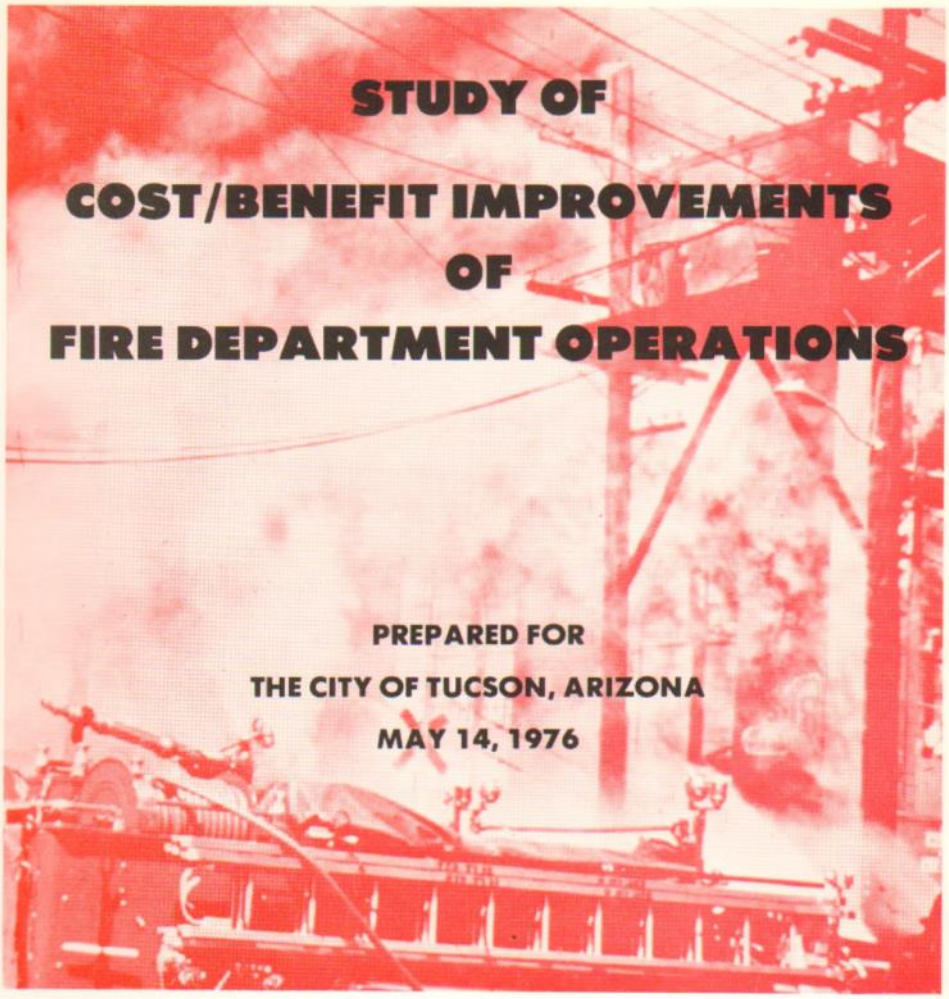
Tucson Fire Department

1976 Study of Cost/Benefit Improvements of Fire department Operations



STUDY OF COST/BENEFIT IMPROVEMENTS OF FIRE DEPARTMENT OPERATIONS

PREPARED FOR

THE CITY OF TUCSON, ARIZONA

MAY 14, 1976

PREPARED BY

The FPE Group

145 Natoma Street
San Francisco, California 94105

Telephone: (415) 495-3310
Telex: 340860

Report No. 76007

The FPE Group
Formerly The Sierra Group

145 NATOMA STREET
SAN FRANCISCO, CALIFORNIA 94105
TELEPHONE (415) 495-3310

FIRE PROTECTION ENGINEERS
AND CONSULTANTS

REPORT NO. 76007

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THE FPE GROUP
145 Natoma Street
San Francisco, California 94105
Telephone: (415) 495-3310

Louis E. Almgren, P.E.
Project Engineer

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INTRODUCTION

The City of Tucson has enjoyed a satisfactory level of traditional public fire department service for many years. With growth accelerated in the 1950's the cost of operating the fire department went up. The most expensive single factor that caused costs to rise was the reduced work hours for fire fighting personnel, resulting in a considerable increase in total fire department personnel. An added factor has been the expanded services offered by new engine and ladder companies and paramedic service.

Public policies and the economics of the mass home building industry favored peripheral growth rather than fill-in development of the core area and existing neighborhoods. The peripheral growth resulted in regional and area shopping centers and strip commercial development along major streets.

In recent years city growth has tapered off which will result in a lower rate of annexation for the future. The fire department growth and expansion appears to have overtaken and surpassed the 2.76% per annum growth rate of the city. In fact, the fire department budget of $9,447,602 exceeds the revenue received from property taxes by almost 35%.

In conducting this study the following criteria were used as basic guides:

1. The primary objective of public fire defense programs is to save lives.

2. The second most important objective of the fire defense program is to prevent the destruction of economically essential industries and businesses.

3. The third objective of the fire defense program is to protect homes and other individually owned private property.

The scope of this study included the following areas of investigation:

1. A survey of the existing fire problems, fire department operations, fire loss records, and the factors that affect Tucson's fire defense system.

2. An evaluation of department operations and use of facilities. Alternate plans for more efficiently utilizing existing resources. Primary areas of investigation were:
   - Company response patterns
   - Staffing assignments
   - Fire station distribution
   - Company manning assignments
   - Paramedic service
   - Fire suppression techniques

3. A study of the relationships between fire damage and burning time. (This analysis was used to estimate the probable damage that would occur under various fire department operational plans.)

4. A study of the codes and ordinances which pertain to fire and life safety and estimate their effectiveness as fire control measures.

5. An analysis of the most recent ISO insurance gradings and a determination of the impact that suggested changes in the city's fire defense system may have.

Work began on February 2, 1976 with the start of the field survey. Primary investigators were: Louis E. Almgren, P.E., President of The FPE Group, Project Engineer; W. Bryce Connick, Senior Fire Protection Analyst, field investigations, analysis and report preparation phases of the study; Steve J. Weirsma, PhD., a mechanical engineer at Stanford Research Institute, statistical analysis of Tucson Fire Department records and projections of probable loss experience resulting from alternative fire protection configurations.

SUMMARY AND RECOMMENDATIONS

Summary

The primary objective of the study was to find ways of reducing fire department costs without a significant reduction in fire department effectiveness and an increase in basic fire insurance costs.

The potential fire problems in Tucson are light to moderate. Buildings are essentially of low height with a few high rise structures. Fire life safety hazards are considered minimal.

The fire department maintains 15 fire stations with 16 engine and 5 ladder trucks in service. In addition 5 rescue companies and a paramedic company are in service. These companies are manned by 102 on-duty fire fighting personnel. With the administrative staff and personnel necessary to maintain shift strength, the department totals 410 uniformed personnel. Fire prevention and communication services are considered good.

The recommended program will eliminate four engine companies, one ladder truck company and one rescue company; three stations should be closed. Company manning levels should be reduced and the paramedic/rescue service improved. The net result will be reduced fire department costs with overall fire department effectiveness only slightly reduced. The cost effectiveness of fire department expenditures will be greatly improved and approximately $1,900,000 will be saved annually in salary costs.

In the past the Tucson Fire Department expansion has been based upon the administration's reaction to anticipated community development and standards of the Insurance Services Office. The program recommended by this study will shift the fire department development away from these standards toward a system of balancing fire department resources with the fire problems in Tucson. Thus, the protection of potentially severe

fire problems can be considered and resolved during planning and design stages. Also, the financial burden of protecting the building from fire, beyond the fire department's capability, will be borne by the owner of the building.

The impact of this program on the fire insurance grading is estimated to be slight. Fire insurance costs will most likely remain unchanged. It should be kept in mind that the ISO grading schedule is applied solely by ISO engineers and their results can only be estimated.

Recommendations

1. Amend the Tucson Building Code to require sprinkler systems in new buildings where the potential fire threat indicates a fire flow in excess of 4500 gallons per minute.

   Adopt an ordinance requiring the installation of sprinkler systems in existing buildings where the potential fire threat indicates flows in excess of 5000 gallons per minute.

   ESTIMATED COST: Negligible

2. Close fire stations 7, 11 and 12.

   ESTIMATED COST SAVINGS: $ 40,000 per year

3. Reduce the number of engine companies from 16 to 12 and the number of ladder truck companies from five to four. Operate four of the engine companies with a second pumping apparatus and continue to use two engines with large water tanks for two engine companies.

   ESTIMATED COST SAVINGS: $ 1,182,000 per year

4. Establish a joint cooperative paramedic program using fire department initial response supplemented by support from private ambulance companies.

   ESTIMATED ADDITIONAL COST: $ 10,000 per year

5. A. Establish uniform staffing standards for fire companies.
   B. Change fire methods to make better use of personnel.

ESTIMATED COST SAVINGS: $ 550,000 per year

6. A. Reorganize the fire department.
   B. Perform most administrative tasks with non-uniform civilian personnel.
   C. Move the department administrative staff and the fire prevention division into City Hall.

ESTIMATED COST SAVINGS: $ 80,000 per year

7. The personnel department should assume the following functions:

   A. The monitoring of personnel assignments to keep abreast of any situation where personnel are working out of classification.
   B. The monitoring of work assignments to assure that job descriptions are kept current.
   C. The development of inter-departmental promotional possibilities and incentives.
   D. The monitoring of administrative responsibility and decision making authority to assure that the work is performed at the proper level.

COST SAVINGS NOT ESTIMATED

8. Eliminate unnecessary training drills and establish a training committee representative of all personnel ranks and assignments.

COST SAVINGS NOT ESTIMATED

9. A. Transfer responsibility for routine occupancy fire prevention inspections to fire companies and increase the frequency of such inspections.
   B. Reorganize the fire prevention division along functional lines.

C. Begin charging fees for the inspection of new construction and hazardous operations.

COST SAVINGS NOT ESTIMATED

10. Divide the 24 hour shift system into a 10 hour and a 14 hour shift. Develop activity schedules to make effective utilization of the time of company personnel in fire prevention, training, maintenance, physical fitness, meals and rest.

COST SAVINGS NOT ESTIMATED

Advantages

1. The city, through the fire department, can place itself in position to exercise positive management control of fire problems in Tucson.

2. The reduction of fire companies in service together with standardization of fire company staffing will result in an annual savings of approximately $1,900,000.

3. The establishment of five full paramedic companies will respond to the rapid increase in requests for this kind of service.

4. The strengthened fire prevention program will reduce the likelihood of serious fires as a result of improved inspection techniques and frequencies.

Disadvantages

1. The recommended program will require a major reorganization of the fire department that will create confusion and low morale through the transition period.

2. The new fire station plan will not utilize a fire station now under construction.

RECOMMENDATIONS

Introduction

The public is understandably concerned over the effectiveness of their fire department and they generally react to any situation that appears to threaten the fire department. However, fire department operations are difficult to understand and it is difficult for the public to assess the true effect of possible fire department changes.

There are many fire department operational practices and policies that have grown from the experiences of the past. There are also traditions that have had some limiting effect on fire department efficiency when considered in light of today's fire problems. Changing these practices and traditions many times will improve efficiency as well as reducing costs.

Traditionally, city administrators have relied on the fire chief and his staff to establish the requirements and needs of the fire department. Justification for additional manpower and equipment has largely depended on the fire chief to "build a case." Frequently the only opposition was the financial ability of the city to approve the request since there was no one available that possessed the basic knowledge of fire department operations that could objectively analyze the situation.

Seldom was the fire chief effectively challenged on the technical basis of whether the improvement was actually needed or whether the expenditure would have a corresponding improvement in fire protection. Such a critic would not only have to confront the fire chief in a field where he is most familiar, but public concern would likely support the fire chief on the basis of "if we err, let us err on the side of greater public security."

Only in recent years where public funds for fire protection have become limited, due to public resistance to further taxation, has the fire chief been really challenged as to cost effectiveness of the fire department costs. Very few communities even consider if they can afford the level of fire protection that they currently have. Today, the fire chief's demands for more manpower and equipment are not only being questioned, but he is being asked to evaluate what the effects would be on fire losses if manpower and fire stations were reduced. He is being asked to consider combining some fire department functions with other departments of the city or with other fire departments in other cities. He is being asked to reduce service in noncritical areas where possible. In short, he is being asked to push aside the traditional ways the fire service has dealt with public protection problems and to objectively evaluate the cost effectiveness of the needs of his department. This is not only a very difficult assignment for the fire department, but is nearly impossible without objective support and expertise from sources outside the fire department.

On many occasions, the fire chief has sought and used the support of the Insurance Services Office and its grading of the city's fire defense system. The Insurance Services Office municipal fire protection standards are helpful in determining reasonable levels of property protection. The primary purpose of ISO standards and their grading procedures is to develop a system that would evaluate fire protection factors that affected the fire insurance business and these factors are not always the same factors that importantly affect municipal fire protection. ISO never intended that their standards be used as the only planning tool employed in the design of a good public fire protection system. Actual conditions in Tucson have been the prime determinates for this study. Careful consideration has been given to protection against loss of life, the economic capacity of the city and coordination with other programs.

It is the primary purpose of this study to objectively look at the basic fire department functions from the viewpoint of actual need and cost effectiveness. The discussion for each suggested recommendation is designed to provide a rationale that is based on (1) actual need, (2) the effects on fire losses, and (3) the cost/effectiveness implications.

The total program, as represented by all the recommendations, will result in a reduction in the level of fire protection now existing in the City of Tucson. However, the overall reduction is slight while the cost effectiveness will vastly improve. Fire insurance rates should not change.

The study has indicated that the cost effectiveness could be further improved by implementing more drastic reductions in the fire department resources. The analysis of fire department response time and fire losses (see Appendix) indicates six stations would produce the most cost effective combination. However, this statistical analysis should be modified by sound fire protection judgment. It is, therefore, recommended that a moderate approach be taken. A gradual transition is important if the program is to succeed. The program recommended herein should be considered a first step after which the community can assess the results and determine whether additional reductions are desirable and in the public interest.

ITEM NO. 1: FIRE PROTECTION PLAN

Recommendation

AMEND THE TUCSON BUILDING CODE TO REQUIRE SPRINKLER SYSTEMS IN NEW BUILDINGS WHERE THE POTENTIAL FIRE THREAT INDICATES A FIRE FLOW IN EXCESS OF 4500 GALLONS PER MINUTE.

ADOPT AN ORDINANCE REQUIRING THE INSTALLATION OF SPRINKLER SYSTEMS IN EXISTING BUILDINGS WHERE THE POTENTIAL FIRE THREAT INDICATES FIRE FLOWS IN EXCESS OF 5000 GALLONS PER MINUTE.

Discussion

The City of Tucson should adopt a long range program that confines the size of potential fires to that which is manageable by the fire department. Basically this would limit the maximum acceptable size of potential fire problems by requiring built-in fire protection in buildings which represent a fire of greater magnitude than the size specified. The best method of providing this control is to amend the building code so that the maximum unprotected building size will be limited; beyond this size in-building fire protection, such as automatic fire sprinklers will be required.

The development of such a program requires that fire department capability be related to potential fire size. The best method is to equate fire department capability into water deliverable to the fire and fire size into fire flow needed for extinguishment. The Insurance Services Office's Guide For Determination of Required Fire Flow considers types and density of construction, level of occupancy hazards, type and value of built-in fire protection features. A required fire flow is developed expressed in gallons of water per minute. This quantity of water is considered to be necessary by ISO to control a serious fully developed fire in the building. Fire department capa-

bility can be determined by estimating the number of fire hose streams the department is capable of delivering within a reasonable length of time after the fire starts.

Unprotected buildings should be limited to that size which will produce a maximum required fire flow of 4500 gallons per minute as determined by application of the Guide For Determination of Required Fire Flow published by Insurance Services Office. The maximum building size can be characterized in terms of ground floor area, height, type of construction and combustibility of content. These characteristics can in turn be translated into modifications of building code requirements. Protected buildings (sprinklered) would be allowed to be built larger.

In 1973 the California Chapter of the International Conference of Building Officials and the California Fire Chiefs Association became concerned about the many sprinkler ordinances that have been adopted by municipalities without uniformity of approach. They formed a joint committee of fire marshals and building inspectors to develop a method of approach to the problem that would fit all communities. In 1975 the joint committee submitted the results of their efforts and their analysis and recommendations are currently under review for inclusion in the 1979 edition of the Uniform Building Code. A copy of these recommendations are included in the Appendix section.

The significance to Tucson is that the recommended amendments to the Uniform Building Code directly relate to the changes needed to implement Recommendation No. 1. The city should review these amendments and substantially adopt those that apply to the requirements of 4500 gpm fire flow.

A retroactive sprinkler ordinance that essentially specifies automatic fire sprinklers in all existing buildings that have a fire flow requirement of 5000 gpm or greater is needed to reduce the fire potential of the few existing buildings in Tucson that are in this category.

With appropriate and sufficiently long moratoriums the financial impact on owners will not be severe. Only three areas of the city now require fire flows in excess of the recommended 4500 gpm according to the most recent ISO fire protection grading survey, and these are in the older parts of the city. Implementation of the rest of the recommendations (Nos. 2-10) need not await improvement of the existing larger fire problems because they are few in number. Assigning them to an increased inspection frequency will reduce the probability of serious fires.

This recommendation constitutes the basic step towards bringing the Tucson fire potential under sound management control. This will allow the city to institute reductions in fire department resources within the protection level indicated by 4500 gpm without fear of placing public safety in jeopardy.

ITEM NO. 2: FIRE STATION DISTRIBUTION

Recommendation

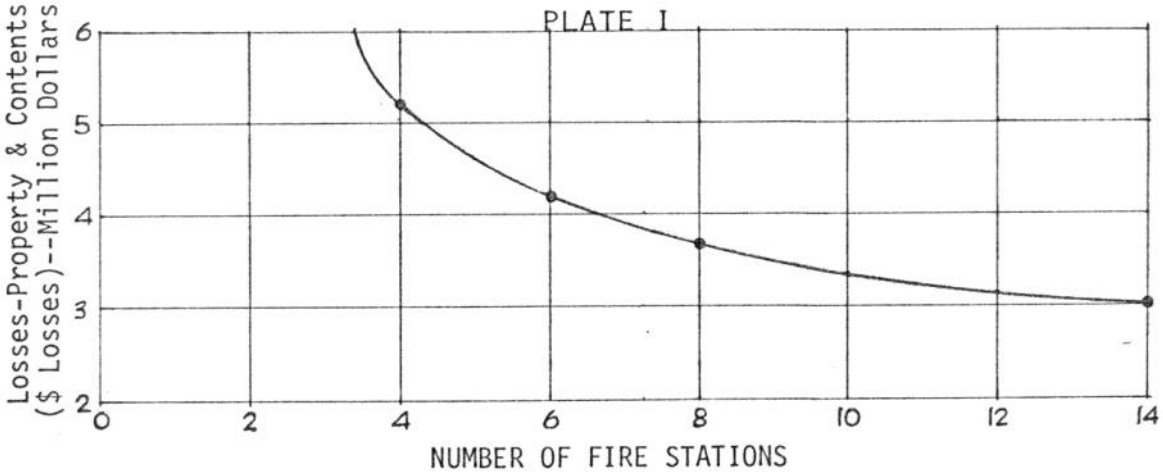
CLOSE FIRE STATIONS 7, 11 and 12.

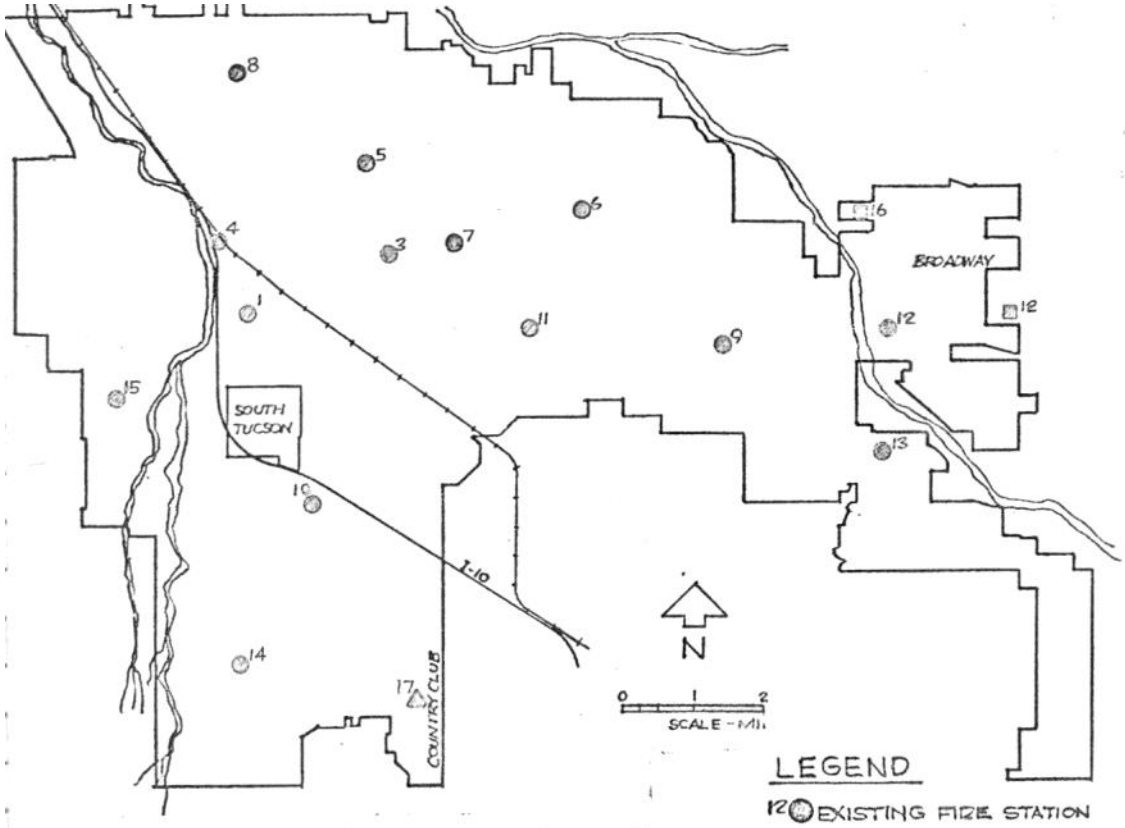
Discussion

Recommendation No. 1 urges the adoption of a fire loss management program that will eventually reduce the maximum fire problem size in Tucson to a level indicated by a fire flow requirement of 4500 gpm. Also, analysis of recent fire experience in Tucson indicates that a reduction in fire station density will not increase fire losses proportionately. Therefore, the ultimate fire station plan for Tucson should be based upon a new criteria more nearly representative of the real physical conditions of the city.

A detailed study was made of the 1974 and 1975 fire losses in Tucson and how they would be altered if the number of fire stations and companies were reduced and the results are shown in Plate No. I. (The details of this evaluation are presented in the Appendix section.) The results of this study and analysis show that reductions of fire stations from 15 to 12 will have very little effect on the fire loss ($110,000 per annun increase). Even a drastic reduction to eight stations would only increase fire losses by $350,000. The elimination of three fire stations (and five companies) thus will have have any significant effect on the fire losses in Tucson.

PLATE I





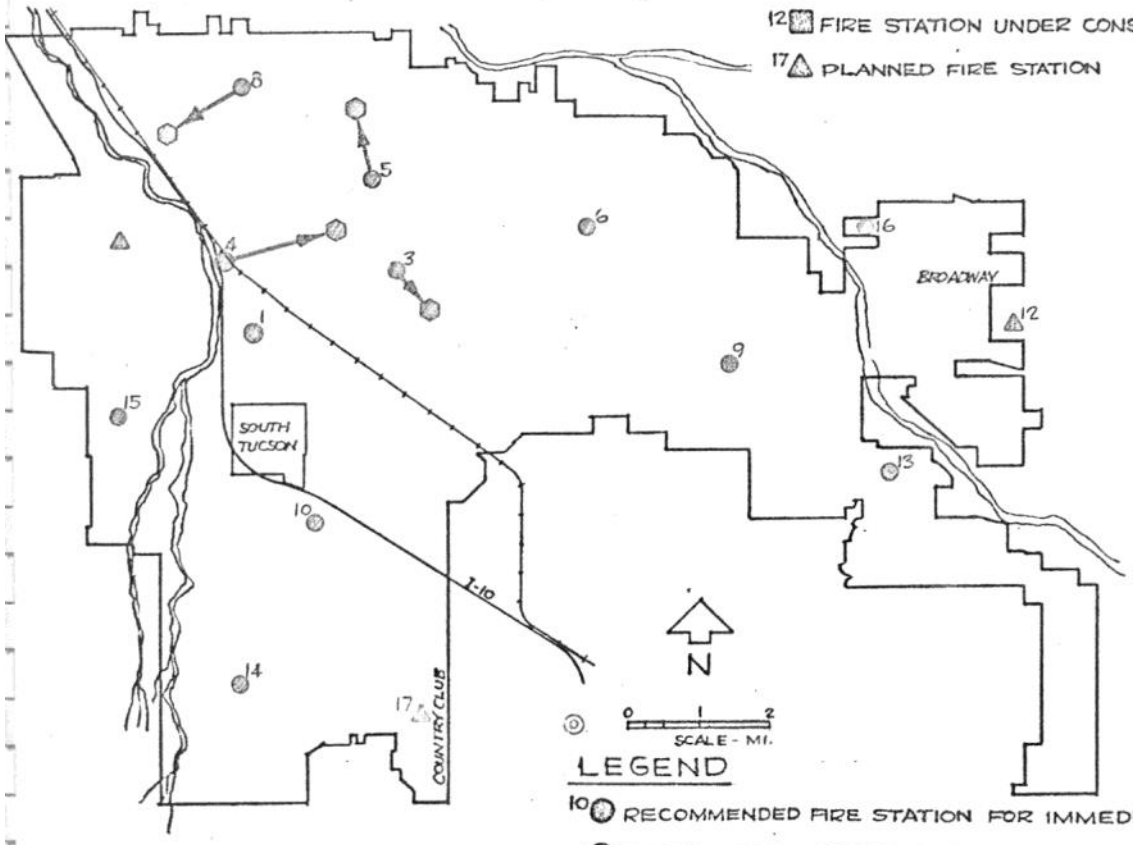
LEGEND

12 EXISTING FIRE STATION

12 FIRE STATION UNDER CONSTRUCTION

17 PLANNED FIRE STATION

PLATE NO. II



LEGEND

10 RECOMMENDED FIRE STATION FOR IMMEDIATE USE

RURAL-METRO FIRE DEPARTMENT STATION

ULTIMATE RELOCATION OF EXISTING STATION

12 NEW STATION, ULTIMATE

PLATE NO. III

Plate No. III shows the fire station plan with the closing of stations 7 at 3202 East First Street, 11 at 4075 East Timrod and 12 at 7901 East Scarlett Street. The arrows indicate the possible future positioning of other stations to better cover that area of the city.

Planning for future fire station locations is difficult and complex because the optimum location depends both on the extent of urban growth and the character of development that has not yet occurred. Therefore, great care should be taken to avoid unnecessary costs. The location and distribution of fire stations is influenced by many factors. The most important factors are:

1. Distance to buildings within the response district of the stations, particularly high hazard buildings and areas.

2. Access to major streets.

3. Access to other parts of the city.

4. Topographical impairments to company response.

5. Peak load traffic congestion.

As part of this study the city was surveyed and the above factors were applied to actual conditions and needed fire station locations determined. Basically this analysis resulted in the following response distance criteria:

Residential Districts	2 - 4 miles
Commercial and Industrial Districts	1-1/2 - 3 miles
Congested Downtown Districts	1-1/2 miles
Institutional Districts	1-1/2 - 2 miles

In order to achieve the best balance between cost and effectiveness, the following should be used in planning future fire stations:

1. Station locations should be selected on the basis of maximum need and overlapping of service areas should be avoided whenever possible.

2. A new station should not be built until its need is clearly defined by actual growth and development (55%-65% of area developed).

This austere approach will have double benefits of saving the capital cost of the building and land and the continuing cost of salaries and maintenance that are needed to man and operate the station. In the case of the three stations that can be eliminated, the savings per year in salaries is estimated at $1,080,000.

Consideration should also be given to the emergency response load of each company. Although it is impossible to have a balanced response load and also meet the travel distance requirements, unusual imbalances should be corrected. Consideration has also been given to the fire response load of each company. No significant or serious imbalances have been experienced. Engine Company 4 responded to the highest average, 1.34 fires per day during 1975. Engine Company 15 responded to an average of 0.57 fires per day, the lowest. The study anticipates redistribution of Engine 7 fire responses (0.84 per day) to Engines 5, 3 and 6. The Engine 11 fire responses (0.79 per day) will probably be made by Engines 3, 6 and 9.

Stations 7, 11 and 12 should be closed as soon as the personnel can be reassigned; largely governed by the rate of attrition. Recommended priority order for closing is Station 12, 7 and 11, in that order.

It is recognized that design for a new station 17 is in progress and that the design incorporates plans for an innovative solar heating/cooling system. The design can probably be modified for site details and used at another location at a later date.

In the future, a new station may be needed to serve the Saint Mary's Hospital/Pima Community College section. The location of four existing stations should ultimately be changed: Station 4 should be relocated one mile to the east; Station 5 should be relocated one mile to the north; Station 3 should be relocated south and east to the vicinity of East 22nd and Country Club Drive and Station 8 should be relocated about one mile to the southeast. (See Plate III.) Existing station repositioning should not be implemented until there are other reasons for the change; i.e., re-development, alterations needed, highway relocation.

The easterly half of the Engine Company 14 response district may develop to an extent that will make an additional station desirable. However, since the best location, in relation to other stations, is near the present city boundary, an interim joint response contractual agreement with the Rural Metro Fire Dept., Inc. may best serve the city.

Probably the most difficult aspect of fire protection for the public to understand is the fundamental difference between protection of life and protection of property from fire. Public comprehension is further complicated by the fact that fire department response and fire attack appear the same whether the fire fighting involves primarily life saving or property protection. Protection of life, however, differs in a few important respects from the protection of property, and this should be understood before the role of the fire department can be evaluated.

There have been many fires where property damage has been relatively low, but where several lives have been lost and where many injuries have occurred. When discovery of a fire is delayed, response of the fire department may not be a factor in protecting people from the effects of heat and smoke. The basic principles of protection of life from fire are (1) prompt fire detection, (2) notification of occupants, and (3) adequate exit facilities. If sufficient attention is given to these fundamentals of building construction, fire department activities

need only be directed to property protection; rescue activities take on a minor role due only to unusual circumstances where individual people become confused and trapped. However, the ideal condition seldom exists, and the fire department's role in life safety from fire is important.

In Tucson adequate fire life safety must be part of the building structure in the form of fire detection and alarm systems, stairway and exit corridors. Properly installed these facilities should be adequate to assure a low level of loss of life due to fire. Enforcement will provide reasonably safe conditions for all new buildings. Provisions of Ordinance No. 4403 requires that the basic provisions of Chapter 33 of the Uniform Building Code be enforced for existing buildings. Therefore, enforcement of existing building regulations will produce a good level of fire life safety protection in Tucson.

ITEM NO. 3: FIRE COMPANIES

Recommendation

REDUCE THE NUMBER OF ENGINE COMPANIES FROM 16 to 12 AND THE NUMBER OF LADDER TRUCK COMPANIES FROM FIVE TO FOUR. OPERATE FOUR OF THE ENGINE COMPANIES WITH A SECOND PUMPING APPARATUS AND CONTINUE TO USE TWO ENGINES WITH LARGE WATER TANKS FOR TWO ENGINE COMPANIES.

Discussion

Present fire suppression needs of Tucson can be well served by 12 engine companies. Engine companies should be operated from fire station numbers 1, 3, 4, 5, 6, 8, 9, 10, 13, 14, 15 and 16. The exact disposition of apparatus will depend on several variables and no specified recommendations are made in this report. Engine companies 1, 4, 9 and 10 should be two-piece companies operating with triple combination pumping engines. Apparatus employed consists of two triple combination pumping engines which respond together from the same station and operate as a two-piece company. This operation is recommended to achieve greater manpower utility and company versatility. The details of the tactical operation are as follows:

The first engine is generally referred to as the wagon and the second as the engine. Both are identically loaded and equipped. The first apparatus or wagon carried the company officer, a fire engineer and two or more fire fighters, and the engine carries only a fire engineer driver. The wagon runs first, followed by the engine. The wagon usually will lay one of two 2-1/2 in., 3 in. or larger hose lines from the hydrant to the fire where the company can employ any one of several operational options, as conditions may dictate. The engine stops at the hydrant, makes the appropriate connections to the hydrant and to the wagon's hose lines, and

supplies water at the desired pressures. The system provides a maximum number of fire fighting options not afforded by a single pumper operation and is considerably more effective per on-duty fire fighter than a single triple on initial attack when properly utilized.

First alarm response to structural fires should consist of three engine companies and two ladder truck companies in the downtown area; two engine companies and one ladder truck company in other high value areas or to tall buildings and at least two engine companies in residential districts. The response distances of the first and subsequently responding companies substantially satisfy ISO standards.

The continued employment of a second apparatus with a large water tank to respond with both engine companies 15 and 16 is recommended. As structural improvements develop in the area south and east of Station 14 it may become desirable to assign an additional engine company to Station 14. This assignment would be an interim reinforcement for response to alarms in the south and east pending final location of a new station. An alternative solution is an initial response contract with Rural/Metro Fire Dept., Inc. for an agreed upon minimum apparatus and staff.

Ladder truck companies should be assigned to Stations 1, 4, 9 and 10. Tucson is not a high-rise city and the few high-rise buildings are widely distributed. Ladder service should therefore be carefully distributed in order to avoid excessive costs. In areas where ladder truck service is not within reasonable distances, additional ladder truck equipment can be added to the engine companies in the area. The proposed distribution will provide coverage that is in substantial agreement with ISO standards. Aerial ladder trucks should be assigned to Station Nos. 1, 4 and 10 and the 90 ft. elevating platform truck assigned to Station No. 9. Station No. 1 should house a standard 100 ft. aerial ladder truck.

The 150 ft. "Firebird" elevating platform will be particularly useful for specific locations in Tucson. It is not needed for effective operations in most sections of the city and is somewhat cumbersome to operate for response to some areas. It is therefore recommended that the Firebird be assigned for response only when needed for specific areas where it will be most effective.

In the future Tucson should develop a smaller "squad" type vehicle for use where the need for ladder service is minimal. The squad should carry one or two 35 ft. ladders, salvage, lighting, rescue and overhaul equipment and other equipment usually carried on ladder trucks for service to areas where ladder trucks are not otherwise needed.

The recommended company assignments are summarized in the following table.

TABLE NO. 1

Station No.	Engine Co. No.	Ladder Truck Co. No.	Engine Tanker No.	Rescue No.
1	1 (2 pc.)	1	-	1
3	3	-	-	-
4	4 (2 pc.)	4	-	-
5	5	-	-	-
6	6	-	-	6
8	8	-	-	8
9	9 (2 pc.)	9	-	9
10	10 (2 pc.)	10	-	10
13	13	-	-	-
14	14	-	-	-
15	15	-	15	-
16	16	-	16	-

ITEM NO. 4: EMERGENCY MEDICAL AID

Recommendation

ESTABLISH A JOINT COOPERATIVE PARAMEDIC PROGRAM USING FIRE DEPARTMENT RESPONSE SUPPLEMENTED BY SUPPORT FROM PRIVATE AMBULANCE COMPANIES

Discussion

The fire department should organize five rescue companies equipped with squad-type vehicles and staffed by one certified paramedic person and one Emergency Medical Technical II. The private ambulance companies should agree to maintain a specified number of vehicles capable of paramedic service and transportation of patients staffed by one fully certified paramedic person and one Emergency Medical Technical II. All emergency medical care and transportation shall be dispatched by the Meds system. The Meds system dispatchers should interrogate callers to determine the extent and type of aid required. Over-responses should be avoided. If it is reasonably clear to the dispatcher that only transportation is needed and the injured person is not in need of advanced life support, a dispatch of only an ambulance should be made. In the event that a fire department paramedic person is engaged in advance life support activity and the victim is to be transported, the fire department paramedic should accompany the victim to the hospital, and be assisted by the private paramedic. The private ambulance companies should be reimbursed every time they are dispatched whether they end up transporting someone to a hospital or not.

At present the Tucson Fire Department operates a Paramedic and Rescue/First Aid service from six fire stations. A single paramedic vehicle (Medic One) is staffed with two or three certified paramedic fire department personnel and is capable of patient transportation. Five rescue vehicles respond to incidents with two fire department personnel who are certified as Emergency Medical Technicians II.

The rescue unit which is located at Fire Station 10 is staffed with paramedic personnel and provides backup to Medic One. In all there are 16 paramedic personnel on the fire department roster. A Battalion Chief is assigned full time to supervise the paramedic and rescue services.

Medic One and fire department rescue units respond to calls with little, if any, regard for jurisdictional boundaries since Medic One was funded by public subscription. Twelve percent of their runs are estimated to be to locations outside of the city. If closest, a rescue unit responds to requests for paramedic service in addition to Medic One. Almost 70% of all fire department responses are for rescue or paramedic service.

There are two privately operated ambulance companies serving Tucson and vicinity: A&A Ambulance Company and Kords Ambulance Company. Both companies employ certified paramedic personnel and offer paramedic service in addition to the transportation of patients. Each company has a mobile intensive care unit. The units are staffed by at least one certified paramedic and one Emergency Medical Technician and can transport patients.

City fire department paramedics and rescue units and units of the A&A Ambulance Company are dispatched by the city emergency dispatching at the Randolph Park facility. Kords Ambulance Company does not participate in the publicly operated Meds Communication System. The private companies have complained about the number of "over responses" and "dry runs" for which no compensation is received. The problem with this multi-service is that they seem to work in competition with each other to the detriment of the public. The recommended program will change the arrangement and each service will act in support of the other. The net effect should be to produce a better level of service at equivalent or less cost.

An examination of the potential solution suggests three logical alternative service delivery systems:

1. A totally privately operated emergency medical care system.

2. A publicly operated emergency care system to the exclusion of all private participation, or

3. A cooperative combined effort of the private and public sector.

Research indicates that the population density of the Tucson metropolitan area will support paramedic service to the extent that any choice would be cost-effective. After careful consideration of all factors the third alternative appears to best serve the public interest and the foregoing specific program is recommended.

A case can be made for removing the fire department from the paramedic field in the case of Tucson. Many fire administrators who have studied the subject in depth have concluded in many cases that the proper course of action is to use an upgraded first aid service from the closest engine company and to depend on private paramedic service to be furnished by competent ambulance operators. When ambulance service is free, there tends to be a big demand for it. But if people have to pay a private company for ambulance service, the number of calls is generally much lower. The effect of this is not a lower grade of medical care service but rather a medical care service that is only called upon in the time of real need which could in effect increase the level of service in the case treated.

There have been questions as to the medical effectiveness of paramedic service. Surveys were conducted in the City of Seattle after the installation of a similar type service. There was a slight increase in the number of coronary patients who "walked away" from

the hospitals when compared to the record prior to installation of the service. Then a public education program was instituted in Seattle aimed at making the public aware of the symptoms of coronary problems and encouraged early entry into medical care and this program resulted in marked increases in the walk aways. Thus, the public education was far more medical effective than the paramedic service.

On the other hand the hospital emergency rooms which participate in the City of Long Beach paramedic program report a decrease of 30% in victims dead on arrival at the emergency room. Similarly, the Long Beach Fire Department reports an increase in successful resuscitations to 44% from the 10% experienced prior to the paramedic program.

Another noteworthy case history is in the Modesto-Ceres area of Central California whereby private enterprise, i.e., two ambulance services collaborated with two hospitals, one public, one private, to provide an effective paramedic ambulance service without the involvement of any public jurisdiction. In this case private enterprise moved into an area where public agencies either had not shown an interest or had been unable for various reasons to provide paramedic service in a metropolitan area. All ambulance service in the area was traditionally provided by private enterprises. Public fire jurisdictions who have normally pioneered in the paramedic field consisted of numerous small cities and fire protection districts and for economic and other considerations had not provided the service. There was coordination between the county hospitals and sheriff's department. The service to date has been good and there appears to be a good deal of public acceptance of the program.

Some adverse comments are now being heard from hitherto strong supporters and proponents of fire department paramedic service. In some cases the uneven work load is causing disaffection among paramedic personnel. In other cases the number of units is so saturated in an area that the number of paramedic calls per unit is insufficient for the assigned personnel to maintain their certification.

City of Fresno's experience has been adverse from the point of view that the growth in number of calls for the service so exceeded the anticipation of the fire department administration that it has seriously weakened the fire fighting capability of the associated companies. This points to the need for discretionary dispatch by a trained medical oriented dispatcher rather than the need for additional paramedic units.

The Mid-Valley Fire Protection District of Fresno County, California, which began providing paramedic service at the beginning of the year, has experienced sizable increases in equipment operation costs because of the need to dispatch full engine companies to both provide basic life support and to assist their paramedic teams at the scene of an emergency. Unanticipated costs include expenditures for consumable medical supplies which are reimbursed by local hospitals; i.e., bandages, sterile dressings, disposable splints, etc.

Los Angeles City Fire Department uses civilian crews on 31 ambulances in fire stations. Pay is the same as for Fire Engineer. No personnel or morale problems are reported to be arising from mixed crew living quarters.

ITEM NO. 5: FIRE METHODS AND COMPANY STAFFING

Recommendation

A. ESTABLISH UNIFORM STAFFING STANDARDS FOR FIRE COMPANIES.

B. CHANGE FIRE METHODS TO MAKE BETTER USE OF PERSONNEL.

Discussion

A. Recommended fire company staffing for Tucson should be as follows:

TABLE NO. 2

Type Company	Personnel Assignment
Triple Combination Engine Co.	1 Fire Captain 1 Fire Engineer 2 Fire Fighters
Two Piece Engine Co. and Engine/Tanker Combination	1 Fire Captain 2 Fire Engineers 2 Fire Fighters
Ladder Truck Company	1 Fire Captain 1 Fire Engineer 2 Fire Fighters
Emergency Medical Service Unit	1 Fire Captain, Fire Engineer or Fire Fighter Paramedic 1 of above, EMT II

Currently engine and ladder companies are staffed at levels of 20% to 35% higher than in the fire departments of Los Angeles County, Fresno and Contra Costa County. These fire departments protect municipalities that have fire problems similar to or greater than those in Tucson. The manpower assignments indicated above will adequately achieve the necessary level of engine company efficiency.

With the lowering of company manning levels the ISO grading will be adversely affected. It is probable that the grading items dealing

with manpower will show a backward trend. However, as shown in detail in the Appendix, the grading will not change sufficiently to affect the fire insurance rates in Tucson.

B. Tucson engine companies now typically stop at the fire, unload breathing apparatus, forcible entry tools, hose and other equipment, then lay one or two hose lines to a hydrant, sending two men with the engine to connect the engine to the hydrant and finally supply water to the fire. Changes in fire fighting methods can improve manpower utilization and largely offset the recommended staffing reductions. Whenever possible engine companies should lay lines from the hydrant to the fire: a tactic which permits simultaneous job accomplishment thereby reducing the time consumed by the operation. Another change for improving manpower utilization is the employment of two-piece engine companies as outlined in Recommendation No. 3. Other suggested refinements are using fire engineers as fire fighters at every opportunity, more frequent use of breathing apparatus, better deployment of personnel at the fire ground and elimination of the present practice of assigning more than one person to essentially one-man operations. In general, these methods are a combination of those that have long been successfully employed by the City of Los Angeles Fire Department and the Contra Costa Consolidated Fire Protection Districts. Their methods should be thoroughly studied before a change of fire fighting tactics is implemented.

Loading and equipping of fire apparatus will require some alteration in order to accommodate the recommended changes in fire methods. Breathing apparatus should be removed from compartments and be relocated to a position where firemen can quickly get into the harness prior to leaving the apparatus. Breathing apparatus face pieces should be carried in special holsters which can be made a part of all turnout coats. Improved transverse hose trays for small line service and some changes in piping and valving should be made. All of the apparatus changes can be done by city shop forces.

The suggested sequence of shifting to the recommended operational mode is as follows:

1. Select and assign a "retraining team" of a well-motivated chief officer and two fire captains who are knowledgeable and sympathetic to the recommended operational changes.

2. Assign the retraining team to intensive "hands on" and operational training. Arrangements should be made with the Los Angeles Fire Department, Contra Costa Consolidated Fire Protection District, and/or Los Angeles County Consolidated Fire Protection District for the training team to visit, participate in drills, observe and learn proper techniques for the Tucson Fire Department. Approximately one-half of the training should be at Los Angeles City Fire Department and the remainder to be at Contra Costa Consolidated Fire Protection District or Los Angeles County Consolidated Fire Protection District .

3. The retraining team should then be assigned to a period of intensive preparation and recommended alterations should be made to at least two pumpers.

4. One engine company and one ladder truck company should be removed from service.

5. Crews of the deactivated companies should be assigned to the retraining team at the training center for three to four weeks of orientation to the new methods. They should be assigned to 40 hour service during this period.

6. Upon completion of reorientation, the training companies should be assigned "as units" to replace field companies who would then be assigned to retraining. The process should continue rotation until all personnel who are to be retrained have been trained.

The new fire methods work best if the staffing level is constant. Therefore, the recommended number of personnel for each type of company is both a minimum and a maximum. When manpower is deficient, off-duty members should be called in to fill out companies. Likewise, when surplus personnel are on duty, they should be assigned to some other productive fire related tasks.

Nine Battalion Chiefs and all personnel assigned to fire companies are on duty for 56 hours per week. Thus, each position which is staffed 24 hours per day requires three persons plus an allowance for vacations and time off due to illness or injury. Nationally, agencies where the 56 hour duty week is in effect use multipliers varying from as low as 3.25 to 3.9 persons on the payroll per on-duty position. Tucson has been employing a multiplier of 3.8. In March the Tucson City Budget and Research Office analyzed recent experience and determined that a new multiplier of 3.37 was adequate. The recommendations of this study are based upon a 3.4 multiplier and should enable maintenance of a "constant manning" level of 84 members on duty.

TABLE NO. 3

On Duty Staffing

Company	PRESENT		Recommended Staffing	CHANGE	
	Maximum Manning	Minimum* Manning		Maximum	Minimum
Engine 1	6	5	5	-1	0
Engine 2	6	5	0	-6	-6
Engine 3	5	4	4	-1	0
Engine 4	5	5	5	0	0
Engine 5	5	4	4	-1	0
Engine 6	5	4	4	-1	0
Engine 7	5	4	0	-5	-4
Engine 8	5	4	4	-1	0
Engine 9	5	4	5	0	+1
Engine 10	5	4	5	0	+1
Engine 11	4	4	0	-4	-4
Engine 12	5	5	5	0	0
Engine 13	5	4	4	-1	0
Engine 14	5	4	4	-1	0
Engine 15	6	5	5	-1	0
Engine 16	4	4	4	0	0
Ladder 1	7	7	4	-3	-3
Ladder 2	6	5	4	-2	-1
Ladder 3	6	6	4	-2	-2
Ladder 4	6	6	4	-2	-2
Ladder 5	5	5	0	-5	-5
PMO One	3	2	0	-3	-2
Rescue 1	1	0	2	+1	+2
Rescue 2	1	1	2	+1	+1
Rescue 3	1	0	2	+1	+2
Rescue 4	1	0	2	+1	+2
Rescue 5	1	1	2	+1	+1
Totals	119	103	84	-35	-22

* Constant Manning

ITEM NO. 6: FIRE DEPARTMENT ORGANIZATION

Recommendation

REORGANIZE THE FIRE DEPARTMENT.
PERFORM MOST ADMINISTRATIVE TASKS WITH NON-UNIFORM CIVILIAN PERSONNEL.
MOVE THE DEPARTMENT ADMINISTRATIVE STAFF AND THE FIRE PREVENTION BUREAU INTO CITY HALL.

Discussion

The present organization of the fire department duplicates many services which are also performed in or for other city departments. Some functions which are now being performed by uniformed fire department personnel can be accomplished by civilian personnel or by other city departments at less cost and greater efficiency. Likewise, services performed by some civilians who are employees of the fire department can be made more efficient and equally effective if they are furnished by other appropriate departments. It should not be necessary for the fire department to be self-sufficient for every clerical, fiscal, mechanical and analytical function in a modern city organization. This recommendation suggests an organization that is more dependent upon support from other city departments and restricts the employment of uniformed personnel to those positions which demand their special expertise.

The fire department should continue to be headed by the Fire Chief functioning as the general manager. The chief should continue to be furnished with an administrative assistant who should function as the principal administrative advisor and assistant to the chief. A single deputy fire chief should function as executive officer of the fire department. It would be the executive officer's responsibility to assure that the administrative policies and directives eminating from

the fire chief's office are carried out by the operating divisions of the department. This basic change would eliminate two uniformed positions; one deputy fire chief and one fire captain management analyst.

The executive officer should have a battalion chief assigned to him as staff who would function as personnel officer of the fire department. The personnel officer should have general personnel responsibilities (including liaison and cooperation with the City Personnel Department), assignment of personnel, keeping personnel balanced among the shifts, battalions and activities and should be an active participant in labor relations activities. This modifications moves the personnel function to a higher level on the organization table than at present emphasizing its importance.

TABLE NO. 4

Present & (Recommended) Assignments, Uniformed Personnel

(City of Tucson Personnel Roster Dated 12-31-75 pages 94 through 105)

Rank	Administration	Services*	Research & Development*	Prevention & Investigation	Suppression & Rescue	Totals
Fire Chief	1 (1)					1 (1)
Deputy Fire Chief	2 (1)					2 (1)
Asst. Fire Chief		1 (1)	1 (0)	1 (1)	1 (1)	4 (3)
Fire Battalion Chief	(1)	3 (0)	1 (0)	1 (2)	11 (11)	16 (14)
Fire Captain	1 (0)	0 (3)	3**(0)	4 (5)	77 (73)	85 (81)
Fire Engineer			1 (0)		99 (92)	100 (92)
Fire Inspector				8 (8)		8 (8)
Fire Fighter		1 (0)			200 (109)	201 (109)
Totals	4 (3)	5 (4)	6 (0)	14 (16)	388 (286)	417 (309)

( ) = Recommended

* The Services Division and the Research and Development Division are recommended to be combined into a new Support Services Division.

**Includes two training officers.

Fire department operations should be divided into three principal divisions each under the direction of an assistant fire chief, one less than now. Each of these assistant fire chiefs would have fire suppression responsibilities as back-up to field battalion chiefs whenever necessary. The recommended reorganization is shown on the chart on page 39.

The present services division and research and development division are recommended to be combined into a single support services division under a single assistant fire chief. The recommendation anticipates arrangements for certain services to be furnished by appropriate city departments. Positions of one assistant fire chief, three battalion chiefs, three fire captains, one fire fighter and two draftsmen are eliminated by combining these functions. The training section consisting of a battalion chief and two fire captains is moved to the fire suppression division.

The new support services division should perform all of the clerical work and fiscal accounting work necessary for the fire department. They should coordinate the supply and maintenance needs of the fire department with the appropriate city departments who normally furnish such service. These functions should largely be carried out as a service to the fire department rather than being part of the fire department itself. Fire department personnel involvement in these functions should be limited to liaison, specification development, maintenance scheduling, quality control, etc.

The technical services section of the support services division should carry out the functions necessary to keep the data processing of fire department information current and correct. The technical services section should serve as liaison between the fire department and the various other city agencies which can perform mapping services and like functions for the fire department as required.

The fire prevention division should remain essentially as presently organized and would continue to function under the direction of an assistant fire chief. The fire prevention division should be divided into two basic sections: Inspection & Investigation and Plan and Code Checking. The first section should conduct periodic inspections of all occupancies of importance in the City of Tucson. This section would coordinate the activities of fire companies in the occupancy inspection area. Generally speaking the fire prevention division personnel would confine their activity to the more complicated occupancies which can be expected to be beyond the capability of engine companies in the field. Inspection section personnel would be responsible for coordinating all engine company inspection work in the field with the division. This section would also be responsible for investigating the following kinds of fires: all fires of more than $1500 loss, those where a person is injured or killed, and any fires of a suspicious nature. A battalion chief should be assigned to head the Inspection and Investigation Section.

The second section (Plan Check & Code Administration) should be responsible for engineering plan checks of fire protection features of all new construction. Included in the personnel for this section should be a qualified graduate fire protection engineer. A battalion chief should head the Plan Check and Code Administration Section. (Fire prevention is further discussed under a separate recommendation.)

The fire and rescue operations division of the fire department should continue to be headed by an assistant chief. Additional personnel should be assigned to the training section as required by the work load. This may necessitate temporary assignments of people from companies to the training division for certain specific tasks. The training officer will be responsible for coordinating in-service training. (The training section is further discussed under a separate recommendation.)

The rescue medical service (which has already been discussed in Recommendation No. 4) should be under the overall direction of the assistant fire chief in charge of fire and rescue operations. This activity will not require a full time battalion chief. The swing battalion chief, that is the battalion chief who relieves the regularly assigned district battalion chiefs, can readily provide all the necessary supervision. This level of supervision will exceed that now exercised in Los Angeles County. The balance of the supervisory activity can come from the district battalion chiefs where the rescue unit is assigned.

To help the administrative staff of the fire department function as part of the city management team, they should move their offices into City Hall. The staff should include the Fire Chief, Administrative Assistant, Deputy Fire Chief, Battalion Chief for personnel, Assistant Chief for support services and necessary support office staff.

A great deal of effective fire prevention activity entails close cooperation with the Building Inspection Department. Often the jurisdiction for any given project rests simultaneously in both the fire prevention and building inspection agencies. Many provisions of the building code directly affect the fire protection features of buildings. It would be beneficial and more convenient to the public being served if both agencies were at the same location. Also close cooperation and work location will stimulate improved understanding of each agency's functions by the other and thereby improve efficiency.

The recommendation does not represent a dramatic saving at the present time. Its object is to reduce the administrative force to a size that is fully employed at low average activity levels and to develop a dependency on outside resources for the occasional or peak activity occurrences.

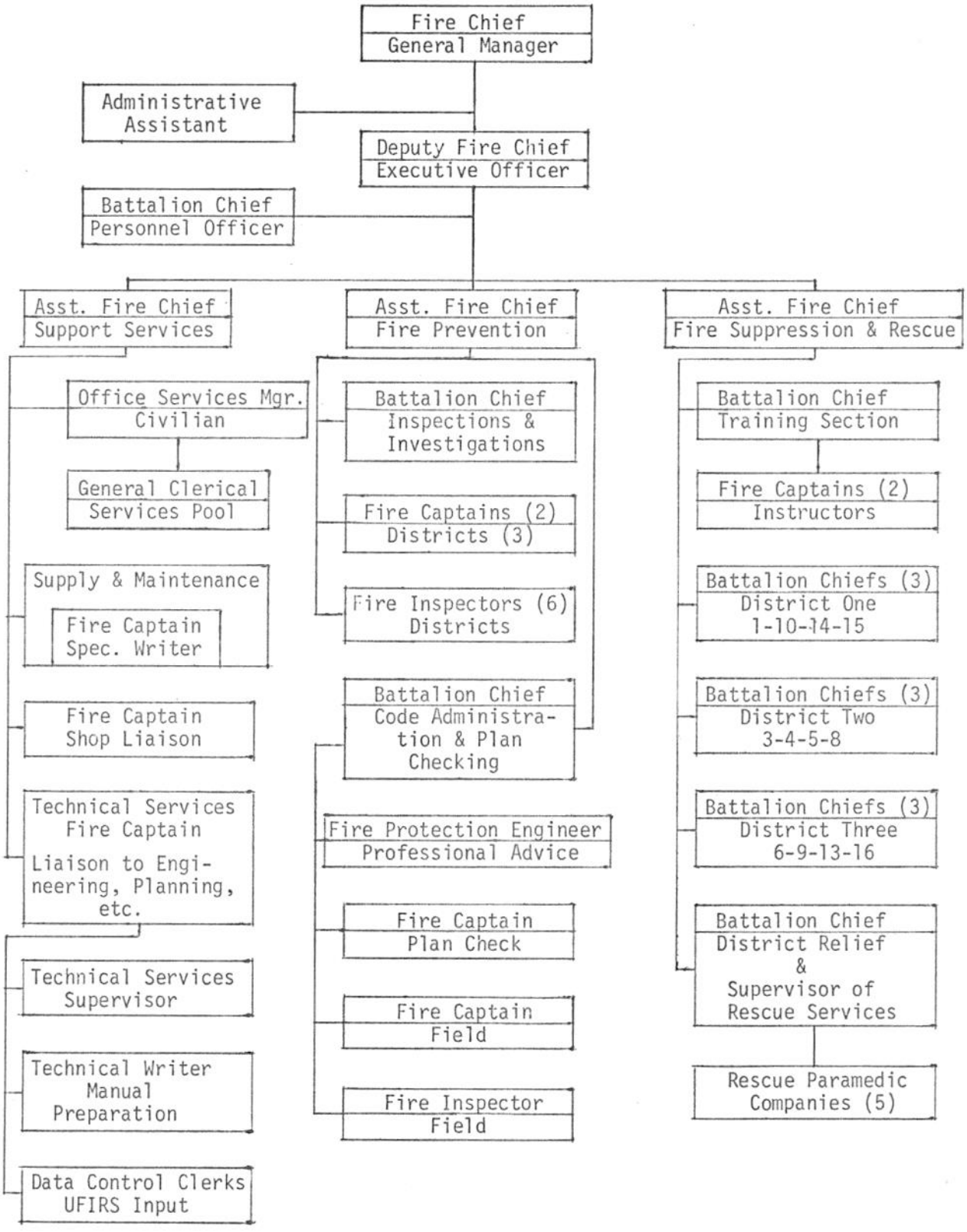
TABLE NO. 5

Costs or (Savings) of Personnel
Additions or Reductions

Rank	No. Added Or (Reduced)	Gross* Annual Cost Per Position	Costs or (Savings)
Deputy Fire Chief	(1)	31,643	(31,643)
Asst. Fire Chief	(1)	28,757	(28,757)
Fire Battalion Chief	(2)	27,128	(54,256)
Fire Captain	(4)	23,147	(92,588)
Fire Engineer	(8)	19,398	(155,184)
Fire Fighter	(92)	16,977	(1,561,884)
Totals	(108)		(1,924,312)

* Gross cost includes all fringe benefits

RECOMMENDED FIRE DEPARTMENT REORGANIZATION



ITEM NO. 7: PERSONNEL ADMINISTRATION

Recommendation

THE PERSONNEL DEPARTMENT SHOULD ASSUME THE FOLLOWING FUNCTIONS:

A. THE MONITORING OF PERSONNEL ASSIGNMENTS TO KEEP ABREAST OF ANY SITUATION WHERE PERSONNEL ARE WORKING OUT OF CLASSIFICATION.

B. THE MONITORING OF WORK ASSIGNMENTS TO ASSURE THAT JOB DESCRIPTIONS ARE KEPT CURRENT.

C. THE DEVELOPMENT OF INTER-DEPARTMENTAL PROMOTIONAL POSSIBILITIES AND INCENTIVES.

D. THE MONITORING OF ADMINISTRATIVE AND DECISION MAKING RESPONSIBILITY TO ASSURE THAT THE WORK IS PERFORMED AT THE PROPER LEVEL.

Discussion

A. All personnel assignments should be continuously monitored in order to assure that personnel are performing functions that are reasonably within their classification. The fire department has, in its quest for self-sufficiency, assigned uniformed members to essentially analytical and administrative tasks. The justification for assigning uniformed firemen to administrative and clerical tasks has always been that this experience is valuable to them when they are promoted into administrative positions. But it makes far better sense merely to expose these people to the services that are available from other city departments than to waste time training them to become proficient at such tasks themselves. Therefore, continuous monitoring of assignments is necessary to assure that personnel assigned actually perform liaison activities and not the work they are assigned to coordinate.

B. Current job descriptions of fire department personnel are overly general in nature. They should be re-written to more accurately describe the tasks that people actually perform. They then should become a factor in the salary setting procedure. There should be different job descriptions for such positions as fire captain, engine company, fire captain, truck company, fire captain, emergency medical services and so forth.

C. Many young people now entering the fire service are well qualified in academic background and intellectual ability for eventual promotion to the upper ranks of the department. However, the personnel turnover is so low in the upper ranks that the department will never get the opportunity to make full use of the talents of many of the younger firemen. Since the fire department is an excellent place for attracting people into general governmental service, the City of Tucson should create opportunities and incentives to facilitate the transferral of such persons to other city departments.

D. The Tucson Fire Department is over-burdened with rules, regulations and manuals of procedure. These are not only unnecessary in departments like Tucson where the officer personnel are well-qualified and fully capable, but they serve to restrict individual initiative and performance. Fire captains are key people. They should be given as much latitude as possible in the operations of their companies. Rather than being saddled with performance times, they should be given objectives and left to accomplish them at their own rate. This will considerably reduce the need for upper level supervision of operation details within the department.

ITEM NO. 8: FIRE DEPARTMENT TRAINING

Recommendation

ELIMINATE UNNECESSARY TRAINING DRILLS AND ESTABLISH A TRAINING COMMITTEE REPRESENTATIVE OF ALL PERSONNEL RANKS AND ASSIGNMENTS.

Discussion

Training in the Tucson Fire Department is adequate for indoctrination of new personnel. Thereafter training is scheduled throughout the year on an annual basis which assures coverage of each training sebject and operational area. As a result, departmental personnel receive repeated training on the same subject regardless of need, simply to keep the program on schedule.

To help eliminate this unnecessary repetition, a committee is needed to advise the Fire Chief and the training section on training matters. This committee should be made up of the training officer as chairman, the assistant chiefs in charge of all divisions, one battalion chief from each of the battalions, preferably each from a different shift, one engine company captain from a two-piece engine, one captain from a single pumper engine company, one truck company captain, one medical rescue unit captain and one fire engineer.

The responsibility of this committee will be to keep the training system responsive to the real needs of the fire department. This should mean shorter term scheduling than is now the practice in Tucson. The in-service training schedule would be adjusted to be:

1. Responsive to the needs demonstrated by recent fire experience; and

2. Less wasteful of time.

For example, if an operational drill requires four hours for completion, the four hour drill can be accomplished at one time as a single operation rather than two hours per shift.

The fire department spends considerable time and money drilling personnel in manipulative skills. Much of this is unnecessary. Experience has shown that most firemen do not need constant repetitive drilling to remain proficient. Annual testing in these skills is adequate. Persons who fail to pass the test can be scheduled for additional training. Elimination of unnecessary repetitive drills will free the firemen to use their time in a more productive manner. And it will help eliminate the boredom unnecessary training generally produces.

ITEM NO. 9: FIRE PREVENTION

Recommendation

A. TRANSFER THE RESPONSIBILITY FOR ROUTINE OCCUPANCY INSPECTIONS TO THE FIRE COMPANIES AND INCREASE THE FREQUENCY OF SUCH INSPECTIONS.

B. REORGANIZE THE FIRE PREVENTION DIVISION ALONG FUNCTIONAL LINES.

C. BEGIN CHARGING FEES FOR THE INSPECTION OF NEW CONSTRUCTION AND HAZARDOUS OPERATIONS.

Discussion

A. Tucson fire companies can readily assume responsibility for inspection of most of the commercial and some institutional occupancies on a regular basis in place of Fire Prevention Division specialists. Full utilization of company personnel will make it possible to achieve a more frequent inspection. This program schedule will also free Fire Prevention Division personnel for a higher frequency of inspections of the more complicated occupancies. Most commercial occupancies (retail stores, warehouses, etc.) should be inspected twice per year. Less hazardous occupancies such as offices should be inspected annually and the more hazardous occupancies should be checked at least quarterly. Schools (through high school), convalescent homes and similar occupancies should be inspected semi-annually. Inspection of the more complicated occupancies should remain the responsibility of the Fire Prevention Division.

Training of fire company personnel in fire prevention procedures should be carried out by fire prevention personnel but should be coordinated by the training section.

B. The Fire Prevention Division should functionally be divided into two sections; Inspection and Investigations and Plan Checking and Code Administration.

The Inspection and Investigations Section, under the direction of a Battalion Chief would be responsible for the routine and regular inspection of occupancies and for training and assistance to the fire company inspection program. This section would also be responsible for investigation of false alarms, fire cause, incendiary fires and be the fire department liaison with law enforcement agencies.

The Plan Checking and Code Administration Section would concern itself primarily with the fire protection features of new construction, the installation of hazardous storage of materials and hazardous processes. This section should be under the supervision of a Battalion Chief. A fire protection engineer should be on the staff for the purpose of furnishing sound engineering judgment in matters of code interpretation. The fire protection engineer should also have primary responsibility for developing and recommending new code provisions or amendments to existing codes. It should also be his responsibility to advise the Assistant Chief in charge of the Fire Prevention Division on relating fire prevention effort to the output from the Uniform Fire Incident Reporting System.

C. Traditionally, fire prevention service has been provided to the public on a no-fee basis--paid for by general tax assessment. The primary reasons for this are:

- Fire prevention is usually "sold" rather than "forced." Charging of fees may work against this practice.
- Many fire departments did not have a fire prevention code in the beginning. Although adherence to fire prevention standards was promoted, there was no legal

basis for establishing a fee. When the code was adopted, the pattern was already established.

- In many respects, fire prevention activities are a benefit to the whole community, and the cost should be borne by the whole community.

There are counter arguments which have merit, but the overriding fact is that with limited manpower, the Bureau is devoting too much effort to the problems created by new construction and hazardous operations, at the expense of reasonable inspection service to the remaining taxpayers. A moderate fee schedule for the services which require unusual amounts of time is a way of offsetting this imbalance. Instances where fees should be assessed are as follows:

1. New Buildings. Review plans, consultation, inspection during construction (this includes fire protection systems plans).

2. New Flammable Liquid and LPG Installations. Review plans, consultation, inspection and test observation.

3. Storage of Explosives. Inspection of facility.

4. Wrecking Yards. Inspection of facility.

5. Fumigation. Inspection of premises.

6. Installation of New Processes.
   - Chemical plants
   - Processes using flammable liquids or gases
   - Refineries
   - Combustible metals plants
   - Oil burning equipment (large installations)
   - Drying ovens (large installations)
   - Manufacturing of combustible materials (involving hazardous operations)

The size of the fee should be based on installation cost and should be fairly consistent with the building permit fee schedule. The fee should be collected as part of the building permit fee.

ITEM NO. 10: DUTY SCHEDULES

Recommendation

DIVIDE THE 24 HOUR SHIFT SYSTEM INTO A 10 HOUR AND 14 HOUR SHIFT. DEVELOP ACTIVITY SCHEDULES TO MAKE EFFECTIVE USE OF THE TIME OF COMPANY PERSONNEL IN FIRE PREVENTION TRAINING, MAINTENANCE, PHYSICAL FITNESS, MEALS AND REST.

Discussion

Shift personnel of the Tucson Fire Department are on duty for a 24 hour period followed by periods of 24 or more hours off-duty. Personnel must be able to respond to fires and other emergencies at any time during the 24 hour duty period which makes reasonable rest and relaxation necessary. The present duty schedule is wasteful of time as it only permits the realistic use of a maximum of 8 hours of productive time of each man's time in a 24 hour shift. The present daily activity schedule which is admittedly rigid almost fully utilizes the time available. If the shifts were split into a 10 hour day shift and a 14 hour night shift, four more productive hours will be available every day for each on-duty man.

The day shift should commence at 8 a.m. and extend until 6 p.m. Day shift activity would include participation in the physical fitness program and time for one meal daily. Monday through Friday should be devoted to the pre-fire planning inspection program, fire prevention inspections and can include zoning inspections on behalf of the Planning Department. Saturday, Sundays and holidays should be devoted to training and drills.

One night shift can produce four to five usable hours. Time should be allowed for one meal and most of the time reserved for bed rest. On all days but Sunday, night time spot inspections of places of public assembly and institutions can be conducted. Maintenance, physical fitness and some training and drills can be carried out during evening hours.

Crews should be rotated from day to night duty no more frequently than weekly but no less than monthly. Under this system the inspection work loads will not be uniform between stations. This should neither preclude adoption of the system nor attract non-fire protection related tasks to the fire house.

The assignments of time to various activities should be objective in nature. That is, when the assigned task has been completed the personnel should be permitted (and expected) to relax. Assignments should be realistic, related and needed. The program should not become a "make work - fill time" exercise in futility.

APPENDIX

Existing Conditions

Relationship Between Fire Department Response Time and Fire Losses

Plate VI: Existing Fire Stations

Plate VII: New Fire Station Plan

Estimate of Fire Insurance Grading Impact

Uniform Building Code Amendments

EXISTING CONDITIONS

General

The present range of potential fire problems within the City of Tucson is not extensive, ranging from sparsely developed desert land to typical urban commercial improvements. Included within this range are substantial residential developments, two regional shopping centers, the University of Arizona, an older central business district and some miscellaneous manufacturing and warehousing operations.

The Southern Pacific Railroad and Interstate Highway 10 traverse the city on nearly parallel routes on an approximate northwest to southeast axis. The location of manufacturing and warehousing activity has been influenced by these routes. A major steam powered electrical generating plant of the Tucson Gas and Electric Company is located in the northwest quadrant of the city but presents little in the way of a fire control problem.

The 1970 U.S. Census indicated a population of 262,933; the preliminary counts (December 15, 1975) from the 1975 Special Census, by the U.S. Bureau of Census, indicates a present population of 297,739. The city covers an area of nearly 100 square miles. Approximately 70% of the city area is built upon.

Basically Tucson is a typical low density community of light to moderate combustibility. The most serious fire and life hazards eminate from the older downtown area and at some warehousing locations. There are only three areas where Insurance Services Office engineers considered more than 4500 gpm fire flows to be indicative of the fire potential. High rise structures have been and are being constructed; recent construction has conformed to new code provisions that are more restrictive than the 1973 Uniform Building Code. Tall buildings

are located in the downtown business district, along East Broadway, at the University of Arizona campus and at a few scattered locations. Nearly all the buildings in Tucson are three stories or less in height.

The terrain is generally flat. The city is traversed by the Interstate Highway 10, the Southern Pacific Railroad and two major riverbeds. None of these poses serious obstacles to fire department vehicles or significantly increases response time.

Buildings in both of the regional shopping centers have been constructed under modern building code standards. Most of the buildings are protected by automatic fire sprinkler systems.

The congested older part of the downtown business district contains some older buildings that are predominantly fire resistive construction. Building congestion is not considered serious. Apartment buildings of low rise configuration and both ordinary and wood frame construction are located throughout the city. Most are new and comply with building codes. In residential districts the dwellings are well-spaced detached structures. Many of these dwellings are primarily of masonry construction, a factor which favorably affects the potential fire spread.

Construction in the smaller business districts which extend along principal streets presents fire control problems well within both the existing and recommended fire department capabilities.

Fire Department

The fire department presently maintains 102 fire fighting personnel on duty. There were 417 uniformed personnel on the rolls on December 31, 1975. They are assigned to 16 engine companies, five ladder truck companies, five rescue companies and a paramedic company and are housed in 14 fire stations. Two new fire stations are near completion.

The following vehicles are in service: 16 triple combination pumping engines, two elevating platform trucks, three aerial ladder trucks, two pumper tank wagons, five rescue trucks and a paramedic vehicle. There is ample apparatus in reserve.

The city is divided into three battalion districts for purposes of supervision of fire fighting operations. Each battalion is under the command of a battalion chief for each duty platoon.

At present, the fire chief functions as general manager of the department. He is aided by a civilian administrative assistant who nominally supervises the clerical/accounting pool, which serves the headquarters and fire prevention staffs. The chief is also aided by a management analysis unit consisting of a fire captain who is trained in business administration. The position is engaged in a continuous program of monitoring administrative work flow, management studies and related activities.

The balance of the fire department is presently divided into two primary functions; administration and fire operations. Both of these functions are supervised by a deputy fire chief. The fire administration function is divided into two divisions; Administrative Division and a Resources Division, each supervised by an assistant fire chief. The administrative assistant fire chief supervises a staff of uniformed and civilian personnel in the budget, personnel and training sections. The resources division assistant fire chief exercises supervision over the technical services, maintenance and supply sections.

The fire operations function presently includes supervision of the fire prevention division and the fire suppression division. The fire prevention division is headed by an assistant fire chief. Fire prevention includes a full range of fire prevention services including plan checking, installation inspections, occupancy inspections and fire investigations. The fire prevention division also has a uniformed fire captain for public relations who is designated the community relations unit. The suppression division assistant fire chief is in overall command of the three battalion districts and the medical section.

Communications

Fire and rescue service communications are combined with public works in a communication center facility in Raldolph Park. The center and maintenance services are administered by the city's Operations Department. A radio street fire alarm box system of recent design is in service with many of the boxes serving the city's high value districts. The system is used to connect private auxiliary fire alarm systems into the communications center. Radio, telephone and recording capabilities are complaete and three or four operators are on duty at all times. Two operators are assigned exclusively to fire alarm service and one operator handles all requests for rescue or emergency medical care.

Code and Ordinances

Tucson has adopted the 1973 editions of both the Uniform Fire Code and the Uniform Building Code. Both codes were extensively amended at the time of adoption and as a result are somewhat more restrictive than that published by the code development agencies. The Fire Code as adopted requires improved access and on-site water supplies for building groups which are excessively set back from streets, local fire alarm systems in certain dwelling units and automatic sprinklers in some occupancies. The Building Code has been amended to be more restrictive in the application of fire detection and automatic sprinkler systems. Also, a locally prepared Chapter 55 has been added to the Building Code to regulate life safety in existing buildings. Tucson has also adopted the 1973 edition of the Uniform Code for the Abatement of Dangerous Buildings.

Water System

Water supplies for fighting fires are mostly furnished by the Municipal Utilities Management Agency facilities. The water system is generally strong. Fire flow tests of March, 1975, by Insurance Services Office engineers list only five locations where the water available fails to meet the maximum standards for quantity and pressure: 44th St. & 6th Ave., Park Ave. & Miles St., Tucson Blvd. & Medina Dr., 6th St. & 3rd Ave., and at Carravelle & Lands End Roads.

Future Development

Tucson is expected to continue to grow, although it will do so under somewhat firmer controls than were in effect during the explosive growth period of the 1960's. No spectacular industrial growth has been forecast. High rise development will continue but with controls on location. Considerable construction of apartment buildings and other dwellings can be expected. Tucson will most likely continue to be a low rise city with good separation between buildings. The University of Arizona campus facilities will continue to expand, but the overall fire potential will remain about the same.

The need for traditional fire department service will continue to diminish as the provisions of modern codes gradually take effect.

RELATIONSHIP BETWEEN FIRE DEPARTMENT RESPONSE TIME AND FIRE LOSSES

By reducing the number of fire stations obviously the fire department response times to fires will increase. With increasing response time it is likely that fire losses will increase. The following calculations are designed to evaluate the relationship between fire station distribution and fire losses in Tucson.

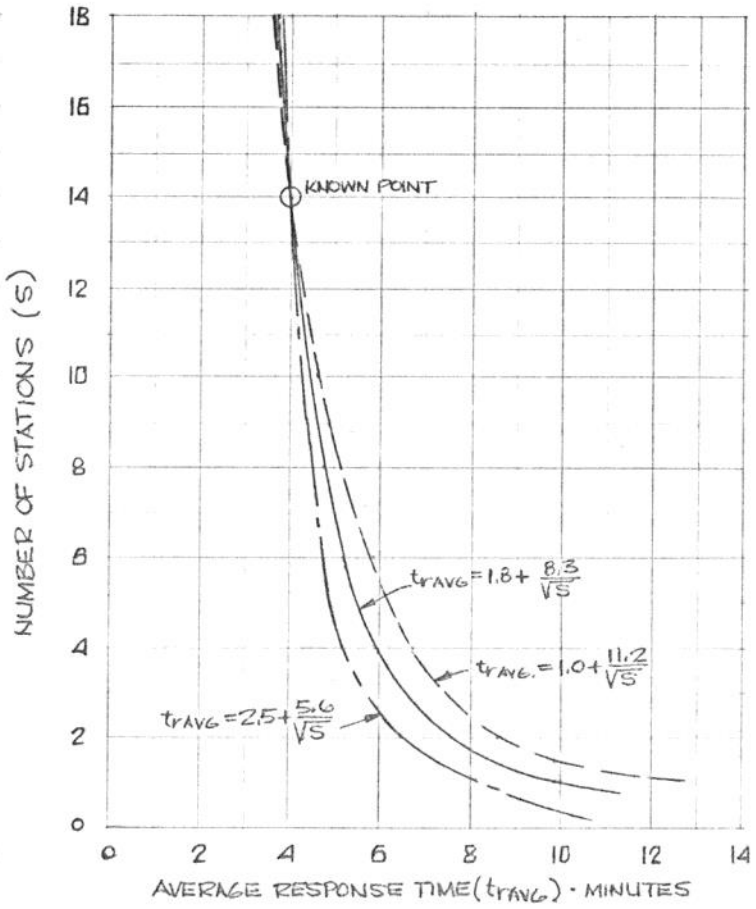
Plate No.III plots the estimated average response time of the first company to a fire versus the number of stations for the City of Tucson using the function:

$$t_{avg} = C_1 + C_2/\sqrt{S}$$

where t_{avg} - average response time in minutes
s - number of stations (locations)
C_1, C_2 - constants

C_1 is the time it takes the fire company to begin traveling plus the time it takes to initiate suppression after it has arrived at the scene (to get the hose out, etc.). This would be the time it would take for the company to respond to a fire next door to the station.

PLATE NO. IV



Therefore, the average time of travel, $t_{avg} - C_1$, is equal to $C_2/\sqrt{S}$. For a given area of coverage the travel time varies as the inverse of the square root of the number of stations. For example, if one station is located in the middle of a two mile square, in order to reduce the average distance traveled (and therefore the average travel time) by a factor of two, the two mile square would have to be divided into four one mile squares with a station located at the center of each.

The function strictly holds only for uniform areas of first response coverage with each station at the center of its area. It also assumes uniform travel speeds.

One point on the curve is known for Tucson's 14 stations with an average first alarm response time of 4.0 minutes. This number was obtained from data for all fires which had more than $5000 in losses during 1974 and 1975. Actually, in 1974, for 88 fires the t_{avg} = 4.05 minutes and for 1975, for 83 fires the t_{avg} = 3.95 minutes.

It is necessary to define a second point or a limiting condition to evaluate the two constants in the function. Two possibilities exist, (1) to approximate C_1, the average time it would take for a company to respond to a fire next door to the station or (2) to approximate the average travel time if one station were located in the center of a circle with an area equal to that of Tucson. The latter approximation was made, then C_1 was checked for reasonableness.

An area of 107 square miles was used for Tucson. An equivalent area circle has a radius of 5.83 miles. The average travel time would be the time to travel 4.13 miles which is the radius of a circle with half of the 107 square mile area inside the circle and the other half of the area between 4.13 miles and 5.83 miles. If the average speed is 30 mph then the average travel time is 8.3 minutes. Therefore, $t_{avg} = C_1 = 8.3 \text{ minutes} = C_2/\sqrt{S}$ or $C_2 = 8.3$. Using the known point of t_{avg} = 4.0 minutes when s = 14, C_1 can be determined:

$$C_1 = t_{avg} - C_2/\sqrt{S} = 4.0 - 8.3/\sqrt{14} = 1.8 \text{ minutes}$$

The value of C_1 = 1.8 minutes appears to be a reasonable time for a company to leave the station after the alarm is received plus the time necessary to apply water on the fire after arrival. Therefore, using the equation: $t_{avg} = 1.8 + 8.3/\sqrt{S}$ minutes in Plate IV. Checking the sensitivity of the function to changes in C_1 a range of values $1.0 \leq C_1 \leq 2.5$ was chosen. In Plate IV, curves for C_1 = 1.0 and C_1 = 2.5 are shown as dashed lines. For each of these two cases C_2 is chosen such that the curve will go through the known point of t_{avg} = 4.0 at s = 14. As can be seen, there is very little difference in the three curves for s greater than 8. However, the curve in which

C_1 = 2.5 begins to give unrealistically low times (fast travel speeds) for low values of s. Since we are really only interested in the upper portion of the curve, it can be seen that any analysis made about the number of stations necessary is not extremely dependent upon our estimate of C_1.

A report on planning fire stations for Glasgow, Scotland by Jane M. Hogg* makes a similar analysis for the average travel time versus the number of stations. The procedure used in her analysis to predict average travel times was to actually pick possible fire station site combinations and then, using addresses of fires responded to in Glasgow in 1966, determine the average travel time had the chosen fire station site combinations existed. The function I have used, that is that the average travel time ($t_{avg} - C_1$) is inversely proportional to the square root of the number of stations, fits her analysis very well. Of course, the constant C_2 is different, as it would be for a different area and probably different average speeds of travel. But Hogg's analysis supports the validity of our model and chosen function.

Plate No. V estimates the property and contents losses versus the average response time of the first company to the alarms in the City of Tucson.

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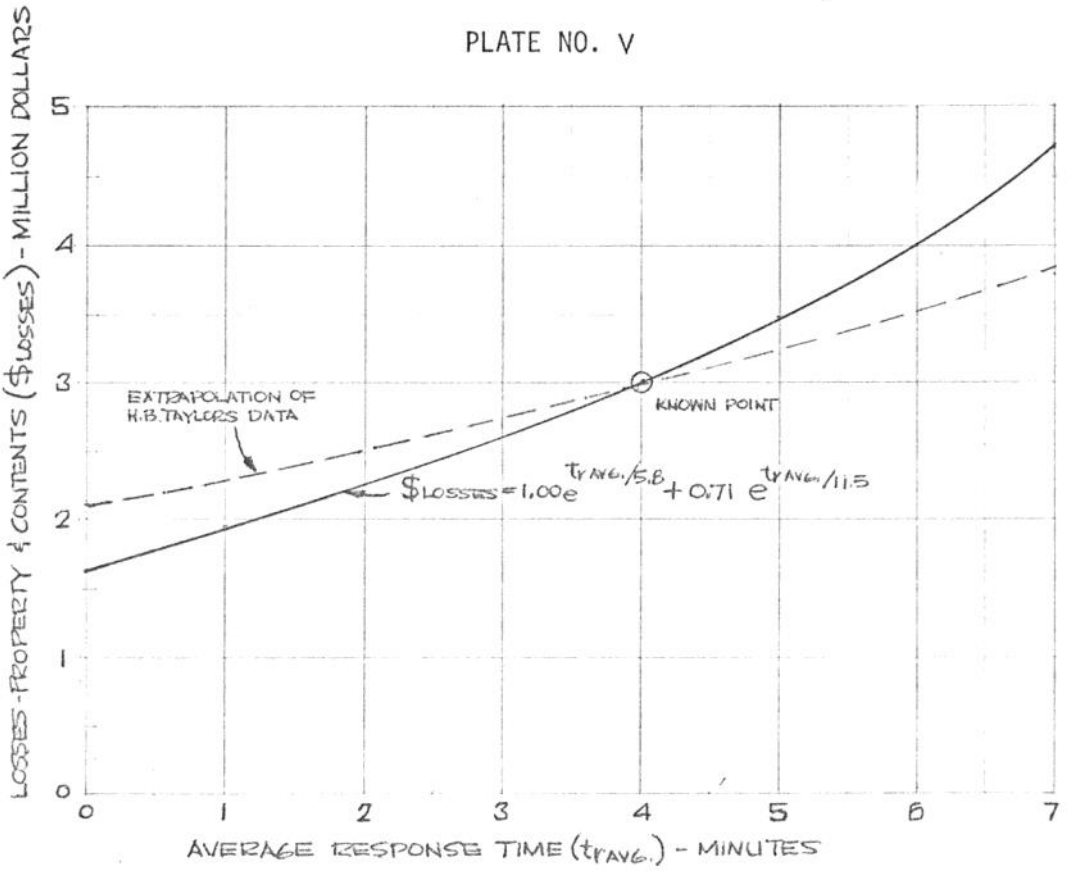
* Jane M. Hogg, Fire Research Report No. 1/68: Planning for Fire Stations in Glasgow in 1980, Home Office Scientific Adviser's Branch, London (October 1968).

PLATE NO. V



Several assumptions had to be made to arrive at this curve. The rate of growth of fires had to be predicted. Three experimental studies* have shown that the rate of growth of fires in structures can be expressed by the following equation.

$$V_t = V_o \exp [(t-t_o)/m]$$

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* W. G. Labes, "The Ellis Parkway and Gary Dwelling Burns", Fire Technology Vol. 2, p. 287 (November 1966).

F. J. Vodvarka, Urban Burns-Full Scale Field Studies, Final Technical Report to the Office of Civil Defense on IITRI Project J6171, IIT Research Institute, Chicago (January, 1970).

C. P. Butler, S.B. Martin, S.J. Wiersma, "Measurements of the Dynamics of Structural Fires," Fourteenth Symposium (International) on Combustion, The Combustion Institute, Pittsburg, p. 1053 (1973).

where V_t - volume of compartments in flame at time t after ignition
V_o - volume of the originally ignited compartment
t - time after ignition
t_o - time to flashover of the original compartment
m - time constant which is a measure of fire spread

It can be seen, then, that the volumetric doubling time, that is, the time for the volume (size) of the fire to double is:

$$VDT = m \ln 2$$

The VDT ranged from about 3 to 14 minutes depending on the structural type, wind conditions, and fuel loading inside the buildings. Wooden buildings with high fuel loadings burning in high wind conditions would have a low VDT. Brick buildings with low fuel loadings burning in low wind conditions would have a high VDT.

The following assumptions were made to arrive at Plate No. V.

1. The property and contents losses vary directly as the volume of the structure that experiences flame, e.g., if half the rooms in a house experience flaming then half of the value is destroyed.
   Therefore: \$ losses = $K_{exp}\ [(t-t_o)/m]$
   where: K - constant yet to be determined
   t, t_o, m - same as in equation 2.

2. The losses that occur from fires in Tucson have rates of growth predicted by equation 2.

3. The losses in a fire are a direct function of the volume burning at the time the first company arrives. This does not mean that the response time of the other companies is not important but that if the average response time of the first company were changed because of a change in station densities in the area, the average response time of other responding companies would be changed in a similar manner.

4. Two-thirds of the losses that presently occur are from fires having a VDT = 4 minutes (m = 5.8) and one-third of the losses are from fires having a VDT = 8 minutes (m = 11.5). This breakdown was arrived at by looking at fires that occurred in Tucson in 1974 and 1975 in which approximately two-thirds of the losses occurred in residential dwellings and small commercial structures for which the estimated average VDT = 4 minutes. The other one-third of the losses occurred in structures which were better built for which the estimated average VDT = 8 minutes. The longer the VDT the less sensitive the predicted losses will be on the average response time. The estimates are conservative and predict more sensitivity to response time than would actually occur.

5. The known point is that 3 million dollars of losses occur in Tucson when the average response time is 4 minutes.

6. In equation 4, the $(t - t_o)$ is not known. However, it is assumed that the average $t_o = t_a + c$ where t_a is the alarm time and c is a constant. Therefore:

$$\$ \text{ losses} = K\, e^{\frac{t-t_a-c}{m}}$$

$$= K\, e^{-c/m}\, e^{\frac{t-t_a}{m}}$$

$$= \hat{K}\, e^{\frac{t-t_a}{m}}$$

where $\hat{K} = K\, e^{-c/m}$, a new constant.

Now the average $(t - t_a)$ is simply our t_{avg}. Putting our assumptions together and evaluating the constants from known points follows:

$$2/3\ (\$ \text{ losses}) = \hat{K}_1\, e^{\frac{t_{avg}}{m_1}}$$

$$1/3\ (\$ \text{ losses}) = \hat{K}_2\, e^{\frac{t_{avg}}{m_2}}$$

where $t_{avg} = 4.0$ $\qquad m_2 = 11.5$

$m_1 = 5.8$ $\qquad \$ \text{ losses} = \$3M$

Therefore, $\hat{K}_1 = 1.00$ and $\hat{K}_2 = 0.71$ and the total estimated losses as a function of the average response time is given by the equation.

$$\$ \text{ losses} = 1.00\ e^{t_{avg}/5.8} + 0.71\ e^{t_{avg}/11.5} \text{ (million dollars)}$$

This function is plotted in Plate No. V.

The analysis does not consider fires in which a total loss occurs. Such fires would tend to make the loss curve less sensitive to the average response time than shown in Plate No. V. However, in Tucson only about 10% of the losses occur in structures which have loss to value ratios greater than 0.8. Therefore, accounting for total loss fires would alter the curve very little.

Nonstructural fires and small structural fires probably do not correlate to equation 2 accurately. Although these classes of fires may be numerous the total loss will be small compared to the total loss from the structural fires whose growth is predicted by equation 2.

A study was made in England* which used data collected by the British Fire Protection Assosciation on actual response times and losses. If their data were extrapolated to the Tucson situation, it would predict a slightly flatter curve, i.e. losses less sensitive to average response time, than our analysis. An extrapolation of their data is shown by the dotted line in Plate No. V.

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* H. D. Taylor, "Operational Research at the Home Office," Home Office, Scientific Advisory Branch, London (1971).

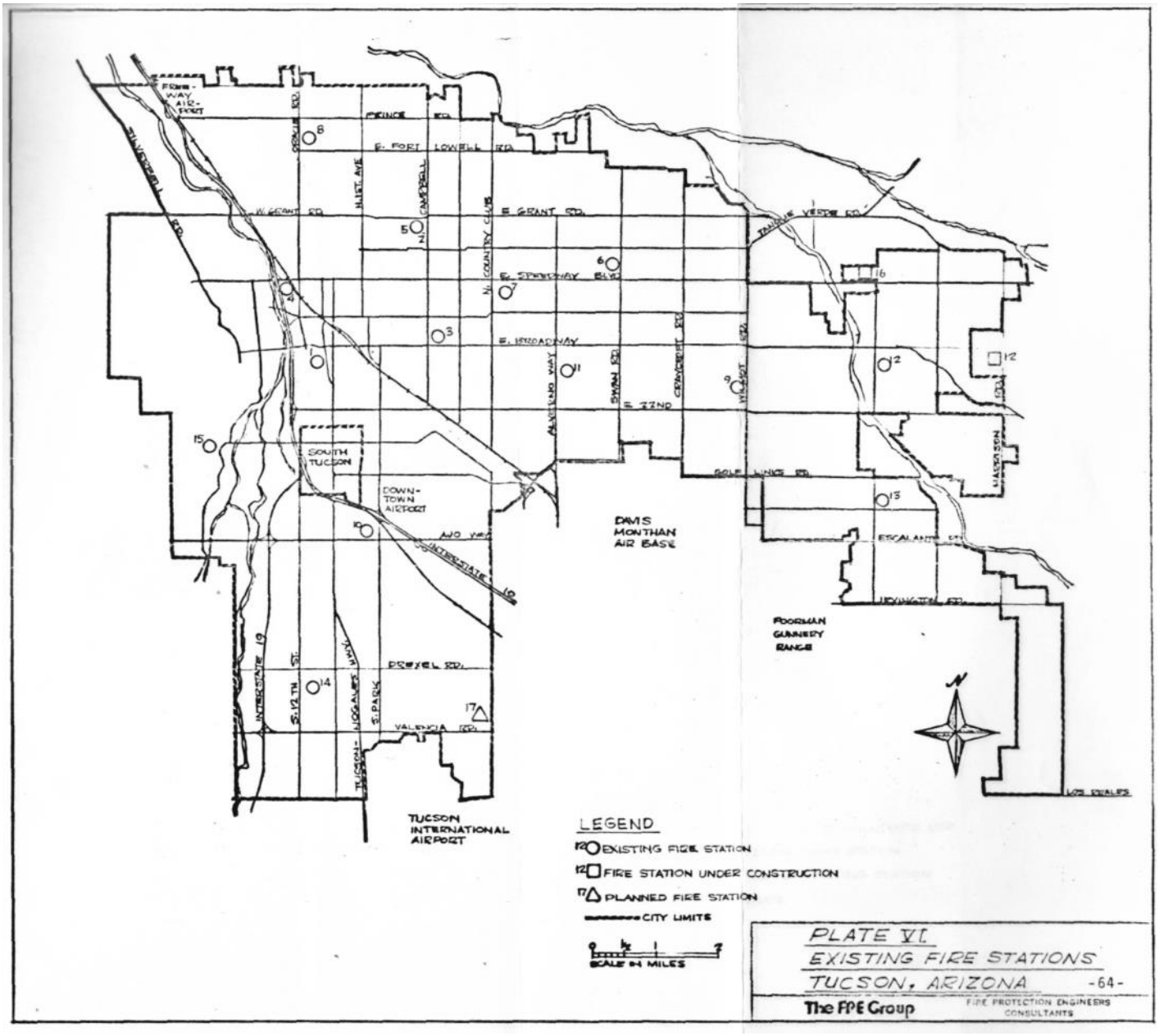

PLATE VI.
EXISTING FIRE STATIONS
TUCSON, ARIZONA

The FPE Group
FIRE PROTECTION ENGINEERS
CONSULTANTS

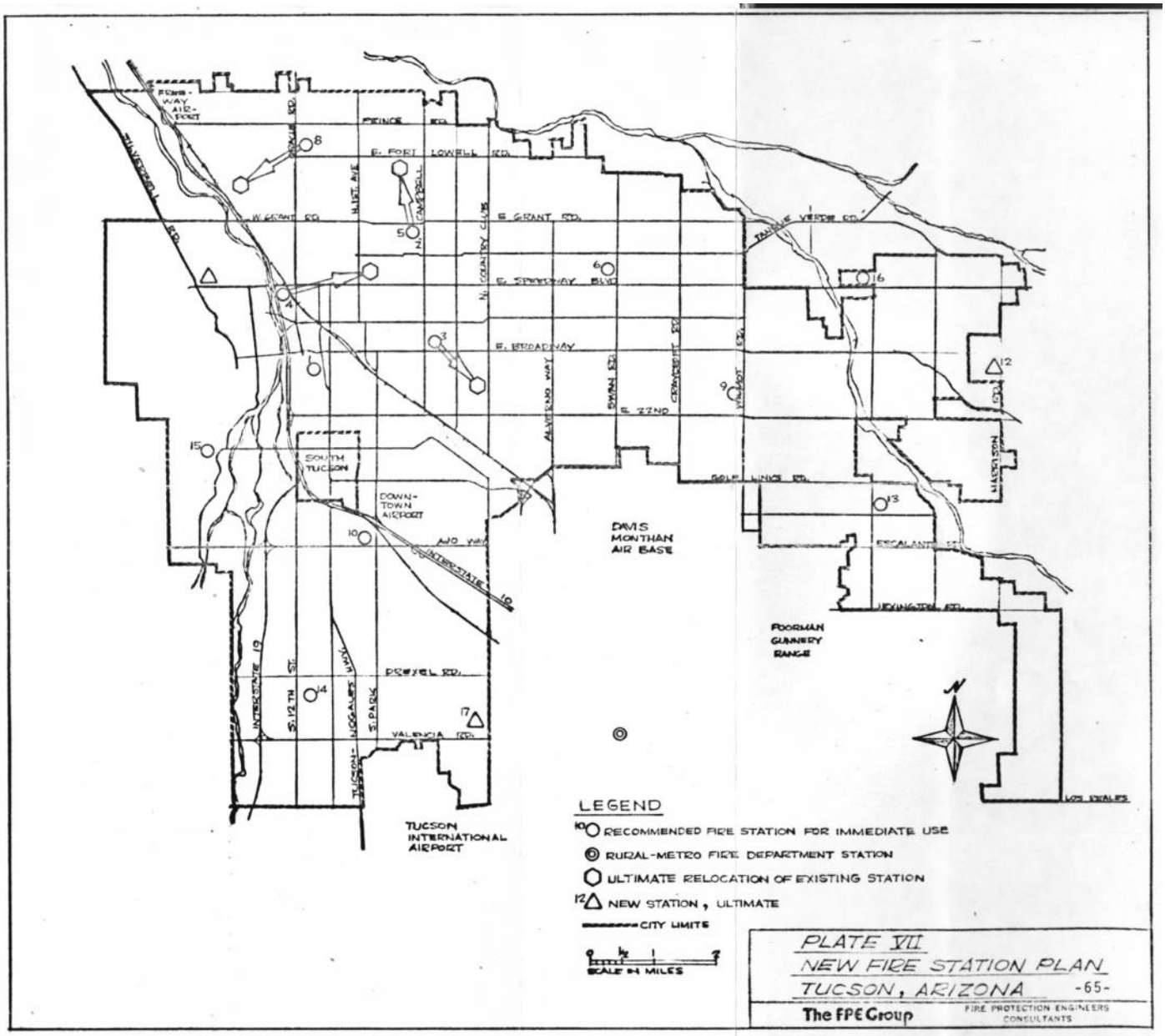

PLATE VII
NEW FIRE STATION PLAN
TUCSON, ARIZONA -65-

The FPE Group FIRE PROTECTION ENGINEERS CONSULTANTS

ESTIMATE OF FIRE INSURANCE GRADING IMPACT

The fire insurance companies through their trade association, Insurance Services Office, classify municipalities as to the effectiveness of their fire defense system in reducing loss of property due to fire. The Insurance Services Office use a grading system that evaluates the fire defense system in comparison with established standards. The grading is divided into five sections as follows:

Water Supply
Fire Department
Fire Service Communications
Fire Safety Control
Additional Deficiencies

Public protection, consisting of the above items, is graded by ISO engineers to classify cities into ten classes. Tucson is presently in Class 3 (Class 10 being the poorest). Points of deficiency are assessed against each item of significance according to the percentage of deviation from the standard, in the same manner as scoring a game of golf - the higher the total number of deficiency points, the poorer the condition. The items measured are weighted according to their relative importance in the fire protection system. The total points determine the protection classification of a community which in turn plays a part in the basis of establishing fire insurance premiums.

An analysis of the most recent ISO grading of Tucson (March, 1975) shows that implementation of this recommended program will increase deficiencies by 62 points. Changes to the fire department will produce an increase of 86 deficiency points. Improvements in Fire Safety and Control reduce deficiencies by 24 points. The City of Tucson's overall fire insurance grading should increase from 1105 to 1167 points without changing the overall class or the fire insurance rates.

Estimated changes in the assessment of deficiency points is illustrated in the following table.

TABLE NO. 6

ESTIMATED DEFICIENCY POINT CHANGES

Item	Present	New	Change
FD 1 Pumpers	8	39	+30
FD 2 Ladder Trucks	36	61	+25
FD 6 Number of Officers	9	25	+16
FD 7 Department Manning	28	70	+42
FD 8 Engine & Ladder Company Unit Manning	15	20	+ 5
FD 13 Training	86	53	-33
Net Change, Fire Department	182	268	+86
FSC 1 Flammable or Compressed Gases	9	8	- 1
FSC 2 Flammable or Combustible Gases	46	35	-11
FSC 3 Special Hazards	23	19	- 4
FSC 4 Misc. Hazards (Enforcement & Conditions)	17	15	- 2
FSC 5 Supplemental Fire Prevention Activities	16	10	- 6
Net Change, Fire Safety & Control	158	134	-24
TOTAL NET CHANGE IN GRADING	1105	1167	+62

Should Tucson not accomplish the anticipated improvements to fire department training and to Fire Safety Control, (items 1 through 5), the overall fire insurance protection class will still remain a 3.

Effects of class changes on fire insurance premiums are adequately estimated in a report entitled "Analysis of Fire Insurance Costs for Alternative Rate Classes: City of Tucson, Arizona" by Peter MacDonald, Aide to the Council, Tucson, Arizona, dated December 13, 1975.

Page 1 & 2 not included:

POSITION PAPER ON LOCAL CODE AMENDMENTS

California Chapter, International Conference of Building Officials (ICBO)

California Fire Chiefs' Association (CFCA)

Objective:

1. This paper sets forth the position of CFCA and the California Chapter of ICBO on local amendments of fire and building codes for recommendation to their respective members.

Position:

2. The Uniform Building Code administered by the ICBO and the Uniform Fire Code administered by the Western Fire Chiefs' Association (WFCA) are considered to be minimum standards for the construction of buildings and the protection of occupants, property and contents from fire and panic.

3. The objective of each association administering subject codes is as the name implies to provide uniformity and to that end an adequate procedure has been established to effect code changes.

4. It is the position of the California Chapter of the ICBO and CFCA that a lack of uniformity causes confusion among fire chiefs, building officials, builders, planners, architects and the public and this confusion should be avoided. However, it is also realized that local conditions could be cause for local amendments to codes, but such amendments should be held to a minimum.

5. Historically building construction codes have been basically concerned with the reaction of buildings to fire with minor consideration given to the problems of contents and processes.

Recognizing that the supplying of fire protection includes several elements, i.e., building size, type of construction, contents, processes, life exposure and local fire suppression capabilities, it is incumbent that building and fire officials embark on a program of shared responsibility that will provide a balanced level of fire protection in buildings for the community with the lowest economic impact.

The CFCA and California Chapter ICBO recognize that economic limitations of fire departments are rapidly developing as critical factors which must be more fully considered in the development of building code regulations. The current trend to construct buildings of excessive height and area together with critical fire loading of high value contents emphasize the urgent necessity for a joint effort by California Building and Fire Officials to develop an effective and reasonable solution to be effected through established model code change procedures.

President, California Chapter
International Conference of
Building Officials

President, California Fire Chiefs'
Association

4/73

PROPOSED AMENDMENTS TO UNIFORM BUILDING CODE

AMEND SECTION 104 (a) TO READ:

Section 104(a) General. Buildings or structures to which additions, alterations or repairs are made shall comply with all the requirements for new buildings or structures except as specifically provided in this Section.

For construction in Fire Flow Districts, see Chapter 16.

AMEND SECTION 105 TO READ:

Section 105. Building or structures which are moved shall comply with the provisions of this code for new buildings or structures. See Section 1602 for restrictions in fire flow districts.

ADD DEFINITIONS TO SECTION 407 AS FOLLOWS:

Fire Flow is an expression of the amount of water in gallons per minute that should be available and that can be applied by the fire department to control fire in a fully-involved fire area and maintain protection of exposed properties.

Fire Flow District is a geographic area within which a level of fire flow has been established as the determining factor upon which allowable building area and construction are to be based.

The Fire Flow designations shown on Table 5-C are equivalent to the fire flow capabilities derived from Article 37 of the Uniform Fire Code.

REVISE PART III, TABLE 5-A, AS SHOWN.

AMEND SECTION 503(a). LAST LINE TO REFLECT "TABLE 5-E" RATHER THAN 5-D.

AMEND SECTION 504(a) TO READ:

Section 504(a) General. Buildings shall adjoin or have access to a public space, yard or street on not less than one side. Required yards shall be permanently maintained. For Fire Department vehicular access requirements, see the Uniform Fire Code and Table 5E of this code. For the purpose of this Section, the centerline of an adjoining street or alley shall be considered an adjacent property line.

Eaves over required windows shall not be less than 30 inches from the side and rear property lines. For eaves, see Section 1710.

CHANGE SECTION 504(b) TO REFER TO NEW TABLE 5D AND DELETE LAST SENTENCE.

Section 504(b). Exterior wall shall have fire resistive opening protection and percentage of opening permitted as set forth in Table 5-A and 5-D, Part III, etc.

Delete last paragraph of 504(b).

SECTION 505 IS AMENDED TO READ:

Section 505(a) Type I or II Buildings. The combined floor areas of the three largest successive floors of a Type I or Type II building shall not exceed the limits set forth in Table No. 5-C except as provided in Section 506.

(b) Type III, IV, V Buildings. The combined floor areas of all floors of a Type III, Type IV or Type V building shall not exceed the limits set forth in Table No. 5-C except as provided in Section 506.

Section 505(c) Basements and Cellars. The total combined areas of all basement and cellar floors shall not exceed the area allowed for the type of construction and occupancy of such basements and cellars. Basement or cellar floor areas need not be included in calculating the total allowable floor area for the portions of the building above the basement, provided such basement or cellar does not qualify as a story.

(d) Area Separation Walls. Each portion of a building separated by one or more area separation walls may be considered a separate building providing the area separation walls meet the following requirements:

1. Area separation walls shall be not less than four-hour fire-resistive construction in Types I, II or III buildings and two-hour fire-resistive construction in Types IV or V buildings. The total width of all openings in such walls shall not exceed 25 percent of the length of the wall in each story. All openings shall be protected by a fire assembly having a three-hour fire-protection rating in four-hour fire-resistive walls and one and one-half hour fire protection rating in two-hour fire-resistive walls. For computing deficiency points for area separation walls, see Table 5-D.

2. Area separation walls need not extend to the outer edges of horizontal projecting elements such as balconies, roof overhangs, canopies, marquees, or architectural projections provided the exterior wall at the termination of the area separation wall and the projecting elements above are not less than one-hour fire-resistive construction for a width equal to the depth of the projecting elements. Wall openings within such widths shall be protected by assemblies having a three-fourths hour fire-protection rating.

3. Area separation walls shall extend from the foundation to a point at least 30 inches above the roof.

EXCEPTIONS:

1. Area separation walls may terminate at the roof soffit provided the roof is of at least two-hour fire-resistive construction.

2. Two-hour area separation walls may terminate at the underside of roof sheathing provided that the roof has at least one-hour fire-resistive time period for a width of not less than 5 feet on each side of the area separation wall termination.

3. Two-hour area separation walls may terminate at roofs of entirely non-combustible construction.

4. Where an area separation wall separates portions of a building having different heights, such wall may terminate at a point 30 inches above the lower roof level provided the exterior wall for a height of 10 feet above the lower roof is of one-hour fire-resistive construction with openings protected by assemblies having a three-fourths hour fire-protection rating.

   EXCEPTION: The area separation wall may terminate at the sheathing of the lower roof provided the roof is of at least one-hour fire-resistive construction for a width of 10 feet without openings measured from the wall.

SECTION 506 IS AMENDED TO READ:

Section 506(a) General. The basic allowable floor areas specified in Section 505 may be increased by one or more of the following.

1. Separation and Wall Exposure. An increase in floor area may be permitted based upon building separation and exposure of exterior walls or area separation walls. To determine the maximum allowable area permitted by this Section, add the deficiency points for each exterior wall or area separation wall as determined from Table 5-D. Multiply the basic allowable area from Table 5-C by the corresponding multiplier from the following:

Sum of Deficiency Points from Table 5-D	Multiplier
0-5	3.00
6-10	2.75
11-15	2.50
16-20	2.30
21-25	2.10
26-30	1.95
31-35	1.80
36-40	1.65
41-45	1.55
46-50	1.45
51-55	1.40
56-60	1.30
61-65	1.20
66-70	1.10
71-75	1.05
76+	1.00

See also Section 505 (d) 1.

2. The floor areas allowed by paragraph No. 1 above may be increased three (3) times if the building is provided with an approved automatic fire extinguishing system throughout. The area increases permitted by this paragraph shall not apply when automatic fire extinguishing systems are installed under the following provisions:

   a. Section 3802 (b) Group H, Divisions 1 and 2 Occupancies.

   b. Substitution for one-hour fire-resistive construction pursuant to Section 508.

3. Special Area Increases. Where public space, streets or yards more than 20 feet in width extend on all sides of a one or two story, Group B-4 Occupancy or a one story Group B-3 aircraft storage hangar or a one story Group H-5 aircraft repair hangar, and adjoin the entire perimeter of such buildings, floor areas may be increased at the rate of 5 percent for each foot by which the minimum width exceeds 20 feet. See Section 1002 (b) for further limitations for aircraft repair hangars.

4. Unlimited area. The area of any building, other than aircraft storage hangars and Divisions 1, 2, 3, and 4 of Group H Occupancies shall not be limited if the building is provided with an approved fully supervised automatic fire extinguishing system throughout, as specified in Chapter 38, and entirely surrounded and adjoined by fire access roads not less than 20 feet in width.

   The area of a Group B-4 occupancy in a one story Type II, Type III, Heavy Timber, Type III one-hour or Type IV building shall not be limited if the building is entirely surrounded and adjoined by fire access roads not less than 20 feet in width.

AMEND SECTION 702 (a) General. Buildings or parts of buildings classed in Group A because of the use or character of the occupancy shall be limited to the types of construction set forth in Tables 5-C and 5-E and shall not exceed in area or height, the limits specified in Sections 505, 506, and 507.

THE CORRESPONDING TABLE DESIGNATIONS IN SECTIONS 802(a), 902(a), 1002(a), 1102(a), 1202(a), 1302(a) and 1402(a) SHOULD LIKEWISE BE AMENDED.

AMEND SECTION 1002 (b) Delete words "when located in Fire Zone No. 3" from last sentence of last paragraph of subsection 1002 (b).

SUBSECTION 1109 (d) PARAGRAPH ONE IS AMENDED TO READ:

d. Area and Height. Area and height of open parking garages shall be limited as set forth in Table 5-C except as amended by Section 505 and Subsection (a) of this Section.

AMEND CHAPTER 16 TO READ:

REQUIREMENTS BASED ON LOCATION OF FIRE FLOW DISTRICTS

CHAPTER 16

ESTABLISHMENT OF FIRE FLOW DISTRICTS

Section 1601. For the purpose of this Code, all portions of the City (County) are hereby designated as being located within a Fire Flow District or Districts. The boundaries of such district or districts are as shown on the map attached to the ordinance adopting this Code and by adoption thereof or by subsequent ordinance or resolution of the legislative body, are made a part of this Code. Whenever in this Code reference is made to a fire flow district, it shall be construed to mean the district or districts created by said ordinance. Fire Flow Districts shall be determined by an evaluation of the jurisdiction's fire flow capabilities for a specific area in the manner outlined in Article 37 of the Uniform Fire Code and a numerical designation equivalent to one of those outlined in Table 5-C assigned to each Fire Flow District.

RESTRICTIONS IN FIRE FLOW DISTRICTS

Section 1602(a) General. Buildings or structures hereafter erected, constructed, moved within or into a fire flow district shall be one of the types of construction as defined in this Code and shall meet the requirements of this Section. For allowable areas, for fire resistive construction, requirements, and protection of exterior openings with relation to property lines, and roof coverings, see Chapter 5 and Part V.

(b) Buildings Located in More Than One Fire Flow District. A building or structure located partly in one fire flow district and partly in another shall be considered to be in the more highly restricted fire flow district.

(c) Moved Buildings. Any building or structure moved within or into any fire flow district shall be made to comply with all requirements for new buildings in that fire flow district.

(d) Temporary Buildings. Temporary buildings such as reviewing stands and other miscellaneous structures conforming to the other requirements of this Code, may be erected in any fire flow district by special permit from the Building Official upon concurrence from the Fire Chief. Such permit shall be issued for a limited period of time, and such building or structure shall be completely removed upon expiration of the time limit stated in such permit, unless an extension of time is granted.

(e) Alterations. No building or structure of any type of construction which exceeds the area allowed by Chapter 5 shall hereafter be altered, raised, enlarged, added to or moved except as follows:

1. Such building shall be made to conform to all the provisions of this Code.

2. Changes, alterations, and repairs to the interior of the building or to the front facing a public street may be made provided such

changes do not, in the opinion of the Building Official, increase the fire or life safety hazard of the building.

3. Roofs may be as specified in Section 1704. See Section 104(f) for repairs.

4. Such building or structure may be demolished.

5. Combustible finish on the outside of walls may be replaced by or covered with non-combustible or fire-resistant materials.

AMEND SECTION 1701, DELETING WORDS "or location in Fire Zone (Part IV)" from fourth and fifth lines of Paragraph 2.

AMEND SECTION 1704 TO READ:

Sec. 1704. Roof covering shall be fire retardant.

EXCEPTIONS:

1. Single Groups R-3 and M occupancies may have ordinary roof covering as specified in Sec. 3203(f) when no part of the roof is less than 3 feet from a property line.

2. Group R-1 and attached R-3 occupancies may have ordinary roof covering as specified in Sec. 3203(f) when all parts of the roof more than 10 feet from an exterior property line and the total roof area does not exceed 4,500 square feet.

3. Group R-1 occupancies of Type III and Type V construction may have special purpose roofs of No. 1 cedar or redwood shakes or No. 1 shingles constructed in accordance with U.B.C. Standard 32-14 or Class C roof covering complying with U.B.C. Standard 32-7 when all parts of the roof are more than 10 feet from a property line.

4. Groups A-3, A-4, B-1, B-2, and E Occupancies of Types III-N and V-N construction may have roofs complying with Exception No. 3 when no part of the roof extends into an area where openings in exterior walls are required to be protected.

AMEND SECTION 1705(d), FIRST PARAGRAPH, TO READ:

(d) Walls fronting on streets or yards. Regardless of fire-resistive requirements for exterior walls, certain elements of the walls fronting on streets or yards having a width of 40 feet may be constructed as follows:

SECTION 1710, EXCEPTIONS ARE AMENDED TO READ:

EXCEPTIONS:

1. For Type III and V construction, when projecting from walls required to be fire resistive, such projections may be of combustible one-hour fire-resistive construction or heavy timber throughout protected with an approved automatic fire sprinkler system, or may be of heavy

timber throughout and constructed of approved fire-retardant treated wood, provided the roof deck of such fire-retardant treated wood is not a weather-exposed surface.

2. In Types III and V construction, when projecting from walls having no required fire resistive rating, such projections may be unprotected combustible construction.

AMEND SECTION 1803 TO READ:

Section 1803(a) Exterior Walls. Exterior walls and all structural member shall comply with the fire-resistive requirements specified in Section 504, Table 5-A, and the fire-resistive provisions set forth in Table 17-A.

Delete Exception.

AMEND SECTION 1804(b) TO READ:

(b) Mezzanine Floors. Mezzanine floors shall be of non-combustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as specified for floors in Section 2006(e). Not more than two mezzanine floors shall be in any room of a building. No mezzanine floor or floors shall cover more than 33 1/3 percent of the area of any room.

AMEND SECTION 1903 TO READ SAME AS SECTION 1803.

AMEND SECTION 2003 TO READ:

Section 2003(a) Exterior Walls. Exterior walls shall be constructed of non-combustible materials and shall comply with the fire-resistive requirements set forth in Section 504, Table 5-A, and Table 17-A.

EXCEPTIONS:

1. Non-bearing walls fronting on streets or yards having a width of 40 feet may be of unprotected non-combustive construction.

2. In other than Groups I and H Occupancies, exterior non-bearing walls may be one-hour fire-resistive where unprotected openings are permitted and two-hour fire-resistive where protection of openings is required.

3. In Groups B and R-1 Occupancies, exterior bearing walls may be two-hour fire-resistive where openings are permitted.

4. Approved fire-retardant treated wood framing may be used within the assembly of exterior walls as permitted by Exceptions 1, 2 and 3 provided the required fire-resistance is maintained and the exposed outer and inner faces of such walls are non-combustible.

5. Wood columns and arches conforming to heavy timber sizes may be used externally where exterior walls are permitted to be unprotected non-combustible construction.

AMEND SECTION 2103 TO READ:

Section 2103. For fire protection of exterior walls and openings as determined by location on property, see Section 504 and Table 5-A.

Delete Exceptions.

AMEND SECTION 2203 TO READ:

Section 2003. For fire protection of exterior walls and openings as determined by location on property line, see Section 504 and Table 5-A.

Delete Exception.

THE FOURTH PARAGRAPH OF SECTION 3401 IS REVISED TO READ:

Ordinary glass may be used in roofs and skylights for greenhouses, provided the height of the greenhouse at the ridge does not exceed 20 feet above the grade. The use of wood in the frames of skylights will be permitted in greenhouses if the height of the skylight does not exceed 20 feet above the grade, but in other cases metal frames and metal sash bars shall be used.

SUBSECTION 5209(b) IS AMENDED TO READ:

(b) Limitations. Exterior plastic veneer which meets the requirements for noncombustibility as defined in Section 415 shall be unlimited as to height and length of veneered area except as limited by Sections 3001(b) and 3005(c).

All other approved plastic materials shall conform to the following provisions:

1. Height. The approved plastic veneer shall not be attached to any exterior wall above 50 feet.

2. Area. Sections of plastic veneer shall not exceed 200 square feet in area.

3. Separations. Sections of plastic veneer shall be separated by a minimum of 4 feet vertically.

SECTION 5212 IS AMENDED TO READ:

Section 5212. Approved plastic panels may be installed in canopies erected over motor vehicle service station pumps provided the panels are located at least 10 feet from any building on the same property, face yards or streets not less than 40 feet wide on the other sides. The aggregate area of plastic shall not exceed 1,000 square feet. The maximum area of each panel shall not exceed 100 square feet.

APPENDIX, CHAPTER 15, SECTION 1507, IS AMENDED TO READ:

Section 1507. The purpose of this Chapter is to provide a reasonable degree of fire safety for agricultural buildings, recognizing that because of their generally remote locations, adequate fire flow is not available and the buildings must be considered an acceptable fire loss.

APPENDIX, CHAPTER 15, SECTION 1508, IS AMENDED TO READ:

Section 1508. The provisions of this Chapter shall apply exclusively to agricultural buildings in rural areas. Such buildings shall be classified as Group M, Division 2 Occupancies and shall include the following uses.

1. Storage, livestock and poultry.
2. Milk barns.
3. Shade structures.
4. Horticultural structures (greenhouse and crop protection).

TABLE 5-A

PRESENT GROUP CLASSIFICATION	M.C.S.C. GROUP CLASSIFICATION	OCCUPANCY DESCRIPTION	HAZARD CLASSIFICATION	CONSTRUCTION TYPE	FIRE RESISTANCE OF EXTERIOR WALL		OPENING PROTECTION	% OF OPENING PERMITTED EACH STORY
					BEARING	NON-BEARING		
A	1-A	See Table 5A-1	2.75	I-II	4-HR	2-HR N/C @ 5'+ 1-HR N/C @ 20'+ N/P N/C @ 40'+	Not permitted less than 5' Protected less than 20'	5'+ to 20' 25% 20'+ to 30' 50% 30'+ 100%
B-1-2-3-4	2-A, 2.1A, 3-A, 4-A		2.75	I-II-III	4-HR	2-HR N/C @ 5'+ 1-HR N/C @ 20'+ N/P N/C @ 40'+	Not permitted less than 5' Protected less than 20'	
B-2	2-A, 2.1A			IV-V	2-HR less than 10' 1-HR elsewhere	N/P @ 40'+ Same as "Bearing"	Not permitted less than 5' Protected less than 10'	5'+ to 20' 25% 20'+ to 40' 50% 40'+ 100%
B-3-4	3-A, 4-A			IV-V	2-HR less than 5' 1-HR elsewhere	N/P @ 40'+ Same as "Bearing"	Not permitted less than 5' Protected less than 10'	
C-1-2-3	1-E, 2-E, 3-E		2.75	I-II-III	4-HR	2-HR N/C @ 5'+ 1-HR N/C @ 20'+	Not permitted less than 5' Protected less than 20'	5'+ to 20' 25% 20'+ to 30' 50% 30'+ 100%
			2.75	IV-V	2-HR less than 5' 1-HR less than 10'	N/P @ 40'+ Same as "Bearing" (1)	Not permitted less than 5' Protected less than 10' (1)	5'+ to 20' 25% 20'+ to 40' 50% 40'+ 100%
D-1	3-I		2.75	I-II	Fire Resistance of exterior wall and opening same as "A". See Section 902(b).			5'+ to 20' 25% 20'+ to 30' 50% 30'+ 100%
D-2-3	1-I, 2-I			I-II-III	4-HR	N/P N/C @ 40'+ Same as "Bearing"	Not permitted less than 5' Protected less than 20'	
D-2	1-I			IV-V	2-HR less than 5' 1-HR elsewhere	Same as "Bearing"	Not permitted less than 5' Protected less than 10'	5'+ to 20' 25% 20'+ to 40' 50% 40'+ 100%
D-3	2-I			IV-V	1-HR	Same as "Bearing"	Not permitted less than 5' Protected less than 10'	
E-1-2 -3-4 (-5*)	1-H, 2-H, 3-H, 4-H, 5-H		1.00 (E-4 1.30)	I-II-III	4-HR 4-HR less than 5'	N/P @ 40'+ Same as "Bearing"	Not permitted less than 5' *Same as E-5 below.	5'+ to 20' 25% 20'+ to 30' 50% 30' 100%
E-1-2-3-4	1-H, 2-H, 3-H, 4-H				2-HR less than 10' 1-HR less than 20'	N/P @ 40'+ Same as "Bearing"	Protected less than 20'	5'+ to 20' 25% 20'+ to 40' 50% 40'+ 100%
E-5	5-H			IV-V	1-HR less than 60'	N/P @ 40'+ Same as "Bearing"	Not permitted less than 5' Protected less than 60'	5'+ to 30' 25% 30'+ to 60' 50% 60'+ 100%

(CONTINUED)

TABLE 5-A (continued)

PRESENT GROUP CLASSIFICATION	M.C.S.C. GROUP CLASSIFICATION	OCCUPANCY DESCRIPTION	HAZARD CLASSIFICATION	CONSTRUCTION TYPE	FIRE RESISTANCE OF EXTERIOR WALL		OPENING PROTECTION	% OF OPENING PERMITTED EACH STORY
					BEARING	NON-BEARING		
F-1-2-3	1-B, 2-B, 3-B	See Table 5A-1	F-1 2.00 F-2 2.75	I-II-III	4-HR less than 5' 2-HR more than 5'	2-HR N/C @ 5'+ 1-HR N/C @ 20'+ N/P N/C @ 40'+	Not permitted less than 5' Protected less than 20'	5'+ to 20' 25% 20'+ to 30' 50% 30'+ 100%
F-1-2	1-B, 2-B		F-3 1.55	IV-V	1-HR less than 10'	N/P @ 40'+ Same as "Bearing	Not permitted less than 5' Protected less than 10'	
F-3 (?)	3-B			IV-V	1-HR less than 20'	Same as "Bearing"	Not permitted less than 5' Protected less than 20'	
F-4	3.1B					Same as "Bearing"		
G	4-B		2.00	I-II-III	4-HR less than 5' 2-HR more than 5'	2-HR N/C @ 5'+ 1-HR N/C @ 20'+ N/P N/C @ 40'+	Not permitted less than 5' Protected less than 20'	5'+ to 20' 25% 20'+ to 30' 50% 30'+ 100%
				IV-V	1-HR less than 3'	N/P @ 40'+ Same as "Bearing"	Not permitted less than 3'	
H	1-R		2.75	I-II-III	4-HR less than 5' 2-HR more than 5'	2-HR N/C @ 5'+ 1-HR N/C @ 20'+ N/P N/C @ 40'+	Not permitted less than 5' Protected less than 20'	5'+ to 20' 25% 20'+ to 30 50% 30'+ 100%
				IV-V	1-HR less than 5'	Same as "Bearing"	Not permitted less than 3' Protected less than 5'	
I	2-R		2.75	IV-V	1-HR less than 3'	Same as "Bearing"	Not permitted less than 3'	5'+ 100%
J-1-2-3	1-M, 2-M 3-M		2.75	IV-V	1-HR less than 3' (or may be protected...etc...)	Same as "Bearing"	Not permitted less than 3'	

① Section 809, Exceptions: "1. Exterior walls or parts of walls which are less than 3 feet from adjacent property lines shall have no openings therein and shall be of not less than one-hour fire-resistive construction as specified in Chapter 43."

GROUP

TABLE 5A-1

	DESCRIPTION OF OCCUPANCY
A*	1-Any assembly building with a stage and an occupant load of 1000 or more in the building..... * Occupancies when used as an exhibition hall.....
A*	1-Any assembly building with a stage and an occupant load of less than 1000 in the building.....
A*	2-Any assembly building without a stage and having an occupant load of 300 or more in the building including such buildings used for educational purposes not classed as a Group C or Group F, Division 2 Occupancy.....
*	3-Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for educational purposes and not classed as a Group C or Group F, Division 2 Occupancy.....
*	4-Stadiums, reviewing stands, and amusement park structures not included within Group A nor Divisions 1, 2 and 3, Group B, Occupancies..... * -Any B Occupancy when used as an exhibition hall.....
	DIVISION 1. Any building used for educational purposes through the 12th grade by 50 or more persons for more than 12 hours per week of four hours in any one day..... DIVISION 2. Any building used for educational purposes through the 12th grade by less than 50 persons for more than 12 hours per week or four hours in any one day..... DIVISION 3. Any building used for day care purposes for more than six children.....
	1-Mental hospitals, mental sanitariums, jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained.....
	2-Nurseries for full-time care of children under kindergarten age, Hospitals, sanitariums, nursing homes with nonambulatory patients, and similar buildings (each accommodating more than five persons).....
	3-Nursing homes for ambulatory patients, homes for children of kindergarten age or over (each accommodating more than five persons).....
	1-Storage and handling of hazardous and highly inflammable or explosive materials other than flammable liquids.....
	2-Storage and handling of Class I, II and III flammable liquids, as specified in U.B.C. Standard No. 9-1; dry cleaning plants using flammable liquids, paint stores with bulk handling; paint shops and spray painting rooms and shops..... 3-Woodworking establishments, planing mills and box factories; shops, factories where loose, combusitble fibers or dust are manufactured, processed, or generated; warehouses where highly combustible material is stored..... 4-Repair garages.....
	5-Aircraft repair hangars.....

GROUP	DESCRIPTION OF OCCUPANCY
1-B	Gasoline and service stations, storage garages where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.....
2.1-B	Office buildings, drinking and dining establishments having an occupant load of less than 100, municipal police and fire stations.....
	Buildings or portions of buildings having rooms used for educational purposes, beyond the 12th grade with less than 50 occupants in any one room.....
2-B	Wholesale and retail stores, factories and work shops using material not highly flammable or combustible, storage and salesrooms for combustible goods, paint stores without bulk handling.....
3-B	Aircraft hangars where no repair work is done except exchange of parts and maintenance requireing no open flame, welding, or the use of highly flammable liquids.....
3.1-B	Open parking garages.....
4-B	Ice plants, power plants, pumping plants, cold storage, and creameries, factories and workshops using noncombustible and nonexplosive materials. Storage and sales rooms of noncombustible and nonexplosive materials.....
1-R	Hotels and apartment houses Convents, monasteries (each accommodating more than 10 persons.
3-R	Dwellings and lodging houses.....
1-M	Private garages, carports, sheds and agricultural buildings used as accessories only when not over 1000 square feet in area.
2-M	Fences over 6 feet high, tanks and towers.....

450 PM TABLE 3C

OCCUPANCY	CONSTRUCTION TYPE							
	I	II	III		IV		V	
			1 - hr.	N	1 - hr.	N	1 - hr.	N
1-A*	106450	78200	NOT PERMITTED					
2-A* 2.1-A*	106450	78200	47300	NOT PERMITTED	68150	NOT PERMITTED	24500	NOT PERMITTED
3-A 4-A	106450	78200	47300	38300	68150	59850	24500	17050
1-E, 2-E 3-E	106450	78200	47300	38300	68150	59850	24500	17050
3-I	106450	78200	NOT PERMITTED					
1-I, 2-I	106450	78200	47300	NOT PERMITTED	68150	NOT PERMITTED	24500	NOT PERMITTED
1-H, 2-H 5-H	38300	28150	17000	13800	24500	21550	8800	6100
3-H, 4-H	49450	36350	22000	17800	31650	27850	11400	7900
1-B, 2-B 3-B	59900	44000	26600	21550	38300	33700	13800	9600
2.1-B	106450	78200	47300	38300	68150	59850	24500	17050
3.1-B	106450	78200	47300	38300	68150	59850	24500	17050
4-B	106450	78200	47300	38300	68150	59850	24500	17050
1-R	106450	78200	47300	38300	68150	59850	24500	17050
2-R	106450	78200	47300	38300	68150	59850	24500	17050
1-M, 2-M 3-M	SEE CHAPTER 15							

* When used as an exhibition hall, use Occupancy Group 3-H

Pages 17 to 25 not included:

OCCUPANCY	CONSTRUCTION TYPE							
	I	II	III		IV		V	
			1 - hr.	N	1 - hr.	N	1 - hr.	N
1-A*	130650	96000	NOT PERMITTED					
2-A* 2.1-A*	130650	96000	58100	NOT PERMITTED	83600	NOT PERMITTED	30100	NOT PERMITTED
3-A 4-A	130650	96000	58100	47050	83600	73500	30100	20900
1-E, 2-E 3-E	130650	96000	58100	47050	83600	73500	30100	20900
3-I	130650	96000	NOT PERMITTED					
1-I, 2-I	130650	96000	58100	NOT PERMITTED	83600	NOT PERMITTED	30100	NOT PERMITTED
1-H, 2-H 5-H	47000	34550	28900	16900	20100	26450	10800	7500
3-H, 4-H	60700	44600	27000	21850	38850	34150	14000	9700
1-B, 2-B 3-B	73500	54000	32650	26450	47050	41350	16900	11750
2.1-B	130650	96000	58100	47050	83600	73500	30100	20900
3.1-B	130650	96000	58100	47050	83600*	73500	30100	20900
4-B	130650	96000	58100	47050	83600	73500	30100	20900
1-R	130650	96000	58100	47050	83600	73500	30100	20900
2-R	130650	96000	58100	47050	83600	73500	30100	20900
1-M, 2-M 3-M	SEE CHAPTER 15							

* When used as an exhibition hall, use Occupancy Group 3-H

Table 5-D

DEFICIENCY POINTS FOR EXTERIOR AND AREA SEPARATION WALLS(1)

Distance From Property Line	Non-Rated Wall	Openings with 3/4 hr. or where no protection required (2)								1½ hr. Opening Protection				3 hr. Opening Protection				No Openings		
		1 hr. Walls				2 & 4 hr. Walls				2 & 4 hr. Walls				4 hr. Walls				1 hr	2 hr	4 hr
		Percent of Wall Opening																		
		10	25	35	50(3)	10	25	35	50(3)	10	25	35	50(3)	10	25	35	50(3)			
		DEFICIENCY POINTS																		
0-5		Not Permitted																25	10	0
5-10	25	22	NP	NP	NP	15	20	NP	NP	0	10	NP	NP	0	5	NP	NP	20	5	0
10-15	22	18	20	NP	NP	10	15	20	NP	0	5	10	15	0	0	5	10	15	0	0
15-20	20	13	15	18	NP	8	10	15	NP	0	0	5	10	0	0	0	5	10	0	0
20-25	18	8	10	12	15	0	5	7	10	0	0	0	5	0	0	0	0	5	0	0
25-30	15	0	5	7	10	0	0	5	8	0	0	0	0	0	0	0	0	0	0	0
30-50	10	0	0	0	8	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
50-75	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area Separation Walls		Not Permitted				25		Not Permitted		20		Not Permitted		15		Not Permitted		NP	10	0

Footnotes: (1) Type V Construction with wood shingles, add 5 points.
(2) See Table 5A for opening protection requirements.
(3) Opeings greater than 50% shall be considered as a nonrated wall.

Pages 28 to 33 not included:

OCCUPANCY	TYPE OF CONSTRUCTION															
	I		II		III 1hr. HT		III N		IV 1 hr.		IV N		V 1 hr.		V N	
	AS	NO AS	AS	NO AS	AS	NO AS	AS	NO AS	AS	NO AS	AS	NO AS	AS	NO AS	AS	NO AS
A)			5	4	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]
B) 1-2			5	4	3	2	1	0[1]	3	2	1	0[1]	3	2	1	0[1]
B) 3-4			15	9	3	2	2	1	3	2	2	1	3	2	2	1
C)			5	4	3	2	2	1	3	2	2	1	3	2	2	1
D) 1			3	0[1]	1	1	1	0[1]	1	1	1	0[1]	1	0[1]	1	0[1]
D) 2			4	0[1]	2	0[1]	1	0[1]	2	0[1]	1	0[1]	2	0[1]	1	0[1]
D) 3			4	0[1]	3	0[1]	1	0[1]	3	0[1]	1	0[1]	3	0[1]	1	0[1]
E) 1			3	1	2	1	2	1	2	1	2	1	2	1	2	1
E) 2-3-5			6	1	3	1	2	1	3	1	2	1	3	1	2	1
E) 4			5	5	2	2	1	1	2	2	1	1	2	2	1	1
F) 1-2-3			15	9	5	4	3	2	5	4	3	2	4	3	3	2
G)			15	9	5	4	3	2	5	4	3	2	4	3	3	2
H)			15	9	5	4	3	2	5	4	3	2	4	3	3	2
I)			4	3	4	3	4	3	4	3	4	3	4	3	4	3
J)																
	MAXIMUM HEIGHT IN FEET															
	Unl	75	170	75[2]	75	65[2]	65	55[2]	75	65[2]	65	55[2]	60	50[2]	50	40[2]

1. Not permitted.
2. The maximum height of unsprinklered building shall not exceed 35 feet unless all of the following conditions exist:
   a. The fire agency has aerial ladder equipment avilable within response time as derived from Article 37 of the Uniform Fire Code.
   b. Access roads, a minimum of 30 feet in width are provided immediately adjoining the two longest sides of the building.
   c. The two longest sides of the building have openings readily accessible to fire department access as specified in Section 3802(b) 1 in the exterior walls adjoining the fire access roads, for each floor.

ARTICLE 37

THE UNIFORM FIRE CODE

INTENT

Sec. 37.101 This Article of the Uniform Fire Code provides a method for evaluating the fire problem and fire suppression capabilities within a community by these guidelines, which may be used by administrators, fire officials, building officials, and local legislative bodies in determining the means of providing fire protection as it relates to buildings constructed in accordance with the Uniform Building Code.

SCOPE

Sec. 37.102 This Article provides alternate methods whereby local jurisdictions may establish an acceptable balance between effective fire suppression, the jurisdictions' financial ability to provide those factors traditionally considered the responsibility of government, and the regulation of building size and construction, and occupancy which affect fire suppression capabilities.

GENERAL REQUIREMENTS

Implementation may require the establishment of one or more fire flow districts.

DEFINITIONS

Sec. 37.104 For the purpose of this Article, certain terms are defined as follows:

AUTOMATIC EXTINGUISHING SYSTEMS

Automatic extinguishing systems are systems providing an emergency fire control function without the necessity of human intervention and activated as a result of a predetermined fire sensing device which releases an extinguishing agent at the source of ignition.

FIRE AREA

Fire area is that maximum allowable square footage of a building or part of a building which is considered to be (1) within the fire flow capabilities of the fire department and/or (2) an acceptable loss. The areas utilized in arriving at fire flow determinations correspond with the building areas and fire flows in Table 5C of the Uniform Building Code.

FIRE FLOW

The term fire flow is an expression of the amount of water in gallons per minute which should be available and applied by the fire department to control fire in a fully-involved fire area and maintain protection of exposed properties. The total fire flow required for combatting a fully-developed fire in a fire area is a function of construction, fire

loading, occupancy, area, height, and distance from other buildings.

FIRE FLOW DISTRICT is a geographic area within which a level of fire flow has been established as the determining factor upon which allowable building area and construction are to be based. Its boundaries may be defined by:

a. generally homogeneous regions

b. natural and man-made barriers

c. city blocks

d. jurisdictional regions

e. census tracts

f. fire station first-in response areas or combinations thereof

g. combinations of the above

h. one or more fire flow districts

WATER SUPPLY

Water supply is the amount of water available for application by the fire department to control fire in a fully-involved fire area. Water supply may consist of reservoirs, pressure tanks, elevator tanks, water mains, fire hydrants, or other fixed systems capable of supplying the required fire flow.

PERSONNEL

Personnel is the number of trained persons available for operation of apparatus and equipment to apply the fire flow and to supply support services such as truck company operations, rescue, and salvage.

The capability of fire combat companies is primarily measured by their ability to apply water to a fire. The manpower listed in Table 37.101 includes personnel required to apply water, as well as the personnel required for such support services as truck company operations, rescue and salvage. Where apparatus is manned by volunteer or an "on call" force, the required manpower would be considered available if personnel arrive at incident scene within the response times specified in Table 37.101.

ESTIMATED PERSONNEL REQUIREMENTS

Guidelines for estimating the total fire suppression manpower response is shown in Table 37.101. Truck as well as engine manning is included in the total.

The Table 37.101 also provides guidelines for determining the time within which various portions of the manpower must respond. The Table 37.101 is based on the ISO grading schedule assuming conventional fire fighting

tactics and apparatus. Adjustments to these guidelines should be made based on local conditions.

The requirement for fire suppression personnel becomes judgemental in special fire situations and may increase for situations such as harbors, airports, high rise buildings, or extensive brush areas.

Fire suppression is also related to the ability of fire combat forces to rescue occupants of a fire area. Since first alarm response personnel are considered to be also used for rescue operations, first alarm manpower may need to be increased in areas of high rescue potentiality.

EQUIPMENT

Equipment includes all apparatus, fixtures, and supplies necessary to enable fire safety personnel to reach the fire scene in a reasonable period of time, complete necessary rescue operations and apply a required fire flow whereby fire losses may be limited to an acceptable measure of risk. See Table 37.101, footnote 5.

PUMPERS

To estimate the number of pumpers required to satisfy a single fire flow requirement, allow full credit at the pumper rating for in-service and reserve vehicles provided sufficient manpower is available to respond within established time limits. The number of pumpers required to satisfy all fire flow requirements throughout the community will depend on the distribution of fire stations and corresponding pumper assignments. Pumpers from different stations or even different fire flow areas can be used to satisfy any single fire flow requirement provided they can respond within established time limits.

In general, it will be necessary to determine the capability of the community's current pumpers to satisfy current or future fire flow requirements.

LADDER TRUCKS

The requirement for a ladder truck is based on the height of buildings in the community and the magnitude of potential serious fires as measured by fire flow requirements.

OTHER MAJOR APPARATUS

The requirement for other major pieces of apparatus is a judgemental situation. The number and kind is to be based on modern fire fighting practices and special local situations such as harbors, airports, high rise buildings, or extensive brush areas.

RESPONSE TIME

Response time is the period within which required numbers of personnel and equipment for their use can be marshalled at the fire to effect rescue and/or fire suppression. See Table 37.101, footnote 2.

DETERMINING FIRE FLOW CAPABILITIES

Sec. 37.105

1. Determine fire flow capabilities of resources available within time stated in Table 37.101, see procedure 1, Sec. 37.106.

2. Determine fire flow requirements for existing buildings, see procedure 2, Sec. 37.107.

3. To establish future fire department fire flow capabilities for building's height and area. See procedure 3.

Sec. 37.106 Procedure 1

To determine fire flow capabilities of present resources.

a. Determine normal daily available manpower. Refer to Table 37.101.

b. Determine pumping capacity of equipment available within the response time given in Table 37.101.

c. Determine available water supply.

d. Select limiting factors imposed by a, b, or c above for fire flow capabilities.

e. Refer to Table 37.101 to determine fire flow capabilities, Column 1, based upon normal daily manning, Column 2, and response time, Columns 3-10.

Sec. 37.107 Procedure 2

Determine fire flow requirements of existing buildings.

a. Utilize Form A to determine fire flow requirements for existing buildings.

b. Compare fire flow capabilities available to fire flow requirements for existing buildings.

c. Divide the jurisdiction into fire flow districts based upon items a and b above.

d. Upon determining existing fire problem, the jurisdiction has several choices.

   1. Requiring built-in fire protection if fire problem exceeds capabilities of the fire department

   2. Expand the fire flow capabilities to meet existing fire problems.

   3. Accept the risk.

Sec. 37.108 Procedure 3

Confirm present needs, project future needs based on growth patterns, and the community's general plan, determine alternates acceptable to the community.

Alternates:

a. To continue with present resources.

b. Increase fire combat resources.

c. To require built-in fire protection for buildings.

d. To limit area and height of buildings.

e. To accept the increased fire risk.

CONCEPT

Sec. 37.110

The concept of relating the occupancy, degree of hazard, type of construction, and size of building to the capability of fire combat forces is realistic and will provide alternate solutions to communities based upon their particular needs.

Each jurisdiction must determine the quantity of public resources it will allocate to fire protection. This should include the determination of present resources, future needs, levels of service, and levels of acceptable risk. Acceptable risk implies that risks are identified and evaluated. A decision is made to eliminate, modify, or accept the risk.

The fire area and relative hazard of an occupancy determines the fire protection resources which will be necessary to control a fire within acceptable limits. Determination of the maximum allowable fire areas must include consideration of access, height, degree of hazard, rescue problems, and special local conditions such as terrain, climactic conditions, and water supply, as well as manpower and equipment, and their capability to successfully control the fire within the fire area.

The maximum floor area allowed in the Uniform Building Code for the various occupancies and types of construction are considered fire areas. These maximum fire areas thus allowed are considered to be acceptable fire loss risks. Fire areas may be increased in size when automatic extinguishing systems are provided since full fire involvement of the area is not anticipated.

The capability of fire combat forces is primarily measured by their ability to apply water (fire flow). The manpower listed in Table 37.101 offers guidelines for determining personnel required for application of water and support services. Where rescue operations are required, the initial operations are concerned with life safety of occupants by fire combat personnel.

The Building Code, by requiring added fire protection, limiting flame spread characteristics and smoke density of finish materials, specifying exit requirements and areas of refuge, provides life safety protection for occupants in the various occupancies based on the degree of hazard and relative ability of the occupants to self exit.

The calculation of fire flow is intended to assist fire administrators in determining the maximum fire loss potential. Fire loss management may be accomplished by controlling fire potential to coincide with a fire department's capability or by increasing capability to meet potential needs. Through coordination with the Uniform Building Code, administrators may define fire suppression capabilities and limit the scope of fire problems to coincide with those capabilities. It is recognized that manpower, water supply, access, terrain, time-distance, traffic, vegetation, climate, type of construction, building height, occupancy, and other factors may combine to establish the fire suppression resource needs of a fire department.

Other types of fires such as grass, brush, timber, as well as fires in boats, ships, aircraft, and land vehicles may, because of local conditions, be the predominate problem and must be separately considered, as well as multiple incident occurrence. The guidelines may be used, in conjunction with a community's General Plan, to develop master planning for fire protection of the community as it grows. The degree of protection is governed by the fire loss risk a community is willing to accept.

The Building Code provides a means of permitting building size based on the factors of occupancy, type of construction, height, hazards and capability of the fire combat forces to control a fully-involved fire. It is readily apparent that the size of structures allowed will vary proportionally to the capabilities of the Fire Department.

TABLE 37.101

STANDARDS FOR FIRE PROTECTION

Fire Flow Required	Total Suppression Personnel Required	Personnel Required within Response Time (min.)									
		2.5	3.0	3.5	5.0	6.5	7.5	9.0	10	11.5	12.5
250	3				3(1)				3		
500	6				6(1)				6		
750	9				6(1)				9		
1,000	12				6(1)				12		
1,500	15				6(1)				15		
2,000	18			6	12	18					
2,500	21			6	12	21					
3,000	24			6	12	18	24				
3,500	27			6	12	18	27				
4,000	30			6	12	18		30			
4,500	33			6	12	18		33			
5,000	36		6	12	18	24		36			
5,500	42		6	12	18	24		42			
6,000	48		6	12	18	24			48		
6,500	54		6	12	18	24			54		
7,000	60		6	18				30	60		
7,500	66		6	18				30		66	
8,000	72		6	18				30		72	
9,000	84	6	12	24	30				42	84	
10,000	102	6	12	24	30					48	102
11,000	120	6	12	24	30						120
12,000	132	6	12	24	30						132

(1) Increase to 10 minutes if buildings are 1 and 2 family dwellings with an average separation of 100 feet.

TABLE 37.101

FOOTNOTES (Cont'd.)

(2) Response Time: Time starts when apparatus starts rolling. Time ends when apparatus stops at operating position at fire.

In order to be effective, fire flow must be applied within a reasonable time. The time within which trained personnel can arrive at the fire scene to commence suppression and rescue operations is directly related to the availability of personnel and the time, distances, and directness of their respective routes to the fire area.

The response times specified in Table 37.101 presumes unobstructed response routes. Anticipated traffic congestion, peak hour traffic, or frequent obstructions may necessitate modification of response times, or limitation of the fire management area.

(3) A higher ratio of manpower to flow may be required where the flow is below 1,500 GPM because of the need of hand line application. Hand line application is based upon three men, 2½ inch hose stream.

(4) For flows exceeding 1,500 GPM, manpower was estimated at three men per 500 GPM having available and using master hose streams. Indicated manpower and flows above 1,500 GPM have considered use of special apparatus, i.e. master stream appliance.

(5) Sufficient equipment shall be provided to provide required fire flow. In determining adequate equipment, consideration must be given to the number of pumping units responding and their pumping capacities to apply available water, and to the number of aerial ladder trucks and their support equipment for rescue and application of large volumes of water. Ladder truck companies are considered mandatory when unsprinklered building heights within the fire flow area exceed 35 feet.

(6) Above table may be modified predicated on occupancy, access, height, rescue or other local conditions.

(7) Round off the final answer to the nearest 250 GPM if less than 2,500 GPM and to the nearest 500 GPM if greater than 2,500 GPM.

This Table estimates resource requirements for a single fire incident. Each jurisdiction must determine its resource needs to cope with simultaneous incidents.

TABLE 37.102*

BASIC ALLOWABLE FLOOR AREAS
(for use with Form A)

FIRE FLOW	TYPE OF CONSTRUCTION I	II	IV 1 hr.	IV N	III 1 hr.	III N	V 1 hr.	V N
500	696	511	445	391	309	250	160	111
750	1,371	1,007	877	771	609	493	316	219
1,000	2,265	1,664	1,449	1,274	1,006	815	521	362
1,250	3,381	2,484	2,163	1,901	1,502	1,217	779	540
1,500	4,720	3,467	3,020	2,655	2,097	1,699	1,087	755
1,750	6,282	4,615	4,020	3,533	2,792	2,261	1,447	1,005
2,000	8,083	5,938	5,173	4,546	3,592	2,910	1,862	1,293
2,250	9,944	7,306	6,364	5,593	4,419	3,580	2,291	1,591
2,500	12,345	9,070	7,901	6,944	5,486	4,444	2,844	1,975
2,750	14,802	10,875	9,473	8,326	6,579	5,329	3,410	2,368
3,000	17,482	12,844	11,188	9,834	7,770	6,293	4,028	2,797
3,250	20,385	14,977	13,046	11,465	9,060	7,338	4,696	3,261
3,500	23,511	17,273	15,047	13,255	10,449	8,464	5,416	3,761
3,750	26,889	19,755	17,209	15,125	11,951	9,680	6,195	4,302
4,000	30,463	22,381	19,496	17,135	13,539	10,996	7,013	4,874
4,250	34,293	25,195	21,947	19,290	15,241	12,345	7,901	5,486
4,500	38,314	28,149	24,521	21,551	17,028	13,793	8,827	6,130
4,750	42,558	31,267	27,237	23,938	18,914	15,320	9,805	6,809
5,000	47,024	34,548	30,095	26,451	20,399	16,928	10,334	7,523
5,250	51,714	37,944	33,097	29,089	22,934	18,617	11,914	8,274
5,500	56,670	41,635	36,269	31,877	25,186	20,401	13,056	9,067
5,750	61,807	45,409	39,556	34,766	27,469	22,507	14,240	9,889
6,000	67,215	49,332	43,017	37,808	29,873	24,197	15,486	10,754
6,250	72,800	53,485	46,592	40,950	32,355	26,208	16,773	11,648
6,500	78,607	57,752	50,308	44,216	34,936	28,298	18,111	12,577
6,750	84,637	62,182	54,168	47,608	37,616	30,469	19,500	13,542
7,000	90,891	66,777	58,170	51,126	40,396	32,720	20,941	14,542
7,250	97,424	71,577	62,351	54,801	43,299	35,072	22,446	15,587
7,500	104,125	76,500	66,640	58,570	48,278	37,485	23,990	16,660
7,750	111,111	81,632	71,111	62,500	49,332	40,000	25,600	17,777
8,000	118,259	86,884	75,686	66,521	52,559	42,573	27,247	18,921
8,250	125,630	92,300	80,403	70,661	55,835	45,227	28,945	20,100
8,500	133,225	97,879	85,264	74,939	59,211	47,961	30,965	21,316
8,750	141,041	103,622	90,266	79,336	62,685	50,775	32,469	22,566
9,000	149,153	109,582	95,458	83,898	66,290	53,695	34,364	23,864
9,250	157,417	115,653	100,747	88,547	89,693	56,670	36,269	25,185
9,500	165,950	121,945	106,227	93,364	73,769	59,753	38,241	26,356
9,750	174,693	128,345	111,803	98,264	77,641	62,889	40,249	27,950
10,000	183,628	134,910	117,521	103,290	81,612	66,106	43,307	29,380
10,250	192,786	141,638	123,363	108,442	85,682	69,402	44,417	30,845
10,500	202,166	148,530	129,386	113,718	89,851	72,780	46,579	32,246
10,750	211,855	155,649	135,597	119,168	94,158	76,268	48,811	33,896
11,000	221,634	162,869	141,877	124,697	98,526	79,806	51,076	35,469
11,250	231,824	170,319	148,367	130,401	103,033	83,456	53,412	37,091
11,500	242,100	177,869	154,944	136,131	107,600	87,156	55,779	38,735
11,750	252,599	185,583	161,663	142,087	112,266	90,935	58,198	40,415
12,000	263,321	193,460	168,525	148,118	117,031	94,795	60,669	42,131

*Calculations based on this Table may vary from Table 5-Cs in the Uniform Building Code due to use of round numbers.

TABLE 37.-5A

GROUP NEW	GROUP PRESENT	DESCRIPTION OF OCCUPANCY
1-A*	A	1-Any assembly building with a stage and an occupant load of 1000 or more in the building..... *2-A Occupancies when used as an exhibition hall.....
2-A* 2.1-A*	B	1-Any assembly building with a stage and an occupant load of less than 1000 in the building..... 2-Any assembly building without a stage and having an occupant load of 300 or more in the building including such buildings used for educational purposes not classed as a Group C or Group F, Division 2 Occupancy.....
3-A*	B	3-Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for educational purposes and not classed as a Group C or Group F, Division 2 Occupancy.....
4-A*	B	4-Stadiums, reviewing stands, and amusement park structures not included within Group A nor Divisions 1, 2 and 3, Group B, Occupancies..... *5-Any B Occupancy when used as an exhibition hall.....
1-E 2-E 3-E	C	DIVISION 1. Any building used for educational purposes through the 12th grade by 50 or more persons for more than 12 hours per week of four hours in any one day..... DIVISION 2. Any building used for educational purposes through the 12th grade by less than 50 persons for more than 12 hours per week or four hours in any one day..... DIVISION 3. Any building used for day care purposes for more than six children.....
3-I	D	1-Mental hospitals, mental sanitariums, jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained.....
1-I	D	2-Nurseries for full-time care of children under kindergarten age, Hospitals, sanitariums, nursing homes with nonambulatory patients, and similar buildings (each accommodating more than five persons).....
2-I	D	3-Nursing homes for ambulatory patients, homes for children of kindergarten age or over (each accommodating more than five persons).....
1-H	E	1-Storage and handling of hazardous and highly inflammable or explosive materials other than flammable liquids.....
2-H	E	2-Storage and handling of Class I, II and III flammable liquids, as specified in U.B.C. Standard No. 9-1; dry cleaning plants using flammable liquids, paint stores with bulk handling; paint shops and spray painting rooms and shops.....
3-H 4-H	E	3-Woodworking establishments, planing mills and box factories; shops, factories where loose, combusitble fibers or dust are manufactured, processed, or generated; warehouses where highly combustible material is stored..... 4-Repair garages.....
5-H	E	5-Aircraft repair hangars.....

GROUP			DESCRIPTION OF OCCUPANCY
1.55	1-B	F	1-Gasoline and service stations, storage garages where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.....
1.75	2.1-B	F	2-Office buildings, drinking and dining establishments having an occupant load of less than 100, municipal police and fire stations..... Buildings or portions of buildings having rooms used for educational purposes, beyond the 12th grade with less than 50 occupants in any one room.....
1.55	2-B	F	3-Wholesale and retail stores, factories and work shops using material not highly flammable or combustible, storage and salesrooms for combustible goods, paint stores without bulk handling.....
1.55	3-B	F	4-Aircraft hangars where no repair work is done except exchange of parts and maintenance requireing no open flame, welding, or the use of highly flammable liquids.....
2.75	3.1-B	F	5-Open parking garages.....
2.75	4-B	G	Ice plants, power plants, pumping plants, cold storage, and creameries, factories and workshops using noncombustible and nonexplosive materials. Storage and sales rooms of noncombustible and nonexplosive materials.....
2.75	1-R	H	Hotels and apartment houses Convents, monasteries (each accommodating more than 10 persons.
2.75	3-R	I	Dwellings and lodging houses.....
2.75	1-M	J	1-Private garages, carports, sheds and agricultural buildings used as accessories only when not over 1000 square feet in area.
	2-M	J	2-Fences over 6 feet high, tanks and towers.....

DEFICIENCY POINTS FOR EXTERIOR AND AREA SEPARATION WALLS(1)

Distance From Property Line	Non-Rated Wall	Openings with 3/4 hr. or (2) where no protection required								1½ hr. Opening Protection				3 hr. Opening Protection				No Openings		
		1 hr. Walls				2 & 4 hr. Walls				2 & 4 hr. Walls				4 hr. Walls				1 hr	2 hr	4 hr
		Percent of Wall Opening																		
		10	25	35	50(3)	10	25	35	50(3)	10	25	35	50(3)	10	25	35	50(3)			
		DEFICIENCY POINTS																		
0-5		Not Permitted																25	10	0
5-10	25	22	NP	NP	NP	15	20	NP	NP	0	10	NP	NP	0	5	NP	NP	20	5	0
10-15	22	18	20	NP	NP	10	15	20	NP	0	5	10	15	0	0	5	10	15	0	0
15-20	20	13	15	18	NP	8	10	15	NP	0	0	5	10	0	0	0	5	10	0	0
20-25	18	8	10	12	15	0	5	7	10	0	0	0	5	0	0	0	0	5	0	0
25-30	15	0	5	7	10	0	0	5	8	0	0	0	0	0	0	0	0	0	0	0
30-50	10	0	0	0	8	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
50-75	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area Separation Walls	Not Permitted					25		Not Permitted		20		Not Permitted		15		Not Permitted		NP	10	0

Footnotes: (1) Type V Construction with wood shingles, add 5 points.
(2) See Table 5A for opening protection requirements.
(3) Opeings greater than 50% shall be considered as a nonrated wall.

TABLE 37-5-D-1

Sum of Deficiency Points From Table 37-5D	Factor
0-5	3.00
6-10	2.75
11-15	2.50
16-20	2.30
21-25	2.10
26-30	1.95
31-35	1.80
36-40	1.65
41-45	1.55
46-50	1.45
51-55	1.40
56-60	1.30
61-65	1.20
66-70	1.10
71-75	1.05
76+	1.00

FORM A

DETERMINING REQUIRED FIRE FLOW of EXISTING BUILDING

1. TYPE OF CONSTRUCTION _____

2. HAZARD CLASSIFICATION _____ (See Table 37-5A)

3. DETERMINE TOTAL DEFICIENCY POINTS FOR EXTERIOR WALLS (See Table 37-5D)

   NORTH _____

   EAST _____

   SOUTH _____

   WEST _____

   TOTAL _____

4. DETERMINE FACTOR _____ (See Table 5D-1)

5. DETERMINE GROSS AREA OF BUILDING _____ SQ. FT.
   Gross area is the total area of all floors except basements.

6. DIVIDE GROSS AREA (Step 5) BY HAZARD CLASSIFICATION (Step 2) _____ SQ. FT.

7. DIVIDE AREA IN Step 6 BY THE FACTOR FOUND IN Step 4 _____ SQ. FT.

8. DETERMINE FIRE FLOW USING TABLE 37.102
   FIRE FLOW = _____ G.P.M.

   Find the area found in Step 7 under the column for type of construction in Table 37.102. Do Not use closest area, go to next highest area in Table 37.102.

   Example:

   9,894 Sq. Ft. Type III N Construction
   Do Not use 9,060, Use 10,449
   Fire Flow = 3,500 GPM

FORM B

DETERMINING MAXIMUM ALLOWABLE HEIGHT & SQUARE FOOTAGE OF BUILDINGS

OCCUPANCY _____

ADDRESS _____

TYPE OF CONSTRUCTION: I, II, III 1 Hr., IIIN, IV 1 Hr., IVN, V 1 hr., VN
(Circle One)

OCCUPANCY CLASSIFICATION: _____

PROPOSED HEIGHT _____ ALLOWABLE HEIGHT (Table 5E) _____

BASIC ALLOWABLE AREA (Table 32102) _____ (1)

HAZARD CLASSIFICATION (Table 37-5A) _____ X (1)_____ = (2)_____SQ. FT.

EXPOSURE DEFICIENCY (Table 37-5D)

	Distance	Wall Const	Opening Protection	Deficiency Points
North	_____	_____	_____	_____
East	_____	_____	_____	_____
South	_____	_____	_____	_____
West	_____	_____	_____	_____

Total Deficiency Points _____(3)

TOTAL AREA (2) _____ X (3) _____ = (4)_____SQ. FT. (See Note)

Total Allowable Area (Table 5C, UBC) (5)_____SQ. FT.

Total Allowable Area with Exposure Charge (6)_____SQ. FT.

(Note) Total area cannot be greater than total allowable area by Table 5C, UBC and exposure charge

Area may be increased by installing automatic fire sprinklers.

EXAMPLE OF HOW TO FIND FIRE FLOW OF EXISTING BUILDING

BUILDING

CONSTRUCTION:	III 1 hr.
HEIGHT:	3 STORIES
AREA:	EACH FLOOR 10,000 SQ. FT.
WALLS:	NORTH - 4 HR. NO OPENINGS
	EAST - 2 HR. NONCOMBUSTIBLE, OPENINGS PROTECTED FOR 1-1/2 HR. 10' FROM PROPERTY LINE
	SOUTH - NON RATED WALLS BECAUSE OF OPENINGS
	WEST - ARE NOT PROTECTED
	SOUTH - 60' FROM PROPERTY LINE
	WEST - 15' FROM PROPERTY LINE
OCCUPANCY:	2-B

1.	TYPE OF CONSTRUCTION		III 1 hr.
2.	HAZARD CLASSIFICATION FOR 2-B OCCUPANCY		1.55
3.	TOTAL DEFICIENCY POINTS:	NORTH	0
		EAST	5
		SOUTH	5
		WEST	20
		TOTAL	30
4.	DETERMINE FACTOR		1.95
5.	GROSS AREA OF BUILDING		3 X 10,000 = 30,000 SQ. FT.
6.	DIVIDE GROSS AREA BY HAZARD CLASSIFICATION (30,000 ÷ 1.56 = 19,354)		19,354 SQ. FT.
7.	DIVIDE AREA IN Step 6 by Step 4 (19,354 ÷ 1.95 = 9,894)		SQ. FT.
8.	FIRE FLOW = 3,500 GPM		

Greater Tucson Fire Foundation

Thanks you for taking an interest in Tucson Fire Department history —

This is one of many sections that contain information, documents, letters, newspaper articles, pictures, etc. They have been collected and arranged in chronological order or by a subject. These items were collected, organized and entered into a computerized database by Dave Ridings Assistant Chief Tucson Fire Department, Al Ring friend of the department, Greater Tucson Fire Foundation and with the help of many friends and fellow firefighters.

All graphics have been improved to make the resolution as good as possible, but the reader should remember that many came from copies of old newspaper articles. This also applies to other items such as documents, letters, etc.

Credit to the source of the documents, photos, etc. is provided whenever it was available. We realize that many items are not identified and regret that we weren't able to provide this information. As far as the newspaper articles that are not identified, 99% of them would have to be from one of three possible sources. The *Arizona Daily Star,* The *Tucson Citizen* and the *Tucson Daily Citizen,* for which we want to give a special thanks.

Please use this information as a reference tool only. If the reader uses any of the information for any purpose other than a reference tool, they should get permission from the source.

Should the reader have additional information on the above subject we would appreciate you sharing it with us. Please see the names and contact information on the 1st. TFD Archives page right below this paragraph.

Greater Tucson Fire Foundation