

162

RALEIGH,
N. C.

August, 1931

Report No. 162

NATIONAL BOARD OF FIRE UNDERWRITERS
COMMITTEE ON
FIRE PREVENTION AND ENGINEERING STANDARDS

REPORT
ON THE
CITY OF RALEIGH, N. C.
(SUPERSEDING THAT OF 1924)

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The investigation of conditions in Raleigh, N. C., was made during March, 1931, by Engineers Geo. J. Robinson, S. Q. Stoneseifer, and Geo. J. Lyon.

Acknowledgment is made of the valuable assistance rendered by the Hon. Eugene C. Culbreth, Mayor, at the time of the investigation; the officials of the various city departments, and others.

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August 31, 1931

RALEIGH, N. C.

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(Superseding that of 1924)

CITY IN GENERAL

The city government is of commission form consisting of three members: Hon. George A. Iseley, Mayor; Charles C. Page, Commissioner of Public Works, and Carl L. Williamson, Commissioner of Public Safety.

Population estimated to be 38,700; the 1930 United States census showed 37,379. The city is the State capitol and the seat of several colleges, preparatory schools and State institutions which have been of great importance in the city's growth. Local industries, which are few in number, are in railroad repair shops, and cotton, hosiery and planing mills. Shipping facilities are provided by 3 railroads.

The area of the city is 7.5 square miles, about two-thirds of which is built upon. The surface is undulating; elevations in feet above mean sea level range from 241 at the southern city limits to 427 near the western limits. Street grades are mainly moderate. Four streets extending from the capitol are 99 feet wide; others are mainly 66 feet in width. There are

approximately 150 miles of streets of which about half are paved; unpaved streets have been gravelled. Bituminous coal is used as fuel for manufacturing purposes, and anthracite and bituminous coal, fuel oil and wood are used for domestic purposes.

Records of the United States Weather Bureau show that winds of 25 miles and over are infrequent; winter temperatures are mild and there is no interruption to traffic caused by snowfall; periods of hot, dry weather are few.

The gross fire loss for the last 5 years, as given in the fire department records, amounted to \$940,222, the annual loss varying between \$51,084 in 1927 to \$433,755 in 1926. The number of actual fires varied between 130 in 1930 and 159 in 1929, with an average of 145. The average loss per fire was \$1,297, a very high figure. Based on an average population of 34,500, the average annual number of fires per 1,000 population was 4.20, a moderate number, and the average loss per capita was \$5.45, a high amount.

FIRE-FIGHTING FACILITIES

WATER SUPPLY

OWNERSHIP.—The system, supplying all built-up parts of the city and approximately 1,000 consumers just outside of the corporate limits, formerly owned and operated by the Wake Water Company and originally built in 1886-87, was taken over by the municipality in June, 1913. Major improvements were made in 1913, 1919, 1920 and 1927.

ORGANIZATION.—Administrative control is vested in the Commissioner of Public Works. The 2-year term of the present commissioner, Charles C. Page, expires in May, 1933. E. B. Bain, engineer and superintendent, has been in direct charge for 33 years; he is a registered engineer in North Carolina, a member of various water works and engineering organizations, and well qualified to perform the duties of his office. W. B. Bandy, assistant to the superintendent, also a registered engineer and member of the American Water Works Association, has charge of construction work. There are 30 permanent employees. Long terms of service are the rule.

RECORDS.—These include a skeleton map of the system showing pipes, valves and hydrants; a partially completed sectional map on 148 sheets, showing all details of the distribution system; plans of the supply works except Swift Creek dam, and complete operating records. Records are indexed and are filed in steel cabinets at the water works office, but no vault is provided.

Quarters.—Main office, with repair shop and store room behind it, is at 115 West Morgan street; pipe yard is at College place and St. Mary's street.

Fire Service and Emergency Operations.—Fire alarms sound in the main pumping station. Ordinarily the elevated tank is kept nearly full and pressures are not raised for fires. At least one responsible employee attends all large fires. Two of five motor trucks are generally available for emergency service. Responsible employees have automobiles. Telephones connected to the public exchange are installed in all quarters of the water department and in the houses of responsible employees.

GENERAL OUTLINE OF SYSTEM.—A gravity supply from Walnut Creek and impounding

WATER SUPPLY

reservoirs flows to the purification works at the pumping station; supply may also be pumped from Swift Creek to the purification works. High-lift pumps take suction from clear water basins and discharge directly to the distribution system in one service, with an elevated tank as equalizer.

SUPPLY WORKS.—General.—Walnut Creek has a drainage area above Lake Raleigh of 12.63 square miles, and Swift Creek a drainage area of about 62 square miles above the dam. The minimum annual rainfall recorded in the past 45 years is 32.09 inches, October, 1921 being the driest month.

Impounding Reservoirs.—Located respectively 2½ and 4 miles above the pumping station on Walnut Creek are Lake Raleigh and Lake Johnson, formed by substantially constructed earth dams with concrete spillways and either core wall or upper slopes of concrete.

Lake Johnson has a full storage capacity of 500,000,000 gallons; it supplies Lake Raleigh about 1½ miles below by way of Walnut Creek.

Lake Raleigh, with spillway at elevation 281, has a storage capacity of 125,000,000 gallons. A 30-inch cast-iron supply main extends 6,060 feet from the dam at Lake Raleigh and divides into one 24- and one 18- reducing to 14-inch line, both of which continue about 6,500 feet to the coagulating basin. These lines pass under pressure through a concrete chamber to which are also connected the independent suction of two low-lift pumps now held in reserve. The maximum gravity discharge through these supply lines into the coagulating basin measured by Venturi meter is about 6,000,000 gallons a day; at this rate the low-lift pumps would be under a slight head. With low-lift pumps in operation the lines could supply about 10,000,000 gallons a day.

Swift Creek Supply.—A concrete dam 17 feet high, on rock foundation, with spillway 150 feet long at elevation 227, impounds about 20,000,000 gallons. From the dam a 24-inch cast-iron line extends about 135 feet to the pumping station where it connects to the pump suction and also to a suction well. A 30-inch cast-iron line about 60 feet long from the stream below the dam also enters the suction well. Equipment consists of two 3,500,000-gallon, electrically driven, centrifugal pumps. Each pump discharges at about 120 pounds pressure through independent 12-inch lines to a line which extends to the main pumping station, consisting of 24,520 feet of 24-inch and 13,000 feet of 20-inch.

The station, built in 1927, is a small area, concrete and brick building; all doors and wire glassed window frames are steel.

Filter Plant.—The lines from Lake Raleigh and from Swift Creek discharge directly to a reinforced concrete coagulating basin, with operating level at

262, only the top 15 inches of the storage capacity being available for filtering. The filter house, about 125 feet northwest of the pumping station, is a moderate area 1-story and basement brick building with concrete floors and metal covered plank roof on wood trusses. The plant consists of 12 rapid sand filter units having a combined rated capacity of 6,000,000 gallons a day.

From a small concrete well under the filters, the water flows to an elliptical, masonry lined, clear water reservoir holding 2,000,000 gallons at a high water elevation of 254, with independent suction connection to each steam high-lift pump and a common suction line to the two electric pumps. The elliptical basin is connected to an adjacent rectangular, reinforced concrete, clear water basin of 2,400,000 gallons capacity by one 14-inch and one 24-inch line; a 30-inch extension of the latter connects with the line from the elliptical basin that provides suction for the two electrically driven high-lift pumps.

Main Pumping Station.—General.—Erected in 1887 and enlarged in 1925, this station is on the north bank of Walnut Creek, 1½ miles south of the principal mercantile district. Equipment is well above the level of the highest floods. Current for electrical operation is brought at 2,200 volts over a single wood pole line about ¾-mile long from a substation of the Carolina Power and Light Company that can be supplied by independent circuits. Interruptions of current supply do not exceed 15 minutes. Fuel for operation of steam units, which are held in reserve, is bought under contract and delivered in carts; about 75 tons is kept on hand. The plant is operated in three shifts of 3 to 6 men each. All equipment is in good condition.

Equipment.—Equipment in regular use consists of two units, each consisting of two Morris centrifugal pumps in series, driven by a 300-h.p. induction motor, rated at 3,500,000 gallons a day against 151 pounds net pressure; one pump is normally operated intermittently for 16 to 18 hours a day discharging at a rate of about 5,000,000 gallons a day measured by Venturi meter, at a pressure to 130 to 135 pounds at elevation 243.

In reserve are three horizontal, compound, condensing, duplex, double-acting high-lift pumps, one Prescott installed in 1913 and one Worthington in 1904, of 2,500,000 gallons, and a McGowan of 3,000,000 gallons capacity put in service in 1908.

The two low-lift pumps, normally in reserve, are Morris, double suction, centrifugal type, one of 5,000,000 gallons driven by an 8-stage Kerr steam turbine, the other of 6,000,000 gallons capacity by a 60-h.p. General Electric induction motor.

There are 3 boilers of the horizontal, marine, fire-tube type; two of 125-h.p. installed in 1901 and 1908 are of the Walsh and Weidner make and one of

150-h.p. is a Casey-Hedges make of 1912. Steam is supplied through a single ungated header.

High-lift pumps take suction under a slight head. Discharge is to a loop which supplies a 16-inch and a 14-inch main to the distribution system; the repair of one valve in the loop might make it necessary to shut down both lines to the system, putting the station out of service.

Construction.—The station is a high, 1-story brick building of small area, divided into boiler room, steam pump room and electrical pump room. A 13-inch parapetted brick wall with one unprotected door opening separates boiler and steam pump room; there is an unprotected opening between the latter and the electric pump room. Boiler room and electric pump room have cement floor, steam pump room wood floor. Steel roof covered with corrugated iron is over boiler room; other rooms have slate roof with wood sheathing, purlines and trusses.

Oil and miscellaneous tools are kept in a small brick building 110 feet distant.

Hazards.—There are no exposures. Each boiler has an independent stack; 2 of metal extend through the roof; a brick stack is outside; all are well installed. Lighting is by electricity. All wiring is in conduit. The boiler room is heated by a coal stove. Oils and waste are well cared for.

Protection.—One hydrant with 2 hose outlets is between pumping station and filter house. A 2½-inch standpipe with 50 feet of 2-inch hose and nozzle attached is in pump room; an additional 100 feet of hose and an extra nozzle hang nearby, and there is 150 feet of 2½-inch hose in the filter house, 125 feet of ¾-inch hose is provided for boiler and yard use and there are 3 fire extinguishers. Nearest fire station is 1¼ miles distant.

Elevated Tank.—A riveted steel tank with elliptical bottom, on a steel tower, is on College place about 1 mile northwest of the principal mercantile district. At elevation 497 the tank holds 600,000 gallons.

Consumption.—See Table 1. Statistics are based on records of Venturi meters. Consumption is under good control; it has been reduced considerably since the last report by the installation of additional service meters.

Maximum.—Large consumption usually occurs in hot weather. Maximum days occurred on August 7, 1928 with 3,913,000 gallons, September 3, 1929 with 4,246,000 and on August 5, 1930 with 4,621,000 gallons.

Meters and Service Connections.—See Table 1. —Large services that are metered include 16 four-, 2 six-, and 1 eight-inch. There are 44 connections used solely for automatic sprinklers, all unmetered; of these 3 are four-, and 41 are six-inch.

TABLE 1.—CONSUMPTION

Year Ending May 31	Average Pumpage Gallons per Day	Estimated Population Supplied	Gallons per Capita	Number of	
				Services (Active)	Meters
1926	4,214,025	36,500	115	7,752	4,768
1927	3,632,221	37,000	98	7,978	7,556
1928	3,037,266	37,500	81	8,320	7,914
1929	3,552,299	38,000	80	8,636	8,235
1930	2,947,575	39,000	76	8,771	8,395
1931*	2,977,838	40,000	77	8,865	8,473

*To February 28, 1931.

PRESSURES.—Recording gages are maintained at the Main pumping station and at the water works office which is about 200 feet northwest of the principal mercantile district. At the Main station charts at elevation 243 show pressures between 130 and 135 pounds while pumping and about 110 pounds with pumps shut down. At the office, charts at elevation 356 show pressures ranging between 60 and 62 pounds while pumping and as low as 56 pounds at other times.

In March, 1931, pressures were observed by a National Board engineer between 8:40 and 10:30 a. m. at 22 hydrants well distributed throughout the city, which showed an average pressure of 68 pounds with a maximum of 98 and a minimum of 35 pounds. In the principal mercantile district the average was 72, the maximum 78 and the minimum 61 pounds. During these observations one electric pump was operated at the Main pumping station.

DISTRIBUTION SYSTEM.—See accompanying plan. Supply to the principal mercantile district is through one 16- and one 14- reducing to 12-inch force main from the Main pumping station that extend through and along one side of the district and then connect with a 20-inch line from the elevated tank. A 12-inch that runs about 500 feet south of the district and also along its west end completes a loop. East and west lines across the district are largely of small size.

Of a total of 14,945 feet of pipe in the principal mercantile district, 5 per cent is 4-inch, 56 per cent 6-inch, 9 per cent 8-inch, 22 per cent 12-inch and 8 per cent 14-inch. Minor distributors are mainly 6-inch, with some 4- and some 8-inch. Six-inch pipe is the minimum size laid for hydrant distribution. Throughout the system the average length of 6-inch or smaller pipe on the long side of blocks between cross-connections is 765 feet; there are about 1.9 miles of 6-inch and smaller pipe in dead ends supplying hydrants, or 2.4 per cent of the total. There are 15.9 miles of pipe less than 4 inches and mainly 2 inches, installed for domestic distribution but not providing fire protection.

WATER SUPPLY

PIPE.—Length and Age.—See Table 2. All pipe is tar coated cast-iron. Of the present mileage about thirteen miles was laid prior to 1890, forty miles between 1890 and 1925 and twenty-six miles since 1925.

Condition and Cover.—Interior of pipes become slightly tuberculated. Little trouble is experienced from sediment; dead ends are flushed systematically, the whole system being covered twice a year. Mains are laid with a minimum cover of 2½ feet; no mains have ever been frozen.

Specifications.—Pipe purchased is of Classes C and D of the American Water Works Association specifications. It is inspected on receipt and at the trench. Domestic pressure is applied before joints are covered.

GATE VALVES.—Number and Type.—See Table 2.—Valves are of the double disc type; all except 3, the locations of which are well marked on the maps, open counterclockwise. All 20-inch and the control valves at the pumping station are geared and set in manholes; others are direct acting with nuts of uniform size operated through extension iron boxes.

TABLE 2.—PIPES AND VALVES IN THE DISTRIBUTING SYSTEM
FEBRUARY 28, 1931

Diameter in Inches	PIPES			Number of Gate Valves
	Length, Miles	Per Cent of Total	Increase Since 1924	
4.....	7.40	9.3	0.68	4
6.....	52.21	65.3	18.45	543
8.....	10.56	13.2	3.32	66
10.....	0.40	0.5	0.01*	5
12.....	0.40	8.0	2.97	45
14.....	0.87	1.1	0.03	4
16.....	1.30	1.6	0.00	4
20.....	0.81	1.0	0.00	7
Totals...	79.95	100.0	25.44	678

*Decrease.

Location and Spacing.—Valves are located generally at street intersections on the property lines; a small per cent are close to main intersections. Detail measurements of locations are shown on the atlas sheets; about 15 per cent of all valve locations are shown on loose leaf sheets not convenient for field use.

The average length of main that would be shut off in consequence of a single break in the principal mercantile district is 970 feet, with a maximum of 1,650 feet. In a representative residential district the average was found to be 1,200 feet with a maximum of

3,700 feet. On mains 12 inches and larger in diameter the average length is 1,300 feet.

Inspection and Condition.—No systematic valve inspections are made; many valves are operated each year in connection with repair work. An inspection of 33 valves from 4 to 20 inches in diameter was made by a National Board engineer in March, 1931. All were located easily and were found to be in good operative condition.

Closing of Valves.—The fire department is notified verbally when valves affecting hydrant supply are operated.

HYDRANTS.—Number and Type.—On February 28, 1931, there were in service 557 public and 133 private hydrants. All are of the post type with nuts of uniform size and open counterclockwise. Except for 64 Columbian, all of the public hydrants are of the Mathews pattern; 77 have two 2½- and one 4½-inch outlets and all except one of the remainder have two 2½-inch outlets, the exception having a single 2½-inch outlet. Except 97, which have 4-inch branch connections, hydrants have 6-inch branch connections with the mains. Hydrant branches are ungated except those from mains larger than 8 inches, the number of gated branches being 34.

Drainage.—All hydrants have automatic drip valve and are set in pockets of broken stone or brick; those operated drained well. No hydrants have been found frozen in recent years.

Inspection and Condition.—Regular inspections are made each spring and fall when hydrants are oiled, packed, greased and overhauled as needed. All hydrants used during this examination were in good operative condition.

Distribution.—In the principal mercantile district the average area served by each hydrant is 91,000 square feet. Of the 14 hydrants within and the 21 adjacent to the district, 27 are Mathews and 8 are Columbian; 19 have two 2½-inch outlets and 16 have two 2½- and one 4½-inch outlets; all have 6-inch branch connection with the mains, of which 24 are not gated. Elsewhere in the city the average area served by each hydrant is about 200,000 square feet.

FIRE FLOW TESTS.—See Table 3. Tests were made on Tuesday, March 10th, 1931, between 8:50 a. m. and noon, the consumption rate being 3,600,000 gallons. Tests 1, 2 and 3 were made both with the two electrically driven pumps in operation and without the pumps, the elevated tank being open to the system at all times and nearly full. The remaining tests were made under normal operating conditions, one electrically driven pump being in operation. The 6-inch line on the Boylan street

WATER SUPPLY

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TABLE 3.—FIRE FLOW TESTS

District	Number and Location of Group*	Discharge, Gallons per Minute					Pressure, Pounds per sq. in.		Quantity	
		Individual Hydrants				Total of Group	Hydrants Closed	Hydrants Open	Re-quired	Avail-able for Engine Supply
Principal Mercantile	1. Blount and Davie Sts.....	820	1000	1040	1180	4040	83	72	6000	10400
	1a. Same Location. See Note Below....	680	900	990	1080	3710	67	41	6000	5100
	2. Blount and Morgan Sts.....	820	870	980	1220	3890	67	57	6000	9000
	2a. Do.....	680	860	920	940	3400	58	34	6000	4400
	3. Wilmington and Hargett Sts.....	510	540	610	660	2320	72	54	6000	4100
	3a. Do.....	480	540	600	660	2280	61	39	6000	3200
Manu-facturing	4. Davie and Harrington Sts.....	540	640	980	.....	2140	71	57	3500	4300
	5. West and Hargett Sts.....	360	370	560	910	2200	72	55	3500	4000
Residential	6. Lenoir and Cutler Sts.....	500	560	.....	.....	1060	82	42	2000	1300
	7. Woodburn Rd. and Hillsboro St....	620	720	860	.....	2200	39	17	2000	2000
	8. Pogue and Clark Sts.....	460	500	.....	.....	1050	32	20	2000	1050
	9. Fairview Rd. and Glenwood Ave.....	320	410	430	.....	1200	60	30	2000	1400
	10. Mordecai Dr. and Sycamore St.....	350	390	.....	.....	770	88	19	2000	800
	11. Martin and State Sts.....	470	490	.....	.....	960	60	40	1500	1300

*Location of groups shown on accompanying plan by corresponding numbers.
Tests 1a, 2a and 3a were made with no pumps in operation.

bridge over railroad tracks was closed at each end of the bridge.

IMPROVEMENTS.—Since the previous National Board report storage on the gravity supply has been increased 100,000,000 gallons, and the wood stave supply line replaced with cast-iron pipe. A pumped supply from an independent source has been provided. A slight increase in filter capacity has been made, a clear water reservoir added and additional pumping capacity installed at the Main pumping station. Total pipe mileage has been increased by about 33 per cent. and 226 hydrants have been added.

CONCLUSIONS.—Organization.—The superintendent and staff are experienced and efficient. Records, which are not filed safely, are slightly incomplete but are being brought up to date; pumping station records of operation are excellent. Response to alarms of fire is made; cooperation with the fire department is excellent.

Supply Works.—The yield from Walnut Creek in connection with considerable storage together with the yield from the larger Swift Creek area is ample. Filter capacity in connection with clear water storage is adequate for present needs. High lift pumps are slightly inadequate in reserve. The availability of both steam and electric equipment partially offsets features of unreliability in each.

Consumption.—The per capita consumption is moderate and is well controlled.

Pressures.—Pressures are sufficiently high for automatic sprinklers and are well maintained.

Protection.—Fire flow tests indicate that adequate quantities for reasonable fire protection are available in most of the principal mercantile district and in the manufacturing section. Quantities are generally only poor to fair in most residential sections owing to lack of feeders of proper size.

Mains.—Arteries to the principal mercantile district and to the western part of the city are well arranged and of good capacity, but with either of the lines from the pumping station out of service supply would be seriously deficient; in residential sections they do not generally provide mutual support. Minor distributors are mainly 6-inch with only a small percentage of dead ends and with a fair grid-iron. Pipe is in good condition as regards incrustation, sediment and electrolysis.

Gate Valves.—Spacing is fair throughout the system. Valves are in good condition, but systematic inspection is lacking.

Hydrants.—Hydrants are well maintained; regular inspections are made. A moderate percentage of small hydrants are in use; very few have gate valves in the branch connections. Spacing in the principal mercantile district is good; elsewhere it is too wide.

Improvements.—Valuable improvements have been made since the previous National Board report.

FIRE DEPARTMENT

FIRE DEPARTMENT

ORGANIZATION.—Basis.—Full paid, on 2-platoon basis.

Supervision.—Under the supervision of Commissioner of Public Safety Carl L. Williamson, who is elected for a 2-year term; he was elected to this office May 1, 1931. He also has supervision over the Police, Sanitary, Building and Electrical departments.

Officers.—Chief W. E. Holland, age 41, was appointed to his present position in September, 1926, after having served in the various other grades since 1913. He has attended two of the State training courses and is an experienced and competent officer.

First Assistant Chief E. R. Smith has been in the department since 1918 and was appointed to his present position in September, 1926.

Second Assistant Chief R. D. Upchurch has been a member of the department since 1919 and was appointed to his present position in September, 1927.

Membership.—Total membership, 56, including the chief, 2 assistant chiefs, 6 captains, 6 lieutenants, 1 mechanic and 40 privates.

Expenses.—The average maintenance expense of the fire department, excluding the fire alarm system, for the last 5 fiscal years ending on May 31st was \$86,100; in addition, \$47,480 has been spent for apparatus, \$27,113 for new fire stations, and \$30,689 for additions to the fire alarm system. For 1930, the maintenance expense of the fire department was \$93,678; this is a per capita expense of \$2.51, based on a population of 37,379.

Appointment and Promotion.—The chief is appointed by the Board of Commissioners for a 2-year term; other officers are appointed by the Commissioner of Public Safety on the recommendation of the chief. Members are appointed by the chief subject to a probationary period of 60 days. Applicants for appointment must pass a physical examination and be between 21 and 30 years of age.

Retirement and Pension.—No age limit has been set for compulsory retirement; no members are over 42 years of age.

The Firemen's Relief Fund, instituted by State law is supported by $\frac{1}{2}$ of 1 per cent. on all fire insurance premiums collected within the State. The fund is designed to care for firemen injured in service, to provide for dependents of firemen killed in service, and to safeguard any fireman who honorably served a period of 5 years from becoming an inmate of any almshouse or actually dependent upon charity. Members also come under the North Carolina Workmen's Compensation Act which pays specified sums for certain injuries and \$6,000 for death incurred while on duty.

Companies.—Organization.—See Table 4. Five engine and 2 ladder companies are in service in 5 stations. A captain and a lieutenant are provided, with one exception, for each company; the two ladder companies have only one officer on duty with each shift. Company membership is divided into two equal platoons working 10 and 14 hours. Members are allowed 10 days' annual vacation, the maximum number allowed off at one time being four; no substitutes are employed. Continuous watch is maintained in stations except when the companies are out.

Distribution.—Headquarters, containing an engine and 2 ladder companies, and 2 other stations, each containing an engine company, are located within 1500 feet of the center of the principal mercantile district. The other two engine companies are located in the northern and western portions of the city so that all sections are within $1\frac{1}{2}$ miles of an engine company, but some large institutions are $1\frac{3}{4}$ miles from the nearest ladder company.

EQUIPMENT.—Pumpers.—See Table 4. One 1,000-gallon and four 750-gallon American-LaFrance pumpers are in service and a 600-gallon steamer, equipped for towing, is in reserve. The chemical tanks on the pumpers have been changed to booster tanks.

Pumper Tests.—Pumpers were tested during this inspection by a National Board of Fire Underwriters engineer to determine their condition and the ability of their operators. They were generally well operated and all but one, which delivered 97 per cent. of its capacity, delivered over their rated capacities at satisfactory pump pressures.

Ladder Trucks.—See Table 4.—Two American-LaFrance ladder trucks are in service; one, a 75-foot quick-raising aerial, carries, in addition to the aerial ladder, a 45-foot ground extension and 5 other ladders, including one pompiet; and the other, a combination city service truck, carries a 50-foot extension and 7 other ladders, including two with roof hooks. The aerial also carries a ladder pipe equipped with a $1\frac{1}{2}$ -inch tip.

Chief's Car.—Fuel.—The chief is provided with a 5-passenger sedan. The first assistant chief uses his own car and the second assistant chief rides the apparatus. Headquarters is provided with an underground 800-gallon gasoline tank with visible measure curb pump from which fire department and all other city automobiles obtain fuel. The chief's car would be used to carry gasoline to a fire or a tank wagon would be called. The gasoline is bought from the several dealers in the city and the various kinds mixed, resulting in a fuel which is not as good as it should be.

FIRE DEPARTMENT

RALEIGH, N. C.

TABLE 4.—FIRE COMPANIES—LOCATION AND EQUIPMENT

COMPANY	LOCATION	Members on Duty Each Platoon	APPARATUS			Hose Carried, Feet	2½" Spare Hose Feet	Ladders Carried	Extinguishers and Tanks, Gallons
			Type	Motor H. P.	Put in Service				
Engine 1 <i>h.</i>	Headquarters: W. Morgan St. bet. Salisbury and McDowell Sts.	4	750-gallon Pumper.	73	1926	{1150-2½" 200-¾"	3550*	{2-12' 1-21'	{1-40 2-2½
Engine 2 <i>h.</i>	Salisbury St., bet. Davie and Cabarrus Sts.	4	1000-gallon Pumper.	73	1917	{1100-2½" 200 ¾"	.....	{1-14' 1-28'	{1-40 2-2½
Engine 3....	Hargett and Blount Sts.	4	750-gallon Pumper.	73	1922	{1200-2½" 150-¾"	.....	{1-12' 1-22'	{1-40 2-2½
Engine 4....	Jefferson St. bet. Fillmore and Glenwood Sts.	4	750-gallon Pumper.	73	1925	{1100-2½" 150-¾"	.....	{2-12' 1-22'	{1-40 2-2½
Engine 5....	Park Drive and Oberlin Road	4	750-gallon Pumper.	73	1926	{1000-2½" 200-¾"	.....	{2-12' 1-24'	{1-40 2-2½
Ladder 1 <i>h.</i>	Headquarters	2	75' Quick-raising Aerial.	73	1915	.....	{7 Ladders; total length, 228'	.....	.....
Ladder 2....	Headquarters	4	Combina-tion City Service.	73	1923	150-¾"	{8 Ladders; total length, 215'	{1-40 2-2½	

*Spare hose for all companies.

h. Company located in High Value District.

Hose.—Hose is 2½-inch, double-jacketed, cotton rubber-lined, purchased under the usual trade guarantees. It is tested on delivery to 300 pounds and every three months thereafter to 250 pounds; practically all is less than 5 years old. Companies bring their wet hose to headquarters and leave it to be dried, replacing it with dry hose; at headquarters the hose is dried on the sidewalk or inside on the apparatus floor after which it is rolled and stacked. Hose is shifted on wagons occasionally if not used. The amount on hand allows an average of 1,820 feet for each company.

Couplings.—Couplings of this and neighboring cities are of the usual screw type and of the following dimensions:

TABLE OF COUPLINGS

Connection	Nominal Size, Inches	Outside Diameter, Male Thread, Inches	Threads per Inch
Raleigh Hose.....	2½	3⅞	6
Raleigh Hydrants.....	2½	3⅞	6
Durham Hose.....	2½	3	8
Goldsboro Hose.....	2½	3⅞	8
Fayetteville Hose.....			
Wilson Hose.....			
Henderson Hose.....	2½	3⅞	8
National Standard.....	2½	3⅞	7½

Two adapters for Durham hose are carried by Engine 1.

Minor Equipment.—Equipment carried on the pumpers is fairly uniform but incomplete; it usually includes an axe, distributing nozzle, crowbar, hose shut-off, hose straps, hydrant wrenches, lanterns, shut-off nozzles with ⅞- to 1¼-inch tips, plaster hook, spanners and double connections. The ladder trucks carry a very limited amount of equipment; the service truck carries axes, bale hooks, brooms, mops, crowbar, waterproof covers, door opener, hose shut-off, hose straps, lanterns, plaster hooks, rope, ram and wall cutter, roof cutter, shovels, wire cutters and 2 portable searchlights; the aerial truck carries axes, cellar pipe, door opener, deluge set with 1½- to 2-inch tips, hose shut-off, hose straps, life net, life belt, one shut-off nozzle with 1¼-inch tip, pick, plaster hook, roof cutter, siamese, wall hook and chain, wire cutters, hose rollers and a ladder pipe with 1½-inch tip.

The appliances for handling special or heavy streams consist of one cellar pipe, 6 distributing nozzles, 2 siamese connections, 1 deluge set and the ladder pipe.

Stations.—Three of the five stations are 2-story brick, one is 2-story brick and frame, and the fifth is a one-story brick building, all of joisted construction. Apparatus floors are of concrete. Two of the stations, including headquarters, are old and in need of repairs; three are heated with stoves and two by steam with the heaters in small basements. No hose drying facilities are provided in any of the stations; the tower at headquarters in which hose was formerly dried is no longer used for this purpose.

FIRE DEPARTMENT

Repairs.—Minor adjustments and repairs are made at headquarters, where a work bench and some hand tools are provided, by the mechanic who is a member of Engine Company 1; he is subject to call at all times. Other repairs are made in local garages. Only a few spare parts are on hand, but they are said to be readily obtainable from Atlanta. All apparatus is of one make.

SUMMARY OF APPARATUS

	In Service	In Reserve
Fire Engines, Pumps—		
1,000 gallons.....	1	0
750 gallons.....	4	0
Steamers—		
800 gallons.....	0	1
Ladder Trucks:		
Aerial, automobile.....	1	0
Combination, automobile.....	1	0
Chief's automobile.....	1	0
Fire alarm automobile.....	1	0
Hose, 2½-inch.....	9,100'	0
Hose, ¾-inch for chemical.....	1,050'	0
Ladders, total length.....	658'	0
Ladders, short, on hose wagons, etc.....	13	0
Portable extinguishers.....	12	0
Deluge Set.....	1	0
Siamese connections.....	2	0
Ladder pipe.....	1	0
Cellar pipe.....	1	0
Distributing nozzles.....	6	0
Special couplings (for engines from other cities).....	3	0
Waterproof Covers.....	6	0

OPERATION.—**Discipline.**—There are no printed rules or regulations. The chief has power to suspend or dismiss a member subject to approval by the commissioners; the member may appeal to the board of commissioners who hold a hearing. The penalty for ordinary infractions of the rules is loss of time off. Discipline appears to be good.

Drills and Training.—Members are given calisthenic drills daily. Company drills are held on an average of once a week in hose and ladder work including the use of pompier ladders. The drill tower at headquarters is used but its value is limited by the lack of sufficient open space around it. Pumps are run occasionally, suction being taken from draft or from a hydrant. Meetings of the officers are held occasionally when the chief takes up special hazards and methods of fighting fires in the various buildings in the business district.

At exhibition drills held during this inspection the men showed that this training, while of benefit, is not comprehensive enough.

Response to Alarms.—Three pumps and 2 trucks respond to first alarms from the business district, with another pump responding on a second and

the last one on a third alarm. The response to residential sections consists of 2 pumps and the service truck unless it is in a section where the houses are all of one story when the truck does not respond until the second alarm. For telephone alarms from the principal mercantile district, the pumper and 2 trucks in headquarters respond after notifying the other companies; a box is pulled calling two more pumps if help is needed. For a telephone call from residential districts the pumper and service truck from headquarters and the nearest pumper respond.

An engine company moves in to headquarters whenever the three companies there are out. The off-shift members are called on a third alarm.

The chief responds to all alarms except to some in outlying sections; the first assistant chief, when off duty, answers first alarms in the business district and from colleges, and second alarms elsewhere. Streets that are not paved are graveled so that, while they may be rough, they should not seriously delay apparatus. Grade crossings are said to seldom delay response.

Fire Methods.—Fire department records show that for 1930, 57 per cent of fires were extinguished with chemicals or a small water line, and the remainder about evenly divided between direct hydrant and pump streams. Ordinarily the first company to arrive lays a hose line and, unless the fire is showing, takes in its small line; the second company lays a line and connects its pump and the third company stands by waiting for orders. The ladder companies raise ladders if needed, ventilate, help on hose lines, use salvage covers and remove water and rubbish after the fire is out. Shut-off nozzles with ¾- to 1¼-inch tips are generally used and an effort is made to prevent unnecessary water damage. Suction would usually be taken from hydrants but five 40,000-gallon underground cisterns, which are located in or near the business district, would be used if needed. They are filled from hydrants and are inspected regularly by members of the fire department. Outside connections for standpipes or sprinkler systems would be used on order of the officer in command. After fires, hose is rolled, taken to headquarters and replaced with dry hose.

Inspections.—Members devote part of their time, both while on duty and on the off-shift, to the inspection of all buildings, except dwellings, for hazardous conditions and to familiarize themselves with the construction of the buildings; complete inspections of the principal mercantile district are made about once every two months. Records are made only when hazardous conditions are found and are turned over to the chief who, with the assistant chief, attempts to get the condition remedied. He can bring court action if necessary. For actual conditions see Explosives and Inflammables, page 13.

Reports and Records.—Company officers send a report to the chief of every alarm received. The chief makes out a report of every fire and sends it to the Insurance Commissioner, and sends in a monthly report of fires to the Commissioner of Public Safety. The chief keeps a card index record of all fires filed by streets, a personnel record book and the usual fire record book.

IMPROVEMENTS.—Since the 1924 report the department has changed over to the 2-platoon system, 23 men have been added and 2 additional engine companies have been organized.

CONCLUSIONS.—The fire department is under the command of a capable chief officer who, however, is handicapped by being appointed for a short term. Sufficient companies are provided but they are all somewhat undermanned, especially the aerial ladder company. The efficiency of the department is further lessened by the deficiency in heavy stream appliances and in minor equipment. The lack of hose drying and gasoline storage facilities at all stations except headquarters means that the apparatus is away from their stations when replenishing these supplies. The lack of any reserve apparatus would handicap the department in case any of the apparatus had to be placed out of service for repairs. Building inspections are of value but would be improved by the making out and filing of complete reports of each inspection.

FIRE ALARM SYSTEM

ORGANIZATION.—The fire alarm system is under the supervision of the Commissioner of Public Safety and is maintained by J. W. Mangum, Superintendent of Fire Alarm and Police Patrol, who is appointed for a 2-year term. He has held office from 1905 to date, except for four years between 1909 and 1913; he also has supervision over the building and electrical departments and has charge of traffic lights. He is assisted by one line-man and a helper.

HEADQUARTERS.—Headquarters apparatus is in a 1-story joisted brick building with metal lath and cement ceiling and with wired glass windows and metal covered doors at openings, built in 1925 and located in the yard at the rear of fire headquarters. There is no private fire protection.

EQUIPMENT.—Apparatus at Headquarters. —The system is of automatic type, Gamewell make, installed in 1925, and consists of a 12-circuit slate switchboard with the usual devices for charging and operating with batteries, and a 10-circuit automatic, non-interfering repeater with contacts on the drum

for 4-alarm circuits. The former 4-circuit switchboard is set up in the operating room but is not used. No transmitter is provided.

Circuits enter underground to a wooden terminal box partly lined with asbestos, where the circuits are protected by vacuum type lightning arresters and 5-ampere, 2500-volt fuses. From the terminal box, the circuits extend in No. 14 rubber-covered copper wires, bunched, in conduit to the switchboard, repeater and batteries. They are protected on the switchboard by $\frac{1}{4}$ -ampere link fuses and by 3-ampere fuses on the battery racks, and at fire stations by vacuum type lightning arresters and 5-ampere, 2500-volt fuses.

Batteries. — Current for operating the system is supplied by a total of 288 cells of storage battery of the lead and acid type, in duplicate sets, on glass rods on porcelain insulators on pipe racks, in a well ventilated room adjoining the operating room and cut off from it by a brick wall and metal-clad door. Each set is charged for about 5 hours every other day through lamp resistance by a motor-generator set located in the operating room; another motor-generator set is in reserve. The 220-volt charging circuit enters underground thence in conduit to the switches and motor. It is protected by 35- and 30-ampere fuses and protection on the switchboard consists of a no-voltage, reverse-current relay and 10-ampere fuses. No duplicate charging current is provided, but one could be easily obtained from a trolley circuit nearby. A good supply of spare battery parts is on hand.

Apparatus at Fire Stations and Elsewhere. — Each fire station is equipped with a gong and register on some box circuit, and an automatic light switch. In addition, gongs are provided in the pumping station and in the residences of the chief and first assistant chief. A tower bell is provided at the fire headquarters, but is not used.

Boxes. — *Description.* — Total number, 120, of which 108 are of succession and the remainder of non-interfering types; 3 are of the inferior Gardiner type. Three are auxiliary with from 2 to 5 auxiliary stations on each, and 6 others have the auxiliary attachments but are not so used. Two-thirds of the boxes have quick-action doors and the remainder have keys under glass guard; all are of the trigger pull type with telegraph key, bell or siren, door shunt and lightning arrester; about half are grounded.

Nine boxes are on iron lamp posts and the remainder are attached to any available pole usually at or near street intersections. No special indicating lights are provided nor are any bands painted on supporting poles; boxes are painted red annually. All boxes were inspected and 18 were tested during this inspection; they were found to be in generally good

FIRE DEPARTMENT AUXILIARIES

condition and are timed to operate at about one and one-half seconds between blows.

Distribution.—Box distribution is fairly good in the principal mercantile district and fair to good elsewhere; it is estimated that about 40 additional boxes are needed to provide adequate protection.

Circuits.—Nine all-metallic, normally closed box and one similar alarm circuit are in use, to which all boxes and alarm instruments are connected. The alarm circuit, connected to one of the box circuit connections on the repeater, connects only the alarm instruments in headquarters. Five of the box circuits do not enter any fire station. The total length of circuits is approximately 50 miles, of which 17 per cent. is underground; overhead circuits are No. 10 rubber-covered copper wire with double-braid weatherproof insulation on brackets on any available pole, some of which carry up to 2300-volt circuits, and mostly over other wires. When circuits are changed or extended the wires are placed under other wires. Underground circuits are No. 14 rubber-covered copper wire in lead sheath in ducts of the telephone company; there is no protection between the overhead and underground circuits. Leads down poles are No. 14 rubber-covered copper wire in conduit, all with weather cap and part with insulating joint. Wiring in stations is part in conduit and part in metal molding.

Telephones.—Each fire station is connected with the public exchange of the telephone company by a single-party line.

OPERATION.—Routine and Maintenance.—The superintendent devotes such time as his other duties permit to the fire alarm system, and the lineman and helper spend most of their time on the maintenance of the fire alarm and traffic signal systems. Circuits are tested twice daily for current, voltage and grounds; hydrometer tests of some battery cells are made weekly and individual voltage tests of all cells are made monthly; circuits are examined monthly and boxes tested twice yearly. Records are lacking. Continuous watch is maintained in fire stations, except when companies are out, to handle telephone alarms.

Alarm Transmission.—Four rounds of box alarms are automatically transmitted over the system. Telephone alarms are usually transmitted to fire headquarters but may go to any station called. Other companies are notified of the fire by telephone; such calls are not transmitted over the fire alarm telegraph system. In 1930, there were 440 alarms of which 180 were by box, 245 by telephone and 15 verbal; 81 were false.

IMPROVEMENTS.—Since the 1924 report, a new headquarters building and headquarters appa-

atus have been provided and 49 boxes have been added to the system.

CONCLUSIONS.—The fire alarm system is under suitable supervision and is generally well maintained but the superintendent cannot devote sufficient time to the system on account of his other duties. It is of suitable type and headquarters is fairly well located, but the apparatus is somewhat incomplete; batteries are well located and in good condition. Apparatus in fire stations is incomplete; the reliability of the system is further lessened by the lack of duplicate alarm circuits to stations. Circuits are in good condition but are mostly overhead.

Most of the boxes are of modern succession type and in good condition but are not conspicuous, lacking distinctive marks on supporting poles and special lights to indicate their location at night. They are fairly well distributed in the business district, and elsewhere the distribution is fair to good.

The method of handling telephone alarms is not in accordance with best practice. Tests, except of boxes which are too infrequent, are generally satisfactory. Records are poor.

FIRE DEPARTMENT AUXILIARIES

FIRE MARSHAL.—In accordance with a State law it is the duty of the chief of the fire department to investigate all fires within 3 days after their occurrence, and furnish the insurance commissioner, within one week, with a written statement of all the facts relating to the cause, location and extent of damage by the fire. The insurance commissioner or his deputies have, in connection with the investigation of suspicious fires, all the powers of an examining court, may subpoena witnesses, administer oaths and, upon finding evidence of arson, may cause the arrest of the suspected person.

Dan C. Boney is Insurance Commissioner and Fire Marshal; Sherwood Brockwell is a Deputy State Fire Marshal handling the work in connection with the State laws on the erection and inspection of buildings. Three men are assigned to arson work.

In 1930, four investigations of suspicious fires were conducted in Raleigh, resulting in no convictions.

POLICE DEPARTMENT.—Chief, Clarence B. Barbour. Active force, 50.

Equipment.—Five automobiles and 2 motorcycles are provided for the use of the police department. A police signaling system, with 15 Gamewell boxes equipped with telephones, on 2 all-metallic circuits, is maintained by the superintendent of fire alarm and police patrol. Patrolmen report hourly.

Fire Service.—Alarms of fire are received by telephone from fire department headquarters. The patrolmen on adjoining beats and men from headquarters report to fires and establish fire lines if necessary. Cooperation between the police and fire departments is reported to be good; they have not been checking up on new building construction.

PUBLIC SERVICE CORPORATIONS.—One man from the Carolina Power and Light Company responds to alarms in the business district and the Raleigh Gas Company would send men if requested. Neither company receives alarms of fire.

TELEPHONE SERVICE.—The Southern Bell Telephone Company serves approximately 6,000 subscribers, with 8,000 stations within the city limits, over 1-, 2- and 4-party lines through one exchange located in a 2-story semi-mill constructed building. Windows are protected by wired glass against severe

exposures, and doorways to the 2-story frame building adjoining are protected by automatic fire doors; a standpipe connected to city water, with hose on each floor, soda and acid extinguishers, sand and water pails and asbestos gloves and blankets are provided for internal protection. Cables are underground in the business district and on some important thoroughfares; 25 per cent. of the duct space is reserved for the city's use. Most of the overhead lines are in aerial cable. Single-party lines extend to each fire station. During 1930, 56 per cent. of all alarms were received by telephone. Calls are partly supervised.

OUTSIDE AID.—Outside Aid is available within an hour from Durham, 26 miles distant; two adapters for Durham hose are carried by Engine 1. Additional aid could be obtained in from one to two hours from Dunn, 40 miles, Henderson, 45 miles, Goldsboro, 49 miles, and Wilson, 60 miles distant.

STRUCTURAL CONDITIONS AND HAZARDS

BUILDING DEPARTMENT

ORGANIZATION.—**General.**—The supervision of building construction is delegated to the city electrician, who also supervises the fire alarm and police telegraph systems. He is elected by the Board of Commissioners for a two-year term. His duties are to enforce State, municipal and zoning laws, issue permits, inspect all buildings under construction, make an annual inspection of all buildings in the city and a quarterly inspection of all buildings in the fire limits, and to make reports to the State Insurance Commissioner.

Personnel.—J. W. Mangum, an experienced contractor, has supervised building construction since 1909.

Permits and Records.—A permit must be obtained before any building may be commenced. Applications are made on the stubs of permit books furnished by the insurance commissioner and require very little data. Plans and specifications in duplicate are required, one of which is permanently filed. Permit cards are required to be posted.

The police have not been required to report building construction started without a permit. Filing facilities are poor and records are incomplete.

Inspections.—The inspector visits all buildings under construction as often as time permits. Insofar as his other duties permit, he complies with the State law requirements for quarterly and annual inspection of buildings. During times of normal building activity the inspection force is inadequate.

BUILDING LAWS.—**General.**—State laws of 1921, last amended in 1928, in regard to erection and inspection of buildings govern these matters locally. Stairways of all schools are required to be enclosed in smokeproof towers and heating plants cut off from main buildings. Provisions governing the thickness of walls are good, except that only 4 inches of brick work is required between ends of floor beams entering a wall from opposite sides. Parapets not less than 13 inches thick must extend 18 inches above the roof and be coped. Openings in fire or party walls of brick or stone buildings must be protected by standard fire doors on either side of the wall. Requirements for chimney construction are good. Within the fire limits frame construction may not be erected, altered, repaired or removed except upon permit of the building inspector. Standpipes are required in all business buildings more than 56 feet in height and of more than 5,000 square feet area and in all buildings over 80 feet in height; chemical extinguishers must be provided on each floor. Fire escapes are required on all hotels over 2

stories in height unless provided with sufficient inside stairways so placed to provide adequate means of egress in case of fire. Buildings found by the inspector to be dangerous because of liability to fire, overloaded floors, decay or other causes must be condemned by him and repaired or removed by the owner.

The municipal building code is practically a reprint of the State statutes on the subject of buildings, as summarized above; however, weight bearing masonry walls for residences must not be less than eight inches; garages erected within the fire limits must be of fireproof construction; fire-resistive roof coverings are required throughout the city. The zoning ordinance of 1923 provides that no building may exceed 150 feet in height at the street line, but may exceed this height if set back. Four height districts are prescribed in which dwellings are restricted to 2½ stories or 40 feet and other buildings are restricted to from one to two times the width of abutting streets. Areas are restricted only insofar as percentages of lot area permits. Fire escapes are required. Other matters bearing on fire protection and prevention are not mentioned.

Appeals from the inspector's decisions are made to the State Insurance Commissioner.

Fire Limits.—The fire limits, as shown on the accompanying map, include, but coincide in part, with the principal mercantile district.

Enforcement.—Provisions of the building laws at present appear to be fairly well enforced, but at times of normal building activity enforcement is obstructed by the inspector's many duties and lack of assistance.

LOCAL CONDITIONS.—In the principal mercantile district, out of a total of 326 buildings, 87 are, and 18 exceed, 3 stories in height; 46 buildings and 26 groups of buildings are of large or excessive area. Proper protection to floor openings is omitted in practically all buildings exceeding 2 stories in height, and of the 59 communicating openings, only 9 are fully and 16 partially protected; however, approximately half of the buildings have exposed windows properly protected. Walls are generally of fair thickness; parapets are invariably low.

The 22 fireproof buildings, scattered throughout 11 of the blocks, cover 15 per cent of the built-on area. The heights of these buildings range up to 12 stories, 9 exceeding 5 stories in height.

Frame construction, including numerous sheds and additions, covers only 4 per cent of the built-on area; none exceed 2 stories in height and areas are small or moderate; 7 of these buildings have combustible roof coverings.

EXPLOSIVES AND INFLAMMABLES

The 276 buildings and 17 sheds and additions of joisted brick construction cover 81 per cent of the built-on area; only 4 of these buildings exceed 3 stories in height, one being 5 stories, and the remainder are mainly 2 or 3 stories high. Buildings of this type of construction are usually weak in fire-resistive features, and half of their fire areas are large or excessive.

Only 11 buildings are equipped with automatic sprinklers; this comprises 6 per cent of the built-on area. Standpipes and hose protect 21 buildings, and chemical and other fire extinguishers are provided in only a small to moderate amount.

The State House and State government buildings adjoin the district on the north; heights are low and buildings are of fireproof or good joisted brick construction.

There are small groups of grade floor mercantiles and garages bordering on the principal mercantile district; heights are mainly low and construction is mostly joisted brick, and floor, communicating and exposed window openings are usually unprotected.

Along the railroad in the western part of the city are a few cotton warehouses, textile mills, cotton seed oil plants, iron works, railroad repair shops, lumber yards and minor industries. Construction is mostly joisted brick and heights are usually low. The more important establishments are provided with automatic sprinklers.

There are a number of schools, colleges and public institutions in the city. Buildings are mainly of joisted brick construction, comprising large or excessive fire areas; heights are usually low; fairly good private fire protection facilities are provided.

The residential sections of the city consist of detached frame dwellings mostly with combustible roof coverings.

CONCLUSIONS.—State and municipal laws include several brief but good regulations; generally, they are of slight value from a fire prevention standpoint. Enforcement at times of normal building operation is obstructed by the inspector's many duties. The fire limits are of insufficient size to suitably protect the principal mercantile district. Fire-resistive roof coverings are required throughout the city. In the mercantile districts construction is, for the most part, weak in fire-resistive features, although improved somewhat by the increase in fire-proof construction. The State government buildings are mainly of good construction. Industrial, college, school and public institutional buildings are usually low in height and of joisted brick construction; many of these buildings have fairly good private fire protection, the more important establishments being sprinklered. In the residential districts, detached frame dwellings with combustible roof coverings predominate.

ORGANIZATION.—**Supervision.**—State laws require that the building inspector make quarterly inspections of all premises within the fire limits and annual inspections elsewhere, for accumulations of combustible materials, and that he submit detailed reports to the insurance commissioner; hazardous conditions must be immediately removed or remedied upon order of the inspector, but the owner or occupant may appeal to the commissioner for further investigation and await his decision. The commissioner or fire chief must make an immediate inspection of hazardous conditions upon complaint of persons having an interest in them or adjacent property.

Inspections.—The building inspector makes quarterly inspections of the business district and annual inspections elsewhere, for hazardous conditions; three members of the fire department assist him in these inspections. Complete inspections of buildings in the principal mercantile district are made once every two months by members of the fire department, for hazardous conditions.

Laws and Ordinances.—A license from the State fire marshal, building inspector or chief of the fire department is required before dynamite cartridges, bombs, or other combustibles of like kind may be stored or sold. Two hundred and fifty pounds of powder may be kept in labeled portable iron chests; retailers must keep powder in cans, and fireworks and other explosives must be placed in movable cases, located as directed by the chief of the fire department. Fireworks may be discharged only upon written permission of the mayor or chief of police. Not more than 10 wooden barrels containing illuminating oils may be kept on hand. Unlimited quantities of gasoline, benzine, naphtha or similar explosives, may be kept in underground tanks in approved locations. Shavings must not be deposited or burned within 30 yards of any building nor in any street. Waste materials must be kept in metal receptacles and removed daily. The manufacture, storage or sale of matches of the single dip type is prohibited; packing and storage of other types are specified. It is the duty of the insurance commissioner and superintendent of public instruction, to have fire prevention taught in schools and colleges. Motion picture booths must be approved by the State insurance commissioner.

LOCAL CONDITIONS.—No dynamite was found in the city. Hardware and sporting goods stores carry small to moderate stocks of fixed ammunition.

Paint and hardware stores carry small to moderate stocks of mixed paints in the usual manner, and

ELECTRICITY

up to 30 drums of various oils, turpentine, alcohol, varnish, etc., which are stored with fair precaution. Up to 600 pounds of carbide in original kegs was noted at two locations. Gasoline in small quantities was found at printers, tailors, hat cleaners and sign painters.

Wholesale grocers carry matches in small amounts, generally stored under safe conditions; 3 carloads of matches were safely stored in a fireproof warehouse. In several buildings in the business district, up to one carload of baled hay or straw, and 800 bales of cotton, were in storage.

The one wholesale drug house in the city is located in a 3-story, sprinklered, joisted brick building; from 50 to 100 pounds of benzol, benzine, chlorate of potash, ether and chloroform, are kept in 1- to 5-pound bottles and cans on the second floor. About 7 barrels of cotton seed, linseed, paraffin and tar oils, alcohol and turpentine, and a small to moderate stock of the usual chemicals and compounds are stored under safe conditions. A warehouse, operated by the above mentioned wholesale druggist, located in the southern part of the city and practically isolated, has in storage 200 pounds of carbon bisulphide and 60 drums of alcohol and turpentine; hazards in connection are satisfactorily safeguarded.

At garages and service stations, gasoline is stored in generally well arranged underground tanks, with approved pumps. Practically all are located in non-fireproof buildings unsuited for such occupancy, but are of low heights; many of them use open stoves for heat. In numerous instances, duco spraying and acetylene welding of automobile bodies and parts are done without special precaution.

Motion picture booths are of fire-resistive construction; shutters have fusible link connections, but in one booth, nails and other obstructions would prevent the shutters from properly closing. Rewinding is done on open reel in the booths; other hazards in connection are fairly well safeguarded. In one theatre, many electrical defects were noted in the so-called switch room located near the main entrance.

The 7 dry cleaning plants in the city are usually small and located in non-fireproof buildings. One plant presents a dangerous hazard, in that gasoline is used for cleaning, underground tanks are not provided, large open containers are used for gasoline and the plant is congested and poorly maintained. The remaining plants use a safety solvent for cleaning, have underground tanks for storage and all operate a continuous flow system; however, one plant was somewhat congested, and at two other plants, fire extinguishers were not provided. All plants expose nearby non-fireproof buildings.

There are 3 small wholesale oil storage plants in the city. At one plant, gasoline is stored in underground tanks. All other plants have aboveground tanks, which are well constructed and maintained,

and are provided with dikes. The largest plant is protected by a 40-gallon portable foam tank; all plants are provided with numerous fire extinguishers. One plant is isolated; the others expose nearby frame and brick buildings.

Subsequent inspections by the State deputy fire marshal and chief of the fire department have led to correction of some of the above conditions where covered by State laws.

Several accumulations of rubbish were noted in buildings and block interiors.

CONCLUSIONS.—Regulations covering explosive and inflammable substances, though well enforced, are incomplete. Fire department inspections are of good value in correcting hazardous conditions and assistance is provided by the State officials. Local conditions are fair.

ELECTRICITY

ORGANIZATION AND CONTROL.—An ordinance requires that a competent and experienced person be elected biennially as city electrician. His duties are to inspect all electrical construction and enforce all ordinances relating thereto. By State law, he is required to inspect new installations before current may be supplied.

Personnel.—J. W. Mangum, an experienced electrician, has been city electrician and building inspector since 1913.

Inspections and Records.—Contractors notify the city electrician when new installations are ready for inspection. Wiring is inspected before being concealed and again when fixtures have been installed. The electric light company will not supply current without the inspector's certificate of approval. In connection with his quarterly and annual inspections of buildings, the city electrician reinspects much of the old wiring and requires defects to be remedied. Records consist of stubs of applications and certificates, which are somewhat incomplete; filing facilities are poor.

LAWS AND REGULATIONS.—Ordinances and statutes require all wiring to conform to the National Electrical Code. All electrical contractors must be examined and licensed.

LOCAL CONDITIONS.—During March, 1931, a number of installations were inspected by a National Board engineer to ascertain the quality of supervision maintained and the general condition of wiring; the new work was found to be well installed. The occasional reinspections have resulted in much old work being placed in conduit, but numerous defects were found in other old work and indicated

the need of more systematic reinspections and subsequent overhauling of many installations.

The Carolina Power and Light Company supplies current to the city for lighting and power. Alternating current, generated outside the city, is transmitted at 22,000 and 60,000 volts to a substation located northwest of the business district. At this substation, it is stepped down to 2,300 and 4,000 volts for primary distribution, to transformers, usually on poles, having 110-220-volt secondaries. The lighting company also operates the street car line using the overhead trolley, at 600 volts d.c., with rail return.

Telephone cables are underground in the business district and in main thoroughfares. Practically all light and power wires are overhead.

ELECTROLYSIS.—No recent trouble is reported from electrolysis; the telephone company makes regular tests.

CONCLUSIONS.—The city electrician has good control over electrical wiring which must, by ordinance, conform to the National Electrical Code; inspections are handicapped at times of normal building activity by the inspector's many other duties; when time permits, reinspections of old work are made and defects corrected. The lighting company will not supply current to any installation without a certificate of approval. New work is being well installed; but the usual defects found in the old work indicated the need of overhauling many installations. Telephone cables are underground in the business district and main thoroughfares; practically all other wires are overhead. No recent trouble from electrolysis reported; tests made.

CONFLAGRATION HAZARD

PRINCIPAL MERCANTILE DISTRICT.—

Limits.—Beginning at Morgan and Salisbury streets; Morgan, Blount, Davie, Wilmington, Cabarrus, Salisbury, Davie, McDowell, Hargett and Salisbury to place of beginning.

General.—The district is in the southeastern part of the city; it comprises 15 blocks and covers 51 acres, 32 per cent of which is in streets. Parks adjoin the district on three sides. The district is practically level; streets are paved and in fairly good condition. With the exception of 3 small area blocks, blocks are of moderate size. Several office buildings, hotels and mercantiles are of high value; otherwise, values are moderate to low and usually of mercantile occupancy, including many garages. The higher value buildings are mostly along Fayetteville street, which is 99 feet wide; other streets are mainly 66 feet in width. Most of the interior blocks are fairly compactly built-up; those on the borders of the district have open spaces and 72 per cent of the

block area is built upon. State government buildings, minor mercantiles and dwellings bordering the district offer mild or moderate exposures on all sides.

Buildings of fireproof construction, occupying 15 per cent of the built-on area, are located in 11 blocks; in six places, these buildings form fire breaks of some importance. Frame construction, covering only 4 per cent of the built-on area, consists mainly of dwellings at the borders of the district. The remaining construction, covering 81 per cent of the built-on area, is of joisted brick, mostly in buildings 3 stories or less in height, but about half of their fire areas are large or excessive. Party and fire walls are moderately frequent and generally of fair thickness; parapets are invariably low. Floor openings are usually unprotected in buildings exceeding 2 stories in height and only a few communicating openings are properly protected, but about half of the buildings have exposed windows protected.

There is some congestion in parts of the district, but accessibility to block interiors is generally good. There is little private fire protection. The water supply is not available, throughout the district, in adequate quantities for extended fires and the fire department is undermanned, lacks proper equipment, and would be hampered by overhead wire obstructions. The probability of serious fires is high in spots.

The block in which the most serious conditions exist is bounded by Fayetteville, Hargett, Wilmington streets and North Exchange place (Sanborn, page 24, block 12). This block is of small size. Buildings are mainly 2 stories high and of old fire-resistively weak joisted brick construction; a 5-story fireproof building of moderate area is located in the extreme southwestern corner of the block. This block is solidly built-up except for a small open space in the center. Two buildings extend through the block. There are several poorly protected communications, floor openings are usually unprotected and very few exposed windows have effectual protection. The northern half of the block is subject to one fire.

OUTSIDE THE PRINCIPAL MERCANTILE DISTRICT.—

Immediately surrounding and bordering the principal mercantile district are small groups of minor mercantiles. Occupancies consist mostly of grade floor mercantiles, but include numerous garages and gasoline filling stations. Construction is mainly weak in fire-resistive features and lacks private fire protection, but due to low heights, good accessibility and lack of congestion, nothing more serious than a small group fire should occur.

The State House and State government buildings adjoin the district on the north; however, as accessibility is good and buildings are usually of fireproof or good brick construction, and not congested, extensive fires are improbable.

CONFLAGRATION HAZARD

Along the railroad in the western part of the city are a few textile and other industrial plants, and lumber yards. The more important plants are equipped with automatic sprinklers or private hydrants and hose; plants are somewhat isolated and no conflagration hazard is presented.

There are numerous colleges, schools and public institutions in various sections of the city; some of these are large, but as good accessibility and private fire protection is provided, no fire should extend beyond building of origin.

In the residential sections, buildings consist mostly of detached frame dwellings with combustible roof coverings, and present the usual hazard of flying brand fires.

CONCLUSIONS.—In the principal mercantile district, many large or excessive fire areas, the general lack of protection to floor and communicating openings, the large proportion of fire-resistively weak construction lacking in private protection, combined with somewhat inadequate fire fighting facilities, render serious fires probable, but heights are generally low, streets are fairly wide and accessibility is good, so that no fire should spread beyond block of origin. Only small group fires are probable in the minor mercantile districts. Spreading fires in college and public institutional buildings and in the industrial district are improbable. In the residential districts there is the usual hazard of flying brand fires.

RECOMMENDATIONS

Recommendations marked with a star (★) are deemed of most importance and their early adoption is urged.

WATER SUPPLY

1. That a fireproof vault be provided at the water works office for the safe filing of records.

Mains

2. That the distribution system be strengthened by the early installation of the mains indicated in the table below and shown on the accompanying map, and that the following be adopted as the standard minimum sizes of mains used for hydrant supply for all future construction.

a. In residential districts, 8-inch; 6-inch to be used only where they complete a good gridiron and in no case in blocks 600 feet or more in length.

b. In mercantile and manufacturing districts, 8- and 12-inch; the former to be used only in sections where they complete a good gridiron and the latter for long lines not cross-connected.

3. That dead ends be eliminated wherever practicable, all 4-inch pipe supplying hydrants be replaced and long unsupported lines of pipe be cross-connected so that not more than one hydrant will be on a 6-inch main between intersecting lines and not more than two hydrants on an 8-inch main between intersecting lines.

RECOMMENDED MAINS

Diam. Ins.	Along	From	To
*16	Private right of way, West, South and Mc- Dowell Sts.....	Main Pumping Station.....	Lenoir St.
12	Peace St. and Glenwood Ave.....	St. Marys St....	Fairview Rd.
12	Pine St. and Wake Forest Rd.....	Blount St....	Mordecai Dr.
8	As shown on the accomp anying plan.		

* Of special importance.

Gate Valves

4. That the distribution system be equipped with a sufficient number of gate valves so located that no single case of accident, breakage or repair to the pipe system in important districts will necessitate shutting from service a length of main greater than the side of a single block, or a maximum of 500 feet, or in other districts greater than two sides of a single block or a maximum of 800 feet.

5. That all valves be inspected annually and large valves more frequently and that records be kept of inspections, operation and condition.

Hydrants

6. That additional hydrants be installed in those sections not properly protected. For good hydrant distribution there should be at least one hydrant to every 80,000 square feet in the principal mercantile district and 110,000 square feet in residential districts.

7. That all hydrants installed in the future have one 4½-inch and two 2½-inch outlets and at least 6-inch barrel and 6-inch gated branch. Present hydrants with 4-inch or smaller connections or with small barrel or foot valve to be replaced; this substitution to be made first in important districts and elsewhere according to a plan by which all will be replaced within a reasonable time.

FIRE DEPARTMENT

Organization

★8. That the manual strength of the department be increased immediately by the addition of one man to each shift of Engine Companies 1 and 2 and of two men to each shift of the aerial ladder company.

9. That eventually sufficient men be appointed so that the least number on duty at any time, including the vacation season, will be as follows:

	Day	Night
Engine Companies 1 and 2 and Ladder Company 1.....	6	8
Ladder Company 2.....	5	7
Engine Companies 3, 4 and 5.....	4	6

10. That all members be appointed under civil service regulations for indefinite terms, with removal only for cause after trial.

Apparatus and Stations

11. That a reserve hose wagon be provided, loaded with 1,000 feet of 3-inch hose, and equipped with a turret pipe.

Equipment

12. That the following equipment be furnished where not already provided:

a. To each pumper: Burst-hose jacket, door opener, hydrant hose gate, bale hooks, brooms, rope,

RECOMMENDATIONS

modern smoke masks and 2 waterproof covers.

b. To each ladder truck: An auger, bale hooks, brooms, cellar pipe, crowbar, 6 waterproof covers, deluge set, forks, rubber gloves, life net, life belts, rope, ram and wall cutter, saws, sledge, shovels, squeegees, oxygen helmets, first-aid kit and a wall hook and chain.

Hose

13. That pumpers carry 200 feet of 3-inch hose with a total of at least 1,000 feet of 2½- and 3-inch hose, with a complete spare shift in quarters; all hose to be fitted with 2½-inch couplings, properly beveled.

Operation

14. That records be kept of all building inspections both by notes and sketches.

15. That pumpers be tested periodically according to methods published by the National Board of Fire Underwriters, those delivering less than 90 per cent. of their rated capacity to be overhauled, their crews drilled, or both.

FIRE ALARM SYSTEM

Apparatus

16. That the following equipment be installed:

a. A manual transmitter to be located where telephone alarms are received.

b. In each fire station, the register and a sounding device on a box circuit and a sounding device on an alarm circuit, with means for transferring the register to the alarm circuit.

Circuits

★17. That the reliability of circuits be increased by:

a. Placing circuits underground wherever possible, using rubber insulated copper wire in lead sheath in ducts containing signaling circuits only.

b. Extending each box circuit to alarm instruments in some fire station and connecting each station to a box circuit.

c. Installing separate alarm circuits to connect each fire station, not over 5 stations to be on a circuit.

Boxes

18. That additional boxes be installed so that a box will be visible from and within 500 feet of every building in high value districts, and within 800 feet of every building in other closely-built sections.

19. That the remaining non-succession boxes be replaced with those of modern succession type.

20. That lights be provided to indicate the location at night of boxes in high value districts, and red bands be painted on poles supporting boxes.

Telephone System

21. That a department telephone switchboard be installed with an operator on duty at all times; individual circuits to be provided to each fire station and at least two trunks to the public exchange, one of which shall be reserved exclusively for alarms of fire. This board may be combined with a police board if desired.

Operation

22. That all telephone alarms for fires in buildings be transmitted as box alarms, after first notifying the nearest company by telephone.

23. That a map showing location of boxes and circuits be prepared and complete records kept of all tests and troubles.

24. That an operator be on duty at all times in fire alarm headquarters.

BUILDING DEPARTMENT

★25. That a complete building code be adopted to conform to modern requirements for construction and fire prevention as given in the National Board Building Code.

★26. That the building inspector be appointed for an indefinite term with removal only for cause, and that he be furnished sufficient assistants to adequately make inspections and keep complete records.

27. That the fire limits be extended to properly safeguard the business district.

28. That the police be required to report all unauthorized construction.

EXPLOSIVES AND INFLAMMABLES

★29. That the laws be amended to form a complete code of regulations covering the manufacture, sale, storage and transportation of explosives and inflammables, the chief of the fire department to be held solely responsible for its enforcement; and that members of the fire department make effective inspections of all buildings and premises in their respective districts, and file complete records of each inspection. It is recommended that the Suggested Fire Prevention Ordinance promulgated by the National Board of Fire Underwriters be used as a guide in framing new regulations.

ELECTRICITY

30. That a complete reinspection of old wiring be made and defects corrected, and that all wiring

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be subsequently reinspected at regular intervals.

31. That a definite plan be adopted for the removal of overhead wires in closely built sections, so that eventually all obstructions to fire department operations will be eliminated.

CONFLAGRATION HAZARD

★32. That owners of existing defectively constructed buildings, which are so located as to

form conflagration areas, be required to suitably protect floor, window and party wall openings.

★33. That automatic sprinkler equipments, with outside siamese hose connections and controlling valve near main in street, be required in all buildings, which by reason of their size, construction or occupancy, singly or combined, might act as conflagration breeders.

GENERAL SUMMARY

CITY IN GENERAL

Population estimated 38,700. City is State capital and the seat of several colleges and institutions. Manufacturing industries of minor importance. Grades moderate. About half of streets paved; others graveled. Winter temperatures mild. Loss per fire very high, loss per capita high, number of fires moderate.

FIRE-FIGHTING FACILITIES

Water Supply.—Municipal works under good supervision. Records mainly good. Supply, filter and clear water storage adequate. High lift pumps slightly inadequate in reserve. Consumption moderate. Pressures good. Distribution in one service. Arterial system of good capacity in central portion but would be seriously deficient with either force main out; gridiron fair. Valve spacing fair. Hydrant spacing good in principal mercantile district; wide elsewhere.

Fire Department.—Full paid, 2-platoon basis. Under suitable supervision. No civil service regulations. Chief appointed for 2-year term. Companies somewhat undermanned. Pumping capacity and ladder service adequate. Hose supply slightly inadequate; no 3-inch hose. Minor equipment and powerful stream appliances deficient. Discipline good. Drills and training fairly good. Fire methods mainly satisfactory. Response to alarms generally well arranged. Records fair.

Fire Alarm System.—Automatic system, generally well maintained. No duplicate alarm circuits to fire stations. Most boxes of succession type, in good condition; inconspicuous; distribution fairly good in business district, fair elsewhere. Circuits mostly overhead, in good condition. Telephone alarms improperly handled. Tests fairly satisfactory. Records lacking.

Fire Department Auxiliaries.—Duties of fire marshal well performed by State Insurance Commissioner. Cooperation between police and fire departments good. Public service corporations render aid when necessary. Telephone service fairly well distributed; used considerably for transmitting alarms of fire. Some outside aid available.

Summary.—Water supply generally adequate and fairly reliable; generally good quantities available in high value districts; mainly inadequate quantities in residential sections. Fire department somewhat undermanned and only fairly well equipped. Fire alarm system of proper type and fairly reliable.

STRUCTURAL CONDITIONS AND HAZARDS

Building Department.—Brief State regulations fairly well enforced by the municipal inspector. Fire limits inadequate. Fire-resistive roof coverings required throughout the city. Structural conditions somewhat improved, but still weak.

Explosives and Inflammables.—Laws inadequate. Fire department inspections are of value in correcting hazardous conditions. Local conditions fair.

Electricity.—National Electrical Code adopted; good control over electrical installations. New work well installed; old work in fair condition; occasional reinspections made. Telephone lines mainly underground; other wires usually overhead. No recent electrolytic trouble reported; tests made.

Conflagration Hazard.—In the principal mercantile district, structural conditions are mainly weak and fire-fighting facilities are somewhat inadequate; these features render serious fires probable, but due to low heights, good accessibility and fairly wide streets, such fires should not extend beyond block of origin. Only small group fires are probable in minor mercantile districts. In the college and public institutional buildings, and in the few industrial districts, spreading fires are unlikely. The usual flying brand hazard in the residential district is high.

August, 1931.