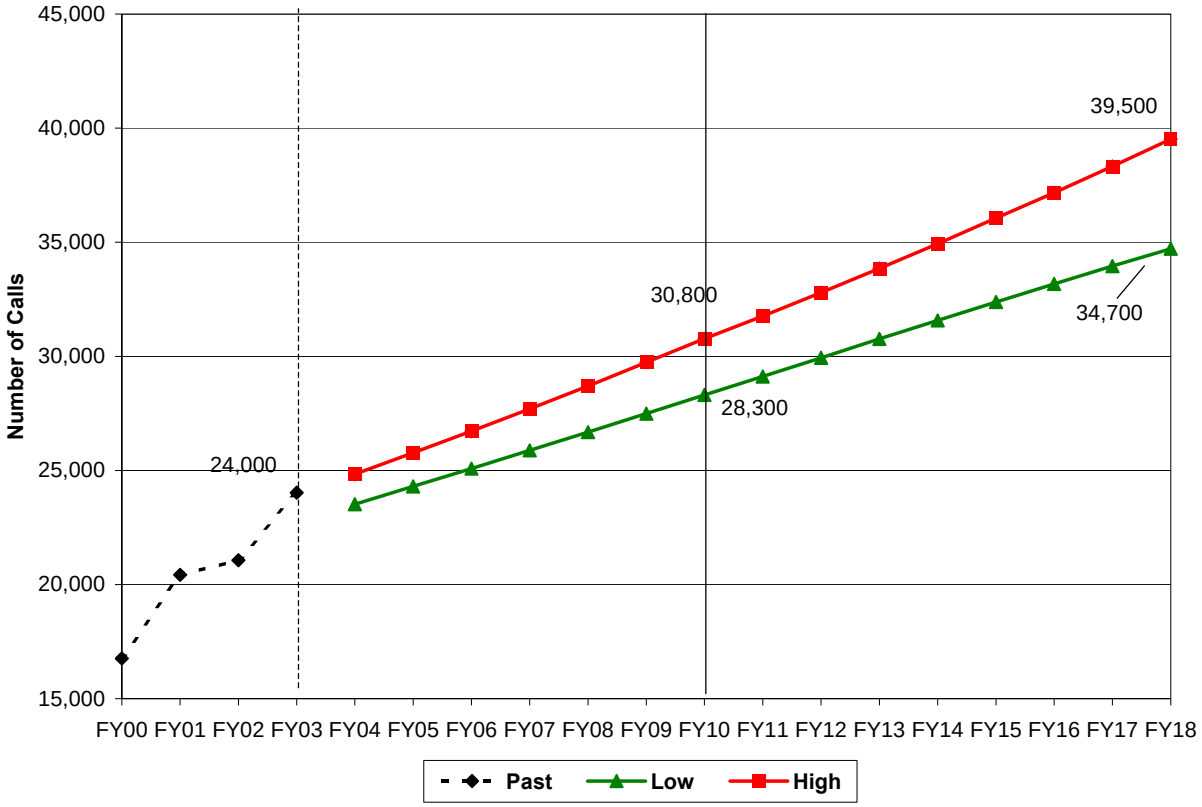


FIGURE 6: EMS DEMAND PROJECTIONS (FY2004 – FY2018) (WHOLE COUNTY, INCLUDING RALEIGH)

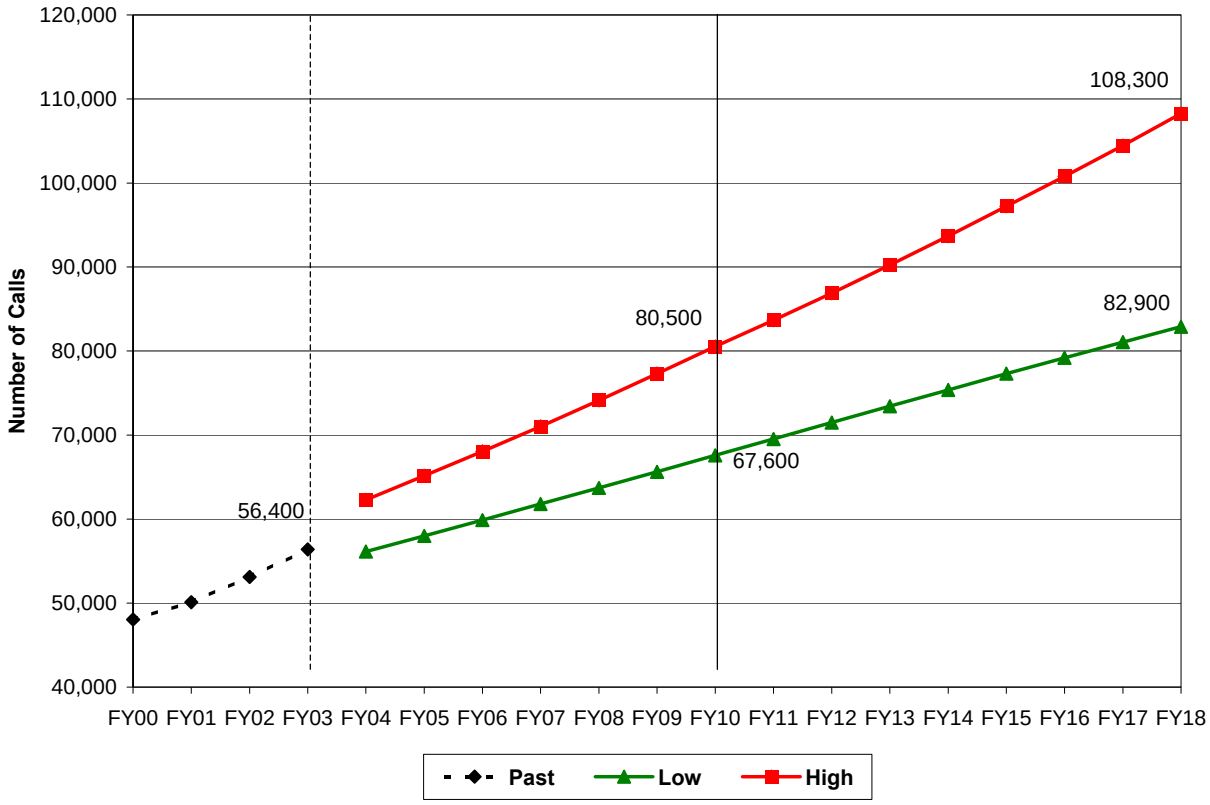


Figure 7 shows the actual demand for fire service in 2002 by TAZ in terms of the number of calls. The figure excludes Raleigh (because comparable data were unavailable). Figure 8 and Figure 9 show the demand for 2010 and 2018.

Figure 10 shows the actual demand for EMS in 2002 by TAZ.[11] Figure 11 and Figure 12 show it for the future years. The TAZs within Raleigh are shown here on the EMS figures because Wake County EMS is the EMS provider within the City of Raleigh.

[11] Depicting demand by TAZ suffers from a presentation problem in that the TAZs are unequal in size and population. A larger TAZ may have more calls than a smaller TAZ, but the sum of calls over several small TAZs equal in area to the large TAZ may be greater. Still, it is useful to see how the number of TAZs with large numbers of calls increases over time.

FIGURE 7: CURRENT FIRE SERVICE CALLS BY TAZ (2002)

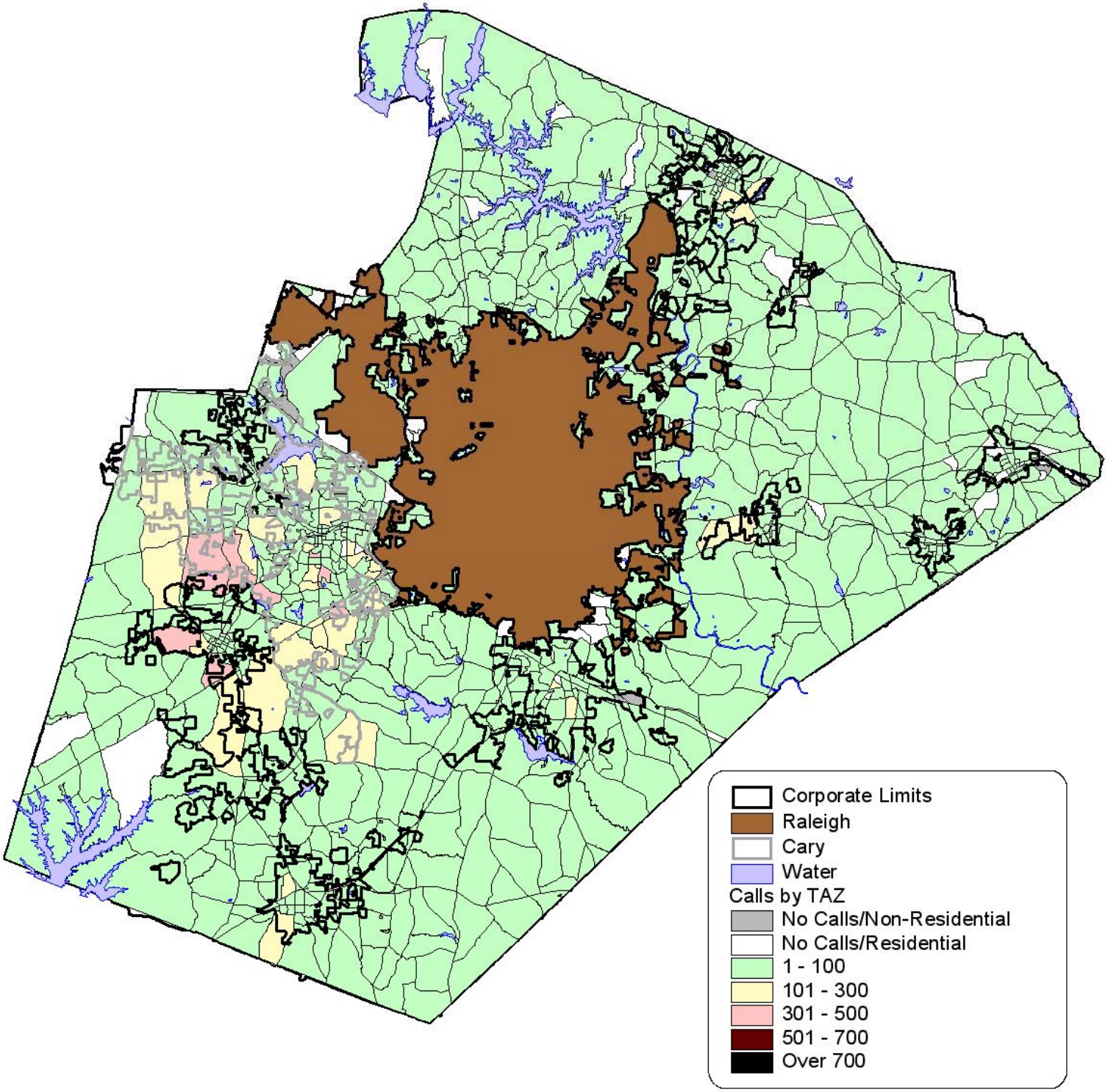


FIGURE 8: PROJECTED FIRE SERVICE CALLS (2010)

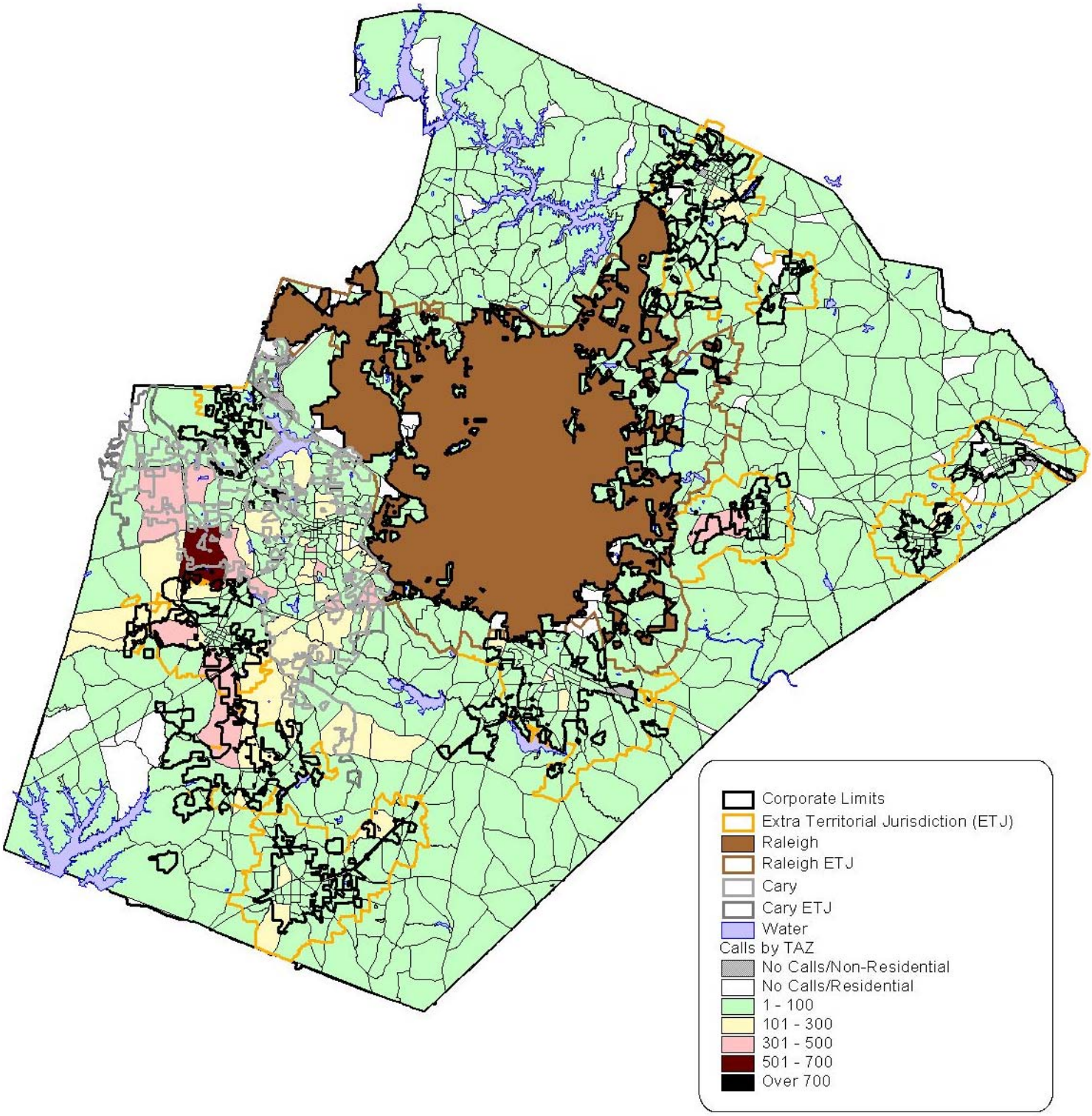


FIGURE 9: PROJECTED FIRE SERVICE CALLS (2018)

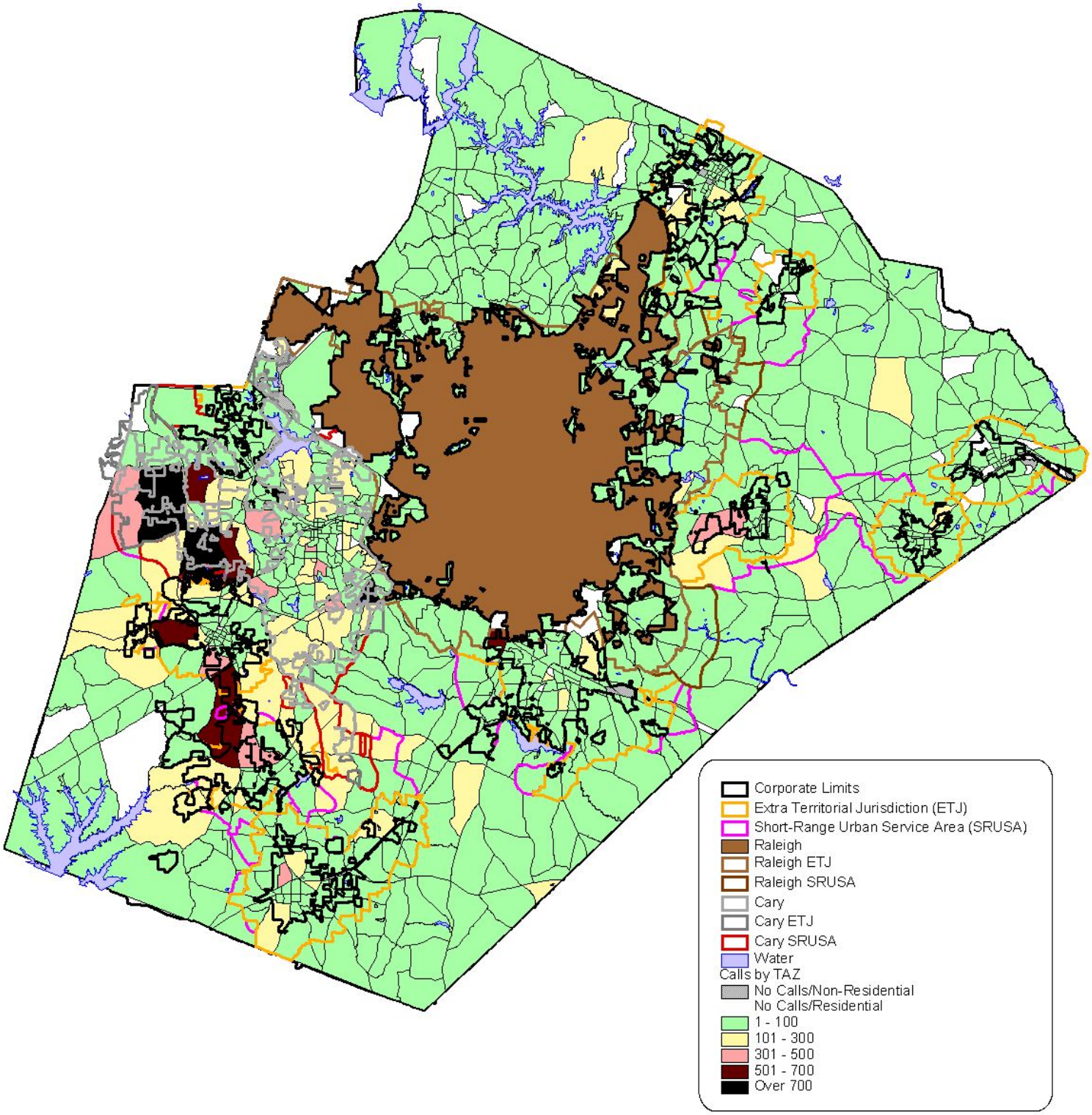


FIGURE 10: EMS CALLS BY TAZ (2002)

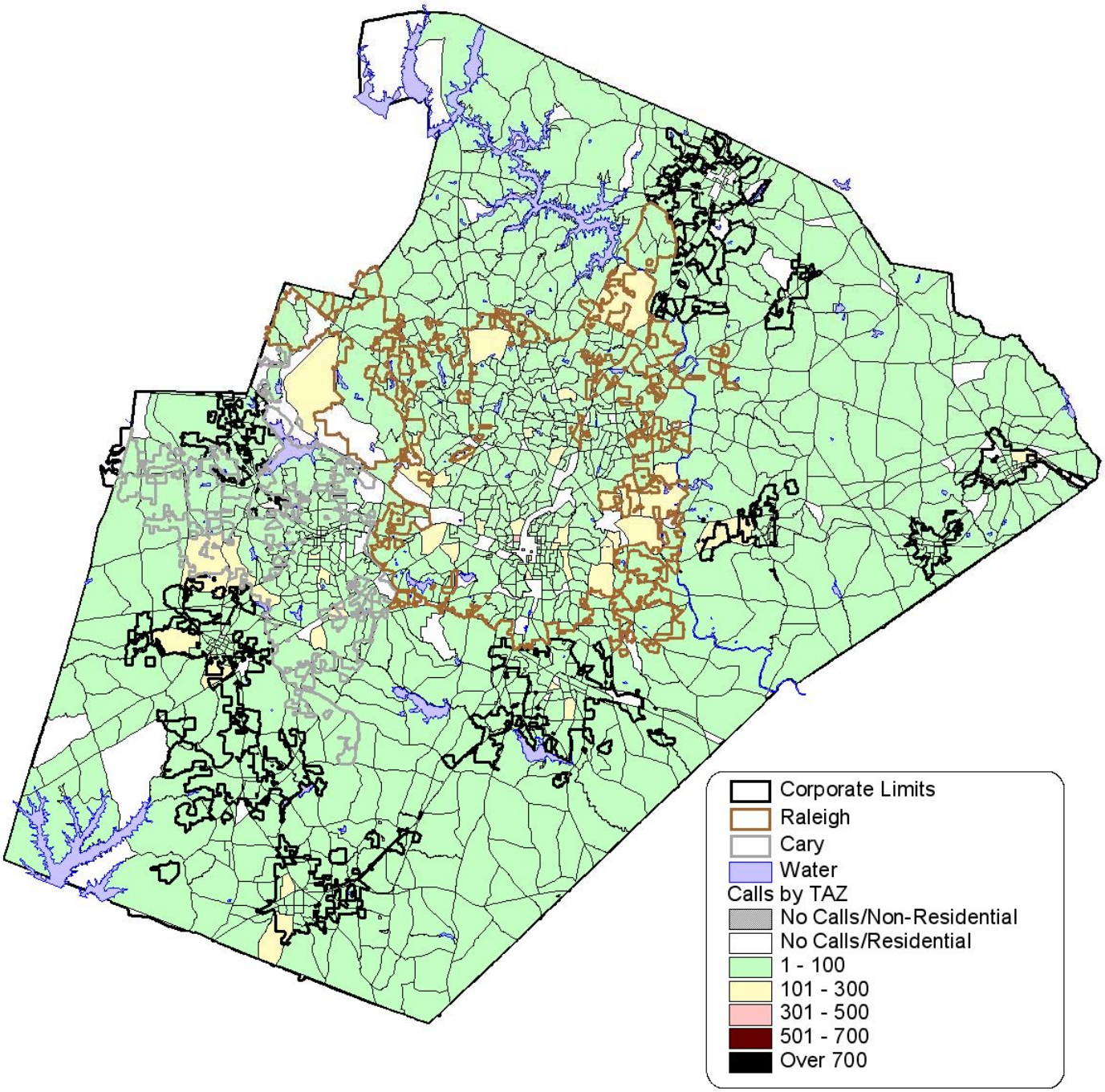


FIGURE 11: PROJECTED EMS DEMAND (2010)

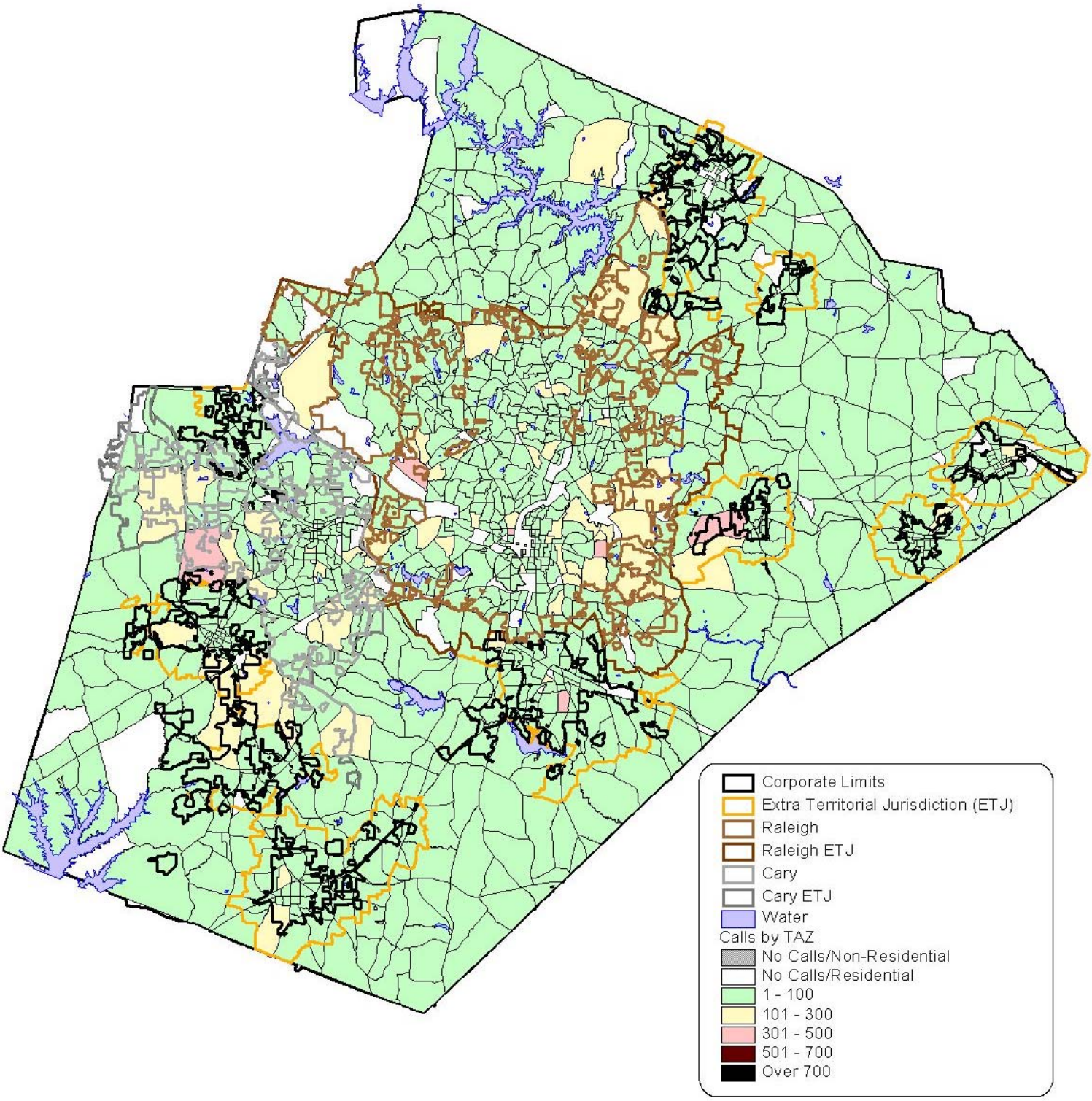
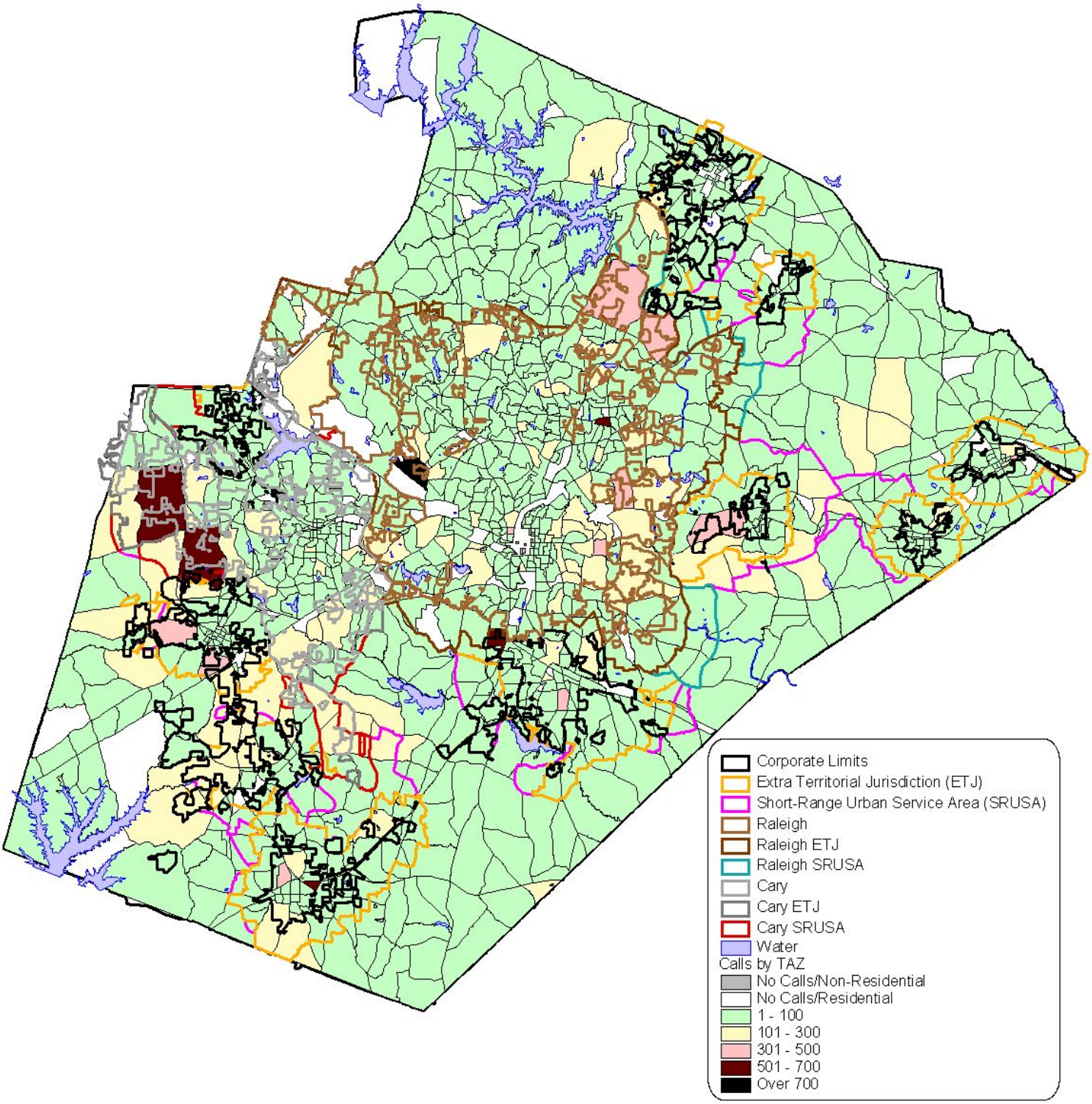


FIGURE 12: PROJECTED EMS DEMAND (2018)



To project the geographic distribution of demand, we used the estimates of population for each TAZ and demand per capita by TAZ to estimate near- and long-term demand for fire service for each TAZ (shown in Figure 8 and Figure 9, respectively). This methodology was also employed for projecting EMS demand by TAZ (Figure 11 and Figure 12, respectively). The maps of demand by TAZ look roughly similar for both fire and EMS (setting aside the fact that the EMS maps depict TAZs in Raleigh). This is not surprising: people are the main cause of both fires and EMS calls. Both types of incidents occur mainly where people are located, although there are some differences because people move about during the day and commercial/industrial areas may not generate the same number of fire or EMS calls as do residential areas. Also, a significant portion of the "fire" calls are actually first responder EMS calls, not fires.

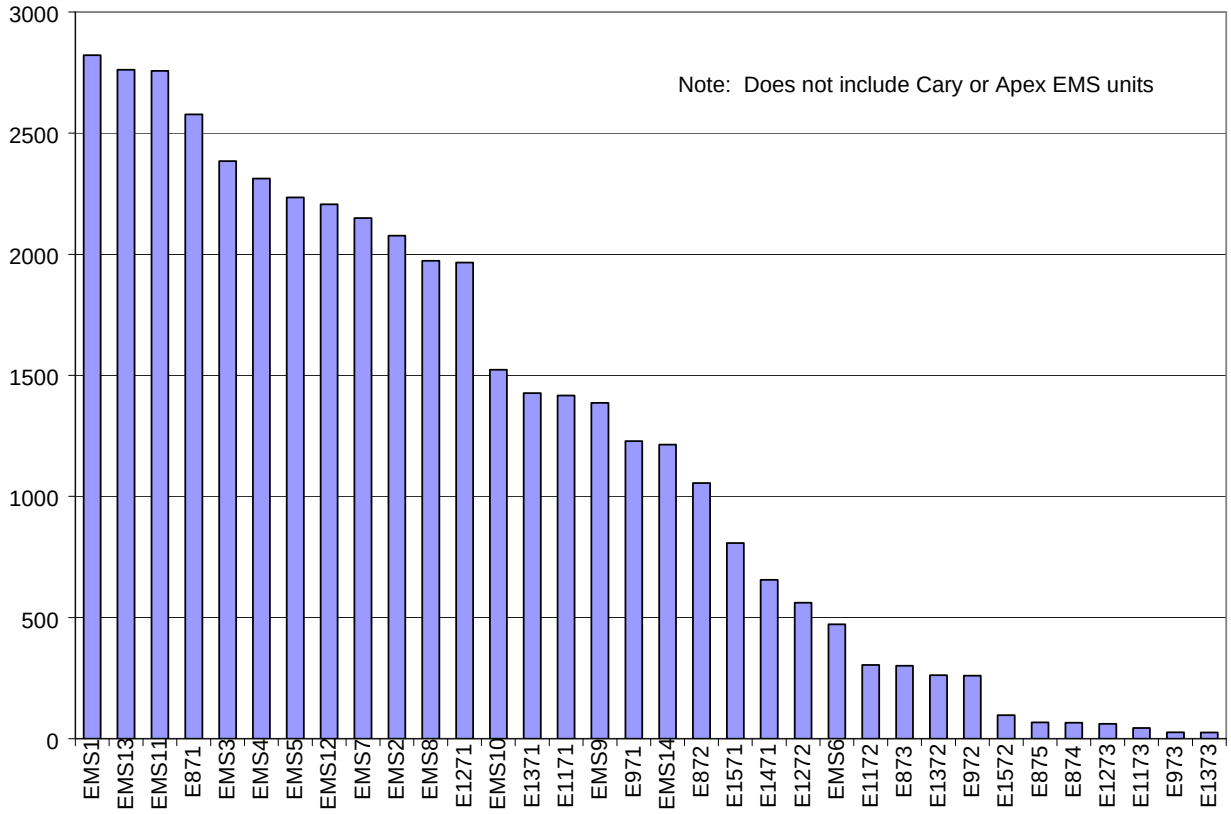
The average projected yearly countywide increase in the number of fire and EMS calls over the 15-year planning horizon of the study is shown in Table 3. As noted above, we analyzed the demand by TAZ, and use that level of detail in the chapter on station locations. But this overview reveals an interesting point: the expected growth in demand averages only 10–23 fire calls per year per fire station, and 48–105 for EMS units. A fire station in a new location usually is not warranted until the additional call volume reaches about 500 to 600 calls per year, as a rule of thumb we developed. There is no nationally used standard or common practice on when to add a station in an area with low demand (few calls) but high response times; it is a judgment call. Many volunteer units respond to less than one call a day. The projections show that it is unlikely that fire service workload considerations alone would necessitate adding fire stations. In light of the low annual increase in demand, the primary motivation for adding a fire station would be to improve response times for a region.

TABLE 3: AVERAGE PROJECTED YEARLY INCREASE IN FIRE AND EMS CALL VOLUME UNDER HIGH AND LOW PROJECTIONS

	Countywide		Per Station/EMS Unit	
	High	Low	High	Low
Fire Service Calls	1,033	453	23	10
EMS Unit Calls	3,466	1,600	105	48

The increase in the EMS call volume would probably necessitate adding a few units (not necessarily new stations) over the 15-year planning horizon. A full-time career EMS unit can generally handle on the order of 2,500 to 3,000 calls per year and still have reasonable response times and not overload the personnel, based on many previous studies. This is also the point where it becomes difficult to meet the 90th percentile targets because the unit is out on calls about 29 percent of the time, if the average EMS call lasts one hour (some require transports and others do not). Acceptable workloads and response times depend on the average length of service time for a call, the nature of the service area and whether career or volunteer personnel are used. (Volunteers cannot be expected to handle the same volume of calls as career units.)

FIGURE 13: CY 2002 EMS CALLS BY TRANSPORT UNIT



Source: Wake County Department of Public Safety

Under the high estimate, one can expect, on average, an increase of 500 to 600 calls per EMS unit over a 10-year period. This should not exceed the capacity of most EMS units; however, individual units should be examined to see whether any will become overloaded or if a station will be needed where none currently exists.

Figure 13 shows the 2002 call volume for all EMS transport units in Wake County (except Cary EMS and Apex EMS, for which unit-specific call volume data were not provided). All but four of the EMS units (EMS 1, 11, 13, and E871) are currently below the 2,500 calls-per-year level. System-wide EMS response capacity might need to be upgraded on the order of one additional unit countywide every two years to keep up with the projected increase in EMS demand. Adding these extra units probably could be avoided by re-deploying the second- and third-duty EMS units in EMS stations with multiple units, i.e., having one per station. This was a recommendation made in the 1999 study of the EMS system,[12] and is still important to consider. Specific recommendations for future EMS unit deployment are given in Chapter IV.

[12] TriData Corporation, "Comprehensive Assessment of the Wake County Emergency Medical Services System," 1999, p. 53 and p. 131.

III. LEVEL OF SERVICE TARGETS

Early in this study, the project team met with the Wake County Fire Commission's Service Level Committee, representatives from Wake County EMS, and various EMS agencies operating in the County to discuss appropriate service level targets upon which to base fire and EMS station plans. Discussions were held around identifying service levels that are appropriate in terms of public expectations of service delivery, modern fire and emergency medical service delivery trends, and the capabilities (current and future) of the County and individual fire and EMS agencies in the county.

Background on Service Level Measurement

In the fire and EMS industry, service level goals generally are set in terms of response times. The service levels may be expressed in terms of the first unit to respond or an entire complement of units, and/or numbers of firefighters or EMTs arriving within specified times. A goal may be set for an entire jurisdiction or for various areas of the jurisdiction or both.

There is no single, nationally accepted response time standard, although a number of organizations, notably the National Fire Protection Association (NFPA), have issued their own standards. A wide range of response time goals can be found in use across the nation. Current best practices are to use "fractile" response time goals (i.e., to set response time goals in terms of the "percent of calls responded to in *x* minutes" rather than to use average response times.) For example, one performance goal might be to respond to 90 percent of EMS cardiac calls in six minutes. Going further, one may define service levels not only in terms of response times but also in terms of the number and types of units arriving in *y* minutes, the number of trained personnel, or the functional capability (e.g., a defibrillator with someone trained to use it; one or more fire vehicles with 500 gallons of water and four firefighters).

Many emergency services systems still report "average" response times, but average response times have become increasingly discredited measures by the emergency services industry because small numbers of very short or long responses can distort the true picture of how fast it *usually* takes for resources to arrive at an emergency. Someone interested in how fast a system responds is more interested in what the response time will likely be *in most cases* (i.e., "How long will it take for an ambulance to arrive if I need one?"). This is better described by reporting the response time for a high percentile of the universe of emergency calls – the concept called "fractile reporting."

Modern emergency response systems have generally adopted the 90th percentile for fractile reporting. In other words, a fractile response time at the 90th percentile tells the

consumer how fast the system responds to 90 percent of all calls. In fact, NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2001 Edition),* Section 4.1.2.1.2 requires that departments "establish a performance objective of not less than 90 percent" for fractile reporting. The remainder beyond the compliance fractile is the "operational tolerance" defined for the system, which is usually 10 percent – meaning the system is designed with the understanding that 10 percent of the calls will have response times that exceed the target.

As the preceding discussion in establishing service level targets implies, it is critically important to clarify the terminology and the tradeoffs to be made. Setting response targets requires making a tradeoff between cost and coverage. Because emergency services are delivered across two dimensions—time and distance—the central question in designing fire and EMS systems amounts to what resources and how many resources should be devoted to cover a given geographic service area in order to produce a desired response time at a certain level of reliability.

It is possible to design a system that will ensure rapid service to 100 percent of any geographic area of the County. This would, however, require building fire stations in areas with extremely low call volumes simply to maintain what most would consider an unrealistically high service level standard. It would drive costs up exponentially for a relatively small return.[13] The costs would be financially prohibitive for most risks (although there might be some worth such coverage). In virtually all communities, elected officials try to be financially prudent and design response systems that will provide adequate coverage for most situations *within designated operational tolerances*. In other words, rather than placing a fire station within one minute of every house, which might require more than ten times as many stations as now exist, fire stations generally are located to afford a response within a certain number of minutes for most, but not all, calls.

Requiring each area to meet a goal and not just the overall system is a much tougher and more expensive standard to meet. That is, reaching 90 percent of calls in 6 minutes is much more achievable for the whole County for every TAZ, including those where demand is very low. It becomes cost prohibitive to try to meet a goal in every small area. Usually, the goal is set for a system or whole jurisdiction. It is understood that 10 percent of calls will not be within the target response time. Some jurisdictions lower the target

[13] To illustrate the point about an exponential increase in resources, suppose apparatus from a given station currently can get anywhere in an area within six minutes at 30 mph. If there were a perfect east-west, north-south street network the area served by one station would be an 18-square-mile diamond-shaped area three miles in diameter from the center (station location) to any corner. If one wished to serve that same 18-square-mile area with a two-minute response, one would need nine stations instead of one because each station would be able to serve only two square miles.

percentile to 80 percent rather than 90 percent of calls. As will be seen, Wake County is setting separate targets for the urban, suburban, and rural areas, viewed countywide. This is a good practice, and reasonable compromise.

Another critical clarification concerns the definition of "response time," since it is an integral component of both adequacy of response and operational tolerances. Response time is the most widely used and most widely misunderstood measure of fire and EMS system performance. It is widely used because the lay public equates speed of response with quality of service (which is not necessarily correct) and because it is relatively easy to gather and analyze the data needed to publish these measures. It is widely misunderstood because there are no consistently applied data definitions or methods of analysis (i.e., some fire and EMS systems still report average response times while others report fractile response times).

Another problem with using response time as the primary measure of system quality is that speed of response is not necessarily indicative of outcome or quality of service. Fire and EMS operations may be initiated quickly but could nonetheless be of poor quality. Even when fire and EMS operations are of the highest quality, the speed of response may have little impact on the outcome (e.g., when a fire is undetected or unreported for a long time and the building is beyond saving by the time the fire department arrives).

Rexford Wilson, a fire protection engineer, describes a nine-step process (see Figure 14) from ignition to extinguishment of a fire. A fire department usually has control only over steps 5–9. Some have control over step 4, dispatch, but not the Wake County fire departments, which do no supervise the dispatch and communications center.

FIGURE 14: WILSON NINE-STEP SCHEMA

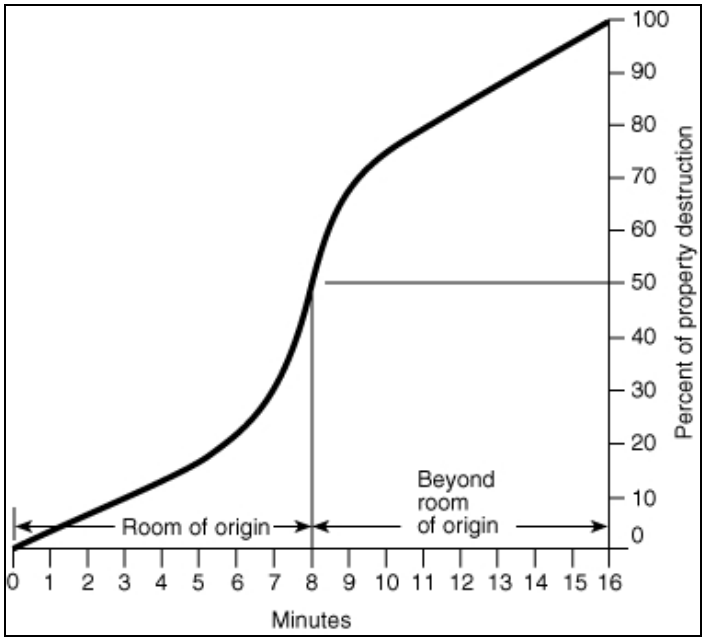
1	2	3	4	5	6	7	8	9
Free Burn	Permitted Burn	Notification	Alarm Processing	Turnout Time	Travel	Setup	Combat	Overhaul

Source: Wilson R, Nine Steps from Ignitions to Extinguishment (2e), FirePro Institute, Putney, VT (1994), pp. 2-3

A fire that smolders or burns undetected or is unreported for a long time (steps one through three) may make such sufficient headway as to negate even the fastest response by a fire department. (Offsetting this headway is the rationale behind using automatic fire detection/reporting and automatic sprinkler systems.) For example, if the fire burns 20 minutes before it is detected, even with a five-minute fire department response time, the damage will have been done. Figure 15 depicts the conceptual Fire Propagation Curve, the effect of time and temperature rise of a free-burning fire on the destruction of property. According to the NFPA, extension of the fire beyond the room of origin begins approximately eight minutes after ignition, and flashover of the room of origin occurs

within 10 minutes of ignition.[14] In some modern rooms with low ceiling and plastics, flashover can occur as fast as two to four minutes, according to studies by the National Institute of Standards and Technology. Even when there is rapid detection and reporting of a fire, slow call processing or turnout times can slow the response and lead to increased casualties or property damage.

FIGURE 15: FIRE PROPAGATION CURVE



Source: NFPA 1710, Annex A.5.2.1.2.1

The same sort of logic applies to EMS responses. A patient suffering a life-threatening event for which detection or reporting is delayed may not survive if the time between the occurrence of the event and reporting to the scene is sufficiently great.

Therefore, it is important to place "response time" (steps four through six in Figure 14) within a larger context and to acknowledge that detection and reporting are beyond the control of the operations side of an emergency service, though they can be influenced by requirements for smoke alarms, automatic detection systems, and educating the public to call the fire department quickly.

An emergency response time entails several operationally distinct components (call processing, turnout, driving, and getting from the street to the patient's side or the fire location) that must occur in a specified sequence in order to place emergency responders in a position to intervene in an emergency. Because each component begins as soon as its predecessor has ended, response time can be interpreted as a cumulative timeline with distinct time segments.

[14] NFPA 1710, Annex A.5.2.1.2.1

Response time is most fairly viewed from the perspective of the caller, who cares only about the end result—an adequate complement of appropriate skilled and equipped personnel arrives in sufficient time to correct whatever emergency exists. In the Wilson schema, steps four through six most closely represent response time as the public perceives it. Emergency service managers, on the other hand, need to care about each segment of response time, as these are areas that can be improved through better technology, processes, or training to lower overall response times. The following schematic defines the components of response time.

Response Time (lay public conception)		
9-1-1 call received →	Units dispatched →	Apparatus en route → First unit on scene
Call Processing Time – Begins when the emergency call is answered and ends when emergency responders are dispatched to the identified address of the call. Additional activities and information gathering may take place after notification of responders, but this is not included in call processing time.	**Turn-out Time** – Begins when emergency responders are notified and ends when *appropriate* emergency apparatus actually leaves the station en route to the location of the emergency. Response of an inappropriate vehicle (e.g., a personal car or utility truck) does not end this segment.	**Drive time** – Begins when the first *appropriate* emergency apparatus actually leaves the station and ends when the first appropriate apparatus arrives at the scene of the emergency.
Call Processing Segment – We use this term when necessary to contrast with "field segment."	**Field Segment** – This term connotes the time segment from dispatch to arrival. This term aligns with the concept of "response time" used by the Wake County Level of Service Committee.	

The bottom line is this: to the public, "response time" is how fast you get to them after they call. It includes all the operations from the time the caller reaches an emergency telecommunicator to the time help arrives. It is misleading (and a little disingenuous) to quote response time segments publicly as response time performance measures—especially when only drive time is used. Further, as noted above, drive time ends on arrival at the scene outside in the street, not at the fire or patient's side. In a high-rise or large, spread out property (e.g., a mall, golf course), it may take several more minutes to access the site of the emergency. (This concept is captured in the setup step in the Wilson model). In a recent series of articles on EMS quality of service that appeared in *USA Today* (July 28-30, 2003), the time from onset to defibrillation, not arrival on the street, was used as a performance measure.

Fire Service Levels

The Wake County Service Level Committee was chartered to define "adequate" coverage for the County and to decide what the operational tolerances of the system should be. The Committee's service level targets for the first-in apparatus to emergencies are shown in Table 4. The Committee originally expressed these times as the field segment (i.e., turnout time plus drive time); however, as noted above, we recommend that discussions

about response times should include the call-processing segment as well. All this requires is adding about one minute for call-processing to the field segment.[15]

TABLE 4: SERVICE LEVEL TARGETS FOR FIRST-IN FIRE DEPARTMENT FOR EMERGENCY CALLS

	Urban	Suburban	Rural
Field Segment Goal	0:05:00	0:07:00	0:09:00
Response Time Goal (to be communicated to the public)	0:06:00	0:08:00	0:10:00
Reliability	90 percent of all calls		

Thus, the goal in urban areas is to have an engine arrive within six minutes of notification in 90 percent of the calls. It implies a system operational tolerance of 10 percent – that for up to 10 percent of the calls, response time may be higher because the closest engine is already busy or because the call is in a distant, low-density area.

The Service Level Committee believed it should not stop the response time clock until a minimum of four firefighters had arrived on scene for a structure-related emergency,[16,17] the number needed to meet the "Two-In/Two-Out" rule adopted by OSHA.[18] The rule requires that at least two firefighters must be outside a structure into which two firefighters go, unless there is a person inside known to be at risk. This is a laudable goal, but it is difficult in practice to reliably collect the data that will reflect it. (Most CADS do not track the number of firefighters per vehicle.) Further, the Service Level Committee defined response time goals in terms of the first-due unit. In other words, the calculations of tolerance would only apply to the emergency response unit specifically designated as first-*due* to the incident. (The first-due unit is the one expected to be sent first to a call in a given geographic area. Sometimes it is busy and another unit takes the call.) Setting the goal for a "first-due" unit is stricter than requiring the first-*in* unit to arrive in the designated number of minutes. It may only be a minor semantic difference, and the intent

[15] NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2002 Edition)*, Section 6.4.3 provides that "Ninety-five percent of emergency dispatching shall be completed within 60 seconds." The IAFC Self-Accreditation Manual speaks of an average of 50 seconds, which is similar but more lenient as an "average."

[16] The term "structure-related" emergency, as used in Wake County, generally means fires and emergencies in buildings and not grass fires. It includes collapses and indoor gas leaks. It does not include vehicular and medical emergencies. It specifically *excludes* stuck occupied elevators and hazardous materials calls outside of structures.

[17] This practice is also in accord with NFPA 1720, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments (2001 Edition)*, Section 4.2.2.2, which provides that "Initial attack operations shall be organized to ensure that at least four members shall be assembled before initiating interior fire suppression operations at a working structural fire."

was "first-in." It probably does not matter much for Wake County because units are dispersed geographically, with minimal overlapping coverage). Nevertheless, we recommend that the goal be set in terms of the time for the first unit to reach the scene, not the unit that was first-*due*. The citizens care that some emergency unit arrive promptly when needed, not which particular one.

Recommendation 3: Coverage goals in the future should be stated in terms of total response times, including call processing, turnout, and drive times. There can be goals for the field element (combination of turnout and drive time), but it should not be called response time. It is also appropriate to consider the response time for getting four firefighters to the scene. The time to reach the side of the victim or site of the fire or other emergency should also be considered. Each component and each of their measures is informative to assess real-world situations and what ameliorative actions are most needed.

As the Wilson Nine-Step Model indicates, extinguishment of a fire depends on more than rapid arrival; Setup, combat, and overhaul are also essential phases. Steps seven through nine require personnel and resources beyond those that would arrive on the first-due units. These additional personnel and resources are often referred to as the "balance of the full alarm." (The total number of vehicles and personnel dispatched is referred to as the "assignment.") The Service Level Committee agreed on a service level target of an additional eight minutes for units to fill the balance of the full alarm. These targets are represented in Table 5.

TABLE 5: SERVICE LEVEL TARGETS FOR THE BALANCE OF THE FULL ALARM (FOR STRUCTURE-RELATED EMERGENCIES)

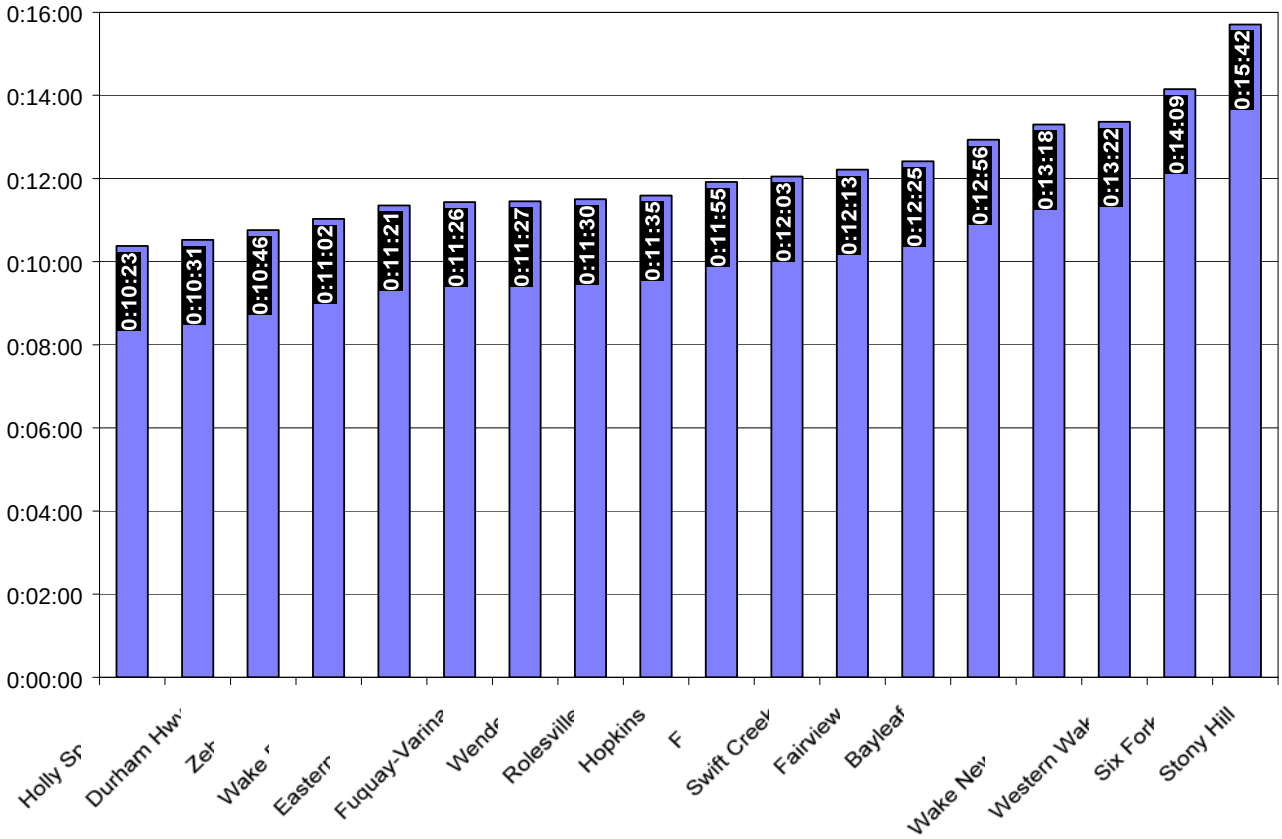
	Urban	Suburban	Rural
A. Field Segment Goal for First-Due Units (from Table 4)	0:05:00	0:07:00	0:09:00
B. Additional Drive Time for Second-Due Units	0:08:00	0:08:00	0:08:00
Total: Field Segment Goal for Balance of the Full Alarm	0:13:00	0:15:00	0:17:00
Reliability	90 percent of all calls		

The goals on the second and third lines of Table 5 are for the time it takes the last dispatched unit to arrive.

[18] 29 CFR 1910.134 (g)(4)

ACTUAL RESPONSE TIMES – As Figure 16 demonstrates, departments are hard pressed to meet the current Service Level Committee goals. The figure shows 90th percentile response times (i.e., total response time) for all areas. Because service level goals are different for urban, suburban, and rural areas, it is not entirely fair to apply the data depicted in this chart to the service level targets. Nonetheless, the chart gives a reasonably clear picture that most calls take a longer time to answer than would otherwise be desired. The 90th percentile ranges from about 10.5 minutes at best (Holly Springs, Durham Highway) to almost 16 minutes at the highest (Stony Hill).

FIGURE 16: 90TH PERCENTILE TOTAL RESPONSE TIME (FY2002)

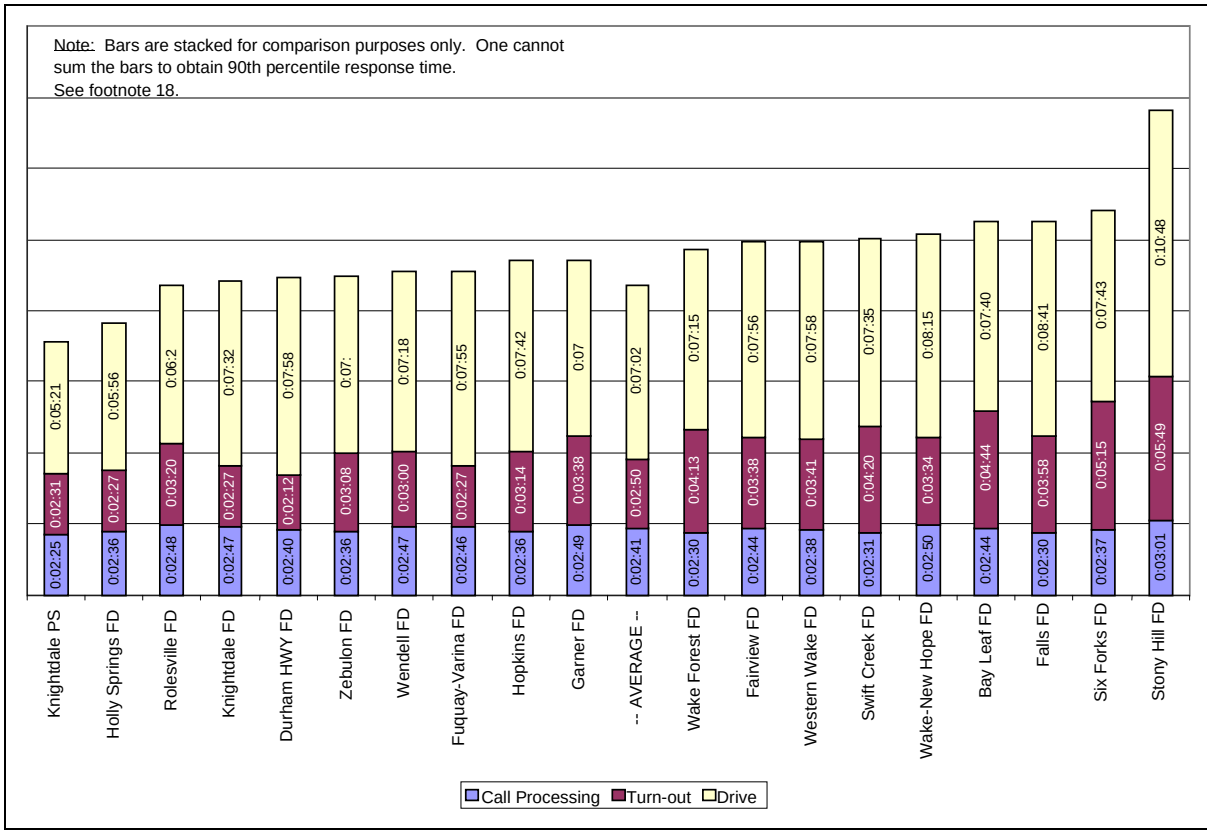


None of the departments with urban services areas to protect meet the urban service level target overall. Only four departments meet the suburban target. All but four meet the rural target.[19] The high response times are in part because of the length of the call processing and turnout segments. Figure 17 and Figure 18 show how overall response times are affected by slow call processing and turnout segments. These charts depict the average

[19] In doing the station location analysis, we worked at the TAZ level, which is more detailed than the department level in general. We looked to see if a TAZ was urban, suburban, or rural, and how well the department met the response time for each area, not just as a whole.

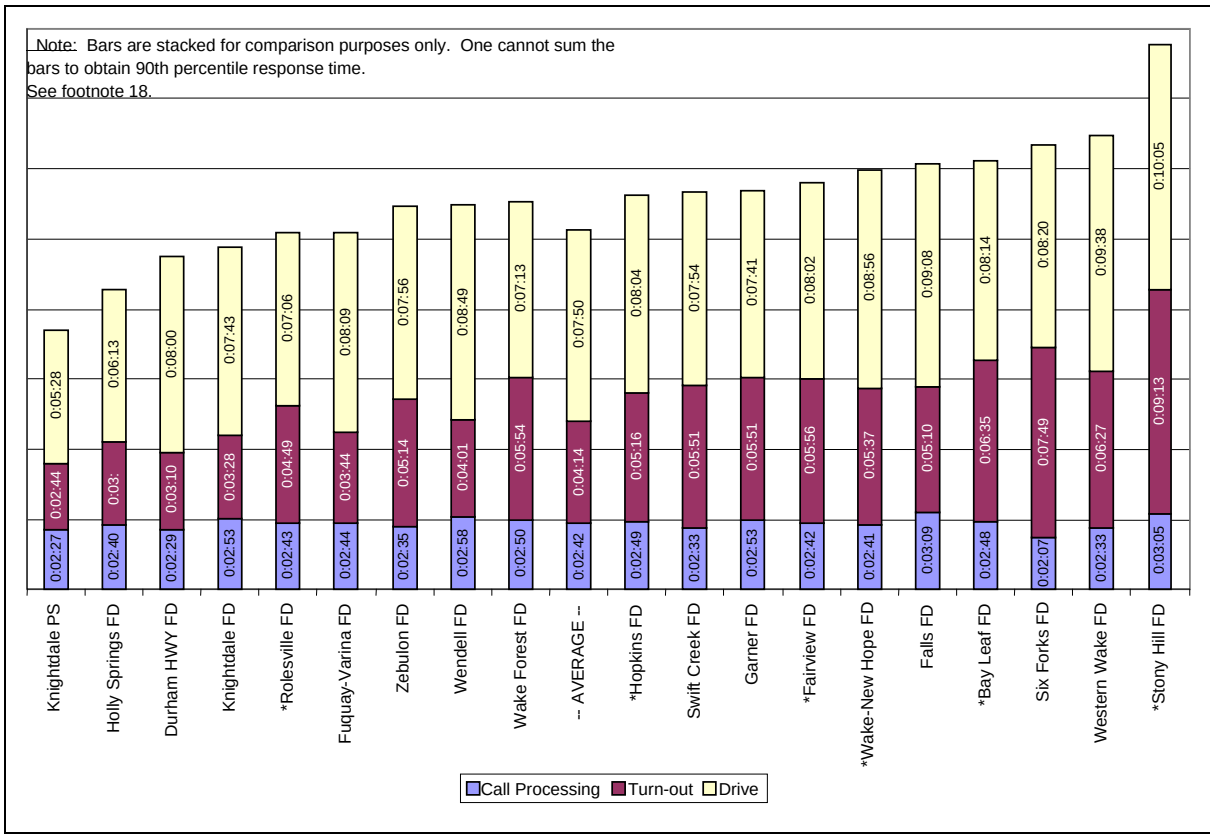
90th percentile daytime and nighttime response time segments for each Wake County fire department for the last three years.[20]

FIGURE 17: AVERAGE 90TH PERCENTILE DAYTIME RESPONSE TIME SEGMENTS



[20] The scales have intentionally been left out of Figure 17 and Figure 18 because the 90th percentile response time is not the height of the bars. That is, the 90th percentile for response time is not the sum of the 90th percentiles of its components. (This is a statistical fact.) Each segment is statistically independent from the others. Usually the 90th percentile of each component is close to the worst case, and the worst cases of call handling do not necessarily occur at the same as the worst cases for turnout and drive time. The "average" bar on each figure shows the average 90th percentile across all departments for each segment. It would be desirable in future studies to compare the true overall 90th percentiles, as well as the average and 90th percentile of each of the three components.

FIGURE 18: AVERAGE 90TH PERCENTILE NIGHTTIME RESPONSE TIME SEGMENTS



* = Departments with stations staffed at night substantially by volunteers responding from home.

As can be seen from the figures above, there is considerable variation among the departments in their ability to respond in a timely manner. Even if the call processing and turnout segments were reduced to one minute (which they should be), the current drive times would still preclude most departments from meeting the goals. That means that more stations are needed.

The 90th percentile call processing time in the Raleigh-Wake County 9-1-1 ECC has been 0:02:42—more than double the NFPA 1221 standard benchmark of one minute. Initiation of the new CAD system can be expected to have some impact on call-processing time. With the guidance of the Wake EMS system's Medical Director, RWCC staff has demonstrated that RWCC cardiac-related call-processing times can be reduced by 20 seconds or more. The response time goals provided in previous tables of targets anticipate such a reduction, but much work remains to be done by RWCC if the County agrees with this study's recommendation that call-processing time be reduced to the level called for by national consensus standards. Left unaddressed, the long dispatch times will continue to be a significant cause of prolonged response times.

Another problem is the length of turnout time. The average across all departments of 90th percentile daytime turnout time is just under three minutes. In the nighttime it is over four

minutes. In the slower departments (the bars on the right of the charts), daytime turnout can exceed six minutes and nighttime turnout time can approach ten minutes. These time segments alone are longer than the time it takes for even a quickly detected and reported fire to move from the incipient stage to free-burning (or even flashover) or for a person in cardiac arrest to suffer irreversible brain damage.

The lengthy turnout times are in part due to heavy reliance on volunteer firefighters responding from home. (Traffic congestion can also have some effect.) Twenty of 45 County fire stations are unstaffed or partially staffed at night. When apparatus from these stations are needed, the 9-1-1 center pages the volunteers of the appropriate fire department. The volunteers then respond from home to the fire station to get the apparatus on the road. As a matter of standard operating procedure and to comply with the OSHA "Two-In/Two-Out" rule, most of the fire departments said they try to wait until four firefighters are in their firefighting gear and safely aboard the apparatus before it leaves the station, but they cannot always achieve that goal. Even in partially staffed stations (those in which one or two firefighters sleep in quarters), waiting can mean a substantial delay in turnout time.

Unless actions are taken to lower turnout time (as well as dispatch time), Wake County fire departments will not be able to provide service that meets the goals adopted by the Service Level Committee.

There are three basic ways to reduce response times:

1. **Decrease call processing time** – As discussed above, call-processing time in Wake County is substantially above the nationally recognized benchmarks and consensus standards. Serious steps need to be taken in the communications center to reduce call processing time. The new CAD will help but the extent to which it will make a difference will not be known until after it is in operation. (It was beyond the scope of this report to make recommendations for improvements in the dispatch center, but we felt it was important to comment nonetheless.)

2. **Reduce turnout time** – Every department should consider two alternatives for reducing turnout time:

   - Increasing paid staffing, and
   - Requiring volunteers to serve duty shifts in the station.

   The former is the surest (but most expensive) approach. The latter has been used with success in a small but growing number of fire departments in Wake County (e.g., Fuquay-Varina and Apex) and in many communities elsewhere in the country (e.g., Prince William County, Virginia; Prince George's County, Maryland; Montgomery County, Maryland). Adopting such a policy runs the risk

of driving away some volunteers or potential volunteers but may be attractive to others.[21, 22]

Wake County may now be at a point of system maturation (i.e., growth in demand and public expectations for service) where reliance on volunteers simply will not produce the desired results—there are too many calls at night and too many competing demands on volunteers' time. Moreover, as public consciousness of the importance of emergency services has been raised by television documentaries and "reality" shows, public expectations of level of service have increased significantly across the United States. Where the public may once have been tolerant of slightly longer response times because people understood that volunteers provided these services, this is no longer the case. The advent of the 911 call system, television shows like "Emergency!" and "Rescue 911," and widely publicized advances in emergency medical care has substantially reduced–if not eliminated—that tolerance. People who move into the County from highly urbanized areas also fuel the expectations of nationally recognized response time goals, as do increased taxes. Volunteers will (and should) continue to play a valuable role in the provision of emergency services in Wake County, but doing so will either require more from them in terms of time committed at the fire and EMS stations, or a larger corps of volunteers, and/or a larger number of full-time personnel, with volunteers acting in support.

3. **Reduce drive time** – There are several ways to reduce drive time. The two major approaches are driving faster to calls or locating stations more strategically. The first method includes use of traffic control devices like Opticon systems, which change traffic lights and give emergency vehicles the right of way. *Simply driving faster, pedal to the metal, will not produce the desired reductions in response times, but may well jeopardize lives and equipment*. Under no circumstances should a department or individual attempt to lower response times by driving faster. Optimization of station locations and adding station is the most viable means to reduce drive times significantly. It is to this end that the majority of this report is dedicated. In the following chapter, station location scenarios are discussed that would reduce drive time and keep within the goals of the Service Level Committee.

[21] Staffing was outside the scope of the base study, but is addressed in an add-on. The surest response would be to have 3-4 person career staffing on duty around the clock. Ultimately, this may be desired as the county gets more urbanized and call volume increases or losses raise to unacceptable levels.
[22]Requiring volunteers to fill set duty nights has proven attractive to retention of volunteers in some communities because their time commitment is limited and known in advance. This means that volunteers who are not on duty do not feel compelled to respond to every call every night. See *Recruitment and Retention in the Volunteer Fire Service*, Final Report, December 1998, U.S. Fire Administration and

The station location recommendations made in this report are based on analyses that assume call processing and turnout time each takes one minute or less, 90 percent of the time. Achieving the turnout goal time is extremely difficult for substantially volunteer departments. Wake County's fire service is neither substantially career nor substantially volunteer, and setting these targets at one minute is not an unreasonable goal for the future. Until such time as the goals are met, it is highly unlikely that desired fire department service level targets would be met. It is less expensive to reduce call processing and turnout time than to achieve the equivalent by redeployment or adding stations. This should be the highest priority to achieve countywide reductions in response time.

Recommendation 4: County fire departments should improve their turnout times by implementing duty night programs to assure adequate volunteer staffing in station, or by other means. Ultimately, more use of career staffing may be needed. As noted earlier, the base study here was to address station locations not staffing. More about staffing will be addressed in the companion staffing report. Nevertheless, we thought it useful to note some of the staffing considerations here, since they are tied to response time goals. However, response times are affected not just by station locations but also by how long it takes firefighters to get to the vehicles.

Recommendation 5: Efforts should be made to reduce call-processing time to average no more than a minute. Though the study did not evaluate the emergency communication center, it is important to flag this need.

Emergency Medical Service Levels

Wake County has had defined EMS service level targets since November 1, 2001, when the Quality Improvement Council's Audit and Review Committee formally adopted an EMS response time goal of 0:11:59 with 90 percent reliability.[23] This response time goal is included in the County's service contracts with EMS agencies.[24]

National Volunteer Fire Council. The chief of the Bayleaf Fire Department contributed to this study, which was undertaken for USFA by TriData.

[23] The EMS Audit and Review Committee also adopted call processing time and turnout time goals of one minute at the 90 percent reliability level. This action underscores the importance of having such goals for the fire service too, to reduce response times.

[24] See the standard EMS contract under "Standards and Procedures, Section 1. Coverage and Mutual Aid."

The study team met with EMS chiefs and representatives of various EMS agencies in the county to hear their views about service level targets for EMS delivery. The group expressed a desire to be able to deliver the following levels of emergency medical service across the County (Table 6).

TABLE 6: ADDITIONAL EMERGENCY MEDICAL SERVICE LEVEL TARGETS PROPOSED DURING MEETING

Type of Service	90th Percentile Response Time for Emergency Calls
AED-equipped First Responder	0:04:59
ALS-capable Transport Unit	0:09:59

Note: Calls at the "Charlie," "Delta," and "Echo" severity levels are considered emergency calls. "AED" means Automated Electronic Defibrillator, needed in many cardiac cases. "ALS" means Advanced Life Support, having a paramedic and associated equipment needed to perform higher level emergency medical services, such as administering drugs, doing intubations.

These targets are substantially more aggressive than those adopted by the Audit and Review Committee. They recognize the fact that EMS is delivered both through ambulance/rescue departments and fire departments (which act as medical first responders throughout the County). The EMS group expressed its service level targets in terms of response times (i.e., inclusive of the call processing segment). This is largely in recognition of the fact that the ability of the EMS system to save a life hinges on the correction of certain medical conditions before irreversible brain damage occurs.

While the goal to place an Automated Electronic Defibrillator (AED) equipped first responder on the scene anywhere in the county in under five minutes is laudable, the ability of the system to meet that goal will be constrained by the fact that first response is performed by fire departments, most of which are presently unable to perform at that level. Further, as these response times include call-processing time, the EMS system is severely hampered by the performance of the 9-1-1 center, which consumes about half of the first responder service level target simply getting the call dispatched.

TriData treated these expressed additional service level targets as desired goals but used the officially adopted service level targets of the Audit and Review Committee in the station location and unit deployment analyses for this report.[25]

[25] Besides relocating emergency response units, another alternative to improve AED response times is to install AEDs in more businesses, institutions, and large facilities or properties (e.g., mall or golf course) for use by employees or others. This is a growing trend nationally. A related approach is to teach a large segment of the adult population how to use CPR and AEDs, as has been done in Seattle and Boston, to name two prominent examples.

Ladder Company Service Levels

Engine companies are the first-due units on structure fires; however, engine companies alone are insufficient to fight many structure fires. Certain specialized functions on a working structure fire—such as roof access, utility control, ventilation, and search and rescue—are generally assigned to ladder companies, which play an invaluable role in the setup, combat, and overhaul phases of fire suppression.

Because ladder companies are an expensive but relatively seldom used resource, it is not economically feasible for one to be deployed in each station. This means that the response area of a ladder company will be larger than that of an engine company. Accordingly, the response-time goals for first-in ladder companies are usually less demanding than for first-in engine companies; the drive-time goals for ladder companies may be longer by three minutes. (One county using this goal is Montgomery County, Maryland.[26]) The adjusted service level targets for ladder companies are shown in Table 7. These targets are more aggressive than the "balance of the full alarm" targets because without a ladder company on the fireground, setup can take much longer and be more difficult for taller structures.

TABLE 7: PROPOSED SERVICE LEVEL TARGETS FOR LADDER COMPANIES

	Urban	Suburban	Rural
Adjusted Field Segment Goal	0:08:00	0:10:00	0:12:00
Response Time Goal (to be communicated to the public)	0:09:00	0:11:00	0:13:00
Reliability	90 percent of all calls		

These service level targets were used in the development of the ladder company location scenario in Chapter VI.

[26] "Aerial Unit Study," Montgomery County, Maryland Fire and Rescue Commission Operations Committee, October 2001, p. 18.

Rural Water Supply Service Levels

Much of Wake County outside the larger cities does not have fire hydrants. The first-arriving fire apparatus might have only a 500-gallon tank. Given the minimum fire flow requirement of 188 gallons per minute (GPM) for a 25 percent-involved fire in an average single-family dwelling in Wake County,[27] it would be possible for a piece of apparatus with a 500-gallon tank and only a 750 GPM pump (the lowest capacity pump for an attack pumper) to exhaust its on-board water supply in under three minutes without making appreciable headway towards controlling or extinguishing the fire.[28] As a safety margin, we rounded the calculated fire-flow of 188 GPM to 200 GPM (assuming that two 1½" handlines were in use). This means that an engine with a minimum-size booster tank of 500 gallons would be able to flow water for 2.5 minutes before draining the tank. Assuming that it takes two minutes for the initial engine company to set up for fire suppression, additional water would need to be available within 4.5 minutes of the arrival of the first-in engine in order to assure a continuous water supply. Accordingly, the service level targets for first-due rural water supply units were set the same as those for engine companies.

To be conservative, we assumed that the first-in water supply unit had only a 1,000 gallon tank. Allowing two minutes for that unit to set up its portable tank and dump its initial load of water, the engine would have an additional five minutes of water supply available to it, bringing to 7.5 minutes the total possible pumping time available to the first-in engine company. Allowing a safety factor of one minute pumping time meant that additional water from a second-in water supply unit would need to be available within 6.5 minutes in order to assure a continuous water supply to the first engine. Therefore, second-due rural water supply units were given an extra 6.5 minutes of drive time beyond the first-due units. Table 8 shows the service level targets for rural water supply apparatus.

[27] Fire flow is the amount of water (expressed in gallons per minute or GPM) needed to extinguish a fire including a certain percentage of a structure of a given size. TriData and the Wake County Fire Marshal's Office calculated the fire-flow requirements for a 2,041 square-foot residence (the average house size in Wake County), assuming 25 percent involvement, to be 188 GPM. NFPA 1710, Annex A.5.2.3.2.1, considers 2,000 square feet to be the norm for a two-story, single-family dwelling (quite similar to the average Wake County house size of 2,041 square feet): "All communities respond to fire incidents in this type of structure on a regular basis …."

[28] In fact, with a 1000 GPM pump (which would be considered standard in many areas of the country), a 500-gallon tank would be pumped dry in 30 seconds.

TABLE 8: PROPOSED FIELD SEGMENT TARGETS FOR RURAL WATER SUPPLY APPARATUS

Running Order	Urban	Suburban	Rural
First-Due	0:05:00	0:07:00	0:09:00
Second-Due	0:11:30	0:13:30	0:15:30
Third-Due (Balance of the Full Alarm)	0:13:00	0:15:00	0:17:00
Reliability	90 percent of all calls		

Third-due tankers were expected within the balance of the full alarm (17 minutes drive time, or 18 minutes after dispatch).

On a related note, we observed that the definitions of pumpers, pumper-tankers, and tankers differed from department to department in the County. This makes it difficult to set service level standards for rural water supply. Recommended standards and designation for rural water supply units and other apparatus will be discussed in Chapter V.

IV. STATION LOCATION SCENARIOS

This chapter discusses a variety of scenarios for locating fire and EMS stations and makes recommendations as to reasonable choices for the future based on what is known about growth trends in the County and the capability of the current system of stations. The station location scenarios are described and assessed against current station deployments and each other.

It is beyond the state of the art to identify the optimal scenarios, and even some question of how to measure optimality. Nevertheless, one can identify several reasonable scenarios for improvement and determine about which are likely to work best.

The scenarios in this chapter were developed by TriData, based on a combination of analyses, professional judgment, experience, and a variety of sources. We used some scenarios provided by fire and EMS departments *as a starting point* for analysis. The conclusions and recommendations of this chapter are TriData's alone.

> *Note: The reader is directed to the accompanying map book, with the set of GIS maps referenced in this section. The maps are bound in a separate document to facilitate reading them while following the narrative.*

The over-riding vision here is to move toward a seamless system of fire and EMS stations in the future with closest units responding, all units backing each other up, and dispatched as an integrated system. The vision also is to retain the volunteer or combination (career and volunteer) units as long as possible and to consider views of all stakeholders as input to the planning process. The goal is to achieve an effective and efficient emergency response system, despite the political pressures and other factors that may not allow an ideal system to be created in the near-term.

Basics of Station Location Analysis

Anyone who looks at an old fire station location study will probably have seen a map with fire stations marked and concentric circles or diamonds drawn around the stations to show the "effective reach" of their units (i.e., distance within a reasonable drive time). Until just a few years ago, the simple circles and diamonds were drawn due to the limited technologies available to fire station planners to easily complete the more complex, actual reach. The object of the exercise was to place fire stations in a manner that maximized the area of the fire service district covered by the circles or diamonds. This is roughly the methodology used by many fire departments when they do self-assessments of station locations in preparation for an Insurance Services Organization (ISO) review.

Simple geometric representations of effective reach (the circles and diamonds) do not reflect the actual street network and the fact that fire apparatus cannot travel "as the crow flies." Also, the effective coverage of fire stations planned in an area with congested traffic is not the same as in a less congested area. Additionally, some roads (e.g., highways) are "straight shots" and can be navigated at high speeds, whereas others are narrow or curvy and must be driven more slowly. To show the problem of using a five-mile circle, consider the Dutchville area of Wake County. A five-mile planning radius from Stony Hill Station 2 covers much of the Dutchville area, but the old saying, "you can't get there from here," applies. A fire response based on the existing road network necessitates driving into Granville County and back down into Wake County. For these reasons, the simplistic radial distance-based approaches to fire station planning are subject to criticism as being inaccurate in many cases.

With the advent of geographic information systems (GIS), modern fire station location analyses can produce the more accurate, irregularly shaped polygons around each station that show the true effective reach of apparatus. The GIS programs allow planners to draw these polygons based on travel times calculated using the actual road network in the county and a variety of potential factors such as time of day, speed limits, and traffic patterns, to the extent that supporting data are available.

TriData has taken a conservative approach by assuming that emergency vehicles will travel an average of 10 mph below the posted speed limits of the Wake County Road network. This compensates for the fact that GIS software calculates road travel time without accounting for acceleration and deceleration around curves, at stop signs, and in traffic. This conservative approach helps ensure that effective reach is not accidentally overstated, and was agreed upon during County review of the first draft of the report.[29]

One final introductory note: The maps that accompany this section show *estimated drive time*. They do not represent total incident response times because these calculations do not include call processing time and turnout time, just the drive time. Also, the drive times are estimates because actual drive times vary based on weather, road conditions, traffic patterns, driver knowledge, and other factors that vary from incident to incident, and cannot be reliably modeled. Data with which to further refine response models were not available. Nevertheless, these maps illustrate the comparative effective reach associated with the various scenarios presented in this chapter.[30]

[29] One could do another analysis with speed limits reduced by, say, five or seven miles per hour, if desired.
[30] An analysis using actual everyday fire and EMS vehicle speeds would be best, but would require data from the forthcoming new CAD system being developed by the County.

Methodology

The County was divided into four regions (quadrants) to facilitate analysis and display the results. (It is difficult to view the entire County in sufficient detail in an 8½" x 11" format.) For each of four regions we produced a series of maps:

- A map of the current effective reach (ER) of existing stations (and ones under construction) showing CY 2002 calls[31] that fell beyond the effective reach (BER).
- Maps of the projected population density for each TAZ for both 2010 and 2018 (seven and 15 years from the present), showing both ER and BER areas.

Effective reach is the area that can be reached from a given station within the service level target response time for that type of area (urban, suburban, or rural).

Using these maps, we performed a two-step analysis. First, we identified areas of current service deficiencies. We looked for clusters of calls beyond the effective reach of a station. Then, as a benchmark for comparing the efficiency of scenarios, we determined whether the count of these calls exceeded the Service Level Committee's operational tolerance.[32] TriData also counted the road miles beyond effective reach (BER). Using all of this information, we highlighted (with red circles) parts of the region that appeared to need additional resources in order to meet current demand.

Although one can estimate the number of calls for a TAZ using the demand projection techniques described in Chapter II, one cannot predict the exact locations of future calls within a TAZ. This means the analytical methodology employed to determine current service deficiencies cannot be used to project future deficiencies. Therefore, as the second step of the analysis, we compared ER and BER areas against the projected call volumes and populations for each TAZ for the years 2010 and 2018. We sought to identify areas of increased population or demand that were beyond the effective reach of a station (i.e., areas with probable future service delivery shortfalls).

Once the current and future service gaps were identified, we considered various scenarios—sets of station locations that would reduce drive times. We considered the opinions of the local professionals we interviewed as to possible sites, and we developed our own set of possible locations. To test the scenarios against each other, we produced a

[31] CY 2002 was the latest full year for which data were available.
[32] This check against the operational tolerance approximates only first-*due* responses, whereas the service level targets are for first-*in* responses. Because the data do not identify which responding apparatus stopped the response time clock, it is not possible to segregate the calls that exceeded the operational tolerance because they were covered by a second-due apparatus. This means that the analysis is, of necessity, limited to examining the ability of a station to cover its first-due area. Accordingly, these counts are used to compare scenarios against each other. They are a relative, not an absolute indicator of compliance with the service level targets.

map of each scenario, a selected set (not all) of which follows the maps of the current status for each quadrant. We performed a series of calculations to compare reductions in road miles BER[33] and numbers of actual CY 2002 calls that would be BER.[34] We used these measures to arrive at the recommended scenario for each region. We tried to identify feasible scenarios that would maximize effective reach and still be affordable.

Criteria Used in Assessing Station Locations

The study team was asked to provide criteria for determining the need, location, size, and opening date for new or expanded stations and for evaluating the consolidation or closure of existing facilities.

New or Expanded Stations – There are no nationally accepted standards for determining need, location, size, or timing for new fire stations. The following criteria were used for this study and can be used by the County in the future:

- ***Need*** – Generally speaking, one should view gaps in coverage combined with significant current or future call volume as the primary indicator of a need for opening a station where one has not existed before.

  In prior studies, and after discussions with local fire, EMS, and elected/ appointed officials, we have generally used the rules of thumb of adding a new station when an area without adequate coverage would generate about 500 calls per year (i.e., one to two calls per day). This is not a hard and fast rule. Other variables, including risk factors, the nature of the occupancies protected, distance from the next closest stations (the ability to meet the 90th percentile response time goals), terrain, limitations on access (e.g., railroad tracks or bodies of water), and the willingness of the public to pay for it can militate in favor of a station that might run fewer than 500 calls per year.

  Improving response time to be in compliance with a service level commitment is a second reason to add or relocate a station. There are limits to this approach, however. For example, should one build a station that responds to a handful of

[33] This is a complicated analysis because as the TAZs a given station serves change in nature from rural to suburban or urban, their associated service level targets (and hence the effective reach of the station) will also change.
[34] Again, we used the FY2002 call volume and locations as a proxy for determining comparative effectiveness of station locations (present and proposed). The figures are not meant to be actual projections of the calls BER of any station in the future.

calls each year in order to meet service level targets? Judgment is needed on when to open a station with low demand; the decision is often political.[35]

A third consideration for opening a new station is when demand exceeds the capability of the unit or units in a current station, and another unit needs to be added. It sometimes can have a better impact on response time to put the new unit in its own station as opposed to being a second unit in an existing station. Which is better depends on the geographic distribution and simultaneity of calls. It may be better to add a second unit to an existing station if the calls are symmetrically distributed around the station and there are frequent call overlaps. If the distribution is skewed (as when a nursing home or large new development opens), then positioning the unit near the new demand center may be preferable. As can be seen, a number of variables must be considered.[36]

- ***Location*** – Once the need for a fire/EMS station in an area has been established, the specific location must be addressed. Generally, fire stations should be sited to allow rapid access to major streets, but not directly on a high-volume street if possible.[37] In some areas, station locations will be limited by zoning requirements. Other considerations include availability of land (for sale or for donation), the suitability of the land (slope, surface permeability, soil density), availability of public utilities, and neighboring uses, such as a nursing home or hospital, which might preclude the noise levels associated with a fire and EMS station.[38] Fire stations should not be located adjacent to elementary schools if possible, as small children walking to or from school may be hard for apparatus operators to see at times, thereby posing an unnecessary danger to the children.

- ***Municipal-County Station Sharing*** – For purposes of development of these scenarios, and consistent with Wake County's "nearest unit" or "seamless" response objective, we considered municipal fire stations that could potentially serve unincorporated Wake County in meetings its service-level objectives as response partners. However, this criterion does not imply a Wake County responsibility to share the cost of addition, renovation or replacement of any fire station located in a municipality unless the addition, renovation or removal helps

[35] To cite one example from a past client: Palm Beach County, FL, which has one of the most sophisticated approaches to planning fire resources, is contemplating placing a station in a remote part of the county to meet a demand of less than 50 calls per year, because of political pressure.
[36] This is not meant to be a treatise on station site design; the focus here is on location of stations, not the details of their site or structure.
[37] Fire stations usually should not be located on extremely busy streets because of the dangers associated with pulling into traffic during an emergency response. Stations that must be located on busy streets preferably should be equipped with traffic signals that can be controlled from the station or apparatus.
[38] Although fire stations have become considerably quieter than in the past, they are still relatively noisier environments than other uses.

Wake County meet its service-level objectives in a response area where those objectives are not being met. We discuss principles for cost sharing in Chapter VII.

- ***Size*** – There is no recognized standard for minimum lot sizes for fire stations. Size is in part a function of the number of bays and the types of apparatus housed as well as other desired features of the building, such as training space, offices, and bunk rooms. On-site storm water retention, building setbacks, and potential for expansion must be considered.

  The U.S. Fire Administration's manual on fire station construction recommends a front apron at least 15 feet longer than the longest anticipated response apparatus to be housed at the station and that there be a rear apron of 125 feet to accommodate the turning radius of apparatus needing to turn around in the back of the station.[39]

  In Wake County, station sites often require three acres to comply with numerous building and zoning regulations, and with necessary site improvements and setbacks. It is essential that potential station expansion be considered in selecting potential building sites. Fire departments often expand the types of services offered or need additional apparatus as demand increases or the nature of the building construction in an area changes over time.

- ***Date of Opening*** – In general, stations should be built in advance of residential or commercial construction that will increase demand for services, when it is clear that such development will take place. There are two reasons for this. First, purchasing land, securing funding, and obtaining clearances to build a fire station is easier and less expensive before the ancillary development occurs. Increasing numbers of communities are land-banking sites for future fire and EMS stations when they are fairly certain they will be needed. (Often, at worst case, they are a good investment or can be swapped for better-located parcels). The second reason is the lead-time needed to obtain a site and construct a station. Preliminary planning and conceptual design work for new stations should begin about two years prior to anticipated need. This allows sufficient time for permits approvals, design, bidding, and some allowance for unforeseen construction delays. It also allows time for operations at the station to ramp up and be "debugged" prior to the onset of the station's real demand. Depending on their extent, renovations of stations generally should be started one year in advance of anticipated need.

[39] U.S. Fire Administration, *Safety and Health Considerations for the Design of Fire and Emergency Medical Services Stations* (FA-168), Emmitsburg, MD (1997), p.27

With all of the above in mind, we factored projected growth into the recommendations for station locations, using the County's desired planning horizons of 2010 and 2018.

Consolidations or Closures – There are two primary criteria for the consolidation of two or more stations or for the closure of a station. The action should either (a) reduce costs while retaining adequate service levels in the service area as a whole or (b) maintain cost levels and improve service levels. It is a cost-effectiveness tradeoff. This does not mean that the proposed action should be rejected if it results in lower service to *some* properties or people. Every consolidation or closure will affect some people adversely. Consider the case of two fire stations with an overlap of 90 percent in their service areas. Obviously if one station were to be closed, the person living directly next door to that station would receive a lower level of service. However, overall, the average resident or property owner generally would be unaffected, or see services improved. Few would argue (especially in tight fiscal times) that both stations should be kept open simply because the immediate neighbors of one station would receive slower service than they had been receiving (as long as the overall service was still within the service level target). For this reason, jurisdictions should not use a local veto approach (i.e., not closing a station because a small number complain), but rather, a utilitarian approach (i.e., "the greatest good for the greatest number of people") in making closure decisions.

It is critical to note that when we refer to a station "closure," we are referring to a process. The fire station closure process does not begin with the closure of a fire station; rather, the decision to close a fire station follows a determination that (a), there is a more effective and efficient alternative available for delivery of fire protection services in a given service area, and (b) the alternative fire department is ready and willing to negotiate an agreement with Wake County to do so.

In this study, we identified service areas that, in terms of nationally recognized deployment standards, can be more efficiently served from another station (or another department) than from an existing station. We also established that the fire departments that could deliver fire services more efficiently are prepared to discuss agreements for delivery of those services with Wake County. (Negotiation of contracts with the fire departments that could deliver the service was beyond the scope of this project.)

Co-Location Options – In the process of formulating development options, we considered opportunities for co-location of fire and EMS units. Because people are the main cause and victims of fire and EMS emergencies, EMS and fire demand zones often coincide. In general, EMS units should be co-located with fire units unless there is a special circumstance precluding that. Co-location is discussed in more detail, later in this chapter.

Assumptions

We made a number of assumptions in designing station location scenarios. (These were discussed with the project coordinator for the County.)

Planned Roadways Counted as Existing – Where a roadway is scheduled by NCDOT for construction we treated it as an existing roadway in the analyses of future scenarios.[40]

Municipal Annexations – Current extraterritorial jurisdictions are a proxy for municipal corporate boundaries in five years. Short-range urban service areas are a proxy for municipal corporate boundaries in 10 years. We used these boundaries on the analytical maps. They may be helpful in determining which suggested station and apparatus would be primarily for the incorporated vs. unincorporated areas.

Planned Reservoir Excluded – The planned Little River Reservoir in eastern Wake County will not be constructed before 2020. Hence, we excluded it from the analysis.

Unstaffed Stations Excluded – Stations that have no assigned staff or no regular cadres of volunteers were treated as not existing for purposes of first-line response needed to meet response time goals. In Wake County, this applied only to Durham Highway Station 2 (CID 17).

Fire Districts That Do Not Exist – The present system of dispatching units by fire district is neither effective nor efficient. A citizen calling for help in an emergency does not care what department responds—as long as it is the closest one available. A more distant emergency resource should not be dispatched to an emergency simply because the event occurred on one side of an arbitrary district line. The analyses were undertaken without regard to current fire district lines and using the concept of "proximity-based dispatch" of response resources consistent with progressive fire service delivery practiced normally, and with the County's own standard of operation with its new CAD system.

County-Municipality Cooperation/Contracting – A corollary to the concept of proximity-based dispatch is the desirability of having incorporated municipalities provide service to some areas of the County that are presently covered by County fire departments and vice versa. The principal of dispatch of the nearest resource should ideally include all fire departments and cover all citizens in the County. It should be beneficial and fair to all parties. This will require the County to negotiate agreements with the municipalities. In considering the scenarios that follow we assumed that this

[40] It was not possible to geocode every planned roadway correctly. The future highways did not have on and off ramps specified. Accordingly, a few roadways were incorporated into the analysis by "eyeballing" the probable effect they would have on responses. This is admittedly unscientific; however, it was the best that could be done, and better than ignoring the change.

higher level of County-municipality cooperation exists. We strongly recommend this approach.

Recommendation 6: The County should negotiate arrangements for municipalities to cover unincorporated areas near them when in the interests of the majority of citizens in the area. It is wasteful for multiple stations to exist virtually side-by-side in an area that can be served by one station. A seamless system of stations serving all the citizens of the County should be the goal. Political disputes about turf should be resolved in the greater interest of a cost-effective system.

Cost Vs. Coverage Trade-Off – Greater coverage to meet service level goals requires more stations, apparatus, and personnel. As discussed earlier in discussing response time goals (service levels), we attempted to limit to 10 percent the number of calls that have a field segment (turnout time plus drive time) of greater than five minutes in urban areas, seven minutes in suburban areas, and nine minutes in rural areas. In some areas of the County, this is not feasible without building a new station. However, there is a point of diminishing returns at which it becomes prohibitively expensive to place stations in low demand areas (less than a call a day or 365 a year) to meet the goals. Of course, ultimately it is up to the citizens of the County to make final decisions on service levels and what they are willing to pay for. We used judgment and the above conditions regarding when to add a station.

Turnout Times Lower Than They Are Now – One of the main causes of prolonged field segments (and, by extension, prolonged response times) is the lengthy turnout times that Wake County fire departments have, as discussed earlier. Much of the reason for these long turnout times is the reliance on volunteers who respond to calls from home. It is likely that, over time, many departments will rely more on paid firefighters or on volunteers who sleep in the station. This was another strong recommendation we made earlier and a necessary ingredient in the formula to reduce response times. Without lowering turnout times there will be no way to achieve the service level targets. We assumed a countywide turnout time of one minute in the scenarios considered (we recommended that as a goal earlier in the report).

Call Processing Times Lower Than They Are Now – We also assumed that needed improvement in the 9-1-1 center will be made and that call processing times are reduced to one minute.

Rural Water Supply Units Are First-Due – Because much of the county lacks fire hydrants, the analysis of deployment of rural water supply units (tanker and pumper-tanker) treats them as first-due units even though they may not yet be listed as a first-due unit in the CAD system.

Location Scenarios

Below are descriptions of a recommended set of station realignment scenarios developed during this study, and some of the alternative scenarios considered. They are presented by region because it is easier to see the impact of realignment at the scale versus the entire County. As noted earlier, these scenarios were chosen after examining the existing and future demand data and many alternatives. The scenarios presented here combine our professional judgment with results of a number of GIS analyses. We do not include here all the scenarios we considered, just the ones thought to be the best.

Along with the description of a region's problem areas and the scenarios studied, a table is provided after each set of scenarios that summarizes the comparison benchmarks for 1) percent of calls BER (beyond effective reach), 2) percent of road miles BER, and 3) comparative cost.

These scenarios should be read with the accompanying map book. For each region, the first map indicates the current status of the region and shows calls that occurred in areas beyond the projected effective reach of any station.[41] The next two maps overlay projected population densities and call volumes in 2010 and 2018 with the current effective reach to identify potential problem areas in the future (areas beyond effective reach with non-trivial call volumes). Following these initial five maps are two maps showing the effect of the changes proposed in the recommended scenario, i.e., with the recommended new stations, closed stations, moved stations, and consolidated stations.

All proposed station locations are approximate (even when an exact address was indicated); the locations can be fine-tuned based on land availability, cost, and other factors. For doing computations we had to pick a spot for each. The idea is to be able to test a station location within a block or two of where it might actually be. Ideally, the locations (or something close) would be available for new stations. We did not attempt to verify the availability of individual parcels.

Land within the corporate limits of Raleigh is excluded from the scenario (except for some "doughnut hole" areas in Raleigh that are still unincorporated). The focus of this study was the unincorporated regions of the County. Other municipalities are included to the extent that they have or might add a station that impacts service to the unincorporated areas of the County. We believe it is in the best interest of the citizens in the County to have a seamless, integrated system for fire service delivery as well as the current EMS delivery. This will undoubtedly take patience and negotiation over several years.

[41] Effective reach varies by station type (e.g., urban, suburban, or rural).

NORTH REGION

The North region is composed of the Bayleaf Fire Department, the Durham Highway Fire Department, Six Forks Rescue, the Stony Hill Fire Department, the Wake Forest Fire Department, and Raleigh Fire Department Stations 25, 23, 18, 4, 22, 17, 16, 9, and 15.

Current Status and Problem Areas

Of the 2,246 geocodable calls[42] that occurred in the North region in 2002, 372 (or 16.6 percent) fell outside the effective reach of existing stations. Of the 1,114 existing road miles in the North region, 296 road miles (or 26.6 percent) fell beyond the effective reach of the present stations (Map 1).

The primary areas of concern are north and west of the town of Wake Forest (shown in a red circle on the map). These areas have a current service deficiency (in terms of a concentration of roads beyond effective reach of existing Wake Forest stations). Further, examination of the growth in population and call volume reinforces the need for stations to the north and west of Wake Forest by 2010 (Map 2). The problem continues into 2018 (Map 3).

The scenarios considered here and elsewhere are to improve overall service levels or improve efficiency of expenditures and precious volunteer time or both.

Scenario N-1

- Close Bayleaf Station 3 as a fire station; continue to use it as an EMS station
- Close Falls Station 1

This scenario involves closing only two stations. Bayleaf Station 3 serves a few "doughnut holes" within Raleigh. It is suitable for use as an EMS station, but it provides little value as a fire station because so few fire calls occur in the areas it covers. Annexations by the City of Raleigh have all but eliminated the unincorporated areas protected by the Falls Fire Department. The populations and call volumes of the areas protected by these two stations will remain relatively stable over the planning horizon of the report. The project team felt that these two stations could be closed without substantial service impact. The majority of calls that would be run out of either station would be in areas surrounded by the City of Raleigh.

[42] Not all calls in the dispatch database can be "geocoded" (i.e., converted from a street address into a GIS format). Some reasons for this: incomplete addresses, use of non-standard information (i.e., landmarks or mile markers). Of the 27,798 calls in the 2002 dispatch database, 4,700 (or 16.9 percent) were unable to be geocoded. Calls for Raleigh are not included as only half of Raleigh's 2002 data were available.

It is far more efficient for a municipality to cover the doughnut holes, especially small, scattered ones. The small incremental increase in call volume for the municipality would not overload any municipal station. The municipalities involved would be compensated based on an agreed upon formula. (Cost allocation models for contracting this call volume with the municipalities are discussed in Chapter VII.)

There would be no cost savings on the conversion of Bayleaf Station 3 to an EMS station. The projected cost of the needed repairs ($262,395) would be shifted from the Fire budget to the EMS budget. Since only the most urgent short-term repairs would be made to the Falls Fire Station (amounting to $6,274), there would be cost savings of $183,390[43] in station improvements, based on the Heery report estimates.[44]

Scenario N-2

- Close Bayleaf Station 3 as a fire station; continue to use it as an EMS station
- Close Falls Station 1
- Build a new Wake Forest station at Main Street and Harris Road
- Build a new Wake Forest station in the 12200 block of Wake Union Church Road
- Build a new joint EMS/fire station at Durant Road and Koupela Road (labeled "EMS" on Map 4.

This scenario includes the conversion of Bayleaf Station 3 to an EMS station and the closure of Falls Station 1. Additionally, stations are added in the west and north of Wake Forest to deal with the current and future service gaps in those areas. Finally, an EMS station with co-location potential for fire units is added at Durant Road and Koupela Road. This is to provide better coverage in the area south of the current Falls Fire Department and southeast of Bayleaf Fire Department. It is unlikely that fire services would be needed there until 2010 to 2015; however, it would be good to have the flexibility to add fire suppression resources to that area as it is currently beyond the effective reach of any surrounding fire station.

[43] Costs in this chapter are approximate and based on early cost data provided by the County. The numbers were updated in the CIP table in Chapter VI, which has been treated as the actual planning tool and given more attention.

[44] All construction costs discussed in this chapter are quoted in 2001 dollars (as they are in the Heery Report). The Capital Improvement Plan developed in Chapter VI calculates costs adjusted for inflation and including fees and project contingency. The costs were based on data from Wake County. Although given as "exact" estimates, based on the spreadsheet program, they need to be reassessed when the time comes; these numbers are intended for long-range planning purposes.

New construction costs for two new fire substations in Wake Forest are estimated to be $2,828,040. A new joint EMS/fire station at Durant Road and Koupela Road is estimated to cost $1,924,899.

Scenario N-3 (Maps 4 through 6)

- Close Bayleaf Station 3 as a fire station; continue to use it as an EMS station
- Close Falls Station 1
- Build a new Wake Forest station at Main Street and Harris Road
- Build a new Wake Forest station at Thompson Mill Road and Elmo Drive
- Build a new joint fire/EMS station at Durant Road and Koupela Road

This scenario is a slight modification of North Scenario 2. It brings the proposed new station in the western part of Wake Forest a little further west than the location in North Scenario 2.

Construction costs would be the same as those for North Scenario 2.

TABLE 9: NORTH REGION SCENARIO COMPARISON

Scenario	Current	N-1	N-2	N-3
Calls BER	372	427	158	156
% Calls BER	16.6	19.0	7.0	7.0
%Δ in Calls BER	**–**	**+2.4**	**-9.6**	**-9.6**
Current Road Mi.	640.9	640.9	640.9	640.9
Current Road Mi. BER	155.7	173.2	98.0	89.3
% Road Mi. BER	24.3	27.0	15.3	13.9
%Δ in Road Miles BER	**–**	**+2.7**	**-9.0**	**-10.4**
2010 & 2018 Total Road Mi.	628.1	628.1	628.1	628.1
2010 Road Mi. BER	155.2	169.1	96.2	88.2
% Road Mi. BER	24.7	26.9	15.3	14.0
%Δ 2010 Road Mi. BER	**–**	**+2.2**	**-9.4**	**-10.7**
2018 Road Mi. BER	158.6	175.3	99.0	91.0
% Road Mi. BER	25.3	27.9	15.8	14.5
%Δ 2018 Road Mi. BER	**–**	**+2.6**	**-9.5**	**-10.8**
Cost	–	$268,669	$5,021,608	$5,021,608

Note: Shaded column is the recommended scenario.

Recommendation

As shown in Table 9, North Scenario 3 is preferable to North Scenario 2 because it affords greater coverage of areas with service deficiencies northwest of the Town of Wake Forest without loss of effective reach in the Capital Boulevard corridor. Scenario 2 is only slightly worse in coverage and a good alternative, if needed.

EAST REGION

The East region is composed of the Eastern Wake Fire Department, the Hopkins Fire Department, the Knightdale Department of Public Safety, Knightdale EMS, Rolesville EMS, the Rolesville Fire Department, the Wake-New Hope Fire Department, Wendell EMS, the Wendell Fire Department, Zebulon EMS, the Zebulon Fire Department, and Raleigh Fire Department Stations 15, 19, 27, 11, 21, and 7.

Current Status and Problem Areas

Of the 3,193 geocodable calls that occurred in the East region in 2002, 405 (or 12.7 percent) fell outside the effective reach of the present stations. Of the 1,206 existing road miles in the East region, 268 road miles (or 22.2 percent) fell beyond the effective reach of the present stations (Map 7).

There are two primary areas of concern in the East region. First, the western portion of the Town of Knightdale has a current service deficiency with a large cluster of calls in a suburban area (shown in a circle on Map 7). The second problem is a rural area southeast of the Town of Knightdale near Lake Myrna (shown as a dashed oval on the map). Although this area should remain fairly rural through 2018, it lies beyond the effective reach of either the Wendell or Eastern Wake Fire Departments (see Maps 8-9). Further, the call volume is projected to increase moderately over the planning horizon of the study.

Scenario E-1

- Close Wake-New Hope Station 1 (We later recommended relocating an EMS unit to it.)
- Co-locate Knightdale DPS in Eastern Wake Station 2
- Build a new Knightdale DPS station near 2128 Mingo Bluff Boulevard

This scenario involves closing Wake-New Hope Station 1, which lies entirely within the City of Raleigh. The unincorporated areas served by this station could just as easily be served by the Raleigh Fire Department (assuming that it acquires rural water supply resources that will allow it to protect the non-hydranted areas west of the Neuse River; the County might transfer a rural water supply unit to the Raleigh Fire Department to help them do this.

The Knightdale DPS is operating out of a maintenance facility about four blocks from Eastern Wake Station 2. This facility is not well suited for use as a fire station. This scenario suggests co-locating the Knightdale DPS in the facility at 401 Hester Street. There is little point to having two stations virtually side-by-side in the eastern portion of Knightdale. It is a waste of resources.

Finally, the scenario addresses the current service deficiency faced by the Knightdale DPS in the western portion of the Town of Knightdale. A significant concentration of calls beyond the effective reach of any station now exists in that area. The Town has identified what it considers to be a suitable site it owns near 2128 Mingo Bluff Boulevard. Given that a station placed anywhere in that area will produce the needed effective reach for the City and surrounding unincorporated area, the scenarios for the East region use the Town's recommended site, but it could be somewhere else in that area, in the unincorporated area, if a reasonable arrangement cannot be reached between the County and the Town on sharing costs of the new station. As the incorporated area of Knightdale is planned to expand over the next 5-10 years (see the maps book), the proportion of the cost borne by the Town should increase over time until it bears the full cost when the first due area is essentially all incorporated into the town.

Closure of Wake-New Hope Station 1 would be expected to avert $386,525 in renovation costs. Use of the Hester Street facility by the Knightdale DPS would require $788,597 in renovation costs (which would need to be expended in any case to keep the facility open for use by the Eastern Wake Fire Department); however, this amount would be shared with the Town of Knightdale (see Chapter VII). Construction of a new station on Mingo Bluff Boulevard is estimated to cost approximately $1,424,020.

A problem in consolidating the stations is that Knightdale uses police officers and town workers to staff the fire units, and has said it does not want them responding to calls outside the Town on a regular basis. Also, their station does not have a tanker needed for responding to fire outside the hydranted area. One alternative is for the County to pay the Town for the time, insurance coverage, and other costs of using its employees, and provide the tanker. Another is for a cost-sharing arrangement for augmenting the paid staff of the station. The solution needs to be negotiated promptly by the county and town; it is highly inefficient for the taxpayers to support two stations in an area where one would suffice.

Scenario E-2

- Close Wake-New Hope Station 1 as a fire station. (We later recommend keeping it open as an EMS station and relocating an EMS unit to it.)
- Relocate Knightdale DPS to 401 Hester Street
- Build a new Knightdale DPS station near 2128 Mingo Bluff Boulevard
- Relocate Eastern Wake Station 2 to the 3200 block of Smithfield Road

This scenario shares two elements with East Scenario 1—closing Wake-New Hope Station 1 and building of a new station on Mingo Bluff Boulevard. The scenario also recognizes the inadequacy of the Knightdale DPS facility on Robertson Street and moves the resources there to the station at 401 Hester Street. The Eastern Wake units located at

401 Hester Street would be relocated to a new station in the vicinity of the 3200 block of Smithfield Road in an effort to improve coverage southeast of the Town of Knightdale (versus co-locating at 401 Hester Street with the Knightdale DPS).

Closure of Wake-New Hope Station 1 would be expected to avert $386,525 in renovation costs. Use of the Hester Street facility by the Knightdale DPS would require $788,597 in renovation costs (which would need to be expended in any case to keep the facility open for use by the Eastern Wake Fire Department); however, this amount would be shared with the Town of Knightdale (see Chapter VII). Construction of a new station on Mingo Bluff Boulevard is estimated to cost approximately $1,424,020. Construction for the station on Smithfield Road would also cost approximately $1,424,020.

Scenario E-3

- Close Wake-New Hope Station 1 (We later recommended relocating an EMS unit to it.)
- Relocate Knightdale DPS to a new station at Laurens Way and McKnight Drive
- Build a new Knightdale DPS station near 2128 Mingo Bluff Boulevard
- Close Eastern Wake Station 2

Under this scenario, Wake-New Hope Station 1 would be closed and a new Knightdale DPS station on Mingo Bluff Boulevard would be built. The scenario also recognizes the inadequacy of the Knightdale DPS station on Robertson Street and moves the resources there to a new station to be built on land owned by the Town of Knightdale at Laurens Way and McKnight Drive.

The scenario seeks to avert costly renovation of the station at 401 Hester Street by closing the station. We compared the effective reach of a station at Hester Street with one at Laurens Way and McKnight Drive. Relocation to Laurens Way has no adverse impact either inside or outside the corporate limits of the Town of Knightdale as the effective reach of a station at Laurens Way and McKnight Drive overlaps the current effective reach from 401 Hester Street.

Closure of Wake-New Hope Station 1 would be expected to avert $386,525 in renovation costs. Closure of the Hester Street facility would be expected to save $788,597 in renovation costs. New construction under this scenario would include $2,252,154 for a new station at Laurens Way and $1,424,020 for the station on Mingo Bluff Boulevard.

Scenario E-4 (See Maps 10–12.)

- Close Wake-New Hope Station 1 (We later recommended relocating an EMS unit to it.)
- Relocate Knightdale DPS to a new station at Laurens Way and McKnight Drive

- Build a new Knightdale DPS station near 2128 Mingo Bluff Boulevard
- Relocate Eastern Wake Station 2 to the 3200 block of Smithfield Road

This scenario is a variant of East Scenario 3. Instead of simply closing Eastern Wake Station 2, it is relocated to the 3200 block of Smithfield Road.

Closure of Wake-New Hope Station 1 would be expected to avert $386,525 in renovation costs. Closure of the Hester Street facility would be expected to save $788,597 in renovation costs. New construction under this scenario would include $2,252,154 for a new station at Laurens Way and $1,424,020 for the station on Mingo Bluff Boulevard, and $1,424,020 for the station on Smithfield Road.

TABLE 10: EAST REGION SCENARIO COMPARISON

Scenario	Current	E-1	E-2	E-3	E-4
Calls BER	405	275	250	297	251
% Calls BER	12.7	8.6	7.8	9.3	7.8
%Δ in Calls BER	**–**	**-4.1**	**-4.9**	**-3.4**	**-4.9**
Current Road Mi.	832.3	832.3	832.3	832.3	832.3
Road Mi. BER	139.2	120.0	110.7	124.8	112.0
% Road Mi. BER	16.7	14.4	13.3	15.0	13.5
%Δ in Road Mi. BER	**–**	**-2.3**	**-3.4**	**-1.7**	**-3.2**
2010 & 2018 Road Mi.	808.7	808.7	808.7	808.7	808.7
2010 Road Mi. BER	149.4	130.5	123.6	135.2	122.5
% Road Mi. BER	18.5	16.1	15.3	16.7	15.1
%Δ 2010 Road Mi. BER	**–**	**-2.4**	**-3.2**	**-1.8**	**-3.4**
2018 Road Mi. BER	155.4	136.4	129.6	141.2	128.5
% Road Mi. BER	19.2	16.9	16.0	17.5	15.9
%Δ 2018 Road Mi. BER	**–**	**-2.3**	**-3.2**	**-1.7**	**-3.3**
Cost	–	$2,212,617	$3,636,637	$3,676,174	$5,100,194

Note: Shaded column is the recommended scenario.

Recommendation

We recommend East Scenario 4. It has the best reduction in miles BER, as shown in Table 10. It would involve building a new station on Smithfield Road when call volume there warranted it. This also would allow the County to save money by not having to renovate the Hester Street station.

It was suggested in the course of our interviews that Eastern Wake Fire Department should vacate 401 Hester Street and build a new station north of the Town of Knightdale. We did not think this idea was preferable because Wake-New Hope Station 2, Wendell Station 2, and Raleigh Station 28 (when it is built) and Knightdale DPS Station 1 (wherever it is built) would be better positioned to provide service under a proximity-based dispatch system. Moreover, the area southeast of the Town of Knightdale will need improved coverage (especially when the Route 64 Bypass is completed). Additionally, a

station on Smithfield Road would be extremely well positioned to provide second-due coverage to Eastern Wake Station 1 and Wendell Station 1.

Comparing the results for East Scenario 2 and East Scenario 4 reinforces the assertion that the effective reach of a station at Laurens Way provides almost exactly the same coverage as the station at 401 Hester Street.

SOUTH REGION

The South region is composed of the Fairview Fire Department, the Fuquay-Varina Fire Department, Garner EMS, the Garner Fire Department, the Swift Creek Fire Department, and Raleigh Fire Department Stations 20, 2, 10, 12, and 26.

While this study focuses on fire and EMS planning for unincorporated areas, it is not possible to separate the response patterns of the municipal fire departments from the analysis because they respond into unincorporated areas and because the municipalities' annexation plans affect the delivery of services in the County. By extension, solutions for unincorporated areas rely on station alignments within the municipalities. For these reasons, the analysis of the South region includes a description of problems areas identified within the corporate limits of Garner and scenarios that address problems in both incorporated and unincorporated areas.

Current Status and Problem Areas

Of the 4,832 geocodable calls that occurred in the South region in 2002, 949 (or 19.6 percent) fell outside the effective reach of the present stations. Of the 1,150 existing road miles in the South region, 270 road miles (or 23.4 percent) fell beyond the effective reach of the present stations (Map 13).

There are three areas with current service deficiencies in the South region. The first is in downtown Garner, where tight urban response time targets mean that numerous calls between Garner Station 1 and Garner Station 3 are beyond effective reach. The second is east of I-40, and the third is in the area between Fuquay-Varina Station 1 and the location of the new Holly Springs station under construction on Holly Springs Road.

Each of the South region scenarios includes relocation of Holly Springs Station 2 to the new station (under construction) in the 10200 block of Holly Springs Road. This is actually in the West region; however, because it is a new station so close to the border of the region, it is included for reference.

Maps 14–15 show the effective reach problem extending into 2010–2018.

Scenario S-1

- Relocate Holly Springs Station 2 to 10200 block of Holly Springs Road
- Build a new Garner station at West Garner Road and Yeargan Road
- Build a new Garner station at Raynor Road and Spaceway Court
- Build a new Fuquay-Varina station at Hilltop Needmore Road and Sunset Lake Road

This scenario addresses the three problem areas simply by adding new stations at strategic locations. The first new station is intended to alleviate response problems in downtown Garner. It also provides response capacity for the area between Garner and Raleigh Station 10. The second Garner station in this scenario is at the Garner Fire Department's preferred location for a new station east of I-40. The new proposed Fuquay-Varina station would facilitate responses in the suburban area north of the Town of Fuquay-Varina. The road network surrounding the proposed location provides good access in any direction, so this station will be very flexible—not only for covering its first-due area, but for providing second-due coverage to Holly Springs Station 2 and Fuquay-Varina Stations 1 and 2.

The construction costs for the three new stations in this scenario are estimated to be $4,272,060. It is assumed that the new Holly Springs station has already been funded, so its costs are not included here.

Scenario S-2

- Relocate Holly Springs Station 2 to 10200 block of Holly Springs Road
- Relocate Garner Station 1 to West Garner Road and Yeargan Road
- Build a new Garner station at Greenfield Parkway and "Unnamed Road" (near Route 70)
- Build a new Fuquay-Varina station at Hilltop Needmore Road and Sunset Lake Road

This scenario attempts to solve the service deficiency in downtown Garner by relocating Station 1, thus saving the cost of a new, additional station in Garner. Since this would shift Garner Station 1 to the west, the proposed site for a new Garner station east of I-40 is shifted west of the fire department's proposed site to a location closer to the junction of I-40 and Route 70. This offers better coverage toward the center of Garner than the proposed site on Raynor Road and Spaceway Court. The rationale for the proposed Fuquay-Varina station remains the same as in South Scenario 1.

The construction costs for the three new stations in this scenario are estimated to be $5,100,194 (one headquarters station and two substations).

Scenario S-3

- Relocate Holly Springs Station 2 to 10200 block of Holly Springs Road
- Relocate Garner Station 1 to West Garner Road and Yeargan Road
- Build a new Garner station at Jones Sausage Road and Route 70
- Build a new Fuquay-Varina station at Hilltop Needmore Road and Sunset Lake Road

This scenario is a variant of South Scenario 2. The difference between this and South Scenario 2 is the placement of the proposed new Garner fire station at Jones Sausage Road and Route 70 instead of on Greenfield Parkway.
Costs for this scenario are the same as for South Scenario 2.

Scenario S-4 (Maps 16–18)

- Relocate Holly Springs Station 2 to 10200 block of Holly Springs Road
- Relocate Garner Station 1 to Benson Road and Route 70
- Build a new Garner station at Greenfield Parkway and "Unnamed Road" (near Route 70)
- Build a new Fuquay-Varina station at Hilltop Needmore Road and Sunset Lake Road

This scenario is a variant of South Scenario 2. The difference between this scenario and South Scenario 2 is the relocation of Garner Station 1 to Benson Road instead of West Garner Road and Yeargan Road.
Costs for this scenario are the same as for South Scenario 2.

TABLE 11: SOUTH REGION SCENARIO COMPARISON

Scenario	Current	S-1	S-2	S-3	S-4
Calls BER	949	678	689	677	628
% Calls BER	19.6	14.0	14.3	14.0	13.0
%Δ in Calls BER	**–**	**-5.6**	**-5.3**	**-5.6**	**-6.6**
Current Road Mi.	983	983	983	983	983
Road Mi. BER	222.8	147.6	150.0	144.9	146.5
% Road Mi. BER	22.7	15.0	15.3	14.7	14.9
%Δ in Road Mi. BER	**–**	**-7.7**	**-7.4**	**-8.0**	**-7.8**
2010 & 2018 Road Mi.	983	983	983	983	983
2010 Road Mi. BER	223.3	148.1	167.5	152.8	150.0
% Road Mi. BER	22.7	15.1	17.0	15.5	15.3
%Δ 2010 Road Mi. BER	**–**	**-7.7**	**-5.7**	**-7.2**	**-7.5**
2018 Road Mi. BER	248.1	166.3	185.7	170.9	168.2
% Road Mi. BER	25.2	16.9	18.9	17.4	17.1
%Δ 2018 Road Mi. BER	**–**	**-8.3**	**-6.3**	**-7.9**	**-8.1**
Cost	–	$4,272,060	$5,100,194	$5,100,194	$5,100,194

Note: Shaded column is the recommended scenario.

Recommendation

Additional response capacity in Garner can be provided in one of two ways. Either another station could be added in the center of Garner to help keep response times down or Garner Station 1 could be relocated westward. While both options require building a new station, relocation has the advantage of reusing personnel, apparatus, and equipment, while adding another station represents increased costs in these budget lines. Therefore, relocating Garner Station 1 seems preferable to moving Garner Station 3 because the latter has a longer serviceable life and because the area surrounding Garner Station 3 is likely to see more of an increase in density over the 15-year planning horizon of the study than the area surround Garner Station 1.

A station is needed north of Fuquay-Varina Station 1 in the near future. A service exists in that area, and will get worse with time.

South Scenario 4 is recommended because it produces the greatest amount of effective reach in the most densely populated TAZs in the year 2018. South Scenarios 2, 3, and 4 are roughly similar in effect, and are only slight variations of each other (See Table 11).

WEST REGION

The West region is composed of Apex EMS, the Apex Fire Department, Cary EMS, the Cary Fire Department, the Holly Springs Department of Public Safety, the Morrisville Fire Department, the Western Wake Fire Department, and Raleigh Fire Stations 24, 14, 6, 8, 5, 1, and 3.

The West region is unlike the other three because about half of it is land in incorporated jurisdictions. As with the South region, solutions for unincorporated areas rely on station alignments within the municipalities. Accordingly, the analysis of the West region includes a description of problems areas identified within the corporate limits of Cary, Apex, Morrisville, and Holly Springs and scenarios that address problems in both incorporated and unincorporated areas.[45]

The Cary Fire Department accounts for almost three-quarters of the call volume in the West region, which complicates the analysis of the region to some degree. For this reason, the analysis of the West region was done two ways: including and excluding the

[45] The Towns of Cary and Apex operate their own Public Safety Answering Point (PSAP) or 9-1-1 centers. The Cary PSAP dispatches the Morrisville Fire Department as well. The locations of incidents can be plotted using the call information provided by the Cary and Apex PSAPs; however, limitations of the dataset prevent the computation of response times. Therefore, the markers for most of the calls in the West region are not color-coded for length of response time, as they are in the other regions. Most incidents in the West region are depicted with the '?' icon for "Data Not Available." Readers should understand that the analysis of effective reach is unaffected by the unavailability of these response time data.

Cary data. This helps differentiate the impacts of station realignment scenarios inside and outside of the Town of Cary.

Current Status and Problem Areas

Of the 12,799 geocodable calls that occurred in the West region in 2002, 2,688 (or 21.0 percent) fell outside the effective reach of the present stations. This was the largest difference in effective reach computed among the four regions of the county because the universe of calls in this region includes calls in the Town of Cary. Of the 12,799 calls, 9,190 occurred in the Town of Cary. This leaves 3,609 calls outside of Cary that occurred in unincorporated areas and small towns of the West region. Of these calls, 543 (or 15.0 percent) fell outside the effective reach of the present stations. Of the 1,597 existing road miles in the West region, 401 road miles (or 25.1 percent) fell beyond the effective reach of the present stations. The Town of Cary has 404 road miles, leaving 1,193 road miles in unincorporated areas and small towns of the West Region, of which 312 (or 26.1 percent) fell beyond the effective reach of the present stations (Map 19).

The heaviest concentration of current calls beyond effective reach is in the Town of Cary. This occurs because the population density results in an urban classification for a large number of the TAZs within Cary, which in turn imposes a stricter response time requirement that reduces the effective reach of the Cary stations. Accordingly, there are areas within the city limits of Cary that have an intense concentration of calls beyond effective reach, indicating a current service deficiency. These areas will only get worse over time, as the population grows and the Town undergoes in-fill development and expands towards Morrisville. The Town of Cary in the context of its municipal planning effort should address these current and future problem areas. Some of the suggestions in the scenarios below might be helpful in this respect.

Areas of current concern in Apex include a pocket of calls in an urban area northeast of Apex Station 1, and a cluster of calls to the west of Apex Station 3, in a suburban area that is largely beyond the effective reach of either Apex Station 3 or Apex Station 2. Most of the future call volume that Apex will face will be inside the town limits, but the scenarios below offer potential solutions that improve service both within and outside of the town limits.

In Holly Springs, the number of calls east of town near Sunset Lake and Bass Lake highlights a current service deficiency that would be expected to worsen as that area is projected to attain urban classification by 2018 (See Maps 20–21)). The opening of the new Holly springs Station 2 in the 10200 block of Holly Springs Road (a part of each of the following scenarios) will obviate the problem.

Scenario W-1

- Close both Western Wake stations
- Relocate Holly Springs Station 2 to 10200 block of Holly Springs Road
- Close Morrisville Station 3 when Cary Station 7 opens next door
- Build a new Apex station at Kelly Road and Olive Chapel Road
- Relocate Apex Station 1 to Lake Pine Drive and Route 64

Under this scenario, both Western Wake stations would be closed, resulting in cost avoidance of $294,027 in renovation costs estimated in the Heery Report (see the discussion section below). As discussed above, it also presumes the completion of the new Holly Springs station. The scenario envisions the closure of Morrisville Station 3 when the new Cary station is opened (resulting in $106,049 in renovation cost avoidance, depending on the work selected to be performed in the short-term). This closure will have no service effect as the effective reach of the two stations overlaps 100 percent.

The three West region scenarios include the construction of a new station in the area of Kelly Road and Olive Chapel Road. This station will serve an area of growing population and development, and it will provide better access to areas north of Apex Station 2 along the county line.

The final component to West Scenario 1 is the construction of a new station on Lake Pine Drive. This station would better serve an urban area that is currently beyond the effective reach of Apex Station 1.

New construction under this scenario would include $1,424,020 for a new station at Kelly Road and $1,424,020 for the station south of Apex (the County shares to be determined).

Scenario W-2

- Close both Western Wake stations
- Relocate Holly Springs Station 2 to 10200 block of Holly Springs Road
- Close Morrisville Station 3 when Cary Station 7 opens next door
- Build a new Apex station at Kelly Road and Olive Chapel Road
- Relocate Apex Station 1 to East Williams Street and the NC 55 Bypass

This is a variant of West Scenario 1. The only change is that Apex Station 1 would relocate to East Williams Street and the NC 55 Bypass. This places the resources south of Apex in a rapidly developing area between Apex and Holly Springs. It affords better effective reach along the NC 55 corridor.

Costs under this scenario would be the same as for West Scenario 1.

Scenario W-3 (Maps 22 to Map 24)

- Close both Western Wake stations
- Relocate Holly Springs Station 2 to 10200 block of Holly Springs Road
- Close Morrisville Station 3 when Cary Station 7 opens next door
- Build a new Apex station at Kelly Road and Olive Chapel Road
- Relocate Apex Station 1 to East Williams Street and Lufkin Road

This is a variant of West Scenario 1. The only change is that Apex Station 1 would relocate to the vicinity of East Williams Street and Lufkin Road. This station placement would afford rapid access to US 1 while assuring effective reach down the NC 55 corridor. Also, keeping the station slightly closer to the center of Apex provides coverage of some relatively urban area (roughly bounded by Center Street and James Street) in the southeast corner of Apex.

Costs under this scenario would be the same as for West Scenario 1.

TABLE 12: WEST REGION SCENARIO COMPARISON (INCLUDING CARY CALLS)

Scenario	Current	W-1	W-2	W-3
Calls BER	2,688	3,241	3,199	2,733
% Calls BER	21.0	25.3	25.0	24.4
%Δ in Calls BER	**–**	**+4.3**	**+4.0**	**+3.4**
Current Road Mi.	1,169	1,169	1,169	1,169
Road Mi. BER	296.4	289.8	284.4	276.6
% Road Mi. BER	25.4	24.8	24.3	23.7
%Δ in Road Mi. BER	**–**	**-0.6**	**-1.0**	**-1.7**
2010 & 2018 Road Mi.	1,169	1,169	1,169	1,169
2010 Road Mi. BER	308.3	304.7	299.2	291.5
% Road Mi. BER	**26.4**	**26.1**	**25.6**	**24.9**
%Δ 2010 Road Mi. BER	**–**	**-0.3**	**-0.8**	**-1.4**
2018 Road Mi. BER	339.8	336.8	331.4	323.6
% Road Mi. BER	**29.1**	**28.8**	**28.3**	**27.7**
%Δ 2018 Road Mi. BER	**–**	**-0.3**	**-0.7**	**-1.4**
Cost	–	$2,912,717	$2,912,717	$2,912,717

Note: Shaded column is the recommended scenario.

TABLE 13: WEST REGION SCENARIO COMPARISON (EXCLUDING CARY CALLS)

Scenario	Current	W-1	W-2	W-3
Calls BER	543	567	466	386
% Calls BER	15.0	15.7	12.9	10.7
%Δ in Calls BER	**–**	**+0.7**	**-2.1**	**-4.3**
Current Road Mi.	767	767	767	767
Road Mi. BER	207.4	179.8	170.6	164.0
% Road Mi. BER	27.0	23.4	22.2	21.4
%Δ in Road Mi. BER	**–**	**-3.6**	**-4.8**	**-5.7**
2010 & 2018 Road Mi.	767	767	767	767
2010 Road Mi. BER	213.2	186.4	177.2	170.6
% Road Mi. BER	27.8	24.3	23.1	22.2
%Δ 2010 Road Mi. BER	**–**	**-3.5**	**-4.7**	**-5.6**
2018 Road Mi. BER	236.1	208.8	199.6	193.0
% Road Mi. BER	30.8	27.2	26.0	25.2
%Δ 2018 Road Mi. BER	**–**	**-3.6**	**-4.8**	**-5.6**
Cost	–	$2,912,717	$2,912,717	$2,912,717

Note: Shaded column is the recommended scenario.

Recommendation

The Western Wake Fire Department primarily serves small doughnut holes within the Town of Cary and the City of Raleigh, state land on the outskirts of Raleigh, and some stretches of I-40. Maintaining the two Western Wake fire stations is costly and inefficient. Hence, all of the above scenarios involve the closure of both stations. The Town of Cary might consider purchasing Western Wake Station 2 and placing apparatus in service there. From the standpoint of the County, maintaining a station in that location is no longer warranted or cost effective. The City of Raleigh or Wake County EMS might use Western Wake Station 1 for reserve apparatus or as a maintenance or other special-purpose facility.

West Scenario 3 is the recommended option. It also provides effective reach into the entire area along Waterford Green Drive, and more coverage of the urban areas of the Town of Apex than the other two scenarios. Table 12 shows the effective reach analysis with Cary included, but the superior performance of this location for the county is most clearly reflected in Table 12, without Cary.

SUMMARY OF RECOMMENDED CHANGES

Of the 23,098 geocodable calls that occurred in Wake County in 2002, 2,269 (or 16.3 percent) fell outside the effective reach of the present stations. Of the 4,663 existing road miles in the county (excluding the roads in the Town of Cary), 1,145 road miles (or 24.6 percent) fell beyond the effective reach of the present stations (Map 25). The effective reach for 2010–2018 is shown in Maps 26–27.

Table 14 is a summary of the changes recommended above across all four regions in the County scenario. The changes are shown for 2002–2018 in Maps 28–30. In total, four relocations, seven closures as fire stations (two of which are retained as EMS stations), and eight new stations (18 changes in total) are recommended to be made by 2010. Note that each relocation means building a new station. Costs for implementing these recommendations are presented in Chapter VII.

As noted throughout this chapter, the order and timing of construction is not sacrosanct. For stations recommended to be closed there hopefully would be other uses for the structure or land, or revenues from its sale to offset some of the new construction costs. (It was beyond the scope to consider that.) A recommended chronological order of construction is given in the implementation chapter.

TABLE 14: SUMMARY OF RECOMMENDED STATION LOCATION CHANGES (BY TYPE OF CHANGE).

Recommendation	Impact	Implementation Timeframe
Relocations		
Relocate HSDPS Station 2 to 10200 block of Holly Springs Road	Improved service to the east and south of the new site. Some calls north of the Town of Holly Springs on NC 55 would fall outside the effective reach of the two Holly Springs stations.	Complete relocation by end of FY2004
Relocate KDPS to a new station at Laurens Way and McKnight Drive	Improved service in the center and north of the Town of Knightdale. KDPS will be in facilities appropriate to its mission, instead of a makeshift fire station.	Complete relocation by end of FY2006 (to be consistent with CIP chart)
Relocate Garner Station 1 to Benson Road and Route 70	Improved coverage in the center of Garner where a heavy concentration of calls beyond effective reach exists.	Complete relocation by end of FY2008
Relocate AFD Station 1 to East Williams Street and Lufkin Road	Improved service in a developing area south of the Town of Apex on NC 55. No adverse impact in its current area because the area protected by AFD Station 1 is within the effective reach of AFD Station 3.	Complete Relocation by End of FY2010 (not before)
Closure Process		
Initiate closure process for Falls Station 1	No adverse system impact. The 330 calls that the Falls FD ran last year will be distributed to surrounding fire stations. This is less than one call per day distributed across three stations, so there should be virtually no impact on the operations of those stations. Closing the station does not lead to an increase in the number of road miles beyond effective reach in the region.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for MFD Station 3 when CFD Station 7 opens next door.	No adverse system impact. The County should contract with the Cary FD to provide service (Morrisville Station 3 had 98 calls last year, or one call every three days).	Begin detailed closure analysis and transition process linked with CFD Station 7 development process.

Recommendation	Impact	Implementation Timeframe
Initiate closure process for WWFD Station 1	No adverse system impact. The area is within the effective reach of Raleigh Stations 8 and 14. The call volume would not amount to more than two calls per day. Raleigh FD could reuse the station. Raleigh FD might need to provide RWS in some of its non-hydranted areas; the County should assist in this effort by transferring an excess RWS unit to Raleigh FD.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for WWFD Station 2; lease to Raleigh (if they wish)	No adverse system impact. The station lies entirely within the Town of Cary FD. The station serves primarily doughnut holes, some state land, and some stretches of Interstate. The call volume presently handled by Western Wake Station 2 could be redistributed to the Cary FD stations and would not amount to one or two calls a day at the most.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for W-NHFD Station 1	No adverse system impact. The station lies entirely within the City of Raleigh. The 550 calls that W-NHFD Station 1 ran last year represent a total additional workload of fewer than two calls per day to be distributed across five surrounding Raleigh FD stations.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for EWFD Station 2	No adverse system impact. This station lies entirely within the Town of Knightdale, which is now protected by the Knightdale DPS. The 480 calls that EWFD Station 2 ran last year represent a total additional workload of fewer than two calls per day that the KDPS, W-NHFD WFD, and RFD might need to cover. (We recommend using the station as an EMS station.)	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for Bayleaf Station 3 (as a fire station)	Its service areas are donut holes within Raleigh. (We recommend continuing to use it as an EMS station.)	Begin detailed closure analysis and transition process in FY2005
New Stations		
Build a new KDPS station near 2128 Mingo Bluff Boulevard	Improved service in the west of the Town of Knightdale. There is a current service deficiency in that area presently.	Begin design work in FY2005; open new station be end of FY2006
Build a new AFD station at Kelly Road and Olive Chapel Road	Improved service in a developing area west of Apex.	Begin design work in FY2005, open new station by end of FY2006
Build a new Garner station at Greenfield Parkway and “Unnamed Road” (near Route 70)	Improved service on the east side of the Town of Garner. Improved ability to assist EWFD and better access to I-40.	Begin design work in FY2005; open new station in FY2006
Build a new fire station at Main Street and Harris Road in Wake Forest	Improved service north of the center of Wake Forest. There is a current service deficiency in that area presently.	Begin design work in FY2006; open new station in FY2007
Build a new fire station with co-located EMS station at Durant Road and Koupela Road	Improved service along Durant Road and northward along Falls of Neuse Road. This station would be built as a joint EMS/fire station and used as an EMS station first, circa 2006. The fire service would not move in until the call volume warranted it (about 2010).	Begin design work in FY2005; open new station in FY2006

Recommendation	Impact	Implementation Timeframe
Build a new station at Thomson Mill Road and Elmo Road	Improved service west of the center of Wake Forest. Growth is expected in that area, especially as the City of Raleigh annexes additional land north along Capital Boulevard.	Begin design work in FY2008; open new station in FY2009
Build a new FVFD station at Hilltop Needmore Road and Sunset Lake Road	Improved service north of the Town of Fuquay-Varina in an area with a present service deficiency and where growth is expected in the future. Improved ability to assist HSDPS.	Begin design work in FY2009; open new station in FY2010
Build new EWFD Station 2 in the 3200 block of Smithfield Road[46]	Improved service in an area southeast of the Town of Knightdale and west of the Town of Wendell. Improved ability to assist to EWFD Station 1, KDPS, and WFD.	Begin design work in FY2009; open new station in FY2010

A summary of the impact of the full set of recommended station location scenarios countywide are provided in Table 15. The reader is reminded that calculations of calls beyond effective reach are based on the 2002 geocodable calls. The numbers in the table depict the number and percent of 2002 calls beyond effective reach that there would have been had the recommended scenario been in place during 2002. The results for the scenario are provided as a relative gauge of the performance of the scenario and cannot be interpreted as a prediction of what the performance will be in the future. The calculations of road miles beyond effective reach are another indicator of the relative performance of the scenario, and are presented for the present, 2010 and 2018.

TABLE 15: RECOMMENDED COUNTYWIDE SCENARIO

	Current	Recommended Scenario
Calls BER	2,269	1,421
% Calls BER	16.3	10.2
%Δ in Calls BER	**–**	**-6.1**
Current Road Mi.	3,223	3,223
Road Mi. BER	725.1	511.8
% Road Mi. BER	22.5	15.9
%Δ in Road Mi. BER	**–**	**-6.6**
2010 & 2018 Road Mi.	3,187	3,187
2010 Road Mi. BER	741.1	531.3
% Road Mi. BER	23.3	16.7
%Δ 2010 Road Mi. BER	**–**	**-6.6**
2018 Road Mi. BER	798.2	580.7
% Road Mi. BER	25.0	18.2
%Δ 2018 Road Mi. BER	**–**	**-6.8**
Cost		**$18,134,713**

Note: Shaded column is the recommended scenario.

[46] This may be viewed as the movement of current EWFD 2 to this new location, with a pause of 6 years between closure and reopening.

LADDER (AERIAL) COMPANY DEPLOYMENT

The deployment of ladder companies (also called aerial companies) is important because not every station in the county has—or needs—a ladder company. They must be situated so as to be able to provide service on a mutual and/or automatic aid basis.[47] As noted earlier, we strongly recommend dispatching on an automatic aid, rather than on a mutual aid basis. That is the premise behind a "seamless", integrated countywide fire and EMS system. There are about 1,000 structure fires calls in the County annually, and most are in low-rise structures, but ladder companies are critical when needed, and ladder companies have vital fireground functions even at low-rise structure fires.

Sixteen ladder companies currently provide service throughout the county. There are plans for two more ladder companies to be placed in service within a year (in Wake Forest and Holly Springs). Table 16 lists the current locations of ladder companies.

TABLE 16: CURRENT LADDER COMPANY LOCATIONS

North	East
Bayleaf FD Station 1 Raleigh FD Station 16 Raleigh FD Station 22	Eastern Wake FD Station 2 Wendell FD Station 1 Raleigh FD Station 11 Zebulon FD Station 1
West	**South**
Apex FD Station 1 Apex FD Station 3 Cary FD Station 1 Cary FD Station 3 Morrisville FD Station 1 Raleigh FD Station 1 Raleigh FD Station 8	Fuquay-Varina FD Station 1 Garner Station 1

As discussed in Chapter III, the service level targets for ladder companies are three minutes longer than for engine companies.

Current Status and Problem Areas

As with the West region, inclusion of the Cary call volume in the analysis of ladder company placement may tend to skew the results. Accordingly, the analysis of the current status is performed with and without Cary data. No Raleigh calls are included either. However, both Cary and Raleigh ladder companies are in the pool of available mutual aid units and, hence, these units are included in the analysis.

[47] "Automatic aid" implies that a resource is sent on an out-of-area assignment as a matter of protocol, whereas "mutual aid" means that the resource is only dispatched when specifically requested by the department that needs the resource. Automatic aid is an integral part of a "seamless" emergency response system. Mutual aid is a vestige of systems driven by territorialism. As noted earlier, Wake County's new CAD is designed to function on an automatic aid basis.

There were 2,461 geocodable fire structure files and Apex fire calls in 2002.[48] Excluding Cary Fire Department calls from this total, there were 171 structure fire/Apex fire calls (or 6.9 percent) that fell beyond the effective reach of a ladder company. Of the 4,663 existing road miles in the county (excluding Cary), 1,360 road miles (or 29.2 percent) fell beyond the effective reach of the ladder companies as they are presently deployed.

Based on real estate records, there are only 82 parcels of land in the county on which structures of greater than two stories are built. At least 9 of the 82 structures are protected by automatic fire suppression systems. Of the remaining 73 structures, 15 (or 20 percent) were beyond the effective reach of a ladder company; all 15 were outside of the Town of Cary (Map 31).

There are no major problem areas associated with ladder deployment—either now or to the study horizon, as shown in Maps 32–34. Ladder companies adequately serve almost 80 percent of the structures greater than two stories. Further, future county development is projected to occur in areas that already are (or soon will be) well protected by ladder companies.

The only potential service deficiency could arise with the possible relocation of Eastern Wake Station 2. Were the ladder company stationed there to be relocated to a new station in the 3200 block of Smithfield Road, ladder coverage in Knightdale might suffer.

Recommendation

In light of the above analysis, we recommend only the following deployment change:

Ladder Company Deployment Scenario (Maps 35–37)

- If Eastern Wake Station 2 is relocated as recommended earlier, its ladder should be moved to the new Knightdale DPS Station 1 (Laurens Way and McKnight Drive), as the ladder is more likely to be needed in the Town of Knightdale.
- New ladders should be added at Holly Springs Station 2 and Wake Forest Station 1, in accordance with plans currently under way.

This ladder company analysis assumes the existence of the two new ladder companies slated to go in service in the coming year (one in Wake Forest Station 1 and the other in Holly Springs Station 2). With their addition, the County will have ample ladder response time coverage for most foreseeable risks. There are very few structures in the county of sufficient height and volume to require more coverage than currently exists. The

[48] It is not possible to discern which Apex fire calls were for structure fires; however, eliminating the Apex fire calls from the universe of calls analyzed yields too few calls to produce a reliable analysis. Therefore, we included the Apex fire calls. The actual number of 2002 structure fire calls was significantly lower than 2,461; however, basing the analysis on this higher number does not adversely affect the results.

dispersion of ladders is suitable for the population centers now and through the study horizon.

In the event that Eastern Wake Station 2 is relocated from its present quarters, the ladder company at Eastern Wake Station 2 should be relocated to the downtown Knightdale station to prevent a diminution in ladder coverage in Knightdale. Table 17 shows the change in effective reach of the ladder trucks over time.

TABLE 17: LADDER COMPANY DEPLOYMENT SCENARIO

	Current	Ladder Scenario
Calls BER	171	101
% Calls BER	6.9	4.1
%Δ in Calls BER	**–**	**-2.8**
Road Mi. BER	1,059	718
% Road Mi. BER	32.9	22.3
%Δ in Road Mi. BER	**–**	**-10.6**
2010 Road Mi. BER	1,317	981
% Road Mi. BER	41.3	28.8
%Δ 2010 Road Mi. BER	**–**	**-12.5**
2018 Road Mi. BER	1,362	1,025
% Road Mi. BER	41.6	32.2
%Δ 2018 Road Mi. BER	**–**	**-9.4**

Note: Shaded column is the recommended scenario.

RURAL WATER SUPPLY DEPLOYMENT

Rural water supply (RWS) units—tankers and pumper-tankers—were considered on a countywide basis. Their importance in fireground operations and the resulting levels of service was discussed in Chapter III.

Current Status and Problem Areas

The study team views Wake County as having an ample number of rural water supply units in total for its needs, but their distribution could be improved.

There are 80 RWS units deployed across the county. Most fire stations have at least one RWS unit, and many have two or more (e.g., Western Wake Station 1 has four, and Fairview Station 1 has five). This large number of RWS units is an artifact of a fire service era when individual departments premised their operations on being able to supply whatever water was needed without having to call another fire department for mutual aid. That planning framework no longer applies, with countywide response management.

Of the 1,570 geocodable fire calls that occurred greater than 500 feet from a fire hydrant during 2002, none fell outside the effective reach of an RWS unit as they are presently deployed.

Of the 2,450 miles of existing road in the county that lie greater than 500 feet from a fire hydrant, 782 road miles (or 31.9 percent of non-hydranted road miles) fell beyond the effective reach of an RWS unit, as presently deployed (Map 38). Maps 39-40 show effective reach for 2010-2018. However, while the maps depict the best data that was available, the fire hydrant database is far from complete. There are no hydrant locations on file for the Towns of Apex and Fuquay-Varina, though both of these towns have some hydrants. The computed effective reach of the County's RWS units is therefore smaller than it actually is. Overall, we doubt there are significant problems with RWS coverage given the large number of RWS units available throughout the county. Nevertheless, the analysis led to some suggested changes in RWS deployment to improve coverage, especially in light of the proposed closure of several stations that currently have several RWS units.

Recommendations (Maps 41-43)

Building and staffing a fire station merely to house an RWS unit would be expensive, and there is no need to do this. Improvements in RWS service could be obtained by redeploying some of the units now in clusters in individual stations to new fire stations.

Specifically, we recommend reassignment of RWS units from the Wake-New Hope, Western Wake, and Falls stations that were recommended to be closed. They have 11 RWS units in total. The re-distribution would be as follows, each to a station not having an RWS unit at present:

- One unit to the new Apex station at Kelly Road and Olive Chapel Road
- One unit to the new Fuquay-Varina station on Hilltop Needmore Road
- One unit to the new Garner station at Greenfield Parkway and "Unnamed Road"
- One unit to the new Knightdale DPS station on Mingo Bluff Boulevard
- One unit to the planned Raleigh Station 30 at Buffalo Road and I-540 (once it is completed)

Table 18 shows the changes in effective reach for the first, second, and third in RWS unit from 2002–2018.

TABLE 18: RURAL WATER SUPPLY DEPLOYMENT

	Current RWS Units			Recommended RWS Units		
	1st	2nd	3rd	1st	2nd	3rd
Calls BER	0	57[49]	0	0	0	0
Calls BER	0	3.6	0			0
Δ in Calls BER	**–**	**n/a**	**n/a**			**0**
Road Mi. BER	782	134	0	602	89	0
Road Mi. BER	31.9	5.5	0	24.6	3.6	0
Δ in Road Mi. BER	**–**	**n/a**	**n/a**	**-7.3**	**-1.9**	**0**
2010 Road Mi. BER	793	138	0	608	91	0
Road Mi. BER	32.4	5.6	0.0	24.8	3.7	0.0
Δ 2010 Road Mi. BER	**–**	**n/a**	**n/a**	**-7.6**	**-1.9**	**0**
2018 Road Mi. BER	821	141	0	626	95	0
Road Mi. BER	33.5	5.8	0.0	25.6	3.9	0.0
Δ 2018 Road Mi. BER	**–**	n/a	n/a	**-7.9**	**-1.9**	**0**

Note: There is no change in Effective Reach for a third-in unit because the response time goal for this unit is the same across all areas of the county. Hence, it does not change as population density increases.

We are confident of the adequacy of the current and future RWS because we took a very conservative approach to this analysis. We examined structure fires that occurred more than 500 feet from a hydrant. The underlying assumption was that water to fight fires up to 500 feet from a hydrant could be supplied from the hydrant using dual supply lines.[50]

Examining fires farther than 500 feet from a hydrant is a broader universe of fires than fires farther than 1,000 feet. One might consider using a 1,000 foot limit if one was relying on large-diameter hose and not relying on dual supply lines. The broader universe of fires translates to higher numbers of calls beyond effective reach; however, no calls were beyond the effective reach of an RWS unit (especially when large-diameter hose is available).

On top of this conservative analysis, our comfort level reflects the understanding that there are many more fire hydrants in Wake County than are represented in the fire hydrant database.

[49] Most of these calls were in Apex and Holly Springs, and the fire hydrant database for those two areas is highly suspect. If one excludes the calls in Apex and Holly Springs from this analysis, there were no calls beyond the effective reach of a second-due tanker.

[50] An engine company will generally carry 1,000 feet of "supply line" (hose that is attached to a fire hydrant for water supply purposes). In order to provide large volumes of water on a given fire, an engine company may split the supply line into dual lines, thus limiting to 500 feet the distance that the engine can be from the hydrant. Nineteen engines/pumper-tankers in the county carry large-diameter hose (LDH), which can effectively supply large volumes of water without needing to use dual lines. Engines carrying LDH can be as far away as 1,000 feet from a hydrant.

EMERGENCY MEDICAL SERVICE DEPLOYMENT

The EMS system was considered on a countywide basis. This was possible because there are fewer EMS stations than fire stations and because the EMS system is significantly more "seamless" at present than the fire response system.

Current Status and Problem Areas

The County's EMS resources are generally well deployed to meet demand, but some gaps in coverage exist. Of the 29,727 geocodable EMS calls that occurred in 2002, only 1,679 (or 5.6 percent) fell outside the effective reach of the present stations. However, of the 5,067 existing road miles in the county, 842 road miles (or 16.6 percent) fell beyond the effective reach of the present stations (Map 44). Further, looking at Map 45, which depicts the geographic distribution of EMS calls that did not meet the response time goals, it is clear that there are distinct areas where significant numbers of calls are clustered beyond the effective reach of a current EMS station.[51]

Looking solely at the high percentage of FY02 calls within effective reach, one might be tempted to say that these are easily manageable service deficiencies. However, deployment of EMS resources in sufficient depth to meet Wake County's 0:11:59 response time target for 90 percent of emergency responses is still a significant concern. In 2002, 39,475 EMS calls had CAD records with sufficiently complete data to calculate response times. Of those calls, 8,182 (or 20.7 percent) were over the goal, double the County's exception rate goal of 10 percent, and representing a response time variance 14 percent greater than the geographical response time variance noted above.

Recommendation 7: Wake County should develop as soon as possible reliable data collection and analysis measures that support correction of in-depth EMS response (and other) problems—the number of units needed per station by time of day.

Examining the location and number of calls for which an EMS unit from other than the first-due EMS station responded yields insight as to where current service deficiencies are occurring. Map 46 shows this in part. However, data were not available from Apex and Cary to do this analysis. The analysis ought to be done in the future.

We presumed here that all EMS units operated by Wake County or provided by an EMS/rescue squad are reliably staffed. If that is not the case, Wake County must decide whether it can tolerate EMS units that are not reliably staffed. The new CAD will not consider a unit available if it does not have adequate staffing.

[51] Cary, Apex, and Morrisville EMS calls are not depicted because it was not possible to compute response times from their CAD data provided.

Recommendation 8: All EMS units should be reliably staffed and thereby assignable by the new CAD system.

Current response time problem areas include the following: [52]

- The core of Raleigh,
- The Durant Road area of north Raleigh,
- The area within approximately a two-mile radius of Wendell Station 2,
- The area within approximately a three-mile radius of Garner Station 2,
- The Lake Wheeler area (Fairview community),
- The Watkins Road (Wake/New Hope) area,
- The part of the Fairview community served by Apex EMS,
- The area between Raleigh Station 24 and Durham Highway Station 1,
- The Auburn community (in the vicinity of Raleigh Fire Station 26, and
- The Stony Hill area.

Areas of future concern (Maps 47 and 48) include:

- Morrisville/West Cary (which is expected to see a moderate call volume by 2010 and high call volume by 2018),
- North Raleigh (which will see moderate/heavy call volume by 2010, developing to heavy call volume by 2018),
- Knightdale (which will see moderate call volume in the west by 2010 and additional moderate call volume in the south by 2018),
- Areas around Holly Springs (which will see moderate call volume by 2018), and
- Areas west of Apex (which will see moderate/heavy call volume by 2018).
- The Willow Spring area then may be a problem in 10 years based on expected development, though there is little development in this area presently. Wake County already has built a prototype fire station there designed to be expanded to accommodate an EMS unit when needed.
- Hopkins community (area where significant growth is anticipated within five years.)

Recommendations

We propose the following scenario designed to improve response times in areas that might be considered underserved at present. This is a coordinated set of changes and

[52] This includes areas with a geographic reach problem (BER problem) and areas with an actual response time problem.

would ideally be made as soon as possible, except for the changes to be made when the specified new stations become available. We recommend EMS Deployment Scenario EMS-4 as the best.

Emergency Medical Service Deployment Scenario EMS-1

- Cary EMS relocates a unit from its central station to Swift Creek Fire Station 1.
- Wake EMS relocates EMS 6 (from EMS Station 6) to Raleigh Station 24 .
- EMS 13 is relocated to the projected new EMS/fire station on Durant Road and Koupela Road or to a new medical care facility proposed for that area by WakeMed.
- An existing EMS unit (EMS 12) is moved and co-located at Stony Hill Station 1.
- Wendell EMS relocates one unit to Wendell Fire Station 2.
- Knightdale and Zebulon second duty units should be considered for relocation based on analyses of stations missing the most first due calls.
- Garner EMS relocates one of its three staffed units from its headquarters station to Garner Fire Station 2, and a second unit to a new fire station at Benson Road and Route 70.
- An EMS low-utilization second-duty unit is relocated to the Wake EMS Station5/Wake-New Hope Fire Station 1 area, where calls for service have expanded dramatically over the past three years.

Emergency Medical Service Deployment Scenario EMS-2

This scenario is a minor variant of Scenario EMS-1, with the modification that EMS 6 relocating to Raleigh Station 23 (Durham Highway Station 2).

Emergency Medical Service Deployment Scenario EMS-3

This scenario is a variant of Scenario EMS-2, with the modification that EMS Station 1 would close, and its units relocated as follows:

- One unit to a new station in the 400 block of Peace Street
- One unit to Raleigh Station 2
- One unit to the former Wake-New Hope Station 1

Emergency Medical Service Deployment Scenario EMS-4 (Maps 49 to 51)

This scenario is a variant of Scenario EMS-3, with the modification being that EMS 6 would relocate to Raleigh Station 23 (Durham Highway Station 2). Scenario EMS-4 is slightly preferable to the others and our recommendation, but there may be reasons for selecting another scenario; they are all close in effective reach, as shown in Table 19.

TABLE 19: EMS DEPLOYMENT SCENARIO SUMMARY AND OPTIONS

	Current	EMS-1	EMS-2	EMS-3	EMS-4
Calls BER	1,679	691	697	668	662
% Calls BER	5.6	2.3	2.3	2.3	2.2
Δ in Calls BER	**–**	**-3.3**	**-3.3**	**-3.3**	**-3.4**
Road Mi. BER	842	357	366	351	341
% Road Mi. BER	16.6	7.0	7.2	6.9	6.7
Δ in Road Mi. BER	**–**	**-9.6**	**-9.4**	**-9.7**	**-9.9**

Note: Shaded column is the recommended scenario. 2010 and 2018 Effective Reach are not applicable to EMS since the response time goal for EMS is independent of population density. That is, the goal for EMS is 00:11:59 total response time to all areas of the county.

A number of Wake EMS stations—particularly EMS/rescue squad stations— house multiple units. The argument generally proffered in support of this "clustering" of units is that these "second-duty" units need to be available to handle calls when "first-duty" units are unavailable, but the question left unanswered is whether a given first-duty unit would have been the unit dispatched to a call had another unit from that station been positioned elsewhere (potentially closer to the call than the first-duty unit). Given the low call volume of most of the second-duty EMS units, this clustering is inefficient.

One of the primary recommendations of the 1999 TriData Wake County EMS study was that EMS units be unclustered.[53] This would permit redeployment of the units in a manner than ensures greater effective reach (and better overall system response times). We still support this recommendation. It will be even more important to decluster units in the future as areas between current population centers are developed and, in turn, generate demand for EMS in places where heretofore there had been none. As in the case of fire station and fire apparatus deployment, EMS unit deployment should be based on response time goals and demand for service, not on jurisdictional or franchise boundaries.

Unclustering the EMS units means that any of the EMS scenarios below could be implemented without the addition of new units, even for the new stations. Because most second-duty EMS units have such low call volumes, none would face an added call volume that is untenable. In fact, the dispersion of the EMS units to improve response times would probably also reduce the call volume of some of the more heavily worked EMS units.

Recommendation 9: Uncluster the EMS units. They have better impact on response times by being spread out.

In its 1999 study, TriData proposed a unit hour utilization (UHU) goal of 30-35 percent—that is, a typical EMS unit and its staff is responding, providing patient care, transporting, delivering to a hospital and preparing patient care reports for 30-35 percent

[53] TriData Corporation (1999), op. cit., p.53 and p.131

(7.2-8.2 hours) of a 24-hour day. We no longer cite UHU as a primary standard. There is no national consensus regarding an optimal or most appropriate UHU. A recent survey of comparable EMS systems demonstrated that most of the EMS systems they surveyed operate in a UHU range of 20-30 percent. At least one EMS system established a "cap" of 40 percent UHU in recognition of the fact that as UHU increases response times increase as well.[54] The EMS system response components of geographic deployment, in-depth (multiple unit) deployment and UHU must be coordinated so that EMS units operate efficiently and [55] effectively in the face of a steadily increasing volume of responses.

Recommendation 10: Monitor EMS call volume per unit at least annually. Going into the future, EMS call volumes should be continued to be monitored closely. When an EMS unit exceeds approximately 2,500 calls per year, or a UHU of about 25 percent, one should consider adding an additional unit to relieve the workload in that area, either continuously (24/7) or on a peak load schedule. To repeat, the 2,500–3,000 call level is about the workload level when EMS transport units become busy and may have too many calls in their first due area—it depends on the length of the calls and their bunching. The response times should be examined.

Recommendation 11: First consider adding a peak-load EMS unit when a unit is overloaded before adding a full-time unit. Not every unit placed in service needs to be a 24-hour unit. EMS call volume tends to vary greatly by time of day, with half as many calls in the late night/early morning hours before commuting starts. Careful monitoring of EMS demand may reveal that placing a part-time unit in service in a given area can relieve "pressure points" on the system. This is called peak-load staffing, and it has been used with great success in numerous EMS systems across the country, especially where EMS demand varies significantly and consistently by time of day. Peak-load staffing may raise pay equity issues in a workforce that mixes work schedules while maintaining substantially similar pay scales. However, based on the experience of other EMS providers, Wake County should test the efficiency of peak-load units.

Demand for EMS is far more volatile and is increasing at a much greater pace than is demand for fire services. The unavoidable fact is that the EMS system will need continual fine-tuning. The key finding here is that there are sufficient resources at present to meet the EMS service level targets by redeploying the currently clustered resources.

In order for Wake County to achieve its patient care goals, all units must be viewed as part of a countywide system of resources. As current geographic and temporal deployment issues are addressed, redeployment of clustered resources should be

[54] For example, Internal Standard of Washington County, Oregon
[55] This includes areas with a geographic reach problem (BER problem) and areas with an actual response time problem.

undertaken before new units are added to the system. This redeployment vs. new unit assessment should be part of a continual evaluation of system unit utilization and response time. This should be done before any additional units are bought.

Recommendation 12: Declustering (i.e. redeploying) EMS units should be considered before adding new units. As noted in the 1999 TriData report (and re-emphasized in this report), nearest-unit dispatch, guided by automated vehicle location (AVL) technology and undertaken via a common CAD system (either actual or functional) is the ideal way for the County to maintain its EMS system's geographic and temporal balance on a day-to-day basis.

CO-LOCATION OF EMS AND FIRE RESOURCES

In jurisdictions where fire and EMS are provided by the same departments, there is little issue of co-location of units. In Wake County, where fire and EMS are separate entities co-location has been an issue. Many emergency responders interviewed in this study expressed hesitation that the two services could be co-located. This is surprising because the trend nationally has been toward greater integration of the services.

Co-location of fire and EMS offers many benefits in addition to reaping efficiencies of scale in new construction. Better interpersonal knowledge of fire and EMS providers usually leads to better on-scene operations. This has direct benefits for citizens. Co-location also facilitates interdepartmental training – another source of improved service delivery. The benefits work in both directions. Fire crews that have trained EMS providers in exterior fireground operations can expect the EMS responders to assist them with tasks that would otherwise require firefighters to remain outside a structure on fire (e.g., "hooking up" to a hydrant, assisting with personnel accountability). EMS crews that have trained firefighters as first responders or EMTs can expect that these personnel to be better able to render care and assist ambulance crews with preparation of a patient for transport.

During this study we considered each potential station location for the feasibility of co-locating services. This required that we examine intersecting areas of current and future demand for services. This is an easier task than one might expect: demand for EMS occurs just about everywhere that there is demand for fire services. Wherever there are people, there are likely to be both fires and medical emergencies. This observation is confirmed when one compares the maps of demand for both services in Wake County; there is little difference in the spread of calls.

In considering whether a station can be a base for co-location, we had to use fire stations as the primary driver for location assessment. This is a function of four factors:

1. Constraints on locating fire stations (to attain better ISO public protection ratings).
2. Fire units have stiffer service level (response time) targets. (See Chapter III on *Service Levels*.)
3. The resource-intensive nature of fire suppression (i.e., quantities of water must be carried on apparatus that can be deployed rapidly anywhere in the county dictates that fire stations be spaced more closely than EMS stations need be).
4. It is usually easier for a fire station to accommodate an extra EMS unit than vice versa because of the number and size of the fire units.

We looked first at existing or proposed fire stations as possible sites for EMS units before proposing the construction of an EMS-only station to meet current or potential EMS station site needs. In fact, we propose only two new EMS facilities (one on Peace St. near downtown Raleigh, and the second on Durant Road and Koupela Road). In the case of the second, it should be built either as an EMS station capable of being expanded into a joint EMS/fire station, or in cooperation with WakeMed as it moves forward with plans for a new medical care facility in the same area. We also recommend the "recycling" of some fire stations proposed for closure into EMS facilities (e.g., Bayleaf Station 3 and Wake-New Hope Station 1).

Some stations at which we recommended an EMS unit be co-located (e.g., Garner Station 2, Wendell Station 2, Raleigh Station 24, and Raleigh Station 2) cannot accommodate additional apparatus, sleeping quarters or day-room space at present. This problem could be rectified by relocating non-essential apparatus to make room for an EMS unit, or by renovating the station, or by constructing add-on EMS facilities. Some of the locations we propose may not be workable for other reasons, but the proposed EMS locations made the most sense from an operational response time standpoint. If a particular location proves to be unworkable, then it should be viewed as an approximation of where an EMS unit should be located.

The flowchart in Figure 19 describes a methodology for making decisions about the need for and suitability of co-location for a new station. The first step is determining the need for a new station. After the need has been established, the next step is to determine whether an existing facility of the other service provides a suitable location for service delivery. The third step is to determine whether the new station would provide more suitable facilities or improved effective reach to the other service. Finally, one must determine whether co-location will reduce overall cost by capturing efficiencies of scope or scale.

TECHNICAL RESCUE AND OTHER SPECIALTY UNITS

In most communities, technical rescue units and other specialty units usually are centrally located if only one such unit is available. If two units are available, they are often located one to each half of the jurisdiction.

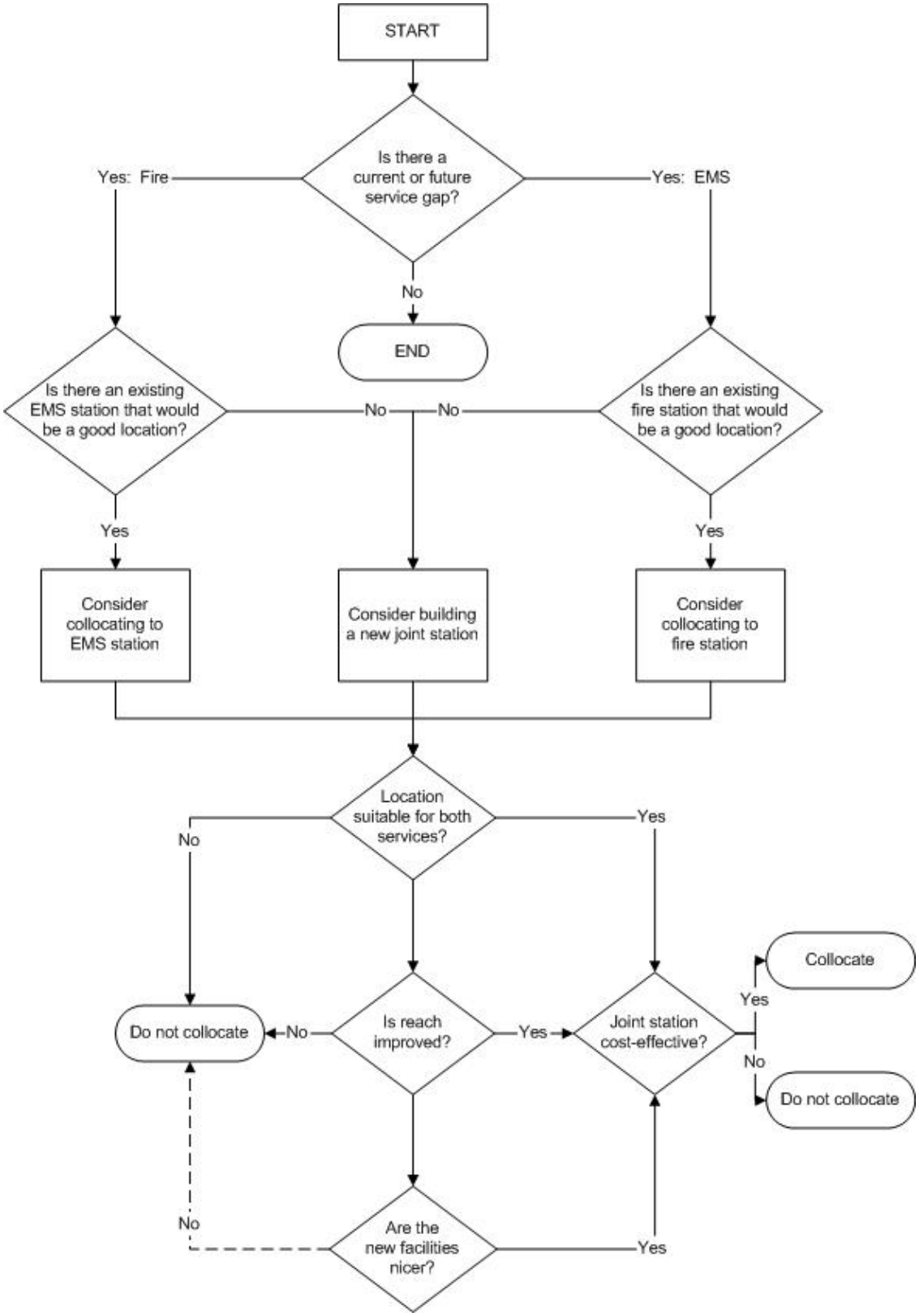
There were no data available on the location of technical rescue or hazardous materials calls, so there is no quantitative basis on which to recommend asymmetrical positioning of such units. The units might be located near clusters of hazards that produce such calls, if the calls are not scattered across the County.

Recommendation 13: Going into the future, data should be collected on the location of calls requiring specialty units. This includes technical rescue and hazmat calls.

Recommendation 14: For hazmat and for technical rescue, there should be at least one highly trained unit of each type in the County, and then one or more satellite units trained to assist the main unit or handle simpler calls.

If calls are few in number and spread over several units, no one builds up enough specialization experience much beyond that of each firefighter. Other than those observations, we have no recommendations for the specific location of these units. Much depends on arrangements with Cary and Raleigh for servicing the areas beyond their boundaries.

FIGURE 19: CO-LOCATION DECISION-MAKING MODEL



V. FIRE VEHICLES

The overall deployment of fire and EMS vehicles—engines, ladders, EMS units, tankers, and special operations vehicles—was discussed in Chapter IV. This chapter continues the discussion on the number of apparatus needed and other vehicle-related issues, including maintenance, apparatus specifications, standardization, customized vs. commercial chassis, spares, and the vehicle replacement policy that drives the Capital Improvement Plan.

Another issue, the methodology for allocating vehicle costs between jurisdictions, can be considered as part of the more general issue of allocating station costs between jurisdictions, which is discussed primarily in Chapter VII, Cost Allocation Models. Some comments on this subject are also given in this chapter.

Strategic Plan for Apparatus

Going into the future, we discussed in Chapter IV the vision of continuing movement toward a seamless, highly integrated fire and EMS system throughout Wake County, which would allow use of a more cost-effective (i.e., smaller) fleet of apparatus. But until call-processing and turnout times can be reduced, the number of fire trucks needed in Wake County will be substantially similar to the size of today's fleet. In the near term, changes in the fire apparatus fleet will be more in the configuration and deployment of vehicles than in the total number of vehicles. We discuss the two visions for apparatus deployment below.

OPTIMUM LONG-RANGE SYSTEM

The projected workload for the next ten years, considering growth of population in the county, indicates that no individual fire station is apt to merit two fire units of a kind in a given location based on workload alone. However, more than one vehicle in a station may be needed to get an adequate complement of vehicles and firefighters to a fire within desired service response time. In general, when a first-due unit gets beyond a certain number of calls, one might have to prescribe a second unit in the station or nearby to maintain an adequate response time because the first unit will be out of the station so often. Achieving the 90th percentile goals may require having more than one unit of a type in a station if the calls are often bunched (one underway while the next call comes in). That is more likely to occur for some EMS units than fire units because of the large and growing volume of EMS calls.

A second point is that any location in the county can be reached within the response time goals set for the urban, suburban, and rural areas by three units coming from three

different stations, as found in our GIS analysis of the relationship between station locations and the road network over time. (Our analysis was conservative; our model assumed fire vehicles would be driven at an average speed of 10 mph less than the posted speed limit.

Based on these workload projections and response analyses, it would be possible to protect the county using one engine per station, 11 ladders, and the distribution of water supply units discussed in Chapter IV. Achieving adequate fire flow at a fire would come from using the first-due engine in a station and the engines from two neighboring stations. That, in fact, is how most career departments operate today. There are fewer and fewer career departments operating stations with multiple engines; instead, resources are spread out to maximize the efficiency in obtaining good first-in response times, which is the most critical response time for the majority of incidents.

This optimum, most cost-effective station equipment scenario assumes several conditions:

- Call processing times of one minute or less for 90 percent of emergencies;
- Turnout times of one minute or less for 90 percent of emergencies;
- Units staffed with four people so that the first fire unit on the scene can go into operation immediately, meeting the “2-in, 2-out” rule;
- An adequate complement of firefighters available at a structure fire (16 firefighters plus at least one incident commander for a working fire).

If those conditions could be met, then the County Fire Commission’s Service Level Committee goals could be satisfied with the “optimum” apparatus fleet described above.

REALISTIC SHORT-TERM SYSTEM

Unfortunately, call-processing at the Raleigh/Wake Communications Center does not currently meet the one-minute/90-percent-of-emergencies standard, and firefighters are not en route to fire emergencies within one minute of dispatch for 90 percent of emergencies. Further, there is no reliable data that demonstrates whether four career firefighters, volunteer firefighters, or a combination of both are available for first-due response, or how long it takes to assemble those four firefighters for response.

The opposite of the optimal system is an environment where every department plans independently for apparatus and staffing, and prepares to meet within its own resources the requirements for moderate-size fires (e.g., a residential house that is 25 percent involved). Although the Wake County system has been moving away from the “each

department an island unto itself" model and toward a more integrated system, most departments have planned to send more than one vehicle from a station in order to get an adequate number of firefighters, pumping power and water to the scene within the desired target service goal. More system integration (send the nearest unit under a borderless response policy) and more use of volunteer shifts in stations (or, alternatively, use of more career staffing) would enable a leaner, more efficient system of apparatus to be used. However, the amortized annual cost of apparatus ($25–30K) is much less than the cost of staffing even one career firefighter around the clock, so staffing is the more important cost issue (and will be addressed in a separate companion report).

In summary, the more the system can count on reliable response by the first engine in each station, the less apparatus is needed. However, at present there is less than optimal call-processing time, less than optimal turnout times, difficulty in getting four-person staffing ready to leave the station within one minute all the time, the probability that stations in neighboring departments are subject to similar turnout time, and staffing problems. Given this situation, we cannot recommend that the optimum (leanest) fire apparatus deployment strategy we have described be put into place at this time. The main strategy we recommended was described in Chapter IV: spreading out the existing EMS units and water supply units, and maintaining all apparatus in good condition. Other recommendations for various types of apparatus are discussed in the rest of the chapter.

VOLUNTEER TRANSPORT

An issue related to the number of fire vehicles required for emergency response is how to provide transportation to an emergency scene for volunteers who are not in the firehouse when the call comes in, and who don't make it to the first-due engine before it leaves. (The same applies to the first-due aerial unit and tanker units.) Some type of vehicle is needed for transportation of the additional volunteers firefighters to a fire scene.

Even if a department can count on its neighboring departments or other stations in its own system for appropriately staffed second- and third-due units, additional volunteers are still desirable for providing more than the minimum number of personnel for fighting a fire, for dealing with a large emergency, or for relieving crews. Transport of these additional volunteers to the scene would be most efficiently accomplished by a personnel transportation vehicle (e.g., a van or SUV) rather than by expensive, slower engines or pumper/engines. Using this model, a station with a single frontline engine would dispatch that engine first. As additional volunteers arrive, they would proceed to the emergency scene in a personnel transport vehicle that costs $35,000 instead of an engine that might cost $350,000. In fact, a number of Wake County fire departments already use this approach for "first responder" response, using a four-door sedan cab pickup, an SUV, or similar vehicle. However, having the additional engines and pumper/tankers does provide

extra insurance that an adequate amount of pumping power and firefighters will arrive at the scene within the service level goals.

In light of all the considerations, we make the following recommendations for equipment per station.

Recommendation 15: At a minimum, every station (39 in total) should have at least one frontline engine. Eleven stations should have one aerial, and 26 stations should have at least one tanker (distributed as discussed in Chapter IV). Each EMS station (or fire station) where an EMS unit is based should have one frontline EMS unit unless demand is high enough and affects response times to warrant more. There should be 25–33 percent spares for each vehicle category, with spares distributed throughout the county, as discussed below. There should be one heavy rescue unit for each side of the county and one hazmat unit plus the Raleigh hazmat unit.

There is an unclear line between the definition of a pumper (or engine) and a pumper/tanker. The standard engine configuration that we recommend below for Wake County would carry 1250 gallons of water. Some may call these pumper/tankers. The idea is for the crew on this type of unit to be able to initiate an effective fire attack in areas without hydrants until a mobile water supply can be established with subsequently arriving pumpers and tankers.

Recommendation 16: The number of pumpers needed beyond one per station should be a function of the ability of the station to reliably turn out the first pumper with four staff, and the reliability of the next two closest stations to do the same. The number of pumper/tankers is the flexible component. To the extent that call-processing time, turnout time, or personnel response casts doubts on the ability to turn out all assigned units within the response-time framework proposed by the Fire Commission's Service Level Committee, a station may need a second pumper or pumper/tanker to help ensure adequate pumping capacity and staffing to meet county goals. As data become available, reassignment of pumper/tankers in a manner consistent with the optimum deployment/replacement system described above can begin.

The available data do not permit our making the recommendation as to which stations should have more than one, so we recommend that the current set of apparatus be maintained, with the redistribution recommended in Chapter IV to get better response times and ensure no worsening of total response capability.

Recommendation 17*: *Fire departments should furnish—and Wake County staff must analyze—certain additional data to that now collected: the number of firefighters dispatched on the first, second, and third units per call in the station's first-due area that would comprise the first-alarm full assignment; the number of structure fires; the number of fires with spread beyond the room of origin; and the number of high risk

structures requiring a fire flow (in gallons per minute) greater than that required for a single-family dwelling.

As the data improves and the overall apparatus deployment system improves, the number of engines per station and per region can be fine-tuned and leaned out closer to one per station. But until that data is available, redeployment decisions must occur on a case-by-case basis.

SUMMARY OF APPARATUS

Table 20 shows the current number of apparatus of each type, and what we recommend as the realistic numbers for the system in the near future. The current front-line apparatus appear to be equipped and generally maintained to high standards. In addition to front-line emergency response equipment, departments maintain command, utility, and (in a few cases) designated reserve vehicles.

As call-processing and turnout times improve, and the reliability of four-person staffing improves, the number of units currently designated as pumper/tankers could be reduced. The number of vehicles required to support this "optimum" deployment model is 165–170, as compared with the current number, 177.

Every station (39 in total) would have at least one engine with common specifications. Some of these could be pumper/tankers. As noted earlier, a streamlined, seamless integrated system would not need the current size fleet of pumper/tankers; but until turnout times are a maximum of one minute for 90 percent of emergency events, and staffing meets Wake County standards, more than one vehicle is needed in most stations. (Pumper/tankers are discussed again later in this chapter.)

One ladder truck would be in each of 11 stations (2 more than at present).

We proposed two technical rescue units, one in each half of the county. We had no recommendations as to their specific locations in the absence of information on where technical rescue incidents (or hazmat incidents) were occurring. Any centrally located station in each half of the county would suffice. Wake County contracts for hazmat response with the Raleigh Fire Department and the Wendell Fire Department at the present time. Raleigh has its own hazmat vehicle. The one vehicle listed in Table 20 is Wendell's.

TABLE 20: CURRENT VS. PROPOSED NUMBER OF APPARATUS

Type	Current		Proposed	
	Front-Line	Reserve	Front-Line	Reserve
Engine (pumper)	37[2]	0[3]	39	10
Ladder (aerial)	11	0	11	2–3
EMS	31	17[4, 5]	31	10[4]
Tankers	29	0	26	7
Pumper/Tanker	43[2]	Unknown	30–35[6]	7
Special Service Squads	1 Heavy Rescue, 1 Hazmat,[2] 0 Air Unit	0 Heavy Rescue, 0 Hazmat, 0 Air Unit	2 Heavy Rescue, [7] 1 Hazmat, 1 Air Unit	1 Heavy Rescue, 1 Hazmat, [8] 1 Air Unit
Brush Units	24	—	24	—
TOTAL	**177**	**17**	**165–170**	**39–40**

TABLE FOOTNOTES:

[1] The County verified the numbers in the left half of the table and the CIP sheet at the end of the chapter as the best enumeration of vehicles available. Some vehicles might be classified as either pumper or pumper/tankers, and could be listed in either category.
[2] Does not include one engine and one pumper/tanker at RDU airport.
[3] No vehicles other than some EMS units are identified as reserves, though some are quite old. Several stations have multiple engines or pumper/tankers, which in effect serve as reserves for each other.
[4] Two reserve EMS units might be classified as "Special Event" units.
[5] One spare EMS unit is not equipped; the rest are.
[6] The number needed is a function of the reliability of neighboring units to turn out within one minute, as discussed in the text above.
[7] The second heavy rescue could be a satellite vehicle rather than a full-fledged rescue vehicle.
[8] The reserve hazmat unit can be a modified rescue/engine.

There are a total of 48 ambulances in the Wake County EMS system: 31 of them are classified as frontline (24/7 staffed at the paramedic level), 16 spare (equipped at the paramedic level but not 24/7 staffed, and one reserve (not equipped). We recommended dispersing most of the EMS units rather than basing them in clusters to improve response times. We note again here that our study addresses response characteristics based on station location and effective response, and that we recommend collection of data that will support deployment or redeployment of ambulances based on temporal demand. Much better use can be made of the fleet by distributing several of the EMS units now in clusters.

MUNICIPAL-COUNTY APPARATUS SHARING

For developing recommendations on apparatus, and consistent with Wake County's "nearest unit" and "seamless response" objectives, we considered the apparatus in

municipal fire stations as part of the system that could potentially serve unincorporated Wake County in meeting its service-level objectives as response partners. However, this consideration does not imply a Wake County responsibility to share the cost of addition, refurbishment, or replacement of any fire apparatus located in a municipality unless the apparatus helps Wake County meet its service-level objectives in a response area where those objectives are not being met and adds to the cost for the municipality. We discuss principles for cost sharing in Chapter VII.

All apparatus in the county can potentially be used at some time on a mutual aid basis if not on an automatic aid (nearest-unit-response) basis. The cost of apparatus being used to provide service on a regular basis to unincorporated areas could be shared by the same principle as its station, with one exception: the cost of adding a rural water supply unit to a municipal station might be borne wholly by the county. (E.g., if the county station is closed in eastern Knightdale and the remaining Town of Knightdale station takes on the regional response role in the area, including the non-hydranted unincorporated area, then the county should provide a water supply unit and, arguably, someone to staff it.) This plan will not require buying any more units in total because, as shown in Chapter IV, there are enough units in the current system to meet all needs if properly redistributed.

COORDINATED PLAN

The current complement and deployment of the Wake County fleet is a function of the evolution of the fire service system in the county, with departments making purchases independently from each other, rather than from a coordinated master plan that prescribes numbers, types, and location of apparatus across the county. However, virtually all of the current apparatus could be used in the proposed deployment scenario.[56]

Recommendation 18: Wake County should develop and manage a coordinated, countywide approach to apparatus procurement and deployment. The county should examine the deployment and apparatus recommendations of this report, and validate or modify them as necessary to create a countywide apparatus plan. Existing apparatus can then be redeployed throughout the county based on the plan. (Understandably, this is not a simple task because of a variety of ownerships of the apparatus and varying amounts of useful life left.) Future apparatus purchases should be based on an identified need in the countywide plan rather than the preferences and desires of an individual department, though department representatives would provide input on needs as participants in the development of the general capital improvement program for financing acquisition of apparatus.

[56] See also Cottett, Jack. (1992, September). Explaining why you need to buy. *Fire Chief, 36 (9), pp. 42–43.*

VEHICLE DATA LIMITATIONS

There was limited data available on the maintenance of apparatus assigned to the fire and EMS departments in Wake County. The analysis and the recommendations here were based on the data that were available.[57]

A group of county fire departments in the Baltimore-Washington area recommended the on-going collection of the following data for all fire, EMS and Rescue apparatus: (a) description of the apparatus, including performance capabilities, (b) year of manufacture and current age, (c) mileage, (d) unit activity levels, and (e) total maintenance costs including parts and labor. They also recommended collecting data concerning operating cost, and performing an assessment of the ability of the apparatus to comply with Federal safety and NFPA standards. They further recommended the collection of additional detailed information such as the vehicle identification number, dates and times of maintenance, name of mechanic performing repairs, and the make and model of parts used in the repairs.[58, 59, 60] We think this is a "best practice."

Recommendation 19: Wake County should start to collect the vehicle maintenance data needed for better analysis of future vehicle replacement programs. The specific data to collect can be similar to that discussed in the paragraph above. Ideally, this should be collected in the form of a computerized database, using off-the-shelf vehicle maintenance software.

The next group of sections in this chapter addresses specifications for vehicles. These are suggested model specifications based on standards and our experience. There are many thoughts about "optimum" specifications, but in fact they do not exist. We provide our rationale and recommendations as was requested by Wake County. There should be standardization of vehicle specifications countywide to gain economies of scale in purchasing, to make maintenance easier, and to make it easier to re-deploy vehicles as needed.

[57] Data supplied by Wake County Public Safety, phone interview with the Fire Marshal's Office and e-mail data sent to TriData.
[58] Phone interviews with the maintenance bureaus of Anne Arundel, Baltimore, Howard, Prince George and Montgomery County Fire Departments. All of these departments have gone to a heavy-duty chassis for the replacement of the EMS fleet.
[59] Commission on Fire Accreditation International. (1997). *Fire and Emergency Service Self-assessment Manual (pp. 20 – 21; 87 – 104).* Fairfax, VA: International Association of Fire Chiefs.
[60] Brown, William A. (1992, July/August). Fleet maintenance information: What is essential & what to do with it. *Rescue-EMS 10, pp. 16 – 18.*

Ambulance Specifications

During interviews with fire and EMS personnel, the condition of the ambulances was raised as a concern but without supporting data being provided to back this up. The vehicles were said to be running more calls than anticipated and needing to be replaced more quickly than originally planned. Those interviewed further commented that because of the added weight of the patient compartment, ambulances built on standard, light-duty chassis have experienced braking and steering deterioration at a faster rate than both lighter trucks on similar chassis and ambulances on heavier duty chassis. In turn, maintenance costs were thought to be higher as the call load increased and the units got older.

However, many of the negative comments we received appear to be outdated. Of the current 48 EMS vehicles in the Wake system, only five were purchased prior to 1998. One of the latter units is "front line" but at a low-volume location, Rolesville. Nine of the 45 units are scheduled for replacement by the end of 2003. The units to be replaced this year were purchased in 1997 or 1998. Thirty-one units were purchased since 2000. Except for Rolesville, all EMS frontline units are now medium-duty grade chassis. In general, the condition of EMS units in Wake County will be at an all time high by the end of 2003 in terms of average age and type of chassis.

Many of the combination Fire/EMS Departments serving counties in the Baltimore/ Washington area that are of similar or larger population (400,000–1 million) and geographic area compared with Wake County have moved from light-duty to heavy-duty ambulances, and had data to back up their decisions. The counties include Anne Arundel, Howard, Baltimore, Montgomery, and Prince George's County. They computed the costs per mile to operate the vehicles over their lifetime. Their analysis showed that the average cost to operate a light-duty unit was $1.00 per mile, versus $0.55 per mile for a heavy-duty chassis—about 45 percent less. The results of a similar analysis of heavy vs. light for Wake County would probably yield a similar result.[61] Wake County agencies are now using a medium-duty chassis Ford E450s or the equivalent—a middle ground between the heavy and light units. It is not clear what is most effective for Wake County in terms of cost-effectiveness. The medium-duty units may well be an optimum choice. Data were not available from Wake County nor from the individual departments on cost per mile for these units to make an evaluation.

Wake County EMS officials said the Wake experience is that after 4 to 5 years of regular service in moderate to high call volume stations, the wear and tear on the modules added

[61] Source: Phone interviews with the maintenance bureaus of Anne Arundel, Baltimore, Howard, Prince George and Montgomery County Fire Departments. The workload of these departments is 72–78 percent EMS, and the rest fire/rescue.

to the chassis require increased maintenance and repair. That is, the modules wear out even if the chassis has not, so why get long life chassis?

Without better fleet maintenance data, it is hard to be definitive. Counties that have better data already are finding heavy-duty chassis such as those available from Freightliner and Navistar to be more cost effective than the light duty units, and possibly more than medium-duty units. Again, this points to the importance of having good maintenance data by unit.

Recommendation 20: Wake County should study the potential cost effectiveness of new ambulances built on heavy-duty commercial chassis as compared with chassis built on medium-duty chassis. Data on initial costs, maintenance costs, and salvage value need to be collected. Also needed is qualitative information on the ease of using vehicles with the different types of chassis.

Fire Vehicle Specifications

Currently, each fire department in Wake County prepares its own specifications for new fire apparatus. This practice does not take advantage of economy of scale in the purchase and production of fire apparatus, eliminating duplicate design and engineering costs.

Recommendation 21: Wake County should manage the development of performance-based fire apparatus specifications by vehicle class, e.g., pumper, pumper/tanker, rescue vehicle, aerial ladder. In developing the standard specifications, several standards need to be considered, as summarized below.

APPLICABLE STANDARDS FOR FIRE APPARATUS

There are several Federal regulations, fire service consensus standards, and fire insurance standards that have influenced the design of modern fire apparatus. The Federal standards include requirements mandated by the National Traffic and Motor Vehicle Safety Act and the Clean Air Act. The fire service consensus standards consist of National Fire Protection Association (NFPA) Standards 1201, 1500, and 1901. The fire insurance standard was that of the Insurance Services Office (ISO). The Commission on Fire Accreditation International (CFAI), a joint endeavor by the International Association of Fire Chiefs (IAFC) and the International City Management Association (ICMA), also has references to fire apparatus design and procurement processes in their assessment manual.

National Traffic and Motor Vehicle Safety Act of 1966 – This Act mandated that all manufacturers adhere to specific safety standards when designing and constructing motor

vehicles. The Clean Air Act has emission control standards that affect engine performance, which led to incorporation of electronic controls on diesel engines.

National Fire Protection Association Standard 1201, Developing Fire Protection Services for the Public (1994) – This standard includes sections on procurement and maintenance of fire apparatus. They require (a) inventory control of all fire apparatus and equipment owned and operated by a fire department; (b) implementation of forecasting methods to project apparatus service-life expectancies and replacement needs; (c) development of written fire apparatus bid specifications in accordance with NFPA standards; (d) implementation of routine inspection and preventive maintenance programs; and (e) implementation of service testing for fire pumpers and aerial devices.

National Fire Protection Association Standard 1500, Fire Department Occupational Safety and Health Program (1992) – Chapter 4, Vehicles and Equipment, addresses (a) fire apparatus design requirements; (b) training and certification of fire apparatus operators: (c) safe driving and operating practices for fire apparatus; (d) safety practices for firefighters riding fire apparatus; and (e) regular inspection and preventive maintenance and repair of fire apparatus.

National Fire Protection Association Standard 1901, Automotive Fire Apparatus (1996) – This standard outlines design requirements for (a) pumper fire apparatus; (b) initial attack fire apparatus; (c) mobile water supply fire apparatus; (d) aerial fire apparatus; (e) special service fire apparatus; (f) chassis and vehicle components; (g) low voltage electrical systems and warning devices; (h) driving and crew areas; (i) body, compartments, and equipment mounting; (j) fire pump and associated equipment; (k) water transfer pump and associated equipment; (l) water tanks; (m) aerial devices; (n) foam proportioning systems; (o) compressed air foam systems; (p) line voltage electrical system; (q) command and communications; (r) air systems; and (s) winches.

Insurance Services Office – ISO rates the capabilities of local fire departments to respond to and suppress fires. The ISO Fire Suppression Rating Schedule (FSRS) rates the fire defenses according to fire flow capabilities, fire department resources, and water supply. Fire departments are classified on a scale of 1 (highest) to 10 (lowest), based on the sum of ratings received for each criterion. Insurance underwriters often base fire insurance rates on the ISO class of the local jurisdiction. The ISO ratings vary from area to area in the county.

Requirements for fire apparatus are addressed in the ISO fire department resources criterion. Based on the results of Basic Fire Flow calculations, one computes the minimum number of engine companies and pump capacities needed to meet estimated fire suppression requirements. Depending on the total number of buildings that are at

least 3 stories or 35 feet in height, the need for ladder or service companies is also determined.

Commission on Fire Accreditation International (CFAI) Assessment Manual – Chapter VI, Physical Resources, Criterion 6B, apparatus and resources says that "Rating for this criterion is based on the performance indicators of (a) apparatus location in accordance with established standards of coverage for the community; (b) appropriateness of apparatus types for services provided; (c) existence of an apparatus replacement schedule; and (d) existence of a program for writing apparatus replacement specifications so that fire apparatus are designed and purchased to be adequate to meet the agency's goal and objectives."

PERFORMANCE SPECIFICATIONS

Performance specifications are a method of stating the requirements for an apparatus procurement in terms of what the vehicles do rather than the way to get there. Most, if not all, apparatus manufacturers today indicate that if the purchaser specifies performance requirements rather than requirements for specific components, the manufacturer can engineer the apparatus to conform. For example, if the county were to specify a 1,250 gallon per minute (gpm) pumper and its road performance requirements, the manufacturer would figure out the appropriate engine, transmission, and the driveline combination to accomplish the goal. The manufacturer would ensure that the horsepower and torque provided would be sufficient to meet the needs of the apparatus. This in turn would save the county money and time by eliminating unnecessary over-sizing of the engine and related equipment for the apparatus.

In using performance-based specifications, consideration must be given to how the configuration will perform as it ages, after routine wear of the apparatus. In other words, one needs to state how long the vehicle is expected to last and still provide the desired performance.

Perhaps the most desirable specification combines a performance specifications format with a general design format (e.g., four doors, bench seat). Including minimum performance standards in the specification for various components and systems is a good way to ensure proper performance.[62, 63, 64] Wake County should manage the development of the basic requirements for any new apparatus purchased with county funds.

[62] Senter, Edward L. (1998, July). *Evaluating Fire Apparatus Design Changes in the Norfolk Department od Fire and Paramedical Services.* Emmitsburg, MD: National Fire Academy, Executive Fire Officer Program.
[63] Norfolk Fire and Paramedical Services. (1993). *Vehicle study.* Norfolk, VA: Author
[64] Capital Safety Systems. (1991). *Calvert County, Maryland emergency apparatus assessment & analysis.* Fuquay – Varina, NC: Author

Recommendation 22: Wake County should standardize apparatus designations by unit name, type, use, and numbering system. Standardization is needed to assist in dispatching by the new CAD and for management of the fleet. Presently, each department calls apparatus what it wants (e.g., pumper and pumper/tanker are not well distinguished).

Recommendation 23: Wake County should manage development of a standard set of specifications for the replacement of ambulances, fire apparatus, and other emergency vehicles. The specifications should be performance-based and should combine a design format and performance specifications. They should conform to the various standards discussed above. Examples of general fire apparatus design criteria are given below. They are intended to suggest minimum standards based on "best practice" from similar departments, the literature, and our project staff experience.

Engine/Pumper – Each pumper company should have a minimum rated capacity for a mounted fire pump of not less than 1,250 gallons per minute (gpm) and should have a single stage pump. (Most of the pumpers are at that level or more.)

They should have a tank constructed of material not subject to deterioration from rust or corrosion (e.g., plastic or fiberglass composite). The tank should hold at least 1,250 gallons and should have an integral foam cell installed. (Many current pumpers have less than this tank capacity but pumper/tankers have more.) The hose bed should be constructed to handle a minimum of 1500 feet of large diameter hose and have a minimum of three hose bed dividers. It should have a power take-off generator (minimum 10,000 watts), all aluminum body or other body type that prevents rusting, with roll-up doors and shelving trays that slide out. A minimum of two live cord reels should be permanently mounted on the vehicle in accordance with NFPA 1901 standards. Rear-drive-axle automatic tire chains may be worth consideration. They are standard now in the Washington-Baltimore area county fire departments and have worked well there, but some other departments (e.g., Asheville) have found them to be ineffective. The cab should be designed to handle a minimum of five fully dressed firefighters and meet the requirements of NFPA 1901 standards. All emergency warning systems should comply with NFPA 1901.

Because Wake County regularly suffers winter ice storms and occasional snow accumulations of eight inches or more, it is worth considering inclusion of all-wheel-drive capability for a certain percentage of pumpers so that there is a "core fleet" of all-wheel-drive vehicles that can overcome winter weather barriers to emergency response.

Ladders/Aerials – There are several designs of ladder/aerial apparatus in use in Wake County today. Minimum requirements for new aerial apparatus can be found in NFPA

1904, *Standards for Aerial Ladder and Elevating Platform Fire Apparatus.*[65] The NFPA ground ladder standard (NFPA 1931) increased the width and strength requirements of the ladders, which in turn has increased the space required for storage and caused an increase in vehicle weight. The NFPA 1904 standard recommends a complement of ground ladders that includes a 10-foot folding attic ladder, two 16-foot roof ladders, a 14-foot combination ladder, a 24-foot extension ladder, and a 35-foot extension ladder.

There is some disagreement in the fire service as to whether ladder units or quints or a mix of both should be used as the aerial ladder trucks in an area like Wake County. There are many examples of both uses nationally. A quint is a combination engine and aerial truck. It can work as the first-in engine or as a ladder truck, but usually not both at the same time. Using quints can improve first-in response times (by providing more first line units that can respond as engines), and give more flexibility with fewer units. The quint has a water tank (typically 200-500 gallons), a pump, and a hydraulic aerial ladder. Quints also have a complement of ground ladders, fire attack hose and fire supply line.

A quint could increase the probability that a hydraulic aerial would be available at the scene of a structure fire in the event of a rescue, or if an elevated fire stream were required, because the one piece could be taken if there were not enough crew to take both a ladder and an engine. Once a second ladder arrives, or after accomplishing a rescue, the quint could revert to an engine company's duty. An elevated stream can be used to protect uninvolved structures from fire spread or to contain fire spread to the involved structure should interior firefighting conditions become untenable for firefighters.

The acquisition of a quint does not result in a company (crew and vehicle) that can simultaneously undertake an initial attack and an aerial-ladder rescue. The principle benefit of a quint is the fact that the cost of an aerial device, spread across the useful service life of the vehicle, is considered by a number of fire service experts to be low compared with the value of availability of the aerial device. The cost of a quint is $600,000-750,000, with equipment.

If a quint is purchased, the county should require as a minimum on a quint:

- An appropriately sized aerial (generally, 75 to 100 feet) with a minimum of 2000 gpm pump and a 500-gallon tank. (This combination of capabilities has become available from several manufacturers in the last three years.)

- An automatic transmission, tandem rear axle assembly, 120–127 feet of ground ladders, 10kw generator, automatic chain system for the rear axles, 1000 gpm monitor pipe and at least three pre-connects for hand lines.

[65] National Fire Protection Association (1997). *Standards for Aerial Ladder and Elevating Platform Fire*

- An assortment of truck company tools, negative and positive pressure fans, cords reels, saws, traps, rescue rope, SCBA and spares and a minimum of 400 feet of 3 inch LDH and 500 feet of LDH.

This minimum set of equipment would allow the unit to operate as an engine/pumper company or a truck company, as needed.

Tankers/Mobile Water Supply Apparatus – The minimum requirements for Tanker/Rural Water Supply Apparatus can be found in NFPA 1003, *Standards for Mobile Water Supply Fire Apparatus.* [66] These units are designed to transport water to the scene of fires or other emergencies. They should have at least a 2000-gallon tank. Off-loading of the water supply must, by the standard, be accomplished at a minimum average rate of 1000 gpm for 90 percent of the tank's capacity.

We would recommend that the county increase the rate of discharge over the normal gravity dump by requiring a jet-assist system or pneumatic pump on all tankers in the future. This allows faster off-loading of the water and faster turn-around time for the tanker's operation. For jet-assist, a single-jet nozzle that directs the discharge at the gravity dump from inside the tank can be installed. The nozzle is supplied by a pump that forces the water out of the dump. A second type of jet-assist system has two or more jets installed in the discharge piping outside the dump. When supplied by the pump, they cause the tank water to be drawn through the dump at an increased rate. The pneumatic system uses a pump to pressurize the tank that expels the water at an increased rate.[67] Either of the systems would be fine for the Wake County Tanker operations.

As with pumpers, the county should consider having some percentage of the tankers equipped with all-wheel drives, to form a core fleet for severe winter conditions.

Pumper/ Tanker – Because of the staffing and response issues facing Wake County, many departments have employed multi-use pumper/tankers. They allow water to be applied to a fire if they are first on the scene and also can be used as a tanker, albeit a relatively small tanker. They improve overall fire suppression capability by providing more vehicles that can pump water; a pure tanker cannot.

A pumper/tanker unit should be equipped with 2000 or more gallons of water, and a fire pump with a minimum capacity of 1250 gpm. Units should carry at least one 3000-gallon folding tank, have rear and side dumps, carry at least 1000 feet of LDH, be

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Apparatus. Quincy, MA: Author.

[66] National Fire Protection Association. (1997). *Standards for Mobile Water Supply Fire Apparatus.* Quincy, MA: Author.

[67] Peters, Williams C. (1994). *Fire apparatus purchasing handbook (pp1-20, 77-94).* Saddle Brook, NJ: Fire Engineering

equipped with cross-lays for firefighting operations, automatic drop chain systems, fully equipped SCBA with extra bottles, and should have roll-up doors.

Here, too, there should be a "core fleet" of all-wheel-drive pumper/tankers, as was suggested above for pumpers and tankers.

Brush Units – Brush units should be a pick-up truck with four-wheel drive, a heavy-duty unit suitable for off-road operations. They should be equipped with a skid mount type pump with a minimum capacity of 200 gpm pump and a 250-gallon tank made of plastics or fiberglass composite materials. This unit should have collapsible wildland hose lines and collapsible "backpack" pump tanks. They should be outfitted with assorted brush and wildland firefighting tools and equipment.

Over the past two years, a number of fire apparatus manufacturers have developed commercial chassis brush fire truck packages. At least two vendors have slide-in compartment/tank/pump packages for popular commercial heavy-duty pickups that are competitive with using surplus vehicles plus skids.

Heavy Rescues/Squads – Special service vehicles such as heavy rescues/squads, chief/command vehicles, can also be standardized, based on our observation of the county's operations and "best practices" elsewhere. We recommend that the following be the minimum requirement for heavy rescue or squad units: a five-person cab, two rescue tools (e.g., jaws, combi-tools), power supplies; two air bag systems, complete cribbing, cascade system, hand tools, 12,000 lb winch, medical equipment, 10 to 15kW on-board generator system, rescue ropes, air and electric reel systems, and some type of tower lighting system. Technical rescue vehicles should have all-wheel drive capability because there are only two and they need to work in all weather conditions.

Hazardous Materials Response Vehicle – Hazardous materials response vehicles can range from light-duty van-type units to a cargo-carrying vehicle (e.g., a beverage delivery truck) to a heavy rescue type design. In most cases, the unit only has to transport the necessary equipment to the incident. The equipment may include protective clothing, monitoring and hazard determination equipment, spill control supplies, reference materials, SCBAs and spares, electrical reels and equipment and lights. Some units also have communications equipment, fax machines, computers and a command center.

The hazmat team's degree of training and expertise as well as the community's need for such services will dictate the type of apparatus and equipment needed. There were no data available from the current CAD or other sources on the number, types, and magnitude of hazardous materials incidents needed to develop a recommendation on the size, style, and other details of a hazmat vehicle. Therefore, we recommend a relatively standard approach in the absence of information on hazards not found elsewhere. As

noted earlier, Wake County currently contracts for hazardous materials response services from the city of Raleigh and from the Wendell Fire Department. The information above is intended as a supplement to future contract negotiations when vehicle replacement may be an issue.

Recommendation 24: Wake County should collect the necessary data on hazmat and technical rescue incidents to support selection of the types of vehicles that will be needed in the future. The hazmat and technical rescue calls were not distinguishable from other calls in the past data, but should be distinguishable with the new CAD.

CUSTOM OR COMMERCIAL VEHICLES

Both custom and commercial chassis can be good choices for fire apparatus today. The debate pitting custom against commercial chassis has been going on for many years. Each type of apparatus has its advantages. The cost and benefits of each approach are discussed below. Ultimately, they should be considered more quantitatively, when better data is collected on maintenance costs per vehicle. One can also consider the cost-effectiveness studies made in similar counties that have had good maintenance data.

Commercial Advantages – Commercial chassis usually have a lower initial purchase price, even when using performance specifications. Depending on the chassis, the custom chassis cost $35–40K more than a commercial chassis.

Commercial chassis with an "engine-forward" configuration usually have better service access than a custom cab-over chassis where the engine is mounted under the cab. Commercial chassis also have longer cab and hood dimensions, as well a farther-forward front axle, which usually mean there is less weight on the front axle. This allows the front axle, tires, wheels and brakes to be specified with a lower load capacity, which can reduce the initial cost. It also can reduce the replacement cost of tires and brake linings for the life of the vehicle. Further, it can result in a sharper front wheel cut for better maneuverability. (The commercial chassis can have up to a 50-degree wheel cut, while most custom chassis have no more than a 45-degree wheel cut.)

Besides cost, the three principal areas where a commercial chassis offers an advantage for fire apparatus are the following:

1. Proven durability and reliability of the product. The cab, hood, and other major components have cumulatively withstood hundreds of millions of road miles in all kinds of service.

2. The models are fully integrated vehicles; i.e., the cabs, chassis, and components are all designed and manufactured by the same company for increased reliability and durability.

3. A large network of dealers provides a ready source of parts and service, which can mean faster service and less downtime. The dealers can handle service under standard and extended warranties locally on most components, rather than having to send items back to the factory for repair. The dealership network is especially important for departments that do not have their own maintenance shop.

Commercial chassis often have standard features that exceed those on custom apparatus chassis. For example, many commercial chassis cabs use all-aluminum construction with overlapping seams and a one-piece roof with structural roof bows. The doors add strength to the cab and have continuous piano-style hinges for long life. Other standard features include 900-square-inch radiators for extra cooling capacity, custom frame rails with Huckbolt frame fasteners for superior frame strength, wire-braid reinforced fuel lines for long life, the previously discussed better front wheel cut for excellent maneuverability, air suspensions for improved ride and a wide range of aluminum components, including battery boxes, fuel tanks and air tanks for additional weight reduction and corrosion resistance.

Custom Advantages – Custom chassis offer the following advantages:

- More interior space with the potential of seating for more than four or five personnel.
- A wide variety of cab and chassis configurations to meet different customer requirements.
- Built-in-systems, electrical, specifically designed for fire apparatus use.[68]
- Higher-horsepower engines than medium-duty commercial chassis (though commercial chassis engines can meet pump capacities up to 2000 gpm—more than enough for Wake.

The replacement cycle for custom and commercial apparatus is substantially the same.

Regarding comparative compliance with rollover safety standards, some fire chiefs take the position that custom fire apparatus are the only fire vehicles that provide adequate rollover protection. But rollover protection is also a feature of many commercial trucks (e.g., with roofs that have bow supports), and all have to comply with NFPA 1901.

[68] A comment on a previous draft of this report said that this advantage could become a disadvantage because the wire looms and related components are non-standard. However, the electrical problems sometimes come from not specifying how the wires are to be run and are not necessarily the manufacturers' fault.

Recommendation 25: Wake County should purchase standard vehicles with commercial chassis for engine/pumpers, tanker/mobile water supply apparatus, heavy rescues/squads, and hazardous materials response units. Ladder units or quints should be custom vehicles. The most desirable specification combines a "design format" with a performance specification. This is the most cost-effective way to purchase needed replacement apparatus in the future. This recommendation is based on experience in a number of counties like Wake County.

Lease-Purchase – Lease-purchase arrangements have been successful in many communities. They allow departments to bank monies each year toward purchase of a vehicle in a future year, without having irregular large expenditures hit in the year when apparatus purchases are made. The county is already using a lease-purchase program for ambulances.

Recommendation 26: Establish a county-managed "lease-purchase" arrangement for buying new fire apparatus. It would be similar to the lease-purchase mechanism recently used by Wake County to purchase replacement ambulances for two EMS squads that could not otherwise afford needed replacements.

Wake County would buy all apparatus, in groups at the same time, under one purchase contract. This will enable the County to stretch its capital dollars by taking advantage of the economies of scale of multiple apparatus purchases, and eliminates individual departments buying unique replacement vehicles one unit at a time.

Wake County would lease the apparatus back to individual departments and fund the annual "lease" payment, which would be banked for replacement of that vehicle. The lease instrument should include maintenance standards and PM reporting.

At the end of its front-line life, a rig would be re-assigned as a reserve unit where it is most needed as its successor (new unit) replaces it in front-line service.

Vehicle Maintenance

Emergency responses vehicles are very specialized and require sophisticated up-keep. They must be dependable beyond the "fail-safe" standard. The apparatus are expensive and carry a large amount of specialized equipment and tools that, in many instances, cost as much as the vehicle itself. They must perform reliably at the scene of an emergency.

Vehicle maintenance is currently the responsibility of the individual fire department corporations or municipalities. The county provides funding for maintenance in its yearly allocation to each corporation and municipal fire department. Significant repairs are contracted out to local commercial truck shops in the county or nearby counties.

No department employs a private mechanic to regularly perform minor repairs or preventive maintenance on its apparatus. Minor repairs and preventive maintenance issues are, for the most part, handled in-house by volunteer members with an interest in and knowledge of the mechanical operation of fire apparatus.

CERTIFICATIONS

The emergency services have always ensured that response and rescue personnel are trained and certified to the appropriate levels based on "accepted standards", such as the NFPA standards for firefighters and fire officers. And a great deal of emphasis is placed on maintaining the condition of fire and EMS apparatus. But what about the staff who maintain and repair the apparatus and equipment for the departments? Unfortunately, many of them have received little or no training in how to keep a sophisticated piece of fire or EMS apparatus in proper operating order.

Wake County in-house personnel working on the apparatus were not certified by either Automotive Service Excellence (ASE) or National Association of Emergency Vehicle Technicians (NAEVT). In many cases, the technicians used for outside-the-department repairs also are not certified.

Emergency vehicle repair technicians need training, education, and certification in their specialty—just as emergency response personnel do. Servicing emergency fire apparatus and ambulances by certified technicians should lead to more reliable equipment, enhancing the safety of the public and emergency personnel. It also increases firefighter confidence in the quality of the maintenance and may improve the organization's reputation.

The National Institute for Automotive Service Excellence (ASE) tests and certifies automobile technicians and heavy-duty truck technicians. Their program consists of a series of written tests given biannually. The tests measure diagnostic and repair knowledge, and skills in various technical areas. When technicians pass one or more tests and complete two years of related work experience, they receive documentation for those areas of certification. The program is administered by ACT, a nonprofit corporation engaged in test development and administration, and educational and vocational research.[69]

STANDARDIZED MAINTENANCE

Concern over apparatus maintenance was expressed by several fire and EMS chiefs. They proposed that maintenance programs be made more consistent throughout the county.

[69] Emergency Vehicle Technician Certification Program, (2003). *Emergency Vehicle Technician Certification Commission, Inc.* Shirley, NY: www.naevt.org/about_us.htm

The emphasis of their comments was not on having a central maintenance facility, or even to have particular mechanics assigned to various fire departments, but rather to ensure that each department is following the same maintenance program and procedures. At the center of their concern is the perceived need for increased emphasis on *preventive* maintenance. A maintenance policy under which each department performs the same preventive maintenance procedures and safety checks, is a "best practice" and should be adopted.

A model worthy of consideration is establishment of a countywide "minimum preventive maintenance standard" and a computerized shared maintenance record-keeping system for all fire departments. The record-keeping data for replacement or redeployment decisions system would support maintenance quality assurance and would provide reliable data for replacement or redeployment decisions.

The maintenance policy should also address standards for performing unscheduled repairs or maintenance as well as the certification of mechanics or facilities for performing key equipment repairs.

Recommendation 27: Wake County should establish a countywide fire vehicle maintenance program with written standards and SOPs. The program should address preventive maintenance and unscheduled repairs. It should include certification standards for mechanics and for apparatus testing. The maintenance budget may need to be increased somewhat to bring all departments to a common level. If the previous recommendation for using a county-run lease-purchase program for fire apparatus is implemented, as is already done for ambulances, then the maintenance program can be an integral part of the leasing agreement.

Vehicle Replacement Program

The overriding question when determining whether to replace a given vehicle is whether it still functions reliably and safely and has adequate capability to fulfill its role.

The county's General Service Administration has guidelines for deciding when to replace county vehicles of all types. A score is given to each vehicle based on age, mileage, condition, type of service, repair frequency, and total repair costs. These guidelines are used for ambulances but not for fire vehicles.

FIRE VEHICLE REPLACEMENT

The National Fire Protection Association (NFPA) has the following guidelines for fire vehicle replacement:

> *The normal life expectancy for first-line fire apparatus will vary from [county to county,] city to city, depending upon the amount of use the equipment receives, and the adequacy of the maintenance program. In general, a 10- to 15-year life expectancy is considered normal for first-line pumping engines. First-line ladder trucks should have a normal life expectancy of at least 15 years. In fire departments where ladder trucks make substantially fewer responses to alarms than engines, a planned first-line service of 20 years may be warranted for ladder trucks. Some smaller fire departments that have infrequent alarms operate pumping engines up to 20 years with reasonable efficiency, although obsolescence will make older apparatus less desirable, even if it is mechanically functional. In some types of service, including areas of high fire frequency, a limit of 10 years may be reasonable for first-line service. The older apparatus may be maintained as part of the reserve fleet, as long as it is in good condition, but in almost no case should the fire department rely on any apparatus more than 25 years old.*[70]

The above guideline provides some latitude in determining useable life for a fire service vehicle. The most important variables are the amount of calls to which the vehicles respond and the frequency and quality of preventive and other maintenance received.

The NFPA guidelines have proven to be reasonable in practice and tend to be followed by most fire departments that have neither extremely high nor extremely low numbers of runs or vehicle mileage. They are a good benchmark for "best practices."

As a rule of thumb, an annual replacement review process should be undertaken for any piece of front-line fire apparatus more than ten years old or with more than 100,000 miles on the odometer to determine whether replacement is warranted. More heavily used apparatus may need to be replaced sooner than less heavily used pieces. Apparatus can be taken out of front-line service and placed in a reserve status for a few additional years of life, as long as such vehicles can still be safely used for their designated purpose and still meet ISO and NFPA performance standards.

Modern safety features also are important to consider. Older vehicles may lack important new features (e.g., enclosed cabs), which may be a reason not to wait until the end of a replacement cycle to get a new vehicle, even if the vehicle is in good condition.

AMBULANCE REPLACEMENT

In various EMS departments nationally, ambulances are replaced in four to eight years, depending on their usage and the type of chassis. Their replacement is much sooner than fire engines because the ambulances receive greater use and many are built on a mid- or light-duty chassis, which are not as durable as fire trucks though ambulances built on heavy-duty chassis are becoming more common. Because of the high volume and critical

[70] NFPA Fire Protection Handbook (18e), Quincy, MA, 2000, pp. 10-208-209.

nature of EMS calls, it is imperative that the reliability of the unit, in terms of the frequency and amount of down time, be considered in the replacement decision.

REPLACEMENT SCORING SYSTEM

Many East Coast fire departments use the scoring system developed by the American Public Works Association Fleet Service Committee for assessing fire apparatus for replacement, or a scoring system similar to it.[71] Examples of its use may be found in Chesapeake, Hampton, Newport News, Virginia Beach, and York County, Virginia. The system entails considering a combination of variables that include age, mileage, maintenance costs, and operating condition. A replacement score is calculated for each vehicle based on the sum of its scores for age, usage, and condition. The data for these calculations usually are obtained from computerized vehicle maintenance records and work orders, but can be obtained otherwise, too.

The age of the vehicle is scored by assigning one point for each month beyond the date on which it was purchased. The usage score assigns one point for each 1,000 miles traveled or 3.5 points for each 100 hours of use, whichever is higher. The condition of the vehicle is scored on a scale of zero, two, or four for each aspect, in accordance with criteria for each of the categories, including the body, interior, installed functional apparatus, maintenance/repair cost, and mission. The sum of the scores for each category is then multiplied by a factor of 12 to obtain the overall vehicle score. If the overall score exceeds the point limit established for the respective vehicle category, the vehicle is recommended for replacement or disposal. The categories and associated maximum scores are listed in Table 21. (This is similar to, but not the same as, the system used by Wake County GSA.) Other factors such as vehicle downtime can be included in such a system.

The critical component in any service-life-assessment system is the absolute requirement that a vehicle must be able to safely and reliably perform in a manner consistent with the vehicle's design purpose, regardless of mileage or hours of use.

TABLE 21: MAXIMUM VEHICLE POINTS BEFORE DISPOSAL/REPLACEMENT IS RECOMMENDED (APWA SYSTEM)

Vehicle Category	Maximum Vehicle Points
Sedans, station wagons, and jeeps	162
Heavy duty trucks and towed equipment	192
Special purpose equipment such as boats and trailers	192
Light-duty trucks	196
Medium- to heavy-duty trucks (including ambulances)	220

[71] American Public Works Association (2003). *Fleet Service Committee. www.apwa.org*

Vehicle Category	Maximum Vehicle Points
Fire apparatus	225

COUNTYWIDE APPARATUS REPLACEMENT PROGRAM

Fire and EMS apparatus can be expensive and have a significant impact on budgets. Even the cheapest commercial pumper costs at least $250,000, and custom apparatus can cost much more. Fire units that respond to five to seven calls a day (2,000 responses per year) typically have a life expectancy of 12 to 15 years as front-line equipment. On a 12-year replacement schedule, the annual replacement cost, with an expected inflation of three to four percent per year, would be approximately $22,000 per unit per year.

A new heavy-duty ambulance can cost up to $140,000 (depending on specifications). These units can expect a front-line usefulness of only seven to eight years. On an eight-year replacement schedule, this would equate to about $18,000 annually for each unit.

Wake County does not currently have a countywide vehicle purchasing schedule for the emergency fleet. The purchasing of replacement vehicles is based largely on what individual fire and EMS departments perceive as needed, rather than through use of a system-wide needs assessment.

The Commission on Fire Accreditation International recommends that replacement decisions include an analysis of maintenance data such as incidence of mechanical failure or number of mechanical defects, in addition to an examination of total maintenance costs and downtime.

Our suggested replacement criteria, shown in Table 22, blend industry practices with NFPA guidelines. Vehicles would be replaced as front-line vehicles when they exceed the age range or the mileage, have unresolved significant safety problems, or have annual maintenance costs above 30 percent of the purchase cost. The county may wish to have more specific criteria, use the APWA point system described earlier, or use its general purpose replacement criteria. In any case, the county needs standard fire and EMS vehicle specifications, replacement standards, and an effective and reliable mechanism for financing replacements.

It is not uncommon to see replacement formulas that require meeting two or three criteria to qualify for replacement. In Table 22, the replacement decision is a function of age of vehicle, mileage, whether there is an unresolved (or unresolvable) safety problem, and whether annual maintenance costs exceed 30 percent of the replacement costs.

TABLE 22: SUGGESTED VEHICLE REPLACEMENT CRITERIA

Vehicle Type	Age (in years)	Road Miles	Safety Problem?	Annual Costs*
Engine (<2,000 calls/yr)	15 to 20	100 – 125K	if unresolved	30%
Engine (2,000+ calls/yr)	10 to 15	100 – 125K	if unresolved	30%
Ladder/Heavy Duty	15 to 20	100 – 125K	if unresolved	30%
Ambulance	7 to 8	100K	if unresolved	30%
Utility/Light Duty	5 to 7	77K	if unresolved	30%

*Replace vehicle if annual costs of planned maintenance exceed this percentage replacement cost.

Recommendation 28: Wake County should establish a formal apparatus replacement program with specific criteria for fire and EMS vehicle replacement (like Table 22, or the APWA Point System, or its GSA system). A vehicle replacement fund should be established with annual allocations based on the anticipated replacement schedule. The replacement criteria should be data-driven. Vehicles should not be replaced solely on the basis of a local recommendation but rather on the basis of a system-wide needs assessment. Vehicles can be retired from frontline service to reserve (spare) status for the last 3-5 years of their service life, if in good condition.

Reserve Apparatus

In order to keep a fire department emergency fleet up and running, there must be an adequate amount of reserve apparatus ready to fill in when a piece of front-line apparatus is in maintenance. In the case of engine and truck companies, the NFPA recommends a ratio of reserve to front-line units of 1:4 or 1:3, depending on the type of apparatus and the frequency with which it is used.[72] In other words, the number of reserve units should be 25–33 percent of the number of frontline units. Reserve apparatus need to meet the same criteria as frontline apparatus in terms of pump capacity, hose carried ladders carried, equipment carried, and annual testing. Age of the apparatus is less a factor, provided that it passes its performance tests and spare parts are still reliably available.

Currently, with the exception of ambulances, Wake County does not have a reserve apparatus program. Some departments have reserve apparatus and may be willing to lend them to another department if needed, but there is no coordinated countywide program. There also is no standard unit identification in the county, so it is difficult to determine what apparatus is front-line vs. reserve or the intended use of each apparatus. Most of the fire departments do not categorize their apparatus as front-line or reserve. They usually

[72] Ibid.

respond to an incident with the newest one first; if additional members come to the station, they take the next best apparatus.

Several departments believe that the county should maintain a "spare fleet" of engines, trucks, special service vehicles, and ambulances, to be used by departments when their apparatus is out of service. The county-owned apparatus could be maintained and stored in a county facility or stored by one of the departments and maintained using county funds or facilities. There would be no acquisition cost for the vehicles in this reserve fleet; they would be the most recently "retired" vehicles from individual departments that are in best condition. They would be placed in reserve status for use by all departments in the county.

Recommendation 29: Wake County should establish standards for the size of its reserve apparatus fleet and manage that fleet. This is needed to develop a clear CIP replacement program. Because there is no tracking as to what is front-line vs. reserve today, it was difficult to determine which (if any) units currently in use are, effectively, reserves. We recommend that the county maintain enough reserve engines, trucks, and ambulances to be in the 25 to 33 percent range recommended by NFPA. This would require 10 reserve ambulances, 10 reserve engines, 2–3 reserve ladders, and 7 reserve tankers and 7 reserve pumper/tankers. When a department retires a piece of front-line apparatus it owns, it should be titled to the county without cost instead of selling it, as is present practice. When a unit is to be discarded, its condition and capability should be compared against those in the reserve fleet, and the better one kept. Some maintenance may be needed to bring recently retired units up to operational condition and keep them in it.

Recommendation 30: Wake County should keep at least some reserve apparatus fully equipped so they would be immediately available to a department if a front-line vehicle breaks down. The equipped reserves can be immediately staffed in case of extreme emergency or when a large number of units are committed to an extensive operation. Firefighters could be called back and immediately assigned to a reserve piece to restore fire protection to a community when other resources are depleted. Equipped reserve apparatus also reduce the time a unit is out of service while a crew is switching vehicles. They can also contribute to a better ISO insurance rating.

Capital Improvement Program

There are advantages to using the Capital Improvement Program to fund the purchasing of fire and EMS apparatus. Setting aside replacement funds annually will assist the county in maintaining a level apparatus budget and preventing budget spikes during the

years when six or seven engines or rescues are purchased at the same time. (The money ––or most of it—will have accrued.) Instead of leasing or paying finance charges, the reserve funds gain interest.

One of the best benefits to having the funds in advance is that manufacturers usually give significant discounts for pre-paying for the chassis at the time of placing an order. They also give additional discounts for paying cash on delivery of the vehicles.

The proposed Capital Improvement Plan shown in Table 23 is an estimate of monies to set aside in the next several years to cover the cost of replacing outdated apparatus. The useful life assigned to each piece of apparatus currently owned by the departments was based on the guidelines of the National Fire Protection Association. The purchase cost of the replacement equipment was derived from current estimates provided by Wake County, TriData and then increased for an estimated annual inflation rate of 3 percent if appropriate. A simple straight-line amortization method over the number of years until the recommended purchase date was used with no calculation for potential interest earnings. Taking into consideration that fiscal year 2004 has already begun and the budget has been established, the schedule begins with fiscal year 2005 for the amortization of the future purchase costs.

There is a large cost bubble (about $10 million) if the apparatus that are over-age now are retired in one year. In practice, the start-up of this replacement cycle might be spread over several years, selecting the vehicles in worst condition to be replaced first, using the point system. In the proposed CIP schedule, the replacement costs for some of these pieces were spread over two or more years.

Recommendation 31: Wake County should ensure that the apparatus replacement program part of the Capital Improvement Program includes adequate funding for the replacement program it administers. This program should include the year vehicles are due to be replaced and the anticipated cost of replacement. The plan should also include funds for the purchase and then annual prorated funds for the replacement of vehicles for new stations. The schedule should be reevaluated annually and revised based on the formula above. The vehicle replacement fund should either enable the Department to set aside a prorated portion of the replacement cost for each vehicle annually, or replace a certain number of vehicles annually.

The proposed schedule here is more an example than the actual schedule to be used; each piece of fire apparatus needs to be evaluated if over 10 years old, less for ambulances. Some of the apparatus should be designated as reserves when replacements arrive. Some of the 43 pumper/tankers might not be replaced at all as the system moves toward the optimum level of seamlessness and integration.

Also, in the CIP there is a set of trucks for which a replacement cost of $30,000 was used but which may cost more.[73] One of the trucks needs to be a heavy rescue truck and one a satellite heavy rescue truck. Adjustments to the CIP will be needed for these and other costs; the CIP table provided in electronic form can be easily revised.

[73] The trucks are as follows:

Durham Highway Rescue 5	Wake-New Hope Truck 14	Hopkins Truck 22
Apex Rescue 1	Wake Forest Squad 6	Rolesville Truck 15
Bay Leaf Squad 25	Wendell Truck 11	Stony Hill Squad 26
Holly Springs Rescue 1	Eastern Wake Truck 11	Western Wake Truck 295
Fuquay Varina Truck 1		

TABLE 23: CAPITAL IMPROVEMENTS PLAN (CIP)

[Manually insert page 1 of 4, Fire Vehicle Capital Improvements Plan (CIP) here.]

[Manually insert page 2 of 4, Fire Vehicle Capital Improvements Plan (CIP) here.]

[Manually insert page 3 of 4, Fire Vehicle Capital Improvements Plan (CIP) here.]

[Manually insert page 4 of 4, Fire Vehicle Capital Improvements Plan (CIP) here.]

VI. IMPLEMENTATION TIMELINE AND CAPITAL IMPROVEMENT PLAN

This chapter describes the timeline for the relocation, closure, and construction of fire and EMS stations recommended in Chapter IV. It also presents criteria and models for making decisions about the timing of the capital improvements, including consideration of the costs of renovating existing stations (as identified in the Heery report).[74]

The total estimated cost (in FY04 dollars) of new stations and required renovations under the countywide scenario is about $18 million, spread over the next 15 years. This is a necessary investment in the emergency services infrastructure in order to accommodate current and future demands for service, and meet service goals.

Some areas of the county will not see an increase in the demand for service for some time. In other areas, growth is rapid and services will need to be provided in fairly short order. But even in areas that will not see a need for a fire or EMS station for some time, it would be wise for the County to "land bank" possible sites to hedge against high land acquisition costs in the future. At worst, the land can be traded or sold if the tentative location needs to be adjusted when its time comes. Moreover, having an idea of the timeframe for construction or renovation of stations allows the County to plan for the financial resources (capital and operating) required to implement the recommendations.

Methodology for Prioritizing Fire/EMS Station Capital Improvements

There are several questions that need to be answered when deciding on the priority for a new or upgraded fire or EMS station:

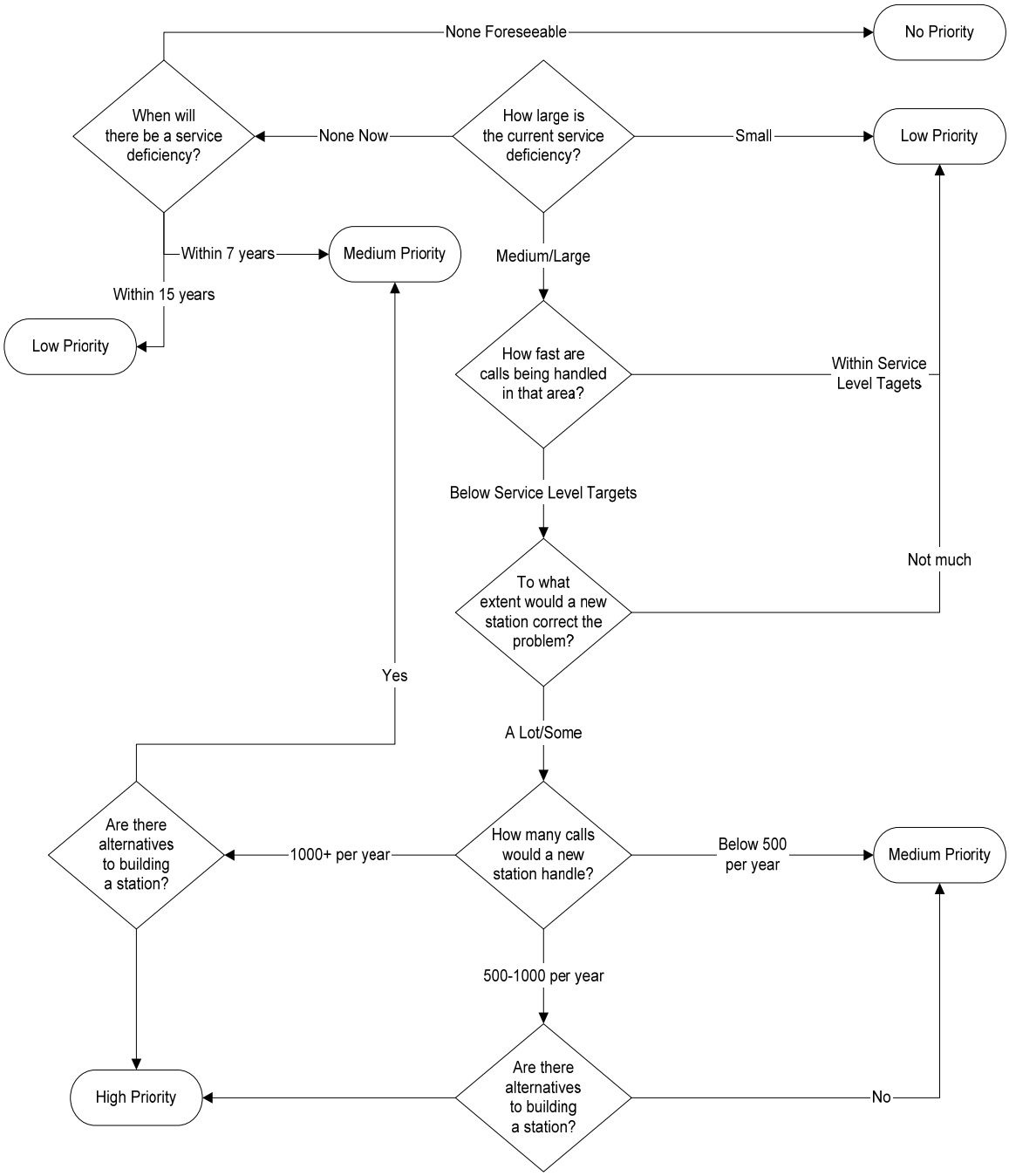
- **Current Service Levels** – How large is the current service deficiency? How fast are calls being handled in that area? How many calls would a new station in that area handle? To what extent would the addition of a station in that area correct the deficiency?
- **Future Service Levels** – If there is no current deficiency, when will there be a service deficiency in the area in the future? Is the deficiency a function of response times, workload, or both?
- **Cost of Alternative Solutions** – What alternatives to building a station exist in the area (e.g., expanding/renovating the current station, redeployment of current resources, contracting out, or co-location of a fire/EMS resource with the other service)? What are the costs and benefits of each option? It may be decided to

[74] The Heery report was an assessment of the repairs needed to each station to bring it up to code and health and safety requirements. It was an earlier independent assessment.

give priority to a less expensive option (such as contracting out) instead of constructing a new station, if the same numbers of calls beyond effective reach are to be handled under the new arrangement.

The flowchart in Figure 20 details the methodology described above.

FIGURE 20: CAPITAL IMPROVEMENTS PRIORITIZATION METHODOLOGY



The Heery Report offered ten categories of improvements that can be made to fire and EMS stations. Obviously, within the context of a constrained budget it is necessary to

make decisions about the relative priority of each type of improvement. The Heery Report classified the improvements into "urgent" (repairs need to be done within one year), "near future" (to be done within two years), and "deferred" (could be done in 5–10 years).[75]

Before applying this classification system an initial screen should be applied to determine the long-term viability of the facility. It is important to know whether the facility will be useful from a system-wide operational standpoint beyond its expected useful lifecycle. If a facility will be unnecessary from a service delivery viewpoint before it would need replacement or major renovation, then it is not worth doing much repair work to it.

The next consideration is how long it will take to provide a suitable replacement if one is needed. If a station needs to be relocated, how long will it be before the replacement station is ready for occupancy? It may be appropriate to only make temporary or relatively minor repairs until the move to the new station is completed. If the delay in opening a new station is going to be lengthy, then more of the necessary repairs should be made in the interim. The following table outlines a methodology for assessing what renovation or repair work should be accomplished for a station that will be closed or moved. (Of course, a 'move' also assumes closing the station and that it will not be used for another County purpose.)[76]

TABLE 24: WORK DETERMINATION MATRIX (REPAIRS TO BE EFFECTED AS A FUNCTION OF TIMING OF THE "MOVE IN" TIME FOR A NEW STATION)

	Heery Work Category										
	1	2	3	4	5	6	6a	7	8	9	10
Move In Timeframe	Life Safety	Bldg. Env.	Sys. Reli.	Emer. Prep.	Life Cycle	Code Comp	Dorm Req.	Veh. Exhst	Funct Proto	ADA	Aesth. Proto
6 months	Yes	No	No	No	No	No	No	No	No	No	No
1 year	Yes	No	No	No	No	No	No	No	No	No	No
2-4 years	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No
5 years	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No

Note: If a move will take more than 5 years, categories 9 and 10 should be seriously considered. Also, specific repairs under each category require professional judgment as to the importance of their implementation.

Using the above criteria, it is possible to generally identify what work should be done on an existing station prior to moving into a new station. These criteria have been applied in the dynamic Capital Improvement Plan (the computerized spreadsheet) that accompanies this report.

[75] Bidding documents for certain categories were being developed as this report was written. Construction is scheduled to begin in January 2004.
[76] This methodology was reviewed and refined by the County's Facilities Design and Construction director.

Proposed Implementation Timeline

Normally, as mentioned earlier in this report, one considers building a new fire station when projected call volume for that station would surpass a threshold of about 1–2 calls per day (or 500 to 600 calls per year). Workload is generally a good driver for serious consideration about building a new station. However, in the case of Wake County, the overall projected increase in demand for fire service is fairly modest, with small yearly increases for most TAZs. This makes it difficult to use a quantifiable method to determine when population or demand would necessitate that a station be built in a given area—there are no characteristic trigger points or demand overloads, just a gradual increase.

Accordingly, service level compliance (response times)—not workload—is likely to be the primary impetus for building a new station. This assumes that the County values meeting its service level goals. If it does, then it will be necessary to build stations that would normally be viewed by fire service professionals as having a low call volume.

Because there is no scientific means of determining exactly when a given station should be built, decisions are based on judgment as to how the system of stations could meet goals as demand increases. One can narrow down the date of construction to a range of years when a station will probably be needed. Information from a variety of sources has been combined with professional judgment to provide recommended milestone dates for each project.

In considering timing of projects, one might rotate construction projects among the various areas of the county in an attempt to ensure that newly constructed and newly renovated stations are equitably distributed and keep units balanced in the various quadrants of the county. Adding stations anywhere in a quadrant that helps the whole system in the region, and possibly beyond. One can continue to look for areas of the county that are more developing and likely to have increased demand sooner than others, or are subject to unusual new risks or conditions that warrant an earlier construction date.

Table 25 describes the proposed timeline for implementation of the various components of the recommended capital improvements. As noted earlier, there is some flexibility in choosing when to build a particular facility. Another factor is the desirability of spreading out costs over several years, to keep the overall plan financially acceptable to the citizens of the county.

A very important consideration to remember is that the entire analysis was predicated on first taking urgent measures to improve call processing and dispatch time and to improve turnout times. To the extent these are not done sooner rather than later, the timetable of adding stations should be speeded up, in order to reduce response times.

TABLE 25: RECOMMENDED IMPLEMENTATION TIMETABLE FOR COUNTYWIDE IMPROVEMENTS

Implementation Timeframe	Recommendation	Consideration	Type
Complete relocation by end of FY2004	Relocate HSDPS Station 2 to 10200 block of Holly Springs Road	Construction of HSDPS Station 2 is underway. This relocation will occur upon completion of the station sometime in 2004.	Relocation
Begin detailed closure analysis and transition process in FY2005	Initiate closure process for Falls Station 1	Initiate contract negotiations with City of Raleigh.	Replace fire service from Falls Station 1 with fire service from City of Raleigh
Begin detailed closure analysis and transition process in FY2005	Initiate closure process for WWFD Station 1	Initiate contract negotiations with City of Raleigh.	Replace fire service from WWFD Station 1 with fire service from City of Raleigh
Begin detailed closure analysis and transition process in FY2005	Initiate closure process for WWFD Station 2	Initiate contract negotiations with Town of Cary.	Replace fire service from WWFD Station 2 with fire service from Town of Cary.
Begin detailed closure analysis and transition process in FY2005	Initiate closure process for W-NHFD Station 1	Initiate contract negotiations with City of Raleigh.	Replace fire service from WNHFD Station 1 with fire service from City of Raleigh
Begin detailed closure analysis and transition process in FY2005	Initiate closure process for EWFD Station 2	Initiate contract negotiations with Town of Knightdale.	Replace fire service from EWFD Station 2 with fire service from Town of Knightdale.

Implementation Timeframe	Recommendation	Consideration	Type
Begin detailed closure analysis and transition process in FY2005	Initiate closure process for MFD Station 3 when CFD Station 7 opens next door.	—Initiate contract negotiations with Town of Cary.	Replace fire service from MFD Station 3 with fire service from Town of Cary.
Begin detailed closure analysis and transition process in FY2005	Initiate closure process for Bayleaf Station 3 as a fire station.	—Initiate contract negotiations with City of Raleigh.	Replace fire service from Bayleaf Station 3 with fire service from City of Raleigh.
Begin design work in FY2005; open new station by end of FY2006.	Build a new KDPS station Near 2128 Mingo Bluff Boulevard in Knightdale	Needed to meet current service deficiency in the west of Knightdale.	New Station
Begin design work in FY2005 , open new station by end of FY2006.	Relocate KDPS to a new station at Laurens Way and McKnight Drive	The KDPS station is inadequate for use as a fire station. Construction of a new station in Knightdale should begin as soon as possible so the relocation can occur.	Relocation
Begin design work in FY2005; open new station by end of FY2006.	Build a new Garner station at Greenfield Parkway and "Unnamed Road" (near Route 70) in Garner	Needed to meet current service deficiency in the east of Garner.	New Station
Begin design work in FY2005; open new station by end of FY2006	Build a new AFD station at Kelly Road and Olive Chapel Road	Needed to meet current and short-term future service deficiency in the west of Apex.	New Station
Begin design work in FY2006; open new station by end of FY2007	Build a new fire station at Main Street and Harris Road in Wake Forest	Needed to meet current and short-term future service deficiency in the north of Wake Forest.	New Station
Begin design work in FY2005; open new station by end of FY2006	Build a new fire station with co-located EMS station at Durant Road and Koupela Road	Needed to provide a permanent home for relocated EMS 15, when demand warrants a changing the unit from peak-load to full-time status.	New Station
Begin design work in FY2007; open new station be end of FY2008	Relocate Garner Station 1 to Benson Road and Route 70	A current service deficiency in the center of Garner argues for moving Garner Station 1 sooner rather than later. Construction starting in 2008 would ensure that the station was operating before 2010, when the downtown service gap will be evident.	Relocation

Implementation Timeframe	Recommendation	Consideration	Type
Begin design work in FY2008; open new station by end of FY2009	Build a new fire station at Thomson Mill Road and Elmo Road	Needed to meet a future service deficiency in the west of Wake Forest.	New Station
Begin design work in FY2009; open new station by end of FY2010	Hilltop Needmore Road and Sunset Lake Road	Needed to meet current and future service deficiency in the north of Fuquay-Varina.	New Station
Begin design work in FY2009; open new station by end of 2010.	Relocate AFD Station 1 to East Williams Street and Lufkin Road	The Apex Fire Department is contractually obligated to keep AFD Station 1 open for another seven years. The Department should explore whether this provision of the contract could be waived by mutual agreement to allow the relocation to occur in a more reasonable timeframe.	Relocation
Begin design work in FY2009; open new station by end of FY2010	Build new EWFD Station 2 in the 3200 block of Smithfield Road	Needed to meet future service demand in this area.	New Station

Closure of a fire or EMS station is a special case and will necessitate the following steps:

1. Ensure adequate alternative coverage through a negotiated contract with a surrounding fire department to provide the needed services.
2. Meet with affected volunteers and paid personnel. Attempt to secure placement for volunteers or employees of other departments, as soon as possible. (More new stations (8) are proposed than are recommended to be closed (6), but some of the closings may come before the openings.)
3. Perform only emergency/critical repairs to the physical plant in the near future (i.e., only those repairs needed to keep the building in service until closure is completed or until the use can be converted).
4. Decommission rolling stock (i.e., apparatus) by beyond or near the end of its useful life. Transfer title of remaining equipment to the County or other fire departments in the county.
5. Transfer or sell surplus emergency equipment, disposable supplies, office and training equipment.
6. Notify the community and be prepared to work with community leaders to ensure that residents and businesses understand that alternative arrangements have been made to assure needed emergency response.

7. File appropriate legal paperwork (e.g., dissolution of corporation).

8. Cease operations.

This series of steps could take at least 3–6 months if not longer, depending on the staff time available and the legal or political obstacles encountered.

Fire and EMS Station Capital Improvement Plan

The recommendations in the timeline (Table 25) were combined with the information in the Heery Report to create a Capital Improvement Plan (CIP) for Fire and EMS Stations. This capital plan was provided to the County in the form of an electronic spreadsheet for use as a dynamic planning tool that can be used for allocating appropriate financial resources in the County's overall CIP, and for budget submission purposes.[77] (This was another product of the study.) The plan for EMS facilities is in Table 26A and for fire stations in Table 26B, followed by extensive footnotes describing various assumptions.

The spreadsheet has two central features that allow it to function as a financial planning tool for future capital spending on fire and EMS facilities. The first feature is a set of user-controllable assumptions. These include per-acre costs of land in various regions of the county, estimated construction costs for each type of facility, lot size needed for each type of facility, and a variety of cost escalation (inflation) factors, designed to provide future year construction costs of repairs (for example, the Heery Report calculated all cost estimates in 2001 dollars) and these costs must be adjusted for inflation.

The second feature is a user-controllable worksheet that allows the user to select work projects to be undertaken for any station. This allows the user to include the entire cost estimate or a just a specific subset of a project's costs. The selected costs are escalated to the year in which the work is to be performed.

The user can modify assumptions as desired, and then select the work to be done and the year in which it should be done (the action date). The spreadsheet is automatically updated using these parameters.

We generated the capital plan that appears on the following pages using the timeline in Table 25 and the criteria in the Work Determination Matrix in Table 24 to select action dates and the work to be included for each station.

TABLE 26: CAPITAL FUND FACILITIES PLAN FOR WAKE COUNTY EMS AND FIRE FACILITIES (WITH FOOTNOTES)

Production notes:

For next four pages, manually insert tabbed sheets from Excel file named "Chapter VI – CIP Plan – EMS, Fire, Footnotes." Table 26**A is EMS tab;** Table 26**B is Fire tab;** Table 26**C is Footnotes tab.**

Manually insert EMS 11x17 sheet here.

Manually insert Fire 11x17 sheet here.

Manually insert Footnotes for Tables 26A and 26B, p. 1 of 2, here.

Manually insert Footnotes for Tables 26A and 26B, p. 2 of 2, here.

Crosswalk of Heery Renovation Estimates and TriData Recommendations

This section examines the relationship between the Heery renovation cost estimates and TriData's recommended action for each fire and EMS station. The County asked TriData to review the Heery estimates to identify stations that are candidates for replacement in our station location analysis. The primary criterion was the suitability of a given site for service delivery. After identifying preferred sites, we assessed the information in the Heery Report to determine whether the cost of renovation might be a convincing argument in favor of relocating or closing a station. In a few cases, building condition argued for or against a possible closure or relocation. In no case, however, was the information in the Heery Report the deciding factor for the ultimate location recommendation.

Table 27 lists each station reviewed in the Heery Report. Six current stations were not reviewed in the Heery Report, including two we recommend be relocated. Four stations were classified as needing "expensive" renovations in the Heery report, of which we recommended relocating one (thus avoiding the renovation costs) but keeping the other three open. All three were in relatively remote areas and deemed essential for adequate levels of fire protection response in the communities they serve. Unfortunately from a budgetary perspective, the expensive renovation of these stations seems warranted. For each of the three stations, adherence to the County's functional prototype accounts for a large share of the estimated renovation costs, ranging from 35 percent of the cost for Hopkins Station 1 to 76 percent of the cost for Fuquay-Varina Station 2. The County should explore whether compliance with the functional prototype could be deferred as a cost-saving measure in these stations.

We recommended closing one station (Wake-New Hope Station 1) that required moderately expensive renovations. We recommended closing four stations that would require only inexpensive renovations.

TABLE 27: CROSSWALK OF TRIDATA RECOMMENDATIONS RELATIVE TO HEERY LEVEL OF COST ESTIMATES TO REPAIR EACH STATION

Station	TriData Rec.
Expensive Renovation/Repair	
Fuquay-Varina #2	Maintain
Hopkins #1	Maintain
Rolesville #1	Maintain
Apex #1	Relocate
Moderate Renovation/Repair	
Wake-New Hope #1	Close
Apex #2	Maintain
Bayleaf #1	Maintain
Fairview #2	Maintain
Fuquay-Varina #1	Maintain
Garner #2	Maintain
Holly Springs #1	Maintain
Stony Hill #2	Maintain
Wake Forest #1	Maintain
Wake-New Hope #2	Maintain
Eastern Wake #2	Relocate
New Station (not in Heery)	
Apex #4	New
Bayleaf #4	New
Fuquay-Varina #4	New
Garner #4	New
Holly Springs #2	New (Under Construction)
Knightdale #2	New
Stony Hill #1	New (Under Construction)
Wake Forest #3	New
Wake Forest #4	New
Rolesville EMS	New (Under Construction)

Station	TriData Rec.
Inexpensive Renovation/Repair	
Falls #1	Close
Morrisville #3	Close
Western Wake #1	Close
Western Wake #2	Close
Apex EMS	Maintain
Bayleaf #2	Maintain
Bayleaf #3	Maintain
Cary EMS	Maintain
Durham Hwy #1	Maintain
Eastern Wake #1	Maintain
EMS10	Maintain
EMS2	Maintain
EMS3	Maintain
EMS4	Maintain
EMS5	Maintain
EMS7	Maintain
EMS8	Maintain
Fairview #1	Maintain
Garner #3	Maintain
Garner EMS	Maintain
Holly Springs EMS	Maintain
Knightdale EMS	Maintain
Morrisville #2	Maintain
Swift Creek #1	Maintain
Wake Forest #2	Maintain
Wendell #1	Maintain
Wendell #2	Maintain
Wendell EMS	Maintain
Zebulon #1	Maintain
Zebulon EMS	Maintain
EMS6	Relocate
Garner #1	Relocate
Morrisville #1	Relocate

Not reviewed in Heery Report	
Station	**TriData Rec.**
Apex #3	Maintain
Durham Hwy #2	Maintain
Fuquay-Varina #3	Maintain
Six Forks Rescue	Maintain
Knightdale #1	Relocate
EMS1	Relocate

VII. COST ALLOCATION MODELS

This chapter discusses methods for allocating costs for the County's contracting out of fire protection for areas that can be more efficiently served by municipal departments. The chapter also discusses approaches for sharing costs between the County and municipalities on joint projects, and between fire and EMS budgets when services are to be co-located.

Cost Allocation Methodology for Contracting Out

As discussed in Chapter IV, our recommended station location plan calls for the closure of six existing fire stations in unincorporated Wake County. The calls currently assigned to these stations would be distributed to surrounding fire stations. To accomplish this, the County would need to contract with the City of Raleigh, Town of Knightdale, and Town of Cary to arrange coverage for the small unincorporated areas that would be closer to a municipal fire station than to another Wake County station.

Such an arrangement should be cost-effective for both the County and affected jurisdictions, providing that a fair contract can be negotiated. Otherwise, there are areas of the county for which Wake County would be required to provide expensive fire protection services, if keeping the stations open, or provide lower levels of service, if the stations are closed without an alternative service provider, which we do not recommend.

The County would be securing currently available excess response capacity from each department. Raleigh, Cary, and Knightdale all have stations with relatively low call volumes for career-staffed departments (well under 2,000 calls per year). The County would be asking each city to go on additional calls to the unincorporated areas instead of waiting for the next call in the city. In most cases, no significant additional staffing or resources would be required by the adjoining department to pick up the workload transferred. (In some cases, a tanker may be needed.) There would be minor wear and tear added to equipment, facilities, and perhaps on personnel, and some expendables. The additional workload would be divided between several stations that overlap the areas of the county where stations may close. The total annual increase is estimated to be on the order of one to two calls (at most) per unit per day for the affected stations, so the County would truly taking advantage of the currently available excess fire service capacity.

Costing Philosophy – To determine the costs of services for the County to contract with a municipality, some assumptions must be made.

1) This methodology applies only if the County is securing currently available fire service excess capacity. If excess capacity does not exist, additional cost for new staff and increased resources might be incurred by the County, or through negotiations.
2) New personnel (uniformed firefighters or other) would not have to be hired to meet the demands of the increased workload (which we also believe would be the case, based on analysis of the fire department's current and predicted workload); and,
3) The County would not pay for the regular salaries and wages, including some employee benefits (e.g., retirement, social security, Medicare health insurance) that are paid by the departments now and which would not be increased by responding to a few more calls. (One would need to check that insurance costs are not increased, and any costs covered beyond what insurance covers would be paid for injuries incurred outside the normal coverage area.)
4) The County would pay the costs of a fire station based on participation level (e.g., number of calls).[78]

Assumption 2, above, might not apply where the County believes that the town is not providing adequate staffing for its own calls. Since any augmented staffing benefits both parties even if desired by only one, the costs would have to be negotiated as a special case. We would argue that they be proportionally shared if one party is providing below-standard service levels.

In computing the cost basis, it is reasonable to include at least the operational costs associated with providing services related to an increased workload (e.g., operations and maintenance, gas and oil, uniforms, equipment). These costs may include line items from personal services (e.g., overtime pay), employee benefits (e.g., health insurance), and direct expenditures (e.g., operational and maintenance supplies, equipment, station costs). In many cases it may be difficult to identify what is truly an incremental cost, and some bargaining may be needed on what to include.

A cost analysis was performed here by first tallying selected line items from each budget and then determining the cost per call (based on the total number of calls). After the per-

[78] Some might argue for using fully allocated costs vs. incremental costs. The fully allocated costs might be the percentage of calls made to unincorporated areas multiplied by (x) the annual operating costs and amortized station costs. This is the fair approach when a station is truly a joint service facility. That case is covered later in the chapter. Some negotiation may be need to arrive at a fair cost between fully allocated and incremental. The final arrangement should help both parties reduce costs.

call costs are calculated for each selected municipal department, the call volume for each proposed area of the unincorporated area of the county can be multiplied by the cost per call for the proposed contract departments.

Based on the above methodology, TriData analyzed the costs of fire services for each selected department (Raleigh, Knightdale, and Cary).

Costs were identified from FY2004 budgets for each of the affected departments. Each city budget is a little different, but we made an effort to include like items (for "apple-to-apple" comparisons).

The first analytical task was to conduct a review of each fire department budget from the affected cities. Based on that review, we identified the following costs:

- Overtime (possibly due to being held over on duty answering a call in the county);
- Health insurance (including workers compensation, life insurance, and disability) directly related to the increased risks to employees posed by the additional county workload; and,
- Operational costs associated with the increased workload (e.g., operations and maintenance, gas and oil, uniforms, equipment).

Based on the above analyses, the net cost of service (based on the line items listed above) and cost per call (based on total number of calls) were identified for each selected department. After the per-call costs were calculated for each department, the call volume for each proposed station to be closed was multiplied by the cost per call for the proposed contract departments. The net cost as well as the positive cost-benefit relationship was calculated for each department and Wake County.

CITY OF RALEIGH

The cost allocation model for the Raleigh Fire Department is premised on the concept of purchasing currently available excess response capacity. There is likely to be excess capacity for at least the next 5 years if not the entire planning period for the stations on the periphery of the City, and those covering the "doughnut" holes. As mentioned in Chapter IV, we recommend that Wake County contract with Raleigh to provide coverage in lieu of four current stations: Bayleaf Station 3, Falls Station 1, Wake-New Hope Station 1, and Western Wake Station 1. Based on the methodology used, the cost of service for Wake County to contract out would be $256,710 in 2004, as computed below.

The City of Raleigh divides its budget by Fire Prevention, Fire Support Services, and Fire Operations. The Fire Prevention budget was not included, because this function would still be performed by the Wake County Fire Marshal's Office.

The model allocates costs based on selected personal services, employee benefits, and direct expenditures, as shown in Table 28. The line items were selected on the theory that these are expenses that the Raleigh Fire Department would incur to answer the additional calls for service.

TABLE 28: RALEIGH FIRE DEPARTMENT SELECTED LINE-ITEM BUDGET

Fire Operations Budget	FY04 Amount	Cost per Call
Personal Services		
Salaries – OT	$312,000	$11.75
Employee Benefits		
Health Insurance	$1,830,678	$68.97
Group Life AD & DI	$44,370	$1.67
Direct Expenditures		
Operational and Maintenance Supplies	$118,790	$4.48
Chemicals	$5,000	$0.19
Hazmat Supplies	$31,000	$1.17
Safety/Medical Supplies	$53,920	$2.03
Equipment Repair/Parts	$3,000	$0.11
Uniforms	$75,690	$2.85
Small Equipment	$97,870	$3.69
Medical Services	$23,000	$0.87
Equipment Usage Charge	$824,966	$31.08
Capital Equipment – New		
Fire Suppression Equipment	$140,000	$5.27
Safety/Hazmat Equipment	$65,830	$2.48
Total	**$3,626,114**	**$136.62**
Support Services Budget	**FY04 Amount**	**Cost per Call**
Employee Benefits		
Health Insurance	$27,412	$1.03
Group Life AD & DI	$599	$0.02
Direct Expenditures		
Operational and Maintenance Supplies	$42,910	$1.62
Vehicle Maintenance and Operation	$5,000	$0.19
Vehicle repair supplies	$4,300	$0.16
Motor fuels and lubricants	$145,000	$5.46
Tires and tubes	$43,000	$1.62
Equipment repair parts	$260,000	$9.80
Uniforms	$298,200	$11.24
Equipment Usage Charge	$3,706	$0.14
Total	**$830,127**	**$31.28**
Grand Total	**$4,456,241**	**$167.89**

Based on the calculation from the selected line items, Wake County should expect to pay $167.89 per call for additional workload provided by the Raleigh Fire Department. The cost per call is based on the number of calls in FY2003 or 26,542. In FY2003, the four selected stations responded to 1,529 calls, which, if handled by Raleigh, would increase its call volume by 5.4 percent. At a rate of $167.89 per call, the cost of service for Wake County to contract with the City of Raleigh would be $256,710, as shown in Table 29.[79]

TABLE 29: RALEIGH FIRE DEPARTMENT COST ALLOCATION MODEL

Closed Station	Call Volume	Cost Per Call	Total Cost
Bayleaf 3	132	$167.89	$22,162
Falls 1	330	$167.89	$55,405
Wake-New Hope 1	555	$167.89	$93,181
Western Wake 1	512	$167.89	$85,962
Total	**1,529**		**$256,710**

As Table 30 demonstrates, Wake County would save approximately $800,000 in operating costs alone by contracting with the Raleigh Fire Department and closing four stations (Bayleaf Station 3, Falls Station 1, Wake-New Hope Station 1, and Western Wake Station 1).

TABLE 30: WAKE COUNTY COST SAVINGS

Closed Station	Recommended FY04 Budget	Anticipated Cost of Contracting out	Cost Savings
Bayleaf 3	$195,330	$22,162	$173,168
Falls	$217,005	$55,405	$161,600
Wake New Hope 1	$239,278	$93,181	$146,097
Western Wake 1	$412,091	$85,962	$326,129
Total	**$1,063,704**	**$256,710**	**$806,994**

While one might argue over which cost factors to include and which not, the bottom line is that the County would pay the City of Raleigh about $250,000 annually to handle an increase of about *one call a day* at several currently under-loaded stations.

[79] One might well compute the costs per call with the new calls added in. The total calls would be 28,071 and the cost per call $158.75.

TOWN OF KNIGHTDALE

The Knightdale and Raleigh budgets are constructed differently. They do not include exactly the same line items. Therefore, one cannot make the model totally comparable to Raleigh or each other. However, the general concept of what costs to include is similar.

First approach – One rationale for the cost allocation model for the Knightdale Department of Public Safety (Knightdale DPS) would be the same approach as used in the Raleigh model, purchasing excess capacity. The Knightdale model is similar to that for Raleigh, with some notable exceptions. Overtime money was not included because the line item had no associated cost. The direct expenditures for operations and maintenance are not identical, but include many of the same items. Table 31 shows the Knightdale DPS's line-item budget.

TABLE 31: KNIGHTDALE PUBLIC SAFETY DEPARTMENT SELECTED LINE-ITEM BUDGET

Category	FY04 Amount	Amount per Call
Personal Services		
Part-Time Salaries	$25,845	$41.62
Public Safety Office Supplement	$53,054	$85.43
Salaries - OT	–	–
Health Insurance	$10,947	$17.63
Operations and Maintenance		
Uniforms	$4,432	$7.14
Gas and Oil	$3,800	$6.12
Repair and Maintenance - Equipment	$2,000	$3.22
Repair and Maintenance - Vehicles	$ 4,000	$6.44
Contracted Services	$20,000	$32.21
Equipment Rental	$2,220	$3.57
Liability Insurance	$20,000	$32.21
Total	**$146,298**	**$235.58**

Based on the calculation from the selected line items, Wake County would pay $235.58 per call for additional workload provided by the Knightdale Department of Public Safety. This amount is higher than the corresponding amount in Raleigh because the cost of service per call is higher in Knightdale than Raleigh.

The cost per call was based on the number of calls in FY2003, or 621. A maximum additional workload of 525 calls would be added to the Department by contracting to provide services to unincorporated areas outside of the Town of Knightdale.[80] The cost

[80] Not all of the current Eastern Wake Station 2 workload would be shifted to the Knightdale Department of Public Safety (because many of the calls run by Eastern Wake Station 2 are in areas that would probably

of service for Wake County to contract with the Town of Knightdale would be $123,682, as shown in Table 32.[81]

TABLE 32: KNIGHTDALE PUBLIC SAFETY COST ALLOCATION MODEL

Closed Station	Call Volume	Cost Per Call	Total Cost
Eastern Wake 2	525	$235.58	$123,682

As Table 33 demonstrates, Wake County would save approximately $96,000 annually by contracting with the Knightdale Public Safety Department and closing Eastern Wake Station 2 using the model proposed. In actuality, if Eastern Wake 2 is closed, Wendell 2 or Wake New Hope 2 would pick up some calls, and so the extra call volume for KDPS would be reduced, and so would the costs for them. If Eastern Wake Station 2 were relocated as opposed to being closed, the call volume shifted to Knightdale would be even less; so would cost.

Second approach – Contracting with Knightdale may be more complex than the above model. There are issues to resolve regarding use of their police and other city workers outside the town, which affects policy more than costs. However, it may be necessary to add employees to their eastern station if there are to be one joint service station instead of two stations virtually next to each other (one City's, one County). The personnel would benefit both the City and County and their costs should be shared. The County also needs to provide a tanker for responding to calls outside the hydranted area. Either incremental costs or fully allocated costs could be used. We would argue that the town needs the same personnel to respond to its structure fires as does the County to meet the goals set by the Service Level Committee (with the exception of staffing the tanker).

TABLE 33: WAKE COUNTY COST SAVINGS

Closed Station	Recommended FY04 Budget	Anticipated Cost of Contracting out	Cost Savings
Eastern Wake 2	$219,643	$123,682	$95,961

still be covered by the Eastern Wake Fire Department from a station located in the 3200 block of Smithfield Road); however, in order to provide a worst-case analysis, we assumed that the entire workload was shifted.

[81] As in Raleigh example, one could argue that the total calls used in the computation should include the new calls added by Wake County. The total calls would be 1,146, and the cost per call $127.66.

TOWN OF CARY

The budget for the Town of Cary is different from that of both Raleigh and Knightdale. Like the other departments, it does not include identical line items. Table 34 shows the Cary Fire Department selected line item budget.

TABLE 34: CARY FIRE DEPARTMENT SELECTED LINE ITEM BUDGET

Category	FY04 Amount	Amount per Call
Personal Services		
Salaries – OT	$623,337	$127.71
Employee Benefits		
Health Insurance	$1,048,827	$214.88
Direct Expenditures		
Repair and Maintenance – Vehicles	$318,764	$65.31
Supplies (Operational and Maintenance)	$135,931	$27.85
Uniforms	$221,171	$45.31
Equipment	$37,937	$7.77
Contracted Services	$297,769	$61.01
Total	**$2,683,735**	**$549.83**

Based on the calculation from the selected line items, Wake County would pay $549.83 per call for additional workload provided by the Cary Fire Department. The cost of service is higher in Cary than in either Raleigh or Knightdale. The additional workload would cause only a two-percent increase in the total number of calls for Cary (or one extra call about every four days).

The cost of service for Wake County to contract with the Town of Cary would be $51,134, annually, as shown in Table 35.

TABLE 35: CARY FIRE DEPARTMENT COST ALLOCATION MODEL

Closed Station	Call Volume	Cost Per Call	Total
Western Wake 2	93	$549.83	$51,134

As Table 36 demonstrates, Wake County would save approximately $88,500 by contracting with the Cary Fire Department to cover the calls resulting from the closing of Western Wake 2, using the cost allocation model described.

TABLE 36: WAKE COUNTY COST SAVINGS

Closed Station	Recommended FY04 Budget	Anticipated Cost	Cost Savings
Western Wake 2	$139,682.00	$51,134	$88,548

OTHER APPROACHES

Fixed Cost per Call, regardless of Department – Another alternative contracting scheme for purchasing coverage from other departments is to pay a fixed cost per call handled by each city – the same rate for all three departments. From the buyer's point of view, the value of service (cost paid per call) is the same regardless of the supplier's cost. So Wake County could decide on the cost per call it is willing to pay, and use that for all service suppliers. It would have to result in a total cost to Wake County that is about 25-50 percent of what it is presently paying for the services or it is probably not worth doing.

Fixed Cost per Year – A variation of the above approaches is to have a fixed price contract each year based on some formula like either of the above plus the call experience of the previous year. This has the advantage of informing all parties a year ahead what they will pay or receive, which facilitates budget formulation. The adjustments – if demand turned out to be much higher or lower – are made in the contract cost for the following year. This approach is used, for example, by the seven communities participating in the North Shore Fire Department, near Milwaukee.[82]

SUMMARY

These models can be used as the starting point for discussions. With greater knowledge about the construction of the budgets, representatives of the County and the three fire departments can refine the models to arrive at a cost sharing methodology that is considered equitable and can be used going into the future. All that would be needed from year to year is to update the appropriate call volumes and budget line items.

Overall, Wake County could save about $1,000,000 per year by closing Bayleaf Station 3, Falls Station 1, Wake-New Hope Station 1, the two Western Wake stations, and Eastern Wake Station 2. In addition is the value of the structures and sites to use for other purposes or to sell them, and use the funds for purchasing sites for new stations.

Cost-Sharing Methodologies for Jointly Constructed or Operated Stations

The above approaches were based on the philosophy that the County was contracting for use of excess capacity in existing stations. This section discusses equitable cost-sharing methodologies when stations are viewed as jointly shared resources.

There are several approaches to distribute costs between the County and incorporated municipalities when a new station is needed to serve both. (Some of these cost allocation methods could also be used for existing stations for that matter.)

[82] TriData consulted on their consolidation and developed a formula for cost sharing.

The methods discussed below for allocating station costs between the County and a municipality are for the situations when the station will be used for significant fire protection and related services in both jurisdictions and is viewed by the County as a joint resource rather than a municipal resource contracted to provide service for a small number of calls (as was the case earlier in this chapter).

All of the stations recommended to be added or moved would benefit the unincorporated areas. However, some of the stations locations were recommended where they would service a town, and where they might be located elsewhere if not serving the town. The proportion of calls handled in the unincorporated area should be a prime factor in proportioning costs. As the proportion in the unincorporated areas decreases with annexation, so should the costs in general. As noted earlier, we make station location recommendations with an eye to an eventual integrated, seamless County fire and EMS system and not just optimizing response to the unincorporated areas. The County should not pay for any service not needed by the unincorporated areas.

OPTION 1 – COUNTY-OWNED STATION/CITY PERSONNEL

Under this type of partnership, Wake County would pay for the construction of a new station, maintaining ownership and control of the station. The municipality would provide the personnel to staff the station and their cost. The viewpoint or philosophy here is that the municipality needed the station for its own purposes and would in any event run units into the nearby county on mutual aid. The County pays the capital cost of the station and the municipality pays for the operating costs. If the County instead paid for the cost per call and not the station, as in the cost model presented earlier in this chapter, the cumulative costs paid over 15–20 years might equal the cost of the station, so a way to look at this option is the County pays for 15–20 years of service up front, but then nothing afterward. Each side gets something out of the deal.

For all of the next set of options below, it is assumed there would be joint ownership of the station with the municipality providing all personnel under various cost allocation schemes.

OPTION 2 – COST ALLOCATION BY USAGE

Wake County would pay a fraction of the costs of a station based on participation level – the percentage of the calls within the County that are handled by that station. The municipality and the County would retain joint ownership and control. The County could pay on a year-to-year basis, or upfront based on the projected call volume for the length of time it takes to pay off the construction costs of the station. Participation rates would be reviewed on a yearly basis. This would take into account the fact that the volume of calls in the county could change depending on both demand (i.e., population changes in the county) and annexation by the town.

OPTION 3 – PER-CAPITA COST DISTRIBUTION (POPULATION BASIS)

Per-capita costs are often used to compare the levels of fire protection or efficiency provided by different communities. In the case of Wake County this factor can be misleading because there is such a wide variation in the makeup of the fire protection budgets of the municipalities in the County (they do not always include the same costs in each budget).

Nevertheless, per-capita costs can be used to allocate station costs between the County and the municipality. The total operating cost and amortized capita cost are divided in proportion to population served.

There are some philosophical problems with "capitation costing" as this model is sometimes called. For one thing, there is no guarantee that the service levels (i.e., fractile response times) will be the same in the incorporated and unincorporated areas. Under this method citizens residing in unincorporated areas pay the same fire tax as people living within city limits, but they can have a much longer response time. Secondly, using capitation assigns costs equally, irrespective of the amount of services consumed. Since population is a reasonable surrogate for demand, this may not be too bad. Thirdly, there may be a problem as to which "capitas" to count—the number of people served that the Station's first due area in and outside the City. The "per capita" basis is easier to implement when used for sharing costs of totally merged departments. On the other hand, capitation is easy to understand and may be easy to calculate.

OPTION 4 – WEIGHTED POPULATION AND ASSESSED VALUATION

Another formula that could be considered for either of the above two ownership scenarios is splitting costs in proportion to a combination of population and assessed valuations, e.g.

- 50 percent based on population, and
- 50 percent based on property assessed valuations.

These factors are appropriate because they reflect the two essential components that are at risk – people and property. The costs can be divided in proportion to the percentage of population in the unincorporated area of the County served by the station versus the protected population of a selected municipality (e.g., Fuquay-Varina).

There are some questions to resolve in using this allocation method:

- Is more of the cost of fire department service attributable to property or people? (Should they be weighted equally?)

- If property tax revenue will be the primary source of funds, should property have a higher weight in the cost distribution formula?
- Should a risk-level factor be included (based on type of property), along with property value?

For the property-related portion, the County and each municipality may consider including different assessed valuation of rates for commercial and residential properties or weighted cost allocations based on risk factors and/or levels of fixed fire protection.

OPTION 5 – THE "NORTH SHORE" FORMULA (3 FACTORS)

The North Shore Fire Department, the largest cooperative fire department in Wisconsin, was created when seven communities in the suburbs of Milwaukee consolidated their fire departments in 1994. The new consolidated department used a funding formula (proposed by TriData) for cost sharing among the seven communities based on three factors:

- 1/3 based on population
- 1/3 based on assessed property value; and,
- 1/3 based on call volume.

The three-part formula adds an additional factor over Option 4 above that accounts for the actual consumption of operations services by each jurisdiction. This formula has proven to be acceptable to a number of jurisdictions over a number of years.

The bottom line is that regardless of the cost allocation method chosen, both the County and contracted municipality will have a cost savings. The option selected may vary with each particular station, depending on which situation and viewpoint fits best, and what can be negotiated. The end result has to be a significant cost saving to the County compared to providing the station, apparatus, or service on its own to its area of responsibility.

Cost Sharing for Joint Fire/EMS Station or Fire/Other/Service Station

Fire and emergency medical services are funded out of separate revenue sources in the Wake County budget. Accordingly, construction costs for new facilities from which fire and emergency medical services will be jointly housed and delivered (i.e., co-located services) need to be allocated to the respective budget funds in some reasonable manner.

In order to determine how to assign costs, one must first know the principal purpose for which the building, if one can be said to be the principal service. If the facility would need to be built for one service, and the other service was "piggybacking" its location on

the first out of convenience or in an attempt to seek efficiencies of scale, then the secondary service might be expected to pay only the marginal costs of construction. On the other hand, if both services require a facility in relatively equal measure, then the construction costs should be borne by both services without respect to marginality of use.

Hence, the first step in a cross-budget cost-sharing methodology is to determine relative need. This may not always be obvious, and final determination will require objective analysis of the budget request justification documents (and perhaps some negotiations).

The second step in the methodology is to determine whether costs are fundamental or incremental. For example, in a facility that was primarily needed for EMS purposes, lockers for bunker gear would be considered a fire-service incremental cost – not a shared cost (unless the EMS personnel had similar storage needs). In a facility that was primarily needed for fire suppression, the length of an apparatus room needed to accommodate a ladder company would be considered fundamental, not incremental.[83] There are no definitive rules about how costs should be classified. These are matters that must be decided on a case-by-case basis.

The service with the primary need for the site should pay the land costs for the acreage required to build the basic type of facility needed. The other service should pay the increment. For example, assume that a fire department needed to build a substation (not a headquarters station) in an area because existing stations were too far from a concentration of new construction. The County's Office of Facilities Design and Construction estimates that a fire substation should require a lot size of approximately 3.5 acres. If an EMS department wanted to co-locate at that site, the required lot size would be 4.5 acres. The extra acre of land should be paid for out of the EMS budget, whereas the base cost of 3.5 acres should be paid for out of the fire service budget.

Once the service-specific land and construction costs are assigned, operating costs of the structure must be allocated on some rational basis. Percentage of the square footage of the building used by a given service is a readily quantifiable factor. In fact, this principle is often employed in commercial real estate activities when space is divided (for example, when two tenants share built-to-suit space on a single floor of an office building). Using square footage as a factor also allows equitable division of utility costs when separate metering and billing is not available. This principle can also be applied to exterior land usage (e.g., parking spaces).

[83] Of course, in the example at hand it may be possible to design a fire apparatus room such that no extra space is needed where the EMS vehicles would park. Nonetheless, it is highly likely that the larger footprint of the building would demand a larger lot size – a cost that should be assigned to the fire service budget.

The personnel costs, supplies, and apparatus used by each service would be wholly borne by that service.

It is easier to allocate costs to a given service when facilities are designed with separate sleeping quarters, day rooms, and for the different services (it is also easier to assign housework as well as costs).[84] Costs for fully shared facilities (e.g., an exercise room) could be allocated by the number of potential users or on a straight 50-50 basis. This is a matter for discussion between the services.

There are other ways—in addition to square footage—to allocate costs; however, none seems as easy or intuitive to apply. We recommend that incremental costs be assigned in this manner.

[84] Additionally, separate facilities can reduce friction caused by waking other service members when only one service gets a call in the middle of the night. Unfortunately, duplicate facilities housed under one roof do not produce cost efficiencies to the extent that shared usage of those facilities would. Moreover, physically separating crews does nothing towards improving inter-department relations.

VIII. SUMMARY OF RECOMMENDATIONS

This report includes over 60 recommendations (including suggested changes in station locations, EMS unit locations, and tanker locations). For convenience we provide a list here of the explicit recommendations made in the text. Some other suggestions and recommendations are implied.

The recommendations should be read in context, especially the recommendations for station locations and re-deployment of vehicles. Alternative scenarios are discussed in the text, as is the rationale for each recommendation. Capital improvement plans for stations and apparatus are found in the text and not repeated here.

The recommendations are presented in the order they appear in the text, by chapter.[85]

Recommendations

Chapter I. Introduction

1. The completion and quality of fire and EMS data should be improved countywide, for each department.

Chapter II. Demand and Population Projections

2. Update the demand projections annually, and compare them to unit workloads and planned station locations.

Chapter III. Level of Service Targets

3. Coverage goals in the future should be stated in terms of total response times, including call processing, turnout, and drive times.
4. County fire departments should improve their turnout times by implementing duty night programs to assure adequate volunteer staffing in station, or by other means.
5. Efforts should be made to reduce call-processing time to average no more than a minute.

[85] This listing presented an awkward problem in that recommended scenarios with multi-part sets of deployment changes are mixed in with discrete, numbered recommendations. However, we believed it would be better to group the recommendations and scenarios by chapter rather than just present the numbered recommendations.

Chapter IV. Station Locations and Unit Redeployment

FIRE STATIONS (INCLUDING UNIT REDEPLOYMENT)

A set of 18 fire station closures, relocations, and openings is recommended, as shown in Table 37. There are slight variations presented as alternative scenarios in Chapter IV. The recommended station closings, moves, new stations, and unit redeployments are an integrated set and need to be considered as a package. Elements can be changed, but the changes may require a related series of other changes (e.g., if a station recommended to be closed is not closed, its units obviously cannot be redeployed).

TABLE 37 – RECOMMENDED COUNTY-WIDE STATION LOCATION CHANGES

Recommendation	Impact	Implementation Timeframe
Relocations		
Relocate HSDPS Station 2 to 10200 block of Holly Springs Road	Improved service to the east and south of the new site. Some calls north of the Town of Holly Springs on NC 55 would fall outside the effective reach of the two Holly Springs stations.	Complete relocation by end of FY2004
Relocate KDPS to a new station at Laurens Way and McKnight Drive	Improved service in the center and north of the Town of Knightdale. KDPS will be in facilities appropriate to its mission, instead of a makeshift fire station.	Complete relocation by end of FY2006 (to be consistent with CIP chart)
Relocate Garner Station 1 to Benson Road and Route 70	Improved coverage in the center of Garner where a heavy concentration of calls beyond effective reach exists.	Complete relocation by end of FY2008
Relocate AFD Station 1 to East Williams Street and Lufkin Road	Improved service in a developing area south of the Town of Apex on NC 55. No adverse impact in its current area because the area protected by AFD Station 1 is within the effective reach of AFD Station 3.	Complete Relocation by End of FY2010 (not before)
Closure Process		
Initiate closure process for Falls Station 1	No adverse system impact. The 330 calls that the Falls FD ran last year will be distributed to surrounding fire stations. This is less than one call per day distributed across three stations, so there should be virtually no impact on the operations of those stations. Closing the station does not lead to an increase in the number of road miles beyond effective reach in the region.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for MFD Station 3 when CFD Station 7 opens next door.	No adverse system impact. The County should contract with the Cary FD to provide service (Morrisville Station 3 had 98 calls last year, or one call every three days).	Begin detailed closure analysis and transition process linked with CFD Station 7 development process.

Recommendation	Impact	Implementation Timeframe
Initiate closure process for WWFD Station 1	No adverse system impact. The area is within the effective reach of Raleigh Stations 8 and 14. The call volume would not amount to more than two calls per day. Raleigh FD could reuse the station. Raleigh FD might need to provide RWS in some of its non-hydranted areas; the County should assist in this effort by transferring an excess RWS unit to Raleigh FD.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for WWFD Station 2; lease to Raleigh (if they wish)	No adverse system impact. The station lies entirely within the Town of Cary FD. The station serves primarily doughnut holes, some state land, and some stretches of Interstate. The call volume presently handled by Western Wake Station 2 could be redistributed to the Cary FD stations and would not amount to one or two calls a day at the most.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for W-NHFD Station 1	No adverse system impact. The station lies entirely within the City of Raleigh. The 550 calls that W-NHFD Station 1 ran last year represent a total additional workload of fewer than two calls per day to be distributed across five surrounding Raleigh FD stations.	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for EWFD Station 2	No adverse system impact. This station lies entirely within the Town of Knightdale, which is now protected by the Knightdale DPS. The 480 calls that EWFD Station 2 ran last year represent a total additional workload of fewer than two calls per day that the KDPS, W-NHFD WFD, and RFD might need to cover. (We recommend using the station as an EMS station.)	Begin detailed closure analysis and transition process in FY2005
Initiate closure process for Bayleaf Station 3 (as a fire station)	Its service areas are donut holes within Raleigh. (We recommend continuing to use it as an EMS station.)	Begin detailed closure analysis and transition process in FY2005
New Stations		
Build a new KDPS station near 2128 Mingo Bluff Boulevard	Improved service in the west of the Town of Knightdale. There is a current service deficiency in that area presently.	Begin design work in FY2005; open new station be end of FY2006
Build a new AFD station at Kelly Road and Olive Chapel Road	Improved service in a developing area west of Apex.	Begin design work in FY2005, open new station by end of FY2006
Build a new Garner station at Greenfield Parkway and “Unnamed Road” (near Route 70)	Improved service on the east side of the Town of Garner. Improved ability to assist EWFD and better access to I-40.	Begin design work in FY2005; open new station in FY2006
Build a new fire station at Main Street and Harris Road in Wake Forest	Improved service north of the center of Wake Forest. There is a current service deficiency in that area presently.	Begin design work in FY2006; open new station in FY2007
Build a new fire station with co-located EMS station at Durant Road and Koupela Road	Improved service along Durant Road and northward along Falls of Neuse Road. This station would be built as a joint EMS/fire station and used as an EMS station first, circa 2006. The fire service would not move in until the call volume warranted it (about 2010).	Begin design work in FY2005; open new station in FY2006

Recommendation	Impact	Implementation Timeframe
Build a new station at Thomson Mill Road and Elmo Road	Improved service west of the center of Wake Forest. Growth is expected in that area, especially as the City of Raleigh annexes additional land north along Capital Boulevard.	Begin design work in FY2008; open new station in FY2009
Build a new FVFD station at Hilltop Needmore Road and Sunset Lake Road	Improved service north of the Town of Fuquay-Varina in an area with a present service deficiency and where growth is expected in the future. Improved ability to assist HSDPS.	Begin design work in FY2009; open new station in FY2010
Build new EWFD Station 2 in the 3200 block of Smithfield Road[86]	Improved service in an area southeast of the Town of Knightdale and west of the Town of Wendell. Improved ability to assist to EWFD Station 1, KDPS, and WFD.	Begin design work in FY2009; open new station in FY2010

ANOTHER FIRE STATION RECOMMENDATION

6. The County should negotiate arrangements for municipalities to cover unincorporated areas near them when in the interests of the majority of citizens in the area.

EMS STATIONS AND UNITS

Changes recommended for EMS stations and unit redeployment are as follows. Some alternative scenarios are presented in Chapter IV.

- Relocate Cary EMS from its central station to Swift Creek Fire Station 1.
- Relocate EMS 6 to Raleigh Fire Station 23.
- Relocate EMS 15 to the projected new EMS/fire station on Durant Road and Koupela Road or to a new medical care facility proposed for that area by WakeMed.
- Move EMS 12 to be co-located with fire units at Stony Hill Station 1.
- Relocate Wendell EMS to be co-located with Wendell Fire Station 2.
- Relocate one of the three staffed units from the Garner EMS headquarters station to Garner Fire Station 2, and a second unit to a new fire station at Benson Road and Route 70.
- Relocate a second-duty EMS unit with low utilization to the Wake EMS Station5/Wake-New Hope Fire Station 1 area, where calls for service have expanded dramatically over the past three years.
- Close EMS Station 1 and relocate its three units relocated to
  - A new station in the 400 block of Peace Street

[86] This may be viewed as the movement of current EWFD 2 to this new location, with a pause of 6 years between closure and reopening.

- Raleigh Station 2
- The former Wake-New Hope Station 1

- Consider relocating Knightdale and Zebulon second duty units to other stations where the most first-due calls are missed (when data is available to do the analysis).

WATER SUPPLY

- Redeploy rural water supply units from three stations recommended to be closed (Wake-New Hope, Western Wake, Falls), one each to

  — New Apex station at Kelly Road and Olive Chapel Road
  — New Fuquay-Varina station on Hilltop Needmore Road
  — New Garner station at Greenfield Parkway and "Unnamed Road"
  — New Knightdale DPS station on Mingo Bluff Boulevard
  — Planned Raleigh Station 30 at Buffalo Road and I-540 (once it is completed)

LADDERS

- Redeploy the ladder at Eastern Wake Station 2 to the recommended Knightdale DPS Station 1.

- Add new ladders, as currently planned, to Holly Springs Station 2 and Wake Forest Station 1

7. Wake County should develop as soon as possible reliable data collection and analysis measures that support correction of in-depth EMS response (and other) problems—the number of units needed per station by time of day.

8. All EMS units should be reliably staffed and thereby assignable by the new CAD system.

9. Uncluster the EMS units. They have better impact on response times by being spread out.

10. Monitor EMS call volume per unit at least annually.

11. Consider adding a peak-load EMS unit when a unit is overloaded before adding a full-time unit.

12. Consider declustering (i.e. redeploying) EMS units before adding new units.

SPECIALTY UNITS

13. Going into the future, collect data on the location of calls requiring specialty units.

14. For hazmat and for technical rescue, have at least one highly trained unit of each type in the County, and then one or more satellite units trained to assist the main unit or handle simpler calls.

Chapter V. Fire Vehicles

Overall

15. At a minimum, every station (39 in total) should have at least one frontline engine. Eleven stations should have one aerial, and 26 stations should have at least one tanker (distributed as discussed in Chapter IV). Each EMS station (or fire station) where an EMS unit is based should have one frontline EMS unit unless demand is high enough and affects response times to warrant more.

16. The number of pumpers needed beyond one per station should be a function of the ability of the station to reliably turn out the first pumper with four staff, and the reliability of the next two closest stations to do the same.

17. Fire departments should furnish—and Wake County staff must analyze—certain additional data to that now collected: the number of firefighters dispatched on the first, second, and third units per call in the station's first-due area that would comprise the first-alarm full assignment; the number of structure fires; the number of fires with spread beyond the room of origin; and the number of high risk structures requiring a fire flow (in gallons per minute) greater than that required for a single-family dwelling.

18. Wake County should develop and manage a coordinated, countywide approach to apparatus procurement and deployment.

19. Wake County should start to collect the vehicle maintenance data needed for better analysis of future vehicle replacement programs.

Specifications

20. Wake County should study the potential cost effectiveness of new ambulances built on heavy-duty commercial chassis as compared with chassis built on medium-duty chassis.
21. Wake County should manage the development of performance-based fire apparatus specifications by vehicle class, e.g., pumper, pumper/tanker, rescue vehicle, aerial ladder.

22. Wake County should standardize apparatus designations by unit name, type, use, and numbering system.

23. Wake County should manage development of a standard set of specifications for the replacement of ambulances, fire apparatus, and other emergency vehicles.

24. Wake County should collect the necessary data on hazmat and technical rescue incidents to support selection of the types of vehicles that will be needed in the future.

25. Wake County should purchase standard vehicles with commercial chassis for engine/pumpers, tanker/mobile water supply apparatus, heavy rescues/squads, and hazardous materials response units. Ladder units or quints should be custom vehicles

Procurement

26. Establish a county-managed "lease-purchase" arrangement for buying new fire apparatus.

Maintenance

27. Wake County should establish a countywide fire vehicle maintenance program with written standards and SOPs.

28. Wake County should establish a formal apparatus replacement program with specific criteria for fire and EMS vehicle replacement (like **Table 22**, or the APWA Point System, or its GSA system).

Reserves

29. Wake County should establish standards for the size of its reserve apparatus fleet and manage that fleet.

30. Wake County should keep at least some reserve apparatus fully equipped so they would be immediately available to a department if a front-line vehicle breaks down.

CIP

31. The county should ensure that the apparatus replacement program part of the Capital Improvement Program includes adequate funding for the replacement program it administers.

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APPENDIX A.
DEPARTMENT-BY-DEPARTMENT COMMENTS

This appendix describes the current status of the various fire and EMS departments in Wake County. It also discusses planned and possible growth patterns, annexation plans, and future needs, as related by each Department during interviews with us.

For analytical purposes, departments were grouped into regions except for the Raleigh Fire Department, which has no region because it is at the center of the county, and Wake County EMS, which has resources throughout the county. The regions and the departments that comprise them are shown in Table 38.

The total runs by each station in a department may be more than the number of calls because of multiple runs per call (e.g., when both departments send units). Also, the reliability of the data is questionable for several departments. The data we were given was repeatedly changed, and so the number should all be considered approximate indications of workload—and they suffice for that purpose.

TABLE 38: REGIONS AND DEPARTMENTS

Region	Fire Departments	EMS Departments
North	Bayleaf Durham Highway Falls Stony Hill Wake Forest	Six Forks Rescue Squad
East	Eastern Wake Hopkins Knightdale DPS Rolesville Wake-New Hope Wendell Zebulon	Knightdale EMS Rolesville EMS Wendell EMS Zebulon EMS
South	Fairview Fuquay-Varina Garner Swift Creek	Garner EMS
West	Apex Cary Holly Springs DPS Morrisville Western Wake	Apex EMS Cary EMS Holly Springs DPS

For the remainder of this appendix, a table summarizing department attributes accompanies each of the narrative department descriptions. Following is a translation of the abbreviations TriData employs in these tables.

TABLE 39: DEFINITIONS OF ABBREVIATIONS

Abbreviation	Meaning	Abbreviation	Meaning
CID	County ID – A unique fire or EMS station identifier.	P	Pumper-Tanker
E	Engine Company/Pumper	B	Brush Truck
A	Aerial Ladder (or equivalent)	r	Indicates unit is a reserve unit
T	Tanker	O	Other type of unit
S	Squad (heavy or light rescue squad)	Number followed by a letter	Number of each type of unit
M	Paramedic unit/ambulance		

Each department has a different daytime and nighttime staffing pattern. For the purposes of this appendix, the slight differences in workdays and starting and ending times are not very important. Accordingly, the staffing is listed under the generic headings of "Daytime Staffing" and "Nighttime Staffing" rather than the actual times stations are staffed. The term "Nighttime" should be taken to mean nights and weekends, unless otherwise noted. The following abbreviations apply to the staffing columns.

Abbreviation	Meaning
P	Paid personnel
V	Volunteer personnel
M-F	Monday through Friday

The number in front of the abbreviation indicates how many personnel of each type are normally expected to be on duty. Where an unknown number of volunteers may respond from home or be in the station, the word "volunteer" will appear without a number.

A Note on the Relevance of Information Contained in this Appendix

The information in this appendix was gathered largely through interviews with members and officers of the various fire and EMS departments. Much of it is the opinion of the people with whom we spoke. Although we attempted to validate the information through other sources, we could not warrant that it is correct. The information is presented to provide further background for the station location scenarios that appear in Chapter IV. We used some of this information *as a starting point* for analysis. For example, if a fire chief told the project team that the department was considering building a station in a given area, we attempted to find out why, compared the rationale given other information, and, when it appeared appropriate, worked the department-provided new station plans or other information into the station location scenarios that were considered. Some station locations we recommended for the future coincide with locations suggested by departments, and some are not. The recommended station locations and the

conclusions about the scenarios presented in Chapter IV of this report are TriData's alone.

Raleigh Fire Department (no region)

CURRENT STATUS

The Raleigh Fire Department (RFD) is the largest and busiest fire department operating in Wake County. The RFD currently operates 23 stations, employs 493 personnel (461 firefighters and 32 administrative), and responds to approximately 26,500 calls per year (11,500 fire suppression/public service and 15,000 EMS). Full-time paid personnel staff all stations around the clock.

The RFD has tried to plan so as to ensure that engine companies are deployed no more than three miles apart (a 1.5 miles response radius) and that truck companies are deployed no more than five miles apart (a 2.5 miles response radius).

Because the RFD presently covers such a large area of the center of Wake County, this study considered the periphery of the city, where city limits and service delivery areas are in transition, and the interior areas of the city where so-called "doughnut holes" of still unincorporated areas exist.[87]

TABLE 40: RALEIGH FIRE DEPARTMENT DEPLOYMENT AND DEMAND (SELECTED STATIONS)

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
2	R2	263 Pecan Street	paid	paid	1E	1,237
4	R4	121 Northway Court	paid	paid	1E 1O	767
8	R8	5001 Western Boulevard	paid	paid	1E 1A	935
10	R10	2711 Sanderford Road	paid	paid	1E 1Er	803
11	R11	2925 Glenridge Road	paid	paid	1E 1A	1,454
12	R12	3409 Poole Road	paid	paid	1E 1O	1,677
14	R14	4220 Lake Boone Trail	paid	paid	1E 1S	1,682
15	R15	1815 Spring Forest Road	paid	paid	1E	1,095
16	R16	5225 Lead Mine Road	paid	paid	1E 1A	871
17	R1	4601 Pleasant Valley	paid	paid	1E	771

[87] "Doughnut holes" are unincorporated areas of the county that are landlocked, or totally surrounded, by areas incorporated by municipalities. A total of 95 physically distinct doughnut holes exist, comprising 1347 residential structures and 44 commercial structures on 2,053 separate parcels of land. In calendar year 2000, a total of 166 incidents occurred within these doughnut holes.

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
	7	Rd.				
18	R18	8200 Morgan's Way	paid	paid	1E	684
19	R19	4209 Spring Forest Road	paid	paid	1E 1S	1,112
20	R20	1721 Trailwood Drive	paid	paid	1E 2O	780
21	R21	2651 Southall Road	paid	paid	1E 1Ar	920
22	R22	9350 Durant Road	paid	paid	1E 1A	887
23	R23	8312 Pinecrest Road	paid	paid	1E	463
24	R24	10440 Fossil Creek Court	paid	paid	1E 1Sr	242
25	R25	2740 Wakefield Crossing	paid	paid	1E	214
26	R26	3929 Barwell Road	paid	paid	1E	N/A
27	R27	5916 Buffaloe Road	paid	paid	1E	N/A
28	R28	F'ville/Mitchell Mill Rd.	N/A	N/A	N/A	N/A
29	R29	Harrington Grove	N/A	N/A	N/A	N/A
30	R30	Buffaloe Rd./I-540	N/A	N/A	N/A	N/A

Note: Proposed stations shown in grey shading.

The above data shows that none of the Raleigh stations of relevance to this study have a high call workload. All could easily sustain an additional 50 percent growth in call volume without being overloaded. That is, the workload would still be under 2,500 calls for a growth of 50 percent. For all but three, the workload would be under 2,500 for growth of 100 percent (2,500–3,000 calls is the range where a station is considered busy but nor overloaded). In other words, the Raleigh stations have the capacity to easily handle calls in the annexation "doughnut holes" and "peninsulas," if agreement can be reached on doing so. (We recommend developing such agreements in Chapter IV, Station Location Scenarios.)

AREA GROWTH PATTERNS

The City of Raleigh is growing primarily on its periphery through annexation. Core growth appears halted in many places and slow in others, according to the City. Conversely, suburban fringe and in-fill growth appear heavy – both in the commercial and residential sectors. The City's annexation drive tends to spur additional suburban development, which increases the chances for annexation a few years after the completion of such development.

The I-540 Outer Beltline has facilitated the outward expansion, and it is expected to continue to do so for the foreseeable future.

ANNEXATION IMPACT

The City of Raleigh has grown substantially through annexation over the last ten years. The City's policy is to annex land only by petition. The City's annexation policies and permissive state laws have lead to an extremely irregular, discontinuous city border, with the added complication of so-called "doughnut holes". The long "finger-like" projections of the City, the doughnut holes, and the irregular city limit make it difficult to create a rational emergency response scheme for the unincorporated areas of the county, unless closest units responding is the guiding principle.

DEPARTMENT EXPANSION INTENTIONS

In June 2003, the RFD opened two new fire stations: Station 26, at 3929 Barwell Road, and Station 27, at 5916 Buffalo Road. The RFD presently plans to build three additional stations over the next five to eight years. The first of the three stations, RFD Station 28, located at Forestville Road and Mitchell Mill Road would be started in July 2004. The remaining two stations, Stations 29 and 30, would be located in the Harrington Grove subdivision and Buffalo Road and I-540 areas, respectively. Land for these stations has not yet been acquired by the City of Raleigh.

As an aside, the Raleigh Fire Department said it would consider leasing Western Wake Station 1 for future Raleigh Fire Department needs, similarly to the manner in which it now leases Durham Highway Station 2. Since Raleigh's station needs were not within the scope of this study, we focused only on the County's needs, and considered the use of Raleigh stations for the County, but not vice versa.

Wake County Emergency Medical Service (no region)

CURRENT STATUS

Wake County EMS (WCEMS) provides advanced life support in the City of Raleigh and any area of the county that is not covered under contract by a local fire or EMS corporation. WCEMS also provides personnel to some of the contracted EMS agencies (e.g., Wendell EMS). The Department has a total staff of 170, including full- and part-time personnel. Their deployment is shown in Table 41.

Some WCEMS units are housed in WCEMS stations, while others are co-located with fire departments or EMS agencies.

TABLE 41: COUNTY EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	N/A	331 S. McDowell St.	6 P	6 P	3M 2Mr	8,341
2	N/A	2020 Noble Rd.	2 P	2 P	1M	2,077
3	N/A	5305 Six Forks Rd.	2 P	2 P	1M 1Mr	2,385
4	N/A	4017 District Dr.	2 P	2 P	1M	2,312
5	N/A	4707 Hargrove Rd.	4 P	4 P	2M	4,440
6	N/A	1015 National Guard Dr.	2 P	2 P	1M	472
7	N/A	2910 Kidd Rd.	2 P	2 P	1M 1Mr	2,149
8	N/A	136 Varsity Dr.	2 P	2 P	1M	1,973
9	33	301 S. Fuquay Ave.	4 P	4 P	2M	2,600
10	N/A	706 S. Franklin St.	2 P	2 P	1M	1,523
14	7	5617 Hilltop Rd.	relocated	N/A	1M	N/A
15	R22	9350 Durant Rd.	relocated	N/A	1M	N/A

Note: EMS 11 becomes EMS 15 at Raleigh Station 22 from 0900 to 1900 daily. EMS 14 relocates to CID 7 from 0800 to 2000 daily (this will likely become a permanent relocation in the spring of 2004).

(EMS Comment, add as a footnote: Strike line referencing EMS 15; this project ended in early October due to a time limitation established between EMS and the Raleigh Fire Department – any reference to this in the report should note that it is not currently underway, but that the data generated by it substantiated the need for a resource in that location.)

AREA GROWTH PATTERNS

Growth throughout the County will affect the delivery of EMS through increased call volumes and roadway congestion. To the extent that the local fire and EMS corporations are not able to meet increased demand for service, the responsibility for providing service will fall to WCEMS.

ANNEXATION IMPACT

Land in unincorporated areas across the county continues to be annexed by cities and towns. However, annexations have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

There is some possibility that the Sheriff will need to expand within the Public Safety Complex on McDowell Street. Were that to happen, Wake County EMS would probably need to find a new location. The units now stationed at EMS Station 1 could be relocated without necessarily keeping them all in the same station.

The Department is considering building a new EMS station near the Wake Med North hospital. The Department also feels that the North Raleigh area (WCEMS Station 5) will soon require additional EMS presence. To that end it has initiated a pilot program of redeploying EMS 13 (usually stationed at 331 S. McDowell Street) to Raleigh Fire Station 22 (9350 Durant Road) daily from 9:00 a.m. to 7:00 p.m. When redeployed, EMS 13 becomes known as EMS 15.

Bayleaf Fire Department (North region)

CURRENT STATUS

In 2002, the Bayleaf Fire Department (BFD) responded to 860 calls for service from three fire stations. Its service area is almost exclusively residential in nature. The Department has 93 personnel: 11 full-time paid, eight part-time paid, and 74 volunteers (of whom 40 to 45 are active). Volunteers generally respond from home. Station 1, the headquarters station, is in need of renovation. It lacks sufficient office space and has no legal sleeping quarters. Station 2 is equipped with a bunkroom. Station 3 (formerly Six Forks Fire Department Station 1) is within the city limits of Raleigh.

Water supply is an issue for the BFD. A large portion (40 to 45 percent) of the BFD response area lacks hydrants. There are numerous high-value homes in the area. For example, Raven Ridge has homes in excess of 20,000 square feet without stable water supply. Accordingly, the BFD operates mostly pumper-tankers.

The Department also protects a large lake district and therefore has water rescue equipment and capabilities.

TABLE 42: BAYLEAF FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	25	11713 Six Forks Rd.	5 P M-F	volunteer	1B 2E 1P 1A	423
2	36	13116 Norwood Rd.	4 P M-F	volunteer	2P 1O	305
3	12	1431 Lynn Rd.	4 P M-F	volunteer	1B 2P 1E 1T	132

AREA GROWTH PATTERNS

Growth is currently occurring to the northeast (in the Raven Ridge area) and in the northwest (north of Norwood Road along Highway 50).

ANNEXATION IMPACT

Because much of the area is in the Falls Lake Watershed, and annexation into that area would necessitate huge outlays for the provision of water and sewer service, the City of Raleigh has no plans to annex land north of Strickland Road.

DEPARTMENT EXPANSION INTENTIONS

The Department would like to put a station in the Raven Ridge area to accommodate development there.

Durham Highway Fire Department (North region)

CURRENT STATUS

The Durham Highway Fire Department (DHFD) owns two fire stations in the northwest-central portion of the County. It operates primarily out of Station 1 and leases the other (Station 2) to the Raleigh Fire Department (Raleigh Fire Department Station 23). The DHFD considers the non-hydranted area south of Station 2 a wildland interface. The DHFD keeps two pieces of unstaffed apparatus at Station 2.

The Department has approximately 72 personnel: nine full-time paid, 10 to 12 part-time paid, and 55 volunteers (of whom 45 to 50 are active). The DHFD can turn out approximately 24 volunteers on a structure fire.

TABLE 43: DURHAM HIGHWAY FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	16	11905 Norwood Rd.	4 P	4 P, 3 V	1B 2P 1E 1S	~600
2	17	8312 Pinecrest Rd.	unstaffed	unstaffed	1T 1P	N/A

Note: Station 2 is staffed as a Raleigh Fire Department station.

AREA GROWTH PATTERNS

Large commercial growth is expected in the area north of Glenwood and west of I-540.

ANNEXATION IMPACT

No annexation is expected for the DHFD area, according to the Fire Department.

DEPARTMENT EXPANSION INTENTIONS

The Department was interested in examining whether an additional station can be justified north of its current station on Highway 50.

Falls Fire Department (North region)

CURRENT STATUS

The Falls Fire Department operates out of a single station in the north-central portion of the county in an area sandwiched between Raleigh Fire Department Stations 22 and 25. The Department protects a shrinking area between Wake Forest and the City of Raleigh.

This station is in bad physical condition and would necessitate an estimated $189,664 in repairs, according to the Heery Report. We recommend that it be closed.

TABLE 44: FALLS FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	21	11908 Falls of Neuse Rd.	3 P M-F	2-4 V	1B 3P	330

AREA GROWTH PATTERNS

In the last 10 years the area protected by the Falls Fire Department has transitioned from rural to suburban. Presently, growth is mainly residential (in the form of subdivisions); only a few commercial properties are being developed.

The opening of I-540 has increased call volume slightly because the Department now runs with the Bayleaf and Wake-New Hope Fire Departments on highway-related calls.

ANNEXATION IMPACT

Annexation by the City of Raleigh has had considerable impact on the operations of the Falls Fire Department. The Department has lost most of its former response district to the Raleigh Fire Department. It now covers a very small area of the Falls of Neuse Road corridor between Raleigh and Wake Forest. Future planned annexations by the City of Raleigh are expected to cut the FFD response district down to almost nothing, though their plans were not confirmed.

DEPARTMENT EXPANSION INTENTIONS

There is nowhere for the FFD to expand. The Department has had an exploratory conversation about merging with the Wake Forest Fire Department. If this were to occur, they felt it might be possible for the personnel and apparatus from the FFD to be used to open a new Wake Forest station in the vicinity of Durham Road and NC 98.

Six Forks Rescue Squad (North region)

CURRENT STATUS

The majority of Six Forks Rescue Squad (SFRS) units are located in leased space in the Bayleaf Fire Department Station 3 (formerly, the Six Forks Fire Department station). The SFRS also operates units out of Bayleaf Fire Department Station 2. According to SFRS personnel, the combination of the two station locations provides adequate coverage for most responses undertaken by SFRS.

The SFRS has 46 volunteers (31 EMTs and 15 first responder-certified rescue technicians, of whom 35 to 40 are active).

TABLE 45: SIX FORKS FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	127	1431 Lynn Rd.	2 P, volunteer	1 P, volunteer	2M	~2,500
2	127	13116 Norwood Rd.	2 P, volunteer	1 P, volunteer	1M	N/A

Note: SFRS initiated service at Station 2 in February 2003, so call volume is not available for a full year at the time this data was collected. Call volume for Station 1 was estimated.

AREA GROWTH PATTERNS

The area protected by the SFRS is primarily urban and suburban in nature. It is largely developed; hence most of the growth is in-fill development. The northern reaches of the SFRS response area (toward the Durham Highway and Bayleaf Fire Departments) are the most likely to see new housing starts and increasing density.

ANNEXATION IMPACT

The SFRS station lies wholly within the City of Raleigh. Because the SFRS is an EMS and rescue agency, its responses are unaffected by annexation.

DEPARTMENT EXPANSION INTENTIONS

The Department thought an additional station towards Durham or in the Creedmoor/I-540 area will be needed to meet demand created by growth in that area.

The Department would like to add a third ambulance in the main station (Bayleaf Fire Department Station 3) within 18 months.

Stony Hill Fire Department (North region)

CURRENT STATUS

The Stony Hill Fire Department (SHFD) protects an extremely rural and remote area of northwest Wake County. It includes a joint fire-EMS station. Portions of the SHFD response district are inaccessible without leaving the county and re-entering from Granville County because of the configuration of roads and lakes. Response times can be long, not just because distances are great, but because the Department is heavily reliant on volunteers to get its apparatus on the road. The SHFD has approximately 25 personnel, all of whom are active. The Department can usually get 12 volunteers on a house fire and five on a serious medical call. The department relies on one full-time staff

member and a few part-time staff members during workday working hours. The Department has about 350 calls per year for the last three years (about 175 from each station).

Construction is currently underway for a new headquarters fire station with EMS facilities on a lot directly adjacent to the old, existing fire station. The fire station is being built using the County prototype design, which includes sleeping quarters that may be used if the Department initiates a duty night program, possible in the next fiscal year.

TABLE 46: STONY HILL FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	26	7025 Stony Hill Rd.	3 P M-F	volunteer	1B 2P	175
2	39	15633 New Light Rd.	3 P M-F	volunteer	1P 1T 1B	175

Note: Both SHFD stations run together on every call, therefore their call volumes, or more properly run volumes, are identical.

AREA GROWTH PATTERNS

Although there is some new construction in the area, they do not expect that the volume of future construction will rise to an extent that growth will have much impact on the delivery of fire and emergency medical services. (They could have double the current number of calls, and still have relatively low workload of one call per day per unit.]

ANNEXATION IMPACT

No municipal annexation is projected to occur in this area due to its remoteness from any municipality and the difficulty of providing water or sewer services to the area.

DEPARTMENT EXPANSION INTENTIONS

The Department believes it should build a third station in the Dutchville Township area. This area, separated from the rest of the SHFD response area by lakes, is currently getting fire suppression service from the Creedmoor Fire Department (Granville County), but does not receive medical first response because Creedmoor does not provide that service. This expansion to a third station would be difficult, for reasons quite apart from the capital cost of building and equipping a station: SHFD would need to recruit volunteers in the area or hire 24-hour personnel to staff a station. Moreover, since there are only about 30 calls per year in the Dutchville Township area, this would be a very expensive service (on a per-call basis) to maintain.

Wake Forest Fire Department (North region)

CURRENT STATUS

The Wake Forest Fire Department (WFFD) runs approximately 1,600 calls per year from two stations in the northwest portion of the county. The Department has 55 personnel: 12 full-time paid, eight part-time paid, and 35 volunteers (of whom 20 are active).

The WFFD feels Station 1 is sufficient for an in-town station, though being in town can make responses difficult due to traffic. The WFFD also feels Station 2 is well situated.

TABLE 47: WAKE FOREST FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Runs
1	6	420 E. Elm Ave.	4-6 P M-F	2 P	2B 3P 1E	~960
2	43	9925 Ligon Mill Rd.	4 P M-F	volunteer	1P 1E 1O	~640

AREA GROWTH PATTERNS

There has been an increase in commercial construction as well as residential expansion in the western portion of Wake Forest. Much of the area to the west is not hydranted, and homes in that area can reach $500,000 valuation.

A development of 600 to 700 homes in the east (in the Jones Dairy Road area) is expected to occur once the Route 98 Bypass is completed (in 2004).

Four hundred new homes are being built within the town limits, but in Franklin County. Demand generated by the presence of these homes will nonetheless have some impact on WFFD operations in Wake County.

ANNEXATION IMPACT

The Town of Wake Forest has plans to annex land to the east of town (near Jones Dairy Road) once the Bypass is completed.

DEPARTMENT EXPANSION INTENTIONS

The WFFD believes it is necessary to build a new fire station (to house an engine company and a tanker) on the west side of town because a pocket of development is more than five miles from a fire station. Two primary sites are being considered: Old Stadium Drive/New Stadium Drive/Capital Boulevard and Kearney Road/Wake Union Church Road/Capital Boulevard (the latter is their favored site because it has better access). Of the sites the Department has considered, none would be more than 3.2 miles from any residence in the WFFD district.

The Department would like to build an additional station on the east side of town (to cover the projected annexations) within three years.

The Wake Forest and the Falls Fire Departments have had some exploratory discussions about merging.

The WFFD plans to purchase an aerial ladder for Station 1 by the end of the current year (for delivery next year). The rationale is that the Town of Wake Forest has a number of three-story structures on the campus of the Baptist Seminary (formerly Wake Forest College) and is seeing an increasing number of larger structures (i.e., large-scale commercial properties such as a Target store) being built along Capital Boulevard.

Eastern Wake Fire Department (East region)

CURRENT STATUS

The Knightdale Volunteer Fire Department reconstituted itself as the Eastern Wake Fire Department (EWFD) in March 2003. At that time, the EWFD renamed then Knightdale Station 1 (CID 13) to the Eastern Wake Station 2, and then Knightdale Station 2 (CID 38) to be Eastern Wake Station 1.

Using the new designation, Station 2 (CID 13) sits four blocks from the building used as a fire station by the Knightdale Department of Public Safety (located at 306 Robertson Street). Units from Station 2 (CID 13) no longer respond within the town limits of Knightdale.

The EWFD has 40 personnel: 18 full-time paid and 22 volunteers (of whom 12 are active). The Department responds to approximately 1,200 calls per year from the two stations. Responses in the northwest portion of the EWFD response district are augmented by Raleigh Station 12, which responds automatically to any major assignment (including medical first response) west of the Neuse River.

TABLE 48: EASTERN WAKE FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	38	4828 Clifton Rd.	3 P	3 P	1P 1A	~720
2	13	401 Hester St.	3 P	3 P	3P 1B	~480

AREA GROWTH PATTERNS

The completion of the Route 64 Bypass will create new growth to the south of the Town of Knightdale.

ANNEXATION IMPACT

Annexation by the City of Raleigh just to the west of the EWFD response district has caused the Raleigh Fire Department to build a new station – Station 26 – on Barwell Road. This new station opened in early July 2003. It is much closer to some of the western portion of the EWFD district than either EWFD station. Under proximity-based dispatch, it would be more effective to have Raleigh cover some of this area. (In Chapter III, we recommend that the County adopt a policy of sending the closest unit to all calls.)

DEPARTMENT EXPANSION INTENTIONS

The EWFD would like to sell Station 2 (CID 13) and relocate north of the Town of Knightdale. One potential buyer for this station would be the Knightdale DPS, which needs a facility in town because the maintenance building it is presently using as a fire station is inadequate for such purposes. The EWFD said there is a possibility of securing a donation of land for a new fire station in the area of Smithfield Road and Major Slade Road. The Department also thinks it may be possible to secure a donation of land from a private landowner on Route 64.

The EWFD would be willing to host a Wake County EMS unit at Station 1 (CID 38), if needed.

Hopkins Fire Department (East region)

CURRENT STATUS

The Hopkins Fire Department (HFD) serves an extremely rural area from one fire station in the far eastern portion of the county between Rolesville and Zebulon. In 2002, the Department ran 305 calls. It has 25 personnel: five full-time paid, five part-time paid, and approximately 20 volunteers (all of whom are active).

The Department is about to commence construction of sleeping quarters. When the project is completed, the HFD will change its nighttime staffing to one paid and one volunteer firefighter in station.

TABLE 49: HOPKINS FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	22	8933 Fowler Rd.	4-6 P	volunteer	1B 2P 1T	305

AREA GROWTH PATTERNS

The portion of the county currently protected by the HFD is best characterized as a stable, rural area. Little residential or commercial development is expected.

A future waster supply reservoir (the Little Falls Reservoir) is not slated to be built until 2020 at the earliest. Although beyond the planning horizon for this study, we note as a thought for the future, that when constructed, the reservoir will diagonally transect the current Hopkins fire district. Bridges are planned to cross the reservoir at Riley Hill Road and Fowler Road. The east-west travel times in the area will be affected, and there may be a need for a station west of the reservoir. Early consideration might be give to "land banking" a site for this station well in advance while property costs are low.

ANNEXATION IMPACT

No annexation is projected for the Hopkins area.

DEPARTMENT EXPANSION INTENTIONS

The Department does not have any stated expansion intentions at this time. It would like to replace it current station at some point in the next 10 years.

Knightdale Department of Public Safety (East region)

CURRENT STATUS

The Knightdale Department of Public Safety (KDPS) was started in July 2002. KDPS is a public-safety concept department. Town public safety officers (and some public works employees) are cross-trained to provide fire suppression and medical first response. The Department consists of four paid full-time firefighters, 15 cross-trained public safety officers, six cross-trained public works employees, and 25 volunteers (approximately 50 percent of whom are active).

The KDPS responds to approximately 600 calls per year. In addition to the firefighter on duty at the Robertson Street station, a minimum of three public safety officers (and as many as six on weekdays) are on duty. According to the Town of Knightdale, the first-arriving cross-trained public safety officer is usually on the scene within 0:01:10 of dispatch, and a complement of 18 to 20 personnel can be assembled for a structure fire within 10 minutes of dispatch.

The Department currently operates out of a converted maintenance facility approximately four blocks from the former Knightdale Volunteer Fire Department headquarters station (now Eastern Wake Station 2) on Hester Street. This facility is not appropriate for long-term use as a fire station.

TABLE 50: KNIGHTDALE DEPARTMENT OF PUBLIC SAFETY DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	N/A	306 Robertson St.	1 P	1 P	2E 1T	~600

AREA GROWTH PATTERNS

New sewer and water service is being installed north of town. This will support a new park and two new schools (an elementary school and a high school) in the Emerald Point area, northeast of the town center.

There are presently plans for approximately 2,500 new houses to be built in the next three to four years north of town in the area of Forestville Road and Old Crews Road. A subdivision of 300 to 400 homes has been proposed to be built at Hodge Rd. north of the railroad tracks. A second subdivision of 300 to 500 homes has been discussed for Hodge Road south of the railroad tracks toward the Route 64 Bypass.

ANNEXATION IMPACT

The Town of Knightdale is aggressively annexing in all directions except to the south of town. Recent annexations include everything on Route 64 west of town to Hodge Road. (The land surrounding Route 64 will be annexed once it has been developed.) The Town of Knightdale has also annexed land around Route 64 eastward to Acres of Space Road.

The Town also plans to annex land to the north, in the area of Forestville Road and Smithfield Road, including a commercial site where a day care center and office building are under construction. Additionally, the Town will annex the development of 2,500 new homes slated for Forestville Road and Old Crews Road.

Much of the land annexed has been protected by the Eastern Wake Fire Department, and so it is highly likely the combination of additional call volume and additional acreage to protect will necessitate the construction of an additional fire station.

DEPARTMENT EXPANSION INTENTIONS

The KDPS recognizes a need to deploy resources in the western portion of the Town of Knightdale. One location under consideration is 2128 Mingo Bluff Blvd. A preferred location would be in a new Public Safety Center in the area of McKnight Drive and Lauren's Way. The Department feels that co-location with EMS (or another service) would be a possibility in either location.

Town officials are also potentially interested in a new station somewhere in the northeastern portion of the Town to serve the Emerald Point development.

Knightdale Emergency Medical Service (East region)

CURRENT STATUS

Knightdale EMS (KEMS) runs approximately 1,800 calls per year with two units located in its station (built in the late 1970s) in the southern portion of the town center. KEMS has approximately 40 personnel: three full-time paid, 12 part-time paid, and 25 volunteers (of whom about 10 are active). Wake County EMS supplements KEMS staffing with one full-time paid paramedic.

KEMS personnel feel that the station is fairly well located. They describe that the majority of calls occur in the vicinity of and south of the station, and estimate that only 20 percent of the calls happen north of the station.

TABLE 51: KNIGHTDALE EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	137	24 S. First Ave.	4 P	2 P, volunteer	2M 1Mr	~1,800

AREA GROWTH PATTERNS

New sewer and water service is being installed north of town. This will support a new park and two new schools (an elementary school and a high school) in the Emerald Point area, northeast of the town center.

As noted earlier, there are presently plans for approximately 2,500 new houses to be built in the next three to four years north of town in the area of Forestville Road and Old Crews Road. A subdivision of 300 to 400 homes has been proposed to be built at Hodge Rd. north of the railroad tracks. A second subdivision of 300 to 500 homes has been discussed for Hodge Road south of the railroad tracks toward the Route 64 Bypass.

ANNEXATION IMPACT

Annexations by the Town of Knightdale have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

Some personnel felt that a unit would be needed in the Wendell Station 2 area within three to five years to reduce response times. (Wake County EMS has been considering placing a County unit at Wendell Station 2 to answer calls in the area and provide backup coverage to EMS agencies in the eastern portion of the county.)

Although there was no stated intention to expand or relocate, KEMS personnel felt that putting a unit in the Wendell Station 2 or Wake-New Hope Station 2 area might be a good idea. Likewise, they thought that placing a unit in Eastern Wake Fire Department Station 1 (on Clifton Road) might also work well.

Rolesville Fire Department (East region)

CURRENT STATUS

The Rolesville Fire Department station is well located for the majority of calls to which the Department responds. The Department currently has 34 personnel: two full-time paid and 32 volunteers (of whom about 20 represent the core group of active members).

TABLE 52: ROLESVILLE FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	15	104 E. Young St.	2 P M-F	volunteer	2B 2E 1P 2T	740

AREA GROWTH PATTERNS

The area between Rolesville and Wake Forest has been growing steadily over the past few years with new subdivisions and homes.

Future growth is expected south of Rolesville as the City of Raleigh completes its annexations in the area. Further, when the Route 401 Bypass is completed, additional growth in the east can be expected. Current projections range as high as 4,000 additional houses in the next three to five years.

ANNEXATION IMPACT

The City of Raleigh has annexed unincorporated land along the Route 401 corridor.

DEPARTMENT EXPANSION INTENTIONS

The Rolesville FD has identified a need to initiate a nighttime duty crew, especially for Friday and Saturday nights, to ensure adequate response capacity. In order to do this, the fire station will need to be renovated to include a sleeping quarters.

Rolesville Emergency Medical Service (East region)

CURRENT STATUS

This summer, Rolesville EMS (REMS) began construction of a new station adjacent to the Rolesville Town Hall on East Young Street. This new facility is based on the County

EMS station prototype. When completed, the new facility will provide much-needed space for equipment, training, and personnel that the current facility does not have. The new station will not have room for a third ambulance, however.

REMS has 33 personnel: three full-time paid, five part-time paid, 25 volunteer (all of whom are active).

TABLE 53: ROLESVILLE EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	157	204 E. Young St.	1.75 P, V	1 P, 1V	1M 1Mr	~1,100

AREA GROWTH PATTERNS

The area between Rolesville and Wake Forest has been growing steadily over the past few years with new subdivisions and homes.

Future growth is expected south of Rolesville as the City of Raleigh completes its annexations in the area. Further, when the Route 401 Bypass is completed, additional growth in the east can be expected. Current projections range as high as 4,000 additional houses in the next three to five years.

ANNEXATION IMPACT

Annexations by the City of Raleigh have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

If future call volume warrants putting a third ambulance in service, it will need to be in a different station because the station under construction now will not accommodate an additional vehicle. The REMS sees a potential need for a satellite station south of Rolesville in the area of Mitchellville Road and Forestville Road (near the future Raleigh Fire Department Station 28). The Department indicated it would be willing to consider co-locating at Raleigh Station 28.

Wake-New Hope Fire Department (East region)

CURRENT STATUS

The Wake-New Hope Fire Department (W-NHFD) operates two stations – one on either side of the Neuse River. The Department has roughly 59 personnel: eight full-time paid, five part-time paid (which includes an administrative assistant), and approximately 46 volunteers (of whom about 50 percent are active).

W-NHFD Station 1 is located within the City of Raleigh. The station has some physical deficiencies. It does not have enough room for training, it lacks a laundry area or an exercise room, and the parking lot needs repair. The Department's primary argument for keeping this station open is it provides tankers to protect a non-hydranted area west of the Neuse River. The Department notes that the Raleigh Fire Department cannot protect this area because it doesn't have any tankers.

Station 2 protects a primarily rural area east of the Neuse River.

TABLE 54: WAKE-NEW HOPE FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	28	4615 St. James Ch. Rd.	3-4 P M-F	volunteer	1P 1E 1T	550
2	31	4904 Watkins Rd.	3-4 P M-F	volunteer	3E 1B 3T	620

AREA GROWTH PATTERNS

The area around Station 1 is within the City of Raleigh and has already been developed, so growth west of the Neuse River is relatively slow. East of the river, growth is somewhat heavier as developers buy up available farmland for new construction. Two new subdivisions of about 125 homes are nearing completion in the W-NHFD area east of the river.

ANNEXATION IMPACT

Recent annexation by the City of Raleigh has left the W-NHFD with little more than "doughnut holes" to cover west of the Neuse River.

DEPARTMENT EXPANSION INTENTIONS

The Department did not express any intention to expand at this time.

Wendell Fire Department (East region)

CURRENT STATUS

The Wendell Fire Department (WFD) operates two stations in the eastern corner of the county. The headquarters station, Station 1, is located within the town limits. Station 2 is located in a relatively rural area northwest of town. The Department has 42 personnel: 14 full-time paid and 28 volunteers (of whom about 20 are active).

TABLE 55: WENDELL FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	32	2960 Wendell Blvd.	4 P	2 P, volunteer	1A 1B 1E 2P	1,021
2	11	6529 Bethany Church Rd.	2 P	2 P, volunteer	1B 1P 1T	650

AREA GROWTH PATTERNS

Growth west of town is expected to occur due to construction on the Route 64 Bypass. Some residential construction is underway southwest of town in the 11000 block of Poole Road, and northwest of town in the Ramsey Farms subdivision (Rolesville Road at Moores Creek Drive) and in the Bridgegate Estates area.

ANNEXATION IMPACT

The Town of Wendell intends to annex land in the direction of the Route 64 Bypass. Since this area is already served by the WFD, the annexation should not have a direct impact on operations. (An increase in call volume in the annexed area has to be considered, just as increase in call volume for areas currently served by any department.)

DEPARTMENT EXPANSION INTENTIONS

The Department does not have any stated expansion intentions at this time.

Wendell Emergency Medical Service (East region)

CURRENT STATUS

The Wendell EMS (WEMS) operates three paramedic units out of a single station it owns on the east side of Wendell. The station was constructed in 1974, and it is in failing condition. It does not meet either fire/building code or the federal Americans with Disabilities Act requirements. The building has little storage space, poor sleeping quarters, and no room to expand. The Heery Report estimates the Wendell EMS station needs $112,769 in repairs.

In addition to its physical problems, the station is poorly located. Most WEMS runs require a cross-town response, as the majority of WEMS' incidents are north of its current location.

The Department has 20 personnel: eight full-time paid, six part-time paid, and six volunteers (of whom all are active). Volunteers stay in the station and do not respond from home.

TABLE 56: WENDELL EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	117	401 E. Third St.	4 P, volunteer	4 P, volunteer	3M	~1,500

AREA GROWTH PATTERNS

Growth west of town is expected to occur due to construction on the Route 64 Bypass. Some residential construction is underway southwest of town in the 11000 block of Poole Road, and northwest of town in the Ramsey Farms subdivision (Rolesville Road at Moores Creek Drive) and in the Bridgegate Estates area.

ANNEXATION IMPACT

Annexations by the Town of Wendell have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

The WEMS would like to have a new facility with direct access to Wendell Boulevard. At one time, the Department had looked into purchasing land in the vicinity of Wendell Fire Department Station 1. Also, the Department has considered co-locating one of the in-town units in Wendell Fire Department Station 2 (WEMS runs approximately 650 calls per year in this area.)

Zebulon Fire Department (East region)

CURRENT STATUS

The Zebulon Fire Department (AFD) has one station staffed by a core of paid firefighters, supplemented by volunteers at night.

TABLE 57: ZEBULON FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	9	113 E. Vance St.	3 P M-F, 1 P	2 P, volunteer	1A 2E 2P 1T	~600

AREA GROWTH PATTERNS

Growth in Zebulon is primarily in the areas north and west of town. There are plans for a new subdivision of 217 houses in the north of town, near the intersection of Zebulon Road and Proctor Street.

There are also plans for development of some commercial property and a small subdivision west of the town center, near the intersection of Riverview Drive and West Gannon Avenue. Also in the western portion of the town, a nursing facility is being built on Pony Road, and the Pineview subdivision, at West Gannon Avenue and Hinton Road, is expanding slowly.

ANNEXATION IMPACT

The Town of Zebulon would likely annex the proposed subdivision at Zebulon Road and Proctor Street once it was completed.

Annexation should have little impact on the operations of the Zebulon Fire Department since it already serves the areas being considered for annexation.

DEPARTMENT EXPANSION INTENTIONS

The Department would like to build a station on the west side of town to serve the growing Pineview subdivision and the nursing facility under construction.

Zebulon Emergency Medical Service (East region)

CURRENT STATUS

The Zebulon EMS (ZEMS) station is one block from Route 96 in a building that was retrofitted from a former use as a dry cleaning facility. It is fairly well located as approximately 60 percent of the calls ZEMS runs are located within the corporate limits of the Town of Zebulon. Unfortunately, the building is in poor shape, and its sleeping quarters do not meet code (there are no windows in the bunkrooms). The Heery Report estimated repair at a cost of $192,441 to fix the station.

TABLE 58: ZEBULON EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	97	131 E. Vance St.	4 P	2 P, volunteer	2M 1Mr	1,520

AREA GROWTH PATTERNS

Growth in Zebulon is primarily in the areas north and west of town. There are plans for a new subdivision of 217 houses in the north of town, near the intersection of Zebulon Road and Proctor Street.

There are also plans for development of some commercial property and a small subdivision west of the town center, near the intersection of Riverview Drive and West Gannon Avenue. Also in the western portion of the town, a nursing facility is being built

on Pony Road, and the Pineview subdivision, at West Gannon Avenue and Hinton Road, is expanding slowly.

ANNEXATION IMPACT

Annexations by the Town of Zebulon have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

The Department would like to build a new station on its present site. If that were not feasible, ZEMS would like to relocate further west towards Route 64. The Glaxo Corporation owns some property on the western edge of Zebulon that it might be willing to donate or sell. The advantage of that property is that it would still provide a relatively rapid response into the center of town while placing ZEMS closer to Route 64 and areas to the west that currently have no closer emergency medical service (e.g., Hopkins, which is about 10 minutes away).

Fuquay-Varina Fire Department (South region)

CURRENT STATUS

The Fuquay-Varina Fire Department (FVFD) believes its current stations are well situated for present call volume and distribution. The Department felt that its headquarters, Station 1, should be expanded or renovated to accommodate EMS, a bunkroom, and a training room. The bunkroom was too small, and there is no training room. (Construction has begun to renovate FVFD Station 1 and Station 2 to accommodate EMS. Work is scheduled to complete in November 2003. Station 3, Willow Springs Fire Station, is new, constructed in 2002.)

The Department has a total of 68 personnel: 26 full-time paid, 10 part-time paid, and 32 volunteers (of whom approximately 75 percent could be described as active).

The western portion of the current FVFD district is somewhat far from the current station locations. Holly Springs Public Safety is actually closer to some of this western area.

TABLE 59: FUQUAY-VARINA FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	7	5617 Hilltop Rd.	8 P M-F	3 P, 1 V	1B 4P 1A 2T	1,840
2	33	301 S. Fuquay Ave.	4 P M-F	2 P, 1 V	2T 1P	400
3	45	2747 Bud Lipscomb Rd.	3 P M-F	2 P, 1 V	1E 1T	229

Note: Station 3 call volume is for the period from February 4 to June 30.

AREA GROWTH PATTERNS

There has been expansion and growth in the along Hilltop Needmore Road.

ANNEXATION IMPACT

The Hilltop Needmore Road area has recently been incorporated into the Fuquay-Varina extraterritorial jurisdiction. The Bent Winds and Crooked Creek Country Clubs will likely be within the Fuquay-Varina limits within five to ten years. The extraterritorial jurisdiction was also extended north on Route 401 to just before the Wake Tech Campus.

DEPARTMENT EXPANSION INTENTIONS

The Department will increase its paid staff by four people as of October 1, 2003. This will increase nighttime coverage by one over the number each station presently has.

The FVFD has been involved in preliminary discussions about building a fourth station in the Needmore area. Current drive times to the Needmore area are six to seven minutes from present facilities.

Wake County EMS units are now co-located in both FVFD facilities. EMS 9 is in FVFD Station 1 around the clock, and EMS 14 is in FVFD Station 2 from 09:00 to 20:00 daily. Adding EMS space to Station 1 and Station 2 would accommodate a 24-hour EMS unit. New Station 3 was designed to be expandable to hold an EMS unit if needed (it would require adding about 2,500 square feet, including an additional bay).

Garner Fire Department (South region)

CURRENT STATUS

The Garner Fire Department (GFD) runs a total of about 3,000 calls per year out of three stations. The GFD has 84 personnel: 20 full-time paid, 12 part-time paid, and 52 volunteers (of whom approximately 25 would be considered active). The Department can usually count on 10 to 15 volunteers to respond on a nighttime structure fire and five to respond during the daytime. In the Station 2 first-due area, the Department estimates the 15 volunteers will respond on a structure fire irrespective of time of dispatch.

There are paid personnel at Station 1 and Station 3 around the clock. Station 2 is staffed solely by volunteers on nights and weekends. It would be difficult to put 24-hour paid personnel at Station 2 because it does not have sufficient room for a bunkroom.

Station 1 was renovated to bring its sleeping quarters to code in 2002. The newest station, Station 3, was built in 1998. Station 2 was built in 1976.

TABLE 60: GARNER FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	41	503 W. Main St.	3 P	3 P, volunteer	2P 1T 1P 1B	1,510
2	18	9115 Sauls Rd.	2 P M-F	volunteer	1B 1T 1P	641
3	8	1695 Timber Dr.	3 P	3 P	2P	1,414
4	N/A	Raynor Rd./Spaceway Ct.	N/A	N/A	N/A	N/A

Note: Proposed stations shown in gray shading.

AREA GROWTH PATTERNS

I-540 is slated eventually to traverse the Garner area. In fact, it will pass within a few hundred yards of Garner Station 2. The Interstate would make certain responses more difficult as some roads will cease to be through-roads once the Interstate is completed. Further, Station 2 is not within easy reach of any planned on-ramps.[88]

The area of 10-10 Road has seen a lot of growth recently. For example, a new shopping center is slated for 10-10 Road and Old Stage Road.

ANNEXATION IMPACT

The Town of Garner recently annexed the new shopping center near the intersection of I-40 and Route 70. However, it appears that the Town is not interested in annexing much eastward of Raynor Road. The primary area of interest for future annexation appears to be south of town. There are plans to annex the new shopping center at 10-10 Road and Old Stage Road once it has been completed.

These annexations do not appear to impact the operations of the Garner Fire Department because it is already serving these areas.

DEPARTMENT EXPANSION INTENTIONS

Working with the County, the Department has been actively attempting to secure land at Raynor Road and Spaceway Road for a fourth fire station, on which it hopes to break ground not later than 2005 (an appropriate parcel has been identified). (In Chapter VI, we included a station at this location among several alternative-planning scenarios for the East region of Wake County; because there is too little response capacity at present along the eastern border of the County, and the activity there is likely to increase.) This station would serve the eastern portion of Garner – an area that is currently underserved. The County has developed a prototype for fire station design for future fire stations, and that design would be acceptable to the GFD for the new station.

[88] The highway planners should consider the possibility of putting a private service ramp only for emergency vehicle use on one side of the Interstate. This ramp could connect to the back lot of Garner Station 2. On many interstates private service ramps are used for highway maintenance facilities, police barracks. They are marked "For Authorized Vehicles Only."

The GFD has also identified a possible need to relocate Station 2 when I-540 is built. This may need to be done to preserve response capacity on the other side of the Interstate and so that volunteers will be able to come from home directly to the fire station. As noted above, it is not clear when the highway will be built.

Garner Emergency Medical Service (South region)

CURRENT STATUS

Garner EMS (GEMS) responds to a total of approximately 4,200 calls per year with five ambulances, a rescue squad, three boats, and a support vehicle out of its single station on Vandora Springs Road. The GEMS has 98 personnel: 17 full-time paid, 25 part-time paid, and 56 volunteers. The Department has a budget of $1.1 million per year.

TABLE 61: GARNER EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	87	990 Vandora Springs	4 P M-F	2 P, volunteer	3M 2Mr	~4,200

AREA GROWTH PATTERNS

I-40 is slated to traverse the Garner area. The area of 10-10 Road has seen a lot of growth recently.

ANNEXATION IMPACT

Annexations by the Town of Garner have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

GEMS has been actively seeking land south of Garner for an additional station.

Swift Creek Fire Department (South region)

CURRENT STATUS

The Swift Creek Fire Department (SCFD) is not centrally located in its response district, but is well-located for response to major transportation arteries. The SCFD has 44 personnel: 12 part-time paid and 32 volunteers (of whom approximately 20 are active). Nights and weekends, the Department is fully reliant on volunteers. Though there is no formal overnight duty crew, some personnel sleep in the station, and the rest respond from home.

The SCFD protects a unique risk: a North Carolina State University property, which contains pesticides and a snake lab/research area. The Department has a small contract ($2,000 per year) with the University to protect the facility.

TABLE 62: SWIFT CREEK FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	27	6000 Holly Springs Rd.	4 P M-F	volunteer	1B 1E 1P 2T	416

AREA GROWTH PATTERNS

Although rural, part of the area served by the SCFD is growing and transitioning to a more suburban environment. Roadways are being improved, and new commercial structures (i.e., malls) are beginning to appear. This area is ripe for increased development as it is relatively well located for commutes to Raleigh and Cary/Research Triangle Park.

The SCFD also protects a large area of the Swift Creek watershed. Restrictions on building in the watershed means that much of the area will remain low density and will not be annexed.

ANNEXATION IMPACT

Annexation by the Town of Cary has increased growth and development in the area. The Cary town limits are pushing up against much of the area protected by the SCFD.

DEPARTMENT EXPANSION INTENTIONS

There has been discussion about building a station in the Yates Mill Pond Road/Olde South Road area. The SCFD would place a pumper-tanker at this proposed station because although the area is growing, it is still fairly rural and is not yet hydranted.

The Department would be willing to have a Cary EMS unit co-located in its station, provided the station were remodeled to accommodate the unit.

Fairview Fire Department (South region)

CURRENT STATUS

The Fairview Fire Department (FFD) operates two stations in the center-southern portion of the county. The Department runs about 750 calls per year. It has 66 personnel: one paid full-time, 20 paid part-time, and 45 volunteer (of whom about 30 are active).

Both of the Department's stations are fairly new. Station 1 was built in 2000, and Station 2 was built in 1990. Neither station has a bunkroom, but Station 1 could be retrofitted for sleeping quarters. The station was constructed to accommodate sleeping quarters in the future; however, due to restrictions of the septic system, the building cannot be approved for 24-hour occupancy. A new septic system would be needed.

TABLE 63: FAIRVIEW FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	20	4501 Ten-Ten Rd.	4 P M-F	volunteer	2P 3T	337
2	34	7401 Ten-Ten Rd.	3 P M-F	volunteer	2P 1T	406

AREA GROWTH PATTERNS

The area protected by the FFD has seen moderate growth over the past few years. Most of the present growth is off of Westlake Road (south of the two FFD stations), where a large subdivision is under construction. Additionally, two non-hydranted subdivisions are underway near Station 1 in the vicinity of Ten-Ten Road and Holly Springs Road.

Growth has also been occurring in the Cary extra-territorial jurisdiction. There has been almost no growth within the Swift Creek Watershed. Construction of a 300-unit subdivision near Arthur Pierce Road and Optimist Farm Road is also planned, but this subdivision will likely be annexed by the Town of Holly Springs.

ANNEXATION IMPACT

Although the FFD has slowly lost portions of its response area due to annexations by the Towns of Holly Springs and Cary, it has maintained its call volume because it has automatic and mutual aid agreements that make use of the FFD's exceptional rural water supply capabilities.

DEPARTMENT EXPANSION INTENTIONS

The Department does not have any expansion intentions at this time.

Apex Fire Department (West region)

CURRENT STATUS

The Apex Fire Department (AFD) currently has three stations in operation. The headquarters station, Station 3 (CID 44), was built in 2002.

The AFD is a combination volunteer-career fire department, which has 85 personnel: 16 full-time paid (including two administrative), 22 part-time paid, and 47 volunteers (about

half of whom are active). It has become increasingly difficult to rely on volunteers for 24/7 coverage. Stations 1 and 2 rely on volunteers for coverage on nights, weekends, and holidays. Accordingly, AFD requires that volunteers serve two duty shifts each month.

The AFD has endeavored to use a combination of ISO recommendations (1.5 mile engine company response radius) and demographic data as a basis for station location planning.

TABLE 64: APEX FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	4	210 N. Salem St.	3 P M-F	3 V	1T 1B 2E 1A	655
2	40	3045 N.Hill Holleman Rd.	3 P M-F	2 V	1B 2E 1T	46
3	44	736 Hunter Street	4 P, 2 P M-F	4 P	1E 1A 1B	959

AREA GROWTH PATTERNS

The Town of Apex is subject to a self-imposed growth cap of four percent per year. According to the Town Planning Department, the Town of Apex has been growing by just under four people per day for the last several years. The total potential population by build-out of approved residential units would bring the Apex population from 27,588 to 32,360. It is thought that most development will occur in town (i.e., the town getting more densely populated), and not in the west towards Chatham County.

A large (385 acre) tract in the triangle formed by US 1, NC 55, and the planned I-540 has been proposed as the site for a planned-unit development of approximately 1,500 multi-family units. A new subdivision with 125 single-family homes and 129 town homes is presently underway off of NC 55 just north of the planned I-540.

ANNEXATION IMPACT

Annexation in the Town of Apex is done only by petition. The Town has annexed a fair amount of land recently, but there is no consistent pattern or direction to the annexations.

Annexations by the Town of Apex will likely have little effect on the provision of fire service since the Apex Fire Department already protects the unincorporated areas surrounding the town.

DEPARTMENT EXPANSION INTENTIONS

The AFD would like to close Station 1 and build a new station elsewhere. This will not be possible for at least seven years, because under the terms of the agreement that merged the Apex Volunteer Fire Department into the Town of Apex, the AFD is contractually committed to keeping the former Apex Volunteer Fire Department headquarters, Station 1, open for the next seven years.

Students from the Durham Tech Fire Science Program are conducting a station location study for the AFD. The area of consideration for planning is everything within the Town of Apex and its extraterritorial jurisdiction. According to the Apex Fire Chief, the next AFD station will likely be built within five years, somewhere in the area between Jessie Drive, Bobbitt Road, and NC 55.

The Department believes there is a need to staff an additional station in the western portion of Apex, near intersection of Kelly Road and Olive Chapel Road. There are a number of large subdivisions in the area, and the construction of the Beaver Creek Commons at NC 55 and Route 64 will create future population and demand for service.

The AFD would also consider co-location options, but the details would have to be negotiated (e.g., ensuring an equitable and enforceable distribution of housework).

Apex Emergency Medical Service (West region)

CURRENT STATUS

Apex EMS is a combination paid-volunteer EMS agency with a total of 40 personnel: six full-time paid, 19 part-time paid, and 15 volunteers (100 percent of whom are active).

The Department operates out of a single building on Williams Street. This building is owned by Apex EMS, and has been renovated and expanded once since it was built.

TABLE 65: APEX EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	47	315 W. Williams St.	4 P	2 P, 2 V	2M, 1Mr	2,154

AREA GROWTH PATTERNS

The Town of Apex is subject to a self-imposed growth cap of four percent per year. According to the Town Planning Department, the Town of Apex has been growing by just under four people per day for the last several years. The total potential population by build-out of approved residential units would bring the Apex population from 27,588 to 32,360. It is thought that most development will occur in town (i.e., the town getting more densely populated), and not in the west towards Chatham County.

A large (385 acre) tract in the triangle formed by US 1, NC 55, and the planned I-540 has been proposed as the site for a planned-unit development of approximately 1,500 multi-family units. A new subdivision with 125 single-family homes and 129 town homes is presently underway off of NC 55 just north of the planned I-540.

ANNEXATION IMPACT

Annexations by the Town of Apex have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

Although the leadership of Apex EMS recognizes that the service could be better located for the future, it does not wish to be put into a new building by itself. There is the belief that Apex EMS could co-locate with Apex Fire Department if desired.

The Department would like to put a station at 10-10 Road and Penny Road. It maintains that co-locating with Fairview Fire Department (which is 2.2 miles from 10-10 Road and Penny Road) would place Apex EMS too far from most of its calls. Apex EMS might be able to co-locate with Cary Fire Department Station 6, which is only one mile from 10-10 Road and Penny Road.

Cary Fire Department (West region)

CURRENT STATUS

The Cary Fire Department is the second-biggest fire department in Wake County. Aside from Raleigh, it is the only department that has a 24-hour-a-day all-paid staff. The Department employs 216 full-time personnel and operates from six stations.

TABLE 66: CARY FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	N/A	1501 N Harrison Ave.	10 P	10 P	1E 1Er 1A	695
2	N/A	875 SE Maynard Rd.	8 P	8 P	1E 1S	1,065
3	N/A	1807 Kildaire Farm Rd.	10 P	10 P	1E 1A	1,268
4	N/A	1401 Old Apex Rd.	8 P	8 P	1E 1Er 1S	937
5	N/A	2101 High House Rd.	9 P	9 P	1E 1O	716
6	N/A	3609 Ten-Ten Rd.	9 P	9 P	1E 1O	200

AREA GROWTH PATTERNS

There has been rapid in-fill development accompanied by some road improvements between Cary and the Swift Creek area.

The Town of Cary has pursued a policy of encouraging new development to be located in the area where I-540 will intersect with NC 55. The Town Planning Office expects that this area, west of town, is where the majority of new growth will occur.

Growth is also expected to the south of town, in the area Kildaire Road, Optimist Farm Road, and 10-10 Road. The Town has built a new community center and a new park in that area in anticipation of the growth.

ANNEXATION IMPACT

The Town of Cary has a Resolution of Consideration for the annexation of a number of parcels of land. These annexations are primarily in-fill in nature and lie on the northern, southern, and western peripheries of the town. With the exception of one parcel south of I-40 (called "Area 11"), the annexation parcels are relatively small and should not significantly increase the demand for service.

DEPARTMENT EXPANSION INTENTIONS

The CFD has purchased a lot directly next door to the Morrisville Fire Department Station 3, on which it will build a new fire station to serve the western portions of the Town of Cary. The Department has funds budgeted for this project and intends to take occupancy of the station by August 2005. The Morrisville Fire Department currently protects this area under contract to the Town of Cary. The CFD said it does not consider the current Morrisville station to be an adequate structure for its future needs, thereby ruling out its purchase of that station from Morrisville.

Cary Emergency Medical Service (West region)

CURRENT STATUS

The Cary EMS (CEMS) Department has 47 personnel: 14 full-time paid (including two administrative personnel), 23 part-time paid, and 10 volunteers (all are active).

The CEMS leadership feels that its present station location is perfect for response within the Town of Cary. CEMS is has had a 24/7 unit co-located in Morrisville Station 2 on Chapel Hill Road since last year.

TABLE 67: CARY EMS DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	N/A	107 Medcon Ct.	2 P, 2 P or V	2 P, 2 P or V	2M 1Mr	4,991
2	42	10632 Chapel Hill Rd.	1 P, 1 P or V	1 P, 1 P or V	1M	N/A

Note: CEMS data are not separated by station, therefore no call volume is available for Station 2.

AREA GROWTH PATTERNS

There has been rapid in-fill development accompanied by some road improvements between Cary and the Swift Creek area.

The Town of Cary has pursued a policy of encouraging new development to be located in the area where I-540 will intersect with NC 55. The Town Planning Office expects that this area, west of town, is where the majority of new growth will occur.

Growth is also expected to the south of town, in the area Kildaire Road, Optimist Farm Road, and 10-10 Road. The Town has built a new community center and a new park in that area in anticipation of the growth.

ANNEXATION IMPACT

Annexations by the Town of Cary have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

CEMS has seen a slight increase in the EMS call volume in the area of Cary towards Swift Creek. The Department leadership predicts that it will need full-time EMS coverage in the Swift Creek area within five years. CEMS would probably seek, at least initially, to co-locate with Swift Creek Fire Department at its station on Tryon Road and Holly Springs Road.

The Department has been exploring purchasing land in the Morrisville area in order to build a second station to cover the Town's westward expansion.

Holly Springs Department of Public Safety (West region)

CURRENT STATUS

The Town of Holly Springs has a Department of Public Safety that provides fire suppression, law enforcement, and emergency medical service. As such, it is the only fire department in Wake County that also provides emergency medical service. The HSDPS has 31 personnel: 20 full-time paid, 6 part-time paid, and 15 volunteers (10 of whom are active). Fire suppression apparatus and ambulances are routinely staffed with a minimum complement of two personnel on each unit. When the HSDPS responds on a structural fire, HSDPS police officers also respond to fill the complement of firefighters required for an initial attack on the fire.

TABLE 68: HOLLY SPRINGS DEPARTMENT OF PUBLIC SAFETY DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	14	1140 Avent Ferry Rd.	4 P	2 P, volunteer	1P 1Pr	303
2	37	129 N. Main St.	6 P	6 P, volunteer	1E 1T 1M	353 + 672
2	N/A	800 blk Holly Spgs. Rd.	6 P	6 P, volunteer	1E 1T 1M	N/A

Note: Proposed stations shown in grey shading. Station 2 call volume is shown as fire calls + EMS calls.

AREA GROWTH PATTERNS

The Town of Holly Springs has seen enormous growth, with the population rising from 907 to over 14,000 in the last ten years.

ANNEXATION IMPACT

The Town of Holly Springs is aggressively annexing land in all directions except up NC 55 toward Apex, where the limits of the two towns already meet. This annexation will create increased demand for HSDPS as the annexed areas are presently being protected by the Fairview, Fuquay-Varina, and Apex Fire Departments (in order from greatest to least area covered). Much of the area to be annexed already has large-scale residential development in place (with subdivisions of 1,000 to 2,000 homes).

Annexations by the Town of Holly Springs will have little impact on the provision of fire suppression services because the Holly Springs Department of Public Safety is already protecting much of the area being annexed. To the extent that annexations add some area that has been previously protected by neighboring departments, the HSDPS fire suppression call volume may increase accordingly. However, it is unlikely to increase to the extent that it will become necessary for the HSDPS to add additional capacity beyond what it now has. The annexations will have no effect on the provision of emergency medical services since EMS response areas are not related to municipal limits.

DEPARTMENT EXPANSION INTENTIONS

The HSDPS has broken ground on a new two-bay station (modeled on the new Cary and Raleigh stations) in the 800 block (presently called the 10200 block as it has not yet been annexed) of Holly Springs Road. This new station is a replacement for the current Station 2 (on North Main Street).

The HSDPS recently bought a 55-foot telesquirt (articulating boom) that will be placed in service at Station 2 upon delivery.

The Department has discussed the possibility of jointly operating Apex Fire Department Station 2 (CID 40) at some point in the future. This would provide enhanced coverage in the areas near US 1 that the Town of Holly Springs intends to annex. Under this arrangement, HSDPS would provide personnel and the Apex Fire Department would provide the facilities and equipment. The station would be operated as HSDPS Station 3 or Apex Fire Department Station 2 (both CID 40).

Morrisville Fire Department (West region)

CURRENT STATUS

The Morrisville Fire Department protects an area bounded by the western county line, the Town of Cary, Research Triangle Park, and the Town of Apex. In FY2003, the Department responded to 873 calls from three stations. It has 50 personnel: 41 full-time paid, three part-time paid, and six volunteers (all of whom are active).

TABLE 69: MORRISVILLE FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	23	100 M'ville-Carpenter Rd.	4 P + 3 P M-F	4 P, volunteer	1E 1S	445
2	42	10632 Chapel Hill Rd.	5 P	5 P, volunteer	1A 1P	330
3	24	6804 Carpenter Fire Sta. Rd	3 P	3 P, volunteer	1P 2T	98

AREA GROWTH PATTERNS

The population of the Town of Morrisville has grown from 3,000 to 10,000 in the last five years. This growth has been concentrated largely within the town limits. There has also been some light growth outside of the corporate limits towards Chatham County.

ANNEXATION IMPACT

Because the Town of Morrisville is surrounded by the extra-territorial jurisdictions of its neighbors and the county line, there is no likelihood that it will annex any land in the future. The MFD is, however, affected by the annexations of the Town of Cary, which has expanded westward considerably in the recent past. The Town of Cary has purchased land next to Station 3 on which it intends to build a new fire station to serve recently annexed property (and future annexations).

DEPARTMENT EXPANSION INTENTIONS

The Department is currently planning a relocation of Station 1 approximately 1,500 feet from its present location to a new location on Town Hall Drive. This move will be made necessary by expansion of rail service on the train tracks in front of the station that will cut off the front ramp of Station 1. This move is slated to occur no later than June 2006.

The Department is interested in exploring the possibility of building a new station in Research Triangle Park and closing Station 3 when the Town of Cary opens its new fire station adjacent to Station 3. The land for this station would be donated by Cisco Corporation. This effort could be undertaken in partnership with the Parkwood Volunteer Fire Department in Durham County. An alternative suggestion was building a station in

the Breckenridge area and placing a mini-pumper with a three-person crew there for fast attack on residential fires. While these ideas merit consideration, they are probably not the most effective use of limited financial resources given the high degree of built-in fire protection (i.e., automatic sprinklers) present in Research Triangle Park.

Western Wake Fire Department (West region)

CURRENT STATUS

The Western Wake Fire Department (WWFD) provides service from two stations located wholly within incorporated municipalities.[89] The WWFD covers 41 of 95 "doughnut holes". In addition, WWFD is first-due to approximately 11 miles of interstate highway, the RBC Center parking lot, the Carter-Finley Stadium, the flea market, and the state fairgrounds. The Department ran 512 calls in FY2003, about 65 percent of which are medical in nature and 25 percent of which are for motor vehicle crashes.

The Department has approximately 40 volunteers, of whom 30 are active. Nighttime and weekend coverage at Station 1 is accomplished with an in-house duty crew of three volunteers. The Fire Chief reported that it can be difficult to get adequate volunteer coverage from Monday through Thursday nights.

The WWFD leadership noted that it provides a number of essential services beyond its first-response duties. First, it provides second-due response in both Raleigh and Cary fire districts. The Fire Chief said this is important because the back-up resources in the area are thin, and two simultaneous working fires in Raleigh will severely tax the fire response system. Second, the Department provides critical water supply in non-hydranted areas of Cary through its 2,600-gallon tanker and 1,000 gallon pumper. Third, the WWFD is well positioned for response on the interstate highways.

TABLE 70: WESTERN WAKE FIRE DEPARTMENT DEPLOYMENT AND DEMAND

Station	CID	Location	Daytime Staffing	Nighttime Staffing	Apparatus Complement	Call Volume
1	29	4021 District Dr.	3 P	3 V	3P 1T	512
2	19	329 E. Durham Rd.	3 P M-F	volunteer	1B 2P	512

Note: Both WWFD stations run together on every call, therefore their call volumes are identical.

AREA GROWTH PATTERNS

Growth is slow in the area now protected by the Western Wake Fire Department. There is not much available land, so most of the population growth is from in-fill development.

[89] Interestingly, the Department is not first-due to either of its two stations.

ANNEXATION IMPACT

The annexation plans of both Raleigh and Cary have had and continue to have considerable impact on the operations of the WWFD. Over the past 10 years, the WWFD has lost much of its response district to both municipalities. Currently, Cary intends to annex nine of the doughnut holes currently served by the WWFD by the end of June 2003, and it is considering annexing two additional doughnut holes. The City of Raleigh is also considering annexing a doughnut hole currently protected by the WWFD.

DEPARTMENT EXPANSION INTENTIONS

The Department did not express any intentions to expand beyond its current level of service. The WWFD would like to be utilized more by the City of Raleigh.

APPENDIX B. ORIGINAL INCIDENT DATA BY DEPARTMENT

This data was provided early in the project and was used to proiections. The corrected data table was given in the text in Chapter III. The trends per capita and total calls of the converted table were slightly higher than data here. Again, as noted in the text, the quality of data needs to be improved.

TABLE 71: HISTORIC FIRE DEPARTMENT CALL VOLUME (FY1995 – FY2003)

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03
Apex	652	860	1,241	1,205	439	188	1,762	1,849	1,542
Bayleaf	360	389	501	480	531	501	553	459	860
Cary	2,609	2,990	3,894	3,534	3,670	3,785	4,470	4,634	4,881
Durham Highway	493	490	659	645	701	438	396	265	435
Eastern Wake	419	491	666	902	642	1,255	1,402	1,287	1,200
Fairview	513	577	824	717	725	749	748	710	648
Falls	160	153	211	205	194	148	115	138	330
Fuquay-Varina	450	555	819	691	183	1,839	2,044	2,100	2,469
Garner	870	997	1,406	1,346	942	2,479	3,177	3,053	3,565
Holly Springs	125	107	471	472	152	517	559	554	656
Hopkins	98	225	291	199	247	210	255	246	305
Knightdale DPS	–	–	–	–	–	–	–	2	586
Morrisville	396	446	582	638	252	290	252	843	806
Rolesville	177	218	354	296	300	380	531	519	720
Six Forks	149	130	94	208	225	177	220	149	–
Stony Hill	172	173	225	185	223	277	351	274	350
Swift Creek	338	497	605	472	452	322	342	322	408
Wake Forest	329	386	447	451	452	498	609	1,177	1,430
Wake-New Hope	1,092	1,078	1,176	1,070	1,335	785	700	687	836
Wendell	367	400	594	601	651	1,065	1,096	1,073	1,280
Western Wake	406	437	920	583	489	274	278	225	118
Zebulon	126	142	216	213	206	582	569	496	598
Total	**10,301**	**11,741**	**16,196**	**15,113**	**13,011**	**16,759**	**20,429**	**21,062**	**24,023**
Per Capita	**0.0197**	**0.0223**	**0.0294**	**0.0262**	**0.0217**	**0.0268**	**0.0315**	**0.0313**	**0.0344**

Source: Wake County Department of Public Safety. This includes all calls the fire departments went on, including EMS. There was a change in dispatch policy which led to sending fire units on EMS calls in the past few years, causing sharp jumps in total calls in some departments.