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## 1.0 EXECUTIVE SUMMARY

L. Robert Kimball & Associates, Inc. and 9-1-1 SME Consulting have performed a PSAP Staffing Survey and Analysis Study for the National Emergency Number Association (NENA) SWAT Team Operations Group. The objectives of the study were to develop staffing and budget models from data collected from existing PSAPs with which those approximately 432 counties in the United States without Enhanced 9-1-1 can project staffing and associated budgetary needs to implement Enhanced 9-1-1 service. This report presents the findings of the study and the guidelines for optimizing the use of the data.

The premise on which the study was developed was that no one method for determining staffing needs would suffice given the number of influencing factors, both local and industry imposed. Thus, by combining two techniques, a rational approach and an empirical approach, there is a check on each to increase the robustness of the recommendations created.

The Scope of Work for the study included six primary tasks. These were:

1. Define PSAP profiles
2. Review NENA-developed databases
  - a. DOT Project
  - b. PSAP Registry
3. Define specific PSAPs to be surveyed
4. Collect data
5. Determine staffing requirements based on call volume
6. Analyze the collected data and create staffing and budget models

In a SWAT Operations Group meeting held April 5, 2003, the survey tool and study objectives were refined and approved.

It was evident early in the study that the desired number of completed surveys and the required profile-specific PSAPs would be slow in being returned or not forthcoming at all. Numerous attempts were made to gather the data from the necessary PSAPs. Additionally, little data relevant to this study could be gleaned from the existing NENA-developed databases.

The result of the limited number of completed surveys caused a modification of desired goals in that the influence of specific factors on call processing could not be validated to the degree intended by the study. These factors included customer premises equipment (CPE) technology level, the presence of four lane highways within 9-1-1 service areas, and the number of wireless subscribers.

### Summary

This study was designed to collect information on PSAP Staffing for those jurisdictions with populations up to 140,000 and to analyze it to determine the level of staffing required by the major factors that may affect how many persons should be employed in what tasks. Key to the study was determining the extent to which each factor may affect the number of personnel required.

The study specifically collected information and reports on the following factors:

1. Population
2. Four-lane Highway Mileage
3. Number of Wireless Subscribers
4. Population Density
5. Level of CPE expected to be installed

It was thought that all of the above would affect the PSAP staffing based on their effect on how they would influence 9-1-1 and 7/10-digit emergency call volume. Thus, call volume was collected to compare to each of the above factors to validate the factor as an influencer of call volume and thus of PSAP staffing requirements.

To provide the best recommendation, the PSAP categories were divided into three population sizes as determined by PSAP Staffing characteristics defined by the NENA SWAT Team:

1. 0 – 19,000 population
2. 19,000 to 100,000 population
3. 100,000 to 140,000 population

Additionally, since a factor that might influence PSAP staffing would be the level of CPE automation, seven CPE levels were defined (See PSAP Data Sources below for details.), so that there were a total of 21 categories of operation (Three by population times seven by CPE level.). We sought three examples of each category, for a target number of 63 completed PSAP surveys.

The information was gathered by requesting PSAP managers to complete an electronic copy of a PSAP Staffing Study that was both emailed to prospective PSAPs and made available on the NENA web site for downloading. More than 500 surveys were sent to targeted PSAPs and extensive advertising and promotion were done via NENA, Dispatch Monthly News Hound and the National Academies of Emergency Dispatchers talk list.

Additional information about the PSAPs and jurisdictions were obtained by other means. The NENA/DOT Survey and phone calls to PSAPs provided CPE information. Microsoft Streets & Trips® provided four-lane highway miles. The U.S. Census Bureau provided verification of questionable populations and square miles within jurisdictions. A man-hours survey was sent to PSAP Manager who had provided PSAP staffing survey inputs to document the number of hours a year a telecommunicator works for PSAPs of these three sizes.

Although 70 qualified PSAP surveys were received, they did not provide information on each category, so that the PSAP staffing requirements as affected by the level of CPE could not be determined. However, the data did provide sufficient information for other conclusions.

There were two different philosophical approaches used in this analysis to better support the resulting guidance.

1. Rational Approach. This method is based on applying theory to source data. Here, the staffing levels are determined upon call volume, call duration time and queuing theory. The results were close to the actual staffing for those PSAPs that reported all the information.



**Result:** If call volume can be determined, then the number of call-takers required can be determined with good accuracy.

2. **Empirical Approach.** This method is based on observation of similar cases. By noting staffing requirements in jurisdictions that have similar characteristics to one's own jurisdiction, one may assume that similar staffing will be required.

**Result:** Where all inputs were used, the ranges of staff requirements varied so significantly that the only factor that showed good correlation to staffing was the jurisdiction's population. Even there, some factors (for example, the approximately 20 hotels and 20 large office buildings in Agency A1, created a 9-1-1 volume far in excess of what its residential population of 4,224 persons would indicate.) showed that for these office- and hotel-dense areas, that the day-time population must be used – the correlation with day-time population (versus residential) was good in the three examples in this study.

However, none of the other factors (highway mileage, wireless subscribers, population density) could be seen as having an effect. For example, among the PSAPs reporting, there were pairs that were within a few percentage points of call volume per capita yet one had high highway mileage, the other had low. An attempt to do cross-correlation (i.e., show how multiple affecting factors influenced the call volume) yielded no cross-correlation among these three factors.

Thus, the major conclusions of this report are:

1. To predict call volume, additional potentially influencing factors must be considered.
2. True cross-correlation calculations require more examples. If additional work in this area were to be done, good data from at least 150 PSAPs would be required. In this study, owing to not all data being available from all 70 PSAPs, the correlation work was done on 20 to 70 PSAPs. Additionally, of the surveys received, we need a greater percentage of answers in the key areas. For this survey, the following table shows the percent of respondents (of the 70 qualified surveys) that had provided information in each key category.



Category	# Respondents	Percent
Square Miles*	70	100%
Population*	70	100%
Highway Mileage**	70	100%
Operations Personnel	68	97%
Wireline 9-1-1 Calls	67	96%
DBA or GIS Personnel	65	93%
Dispatched calls	59	84%
Operations Budget	58	83%
Wireless 9-1-1 Calls	57	81%
Call durations	53	76%
Customer Premises Equip Level	51	73%
DBA or GIS Budget	33	47%
Wireless Subscribers	20	29%

\*Number of Respondents was not 70, but 9-1-1 SME Consulting research closed gap.

\*\*Highway mileage all done by 9-1-1 SME Consulting.

#### **Table 1-Percent of Data Requested**

3. The data that was obtained was sufficient for general PSAP staffing recommendations based on population and modified slightly for mapping & addressing and call taking attitude factors for each of the three PSAP sizes.

In sum, this report provides two good bases for establishing the number of call-takers at a PSAP, a method to provide support staff, an example of overall budget planning by PSAP size and statistics to provide benchmarks for call taking and costs.

#### Guidelines

Therefore, this study has produced PSAP staffing guidelines based on averages from the reliable data obtained from each PSAP size category. The recommendations are provided in this document in the **RESULTS** section:

1. Call-taker staffing based on call volumes, call durations and queuing theory.
2. Call-taker and support personnel staffing based on sample PSAPs in three jurisdiction sizes.
3. Operations and support budget based on sample PSAPs in three jurisdiction sizes.

Thus, the primary goal of this project to provide guidance to the PSAP manager in making staffing decisions has been met with the production of the “PSAP Staffing Guidelines,” which are both provided below in the body of this document and as a stand-alone Excel document that is proposed for listing on the NENA web site. This “PSAP Staffing Guidelines” guides the PSAP manager to enter call volumes, call durations and information about the jurisdiction to provide recommended staffing.

Up to now, PSAP managers had to rely on call center data for planning staffing even though

9-1-1 has some unique characteristics. They also had to do their own research and try to fit their data into the formulas.

Now with the PSAP Staffing Guidelines, the PSAP manager has an easy-to-use and fairly solid basis for planning operations and support staff customized for the unique aspects of 9-1-1. This also provides a basis for reviewing current PSAP staffing as a check to ensure PSAP manning is sufficient to meet the emergency response needs of the community.

### PSAP Statistics

Additionally, several PSAP statistics were calculated for the three PSAP sizes. These included:

1. Cost per call received
2. Cost per dispatch
3. Budget for Operations Staff
4. Budget for Administrative and Technical Staff
5. Number of Calls and Dispatches per Operating Staff
6. Comparison of Call Duration based on level of CPE

### Next Steps

Yet, the work here actually highlights that further work is needed and defines that work.

### Issues

1. The data was not sufficient to get better than a good correlation based on population. PSAP managers know that there are numerous factors that influence call volume, yet the data from this study was not sufficient to determine them. NENA Western Region Vice President Bill McMurray provided the following comment on the Interim Report in his letter of May 31, 2003:

“I recognize that there is a value in a standardized formula in determining appropriate funding, but as you have found, it cannot be based on the simplistic value average busiest hour, or even population. Rather I believe there are a variety of factors of varying weight that ought to be considered.

“I call this concept, ‘PSAP Profile’, or better stated for the purposes the kind of report you are preparing, a ‘Community Profile’.”

Bill goes on to list the following factors that he recommends be considered in any PSAP Staffing Guideline:

- a. Community Demographics (rural, suburban, urban, metropolitan, etc.)
- b. Discipline Configuration (dispatch just police, or police and fire, or, etc.)
- c. Population Directly Served
- d. Population Indirectly Served
- e. Seasonal High-Visitor Counts



From the conversations and data obtained in researching for this report, the following factors are recommended:

- a. Crime rate
- b. Attitude towards calling the PSAP (whether via 9-1-1 or 7-/10-digit number) and the PSAP's acceptance of these calls. For example, a county where it is acceptable for a child to call the PSAP to learn if school has been closed on account of snow will have significantly higher call volume than PSAPs that will respond only to emergency calls. In another example, a PSAP that also serves as call-taker for municipal utilities will have a higher call volume than one that doesn't take these calls, all other factors remaining equal.
- c. Demographics of the surrounding jurisdictions. The aspects of these will spill over into the target PSAP to some degree.
- d. Does the CPE allow the call-taker to take the next call immediately after hanging up from a call? Some CPE require a few seconds for the integrated CAD to generate files at the conclusion of the call before another call can be answered.

Additionally, in a meeting 9-1-1 SME Consulting had with the 9-1-1 Director of Steuben County, NY (previously the number three person in the Rochester, NY, PSAP), it was learned that weather has a major effect on call volume. We propose to include this.

Thus, there are other factors that should be considered.

2. A key data set is wireless 9-1-1 call volume. With only 20 PSAPs being able to provide this, the information was of no value in determining correlations. The problem was two-fold: (a) Most PSAPs did not have the information, (b) A few of the PSAPs that had the information stated that they could not provide it owing to the Non-Disclosure Agreements they'd signed. Thus, it appears that if the impact of this call volume is to be understood, we should get it from the wireless carriers themselves through a direct approach to them. Working this issue from the top down (i.e., via wireless carrier reps that are already working with NENA) may produce the information we need.
3. There is a need for PSAP Staffing Standards for PSAPs that serve more than 140,000 people, have Automatic Call Distribution and have separate call-takers and dispatchers. Documentation of this need comes from emails posted on NENA's list server and the APCO Project (40) Report that recommends that standard methodologies be used to determine staffing levels, but has no actual recommendation as to a methodology.

The results of this project provide an excellent basis for filling in the gaps to create the definitive PSAP Staffing Standard that would also meet the needs of larger PSAPs and those with Automatic Call Distribution.

#### What we have:

1. Inputs from 76 PSAPs, although data was incomplete with several and six PSAPs were outside our target groups (i.e., were either too large or were airports).
2. Established relationships between the L. Robert Kimball – 9-1-1 SME Consulting team and the PSAP managers who have participated.
3. An understanding of the issues that goes beyond what has been previously published for PSAPs.



What we need:

1. Additional completed surveys, to include larger PSAPs.
2. Additional information about the PSAPs, which is listed along with the recommended sources in the following Table 2.

<b>Data Required</b>	<b>Source</b>	
	<b>PSAP</b>	<b>Other</b>
Crime Rate		FBI Statistics
Attitude towards callers	X	
Emergency Response Agencies Served	X	
Demographics of Jurisdiction		US Census Bureau
Demographics of Surrounding Jurisdictions		US Census Bureau
Modifier for Seasonal Population Variances	X	
Weather Patterns	X	Weather Bureau
Wireless 9-1-1 Call Volume		Wireless Carriers
Additional CPE Level understanding	X	

**Table 2-DATA REQUIRED**

3. Obtaining the “Wireless 9-1-1 Call Volume” will require a new approach. Since it is so difficult to obtain this from the PSAP managers, the wireless carriers should be contacted directly by NENA to provide the data. An NDA is acceptable with the actual numbers not shown in a report, just the needed correlation factor.

Conclusion

Thus, L. Robert Kimball & Associates and 9-1-1 SME Consulting consider that they have met the requirements of the survey to the extent data and available time permitted. In addition to the Guidelines provided below, we offer NENA the option of continuing the effort to develop the complete PSAP Staffing Guide.

Feedback on this report is welcomed. Send comments and critiques to:

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## 2.0 OBTAINING PSAP DATA

### 2.1 SELECTING PSAP DATA CATEGORIES

The project plan was to obtain data in three categories of PSAP sizes based on the populations of the jurisdictions served. The sizes were derived from an early SWAT Technical Team study that delineated PSAPs based on staff structure. The SWAT Team sizes do continue to include larger PSAPs, but those are outside the scope of this study.

1. Small PSAPs – Often have the PSAP manager working as a telecommunicator. (Or you could look at it the other way around – They assigned one of the telecommunicators to do PSAP management functions.). Usually only one call-taker/dispatcher on duty most of time. Population: 0 to 19,000.
2. Medium PSAPs – Have a dedicated PSAP manager who does all the support work. Minimal call volume times will have one call-taker/dispatcher on duty, but have significant periods where two persons are on duty. Population: 19,001 to 100,000.
3. Large PSAPs – Have a dedicated PSAP manager and one or two full-time support personnel such as an administrative assistant/assistant manager, database manager and/or training supervisor. Normally have two to three call-takers/dispatchers on duty. May have one call-taker and two dedicated dispatchers, one for police, other for fire and EMS. Population: 100,001 to 140,000.

We all know that PSAP staffing varies widely, so a staffing recommendation must take into account the key factors that influence the staffing requirements. One factor is the level to which automated CPE can assist the telecommunicator. Thus, we planned to assess PSAPs based on the following seven levels of automation:

- Manual call processing
- Computer-based telephony, no Map display
- Computer-based telephony and Map display only
- Computer-based telephony, Map display and CAD
- Primary PSAP serving Secondary PSAPs with ALI display only (e.g., monitor or printer)
- Primary PSAP serving Secondary PSAPs with computer-based telephony and Map display only
- Primary PSAP serving Secondary PSAPs with computer-based telephony, Map display and CAD

**Table 3** below shows the several sources of data for this survey. While it would be convenient and efficient for the survey team to receive all the data it needed via the primary instrument, the “PSAP Staffing Survey,” that would not be likely and might well, by the additional length of the survey, discourage PSAP managers from filling it out, thereby reducing the number of surveys received. Therefore, some of the data was collected by either a short secondary survey to just those PSAP managers who had replied (the Man-hours Survey), by follow-up phone call, or standard reference (Microsoft Streets & Trips®). Additionally, where the population and/or square miles area of the jurisdiction did not appear to be correct, the U.S. Census Bureau’s web site was used to obtain the information (<http://www.census.gov/main/www/cen2000.html>).



**PSAP STAFFING GUIDELINES REPORT  
AS COMMISSIONED BY  
NENA SWAT OPERATIONS TEAM**

**9-1-1 SME  
Consulting**

Sources of Data Used in this Report

Legend

P – Primary method of obtaining data  
S – Secondary or backup method

<b>Information Sought</b>	<b>Source</b>				
	<b>PSAP Survey</b>	<b>Phone Call</b>	<b>Man-hours Survey</b>	<b>Microsoft Streets &amp; Trips®</b>	<b>U.S. Census Bureau</b>
Agency name and address	P	S			
Contact name title, e-mail and phone numbers	P	S			
Jurisdiction(s) served (Note only one Primary PSAP per survey)	P	S			
9-1-1 service level (i.e., Basic, Enhanced, Phase I, Phase II)	P				
Square miles in jurisdiction	P				S
Population of jurisdiction	P	S			S
Day-time population served	P	S			
Number in incoming trunks	P				
Number of wireless subscribers	P				
Primary PSAP names, call and dispatch responsibilities	P				
Secondary PSAP names, jurisdictions and dispatch responsibilities	P				
How call statistics were determined	P	S			
9-1-1 call volume by wireline and wireless	P	S			
7-/10-digit emergency services number call volume	P	S			
Dispatches by police, fire and EMS per Primary and Secondary PSAP	P	S			
Call duration times	P	S			
Staff budgeted (number of persons per task)	P	S			
Man-hours work per year per telecommunicator			P		
Budget for Operations and Support Personnel	P	S			
CPE level (e.g., map display?)		P			
Highways in jurisdiction and their mileage.				P	

**Table 3-Source of Data**



L. Robert Kimball & Associates  
Architects and Engineers

**PSAP STAFFING GUIDELINES REPORT  
AS COMMISSIONED BY  
NENA SWAT OPERATIONS TEAM**

**9-1-1 SME  
Consulting**

The PSAP Staffing Survey is provided as **Appendix A**.  
The Man-hours Survey is provided as **Appendix B**.



## 2.2 DETERMINING NUMBER OF SURVEYS REQUIRED

With each of the three PSAP sizes (small = 0 – 19,000, medium = 19K –100K, large = 100K-140K) being assessed for each of the above seven levels of automation we have a matrix of 21 PSAP size and automation categories.

In research, validity improves with the increase in the number of examples. However, cost also increases. With 21 categories, that would demand a large number of examples. Yet, since all surveys could be used to answer some questions, it was not felt that we needed, for example, 20 PSAP surveys for each category. We (NENA SWAT Operations Team, L. Robert Kimball & Associates and 9-1-1 SME Consulting) set the balance of validity vs. cost to be three examples of each category for a total of 63 PSAPs.

The effort to obtain sufficient PSAP responses started with a request to NENA Regional Vice Presidents for their PSAP recommendations. When the PSAP contacts were received, PSAP Staffing Surveys were sent to them via e-mail. However, this did not produce the desired number of responses, so publicity and promotions were initiated throughout the collection period. The subsequent efforts to obtain sufficient PSAP responses were:

1. Request to President of NASNA (National Association of State Nine-One-One Administrators) for their help.
2. Posted survey on NENA web site for more than a month.
3. Posted on NENA talk list, twice.
4. Posted on NAED (National Academies of Emergency Dispatchers) talk list, four times.
5. E-mail request sent twice to Dispatch Monthly magazine's News Hound list.
6. E-mail request sent to "All NENA Members."

As of our last day of collecting data prior to working on this report (May 30, 2003), the following numbers of PSAPs by category had provided their data. The definition of each CPE Category is by the equipment in the PSAP and is indicated in the below **Table 4** by an X in the heading. Please note that the DOT/NENA database was used to determine the below categories.

CPE Category	1	2	3	Not used	4	5	6	7	No CPE Info
Secondary PSAP						X	X	X	
Computer-Based Telephony*	X	X	X	X	X	X	X		
Map Display		X		X		X	X		
CAD				X	X			X	
PSAP Population	Number								
0 to 19K	19	0	6	6	0	0			7
19K - 100K	40	0	7	18	1	8			6
100K 0- 140K	11	0	1	5	1	4			0
>140K	4								4
Airport	2								2
Total . . .	76	0	14	29	2	12	0	0	19
Qualified	70								

\*If not checked, then only manual (electro-mechanical) CPE is installed.

**Table 4 -CPE Level by PSAP Size**



On the data availability and usefulness:

1. PSAP Staffing Surveys – The 76 PSAP Staffing Surveys exceeded our target number of 63, but only 70 fit our target categories and we did not reach the goal of 21 PSAPs in the small and large PSAP categories. This affected the ability of the data assessment to provide validity to conclusions within these PSAP sizes. However, since there are sufficient PSAPs for the medium sizes, the conclusions drawn there have good validity. The overall number of 70 valid PSAP Staffing Surveys enables conclusions to be drawn in PSAP staffing issues that use the entire data set with excellent validity. The majority of the surveys returned had missing data or numbers placed in the wrong location (e.g., dollar amounts in the table requesting number of persons assigned) requiring the survey to be returned with a request for the additional info or clarification. Many surveys were followed up with phone calls to further improve on understanding the data.
2. Follow-up phone calls – In order to keep the PSAP Staffing Surveys from being dauntingly large to where PSAP managers would be discouraged from attempting to fill it out, some key data was requested via second survey or telephone call to the PSAP manager. As many PSAPs as could be contacted were asked to define their CPE, whether they have map display capability and Computer-Aided Dispatch.
3. Man-hours Survey – A critical data element in estimating PSAP Staffing is knowing how many hours of work a telecommunicator can be expected to provide in a year. Research on some previous studies indicated 1,575 to 1,877 hours. Therefore a second survey was sent to just the PSAPs that had provided a PSAP Staffing Survey to ask how many hours each year was the average telecommunicator off for holidays, personal days, training, sick, etc. Thirty-three PSAPs reported, providing a good basis for this document. Results of this survey are provided in the Rational Approach section. See **Appendix B** for the Man-hours Survey.
4. Highway mileage – The ease with which the “measure distance” tool can be used in Microsoft Street & Trips® to obtain highway mileage made the use of this software program the most efficient way to obtain the data. Also, the mileage could be captured as four-line divided limited-access highways and as standard highways to see if the individual or combined mileages were factors.
5. U.S. Census Bureau – Most surveys were submitted with what appeared to be accurate population and square mile area information. However, when one PSAP listed its area as 150,000 square miles and other PSAP managers provided round numbers, the U.S. Census Bureau was checked and the numbers for the populations estimated for 2001 were used. (The PSAP with the 150,000 square miles served five counties, but the total area of the five counties was 11,487 square miles.)

With the data collected, the following sections report the assessment of the data, conclusions and PSAP Staffing Recommendations.

## 3.0 RESULTS

### 3.1 PSAP STAFFING GUIDELINES

#### PSAP Staffing Guidelines for Primary PSAPs serving populations of fewer than 140,000

This provides operational and support-staffing recommendations based on either known call volume or upon parameters of the jurisdiction. The two will produce slightly different results primarily because the method that is based on jurisdiction parameters does not take into account all parameters that influence call volume. If there is a choice, use the call volume basis as that, by virtue of resulting from the sum effects of all the influencing parameters, will be more realistic.

Both methods are based on formulas in the Excel spreadsheet version (separate document) that will take data you enter. Thus some data gathering for each method is required.

A separate worksheet is used for each:

1. Call Volume – Staff recommendations based on call volume.
2. PSAP Compare – Staff recommendations based on PSAPs with similar characteristics.

Finally, a third worksheet, "Budget", is provided to show what PSAPs of similar size are budgeting for their Operations.

### 3.2 STAFFING BASED ON CALL VOLUME

Call volumes should be based on the Average Bouncing Busy Hour (ABBH) as measured during a minimum of a 14-day period during the busiest time of the year for 9-1-1 calls. The formulas are not set up for a PSAP that uses automatic call distribution.

#### Preferred Sources of Call Volumes (in descending order)

1. Offered calls from the 9-1-1 control office (AKA 9-1-1 selective router, 9-1-1 tandem). This is a count of calls attempted to be routed to the PSAP or call centers currently accepting 9-1-1 calls that will be a part of the new PSAP's call volume. This may also be tracked for 7-/10-digit emergency calls if the serving central office can track these.
2. Accepted calls arriving at PSAP or call centers currently accepting 9-1-1 and/or 7-/10-digit calls. This does not count the lost calls that occurred when all call-takers were busy.

#### Calculating ABBH and "Normal Hour" call volumes (applies to Offered and Accepted Calls)

1. Select either the "Offered Calls" or "Accepted Calls" method and follow the steps below.
2. Collect Data:
  - a. Plot hourly call volume over a minimum of 14 days during the busiest time of the year for the following categories of calls:
    - (1) 9-1-1 calls (Those coming in over dedicated 9-1-1 circuits.)

- (2) 7-/10-digit emergency number calls (Those coming in over the Public Switched Telephone Network to 7-/10-digit emergency numbers or admin lines that are answered by the call-taker.)
  - (3) Pre-Arrival Instruction Dispatch (These are actually dispatches but have to be counted as they extend the call duration significantly. The "call duration" used is an estimate of how much time the PAI and staying on the line with the caller will take. Thus, this can only be in the "Accepted" category.) If PAI is not used, leave this line blank.
- b. If the PSAP will provide Pre-Arrival Instruction (PAI), also track the number of calls dispatched. This will be noted separately from the call volume.
3. Sum the 9-1-1 and 7-/10-digit calls in each hour to get a total of all calls received during each hour of the monitoring period.
  4. Take the average of the busiest hour of each day for the sum of these calls. This becomes the "Average Bouncing Busy Hour" or ABBH.
  5. Determine the characteristics of the "Busy Hour Shift." Look at the hourly call volumes before and after the ABBH to select an eight-hour period that has the most calls (The period must include the ABBH.). This will be the "Busy Hour Shift." Note these hours.
  6. Take the highest hourly call volume of the remaining hours of the day. This is the "Normal Hour" upon which manning for a "Normal Hour Shift" will be based.
  7. Put the "ABBH" and "Normal Hour" call volumes into the column in the below table that reflects the method you chose ("Offered Calls" or "Accepted Calls"). The different columns calculate the using different queuing theories, although they produce nearly the same result. It is expected that the ABBH and Normal Hour call volumes will be decimals (e.g., 4.3, 2.5), which are entered below as examples.
  8. For the ABBH and "Normal Hour", look at the PAI dispatches (again, this applies only if PAI is used) and note the number of dispatches for each hour. Enter them in the table below.

#### Determining Call Duration

The call duration must also be determined for each category of calls. The duration is the time in seconds from first ring to dispatch and call termination as this captures the telecommunicator's time. If you do not have call durations, use the following numbers (Call duration must be in seconds.):

- 9-1-1 and 7-/10-digit calls = 95 seconds
- PAI dispatch = 400 seconds

Enter data in the yellow highlighted cells in the Data Entry Table below.

#### Data Entry Table

Enter call volume in “Offered” or “Accepted for each line, not both.

Call Volume Category	ABBH Call Volume		Normal Hour Call Volume		Call Duration
	Offered	Accepted	Offered	Accepted	
9-1-1 Calls	4.3	0	0	2.4	95
7-/10-digit emergency #	0	3.6	0	3.1	95
PAI dispatches*	N/A	0	N/A	0	400

\*Leave blank if Pre-Arrival Instructions are not provided. The "9-1-1 calls" will cover this.

NOTE: The PAI dispatches aspect was later decided to be an unnecessary complication for the final PSAP Staffing Guideline Worksheet and so is omitted from it. This PAI aspect remains here for those who would like to use it.

The above calls equate to approximately 55,188 calls per year. Calculated via multiplying (1/3<sup>rd</sup> times sum of ABBH call volumes plus 2/3rds sum of Normal call volumes) x 24 hours x 365 days.

Determine Hours of Work Per Year to be Obtained from Each Call-taker

Enter number of days off per category in table below (highlighted cells).

Days in year	365
<b>Less Days Off:</b>	
Weekends (i.e., 2 days per 52 weeks)	104
Paid Holidays Off	10
Vacation	5
Personal Days off	3
Training	5
Conference	2
Sick	5
<b>Total Days off per Year</b>	<b>134</b>

Days available to work	231
If work eight hours per day	x 8
Hours available to work	1848
<b>Manning Ratio*</b> (Hours in Year/Hours Available)	<b>4.74</b>

\*Manning Ratio - How many persons must be hired to keep one position manned 24 x 7. It is calculated by dividing the number of hours in a year (8,760) by the number of hours a call-taker is available to work at a position (for PSAPs reporting in this study, that is 1,848).

#### **Table 5-PSAP Data Entry Tables**

Calculations for Staff based on above inputs and P.01 Grade of Service

<b>Call Volume Category</b>	<b>Erlangs</b>			
	<b>Busy Hour Shift</b>		<b>Normal Hour Shift</b>	
<b>Offered</b>	<b>Accepted</b>	<b>Offered</b>	<b>Accepted</b>	
9-1-1 calls	0.113	0.000	0.000	0.063
7-/10-digit emergency #	0.000	0.095	0.000	0.082
PAI dispatches*	N/A	0.000	N/A	0.000
Total Erlangs	0.113	0.095	0.000	0.145
Total Erlangs per Shift . . .	0.208	3	2	0.145
Call-takers required per shift . . .				
Number of shifts per day . . .	1			
Total Call-takers on watch in typical day . . . . .				7
Manning Ratio . . .				4.74
<b>Total Call-takers required to man 24 x 7 . . . . .</b>				<b>33.2</b>

**Table 6-Calculations for Staff Based on Inputs**

The **Total Call-takers required to man 24 x 7** above is the result based on the example inputs on the previous page. To calculate your inputs, the document **PSAP Staffing Guidelines** (Appendix D, an Excel spreadsheet) is provided.

In **Table 7** below, for a given number of Erlangs (rows 1, 2 or 3), the following number of call-takers (row 4) are required. In this document, Extended Erlang B is used for Offered Call Volume and Poisson is used for Accepted Call Volume. Erlang B is not used in PSAP queuing owing to the absence of the allowance for redialing (which happens with 9-1-1 calls) and is shown just for comparison.

#### Lookup Table for Required Telecommunicators

For a Given Number of Erlangs (rows 1, 2 or 3), the number of servers required are shown below (row 4).

Extended Erlang B	0.000	0.011	0.152	0.452	0.863	1.350	1.893	2.480
Erlang B	0.000	0.011	0.153	0.456	0.870	1.361	1.910	2.510
Poisson	0.000	0.010	0.150	0.450	0.850	1.300	1.800	2.350
Servers	1	2	3	4	5	6	7	8

**Table 7-Lookup table (Erlangs to Required Call-takers)**

#### Reasoning for choice of Extended Erlang B:

This queuing theory was specifically created to account for call volumes where if the caller was blocked, then at least 85% of the time the caller immediately redials. This is the situation of a person seeking emergency help.

#### Why Erlang B was not selected:

This mathematically represents the situation where if a caller is blocked, the caller will wait some time before redialing.

**Why Poisson was not selected:**

Poisson has been criticized in use in telecommunications because it mathematically assumes that if a call attempt is not successful that the time until it is accepted is counted as "calling time." Of course in reality, there is no communication during that period, so the method is not realistic.

**Why all three are shown:**

Just to highlight the point that there is not much difference among them at these levels of call volumes.

### 3.3 STAFFING BASED ON COMPARISON WITH SIMILAR PSAPS

During the spring of 2003, 70 PSAPs were sampled to determine their call volume, staffing and what factor may have influenced their staffing requirements. In this section you will be asked a few questions about your jurisdiction which will lead to your filling out data tables and coming to a staffing recommendation. The recommendations are based on the staffing of the surveyed PSAP that had similar characteristics.

First, determine your jurisdiction's population.

- If less than 19,000, you will plan with the "Small PSAP" size.
- If between 19,000 and 100,000, you will plan with the "Medium PSAP" size.
- If between 100,000 and 140,000, you will plan with the "Large PSAP" size.

If your PSAP will just handle 9-1-1 and 7-10-digit emergency calls only, then the Operations Staff need not be modified. However, if your PSAP will be routinely handling non-emergency calls, such as answering for municipal utilities or providing information on municipal services similar to 3-1-1 calls, then there must be an adjustment to the call-taker requirement.

The Data Base Administrator's (DBA) workload depends significantly on the mapping and addressing activity in the jurisdiction and must be adjusted from the base number given.

- a. If the jurisdiction has addressed and mapped the area, and the jurisdiction is stable (i.e., no new subdivision and little growth), then the man-hours requirement is minimal. Recommend 0.1 to 0.3 depending on the size of the jurisdiction.
- b. If the jurisdiction is growing with much new development and/or a highly mobile population so that address updates are frequent, the work for the DBA is greater. Recommend 0.2 to 0.6 additional personnel.
- c. If the jurisdiction is in the addressing and mapping mode, even though contractors are doing that work, there is a significant burden on the jurisdiction to validate addresses for 9-1-1 use. Recommend one to three DBAs, depending on the size of the jurisdiction.

See the following table for numbers to enter into the appropriate PSAP Staffing table that follows:

		<b>Additional Personnel Requirement</b>		
		<b>Task</b>	<b>Small PSAP</b>	<b>Medium PSAP</b>
				<b>Large PSAP</b>
MAPPING AND ADDRESSING	Stable community, few changes*	DBA	0	0
	Dynamic, many changes	DBA	0.4	0.8
	New mapping and addressing in progress.	DBA	1.5	3
CALLS ACCEPTED	9-1-1 and 7/10-digit emergency calls only	Call-taker	0	0
	Municipal Utilities	Call-taker	1	1
	Jurisdiction official**	Call-taker	2	4
				6

\*There are zeros in this row as the number required for a particularly PSAP (0.1, 0.2, 0.3) are considered the minimum for that PSAP size and thus are built into Tables 9, 10, and 11 below.

\*\*Jurisdiction official - Take call to answer questions on municipal services as in case of 3-1-1.

**Table 8-Adjustment Numbers for Personnel Requirements**

Enter any adjustments from the above table into the PSAP Staffing matrix below for your size PSAP. The "Total" row in each PSAP Staffing table will automatically add up any adjustments for a staffing recommendation.

Small PSAP Staffing (population less than 19,000)

PSAP Size	CT/ Disp	Ops Supervisor	Total Ops	DBA	Technical	Training	Public Education	Admin	Total Support	Total Staff
< 19,000	7	1	8	0.1	0.2	0.2	0.05	0.45	1	9
DBA Adjust										
Calls Adjust										
Total	7	1	8	0.1	0.2	0.2	0.05	0.45	1	18.00
Decision										

**Table 9-Staffing Recommendations for a Small PSAP**

Medium PSAP Staffing (population between 19,000 and 100,000)

PSAP Size	CT/ Disp	Ops Supervisor	Total Ops	DBA	Technical	Training	Public Education	Admin	Total Support	Total Staff
19K - 100K	12	2	14	0.2	0.25	0.25	0.1	1.2	2.6	16.0
DBA Adjust										
Calls Adjust										
Total	12	2	14	0.2	0.25	0.25	0.1	1.2	2.6	32.6
Decision										

**Table 10-Staffing Recommendations for a Medium PSAP**

Large PSAP Staffing (Population 100,000 to 140,000)

PSAP Size	CT/ Disp	Ops Supervisor	Total Ops	DBA	Technical	Training	Public Education	Admin	Total Support	Total Staff
100K - 140K	19	4	23	0.3	0.4	0.3	0.1	1.5	3.2	25.6
DBA Adjust										
Calls Adjust										
Total	19	4	23	0.3	0.4	0.3	0.1	1.5	3.2	51.8
Decision										

**Table 11-Staffing Recommendations for a Large PSAP**

### 3.4 GUIDELINE FOR BUDGET

The PSAPs in the study were categorized into three sizes based on NENA SWAT Team determinations:

1. Small PSAPs - Often have the PSAP manager working as a telecommunicator. Usually only one telecommunicator on duty most of time; does call taking and dispatching. Serves populations up to 19,000.
2. Medium PSAPs - Have a dedicated PSAP manager who does all the support work. Minimal call volume times will have one telecommunicator on duty, but will have significant periods when there are two persons on duty. Serves populations from 19,000 to 100,000.
3. Large PSAPs - Have a dedicated PSAP manager and one or two full-time support personnel, such as administrative assistant/assistant manager, database administrator and/or training supervisor. Will have two or three telecommunicators on duty, depending on call volume. Serves populations of 100,000 to 140,000.

There are many factors that can influence the Operational Expenses of a PSAP: wage rates in local area benefits packages, paid time off, decision to hire full-time only or to augment with part-time employees and the PSAP manager's desires to have or not have certain levels of support. As a result, simplified Guidelines can only show the statistics of PSAPs similar to the PSAP being designed.

These statistics follow:

<b>PSAP Size</b>	<b>Costs</b>		
	<b>Least</b>	<b>Average</b>	<b>Highest</b>
Small	\$143,370	\$251,500	\$415,966
Medium	\$49,050	\$562,302	\$2,300,646
Large	\$625,293	\$1,395,988	\$2,687,900

**Table 12-PSAP Budget Ranges by PSAP Size**

Please note that some PSAPs reported their costs with statements such as "City provides Internal Telecommunications (or data base administrator) support that is not in our budget." Thus, the Least and Average Costs are low (The Highest Cost PSAPs appeared to report all their costs.)

## 4.0 METHODOLOGY

The first task within the Scope of Work was to define PSAP profiles. It was determined that the study would require a complete set of data from sixty-three PSAPs in order to develop valid conclusions. The PSAP profiles were defined as follows:

### Population Categories (3)

- PSAPs serving populations up to 19,000
- PSAPs serving populations between 19,000 and 100,000
- PSAPs serving populations between 100,000 and 140,000

### CPE Technology Levels (7)

- Manual call processing
- Computer-based telephony, no Map display
- Computer-based telephony and Map display only
- Computer-based telephony, Map display, and CAD
- Primary PSAP serving Secondary PSAPs with ALI display only (e.g., monitor or printer)
- Primary PSAP serving Secondary PSAPs with computer-based telephony and Map display only
- Primary PSAP serving Secondary PSAPs with computer-based telephony, Map display, and CAD

Given the stated parameters, it was desired to use a minimum of three complete sets of data for each of the seven CPE technology levels within the three population categories. Thereby, sixty-three PSAP data sets would be used: **3** PSAP sizes X **3** Population Categories X **7** CPE Technology Levels = **63**.

The preferred tool for data collection was an electronic survey designed by Kimball/SME (See **Appendix A**). In an effort to contact the largest number of PSAPs in each category, the Kimball/SME team would gather the data by e-mail questionnaires and telephone follow-up. This would prove to be a very efficient method of gathering the information, with an optimum amount of data collected with a minimum of time and expense.

The survey sought to gather the following information:

- Agency name, address, contact information, phone, fax, e-mail, website
- Population served for 9-1-1 call taking
- Population served for dispatch by Secondary PSAP(s)
- Square miles of jurisdiction served for 9-1-1
- Number of 9-1-1 trunks, wireline and wireless
- Number of wireless subscribers
- PSAP responsible for dispatching all calls
- PSAP serving Secondary PSAPs
- What types of calls are routed to Secondary PSAPs (Police, Fire, EMS, Jurisdictional)
- PSAP service status (Basic 9-1-1, Enhanced 9-1-1, Phase I, Phase II)

- Total annual incoming emergency call volume at PSAP
- Incoming annual 9-1-1 call volume, broken down into wireline, wireless, and seven-/ten-digit emergency lines
- Total annual dispatch call volume for Police, Fire, and EMS
- Total staff, operational and administrative/support
- Net operating budget
- Call processing times as first ring to answer, call answer through call termination, and total call time

The survey was e-mailed to specific PSAPs as designated by input from NENA Regional Vice Presidents and National Association of State 9-1-1 Administrators (NASNA) members. Additionally, surveys were randomly e-mailed to PSAPs and e-mail announcements directed PSAP managers to a survey link on the NENA web site. The e-mail announcements were sent to members of NENA's Talk List, the National Academies of Emergency Dispatch's (NAED) Talk List, and Dispatch Monthly Magazine's News Hound e-mail list. It is estimated that these three e-mail talk lists reach 6000 readers.

NOTE: It is unknown how many surveys were accessed through NENA's web site as there was no "hit" counter in place.

Representatives of the Monitor Group suggested using a commercial site web-based survey, such as Zoomerang and Survey Monkey. The imposed limits of allowable number of survey questions and number of survey respondents proved to be unacceptable and not cost efficient, excluding this as an option.

Kimball/SME believed that the survey would require contacting more PSAPs than the sixty-three needed to gather data of the desired quality and quantity. It was anticipated that some PSAPs would be able to provide data while others would be lacking important information. The assumption, therefore, was that 2.5 to 3 times the minimum desired number of complete data sets (63) would be needed, or 157 to 189. From the survey e-mail campaign carried out by Kimball/SME staff, well over 500 surveys were sent out. Unfortunately, responses were only seventy-six (76). Of these, six could not be used as they fell outside the parameters of the study; four served populations in excess of 140,000 and two were from airport communications centers. Of the seventy surveys used, many required clarification/correction of information, which was performed by Kimball/SME staff. These, then, were sufficient to provide reliable conclusions and models.

#### **4.1 THE RATIONAL APPROACH**

This method of determining how many persons should staff a PSAP looks at primary workload, which is considered to be the calls received. Then it uses standard queuing theory to determine how many call-takers should be available to process the calls. The strength of this approach is that it should provide a baseline of theoretical staffing requirements. The weakness is that it does not take into account any factors that influence call handling and that are not in the queuing formula. In an attempt to determine if there were additional factors, the staffing required as determined by queuing theory for specific PSAPs' call volume was compared to the actual staffing levels of the PSAPs.

The original design was to use "offered calls" – the number of calls that the wireless carriers generated and attempted to send to the PSAPs. However, in the planning stages it was determined that data could not be easily obtained, therefore the survey was modified to be based



on answered calls. This affected the queuing theory selection in that the theory no longer had to account for blocked calls or redials, but should account for as much of each call's duration as a queuing theory allows – so Poisson (also known as Molina) was selected.

The methodology of obtaining the call volume and current PSAP staffing for comparison, calculating the call-takers (servers) required, then determining how this translated into PSAP staffing requirements was as follows:

**Note:**

*Italic font* is used in this section to signify a question in the PSAP Staffing Survey (**Appendix A**).

**Bold font** is throughout the document for table titles and to signify a column title within a table --- to make it easier for the reader to relate text to table.

1. PSAPs were asked for the following categories of personnel related to call taking:
  - a. Call-takers only
  - b. Dispatchers only
  - c. If Call-takers and Dispatchers are combined, the number
  - d. Operations Supervisors
2. The total of the above was taken as the **Total Ops Staff**, assuming that the supervisors also stood watch as call-takers.
3. PSAPs were asked for:
  - a. Wireline 9-1-1 Calls
  - b. Wireless 9-1-1 Calls
  - c. 7-/10-digit emergency number calls
  - d. Total Incoming 9-1-1 Calls
4. The *Total Incoming 9-1-1 Calls* number was compared to the sum of *Wireline 9-1-1 Calls* and *Wireless 9-1-1 Calls* to determine if the numbers were the same (i.e., was *All Incoming Calls* just the sum of these or did it include other calls?). If it was, then the *7-/10-digit emergency number calls* number was added to it to create *All Incoming Calls*. If it was not, then the *Total Incoming 9-1-1 Calls* was used as the *All Incoming Calls*. In this manner, the incoming call volume load for the call-takers was created.
5. PSAPs were asked for information on the time it takes to process a call:
  - a. First ring to call answer
  - b. Call answer to call termination
  - c. Total time from first ring through call termination
6. The *First ring to call answer* time was added to the *Call answer to call termination* to compare with the *Total time from first ring through call termination* to determine agreement, which became the Holding Time. Where all three were provided, they agreed. In some cases only the first two were provided, so they were summed to provide the Holding Time.

**Holding Time** is the time from first ring until the call is terminated and is a basic input to determining the number of servers required in queuing theory. (Holding Time in network



traffic engineering starts with the dialing of the number, but that is because the server measured is a trunk: A trunk is considered to be captured with the commencement of dialing. Holding Time in this study begins with the ring because the server's first "service" is to answer the ring.)

7. Then the average call volume per hour was calculated. This is the **CCS/Hour** – the number of hundred call-seconds per hour. It was calculated by multiplying the *All Incoming Calls* times the *Holding Time*, then dividing by the number of hours in a year and 100 (to make the number "hundred" call-seconds – The first "C" is Latin for centum, meaning "hundred.").
8. 9-1-1 trunking is based on P.01 GOS (Grade of Service), that no more than one call out of 100 attempts during the Average Bouncing Busy Hour will be blocked. Therefore that same P.01 GOS was selected for PSAP staffing. In studies done with several months of statistics from the Vermont 9-1-1 system, it was determined that there is a rule of thumb that the Average Bouncing Busy Hour (ABBH) will be 1.95 times the average call volume. Thus the CCS/Hour was multiplied by 1.95 to obtain the **ABBH in CCS**.
9. An Erlang is 36 CCS (i.e., 36 hundred call seconds) in call traffic. Therefore the Erlangs were calculated by dividing the ABBH in CCS by 36.
10. The P.01 GOS was used for the calculations to mirror NENA's trunking requirements.
11. Then a queuing theory was selected. Where calls are offered and either accepted or blocked with no redial (also known as Lost Calls Cleared or LCC in traffic engineering), the Erlang B formula is correct. However, in this PSAP Study the data is not offered calls, but accepted calls. Therefore, we need a formula that best reflects that when the caller dials, the call gets through. The Poisson formula (also known as the Molina formula) is close to this requirement as it follows the Lost Calls Held or LCC concept where if the caller doesn't get through on the first try, the caller immediately re-dials and continues to do so until getting through. Please note that there is no difference in the number of servers required between using the Erlang B or the Molina formula until the server requirement increases to **four and there the difference is "0.01" in Erlangs** (See **Table 13** below.). Calculations were done using both formulas and it was found that the call-taker requirements were identical for the call volumes experienced by the target PSAPs owing this small difference and to no PSAP's call volume being near the border of the requirement for one more (or less) server.

	<b>For Given Number of Erlangs (rows 1 or 2) the following number of call-takers (row 3) are required</b>							
Erlang B	0	0.01	0.15	0.46	0.87	1.36	1.91	2.50
Poisson/Molina	0	0.01	0.15	0.45	0.85	1.30	1.80	2.35
Call-takers Required for P.01 GOS	1	2	3	4	5	6	7	8

**Table 13-Queuing Theory Comparison**



12. Telecommunicator positions are often staffed at different levels during a 24-hour period to reflect that call volume varies significantly from the hour with least call volume to the hour with most call volume (the busy hour). To mirror this reality, queuing theory was used to generate two staffing levels:
  - a. Normal Call Volume (Listed as “**Normal CCS**” in **Table 14**) – This is the call volume received in an average hour. **Normal Servers** is the number of call-takers required based on the Normal CCS and Poisson theory. It is assumed that two of three shifts a day will be manned at this level.
  - b. Peak Call Volume (Listed as “**ABBH CCS**” in **Table 14**) – This is the call volume expected to be received during the busiest hour of the day. See paragraph 8 above for details of how this was calculated. **ABBH Servers** is the number of call-takers required based on the ABBH CCS and Poisson theory. It is assumed that one of three shifts a day will be manned at this level.
13. The **Average Servers** is the average number of call-takers on duty per shift during a day. It is calculated as two-thirds the number of Normal Servers plus one-third ABBH Servers (for two shifts of normal traffic and one shift of ABBH traffic in a day).
  - a. What this accomplishes is bringing some reality of PSAP staffing into the queuing theory. The queuing theory is based on the premise that the number of call-takers will always be on duty to handle the highest call activity hour (i.e., the ABBH). But experience in PSAP call volumes demonstrates that the highest call activity hour can be predicted within a couple of hours each day. Therefore, efficient PSAP staffing will dictate a lower number of call-takers at the less busy times and more call-takers on duty at the busiest time.
  - b. If the call volumes (that is both Normal and ABBH) fall in the same range that requires a specific number of call-takers, then there is no difference in the number of call-takers required for either period. The number of call-takers to handle the Normal Call Volume can handle the ABBH Call Volume.
  - c. If the call volumes fall into different ranges, then there will be a different number of call-takers assigned to each period. Here is where the value of this dual calculation has value in avoiding hiring more call-takers than required. Consider the following example:

The assumption in the calculations is that the PSAP has three shifts. The ABBH call volume (which occurs during shift three) requires one more call-taker than the Normal call volume (which occurs during shifts one and two): **ABBH** requires three persons; **Normal** requires two.

<b>Staffing at Call Volume</b>	<b>Shift 1</b>	<b>Shift 2</b>	<b>Shift 3</b>	<b>Total Personnel</b>
ABBH	3	3	3	9
Normal or ABBH	2	2	3	7

**Table 14-Normal vs. ABBH Call Volume Staffing Requirements**



**PSAP STAFFING GUIDELINES REPORT  
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You can see that splitting the requirements so that the shifts are manned according to the call volume that is experienced during the shift represents a savings of two persons. Thus, it is believed that this extra step in calculating staffing requirements is worth the effort.

The following table shows the calculations to determine the **Average Servers** (i.e., average number of telecommunicators who should be on duty per shift each day to handle the call volume).

- 0 – 19,000 population
- 2. 19,000 to 100,000 population
- 3. 100,000 to 140,000 population

The following **Table 15** shows how the **Call Volumes** and **Holding Times** are used to determine the **Average** number of **Servers** per shift required. The initial sort was alphabetical by agency. The PSAP names have been replaced with Agency Ax, Bx, Cx, where A equals population up to 19,000, B equals 19-100,000, and C equals 100-140,000.

PSAP	ST	Call Volume	HT*	CCS/Hour	Normal Erlangs	Normal Servers	ABBH ** -in CCS	ABBH Erlangs	ABBH Servers	Average Servers
Agency B4	SC	13,920	250	3.97	0.11	2	7.75	0.22	3	2.33
Agency B29	IL	50,929	84	4.88	0.14	2	9.52	0.26	3	2.33
Agency C2	MI	189,008	96	20.71	0.58	4	40.39	1.12	5	4.33
Agency B31	IN	27,000	64	1.97	0.05	2	3.85	0.11	2	2.00
Agency B18	AR	8,305	105.7	1.00	0.03	2	1.95	0.05	2	2.00
Agency C3	MI	140,000	71	11.35	0.32	3	22.13	0.61	4	3.33
Agency C10	KY	242,400	150	41.51	1.15	5	80.94	2.25	7	5.67
Agency B22	KY	160,580	65	11.92	0.33	3	23.23	0.65	4	3.33
Agency B27	PA	36,275	73	3.02	0.08	2	5.89	0.16	3	2.33
Agency B13	SD	82,542	51	4.81	0.13	2	9.37	0.26	3	2.33
Agency B36	NC	169,544	61	11.81	0.33	3	23.02	0.64	4	3.33
Agency A8	IL	3,000	63	0.22	0.01	1	0.42	0.01	2	1.33
Agency A21	IA	4,600	26	0.14	0.00	1	0.27	0.01	1	1.00
Agency B17	MI	12,012	126	1.73	0.05	2	3.37	0.09	2	2.00
Agency B1	NC	69,589	93	7.39	0.21	3	14.41	0.40	3	3.00
Agency B33	KY	194,802	77.9	17.32	0.48	4	33.77	0.94	5	4.33
Agency B9	TN	13,000	274	4.07	0.11	2	7.93	0.22	3	2.33
Agency B8	AL	15,167	92	1.59	0.04	2	3.11	0.09	2	2.00
Agency B32	PA	59,734	67	4.57	0.13	2	8.91	0.25	3	2.33
Agency A10	AL	10,300	126	1.48	0.04	2	2.89	0.08	2	2.00
Agency C9	SC	261,180	123	36.67	1.02	5	71.51	1.99	7	5.67
Agency B10	OH	72,950	124	10.33	0.29	3	20.14	0.56	4	3.33
Agency C6	KY	20,950	68	1.63	0.05	2	3.17	0.09	2	2.00
Agency A20	VT	2,337	156	0.42	0.01	2	0.81	0.02	2	2.00
Agency B15	MI	34,886	81.4	3.24	0.09	2	6.32	0.18	3	2.33
Agency B6	MI	13,124	118	1.77	0.05	2	3.45	0.10	2	2.00
Agency B21	FL	18,552	81	1.72	0.05	2	3.35	0.09	2	2.00
Agency A7	TN	105,500	34.8	4.19	0.12	2	8.17	0.23	3	2.33



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PSAP	ST	Call Volume	HT*	CCS/Hour	Normal Erlangs	Normal Servers	ABBH ** -in CCS	ABBH Erlangs	ABBH Servers	Average Servers
Agency A16	IL	3,377	128	0.49	0.01	2	0.96	0.03	2	2.00
Agency B35	LA	31,912	82	2.99	0.08	2	5.83	0.16	3	2.33
Agency A11	LA	4,865	62	0.34	0.01	1	0.67	0.02	2	1.33
Agency B12	IL	9,720	182	2.02	0.06	2	3.94	0.11	2	2.00
Agency B30	TX	66,203	61	4.61	0.13	2	8.99	0.25	3	2.33
Agency A14	MO	5,935	362	2.45	0.07	2	4.78	0.13	2	2.00
Agency B34	MI	158,000	77	13.89	0.39	3	27.08	0.75	4	3.33
Agency A5	KY	36,486	126	5.25	0.15	2	10.23	0.28	3	2.33
Agency C5	TX	62,288	72	5.12	0.14	2	9.98	0.28	3	2.33
Agency B19	PA	18,356	64	1.34	0.04	2	2.62	0.07	2	2.00
Agency A3	GA	50,800	72	4.18	0.12	2	8.14	0.23	3	2.33
Agency A23	MI	67,380	72.7	5.59	0.16	3	10.90	0.30	3	3.00
Agency B23	MO	19,106	87	1.90	0.05	2	3.70	0.10	2	2.00
Agency A4	IL	38,898	40	1.78	0.05	2	3.46	0.10	2	2.00
Agency A17	IL	23,650	600	16.20	0.45	3	31.59	0.88	5	3.67
Agency B16	MT	33,000	95	3.58	0.10	2	6.98	0.19	3	2.33
Agency A13	WV	6,815	240	1.87	0.05	2	3.64	0.10	2	2.00
Agency A1	IL	68,061	40	3.11	0.09	2	6.06	0.17	3	2.33
Agency B5	KY	11,400	183	2.38	0.07	2	4.64	0.13	2	2.00
Agency A6	CA	2,186	64.3	0.16	0.00	1	0.31	0.01	1	1.00
Agency C4	TX	259,000	66	19.51	0.54	4	38.05	1.06	5	4.33
Agency C1	LA	48,000	63	3.45	0.10	2	6.73	0.19	3	2.33
Agency B25	CA	62,400	207	14.75	0.41	3	28.75	0.80	4	3.33
Agency A22	IL	550	60	0.04	0.00	1	0.07	0.00	1	1.00
Agency B2	TN	82,850	38	3.59	0.10	2	7.01	0.19	3	2.33
Agency B20	IL	63,501	62	4.49	0.12	2	8.76	0.24	3	2.33

\*HT – Holding Time (from ring to completion) as reported by PSAP. The RED entries indicate that the PSAP provides Pre-Arrival Instruction (PAI), therefore the telecommunicator will stay on the line with the 9-1-1 caller until the emergency response unit arrives. See Appendix C, which provides the procedure from Agency A17.

\*\*To get Average Bouncing Busy Hour, the average call volume (CCS/Hour column) was multiplied by 1.95, a number determined by a study of total State of Vermont 9-1-1 Traffic during period July through August 2002. Appreciation to Vermont Enhanced 9-1-1 Board for the data.

**Table 15-Staffing Requirements Based on Call Volume**

14. The next step is to determine how many full-time telecommunicators must be employed at the PSAP to provide the number of call-takers required to handle call calls received over the year.
  - a. First datum is the average number of callers that must be on duty. This is the **Average Servers** number calculated above (**Table 15**) for each PSAP.



- b. Next we need to know how many hours of work a year we can expect to receive from a full-time telecommunicator. In order to get current realistic data, a **Man-hours Survey (Appendix B)** was sent to the PSAP Managers who had participated in the PSAP Staffing Study.

Thirty-three PSAP managers replied. The results were tallied based on PSAP size, with the results shown in **Table 16** below.

<b>Hours of Work Available from Full-Time Telecommunicator</b>		<b>PSAP Size</b>		
		<b>0 - 19K</b>	<b>19 - 100K</b>	<b>100 - 140K</b>
PSAPs reporting data		9	19	5
Days in year		365	365	365
<u>Minus Days Off:</u>				
Weekends (2 days/week for 52 weeks)		104.00	104.00	104.00
Paid Holidays Off		9.56	10.35	10.50
Vacation		9.00	12.84	15.00
Personal Days off		1.89	2.25	1.20
Training		2.22	3.63	4.60
Conference		0.56	1.10	0.40
Sick		8.56	7.08	9.20
Total Hours off per Year		135.78	141.24	144.90
Days available to work		229.22	223.77	220.10
If work eight hours per day*, multiply by		8.00	8.00	8.00
Hours available to work		<b>1,834</b>	<b>1,790</b>	<b>1,761</b>

\*If telecommunicators work more than eight hours a day, then their cycle of days-on and days-off no longer follows the seven-day week, but a custom duty cycle. Therefore, the "Weekends" line should be changed accordingly (e.g., If the duty periods are 12-hours, then change the "Weekends" line to "3 days for 35 duty cycles" or 105 days). Thus, you should find that the end result of "Hours available to work" should come close to the numbers for the eight-hour shift days. The point is that regardless of the duty cycle used, the real issue is how much time off that schedule is allowed for holiday, vacation, etc. This table accounts for these key factors.

**Table 16-Available Working Man-hours per Telecommunicator**

Conclusion from Table 16

Interesting that as the PSAPs became larger, the telecommunicators received more time off. But this is to be expected as the larger the PSAP, the more funding that is available.

Also, it is appreciated that the larger PSAPs also provided more time off for training.

Next, we will determine the number of telecommunicators that must be hired to staff the call taking positions per hour that a position must be manned. Obviously, more than one person is required as people must be given time off, take holidays, get sick, etc. **Table 16** considered this factor to provide the **Hours available for work** per year by a full-time telecommunicator. When these hours are divided into the number of hours in a year available (24 hours per day times 365



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days), 8,760, a **Manning Ratio** is produced. This is the number of full time employees required to man one position 24 x 7. See **Table 17** below for the calculations.



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PSAP Size Code	1	2	3
PSAP Jurisdiction's Population	0 - 19,000	19K - 100K	100K - 140K
Hours available for work	1,834	1,790	1,761
Hours in a 365-day year	8,760	8,760	8,760
Manning Ratio*	4.78	4.89	4.98**

\*Manning Ratio = (Hours in a year) / (Man-hours available for work per year)

\*\*Math in table produces "4.97445." However, actual Hours available from previous calculations are 1,760.8, thus rounding to "4.98" is more accurate.

**Table 17-Determining Manning Ratio**

15. Determining the **Telecommunicators required** to staff the PSAP is done by multiplying the **Average Servers** by the **Manning Ratio**. Then the requirement is compared to **Actual PSAP Staff** and sorted by **Call Volume**. This is done in the following **Table 18**. Please note that the **Average Servers** is never less than "one" regardless of **Call Volume** because at least one call-taker position must always be manned.

Source Data			Queuing Calculations				Actual PSAP Staff			Compare
PSAP	ST	Call Volume	Average Servers	PSAP Size	Manning Ratio	Telecommunicators Required	Telecommunicators	Ops Supervisors	Total Ops Staff	Actual Staff vs. Required
Agency A22	IL	550	1.00	1	4.78	4.78	10	1	11	230%
Agency A6	CA	2,186	1.00	1	4.78	4.78	4	0	4	84%
Agency A20	VT	2,337	2.00	1	4.78	9.55	8	1	9	94%
Agency A8	IL	3,000	1.33	1	4.78	6.37	9	1	10	157%
Agency A16	IL	3,377	2.00	1	4.78	9.55	5	2	7	73%
Agency A21	IA	4,600	1.00	1	4.78	4.78	6	1	7	147%
Agency A11	LA	4,865	1.33	1	4.78	6.37	5	0	5	79%
Agency A14	MO	5,935	2.00	1	4.78	9.55	11.2	0	11.2	117%
Agency A13	WV	6,815	2.00	1	4.78	9.55	8		8	84%
Agency B18	AR	8,305	2.00	2	4.89	9.79	6.8	1	7.8	80%
Agency B12	IL	9,720	2.00	2	4.89	9.79	9	1	10	102%
Agency A10	AL	10,300	2.00	1	4.78	9.55	4	4	8	84%
Agency B5	KY	11,400	2.00	2	4.89	9.79	6	1	7	72%
Agency B17	MI	12,012	2.00	2	4.89	9.79	9	3	12	123%
Agency B9	TN	13,000	2.33	2	4.89	11.42	10	1	11	96%
Agency B6	MI	13,124	2.00	2	4.89	9.79	10.5	0.5	11	112%
Agency B4	SC	13,920	2.33	2	4.89	11.42	12	4	16	140%
Agency B8	AL	15,167	2.00	2	4.89	9.79	10.5	2	12.5	128%
Agency B19	PA	18,356	2.00	2	4.89	9.79	13.5	1	14.5	148%
Agency B21	FL	18,552	2.00	2	4.89	9.79	12	1	13	133%
Agency B23	MO	19,106	2.00	2	4.89	9.79	14	3	17	174%
Agency C6	KY	20,950	2.00	3	4.98	9.95	9	4	13	131%



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Source Data			Queuing Calculations				Actual PSAP Staff			Compare
PSAP	ST	Call Volume	Average Servers	PSAP Size	Manning Ratio	Telecommunications Required	Telecommunications	Ops Supervisors	Total Ops Staff	Actual Staff vs. Required
<b>Agency A17</b>	<b>IL</b>	23,650	3.67	1	4.78	17.52	7	1	8	<b>46%</b>
Agency B31	IN	27,000	2.00	2	4.89	9.79	18	3	21	<b>215%</b>
Agency B35	LA	31,912	2.33	2	4.89	11.42	10	1	11	96%
Agency B16	MT	33,000	2.33	2	4.89	11.42	10	1	11	96%
Agency B15	MI	34,886	2.33	2	4.89	11.42	9.5	0	9.5	83%
Agency B27	PA	36,275	2.33	2	4.89	11.42	12	0	12	105%
Agency A5	KY	36,486	2.33	1	4.78	11.15	6	1	7	<b>63%</b>
Agency A4	IL	38,898	2.00	2	4.89	9.79	9	1	10	102%
Agency C1	LA	48,000	2.33	3	4.98	11.61	18	1	19	<b>164%</b>
Agency A3	GA	50,800	2.33	1	4.78	11.15	11.5	0	11.5	103%
Agency B29	IL	50,929	2.33	2	4.89	11.42	15	2	17	<b>149%</b>
Agency B32	PA	59,734	2.33	2	4.89	11.42	19	0	19	<b>166%</b>
Agency C5	TX	62,288	2.33	3	4.98	11.61	21	4	25	<b>215%</b>
Agency B25	CA	62,400	3.33	2	4.89	16.31	13	1	14	86%
Agency B20	IL	63,501	2.33	2	4.89	11.42	12	1	13	114%
Agency B30	TX	66,203	2.33	2	4.89	11.42	28	3	31	<b>271%</b>
Agency A1	IL	68,061	2.33	1	4.78	11.15	6	3	9	81%
Agency B1	NC	69,589	3.00	2	4.89	14.68	8	2	10	<b>68%</b>
Agency B10	OH	72,950	3.33	2	4.89	16.31	16	2	18	110%
Agency A7	TN	80,500	2.33	1	4.78	11.15	14	0	14	<b>126%</b>
Agency B13	SD	82,542	2.33	2	4.89	11.42	11	1	12	105%
Agency B2	TN	82,850	2.33	2	4.89	11.42	10.5	0	10.5	92%
Agency C3	MI	140,000	3.33	3	4.98	16.58	17	6	23	<b>139%</b>
Agency B34	MI	158,000	3.33	2	4.89	16.31	10	4	14	86%
Agency B22	KY	160,580	3.33	2	4.89	16.31	14	0	14	86%
Agency B36	NC	169,544	3.33	2	4.89	16.31	15	3	18	110%
Agency C2	MI	189,008	4.33	3	4.98	21.56	13	5	18	83%
Agency B33	KY	194,802	4.33	2	4.89	21.21	13	4	17	<b>80%</b>
Agency C10	KY	242,400	5.67	3	4.98	28.19	30	1	31	110%
Agency C4	TX	259,000	4.33	3	4.98	21.56	20	4	24	111%
Agency C9	SC	261,180	5.67	3	4.98	28.19	33	5	38	<b>135%</b>
Average Staff vs. Required Staff =										<b>117%</b>

**Table 18-Determining Operations Staff Required**

To highlight extremes, **Red font** is used above to indicate the PSAPs that are manned at 80% or less of what the queuing theory requires and **Green font** is used to indicate the PSAPs that are manned at 120% or more of what the queuing theory requires. **Blue font** indicates that there is discussion of this PSAP below.

Conclusions and Issues from Table 18

1. Whether a PSAP had low or high call volume, there was no significant relationship as to whether they would be likely to be manned correctly.
2. The fact that the queuing theory provides recommendations that are in the middle of actual manning lends credibility to using queuing theory.
3. In considering why actual staff differs from the recommended, additional investigation should be done:
  - a. Were the call volumes and durations correctly reported? A few were stated as estimated.
  - b. Because some PSAPs had very high 7-/10-digit emergency calls, perhaps those did not take the time duration reported (perhaps higher, perhaps lower) for 9-1-1 calls.

3.a. above suggests that another sort should be done to test the hypothesis that perhaps the variances are the result of “estimated call volume” since some PSAPs provided exact call volumes (reported by tracking software), while others estimated the numbers. All PSAPs with call volume estimated data (checked “*Estimated*” on PSAP Survey, or otherwise indicated the data was estimated) were removed from the above table to create **Table 19** below. Yet, please note that there was no “estimated?” question for the call durations, which are also key inputs. There may still be incorrect conclusions if these inputs are not valid.

But one other issue contributed to the most significant variance, which is that of Agency A17, shown as manned at only 46% of the requirements. This resulted from their using **pre-arrival instruction (PAI) call taking** resulting in an average of 600 seconds for the calls dispatched, versus far shorter times for those PSAPs that do not use PAI.

Therefore, the Agency A17 statistics were reviewed to take into account the differences in call duration for those requiring PAI and for those not requiring PAI. Going back to the PSAP Staffing Survey provided the following statistics:

1. Total incoming calls = 23,650
2. Police dispatches = 2,500
3. Fire dispatches = 650
4. EMS dispatches = 500

Since fire is almost always dispatched with EMS and there are some incidents that require all three emergency response agencies, it is estimated that the number of dispatches (requiring PAI that average 600 seconds) is 3,000. Therefore, the Piatt County input was changed to:

1. 3,000 calls taking 600 seconds, plus
2. 20,000 ( $23,650 - 3,650$ ) taking 94 seconds, which is the average of PSAPs not reporting that they use Pre-Arrival Instructions.



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To be fair, the Manning Ratio was also calculated specifically for Agency A17 based on the PSAP's input. That PSAP actually offers more time off for its telecommunicators than the average, thus the Manning Ratio was 5.12 versus 4.77 for the average Small PSAP. These two changes are reflected in the Agency A17 listing below.

**Table 19** below lists only those PSAPs that reported that their call volume was not estimated, but automatically produced by statistics or management information system at the PSAP. The object is to determine if there are any changes in whether these PSAPs are more under- or over-staffed compared to the statistics generated in **Table 18** above which lists all call volumes provided. In other words, if we just used more credible data, would that change the outcome?

Source Data				Telecom- municators Required	Actual PSAP Staff			Compare Actual Staff vs. Req'd
PSAP	ST	Call Volume	HT*		Telecom- municators	Ops Supervisors	Total Ops Staff	
Agency B4	SC	13,920	250	11.42	12	4	16	140%
Agency C2	MI	189,008	96	21.56	13	5	18	83%
Agency B18	AR	8,305	105.7	9.79	6.8	1	7.8	80%
Agency C3	MI	140,000	71	16.58	17	6	23	139%
Agency B22	KY	160,580	65	16.31	14	0	14	86%
Agency B27	PA	36,275	73	11.42	12	0	12	105%
Agency B13	SD	82,542	51	11.42	11	1	12	105%
Agency B36	NC	169,544	61	16.31	15	3	18	110%
Agency A21	IA	4,600	26	4.78	6	1	7	147%
<b>Agency B1</b>	<b>NC</b>	<b>69,589</b>	<b>93</b>	<b>14.68</b>	<b>8</b>	<b>2</b>	<b>10</b>	<b>68%</b>
Agency B33	KY	194,802	77.88	21.21	13	4	17	80%
Agency B9	TN	13,000	274	11.42	10	1	11	96%
Agency B8	AL	15,167	92	9.79	10.5	2	12.5	128%
Agency B32	PA	59,734	67	11.42	19	0	19	166%
Agency C9	SC	261,180	123	28.19	33	5	38	135%
Agency C6	KY	20,950	68	9.95	9	4	13	131%
Agency B15	MI	34,886	81.4	11.42	9.5	0	9.5	83%
Agency B21	FL	18,552	81	9.79	12	1	13	133%
Agency A7	TN	80,500	34.8	11.15	14	0	14	126%
Agency A11	LA	4,865	62	6.37	5	0	5	79%
Agency B30	TX	66,203	61	11.42	28	3	31	271%
Agency A14	MO	5,935	362	9.55	11.2	0	11.2	117%
Agency B34	MI	158,000	77	16.31	10	4	14	86%
Agency B19	PA	18,356	64	9.79	13.5	1	14.5	148%
Agency A3	GA	50,800	72	11.15	11.5	0	11.5	103%
<b>Agency A17</b>	<b>IL</b>	<b>3,000 20,000</b>	<b>600 94</b>	<b>17.52</b>	<b>7</b>	<b>1</b>	<b>8</b>	<b>67%</b>
Agency B16	MT	33,000	95	11.42	10	1	11	96%
Agency A13	WV	6,815	240	9.55	8		8	84%
Agency C1	LA	48,000	63	11.61	18	1	19	164%
Agency B25	CA	62,400	207	16.31	13	1	14	86%



Source Data				Telecom-municators Required	Actual PSAP Staff			Compare
					Telecom-municators	Ops Super-visors	Total Ops Staff	
Agency A22	IL	550	60	4.78	10	1	11	230%
Agency B2	TN	82,850	38	11.42	10.5	0	10.5	92%
<b>Average Staff vs. Required Staff =</b>								<b>117%</b>

Holding Time in red indicates PSAP provides Pre-Arrival Instructions.

**Table 19-Compare Required Staff vs. Actual Staff Using Accurate Data**

Note that the **Average Staff versus Required Staff** for this table of “accurate” call volume is identical to the Average for the previous table, which included “estimated” call volume. This indicates that at least on average, the estimated data is highly credible.

#### Conclusions from Table 19

With only highly credible data being used, the Required Staff based on queuing theory continues to fall near the middle of the range of Actual Staff, again indicating that it is a valid method as a basis for staffing recommendations.

The real concern is how those PSAPs that show manning of 80% or less of the expected requirement are able to accomplish their job. The answer may be that they do overtime work.

Agency B1 is also low in expected manning. In this case it is noted that although the county shows 68,589 incoming calls, only 20,876 result in dispatching. Thus, many calls may take fewer than the 93-second holding time reported. This is reinforced by the fact that many automated call tracking data is available only on the *9-1-1 Wireline* and *9-1-1 Wireless* calls, not the *7-/10-digit Emergency Calls*.

Agency A17 and possibly Agency B1 lead to the conclusion that if a PSAP will handle any non-9-1-1 emergency calls, it must track them for call duration as well, then calculate two levels of service requirement:

1. 9-1-1 Calls
2. 7-/10-digit Emergency Calls

## 4.2 CONCLUSIONS AND RECOMMENDATIONS FROM THE RATIONAL APPROACH

1. Calls Offered versus Calls Received: When an engineer plans to ensure that there are sufficient servers to handle a service load (i.e., call-takers to handle 9-1-1 calls initiated), the desired basic data is “calls offered.” Calls offered is the number of attempts made during the period, stated with the understanding that not all of these attempts will be answered because all call-takers and/or trunks are occasionally busy. You may see that this study dealt only with “calls received,” which may be assumed to be fewer than “calls offered” (The

difference being defined as “Calls Lost.”). Many of the “calls offered” did not show up in the “call volume” reported by the PSAPs as those calls were blocked by call-takers that were already busy.

- a. Thus, if a PSAP has fewer call-takers than required by the call volume, it should be assumed that the actual PSAP Grade of Service (new term here meaning the probability of a call reaching a PSAP during the PSAP’s Busy Hour and not being answered) is less than the grade of service set in the queuing formula. In other words, people seeking help will not be getting that help to the extent that the PSAP manager and the community desire.
  - b. Therefore the PSAP Manager should obtain “calls offered” data. This can be done by asking the E9-1-1 Service System Provider (SSP, the local exchange carrier that is providing 9-1-1 selective routing service), to record call detail at the 9-1-1 selective router.
2. Holding Time: The duration of the activity that uses the server’s capacity. In traffic engineering, it is the time from when the caller begins to dial the number to when the call is disconnected (because this represents the time that a trunk is in use). In PSAP server calculating, it is the time from when the call rings at the PSAP to when the call is disconnected (because this represents the time that a call-taker is engaged).
3. The queuing theory to be used depends upon the circumstances, which are:
- a. Lost Calls Held – Defined as where the offered traffic has callers who will immediately and continually redial until a connection is made. In this case, the Poisson (also known as Molina) formula is used. Because this study had only accepted calls, this formula came closest to representing the number of call-takers required when all you can count are calls that have been received in the past (i.e., there is no offered call volume).
  - b. Lost Calls Cleared – Defined as where the offered traffic has callers, who upon receiving a busy, will not call back within a short time. This is represented by the Erlang B formula. The straight Erlang B does not offer the finesse of allowing an input as to what percentage of the blocked calls will immediately redial as opposed to waiting a short period.
  - c. Lost Calls Immediately Redialed – For queuing systems where a percentage of the callers will immediately redial, the Extended Erlang B is appropriate. The formula allows for a “percent redialed” input to the formula. This formula is recommended for 9-1-1 traffic studies where the offered call volume is allowed.
  - d. Lost Calls Delayed – Defined as where if a call is not immediately answered, it will go into a queue with the caller remaining on the line until the call is answered. This is the Erlang C formula, which should be used where offered call volume is available and the PSAP has Automatic Call Distribution (ACD) equipment.

Thus, the queuing theory recommended for determining number of call-takers when only accepted calls are available is the Poisson (Molina). Note: None of the PSAPs in the survey stated they had an ACD.



4. **Grade of Service:** In keeping with 9-1-1 trunking recommendations, the Grade of Service used was P.01 (No more than one caller out of 100 attempts during the Average Bouncing Busy Hour would be unable to be served.).
5. **Rules for Using Received Call Volume:** The received call volume is a good guideline for PSAP manning, provided the following rules are followed:
  - a. The call volume and durations should be automatically recorded to ensure the data is correctly captured. If the 9-1-1 calls and the 7-/10-digit emergency calls do not come into the same equipment (e.g., one comes into ANI/ALI controller, the other over a PBX connection), then separate call volumes and durations should be captured for both. The importance of this requirement is to ensure the data is accurate.
  - b. Include in the calculations any load balancing staffing. By this is meant that if the number of call-taker positions manned differs depending on the expected call volume over a 24-hour period, the calculation must show the different “servers available” (to use a queuing theory concept) during each shift of the 24-hour period.
  - c. Call data recording should be done over at least a two-week period and may be done at a medium period of call activity during the year, assuming that during peak times, the PSAP manager may use overtime to handle the additional call volume. If the PSAP manager does not have the flexibility to assign overtime, then the call data recording should be done during the peak call volume time of the year – The understanding here is that this is not the most efficient solution over a year’s time, but it will meet the community’s need for proper call taking during the worst times.
6. **Obtaining Queuing Theory Inputs:** Where the PSAP does not exist, the obvious problem is in getting the formula inputs (raw data) to use the Poisson formula. Here is the recommendation:
  - a. **Grade of Service:** Recommend the 9-1-1 trunking Grade of Service that NENA and several states recommend, which is P.01.
  - b. **Call Duration:**
    - (1) **PSAPs that do not provide Pre-Arrival Instruction (PAI)** – The average call duration of the PSAPs that do not provide PAI and who stated their call volume was automatically recorded (which does not prove that the call durations were automatically recorded, but lends credence) was 94 seconds. On a separate study that Russ Russell did based on data from the Vermont Enhanced 9-1-1 Board (total state 9-1-1 calls for period July to August 2002), the average call duration was 84 seconds. Thus, the PSAP Staffing Surveys’ inputs’ average of 94 seconds is a sound number. Yet, those numbers reflect experienced PSAPs. Therefore, it is recommended that the call duration be extended a little for a new PSAP. The recommendation is 95 seconds.
    - (2) **PSAPs that provide Pre-Arrival Instruction** – Where the telecommunicator stays on the call with the 9-1-1 caller until the emergency response unit arrives at the location of the emergency, the call duration is far longer. Agency A17 uses this procedure and volunteered their procedure to this study. The procedure is



provided as **Appendix C**. The PSAPs that reported using PAI in this study gave call duration times from 250 to 600 seconds. If a PSAP plans to use PAI, it is recommended that the jurisdiction base their call duration on 60 to 90 seconds for dispatch plus the average emergency response unit travel time.

- c. **Call Volume:** Call volume should be determined by a study of no shorter than two weeks' duration during the part of the year when the volume of 9-1-1 calls is at the maximum. The Average Bouncing Busy Hour (ABBH) should be used. Owing to the FCC requirement that all LECs and wireless carriers must deliver 9-1-1 calls to a PSAP, the calls that the new PSAP will be handling are already being sent to some call center. The call volume can be determined by one of the following methods:
  - (1) **Obtaining Offered Call Volume:** Ideally, the PSAP manager should request a 9-1-1 traffic study from each ILEC, CLEC and wireless carrier that serves subscribers in the jurisdiction. These should be combined to determine the total offered call volume. If this is obtained, the Extended Erlang B formula should be used.
  - (2) **Received Call Volume from 9-1-1 Selective Router:** If offered calls cannot be obtained from the sources, but the new PSAP will be replacing a call-taking center that is currently receiving calls from the jurisdiction via a 9-1-1 selective router, then the E9-1-1 System Service Provider (SSP) that manages the 9-1-1 selective router should be requested to insert a peg count meter on the trunks from the 9-1-1 selective router to the PSAP. This will provide the number of calls offered to the PSAP and will be more accurate than the current PSAP's accepted call volume because it will also count lost calls (those that did not get through). If any 7-/10-digit calls are also being accepted and will be transferred to the new PSAP, these should also be counted. If this is obtained, the Extended Erlang B formula should be used.
  - (3) **Received Call Data at PSAP:** If only accepted calls can be obtained, then the new PSAP manager should be conscientious in ensuring that the captured data is accurate. Call statistics software on the ANI/ALI controller, a Station Message Detail Record or other automated counting equipment should be used if possible. This will also provide the added benefit of determining the average Holding Time. If this is obtained, the Poisson (Molina) formula should be used.
- 6. **Other staff members:** It must be realized that queuing theory applies to call volume and the time it takes to process a call. It does not provide a recommendation for how many non-call taking supervisors, data base administrators, training supervisors, etc., must be hired to perform the other functions.

**Recommendation:** If call volume can be obtained, it provides a good approximation to the actual number of telecommunicators required.

#### 4.3 THE EMPIRICAL APPROACH

This method looks at the actual staffing in PSAPs and purports to say: If the PSAPs are currently manned at this level for the call volume and other factors, the staffing is probably correct. With staffing of these actual PSAPs correct, then if a jurisdiction has similar characteristics, staffing their PSAP in a similar manner should ensure that sufficient manpower and expertise are available to perform the required functions.

The PSAP Data Sources section above provided the details of the number of PSAPs that fit into each of the 21 categories. The following table shows the information sought on factors that were likely to affect staffing size, reasons why considered and the degree to which the information was obtained. Please note that since this project was structured to provide recommended staffing before there is a PSAP and before there are accurate call volume records that call volume was not used as an influencing factor – it is the influenced factor. A second review later will consider how staffing relates to call volume.

Influencing Factor	Why Chosen	Info Availability
Population	People make calls. Should be an almost direct relationship.	Obtained for all, although some research with U.S. Census Bureau was required.
Wireless Subscribers	Should directly relate to number of wireless calls.	20 PSAPs reported the number.
Four-Lane Highway Mileage	Represents calls coming from non-residents as people travel through the area. Also relates to more accidents with their increase in 9-1-1 calls.	Obtained for all based on the Project Team's independent research. This was not a survey question.
Population Density	Believed by many to influence based on concept that the more persons per square mile, the more conflicts and thus the more calls per capita.	Obtained for all based on the PSAPs providing the population and square miles of jurisdiction or based on research by the Project Team. The Population Density was then calculated.

**Table 20-List of Influencing Factors**

Potential Call Volume Influencing Factors, Sorting by PSAP Population

The first task was to get a feel for the consistency of the relationship of call volume in comparison to the population served. The number of miles of four-lane highways in the jurisdiction is also included for the next comparison (to save duplicating a table). Data for the 70 PSAPs was obtained and is provided in **Table 21** below, sorted by population. The two thicker lines separate the PSAP size categories. Note that **Incoming** includes Wireline 9-1-1, Wireless 9-1-1 and 7-/10-digit Emergency Calls. Agency B37 is omitted owing to not providing call volume.

Note: In the following tables, the column that was used for the sort is highlighted in yellow. The sort is from lowest to highest number.



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<b>Serial</b>	<b>PSAP</b>	<b>ST</b>	<b>Pop.</b>	<b>Incoming</b>	<b>CV/Pop</b>	<b>Total Miles</b>	<b>Pop Density</b>
1	Agency A1	IL	4,224	68,061	1611%	8.3	2,428
2	Agency A2	KS	6,528	4,211	65%	35.2	6
3	Agency A3	GA	7,768	50,800	654%	19	1,618
4	Agency A4	IL	8,702	38,898	447%	0	1,055
5	Agency A5	KY	10,500	36,486	347%	45.3	42
6	Agency A6	CA	10,686	2,186	20%	0	3,339
7	Agency A7	TN	10,898	80,500	739%	0	36
8	Agency A8	IL	13,500	3,000	22%	10.6	35
9	Agency A9	CO	13,500	2,846	21%	160.9	3
10	Agency A10	AL	14,000	10,300	74%	58.9	140
11	Agency A11	LA	14,139	4,865	34%	55.5	22
12	Agency A12	IL	15,000	6,800	45%	66.4	27
13	Agency A13	WV	15,200	6,815	45%	55.1	36
14	Agency A14	MO	15,500	5,935	38%	60.1	19
15	Agency A15	FL	16,000	7,200	45%	28.6	23
16	Agency A16	IL	16,000	3,377	21%	48.9	152
17	Agency A17	IL	16,000	23,650	148%	35	35
18	Agency A18	MI	17,000	6,223	37%	46.9	30
19	Agency A19	KY	17,000	4,923	29%	32	46
20	Agency A20	VT	17,925	2,337	13%	131	105
21	Agency A21	IA	18,187	4,600	25%	49.5	63
22	Agency A22	IL	18,200	550	3%	58.3	34
23	Agency A23	MI	18,773	67,380	359%	119.7	10
24	Agency B1	NC	20,000	69,589	348%	9.2	110
25	Agency B2	TN	23,150	82,850	358%	49.6	37
26	Agency B3	MI	26,000	70,661	272%	96.4	49
27	Agency B4	SC	26,314	13,920	53%	115	52
28	Agency B5	KY	27,000	11,400	42%	36.7	95
29	Agency B6	MI	27,500	13,124	48%	48.2	48
30	Agency B7	IN	27,800	11,988	43%	13.8	70
31	Agency B8	AL	28,756	15,167	53%	73.2	23
32	Agency B9	TN	29,862	13,000	44%	20	107
33	Agency B10	OH	31,000	72,950	235%	35	70
34	Agency B11	FL	34,500	16,881	49%	0	31
35	Agency B12	IL	35,000	9,720	28%	114.4	48
36	Agency B13	SD	35,074	82,542	235%	84.4	20
37	Agency B14	LA	35,644	4,727	13%	55	53
38	Agency B15	MI	36,000	34,886	97%	70.9	35
39	Agency B16	MT	37,304	33,000	88%	73.4	16
40	Agency B17	MI	38,543	12,012	31%	67.1	24
41	Agency B18	AR	40,000	8,305	21%	28.5	72
42	Agency B19	PA	46,000	18,356	40%	54.5	106
43	Agency B20	IL	46,000	63,501	138%	59.6	84
44	Agency B21	FL	46,755	18,552	40%	103.2	1,063
45	Agency B22	KY	49,752	160,580	323%	42.4	311
46	Agency B23	MO	52,000	19,106	37%	30.2	81

Serial	PSAP	ST	Pop.	Incoming	CV/Pop	Total Miles	Pop Density
47	Agency B24	FL	58,000	232,400	401%	77.6	91
48	Agency B25	CA	60,000	62,400	104%	17.1	5,263
49	Agency B26	NY	61,676	38,129	62%	50.1	61
50	Agency B27	PA	62,000	36,275	59%	81.1	55
51	Agency B28	MI	65,000	96,981	149%	43.1	50
52	Agency B29	IL	68,277	50,929	75%	54.8	79
53	Agency B30	TX	73,334	66,203	90%	28	1,346
54	Agency B31	IN	75,000	27,000	36%	84.2	187
55	Agency B32	PA	75,259	59,734	79%	119.9	66
56	Agency B33	KY	78,000	194,802	250%	111.8	108
57	Agency B34	MI	80,000	158,000	198%	73.8	69
58	Agency B35	LA	89,974	31,912	35%	56.2	61
59	Agency B36	NC	94,536	169,544	179%	19.6	2,246
60	Agency C1	LA	104,503	48,000	46%	30.6	50
61	Agency C2	MI	109,000	34,452	32%	97.5	131
62	Agency C3	MI	110,000	140,000	127%	51.5	247
63	Agency C4	TX	110,000	259,000	235%	26.5	1,692
64	Agency C5	TX	117,300	62,288	53%	55.3	125
65	Agency C6	KY	123,000	20,950	17%	164	1,230
66	Agency C7	SD	126,377	66,000	52%	126.6	11
67	Agency C8	PA	127,500	56,891	45%	74.1	76
68	Agency C9	SC	132,000	261,180	198%	146.2	164
69	Agency C10	KY	140,000	242,400	173%	135	700

**Table 21-Potential Call Volume Influencing Factors, Sort by Residential Population**

From the above **Table 21**, we must consider the first anomaly, namely that four PSAPs have extraordinary call volumes for their populations. However, the answer for three is in knowing the daytime populations:

1. **Agency A4** (Serial #4)—This is predominately a commercial area in the Midwest metro area. It has numerous hotels and office building, so that the estimated daytime population is 84,000 to 110,000. For this report, the average of 97,000 is used.
2. **Agency A5** (Serial #3)—This is within a Southern metro area. The 9.5 miles of a major interstated highway has an influence. The estimated day-time population is 70,000.
3. **Agency A1** (Serial #1) – This is also not primarily a residential area – it is mostly large office buildings and hotels within a Midwest metro area. Thus, during the day there are approximately 110,000 persons in the jurisdiction. In this light, the call volume is appropriate.

The fourth PSAP, **Agency A7** (Serial #7), derives its high volume from its policy on calls accepted on the administrative lines. Their wireline 9-1-1 calls are 5,000, wireless 9-1-1 are 500, and 7-/10-digit calls are 75,000, of which only approximately 1,000 were for emergencies (hence the 6,500 reported in the table below). Thus, the PSAP answers approximately 80,500 calls a year for a jurisdiction with a population of 10,898, for a Call Volume/Population of 739%.



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The PSAP Manager for Agency A7, explained: “*We answer for the Sheriff Office which all calls go thru. To check on an inmate, check warrants, check reports, talk to deputies etc all are answered on the lines. The EMS is the same. To check on an EMS bill, etc. In our county anyone needing any info has always called the Sheriff lines no matter what their questions is.*”

“*Kids even call the sheriff line when it snows to check on school the next day.*”  
 “*We get a lot of BS calls but that is the way it has been.*”

“*We answer 3 sheriff lines, 1 city police, 1 power company after hours, 1 emergency management, 2 EMS, 4 9-1-1 lines and 1 9-1-1 admin line. These lines are for emergency and non emergency.*”

So it will be important in sizing PSAP Staffs to set the criteria for what types of calls will be accepted on the 7/10-digit lines.

Therefore, in order to compare PSAP requirements based on emergency calls based on population in the jurisdiction (regardless of whether they live there or not), two corrections to **Table 21** are made in the following **Table 22**:

1. Day-time populations are used for the first three PSAPs mentioned above.
2. Jackson County, TN, emergency call volume (estimated at 6,500) is used.

The sort is by population (using day-time population where provided), with the bold lines separating the PSAP size categories.

<b>Serial</b>	<b>PSAP</b>	<b>ST</b>	<b>Pop</b>	<b>Incoming</b>	<b>CV/Pop</b>	<b>Highway Miles</b>	<b>Pop Density</b>
1	Agency A2	KS	6,528	4,211	65%	35.2	6
2	Agency A5	KY	10,500	36,486	347%	45.3	42
3	Agency A6	CA	10,686	2,186	20%	0	3,339
4	Agency A7	TN	10,898	6,500	60%	0	36
5	Agency A9	CO	13,500	2,846	21%	160.9	3
6	Agency A8	IL	13,500	3,000	22%	10.6	35
7	Agency A10	AL	14,000	10,300	74%	58.9	140
8	Agency A11	LA	14,139	4,865	34%	55.5	22
9	Agency A12	IL	15,000	6,800	45%	66.4	27
10	Agency A13	WV	15,200	6,815	45%	55.1	36
11	Agency A14	MO	15,500	5,935	38%	60.1	19
12	Agency A16	IL	16,000	3,377	21%	48.9	152
13	Agency A15	FL	16,000	7,200	45%	28.6	23
14	Agency A17	IL	16,000	23,650	148%	35	35
15	Agency A19	KY	17,000	4,923	29%	32	46
16	Agency A18	MI	17,000	6,223	37%	46.9	30
17	Agency A20	VT	17,925	2,337	13%	131	105
18	Agency A21	IA	18,187	4,600	25%	49.5	63
19	Agency A22	IL	18,200	550	3%	58.3	34
20	Agency A23	MI	18,773	67,380	359%	119.7	10
21	Agency B1	NC	20,000	69,589	348%	9.2	110



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Serial	PSAP	ST	Pop	Incoming	CV/Pop	Highway Miles	Pop Density
22	Agency B2	TN	23,150	82,850	358%	49.6	37
23	Agency B3	MI	26,000	70,661	272%	96.4	49
24	Agency B4	SC	26,314	13,920	53%	115	52
25	Agency B5	KY	27,000	11,400	42%	36.7	95
26	Agency B6	MI	27,500	13,124	48%	48.2	48
27	Agency B7	IN	27,800	11,988	43%	13.8	70
28	Agency B8	AL	28,756	15,167	53%	73.2	23
29	Agency B9	TN	29,862	13,000	44%	20	107
30	Agency B10	OH	31,000	72,950	235%	35	70
31	Agency B11	FL	34,500	16,881	49%	0	31
32	Agency B12	IL	35,000	9,720	28%	114.4	48
33	Agency B13	SD	35,074	82,542	235%	84.4	20
34	Agency B14	LA	35,644	4,727	13%	55	53
35	Agency B15	MI	36,000	34,886	97%	70.9	35
36	Agency B16	MT	37,304	33,000	88%	73.4	16
37	Agency B17	MI	38,543	12,012	31%	67.1	24
38	Agency B18	AR	40,000	8,305	21%	28.5	72
39	Agency B19	PA	46,000	18,356	40%	54.5	106
40	Agency B20	IL	46,000	63,501	138%	59.6	84
41	Agency B21	FL	46,755	18,552	40%	103.2	1,063
42	Agency B22	KY	49,752	160,580	323%	42.4	311
43	Agency B23	MO	52,000	19,106	37%	30.2	81
44	Agency B24	FL	58,000	232,400	401%	77.6	91
45	Agency B25	CA	60,000	62,400	104%	17.1	5,263
46	Agency B26	NY	61,676	38,129	62%	50.1	61
47	Agency B27	PA	62,000	36,275	59%	81.1	55
48	Agency B28	MI	65,000	96,981	149%	43.1	50
49	Agency B29	IL	68,277	50,929	75%	54.8	79
50	Agency A3	GA	70,000	50,800	73%	5	14,583
51	Agency B30	TX	73,334	66,203	90%	28	1,346
52	Agency B31	IN	75,000	27,000	36%	84.2	187
53	Agency B32	PA	75,259	59,734	79%	119.9	66
54	Agency B33	KY	78,000	194,802	250%	111.8	108
55	Agency B34	MI	80,000	158,000	198%	73.8	69
56	Agency B35	LA	89,974	31,912	35%	56.2	61
57	Agency B36	NC	94,536	169,544	179%	19.6	2,246
58	Agency A4	IL	97,000	38,898	40%	8.3	11,758
59	Agency C1	LA	104,503	48,000	46%	30.6	50
60	Agency C2	MI	109,000	34,452	32%	97.525	131
61	Agency C3	MI	110,000	140,000	127%	51.5	247
62	Agency C4	TX	110,000	259,000	235%	26.5	1,692
63	Agency A1	IL	110,000	68,061	62%	1.7	63,218
64	Agency C5	TX	117,300	62,288	53%	55.3	125
65	Agency C6	KY	123,000	20,950	17%	164	1,230
66	Agency C7	SD	126,377	66,000	52%	126.6	11



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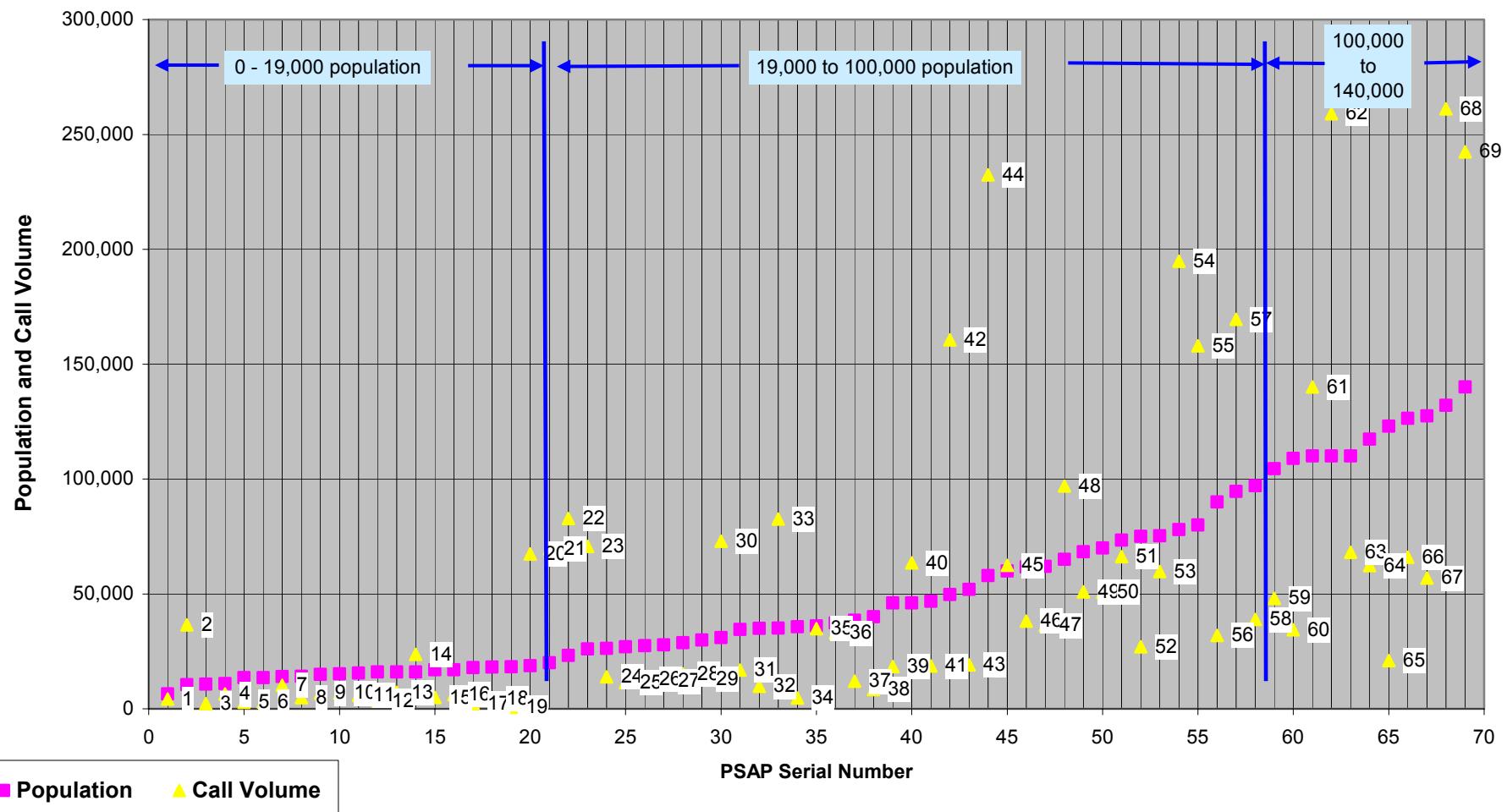
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<b>Serial</b>	<b>PSAP</b>	<b>ST</b>	<b>Pop</b>	<b>Incoming</b>	<b>CV/Pop</b>	<b>Highway Miles</b>	<b>Pop Density</b>
67	Agency C8	PA	127,500	56,891	45%	74.1	76
68	Agency C9	SC	132,000	261,180	198%	146.2	164
69	Agency C10	KY	140,000	242,400	173%	135	700

**Table 22-Call Volume and Other Factors Sorted by Population**

For further examination, the plot of **Call Volume** versus **Population** from **Table 22** is provided on the next page in **Chart 1 – Call Volume Versus Population** to highlight those jurisdictions where the Call Volume does not vary with the Population.

Chart 1 - Call Volume Versus Population



In **Chart 1** on the preceding page, it can be seen that as the population (red squares ■) goes up that the call volume (yellow triangles ▲) also increases. However, there are some noticeable exceptions: Some PSAPs have significantly different call volumes than their populations would indicate. A trend line of call volume could be inserted into the chart, but that would make a complex chart overly complex. Instead, we took the population line as the norm. The task here is to determine which of the factors we obtained are likely to have created that variance (i.e., difference between the plots created by population and call volume numbers).

An examination of the below **Table 22** reveals pairs of PSAPs with similar population but significantly different call volumes that do not appear to be related to either highway mileage or population density. Examples are provided below: High highway mileage and population density occur with low call volume and vice versa. (To find them in the table, find their population in the **Population** column as that is the sort method.)

Serial	PSAP	Population	Highway Mileage	Population Density	Call Volume
12	Agency A16	16,000	48.9	152.4	3,377
14	Agency A17	16,000	35.0	35.5	23,650
32	Agency B12	35,000	114.4	48.1	9,720
33	Agency B13	35,074	84.4	20.5	82,542

**Table 22-Pairing PSAPs with Similar Populations**

Perhaps another method of reviewing the data would provide some insight.

Therefore, the table of key factors was sorted by percentage of **Call Volume versus Population** to determine if any of the factors would group to become common factors for the call volume differences. This is shown in the following **Table 23**.



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<b>PSAP</b>	<b>ST</b>	<b>Population</b>	<b>Incoming</b>	<b>CV/Pop</b>	<b>Total Miles</b>	<b>Pop Density</b>
Agency A22	IL	18,200	550	3%	58.3	34
Agency A20	VT	17,925	2,337	13%	131	105
Agency B14	LA	35,644	4,727	13%	55	53
Agency C6	KY	123,000	20,950	17%	164	1,230
Agency A6	CA	10,686	2,186	20%	0	3,339
Agency B18	AR	40,000	8,305	21%	28.5	72
Agency A9	CO	13,500	2,846	21%	160.9	3
Agency A16	IL	16,000	3,377	21%	48.9	152
Agency A8	IL	13,500	3,000	22%	10.6	35
Agency A21	IA	18,187	4,600	25%	49.5	63
Agency B12	IL	35,000	9,720	28%	114.4	48
Agency A19	KY	17,000	4,923	29%	32	46
Agency B17	MI	38,543	12,012	31%	67.1	24
Agency C2	MI	109,000	34,452	32%	97.525	131
Agency A11	LA	14,139	4,865	34%	55.5	22
Agency B35	LA	89,974	31,912	35%	56.2	61
Agency B31	IN	75,000	27,000	36%	84.2	187
Agency A18	MI	17,000	6,223	37%	46.9	30
Agency B23	MO	52,000	19,106	37%	30.2	81
Agency A14	MO	15,500	5,935	38%	60.1	19
Agency B21	FL	46,755	18,552	40%	103.2	1,063
Agency B19	PA	46,000	18,356	40%	54.5	106
Agency A4	IL	97,000	38,898	40%	0	1,055
Agency B5	KY	27,000	11,400	42%	36.7	95
Agency B7	IN	27,800	11,988	43%	13.8	70
Agency B9	TN	29,862	13,000	44%	20	107
Agency C8	PA	127,500	56,891	45%	74.1	76
Agency A13	WV	15,200	6,815	45%	55.1	36
Agency A15	FL	16,000	7,200	45%	28.6	23
Agency A12	IL	15,000	6,800	45%	66.4	27
Agency C1	LA	104,503	48,000	46%	30.6	50
Agency B6	MI	27,500	13,124	48%	48.2	48
Agency B11	FL	34,500	16,881	49%	0	31
Agency C7	SD	126,377	66,000	52%	126.6	11
Agency B8	AL	28,756	15,167	53%	73.2	23
Agency B4	SC	26,314	13,920	53%	115	52
Agency C5	TX	117,300	62,288	53%	55.3	125
Agency B27	PA	62,000	36,275	59%	81.1	55
Agency A7	TN	10,898	6,500	60%	0	36
Agency B26	NY	61,676	38,129	62%	50.1	61
Agency A1	IL	110,000	68,061	62%	8.3	2,428
Agency A2	KS	6,528	4,211	65%	35.2	6
Agency A3	GA	70,000	50,800	73%	19	1,618
Agency A10	AL	14,000	10,300	74%	58.9	140
Agency B29	IL	68,277	50,929	75%	54.8	79
Agency B32	PA	75,259	59,734	79%	119.9	66

PSAP	ST	Population	Incoming	CV/Pop	Total Miles	Pop Density
Agency B16	MT	37,304	33,000	88%	73.4	16
Agency B30	TX	73,334	66,203	90%	28	1,346
Agency B15	MI	36,000	34,886	97%	70.9	35
Agency B25	CA	60,000	62,400	104%	17.1	5,263
Agency C3	MI	110,000	140,000	127%	51.5	247
Agency B20	IL	46,000	63,501	138%	59.6	84
Agency A17	IL	16,000	23,650	148%	35	35
Agency B28	MI	65,000	96,981	149%	43.1	50
Agency C10	KY	140,000	242,400	173%	135	700
Agency B36	NC	94,536	169,544	179%	19.6	2,246
Agency B34	MI	80,000	158,000	198%	73.8	69
Agency C9	SC	132,000	261,180	198%	146.2	164
Agency B10	OH	31,000	72,950	235%	35	70
Agency B13	SD	35,074	82,542	235%	84.4	20
Agency C4	TX	110,000	259,000	235%	26.5	1,692
Agency B33	KY	78,000	194,802	250%	111.8	108
Agency B3	MI	26,000	70,661	272%	96.4	49
Agency B22	KY	49,752	160,580	323%	42.4	311
Agency A5	KY	10,500	36,486	347%	45.3	42
Agency B1	NC	20,000	69,589	348%	9.2	110
Agency B2	TN	23,150	82,850	358%	49.6	37
Agency A23	MI	18,773	67,380	359%	119.7	10
Agency B24	FL	58,000	232,400	401%	77.6	91

**Table 23-Sort Call Volume versus Population**

The above table is a sort by **Call Volume** (i.e., all 9-1-1 and 7-/10-digit emergency calls) divided by the **Population**.

### Assessing Call Volume Relationships

1. Population relationship to Call Volume:
  - a. The range goes from 3% to 401%
  - b. Looking at PSAP sizes, it can be seen that the percentages vary significantly regardless of size.
  - c. Going back to **Chart 1**, it can be seen that if the exceptions are removed, there is a relationship between Call Volume and Population.
  - d. Conclusion: Population alone is a good indicator of call volume, but should be modified by the influences of other factors to be accurate. Unfortunately, the factors measured in this report do not adequately explain the variances.
2. Highway Miles to Call Volume:
  - a. The high number of miles in Agency A20 and Agency C6 are associated with low call volume.
  - b. The low number of miles in Agency B10 and Agency B1 are associated with high call volume.
  - c. Conclusion: There does not appear to be a correlation.
3. Population Density to Call Volume:
  - a. The high population density of Agency C6 and Agency A6 are associated with low call volume.
  - b. The low population density of Agency B2 and Agency A23 are associated with high call volume.
  - c. Conclusion: There does not appear to be a correlation.

There are at least three possible reasons for the lack of correlation:

1. Key influencing factor(s) has(have) not been captured in the study.
2. The correlations have a tendency to cancel each other out.
3. The 7-/10-digit call volumes reported may have significant differences in the percentage of calls that are emergencies.

### Examining Reasons for Lack of Correlation

1. Key influencing factor(s) have not been captured in the study.
  - a. Crime rate – If there is a high crime rate, then the number of calls should be higher. This data could be obtained from FBI reports.
  - b. Surrounding Demographics – This in a sense has appeared in that small, inner-city (but not meaning ghetto) PSAPs have a higher call volume probably because of the greater transient population from nearby high population jurisdictions. Regional Vice President Bill McMurray suggested this.

- c. Local attitudes and customs on use of PSAP – Some PSAPs willingly take municipal queries (similar to 3-1-1 service), while others discourage any call except an emergency. This may be why the 7-/10-digit emergency call volume differs significantly. While the “attitude” has not been recorded, the next table examines the call volume of just 9-1-1 calls.
2. Influencing factor that has been considered and discounted:
- Whether a PSAP answers just police, or just police and fire, or police, fire and EMS – All the PSAPs in this study answered all three.
3. Considering whether factors cancel each other out.
- a. There are several pairs of closely related PSAPs where one factor is high in the first example in the pair and low in the other, yet the call volume per population is nearly identical.

PSAP	Call Volume/Population	Highway Miles	Population Density
Agency B18	21%	28.5	72
Agency A9	21%	160.9	3
Agency B4	53%	115	52
Agency C5	53%	55.3	125
Agency B13	235%	84.4	20
Agency C4	235%	26.5	1,692

**Table 24-Comparing PSAP Call Volume/Population by Highway Miles and Population Density**

Thus, this is a possible answer, but more sets of PSAPs with similar call volumes per population are needed than were available in this study.



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Perhaps a sort by total miles of four-lane highway (**Hwy Miles**) shows a correlation. This is done in **Table 25** below.

PSAP	ST	Population	Call Volume	CV/Pop	Hwy Miles	Pop Density
Agency A6	CA	10,686	2,186	20%	0	3,339
Agency A7	TN	11,162	6,500	60%	0	36
Agency B11	FL	34,500	16,881	49%	0	31
Agency A4	IL	97,000	38,898	40%	0	12,000
Agency A1	IL	110,000	68,061	62%	8.3	2,428
Agency B1	NC	20,000	69,589	348%	9.2	110
Agency A8	IL	13,500	3,000	22%	10.6	35
Agency B7	IN	27,800	11,988	43%	13.8	70
Agency B25	CA	60,000	62,400	104%	17.1	5,263
Agency A3	GA	70,000	50,800	73%	19	1,240
Agency B36	NC	94,536	169,544	179%	19.6	2,246
Agency B9	TN	29,862	13,000	44%	20	107
Agency C4	TX	110,000	259,000	235%	26.5	1,692
Agency B30	TX	73,334	66,203	90%	28	1,346
Agency B18	AR	40,000	8,305	21%	28.5	72
Agency A15	FL	16,000	7,200	45%	28.6	23
Agency B23	MO	52,000	19,106	37%	30.2	81
Agency C1	LA	104,503	48,000	46%	30.6	50
Agency A19	KY	17,000	4,923	29%	32	46
Agency A17	IL	16,000	23,650	148%	35	35
Agency B10	OH	31,000	72,950	235%	35	70
Agency A2	KS	6,528	4,211	65%	35.2	6
Agency B5	KY	27,000	11,400	42%	36.7	95
Agency B22	KY	49,752	160,580	323%	42.4	311
Agency B28	MI	65,000	96,981	149%	43.1	50
Agency A5	KY	10,500	36,486	347%	45.3	42
Agency A18	MI	17,000	6,223	37%	46.9	30
Agency B6	MI	27,500	13,124	48%	48.2	48
Agency A16	IL	16,000	3,377	21%	48.9	152
Agency A21	IA	18,187	4,600	25%	49.5	63
Agency B2	TN	23,150	82,850	358%	49.6	37
Agency B26	NY	61,676	38,129	62%	50.1	61
Agency C3	MI	110,000	140,000	127%	51.5	247
Agency B19	PA	46,000	18,356	40%	54.5	106
Agency B29	IL	68,277	50,929	75%	54.8	79
Agency B14	LA	35,644	4,727	13%	55	53
Agency A13	WV	15,200	6,815	45%	55.1	36
Agency C5	TX	117,300	62,288	53%	55.3	125
Agency A11	LA	14,139	4,865	34%	55.5	22
Agency B35	LA	89,974	31,912	35%	56.2	61
Agency A22	IL	18,200	550	3%	58.3	34
Agency A10	AL	14,000	10,300	74%	58.9	140
Agency B20	IL	46,000	63,501	138%	59.6	84

PSAP	ST	Population	Call Volume	CV/Pop	Hwy Miles	Pop Density
Agency A14	MO	15,500	5,935	38%	60.1	19
Agency A12	IL	15,000	6,800	45%	66.4	27
Agency B17	MI	38,543	12,012	31%	67.1	24
Agency B15	MI	36,000	34,886	97%	70.9	35
Agency B8	AL	28,756	15,167	53%	73.2	23
Agency B16	MT	37,304	33,000	88%	73.4	16
Agency B34	MI	80,000	158,000	198%	73.8	69
Agency C8	PA	127,500	56,891	45%	74.1	76
Agency B24	FL	58,000	232,400	401%	77.6	91
Agency B27	PA	62,000	36,275	59%	81.1	55
Agency B31	IN	75,000	27,000	36%	84.2	187
Agency B13	SD	35,074	82,542	235%	84.4	20
Agency B3	MI	26,000	70,661	272%	96.4	49
Agency C2	MI	109,000	34,452	32%	97.525	131
Agency B21	FL	46,755	18,552	40%	103.2	1,063
Agency B33	KY	78,000	194,802	250%	111.8	108
Agency B12	IL	35,000	9,720	28%	114.4	48
Agency B4	SC	26,314	13,920	53%	115	52
Agency A23	MI	18,773	67,380	359%	119.7	10
Agency B32	PA	75,259	59,734	79%	119.9	66
Agency C7	SD	126,377	66,000	52%	126.6	11
Agency A20	VT	17,925	2,337	13%	131	105
Agency C10	KY	140,000	242,400	173%	135	700
Agency C9	SC	132,000	261,180	198%	146.2	164
Agency A9	CO	13,500	2,846	21%	160.9	3
Agency C6	KY	123,000	20,950	17%	164	1,230

**Table 25-Sort by Highway Mileage**

If you start at the first PSAP listed and note that Agency A6 has no highway (defined as divided four lanes) in its jurisdiction (it is all city streets) and the **Call Volume to Population** is 20%, then compare that with the next PSAP, Agency A7, which still has zero highway miles (it has two-lane roads), the call volume to population is 60%. Compare it again with the last PSAP on the list, Agency C6, which has 164 highway miles, but only 17% call volume to population.

The highway mileage influence, if there is one, is hidden by other factors.

Yet, there is some information about these PSAPs that provide a hint of the other factors.

For Agency A6, it may be indicating that city street mileage, which was not captured, may have a similar influence as highway mileage, thus a “mileage” number should include both city streets and highways.

For Agency A7, we learned earlier that their high call volume resulted from a policy of the PSAP serving to provide information to the community on a variety of non-emergency services, such as whether school has been closed as a result of snow.

Next we examine whether just looking at **9-1-1 Call Volume to Population** (i.e., 7-/10-digit emergency calls are omitted) shows any correlations with **highway mileage** or **population density**. This is done in the following **Table 26**:

PSAP	ST	Population	9-1-1 Calls	9-1-1 Calls /Population	Total Miles	Population Density
Agency A22	IL	18,200	550	3%	58	34
Agency A4	IL	97,000	8,653	9%	0	11,758
Agency A20	VT	17,925	2,337	13%	131	105
Agency B14	LA	35,644	4,727	13%	55	53
Agency A1	IL	110,000	14,718	13%	8	63,218
Agency C6	KY	123,000	20,950	17%	164	1,230
Agency A19	KY	17,000	3,226	19%	32	46
Agency A6	CA	10,686	2,186	20%	0	3,339
Agency B20	IL	46,000	9,428	20%	60	84
Agency B18	AR	40,000	8,305	21%	29	72
Agency A9	CO	13,500	2,846	21%	161	3
Agency A16	IL	16,000	3,377	21%	49	152
Agency B19	PA	46,000	9,854	21%	55	106
Agency B16	MT	37,304	8,133	22%	73	16
Agency A8	IL	13,500	3,000	22%	11	35
Agency A17	IL	16,000	3,650	23%	35	35
Agency A23	MI	18,773	4,380	23%	120	10
Agency A21	IA	18,187	4,600	25%	50	63
Agency B7	IN	27,800	7,501	27%	14	70
Agency B12	IL	35,000	9,720	28%	114	48
Agency B17	MI	38,543	12,012	31%	67	24
Agency A18	MI	17,000	5,658	33%	47	30
Agency A11	LA	14,139	4,745	34%	56	22
Agency B13	SD	35,074	12,075	34%	84	20
Agency B35	LA	89,974	31,912	35%	56	61
Agency B31	IN	75,000	27,000	36%	84	187
Agency A14	MO	15,500	5,638	36%	60	19
Agency B23	MO	52,000	19,106	37%	30	81
Agency B15	MI	36,000	13,824	38%	71	35
Agency B21	FL	46,755	18,552	40%	103	1,063
Agency B32	PA	75,259	31,268	42%	120	66
Agency B5	KY	27,000	11,400	42%	37	95
Agency B1	NC	20,000	8,638	43%	9	110
Agency B9	TN	29,862	13,000	44%	20	107
Agency A13	WV	15,200	6,815	45%	55	36
Agency A15	FL	16,000	7,200	45%	29	23
Agency A12	IL	15,000	6,800	45%	66	27
Agency C1	LA	104,503	48,000	46%	31	50
Agency B27	PA	62,000	28,775	46%	81	55
Agency C7	SD	126,377	60,000	47%	127	11
Agency B6	MI	27,500	13,124	48%	48	48
Agency B8	AL	28,756	13,807	48%	73	23

PSAP	ST	Population	9-1-1 Calls	9-1-1 Calls /Population	Total Miles	Population Density
Agency B11	FL	34,500	16,881	49%	0	31
Agency A7	TN	10,898	5,500	50%	0	36
Agency C8	PA	127,500	67,211	53%	74	76
Agency B4	SC	26,314	13,900	53%	115	52
Agency C5	TX	117,300	62,043	53%	55	125
Agency B3	MI	26,000	14,661	56%	96	49
Agency B10	OH	31,000	18,950	61%	35	70
Agency A2	KS	6,528	4,211	65%	35	6
Agency C4	TX	110,000	74,000	67%	27	1,692
Agency B28	MI	65,000	44,147	68%	43	50
Agency A3	GA	70,000	50,000	71%	19	14,583
Agency B33	KY	78,000	55,802	72%	112	108
Agency B36	NC	94,536	68,415	72%	20	2,246
Agency B34	MI	80,000	58,000	73%	74	69
Agency A10	AL	14,000	10,300	74%	59	140
Agency B29	IL	68,277	50,929	75%	55	79
Agency B24	FL	58,000	49,400	85%	78	91
Agency B30	TX	73,334	66,203	90%	28	1,346
Agency B25	CA	60,000	62,400	104%	17	5,263
Agency C9	SC	132,000	152,180	115%	146	164
Agency C3	MI	110,000	140,000	127%	52	247
Agency C10	KY	140,000	240,000	171%	135	700
Agency B22	KY	49,752	111,932	225%	42	311
Agency B2	TN	23,150	73,000	315%	50	37
Agency A5	KY	10,500	36,486	347%	45	42

**Table 26-Sort by 9-1-1 Calls to Population**

#### **Assessing Tables 23 - 26**

By removing the 7-/10-digit calls from the call volume count, the variance in the percentage range was reduced from 3% - 401% in **Table 23** to 3% - 347% above. This still does not reduce the range to the point where we need not be concerned about other influencing factors.

As in **Table 23**, **Table 26** has several pairs of similar PSAPs where a high highway mileage and low population density are reversed in ratio in an adjacent PSAP and the 9-1-1 call volume per capita is the same or almost the same.

This also reinforces the argument to conclusion that neither highway miles nor population density can be correlated to call volume.

The final potential influencing factor that remains to be compared is the number of wireless subscribers to the population. The Kentucky Equity Study had a correlation of wireless subscribers to 9-1-1 call volume. Because the populations vary so significantly in this study, it was decided that the number of wireless subscribers to population (**Wrls Sub/Pop**) would be the best way to determine any influence. This is provided in **Table 27** below.

PSAP	ST	Pop	9-1-1 Calls	CV/Pop	Wireless Subs.	Wrls Sub /Pop	Sq. Miles	Pop Density	Total Miles
Agency B21	FL	46,755	18,552	40%	1,350	3%	44	1,063	103.2
Agency A22	IL	18,200	550	3%	1,400	8%	540	34	58.3
Agency B29	IL	68,277	50,929	75%	5,525	8%	866	79	54.8
Agency A1	IL	110,000	14,718	13%	10,000	9%	2	63,218	8.3
Agency B5	KY	27,000	11,400	42%	4,200	16%	285	95	36.7
Agency C10	KY	140,000	240,000	171%	25,000	18%	200	700	135
Agency B2	TN	23,150	73,000	315%	6,000	26%	625	37	49.6
Agency B8	AL	28,756	13,807	48%	7,600	26%	1,238	23	73.2
Agency A11	LA	14,139	4,745	34%	4,000	28%	638	22	55.5
Agency C7	SD	126,377	60,000	47%	40,000	32%	11,487	11	126.6
Agency B11	FL	34,500	16,881	49%	11,000	32%	1,118	31	0
Agency B22	KY	49,752	111,932	225%	16,000	32%	160	311	42.4
Agency B13	SD	35,074	12,075	34%	12,609	36%	1,713	20	84.4
Agency C5	TX	117,300	62,043	53%	48,000	41%	938	125	55.3
Agency B35	LA	89,974	31,912	35%	38,905	43%	1,472	61	56.2
Agency C1	LA	104,503	48,000	46%	46,000	44%	2,100	50	30.6
Agency B17	MI	38,543	12,012	31%	19,000	49%	1,590	24	67.1
Agency B18	AR	40,000	8,305	21%	22,340	56%	554	72	28.5
Agency B36	NC	94,536	68,415	72%	57,000	60%	42	2,246	19.6
<b>Agency A5</b>	<b>KY</b>	<b>10,500</b>	<b>36,486</b>	<b>347%</b>	<b>10,000</b>	<b>95%</b>	<b>251</b>	<b>42</b>	<b>45.3</b>

**Table 27-Sort by Wireless Subscribers to Population**

### Conclusion

There is a fair correlation of call volume to population as is best visually noticed in **Chart 1**. However, based on the data collected, there is no correlation with the number of wireless subscribers, highway miles or population density.

Yet, that could be the result of a few factors:

1. The sample set is too small.
2. The data submitted is not accurate. (Consider that **Agency A5** reports 10,000 wireless subscribers when there are only 10,500 people in the jurisdiction).

With the above conclusion on influencing factors, the solution for PSAP Staffing recommendations is to note that whatever additional factors either increase or decrease the call volume per specific population, these random factors will balance out if the PSAPs are grouped.

Therefore, the PSAPs will be grouped by their size and averages taken for the staffing recommendations.

#### **4.4 CONCLUSIONS AND RECOMMENDATIONS FROM THE EMPIRICAL APPROACH**

The PSAPs have been grouped by size, with one table provided per size. This has been done to take into account the commonality of staffing structural differences within each size and to allow the factors that tend to cause one PSAP to have high call volume for a certain population to be balanced by the factors that cause another PSAP to have low call volume for that same size population.

The recommended staffing will be based on the averages for each PSAP size, modified by a few special situations, which will be covered later.

As is typical of averages, they are not round numbers as you'll see at the bottom of each table. Nor do the totals add up to whole persons. This will be reconciled later. The following three tables merely document current PSAP manning as a basis for analysis which follows.

Finally, the reader should be aware of two facts learned as discussions were held with several of the PSAP managers:

1. The personnel they reported as budgeted were not sufficient to do all the work required. Many PSAPs had personnel working overtime or just didn't spend much time on non-essential tasks, such as training.
2. The PSAPs that did not report any support tasks (DBA through Admin) actually had personnel performing those tasks, but did not report them. In some instances this was because the work, specifically Database Administration and Technical, was done outside the PSAP Manager's chain of command (e.g., PSAP Operations was funded separate from a city or county support staff that did this work without charge to the PSAP).

Thus the numbers reported by some PSAPs are low for proper staffing.

Therefore, the following **Tables 28, 29 and 30** have been developed to show how staffing requirements group by PSAP size. Day-time populations are used and the three PSAPs that have the extra-ordinarily high day-time populations are highlighted in light yellow.



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The following **Table 28** reports Small PSAPs.

PSAP	ST	Pop	CT/ Disp	Ops Super	Total Ops	DB A	Techni- cal	Train - ing	Public Educ'n	Ad- min	Total Spt	Total Staff
Agency A2	KS	6,528	6	0	6	0.1	0	0.15	0.05	0.75	1	7
Agency A6	CA	10,686	4	0	4	0	0	0	0	1	1	5
Agency A8	IL	13,500	9	1	10	0	0	0	0	0	0	10
Agency A10	AL	14,000	4	4	8	0	0	0	0	0	0	8
Agency A12	IL	15,000	5	0	5	0	0	0	0	0	0	5
Agency A13	WV	15,200	8		8	1	0	1	0	1	3	11
Agency A14	MO	15,500	11.2	0	11.2	0.8	0	0	0.3	0.7	1.8	13
Agency A15	FL	16,000	8	2	10	0	0	0	0	0	0	10
Agency A16	IL	16,000	5	2	7	0	0	0	0	0	0	7
Agency A17	IL	16,000	7	1	8	0.2	0	0	0	0.8	1	9
Agency A18	MI	17,000	6	1	7	0	0	0	0	0	0	7
Agency A19	KY	17,000	6	1	7					0	0	7
Agency A20	VT	17,925	8	1	9	0	0	0	0	0	0	9
Agency A21	IA	18,187	6	1	7	0	0	0	0	0	0	7
Agency A22	IL	18,200	10	1	11	3	3	1	0	3	10	21
Agency A23	MI	18,773	4.5	0.3	4.8	1	0	0	0	1	2	6.8
<b>AVERAGE SMALL PSAP ...</b>			<b>6.73</b>	<b>1.02</b>	<b>7.69</b>	<b>0.4</b>	<b>0.2</b>	<b>0.14</b>	<b>0.023</b>	<b>0.52</b>	<b>1.24</b>	<b>8.93</b>

**Table 28-Small PSAP Actual Staffing**

The following **Table 29** reports Medium PSAPs.

PSAP	ST	Pop	CT/ Disp	Ops Super	Total Ops	DBA	Techni- cal	Train - ing	Public Educ'n	Ad- min	Total Spt	Total Staff
Agency B1	NC	20,000	8	2	10	0	0	0.5	0	0.8	1.3	11.3
Agency A5	KY	20897	6	1	7	0	0	0	0	0	0	7
Agency B2	TN	23,150	10.5	0	10.5	1	0	0	0	1	2	12.5
Agency B3	MI	26,000	9	0	9	0	0	0	0	1	1	10
Agency B4	SC	26,314	12	4	16	1	0	0.25	0.25	0.25	1.75	17.75
Agency B5	KY	27,000	6	1	7	0	0	0	0	0	0	7
Agency B6	MI	27,500	10.5	0.5	11	0.5	0	0.5	0	1	2	13
Agency B7	IN	27,800	7	1	8	0.5	0	1	0	1	2.5	10.5
Agency B8	AL	28,756	10.5	2	12.5	1	0	1	0	20	22	34.5
Agency B9	TN	29,862	10	1	11	1	0	0	0	0	1	12
Agency B10	OH	31,000	16	2	18		1	1	1	1	4	22
Agency B11	FL	34,500	12	1	13	2	2	0	0	0	4	17
Agency B12	IL	35,000	9	1	10	0.1	0.125	0.13	0.125	0.5	1	11
Agency B13	SD	35,074	11	1	12	0.2	0.5	0	0.1	0.2	1	13
Agency B14	LA	35,644	9	1	10	1.5	0.15	0.15	0	0.2	2	12
Agency B15	MI	36,000	9.5	0	9.5	0	0	0	0	1	1	10.5
Agency B16	MT	37,304	10	1	11	3	0	0	0	0	3	14
Agency B17	MI	38,543	9	3	12	0	0	0	0	0	0	12



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<b>PSAP</b>	<b>ST</b>	<b>Pop</b>	<b>CT/ Disp</b>	<b>Ops Super</b>	<b>Total Ops</b>	<b>DBA</b>	<b>Tech- nical</b>	<b>Train- ing</b>	<b>Public Educ'n</b>	<b>Ad- min</b>	<b>Total Spt</b>	<b>Total Staff</b>
Agency B18	AR	40,000	6.8	1	7.8	1	0	0.1	0.1	2	3.2	11
Agency B19	PA	46,000	13.5	1	14.5	0.3	0	0.25	0	0.5	1	15.5
Agency B20	IL	46,000	12	1	13	0.3	0.25	0.25	0.25	0	1	14
Agency B21	FL	46,755	12	1	13	2	0	0	0	0	2	15
Agency B22	KY	49,752	14	0	14	1	0	0	0	2	3	17
Agency B23	MO	52,000	14	3	17	1	0	1	0	0	2	19
Agency B37	FL	57,841	10	0	10	0.5	0	0.25	0.25	0	1	11
Agency B24	FL	58,000	25	4	29	6	1	1	0	2	10	39
Agency B25	CA	60,000	13	1	14	0	1	0	0	0	1	15
Agency B26	NY	61,676	9	1	10	0	0		0	0	0	10
Agency B27	PA	62,000	12	0	12	3.5	0	0.5	0	1.5	5.5	17.5
Agency B28	MI	65,000	9	3	12	0.4	0	0	0.1	1	1.5	13.5
Agency B29	IL	68,277	15	2	17	0.2	0.8	0.25	0.25	0.5	2	19
<b>Agency A3</b>	<b>GA</b>	<b>70,000</b>	<b>10</b>	<b>0</b>	<b>10</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>14</b>
Agency B30	TX	73,334	28	3	31	0.2	1.5	0.5	0.1	1.5	3.8	34.8
Agency B31	IN	75,000	18	3	21	0	0.08	0.12	0.02	1	1.26	22.26
Agency B32	PA	75,259	19	0	19	0	0	0	0	2	2	21
Agency B33	KY	78,000	13	4	17	1	0	0	0	1	2	19
Agency B34	MI	80,000	10	4	14	1	1	0	0	1	3	17
Agency B35	LA	89,974	10	1	11	0	0	0	0	1	1	12
Agency B36	NC	94,536	15	3	18	0.3	0.1	0	0.05	0	0.45	18.45
<b>Agency A4</b>	<b>IL</b>	<b>97,000</b>	<b>9</b>	<b>1</b>	<b>10</b>			<b>0.45</b>	<b>0.05</b>	<b>0.5</b>	<b>1</b>	<b>11</b>
<b>AVERAGE MEDIUM PSAP ....</b>			11.8	1.49	13.3	0.82	0.27	0.26	0.09	1.16	2.53	15.8

**Table 29-Medium PSAP Actual Staffing**

The following **Table 30** reports Large PSAP staffing.

<b>PSAP</b>	<b>ST</b>	<b>Pop</b>	<b>CT/ Disp</b>	<b>Ops Super</b>	<b>Total Ops</b>	<b>DBA</b>	<b>Tech- nical</b>	<b>Train- ing</b>	<b>Public Educ'n</b>	<b>Ad- min</b>	<b>Total Spt</b>	<b>Total Staff</b>
Agency C1	LA	104,503	18	1	19	1	1	0.5	0.5	1	4	23
Agency C2	MI	109,000	13	5	18	0	0	0	0	0	0	18
Agency C3	MI	110,000	17	6	23	0	0	0	0	0	0	23
<b>Agency A1</b>	<b>IL</b>	<b>110,000</b>	<b>6</b>	<b>3</b>	<b>9</b>	<b>0.5</b>	<b>0.1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1.6</b>	<b>10.6</b>
Agency C4	TX	110,000	20	4	24	0	0.5	0	0	2	2.5	26.5
Agency C5	TX	117,300	21	4	25	0	0	1	0	2	3	28
Agency C6	KY	123,000	9	4	13	0	0	0	0	0	0	13
Agency C8	PA	127,500	19.5	3	22.5	0	0.25	0	0	0	0.25	22.75
Agency C7	SD	130,000	28	2	30	0	1	1	0	1	3	33
Agency C9	SC	132,000	33	5	38	2	0	1	0	2	5	43
Agency C10	KY	140,000	30	1	31	1	2	0	0	8	11	42
<b>AVERAGE LARGE PSAP ...</b>			19.5	3.45	22.9	0.41	0.44	0.32	0.05	1.55	2.76	25.7

**Table 30-Large PSAP Actual Staffing**



### Considerations in Modifying PSAP Staffing Averages

1. For reasons listed before **Table 28**, some of the PSAPs did not report all the personnel doing work for the PSAP. For example, the “zeroes” listing DBA work in large PSAPs is simply unrealistic. Therefore the averages are low.
2. The greatest variation comes with the database administrator tasks.
  - a. If the jurisdiction has addressed and mapped the area, and the jurisdiction is stable (i.e., no new subdivision and little growth), then the man-hours requirement for the DBA is minimal. Recommend 0.1 to 0.3 depending on the size of the jurisdiction.
  - b. If the jurisdiction is growing with much new development and/or a highly mobile population so that address updates are frequent, the work for the DBA is greater. Recommend 0.2 to 0.6 DBAs, depending on the size of the jurisdiction and the dynamics of the changes.
  - c. If the jurisdiction is in the addressing and mapping mode, even though contractors are doing that work, there is a significant burden on the jurisdiction to validate addresses for 9-1-1 use. Recommend one to three DBAs, depending on the size of the jurisdiction.
3. Part-time employees are acceptable to augment full-time employees. PSAPs will be more flexible hiring part-time workers who are not interested in working 40-hour weeks and who provide an excellent resource for expanding PSAP capabilities during Busy Hours. The part-timer is also excellent for DBA where the tasks don't justify a full-time person or do justify a little more than one person. Therefore, some recommendations will result in decimal recommendations.

	<b>Additional Personnel Requirement</b>			
	Task	Small PSAP	Medium PSAP	Large PSAP
<b>MAPPING AND ADDRESSING</b>				
Little change	DBA	0	0	0
Dynamic area	DBA	0.4	0.8	1
New mapping and addressing in progress	DBA	1.5	3	4
<b>CALLS ACCEPTED</b>				
9-1-1 and Emergency only on Admin	Telecom-communicator	0	0	0
Municipal Utilities	Telecom.	1	1	2
Jurisdiction official*	Telecom.	2	4	6

\*Jurisdiction official – Take calls for other departments that are not emergency response agencies, particularly after-hours.

**Table 31-Additional Personnel Requirements**

Staffing Planning Based on Empirical Data

Using the above information, the PSAP Staff will be calculated by the following:

1. Select the table below that corresponds to the jurisdiction population.
2. Take the average personnel requirements for each task.
3. Modify by adding or subtracting additional personnel for Mapping & Addressing and/or Calls Accepted tasks.
4. Sum for each task.
5. Multiply by the "Adjust for PSAP size"
6. Round up to the nearest half-number (representing that part-time employees are recommended)

Calculating Staff for a Small PSAP

PSAP Size	CT/ Disp	Ops Super	Total Ops	DBA	Techni- cal	Train- ing	Public Educ'n	Admin	Total Spt	Total Staff
< 19,000	7	1	8	0.1	0.2	0.2	0.05	0.45	1	9
DBA Adjust										
Calls Adjust										
Total										
Rounded										

**Table 32-Calculating Staff for a Small PSAP**

Calculating Staff for a Medium PSAP

PSAP Size	CT/ Disp	Ops Super	Total Ops	DBA	Techni- cal	Train- ing	Public Educ'n	Admin	Total Spt	Total Staff
19K - 100K	12	2	14	0.2	0.25	0.25	0.1	1.2	2.6	16.0
DBA Adjust										
Calls Adjust										
Total										
Rounded										

**Table 33-Calculating Staff for a Medium PSAP**

Calculating Staff for a Large PSAP

PSAP Size	CT/ Disp	Ops Super	Total Ops	DBA	Techni- cal	Train- ing	Public Educ'n	Admin	Total Spt	Total Staff
100K - 140K	19	4	23	0.3	0.4	0.3	0.1	1.50	3.2	25.6
DBA Adjust										
Calls Adjust										
Total										
Rounded										

**Table 34-Calculating Staff for a Large PSAP**

The accompanying PSAP Staffing Guideline, will provide an easy to fill out spreadsheet to complete the staffing assessment.

## 5.0 STATISTICS

### 5.1 COSTS PER CALL RECEIVED

The following three tables show the average cost to receive a 9-1-1 call and the average cost to receive all calls (7-/10-digit emergency number calls added). There are three tables as there are significant differences among the PSAP sizes.

PSAP	ST	Pop	TOTAL COST	Total 9-1-1 Calls	Cost per 9-1-1 Call	All Incoming	Cost per Incoming Call
Agency A2	KS	6,528	\$157,028	4,211	\$37.29	4,211	\$37.29
Agency A5	KY	10,500	\$303,000	36,486	\$8.30	36,486	\$8.30
Agency A6	CA	10,686	\$143,370	2,186	\$65.59	2,186	\$65.59
Agency A7	TN	11,162	\$168,800	5,500	\$30.69	80,500	\$2.10
Agency A8	IL	13,500	\$196,000	3,000	\$65.33	3,000	\$65.33
Agency A10	AL	14,000	\$264,000	10,300	\$25.63	10,300	\$25.63
Agency A11	LA	14,139	\$37,500	4,745	\$7.90	4,865	\$7.71
Agency A13	WV	15,200	\$240,000	6,815	\$35.22	6,815	\$35.22
Agency A14	MO	15,500	\$376,565	5,638	\$66.79	5,935	\$63.45
Agency A15	FL	16,000	\$55,000	7,200	\$7.64	7,200	\$7.64
Agency A16	IL	16,000	\$65,000	3,377	\$19.25	3,377	\$19.25
Agency A17	IL	16,000	\$293,000	3,650	\$80.27	23,650	\$12.39
Agency A18	MI	17,000	\$415,966	5,658	\$73.52	6,223	\$66.84
Agency A19	KY	17,000	\$240,200	3,226	\$74.46	4,923	\$48.79
Agency A21	IA	18,187	\$180,000	4,600	\$39.13	4,600	\$39.13
<b>Average Costs ...</b>					<b>\$42.47</b>		<b>\$33.64</b>

**Table 35-Cost per Call for Small PSAPs**

PSAP	ST	Pop	TOTAL COST	Total 9-1-1 Calls	Cost per 9-1-1 Call	All Incoming	Cost per Incoming Call
Agency B1	NC	20,000	\$448,900	8,638	\$51.97	69,589	\$6.45
Agency B2	TN	23,150	\$441,500	73,000	\$6.05	82,850	\$5.33
Agency B3	MI	26,000	\$720,000	14,661	\$49.11	70,661	\$10.19
Agency B4	SC	26,314	\$318,548	13,900	\$22.92	13,920	\$22.88
Agency B5	KY	27,000	\$164,000	11,400	\$14.39	11,400	\$14.39
Agency B6	MI	27,500	\$348,516	13,124	\$26.56	13,124	\$26.56
Agency B7	IN	27,800	\$310,091	7,501	\$41.34	11,988	\$25.87
Agency B8	AL	28,756	\$347,326	13,807	\$25.16	15,167	\$22.90
Agency B9	TN	29,862	\$250,694	13,000	\$19.28	13,000	\$19.28
Agency B10	OH	31,000	\$546,000	18,950	\$28.81	72,950	\$7.48
Agency B12	IL	35,000	\$49,050	9,720	\$5.05	9,720	\$5.05
Agency B13	SD	35,074	\$530,824	12,075	\$43.96	82,542	\$6.43
Agency B14	LA	35,644	\$204,240	4,727	\$43.21	4,727	\$43.21
Agency B15	MI	36,000	\$429,000	13,824	\$31.03	34,886	\$12.30



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PSAP	ST	Pop	TOTAL COST	Total 9-1-1 Calls	Cost per 9-1-1 Call	All Incoming	Cost per Incoming Call
Agency B16	MT	37,304	\$358,000	8,133	\$44.02	33,000	\$10.85
Agency B17	MI	38,543	\$608,000	12,012	\$50.62	12,012	\$50.62
Agency B18	AR	40,000	\$289,262	8,305	\$34.83	8,305	\$34.83
Agency B19	PA	46,000	\$608,000	9,854	\$61.70	18,356	\$33.12
Agency B20	IL	46,000	\$532,300	9,428	\$56.46	63,501	\$8.38
Agency B21	FL	46,755	\$165,518	18,552	\$8.92	18,552	\$8.92
Agency B22	KY	49,752	\$886,190	111,932	\$7.92	160,580	\$5.52
Agency B23	MO	52,000	\$629,450	19,106	\$32.95	19,106	\$32.95
Agency B25	CA	60,000	\$1,007,626	62,400	\$16.15	62,400	\$16.15
Agency B26	NY	61,676	\$743,883	0		38,129	\$19.51
Agency B27	PA	62,000	\$472,000	28,775	\$16.40	36,275	\$13.01
Agency B28	MI	65,000	\$1,049,574	44,147	\$23.77	96,981	\$10.82
Agency B29	IL	68,277	\$829,996	50,929	\$16.30	50,929	\$16.30
Agency A3	GA	70,000	\$414,550	50,000	\$8.29	50,800	\$8.16
Agency B31	IN	75,000	\$1,189,086	27,000	\$44.04	27,000	\$44.04
Agency B32	PA	75,259	\$768,507	31,268	\$24.58	59,734	\$12.87
Agency B33	KY	78,000	\$808,300	55,802	\$14.49	194,802	\$4.15
Agency B34	MI	80,000	\$563,015	58,000	\$9.71	158,000	\$3.56
Agency B35	LA	89,974	\$275,000	31,912	\$8.62	31,912	\$8.62
Agency B36	NC	94,536	\$2,300,646	68,415	\$33.63	169,544	\$13.57
Agency A4	IL	97,000	\$657,160	8,653	\$75.95	38,898	\$16.89
			Average Costs ...		\$29.36		\$17.18

**Table 36-Cost per Call for Medium PSAPs**

PSAP	ST	Pop	TOTAL COST	Total 9-1-1 Calls	Cost per 9-1-1 Call	Incoming	Cost per Incoming Call
Agency C1	LA	104,503	\$670,000	48,000	\$13.96	48,000	\$13.96
Agency C3	MI	110,000	\$1,280,000	140,000	\$9.14	140,000	\$9.14
Agency A1	IL	110,000	\$715,200	14,718	\$48.59	68,061	\$10.51
Agency C4	TX	110,000	\$1,584,012	74,000	\$21.41	259,000	\$6.12
Agency C5	TX	117,300	\$898,859	62,043	\$14.49	62,288	\$14.43
Agency C6	KY	123,000	\$625,293	20,950	\$29.85	20,950	\$29.85
Agency C7	SD	126,377	\$1,673,897	60,000	\$27.90	66,000	\$25.36
Agency C8	PA	127,500	\$1,338,226	67,211	\$19.91	56,891	\$23.52
Agency C9	SC	132,000	\$2,099,295	152,180	\$13.79	261,180	\$8.04
Agency C10	KY	140,000	\$2,687,900	240,000	\$11.20	242,400	\$11.09
			Average Costs ..		\$21.02		\$15.20

**Table 37-Cost per Call for Large PSAPs**

## 5.2 COSTS PER DISPATCH

The following tables show the cost to dispatch a call. Note that the same PSAP total costs are used here as in the “cost to receive a call” tables above, so the amounts cannot be added together. The survey does not provide sufficient information to differentiate between the costs to receive and to dispatch, so the tables below are merely the total PSAP operating costs divided by the number of calls dispatched.

### Cost per Dispatch by Small PSAP

PSAP	ST	Pop	Total Cost	Calls Dispatched	Cost per Dispatch
Agency A2	KS	6,528	\$157,028	22,618	\$6.94
Agency A6	CA	10,686	\$143,370	2,186	\$65.59
Agency A8	IL	13,500	\$196,000	3,000	\$65.33
Agency A11	LA	14,139	\$37,500	4,865	\$7.71
Agency A13	WV	15,200	\$240,000	12,394	\$19.36
Agency A14	MO	15,500	\$376,565	13,648	\$27.59
Agency A15	FL	16,000	\$55,000	7,200	\$7.64
Agency A16	IL	16,000	\$65,000	2,769	\$23.47
Agency A17	IL	16,000	\$293,000	3,650	\$80.27
Agency A18	MI	17,000	\$415,966	7,562	\$55.01
Agency A19	KY	17,000	\$240,200	3,294	\$72.92
Agency A21	IA	18,187	\$180,000	2,200	\$81.82
Agency A22	IL	18,200	\$343,067	13,871	\$24.73
Average Small PSAP ..					\$41.41

Table 38-Cost per Dispatch by Small PSAP

### Cost per Dispatch by Medium PSAP

PSAP	ST	Pop	Total Cost	Calls Dispatched	Cost per Dispatch
Agency B1	NC	20,000	\$448,900	20,876	\$21.50
Agency A5	KY	20897	\$303,000	36,486	\$8.30
Agency B2	TN	23,150	\$441,500	82,850	\$5.33
Agency B3	MI	26,000	\$720,000	34,800	\$20.69
Agency B4	SC	26,314	\$318,548	12,768	\$24.95
Agency B5	KY	27,000	\$164,000	4,800	\$34.17
Agency B6	MI	27,500	\$348,516	13,460	\$25.89
Agency B7	IN	27,800	\$310,091	11,988	\$25.87
Agency B8	AL	28,756	\$347,326	13,300	\$26.11
Agency B9	TN	29,862	\$250,694	13,000	\$19.28
Agency B10	OH	31,000	\$546,000	58,334	\$9.36
Agency B12	IL	35,000	\$49,050	20,876	\$2.35
Agency B13	SD	35,074	\$530,824	20,639	\$25.72
Agency B15	MI	36,000	\$429,000	14,452	\$29.68
Agency B17	MI	38,543	\$608,000	12,012	\$50.62



**PSAP STAFFING GUIDELINES REPORT  
AS COMMISSIONED BY  
NENA SWAT OPERATIONS TEAM**

**9-1-1 SME  
Consulting**

<b>PSAP</b>	<b>ST</b>	<b>Pop</b>	<b>Total Cost</b>	<b>Calls Dispatched</b>	<b>Cost per Dispatch</b>
Agency B18	AR	40,000	\$289,262	8,305	\$34.83
Agency B19	PA	46,000	\$608,000	20,916	\$29.07
Agency B20	IL	46,000	\$532,300	37,235	\$14.30
Agency B21	FL	46,755	\$165,518	18,552	\$8.92
Agency B22	KY	49,752	\$886,190	57,171	\$15.50
Agency B23	MO	52,000	\$629,450	60,000	\$10.49
Agency B25	CA	60,000	\$1,007,626	13,691	\$73.60
Agency B27	PA	62,000	\$472,000	32,600	\$14.48
Agency B28	MI	65,000	\$1,049,574	36,319	\$28.90
Agency B29	IL	68,277	\$829,996	59,555	\$13.94
Agency A3	GA	70,000	\$414,550	50,000	\$8.29
Agency B31	IN	75,000	\$1,189,086	74,787	\$15.90
Agency B32	PA	75,259	\$768,507	35,412	\$21.70
Agency B33	KY	78,000	\$808,300	91,380	\$8.85
Agency B34	MI	80,000	\$563,015	54,728	\$10.29
Agency A4	IL	97,000	\$657,160	12,094	\$54.34
			Average Medium PSAP..		\$22.36

**Table 39-Cost per Dispatch by Medium PSAPs**

**Cost per Dispatch by Large PSAP**

<b>PSAP</b>	<b>ST</b>	<b>Pop</b>	<b>Total Cost</b>	<b>Calls Dispatched</b>	<b>Cost per Dispatch</b>
Agency C1	LA	104,503	\$670,000	90,869	\$7.37
Agency C2	MI	109,000	\$1,102,400	54,939	\$20.07
Agency C3	MI	110,000	\$1,280,000	140,000	\$9.14
Agency C4	TX	110,000	\$1,584,012	158,500	\$9.99
Agency C5	TX	117,300	\$898,859	85,208	\$10.55
Agency C6	KY	123,000	\$625,293	20,950	\$29.85
Agency C8	PA	127,500	\$1,338,226	44,285	\$30.22
Agency C7	SD	130,000	\$1,673,897	229,131	\$7.31
Agency C9	SC	132,000	\$2,099,295	147,377	\$14.24
Agency C10	KY	140,000	\$2,687,900	53,300	\$50.43
			Average Large PSAP ..		\$18.92

**Table 40-Cost per Dispatch by Large PSAPs**

Number of Full Time Equivalent Staff Allocated for Call Center Operations

Provided in **Tables 28, 29 and 30** above.

Number of Full Time Equivalent Staff Allocated for Call Center Management, Administration and/or Technical Support

Provided in **Tables 28, 29 and 30** above.

#### Percentage of Total Operating Budget Allocated to Personnel Budget

The following three tables provide the percentages for each PSAP that provided budget data plus show the average percentage for each of the three PSAP size categories.

#### Average for Small PSAPs

PSAP	Pop	Personnel Costs							Other Operating Costs				TOTAL	
		Ops	DB/GIS	IT	MIS	Admin	Total Personnel	Percent of Total Op Budget	Training	Public Ed.	All Other	Total Other Ops Costs		
Agency A3	6,200	412,000	0	0	850	1,500	414,350	100%	200	0	0	200	0%	
Agency A2	6,528	108,844	0	0	0	42,184	151,028	96%	3,000	3,000	0	6,000	4%	
Agency A6	10,686	143,370	0	0	0	0	143,370	100%	0	0	0	0	0%	
Agency A7	11,162	125,000	25,000	9,000	0	6,800	165,800	98%	2,500	0	500	3,000	2%	
Agency A8	13,500	144,000	0	45,000	0	0	189,000	96%	5,000	2,000	0	7,000	4%	
Agency A10	14,000	175,000	28,000	55,000	0	0	258,000	98%	1,000	0	5,000	6,000	2%	
Agency A13	15,200	65,000	15,000	0	0	30,000	110,000	46%	5,000	0	125,000	130,000	54%	
Agency A14	15,500	292,003	25,392	0	1,000	35,175	353,570	94%	7,920	15,075	0	22,995	6%	
Agency A17	16,000	227,000	0	0	0	45,000	272,000	93%	21,000	0	0	21,000	7%	
Agency A18	17,000	357564	5000	18000	5000	0	385,564	93%	1000	0	29402	30,402	7%	
Agency A19	17,000	164,400	0	20,000	50,800	0	235,200	98%	3,000	1,000	1,000	5,000	2%	
Agency A21	18,187	175,000	0	0	0	0	175,000	97%	5,000	0	0	5,000	3%	
Agency A22	18,200	290,000	14,000	0	14,000	14,000	332,000	97%	4,000	0	7,067	11,067	3%	
<b>Average for Small PSAPs ..</b>		<b>\$206,091</b>	<b>\$8,646</b>	<b>\$11,308</b>	<b>\$5,512</b>	<b>\$13,435</b>	<b>\$244,991</b>	<b>93%</b>	<b>\$4,509</b>	<b>\$1,621</b>	<b>\$12,921</b>	<b>\$19,051</b>	<b>7%</b>	<b>\$264,042</b>

**Table 41-Average for Small PSAP**

**Average for Medium PSAPs**

PSAP	Pop	Personnel Costs						Other Operating Costs				TOTAL		
		Ops	DB/GIS	IT	MIS	Admin	Total Personnel	Percent of Total Op Budget	Training	Public Ed.	All Other	Total Other Ops Costs		
Agency B1	20,000	294,400	0	52,000	2,000	25,000	373,400	83%	5,000	1,000	69,500	75,500	17%	448,900
Agency A5	20897	303,000	0	0	0	0	303,000	100%	0	0	0	0	0%	303,000
Agency B2	23,150	311,000	28,000	20,000	0	39,000	398,000	90%	13,000	2,500	28,000	43,500	10%	441,500
Agency B3	26,000	700,000	0	0	0	0	700,000	97%	15,000	5,000	0	20,000	3%	720,000
Agency B4	26,314	273,071	12,477	0	0	27,000	312,548	98%	6,000	0	0	6,000	2%	318,548
Agency B5	27,000	164,000	0	0	0	0	164,000	100%	0	0	0	0	0%	164,000
Agency B6	27,500	290,975	0	0	0	39,541	330,516	95%	9,500	0	8,500	18,000	5%	348,516
Agency B7	27,800	194,091	0	0	0	41,000	235,091	76%	0	0	75,000	75,000	24%	310,091
Agency B8	28,756	201,326	27,000	32,000	10,000	0	270,326	78%	10,000	1,000	66,000	77,000	22%	347,326
Agency B9	29,862	231,329	19,365	0	0	0	250,694	100%	0	0	0	0	0%	250,694
Agency B10	31,000	380,000	5,000	20,000	50,000	36,000	491,000	90%	6,000	9,000	40,000	55,000	10%	546,000
Agency B12	35,000	49,050	0	0	0	0	49,050	100%	0	0	0	0	0%	49,050
Agency B13	35,074	506,951	5,000	4,500	0	0	516,451	97%	14,373	0	0	14,373	3%	530,824
Agency B14	35,644	153,600	31,025	3,102	0	12,410	200,137	98%	3,103	1,000	0	4,103	2%	204,240
Agency B15	36,000	369,000	0	0	0	60,000	429,000	100%	0	0	0	0	0%	429,000
Agency B16	37,304	300,000	52,500	0	500	0	353,000	99%	5,000	0	0	5,000	1%	358,000
Agency B17	38,543	580,000	0	15,000	0	0	595,000	98%	5,000	5,000	3,000	13,000	2%	608,000
Agency B18	40,000	289,262	0	0	0	0	289,262	100%	0	0	0	0	0%	289,262
Agency B19	46,000	431,000	12,500	70,000	30,000	37,000	580,500	95%	25,000	2,500	0	27,500	5%	608,000
Agency B20	46,000	317,300	44,000	80,000	80,000	0	521,300	98%	6,000	5,000	0	11,000	2%	532,300
Agency B21	46,755	25,124	27,888	90,354	0	0	143,366	87%	1,000	1,200	19,952	22,152	13%	165,518
Agency B22	49,752	506,285	48,547	63,000	71,075	104,193	793,100	89%	4,500	0	88,590	93,090	11%	886,190
Agency B23	52,000	503,450	30,000	0	0	40,000	573,450	91%	20,000	0	36,000	56,000	9%	629,450
Agency B37	57,841	225,371		0	0	0	225,371	95%	4,000	2,000	6,050	12,050	5%	237,421

PSAP	Pop	Personnel Costs							Other Operating Costs				TOTAL
		Ops	DB/GIS	IT	MIS	Admin	Total Personnel	Percent of Total Op Budget	Training	Public Ed.	All Other	Total Other Ops Costs	
Agency B25	60,000	847,276	139,100	5,200	5,050	0	996,626	99%	10,000	1,000	0	11,000	1%
Agency B26	61,676	329,963	33,020	362,104	0	18,796	743,883	100%	0	0	0	0	0%
Agency B27	62,000	300,000	98,000	0	0	57,000	455,000	96%	17,000	0	0	17,000	4%
Agency B28	65,000	503,705	40,179	0	0	70,613	614,497	59%	9,500	16,072	409,505	435,077	41%
Agency B29	68,277	716,964	9,581	0	38,323	28,054	792,922	96%	23,047	14,027	0	37,074	4%
Agency B31	75,000	924,686	0	184,800	0	69,600	1,179,086	99%	10,000	0	0	10,000	1%
Agency B32	75,259	472,186	0	233,690	0	60,631	766,507	100%	2,000	0	0	2,000	0%
Agency B33	78,000	564,000	37,000	79,500	0	39,000	719,500	89%	11,000	0	77,800	88,800	11%
Agency B34	80,000	429,868	27,872	12,000	31,075	45,000	545,815	97%	8,000	200	9,000	17,200	3%
Agency B35	89,974	200,000	0	0	0	75,000	275,000	100%	0	0	0	0	0%
Agency B36	94,536	1,580,646		720,000		0	2,300,646	83%		0		0	17%
Agency A4	99,000	600,120	0	0	0	0	600,120	91%	8,500	0	48,540	57,040	9%
Average for Medium PSAP ..		\$418,583	\$21,413	\$56,868	\$9,086	\$25,690	\$531,641	83%	\$7,186	\$1,847	\$28,155	37,189	17%
													\$566,406

**Table 42-Average for Medium PSAPs**

### Average for Large PSAPs

PSAP	Pop	Personnel Costs						Other Operating Costs				TOTAL
		Ops	DB/GIS	IT	MIS	Admin	Total Personnel	Percent of Total Op Budget	Training	Public Ed.	All Other	
Agency C1	104,503	660,000	0	0	0	0	660,000	99%	10,000	0	0	10,000 1%
Agency C2	109,000	900,500	45,000	0	0	100,900	1,046,400	95%	10,000	1,000	45,000	56,000 5%
Agency C3	110,000	1,060,000	0	50,000	30,000	100,000	1,240,000	97%	20,000	10,000	10,000	40,000 3%
Agency C4	110,000	1,551,672	0	0	0	0	1,551,672	98%	21,100	2,000	9,240	32,340 2%
Agency C5	117,300	785,334	0	0	0	75,306	860,640	96%	38,219	0	0	38,219 4%
Agency C6	123,000	412,233	0	156,560	18,000	0	586,793	94%	12,000	1,500	25,000	38,500 6%
Agency C8	127,500	871,680	204,536	0	0	51,485	1,127,701	84%	17,275	3,000	190,250	210,525 16%
Agency C7	130,000	1,210,172	0	159,725	100,000	139,000	1,608,897	96%	50,000	0	15,000	65,000 4%
Agency C9	132,000	1,559,969	317,326	205,000	0	0	2,082,295	99%	10,000	7,000	0	17,000 1%
Agency C10	140,000	2,200,000	100,000	26,000	189,000	80,000	2,595,000	97%	40,000	0	52,900	92,900 3%
Average for Large PSAPs ..	\$1,121,156	\$66,686	\$59,729	\$33,700	\$54,669	1,335,940	96%	\$22,859	\$2,450	\$34,739	60,048	4% \$1,395,988

**Table 43-Average for Large PSAPs**

### **5.3 PERCENTAGE OF TOTAL OPERATING BUDGET ALLOCATED TO OPERATIONS PERSONNEL**

The following three tables provide the percentages for each PSAP that provided budget data plus show the average percentage for each of the three PSAP size categories. The last table line shows the average for all PSAPs.

#### **Operations Personnel Budget for Small PSAPs**

<b>PSAP</b>	<b>ST</b>	<b>Population</b>	<b>Operations Personnel</b>	<b>Percent of Total Op Budget</b>	<b>TOTAL</b>
Agency A3	GA	6,200	412,000	99%	414,550
Agency A2	KS	6,528	108,844	69%	157,028
Agency A6	CA	10,686	143,370	100%	143,370
Agency A7	TN	11,162	125,000	74%	168,800
Agency A8	IL	13,500	144,000	73%	196,000
Agency A10	AL	14,000	175,000	66%	264,000
Agency A13	WV	15,200	65,000	27%	240,000
Agency A14	MO	15,500	292,003	78%	376,565
Agency A17	IL	16,000	227,000	77%	293,000
Agency A18	MI	17,000	357,564	86%	415,966
Agency A19	KY	17,000	164,400	68%	240,200
Agency A21	IA	18,187	175,000	97%	180,000
Agency A22	IL	18,200	290,000	85%	343,067
<b>Average for Small PSAPs ..</b>			<b>\$206,091</b>	<b>78%</b>	<b>\$264,042</b>

**Table 44-Operations Personnel Budget for Small PSAPs**

#### **Operations Personnel Budget for Medium PSAPs**

<b>PSAP</b>	<b>ST</b>	<b>Population</b>	<b>Operations Personnel</b>	<b>Percent of Total Op Budget</b>	<b>TOTAL</b>
Agency B1	NC	20,000	294,400	66%	448,900
Agency A5	KY	20897	303,000	100%	303,000
Agency B2	TN	23,150	311,000	70%	441,500
Agency B3	MI	26,000	700,000	97%	720,000
Agency B4	SC	26,314	273,071	86%	318,548
Agency B5	KY	27,000	164,000	100%	164,000
Agency B6	MI	27,500	290,975	83%	348,516
Agency B7	IN	27,800	194,091	63%	310,091
Agency B8	AL	28,756	201,326	58%	347,326
Agency B9	TN	29,862	231,329	92%	250,694
Agency B10	OH	31,000	380,000	70%	546,000
Agency B12	IL	35,000	49,050	100%	49,050
Agency B13	SD	35,074	506,951	96%	530,824

PSAP	ST	Population	Operations Personnel	Percent of Total Op Budget	TOTAL
Agency B14	LA	35,644	153,600	75%	204,240
Agency B15	MI	36,000	369,000	86%	429,000
Agency B16	MT	37,304	300,000	84%	358,000
Agency B17	MI	38,543	580,000	95%	608,000
Agency B18	AR	40,000	289,262	100%	289,262
Agency B19	PA	46,000	431,000	71%	608,000
Agency B20	IL	46,000	317,300	60%	532,300
Agency B21	FL	46,755	25,124	15%	165,518
Agency B22	KY	49,752	506,285	57%	886,190
Agency B23	MO	52,000	503,450	80%	629,450
Agency B37	FL	57,841	225,371	95%	237,421
Agency B25	CA	60,000	847,276	84%	1,007,626
Agency B26	NY	61,676	329,963	44%	743,883
Agency B27	PA	62,000	300,000	64%	472,000
Agency B28	MI	65,000	503,705	48%	1,049,574
Agency B29	IL	68,277	716,964	86%	829,996
Agency B31	IN	75,000	924,686	78%	1,189,086
Agency B32	PA	75,259	472,186	61%	768,507
Agency B33	KY	78,000	564,000	70%	808,300
Agency B34	MI	80,000	429,868	76%	563,015
Agency B35	LA	89,974	200,000	73%	275,000
Agency B36	NC	94,536	1,580,646	77%	2,300,646
Agency A4	IL	99,000	600,120	91%	657,160
<b>Average for Medium PSAP</b>			<b>\$418,583</b>	<b>91%</b>	<b>\$566,406</b>

**Table 45-Operations Personnel Budget for Medium PSAPs**

### Operations Personnel Budget for Large PSAPs

PSAP	ST	Population	Operations Personnel	Percent of Total Op Budget	TOTAL
Agency C1	LA	104,503	660,000	99%	670,000
Agency C2	MI	109,000	900,500	82%	1,102,400
Agency C3	MI	110,000	1,060,000	83%	1,280,000
Agency C4	TX	110,000	1,551,672	98%	1,584,012
Agency C5	TX	117,300	785,334	87%	898,859
Agency C6	KY	123,000	412,233	66%	625,293
Agency C8	PA	127,500	871,680	65%	1,338,226
Agency C7	SD	130,000	1,210,172	72%	1,673,897
Agency C9	SC	132,000	1,559,969	74%	2,099,295
Agency C10	KY	140,000	2,200,000	82%	2,687,900
<b>Average for Large PSAP</b>			<b>\$1,121,156</b>	<b>80%</b>	<b>\$1,395,988</b>

**Table 46-Operations Personnel Budget for Large PSAPs**

#### **5.4 PERCENTAGE OF NET OPERATING BUDGET ALLOCATED TO ADMINISTRATIVE AND TECHNICAL STAFF**

##### **Admin and Technical Staff Percent of Budget for Small PSAPs**

PSAP	ST	Pop	DB/GIS	IT	MIS	Admin	Total Support Personnel	Percent of Total Op Budget	TOTAL
Agency A3	GA	6,200	0	0	850	1,500	2,350	1%	414,550
Agency A2	KS	6,528	0	0	0	42,184	42,184	27%	157,028
Agency A7	TN	11,162	25,000	9,000	0	6,800	40,800	24%	168,800
Agency A8	IL	13,500	0	45,000	0	0	45,000	23%	196,000
Agency A10	AL	14,000	28,000	55,000	0	0	83,000	31%	264,000
Agency A13	WV	15,200	15,000	0	0	30,000	45,000	19%	240,000
Agency A14	MO	15,500	25,392	0	1,000	35,175	61,567	16%	376,565
Agency A17	IL	16,000	0	0	0	45,000	45,000	15%	293,000
Agency A18	MI	17,000	5000	18000	5000	0	28,000	7%	415,966
Agency A19	KY	17,000	0	20,000	50,800	0	70,800	29%	240,200
Agency A22	IL	18,200	14,000	0	14,000	14,000	42,000	12%	343,067
<b>Average for Small PSAPs</b>		<b>\$10,217</b>	<b>\$13,364</b>	<b>\$6,514</b>	<b>\$15,878</b>		<b>\$45,973</b>	<b>16%</b>	<b>\$282,652</b>

**Table 47-Admin and Technical Staff Percent of Budget for Small PSAPs**

##### **Admin and Technical Staff Percent of Budget for Medium PSAPs**

PSAP	ST	Pop	DB/GIS	IT	MIS	Admin	Total Support Personnel	Percent of Total Op Budget	TOTAL
Agency B1	NC	20,000	0	52,000	2,000	25,000	79,000	18%	448,900
Agency B2	TN	23,150	28,000	20,000	0	39,000	87,000	20%	441,500
Agency B4	SC	26,314	12,477	0	0	27,000	39,477	12%	318,548
Agency B6	MI	27,500	0	0	0	39,541	39,541	11%	348,516
Agency B7	IN	27,800	0	0	0	41,000	41,000	13%	310,091
Agency B8	AL	28,756	27,000	32,000	10,000	0	69,000	20%	347,326
Agency B9	TN	29,862	19,365	0	0	0	19,365	8%	250,694
Agency B10	OH	31,000	5,000	20,000	50,000	36,000	111,000	20%	546,000
Agency B13	SD	35,074	5,000	4,500	0	0	9,500	2%	530,824
Agency B14	LA	35,644	31,025	3,102	0	12,410	46,537	23%	204,240
Agency B15	MI	36,000	0	0	0	60,000	60,000	14%	429,000
Agency B16	MT	37,304	52,500	0	500	0	53,000	15%	358,000
Agency B17	MI	38,543	0	15,000	0	0	15,000	2%	608,000
Agency B19	PA	46,000	12,500	70,000	30,000	37,000	149,500	25%	608,000
Agency B20	IL	46,000	44,000	80,000	80,000	0	204,000	38%	532,300
Agency B21	FL	46,755	27,888	90,354	0	0	118,242	71%	165,518
Agency B22	KY	49,752	48,547	63,000	71,075	104,193	286,815	32%	886,190
Agency B23	MO	52,000	30,000	0	0	40,000	70,000	11%	629,450



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PSAP	ST	Pop	DB/GIS	IT	MIS	Admin	Total Support Personnel	Percent of Total Op Budget	TOTAL
Agency B25	CA	60,000	139,100	5,200	5,050	0	149,350	15%	1,007,626
Agency B26	NY	61,676	33,020	362,104	0	18,796	413,920	56%	743,883
Agency B27	PA	62,000	98,000	0	0	57,000	155,000	33%	472,000
Agency B28	MI	65,000	40,179	0	0	70,613	110,792	11%	1,049,574
Agency B29	IL	68,277	9,581	0	38,323	28,054	75,958	9%	829,996
Agency B31	IN	75,000	0	184,800	0	69,600	254,400	21%	1,189,086
Agency B32	PA	75,259	0	233,690	0	60,631	294,321	38%	768,507
Agency B33	KY	78,000	37,000	79,500	0	39,000	155,500	19%	808,300
Agency B34	MI	80,000	27,872	12,000	31,075	45,000	115,947	21%	563,015
Agency B35	LA	89,974	0	0	0	75,000	75,000	27%	275,000
<b>Average for Medium PSAP</b>		<b>\$26,002</b>	<b>\$47,402</b>	<b>\$11,358</b>	<b>\$33,030</b>	<b>\$117,792</b>	<b>21%</b>		<b>\$559,646</b>

**Table 48-Admin and Technical Staff Percent of Budget for Medium PSAPs**

**Admin and Technical Staff Percent of Budget for Large PSAPs**

PSAP	ST	Pop	DB/GIS	IT	MIS	Admin	Total Support Personnel	Percent of Total Op Budget	TOTAL
Agency C2	MI	109,000	45,000	0	0	100,900	145,900	13%	1,102,400
Agency C3	MI	110,000	0	50,000	30,000	100,000	180,000	14%	1,280,000
Agency C5	TX	117,300	0	0	0	75,306	75,306	8%	898,859
Agency C6	KY	123,000	0	156,560	18,000	0	174,560	28%	625,293
Agency C8	PA	127,500	204,536	0	0	51,485	256,021	19%	1,338,226
Agency C7	SD	130,000	0	159,725	100,000	139,000	398,725	24%	1,673,897
Agency C9	SC	132,000	317,326	205,000	0	0	522,326	25%	2,099,295
Agency C10	KY	140,000	100,000	26,000	189,000	80,000	395,000	15%	2,687,900
<b>Average for Large PSAP</b>		<b>\$83,358</b>	<b>\$74,661</b>	<b>\$42,125</b>	<b>\$68,336</b>	<b>\$268,480</b>	<b>18%</b>		<b>\$1,463,234</b>

**Table 49-Admin and Technical Staff Percent of Budget for Large PSAPs**

## 5.5 NUMBER OF OPERATIONS STAFF PER INCOMING CALL AND DISPATCH

### Calls per Staff Person for Small PSAP

PSAP	ST	Pop	Total Ops Pers	Incoming Calls	Dispatched Calls	Incoming Calls/Ops Person	Dispatched Calls/Ops Person	Total Staff	Incoming Calls/Staff Person	Dispatched Calls/Staff Person
Agency A1	IL	4,224	9	68,061		7,562		10.6	6,421	
Agency A3	GA	6,200	10	50,800	50,000	5,080	5,000	14	3,629	357
Agency A2	KS	6,528	6	4,211	22,618	702	3,770	7	602	539
Agency A6	CA	10,686	4	2,186	2,186	547	547	5	437	109
Agency A8	IL	13,500	10	3,000	3,000	300	300	10	300	30
Agency A10	AL	14,000	8	10,300	100	1,288	13	8	1,288	2
Agency A12	IL	15,000	5	6,800		1,360		5	1,360	
Agency A13	WV	15,200	8	6,815	12,394	852	1,549	11	620	141
Agency A14	MO	15,500	11.2	5,935	13,648	530	1,219	13	457	94
Agency A15	FL	16,000	10	7,200	7,200	720	720	10	720	72
Agency A16	IL	16,000	7	3,377	2,769	482	396	7	482	57
Agency A17	IL	16,000	8	23,650	3,650	2,956	456	9	2,628	51
Agency A18	MI	17,000	7	6,223	7,562	889	1,080	7	889	154
Agency A19	KY	17,000	7	4,923	3,294	703	471	7	703	67
Agency A20	VT	17,925	9	2,337	1,870	260	208	9	260	23
Agency A21	IA	18,187	7	4,600	2,200	657	314	7	657	45
AVERAGE SMALL PSAP .....						1,555	1,146		1,341	124

**Table 50-Calls per Staff Person for Small PSAP**

Where a cell has no entry, that cell is not counted in the averages.

**Calls per Staff Person for Medium PSAP**

PSAP	ST	Pop	Total Ops Pers	Incoming Calls	Dispatched Calls	Incoming Calls/Ops Person	Dispatched Calls/Ops Person	Total Staff	Incoming Calls/Staff Person	Dispatched Calls/Staff Person
Agency B1	NC	20,000	10	69,589	20,876	6,959	2,088	11.3	6,158	185
Agency A5	KY	20,897	7	36,486	36,486	5,212	5,212	7	5,212	745
Agency B2	TN	23,150	10.5	82,850	82,850	7,890	7,890	12.5	6,628	631
Agency B4	SC	26,314	16	13,920	12,768	870	798	17.75	784	45
Agency B5	KY	27,000	7	11,400	4,800	1,629	686	7	1,629	98
Agency B6	MI	27,500	11	13,124	13,460	1,193	1,224	13	1,010	94
Agency B7	IN	27,800	8	11,988	11,988	1,499	1,499	10.5	1,142	143
Agency B8	AL	28,756	12.5	15,167	13,300	1,213	1,064	34.5	440	31
Agency B9	TN	29,862	11	13,000	13,000	1,182	1,182	12	1,083	98
Agency B10	OH	31,000	18	72,950	58,334	4,053	3,241	22	3,316	147
Agency B12	IL	35,000	10	9,720	20,876	972	2,088	11	884	190
Agency B13	SD	35,074	12	82,542	20,639	6,879	1,720	13	6,349	132
Agency B14	LA	35,644	10	4,727	0	473		12	394	
Agency B15	MI	36,000	9.5	34,886	14,452	3,672	1,521	10.5	3,322	145
Agency B16	MT	37,304	11	33,000	0	3,000		14	2,357	
Agency B17	MI	38,543	12	12,012	12,012	1,001	1,001	12	1,001	83
Agency B18	AR	40,000	7.8	8,305	8,305	1,065	1,065	11	755	97
Agency B19	PA	46,000	14.5	18,356	20,916	1,266	1,442	15.5	1,184	93
Agency B20	IL	46,000	13	63,501	37,235	4,885	2,864	14	4,536	205
Agency B21	FL	46,755	13	18,552	18,552	1,427	1,427	15	1,237	95
Agency B22	KY	49,752	14	160,580	57,171	11,470	4,084	17	9,446	240
Agency B23	MO	52,000	17	19,106	60,000	1,124	3,529	19	1,006	186
Agency B24	FL	58,000	29	232,400	69,000	8,014	2,379	39	5,959	61
Agency B25	CA	60,000	14	62,400	13,691	4,457	978	15	4,160	65
Agency B26	NY	61,676	10	38,129	0	3,813		10	3,813	
Agency B27	PA	62,000	12	36,275	32,600	3,023	2,717	17.5	2,073	155
Agency B28	MI	65,000	12	96,981	36,319	8,082	3,027	13.5	7,184	224

PSAP	ST	Pop	Total Ops Pers	Incoming Calls	Dispatched Calls	Incoming Calls/Ops Person	Dispatched Calls/Ops Person	Total Staff	Incoming Calls/Staff Person	Dispatched Calls/Staff Person
Agency B29	IL	68,277	17	50,929	59,555	2,996	3,503	19	2,680	184
Agency B30	TX	73,334	31	66,203	100,008	2,136	3,226	34.8	1,902	93
Agency B31	IN	75,000	21	27,000	74,787	1,286	3,561	22.26	1,213	160
Agency B32	PA	75,259	19	59,734	35,412	3,144	1,864	21	2,844	89
Agency B33	KY	78,000	17	194,802	91,380	11,459	5,375	19	10,253	283
Agency B34	MI	80,000	14	158,000	54,728	11,286	3,909	17	9,294	230
Agency B35	LA	89,974	11	31,912	0	2,901		12	2,659	
Agency B36	NC	94,536	18	169,544	88,000	9,419	4,889	18.45	9,189	265
Agency A4	IL	99,000	10	38,898	12,094	3,890	1,209	11	3,536	110
AVERAGE MEDIUM PSAP . . . . .					4,023	2,571			3,518	175

**Table 51-Calls per Staff Person for Medium PSAP**

**Calls per Staff Person for Large PSAP**

PSAP	ST	Pop	Total Ops Pers	Incoming Calls	Dispatched Calls	Incoming Calls/Ops Person	Dispatched Calls/Ops Person	Total Staff	Incoming Calls/Staff Person	Dispatched Calls/Staff Person
Agency C1	LA	104,503	19	48,000	90,869	2,526	4,783	23	2,087	208
Agency C2	MI	109,000	18	34,452	54,939	1,914	3,052	18	1,914	170
Agency C3	MI	110,000	23	140,000	140,000	6,087	6,087	23	6,087	265
Agency C4	TX	110,000	24	259,000	158,500	10,792	6,604	26.5	9,774	249
Agency C5	TX	117,300	25	62,288	85,208	2,492	3,408	28	2,225	122
Agency C6	KY	123,000	13	20,950	20,950	1,612	1,612	13	1,612	124
Agency C8	PA	127,500	22.5	56,891	44,285	2,528	1,968	22.75	2,501	87
Agency C7	SD	130,000	30	66,000	229,131	2,200	7,638	33	2,000	231
Agency C9	SC	132,000	38	261,180	147,377	6,873	3,878	43	6,074	90
Agency C10	KY	140,000	31	242,400	53,300	7,819	1,719	42	5,771	41
AVERAGE LARGE PSAP .....					4,484	4,075			4,004	159

**Table 52-Calls per Staff Person for Large PSAP**

## 6.0 BUDGET

### 6.1 PSAP BUDGET FOR OPERATIONS AND SUPPORT

The budget for the following categories of staff personnel were requested:

1. Operations (call-takers, dispatchers and operation supervisors)
2. Database Administration and GIS (data work, not CPE maintenance or programming)
3. Training (personnel, course tuition and training expenses)
4. Internal Telecom (support for telephony, LANs, computer maintenance)
5. MIS (data support)
6. Public Education (materials and expenses incurred to educate the public)
7. Administration only (PSAP Manager and clerical staff)

Replies that provided budgets were received from the following number of PSAPs by size category:

<u>PSAP Size</u>	<u>Replies</u>
1. 0 – 19K .....	17
2. 19K – 100K .....	35
3. 100K – 140K .....	10
Total.....	62

There is a table created for each PSAP size, starting on the next page.

**PSAP Budget for Operations and Support – PSAP Size 0 – 19,000 Population**

PSAP	ST	Pop	Ops	DB/GIS	Training	IT	MIS	Public Ed.	Admin	All Other	TOTAL
Agency A1	IL	4,224	0	0	0	0	0	0		715,200	715,200
Agency A3	GA	6,200	412,000	0	200	0	850	0	1,500	0	414,550
Agency A2	KS	6,528	108,844	0	3,000	0	0	3,000	42,184	0	157,028
Agency A6	CA	10,686	143,370	0	0	0	0	0	0	0	143,370
Agency A7	TN	11,162	125,000	25,000	2,500	9,000	0	0	6,800	500	168,800
Agency A8	IL	13,500	144,000	0	5,000	45,000	0	2,000	0	0	196,000
Agency A10	AL	14,000	175,000	28,000	1,000	55,000	0	0	0	5,000	264,000
Agency A11	LA	14,139	0	37,500	0	0	0	0	0	0	37,500
Agency A13	WV	15,200	65,000	15,000	5,000	0	0	0	30,000	125,000	240,000
Agency A14	MO	15,500	292,003	25,392	7,920	0	1,000	15,075	35,175	0	376,565
Agency A15	FL	16,000	0	40,000	0	15,000	0	0	0	0	55,000
Agency A16	IL	16,000	0	43,000	2,000	14,000	0	1,000	0	5,000	65,000
Agency A17	IL	16,000	227,000	0	21,000	0	0	0	45,000	0	293,000
Agency A18	MI	17,000	357564	5000	1000	18000	5000	0	0	29402	415,966
Agency A19	KY	17,000	164,400	0	3,000	20,000	50,800	1,000	0	1,000	240,200
Agency A21	IA	18,187	175,000	0	5,000	0	0	0	0	0	180,000
Agency A22	IL	18,200	290,000	14,000	4,000	0	14,000	0	14,000	7,067	343,067
<b>Average for Small PSAP ..</b>		<b>13,502</b>	<b>\$157,599</b>	<b>\$13,700</b>	<b>\$3,566</b>	<b>\$10,353</b>	<b>\$4,215</b>	<b>\$1,299</b>	<b>\$10,916</b>	<b>\$52,245</b>	<b>\$253,250</b>

**Table 53-PSAP Budget for Operations and Support – PSAP Size 0 – 19,000 Population**

Determine if integrated systems impact staffing levels compared to non-integrated call processing environment

There was no PSAP with non-integrated call processing environment, so this test could not be accomplished.



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Determine the difference in elapsed time from call ring to termination for agencies with different levels of CPE

The investigation method was to list those PSAPs for which we were able to determine the CPE level (See legend below), that provided holding time and the number of personnel serving as call-takers, dispatchers and operations supervisors. Then for each CPE level, the holding time and the operations staff numbers were copied into separate columns. Thus each column (e.g., With Level 1) represents the performance of the PSAP with that CPE level. By taking the average holding times and average personnel employed one may be able to compare performance based on CPE level. See **Table 54** below.

CPE Level Code

blank – No information

0 - Manual equipment (No PSAP reported this category.)

1 - Computer-Telephony

2 - Computer-Telephony plus mapping and/or CAD

3 - Computer-Telephony, mapping and CAD

PSAP	ST	Population	CPE Level	Holding Time in Seconds			
				PSAP Reports	With Level 1	With Level 2	With Level 3
Agency A2	KS	6,528	1	96	96		
Agency A7	TN	10,898	1	105.7	105.7		
Agency A9	CO	13,500	2	150		150	
Agency A12	IL	15,000	2	51		51	
Agency A13	WV	15,200	1	61	61		
Agency A14	MO	15,500	2	63		63	
Agency A15	FL	16,000	1	26	26		
Agency A17	IL	16,000	2	93		93	
Agency A18	MI	17,000	1	77.88	77.88		
Agency A19	KY	17,000	2	274		274	
Agency A21	IA	18,187	2	67		67	
Agency B1	NC	20,000	1	126	126		
Agency B3	MI	26,000	2	124		124	
Agency B5	KY	27,000	3	68			68
Agency B6	MI	27,500	2	156		156	
Agency B7	IN	27,800	2	81.4		81.4	
Agency B8	AL	28,756	1	118	118		
Agency B10	OH	31,000	2	34.8		34.8	
Agency B11	FL	34,500	2	128		128	
Agency B13	SD	35,074	1	82	82		
Agency B14	LA	35,644	2	62		62	
Agency B15	MI	36,000	1	182	182		
Agency B17	MI	38,543	3	61			61
Agency B20	IL	46,000	2	77		77	
Agency B21	FL	46,755	1	126	126		

PSAP	ST	Population	CPE Level	Holding Time in Seconds			
				PSAP Reports	With Level 1	With Level 2	With Level 3
Agency B22	KY	49,752	2	72		72	
Agency B23	MO	52,000	2	64		64	
Agency B27	PA	62,000	2	72.7		72.7	
Agency B28	MI	65,000	3	87			87
Agency B29	IL	68,277	1	40	40		
Agency B33	KY	78,000	2	95		95	
Agency B34	MI	80,000	1	240	240		
Agency B35	LA	89,974	2	66		66	
Agency A4	IL	100,000	3	183			183
Agency C2	MI	109,000	2	64.31		64.31	
Agency C3	MI	110,000	1	66	66		
Agency C4	TX	110,000	1	63	63		
Agency C5	TX	117,300	2	207		207	
Agency C6	KY	123,000	2	60		60	
Agency C10	KY	140,000	2	62		62	
<b>Call Processing Time/Operations Personnel</b>				<b>100.7</b>	<b>98.0</b>	<b>99.75</b>	

**Table 54-Call Processing based on CPE Level**

The results show that there is no significant improvement in having more CPE. That could be that while the mapping and CAD may speed some tasks, they add others, eliminating the time benefit. Also, the data set is too small for the conclusions to be statistically significant.

## 6.2 DETERMINING EXPECTED BUDGET FOR PSAPS

<b>PSAP</b>	<b>ST</b>	<b>Pop</b>	<b>Ops</b>	<b>DB/GIS</b>	<b>Training</b>	<b>IT</b>	<b>MIS</b>	<b>Public Ed.</b>	<b>Admin</b>	<b>All Other</b>	<b>TOTAL</b>
Agency A2	KS	6,528	108,844	0	3,000	0	0	3,000	42,184	0	157,028
Agency A6	CA	10,686	143,370	0	0	0	0	0	0	0	143,370
Agency A7	TN	11,162	125,000	25,000	2,500	9,000	0	0	6,800	500	168,800
Agency A8	IL	13,500	144,000	0	5,000	45,000	0	2,000	0	0	196,000
Agency A10	AL	14,000	175,000	28,000	1,000	55,000	0	0	0	5,000	264,000
Agency A11	LA	14,139	0	37,500	0	0	0	0	0	0	37,500
Agency A13	WV	15,200	65,000	15,000	5,000	0	0	0	30,000	125,000	240,000
Agency A14	MO	15,500	292,003	25,392	7,920	0	1,000	15,075	35,175	0	376,565
Agency A15	FL	16,000	0	40,000	0	15,000	0	0	0	0	55,000
Agency A16	IL	16,000	0	43,000	2,000	14,000	0	1,000	0	5,000	65,000
Agency A17	IL	16,000	227,000	0	21,000	0	0	0	45,000	0	293,000
Agency A18	MI	17,000	357564	5000	1000	18000	5000	0	0	29402	415,966
Agency A19	KY	17,000	164,400	0	3,000	20,000	50,800	1,000	0	1,000	240,200
Agency A21	IA	18,187	175,000	0	5,000	0	0	0	0	0	180,000
Agency A22	IL	18,200	290,000	14,000	4,000	0	14,000	0	14,000	7,067	343,067
<b>Average for Small PSAP ..</b>		<b>14,607</b>	<b>\$151,145</b>	<b>\$15,526</b>	<b>\$4,028</b>	<b>\$11,733</b>	<b>\$4,720</b>	<b>\$1,472</b>	<b>\$11,544</b>	<b>\$11,531</b>	<b>\$211,700</b>

**Table 55 – PSAP Budget for Operations and Support – PSAP Size 0 – 19,000 Population**

The above Table 55 provides the PSAP budget for operations and support for Small PSAPs.

**PSAP Budget for Operations and Support – PSAP Size 19,000 – 100,000 Population**

PSAP	ST	Pop	Ops	DB/GIS	Training	IT	MIS	Public Ed.	Admin	All Other	TOTAL
Agency B1	NC	20,000	294,400	0	5,000	52,000	2,000	1,000	25,000	69,500	448,900
Agency A5	KY	20897	303,000	0	0	0	0	0	0	0	303,000
Agency B2	TN	23,150	311,000	28,000	13,000	20,000	0	2,500	39,000	28,000	441,500
Agency B3	MI	26,000	700,000	0	15,000	0	0	5,000	0	0	720,000
Agency B4	SC	26,314	273,071	12,477	6,000	0	0	0	27,000	0	318,548
Agency B5	KY	27,000	164,000	0	0	0	0	0	0	0	164,000
Agency B6	MI	27,500	290,975	0	9,500	0	0	0	39,541	8,500	348,516
Agency B7	IN	27,800	194,091	0	0	0	0	0	41,000	75,000	310,091
Agency B8	AL	28,756	201,326	27,000	10,000	32,000	10,000	1,000	0	66,000	347,326
Agency B9	TN	29,862	231,329	19,365	0	0	0	0	0	0	250,694
Agency B10	OH	31,000	380,000	5,000	6,000	20,000	50,000	9,000	36,000	40,000	546,000
Agency B12	IL	35,000	49,050	0	0	0	0	0	0	0	49,050
Agency B13	SD	35,074	506,951	5,000	14,373	4,500	0	0	0	0	530,824
Agency B14	LA	35,644	153,600	31,025	3,103	3,102	0	1,000	12,410	0	204,240
Agency B15	MI	36,000	369,000	0	0	0	0	0	60,000	0	429,000
Agency B16	MT	37,304	300,000	52,500	5,000	0	500	0	0	0	358,000
Agency B17	MI	38,543	580,000	0	5,000	15,000	0	5,000	0	3,000	608,000
Agency B18	AR	40,000	289,262	0	0	0	0	0	0	0	289,262
Agency B19	PA	46,000	431,000	12,500	25,000	70,000	30,000	2,500	37,000	0	608,000
Agency B20	IL	46,000	317,300	44,000	6,000	80,000	80,000	5,000	0	0	532,300
Agency B21	FL	46,755	25,124	27,888	1,000	90,354	0	1,200	0	19,952	165,518
Agency B22	KY	49,752	506,285	48,547	4,500	63,000	71,075	0	104,193	88,590	886,190
Agency B23	MO	52,000	503,450	30,000	20,000	0	0	0	40,000	36,000	629,450
Agency B37	FL	57,841	225,371		4,000	0	0	2,000	0	6,050	237,421
Agency B25	CA	60,000	847,276	139,100	10,000	5,200	5,050	1,000	0	0	1,007,626
Agency B26	NY	61,676	329,963	33,020	0	362,104	0	0	18,796	0	743,883

PSAP	ST	Pop	Ops	DB/GIS	Training	IT	MIS	Public Ed.	Admin	All Other	TOTAL
Agency B27	PA	62,000	300,000	98,000	17,000	0	0	0	57,000	0	472,000
Agency B28	MI	65,000	503,705	40,179	9,500	0	0	16,072	70,613	409,505	1,049,574
Agency B29	IL	68,277	716,964	9,581	23,047	0	38,323	14,027	28,054	0	829,996
Agency B31	IN	75,000	924,686	0	10,000	184,800	0	0	69,600	0	1,189,086
Agency B32	PA	75,259	472,186	0	2,000	233,690	0	0	60,631	0	768,507
Agency B33	KY	78,000	564,000	37,000	11,000	79,500	0	0	39,000	77,800	808,300
Agency B34	MI	80,000	429,868	27,872	8,000	12,000	31,075	200	45,000	9,000	563,015
Agency B35	LA	89,974	200,000	0	0	0	0	0	75,000	0	275,000
Agency B36	NC	94,536	1,580,646			720,000		0	0		2,300,646
Agency A4	IL	99,000	600,120	0	8,500	0	0	0	0	48,540	657,160
<b>Average for Medium PSAP</b>		<b>48,692</b>	<b>\$418,583</b>	<b>\$21,413</b>	<b>\$7,186</b>	<b>\$56,868</b>	<b>\$9,086</b>	<b>\$1,847</b>	<b>\$25,690</b>	<b>\$28,155</b>	<b>\$566,406</b>

**Table 56 – PSAP Budget for Operations and Support – PSAP Size 19,000 – 100,000 Population**

The above Table 56 provides the PSAP budget for operations and support for Medium PSAPs.

**PSAP Budget for Operations and Support – PSAP Size 100,000 – 140,000 Population**

PSAP	ST	Pop	Ops	DB/GIS	Training	IT	MIS	Public Ed.	Admin	All Other	TOTAL
Agency C1	LA	104,503	660,000	0	10,000	0	0	0	0	0	670,000
Agency C2	MI	109,000	900,500	45,000	10,000	0	0	1,000	100,900	45,000	1,102,400
Agency C3	MI	110,000	1,060,000	0	20,000	50,000	30,000	10,000	100,000	10,000	1,280,000
Agency C4	TX	110,000	1,551,672	0	21,100	0	0	2,000	0	9,240	1,584,012
Agency C5	TX	117,300	785,334	0	38,219	0	0	0	75,306	0	898,859
Agency C6	KY	123,000	412,233	0	12,000	156,560	18,000	1,500	0	25,000	625,293
Agency C8	PA	127,500	871,680	204,536	17,275	0	0	3,000	51,485	190,250	1,338,226
Agency C7	SD	130,000	1,210,172	0	50,000	159,725	100,000	0	139,000	15,000	1,673,897
Agency C9	SC	132,000	1,559,969	317,326	10,000	205,000	0	7,000	0	0	2,099,295
Agency C10	KY	140,000	2,200,000	100,000	40,000	26,000	189,000	0	80,000	52,900	2,687,900
<b>Average for Large PSAP..</b>		<b>120,330</b>	<b>\$1,121,156</b>	<b>\$66,686</b>	<b>\$22,859</b>	<b>\$59,729</b>	<b>\$33,700</b>	<b>\$2,450</b>	<b>\$54,669</b>	<b>\$34,739</b>	<b>\$1,395,988</b>

**Table 57—PSAP Budget for Operations and Support – PSAP Size 100,000 – 140,000 Population**

The above Table 57 provides the PSAP budget for operations and support for Large PSAPs.

### 6.3 BUDGET RECOMMENDATIONS

The budget must be based on the number of personnel to be employed. The above tables for each PSAP size provide a range to provide a general estimate.

It is recommended that the budget be developed as follows:

1. Determine the number of personnel to be hired in each task category (using the PSAP Staffing Guideline, **Appendix D**).
2. Obtain example wage levels for your area of the country. PSAP managers of adjacent PSAPs may be willing to provide their pay schedules.
3. Discuss with the PSAP manager whether they feel their pay schedules are appropriate or not. If not, get their reasons.
4. Determine the benefits to be provided. Note the average time off for the PSAP size as provided in this document.
5. Determine the salary costs.
6. Consider the needs for training personnel, both initial and refresher.
  - a. Obtain information about initial telecommunicator training and the legal requirements for that training (if any). This can be done via discussion with other PSAP managers, the State 9-1-1 office (if your state has one), local NENA organization or national NENA headquarters.
  - b. Ensure that you budget for refresher training.
7. To maintain good worker morale and provide the extra training that leads to a more productive PSAP, budget to send a certain percentage of the staff to 9-1-1 conferences.
8. Budget for some promotional material to educate children and the general public on 9-1-1. This is particularly important if you are initiating 9-1-1 service in the area for the first time.
9. Add five to ten percent as a cushion for unexpected costs and errors in estimates.

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