UNITED STATES
CIVIL DEFENSE

CIVIL DEFENSE URBAN ANALYSIS

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FEDERAL CIVIL DEFENSE ADMINISTRATION

INTRODUCTION

This manual presents methods and procedures for use by city civil defense organizations in preparing a civil defense urban analysis. An urban analysis is the process of collecting, presenting, analyzing, and utilizing pertinent information about urban areas. Since the primary purpose of a civil defense urban analysis is to provide the tools for undertaking realistic civil defense planning, all pertinent aspects of the city must be considered.

Assembling data and presenting the information graphically on maps is only the first step in an urban analysis. The area in which an exploded A-bomb can cause maximum casualties and physical damage must be located. Then a hypothetical attack must be assumed and the damage assessed. From this is determined not only the potential casualties but also the potential damage to each urban feature. Next, the physical area of the city must be organized for operations and operational plans developed by the civil defense services. In this manner, the urban analysis can be of practical use rather than as mere reference material to be looked at occasionally before the attack or to be referred to after the attack.

The methods and procedures presented here are suggested ones only. Alternate improved methods may be worked out in some instances. Maximum utilization should be made of available maps and data in municipal and other public offices and agencies as well as those in private institutions.

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(Technical Manual)

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FACTORS AFFECTING CIVIL DEFENSE URBAN ANALYSIS

1.1 Civil defense urban analysis may require extensive reorientation in our thinking. Following enemy attack, facilities and services upon which we habitually depend may no longer be available, and familiar features of a city may assume new significance. For example, restaurants now in existence may not be available as feeding centers. If these establishments escape destruction by blast or fire, they may be made useless by the disruption of facilities which normally provide gas, water, and electricity. Main traffic arteries may not be usable as routes for emergency vehicles. Other streets may become the principal routes at such times. Large reinforced-concrete or steel-frame buildings may become important bomb shelters, and parks may become firebreaks or potential welfare facilities.

1.2 Thus, to prepare an adequate plan of action, the probable effect of an enemy attack on a city must be considered and each feature must be evaluated accordingly. Recognition of elements which would convert familiar features into deathtraps is essential.

Principal Uses for an Urban Analysis

1.3 Data obtained from an urban analysis is used principally for the following purposes:

(*a*) To identify by target analysis the area or areas which an enemy may consider most profitable in terms of maximum casualties and structural damage.

(*b*) To develop a web defense or other sound tactical organization of the ground for the most effective dispersal, use, and control of civil defense services and community facilities.

(*c*) To assist the civil defense services in developing operational plans which can be put into effect automatically after an attack.

(*d*) To estimate, as quickly as possible following an attack, extent of damage to structures and facilities, total casualties, and number of homeless.

(*e*) To develop a program for reducing or eliminating as many physical hazards as possible in advance of attack.

(*f*) To determine location of the city's critical features which may be potential targets for sabotage.

National and International Aspects of Urban Analysis

1.4 In an urban analysis the features and conditions of the city also must be studied in light of various factors of national and international nature. However, an adequate evaluation of such factors

is beyond the scope of defense studies at the local level. Much essential information is not available for reasons of national security, and a thorough analysis of such a complex problem requires facilities and personnel which are usually not available to States and cities. The responsibility for analyzing these factors, therefore, has been delegated to appropriate Federal agencies which transmit their conclusions to the Federal Civil Defense Administration. FCDA then has the responsibility for supplying State and local civil defense organizations with this information.

1.5 Consideration of these broad factors will undoubtedly have important bearing on local civil defense studies and plans. Further, because of constant changes in the various factors, results of civil defense urban analyses must be subjected to constant review and revision with civil defense plans being altered accordingly.

Local Aspects of Urban Analysis

1.6 In contrast to factors of national and international significance, the critical features and characteristics of a city can be analyzed most effectively by its local civil defense organization. Personnel in the civil defense organization are intimately acquainted with the city and its problems and can enlist the aid of experts from various municipal offices.

1.7 Local aspects of urban analysis involve the assembly and study of a great variety of information available in various city offices aside from that which may be obtained from State, Federal, and private publications such as the National Board of Fire Underwriters' reports on the fire defense of each city over 25,000 population. Much information is available on maps which may be used with alterations in civil defense urban analysis and civil defense planning operations. Other material already prepared needs only to be reoriented to make it useful.

Urban Features To Be Studied

1.8 In a civil defense urban analysis, information for the following urban features is collected, analyzed, and evaluated. A map should be prepared for each urban feature. Some of the information is presented graphically and some in the form of tables.

1. Land use.
2. Building density.
3. Building construction.
4. Building heights.
5. Industrial plants.
6. Plants and facilities dealing with highly flammable or explosive materials.
7. Industrial and storage plants using or capable of generating poisonous gases.

8. Public shelters.
9. Public buildings.
10. Population distribution.
11. School population.
12. Armed Forces installations.
13. Police stations and communications system.
14. Fire stations and communications system.
15. Rescue units and location of stored tools.
16. Water distribution system and auxiliary sources.
17. Sewerage system and garbage collection and disposal services.
18. Electric power system.
19. Pipelines and storage tanks (gas and petroleum).
20. Source of supplies for emergency use.
21. Streets and highways.
22. Streetcars, trolleys, buslines, and vehicle storage yards.
23. Railroads.
24. Bridges.
25. Tunnels.
26. Airports and airfields.
27. Port facilities.
28. Telephone system.
29. Teletype system.
30. Radio and TV facilities.
31. Potential assembly areas, such as parks and golf courses.
32. Potential hospitals, such as hotels and nursing homes.
33. Hospitals.
34. Doctors' offices.
35. Zoos.
36. Penal institutions.
37. Firebreaks.
38. Garages and used-car lots.
39. Offices of construction and earth moving contractors; State, county, or municipal equipment storage yards and shops.
40. Repair and maintenance stations for utilities.
41. Underground openings (caves and mines).
42. Topography.
43. Prevailing winds.
44. Potential welfare facilities, such as schools and theaters.
45. Dwelling units.
46. Welfare agencies (other than institutional).
47. Distribution of children under 5 years.
48. Number of employed.

1.9 In addition, information on such community services is collected, analyzed, evaluated, and presented as the following:

(*a*) Public health services.

(1) Food and water inspection.

(2) Visiting nurses.
(3) Quarantine records.
(4) School health programs.
(5) Insect and rodent control.
(6) Housing evaluation.

(*b*) Welfare services.
(1) Public and private agencies dealing with families, children, aged, and handicapped.
(2) Public and private institutions, orphanages or homes for children, the aged, or other special groups.

(*c*) General municipal and miscellaneous services.
(1) Unemployment compensation.
(2) Old age and survivors insurance.
(3) Public employment service.
(4) Voters registry lists.
(5) Local tax lists.

(*d*) Spiritual services.
(1) Protestant.
(2) Catholic.
(3) Jewish.
(4) Other.

(*e*) Potential resources for all services.
(1) PTA's.
(2) Veterans' groups.
(3) Fraternal groups.
(4) Other groups.

1.10 These urban features are listed in appendix B with brief statements of their significance and a list of suggested information sources.

1.11 Only part of the information collected for urban features will appear on the maps. Data for some features are used in the basic analysis and contribute to the final result although they do not appear on the finished maps. Other types of information have no direct relation to the maps and are best presented in tabular form for use in detailed planning and operations. Information of this latter type includes inventories of equipment, and statistics regarding personnel needs for the various services. In general, only those items for each feature should be mapped whose significance results partly from their location relative to each other or to their location relative to possible ground zero (point on ground directly under an A-bomb exploding in the air).

Phases of an Analysis

1.12 Each of the various phases of urban analysis requires the study of a different group of urban features and conditions. *Target analysis* is based on the consideration of only a few of the more

critical conditions. *Development of a ground organization* involves the study of additional features while the *formulation of operational plans* for each civil defense service requires still others. Finally, *general civil defense planning* requires consideration of all the significant urban features and conditions.

1.13 In making a target analysis, urban features considered are:

(*a*) Population distribution.

(*b*) Industrial installations.

(*c*) Port facilities.

1.14 In developing a ground organization, the following urban features should be considered:

(*a*) Population distribution.

(*b*) Streets and highways.

(*c*) Low areas in which poison gas or aerosols may accumulate or which may become flooded and so block routes.

(*d*) Communications (telephone, teletype, radio).

(*e*) Firebreaks.

(*f*) Topography.

(*g*) Transportation systems.

(*h*) Building density.

1.15 In developing operational plans, each of the services has to consider certain urban features related to the ground organization, to the estimation of casualties and uninjured-unhoused, and to physical damage resulting from blast and fire.

1.16 All phases of an urban analysis need not be undertaken simultaneously. Start with the target analysis so that the assumed aiming point can be determined, otherwise the rest of the analysis cannot be completed. If funds or personnel cannot be procured for a complete study, the target analysis alone will give some basis for planning. Other phases can be completed as funds and personnel become available.

MAPS USED IN URBAN ANALYSIS

2.1 Maps are the most valuable of the tools to be used in urban analysis. They present a wide variety of information in a simple, easily understandable and usable form and emphasize those urban area features which are significant primarily because of their relative locations. For example, a broad parkway separating two densely built up areas constitutes a very important firebreak, but a similar open strip which traverses a residential district with widely scattered houses has little fire-protection significance for civil defense.

Source Maps

2.2 The six principal types of source maps used in urban analysis are:

(*a*) Census maps of tracts and enumeration districts, prepared by the Bureau of the Census, Washington, D. C.

(*b*) The Sanborn maps, published by the Sanborn Map Co., 10 Cedar Street, New York City.

(*c*) Topographic maps, published by the United States Geological Survey.

(*d*) Special purpose maps, prepared by various local municipal offices and by other agencies.

(*e*) Hydrographic charts, published by the Coast and Geodetic Survey, Washington, D. C. and the United States Lake Survey, Corps of Engineers, United States Army, Detroit, Michigan.

(*f*) Municipal street maps prepared by local governments or by private map companies.

2.3 These maps may be supplemented by air photographs, air mosaics (composite air photographs), and other materials. A detailed discussion of source maps and supplementary materials is presented in appendix A.

Selection of a Base Map

2.4 All map information used for urban analysis should be presented on copies of the same base map, and whenever practicable, at the same scale. This standardization simplifies comparison of different maps, use of overlays, and transfer of information from one map to another. Where necessary, part of a map may be reproduced on another sheet at a larger scale.

2.5 Standardization of map scale to secure uniformity for all cities is not feasible. A scale suitable for a moderate size city would be unsatisfactory for a large city because resulting maps would be excessively large. Furthermore, adoption of a general scale for a State would necessitate changing scales of the base maps used by various

cities. Such changes would seriously limit usefulness of numerous existing maps for civil defense purposes and would result in a waste of time, effort, and funds.

2.6 Where different base maps are already being used by a city, factors to be considered in selection for civil defense urban analysis are relative accuracy, amount of pertinent information, suitability of scales, and overall sizes. The smaller dimension of a map for a city of 1 million population should be not less than 30 inches and the larger not more than 45 inches. Names of streets should be included, if possible.

Desirable Characteristics of Maps

2.7 Maps prepared for civil defense uses should be clear, easy to read, and free of unnecessary detail. Conflicting features should not be placed on one map. For example, traffic arteries, power lines, gas mains, and similar linear features that lie parallel to each other and close together should be represented on separate maps.

2.8 Map scales should be examined with care. They should be of the graphic type consisting of a line or bar marked off into miles and fractions thereof. Such scales maintain the proper relationship to the distances represented when the map is copied on a larger or smaller scale. However, even graphic scales are subject to error. They may have been incorrectly drawn originally, or they may have been photographically enlarged or reduced separately from the map on which they appear. Therefore, the map scale should be checked by comparing the mileage between two widely separated points on the map with the mileage between the two points on a map of known accuracy. Errors in map scale may be serious and may even introduce fundamental errors into civil defense planning.

2.9 Mapping costs should be kept at a minimum. Wherever practicable, existing maps should be used. Sometimes they may be used with no change, at other times they require small alterations, such as pasting on a new legend to indicate the importance of a feature to civil defense. Finished drafting should be avoided except on the few maps which will be reproduced for distribution. Preliminary drafting and alterations should be made in colored pencil. These pencils may be used also on final copies of maps which are not intended for distribution.

2.10 Maps intended for distribution should be prepared in black and white to avoid the expense of color reproduction. On these maps, conditions relating to areas should be represented by patterns of widely spaced lines oriented in various directions, rather than by solid colors. Two or even three such patterns may be superimposed where the conditions represented overlap. Colors may be applied by hand to maps intended for office use only. Colored pencil applied in the usual way and rubbed with facial tissue is recommended.

2.11 For civil defense purposes, separate paper maps are preferable to transparent overlays which would be superimposed on a single map. Paper maps are much less expensive, more easily handled, and less susceptible to damage. They are easier to draw and alter, and are much easier to read than overlays. Paper maps also are free from surface reflections which commonly obscure map features when overlays are used. They may be designed to avoid the conflict of patterns which commonly result when several overlays are used on one base map or when one overlay is used on different maps. Overlays are recommended only for certain specific purposes which are mentioned elsewhere in the manual.

General Methodology

2.12 For certain urban features, the procedure in map preparation is to present the information in terms of broad areas of a city (at least one-fourth square mile). Included are such urban features as population distribution, land use, building density, building construction, building heights, and fire susceptibility.

2.13 For most urban features, the procedure is simply to assemble a desired type of information on a single map. Ordinarily, each individual feature is represented separately, but in some cases a variety of features which have the same civil defense significance may be mapped together. For example, schools, colleges, homes for the aged, children's institutions, hotels, and similar buildings may all be mapped as potential emergency hospitals.

2.14 All related features needed for general civil defense planning operations or for use by one particular service (fire, police, etc.) should, if practicable, be assembled on one map. The various features represented are dissimilar but are significant because of their interrelationship. For example, one particular street may be important as an emergency route because bordering buildings are not sufficiently high to block the street with rubble in event of their destruction by bomb blast.

2.15 In the preparation of maps, one principal purpose is to anticipate all possible locations of ground zero so as to estimate damage and casualties. Of course, the assumption must be made that the enemy is capable of releasing a bomb where it will yield maximum damage and casualties. However, consideration must be given also to the possibility that the center of the target may be missed. Therefore, these analyses must be sufficiently broad and flexible to meet all probable conditions.

TARGET ANALYSIS

3.1 An enemy attacking a target area will attempt to:
(*a*) Inflict the maximum number of casualties.
(*b*) Destroy the important industrial facilities.
(*c*) Destroy the port facilities.

Purpose of Target Analysis

3.2 A target analysis is an examination of a city to determine the aiming point or points in which an A-bomb or other weapons can cause maximum casualties and damage to vital facilities.

Chief Destructive Characteristics of an A-Bomb

3.3 A target analysis is based primarily on the effects of the shock wave producing blast damage, and the thermal effect producing fires. Only a relatively low air shock pressure is required to damage the majority of manmade structures. In an atomic bombing, these structures are hit with a rapidly moving shock wave which may exert pressures hundreds of times as large as those experienced in the most severe hurricanes.

3.4 The atom bombs which were exploded in Japan are used as a unit of measure of other atom bombs. A bomb of the same power as those dropped in Japan is called 1(X) and releases energy equivalent to 20,000 tons of TNT. A bomb twice as powerful is called a 2(X) bomb, three times as powerful, a 3(X) bomb, and so on. The radius of blast damage varies with the cube root of the energy release of the bomb. This indicates that an increase in the power of the bombs does not yield a directly proportional increase in the area of damage. Therefore, the enemy might cause more casualties and physical destruction by using 2 properly spaced smaller bombs than 1 larger bomb—possibly two 2(X) bombs rather than one 8(X) bomb.

3.5 The topography of the target area will also determine whether one large single bomb or a few smaller bombs would be more effective. A hilly terrain would restrict the effects of an A-bomb by confining its effects to the low-lying areas.

Determining Assumed Aiming Point

3.6 The procedure for determining the assumed aiming point is as follows:

(*a*) Select maps of industrial plants and population distribution. If the city is a port, also use a map of port facilities. (See ch. 2.)

(*b*) Prepare a transparent acetate overlay on which is drawn, to map scale, a pattern of concentric circles. The circles represent the limit of severe damage (outer limit of the zone of B-damage) for each

size of A-bomb, from 1(X) to 8(X). For example, a 1(X) bomb would have a radius of 1 mile, while a 3(X) bomb would have a radius of 1.4 miles. Distances may be obtained from table I, p. 13. The center of the overlay should have a small hole for inserting the point of a pencil.

(*c*) Shift the overlay experimentally on the map of industrial plants until the center of the overlay is in the center of the area of industrial plant concentration. Determine from the overlay the minimum size of bomb which would result in the destruction of the greatest number of industrial plants. If a bomb size greater than 2½(X) is indicated, check whether two smaller bombs dropped at different locations would be more effective. Mark the point or points selected on the map.

(*d*) To determine the center of population, use the isorithmic map for daytime fatal casualties or an equal-value-dot map of population distribution. (See ch. 6.) If this information is not available, use some such point as the center of the downtown area, the courthouse or the city hall. Mark the point on the map.

(*e*) If a map of port facilities is used, follow the same procedures as in (*c*) above.

(*f*) Transfer the selected points to a base map which should be entitled "Target Analysis Map." Identify each point on the map. For example, IP for industrial plants.

(*g*) Join the points by straight lines. Then by means of the overlay, determine the location of the assumed aiming point. If two points are used, one for industrial plants and the other for population, select a position midway between the two points. With the overlay centered at this position determine the size of bomb which would destroy the areas around both. If the required bomb size is greater than 2½-(X), use two smaller bombs each centered at the selected points. The exact size of the smaller bombs would be determined from the individual maps.

3.7 If three or more points are used, it is a matter of shifting the overlay experimentally to determine the size of bomb or bombs as well as the assumed aiming point or points. Use your judgment.

Value of Concept to Civil Defense Organization and Operations

3.8 The assumed aiming point is of primary importance in civil defense organization and operations. This point is a logical center for the pattern of civil defense ground organization of the community as a whole. As the center of an area most likely to be attacked and severely damaged, it provides the basis for plans to disperse fire equipment and other organized civil defense units. It furnishes a logical basis for traffic circulation and control plans and preplanning for opening of access routes by engineering services. Similar uses in planning will suggest themselves.

3.9 In target analysis, the assumption is made that if bad marksmanship or ballistic error causes the bomb to fall elsewhere than above the assumed aiming point or points, the resulting damage will be more easily dealt with. In practically all cases, this assumption is valid; however, it should be tested before being adopted. The test can most easily be made by selection of a point or points at random, and then making out an approximate assessment of the resulting damage.

METHOD OF ESTIMATING DAMAGE TO STRUCTURES AND FACILITIES

Factors Determining Damage

4.1 An atomic bomb damages structures and facilities by blast and fire. The amount of blast damage is determined largely by the energy release of the bomb and is therefore reasonably predictable. Damage from fire, on the other hand, is less predictable and may extend far beyond the limits of blast damage.

4.2 To estimate physical damage and casualties, the general analytical procedures are the same. Three types of transparent overlays are used—one type for assessment of casualties, one type for assessment of physical damage caused by blast, and another type for damage caused by fire. In each case a transparent overlay representing the degree of damage or the percentage of casualties in each of the concentric zones surrounding ground zero is superimposed in turn on various maps which represent locations of significant urban features or distribution of population. Damage to these features or injuries to these people are estimated on the basis of the degree of damage or casualty percentages indicated by various parts of the overlay. Different overlays are used for different size bombs when physical damage is being estimated. A single overlay with ½-mile concentric rings is used for determining the number of casualties from all size bombs. Following this, a study is made of the significance of each feature or specialized component of the population which probably would be damaged, injured, or destroyed. For example, one police station may house all of the police broadcasting equipment and one electric station may have the only available transformer which can change voltage from a distant source of electrical power to the voltage used for distribution through the city.

Blast

4.3 Blast damage to the structures most commonly used in American cities may be estimated with reasonable accuracy on the basis of figures presented in table I. Estimates of blast damage to individual types of buildings may be obtained from figure 1.

4.4 Mark a tracing paper or acetate map overlay with four conconcentric circles representing the outer limit of the zone of A-damage,

the outer limit of the zone of B-damage, the outer limit of the zone of C-damage, and the outer limit of the zone of D-damage. (See table I, The A-zone is the area in which the buildings would be almost completely destroyed by blast and the zone of B-damage is the area in which most of the buildings would be damaged beyond repair. The zone of C-damage is the area in which moderately damaged buildings must be vacated during repairs, and the zone of D-damage is the area in which partially damaged buildings need not be vacated during repairs. The radii of the four circles will vary according to the size of the bomb as determined from the target analysis.

4.5 For facilities such as water distribution and electric power systems, table I gives the type of damage which may be expected at different distances from ground zero for various sizes of bombs. Since critical parts of most facilities are housed in buildings, the extent of damage to these facilities would be very similar to that of the buildings. Parts of facilities which are underground (e. g., pipes and electric cables) would generally be undamaged by air bursts, but exposed pipes and wires would be subject to damage.

FIRE

4.6 Fires, either primary or secondary, may originate in the area of blast damage. Primary fires are caused by thermal radiation, secondary fires by overturned space heaters, broken gas lines, and short-circuited electrical equipment.

4.7 Primary fires would be more numerous where light, dry, flammable materials such as combustible trash, window curtains, interior furniture and furnishings, and frayed wood shingles, are exposed. The danger of fire would be greater in dry weather.

4.8 Since secondary fires occur principally within structures, they are not seriously affected by moisture conditions outside. The incidence of these fires is closely related to the following:

(*a*) Type of heating and cooking equipment.
(*b*) Time of day.
(*c*) Season of year.
(*d*) Presence or absence of flammable rubbish.

4.9 Determination of fire risk and probable type of fire should be based primarily on building density. Thus, under average conditions only isolated fires may be expected in open areas with building densities from 0 to 5 percent. Fires which spread to a few adjoining structures may develop where building density is 6 to 20 percent. Great fires assuming fire storm and conflagration proportions may occur where building density of more than 20 percent prevails over an area of one square mile or more.

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TABLE I.—*Blast damage by A-bomb—air burst at optimum burst height*

No.	Item	Zone of A-damage	Zone of B-damage	Zone of C-damage	Zone of D-damage
1	(*a*) Ordinary buildings—typical urban complex for American cities.	Virtually completely destroyed.	Severely damaged or destroyed; buildings must be torn down.	Moderately or severely damaged; moderately damaged buildings must be vacated for repairs.	Partially damaged; buildings need not be vacated during repairs.
	(*b*) Reinforced-concrete or steel-frame buildings.	Buildings standing but most masonry panel walls and non-load-bearing partitions probably destroyed or displaced.	Buildings standing but many masonry panel walls and non-load-bearing partitions probably destroyed or displaced.	Interiors moderately damaged.	Interiors slightly damaged.
2	Highways and streets	Impassable	Impassable	Many parts blocked by rubble and require clearing before use.	Some parts blocked by rubble and require clearing before use.
3	Elevated roads and short span bridges.	Some destroyed; approaches blocked; decks of steel-plate girder bridges may shift laterally.	Some severely damaged; bridge approaches blocked by rubble and disabled vehicles.	Moderately damaged; approaches blocked; generally usable.	Partially damaged but probably usable.
4	Vehicles: automobiles, busses, trolleys, trucks, etc.	Vehicles unusable	Vehicles generally unusable.	Some vehicles unusable	Most vehicles usable.
5	Railroad yards and tracks	Some tracks blocked by damaged rolling stock and rubble.	Some tracks blocked by damaged rolling stock and rubble.	Some tracks blocked by damaged rolling stock and rubble.	Some tracks blocked by damaged rolling stock and rubble.
6	Water mains	Some mains broken especially at ground zero and on bridges.	Not damaged except on bridges.	Not damaged	Not damaged.
7	Water pipes in buildings	Numerous breaks causing loss of pressure.	Numerous breaks causing loss of pressure.	A few breaks causing loss of pressure.	No breaks.

8	Elevated water tanks and towers.	Mostly destroyed or damaged beyond use; some substantial water towers may be usable.	Mostly destroyed or damaged beyond use; some substantial water towers may be usable.	Tanks supported by frames may fall.	Partially damaged but probably usable.
9	Sewers and storm sewers	Some mains broken especially at ground zero.	Not damaged	Not damaged	Not damaged.
10	Large fuel gas storage tanks.	Destroyed	Probably destroyed	Possibly destroyed	Not damaged.
11	Gas mains	Some mains broken especially at ground zero and on bridges.	Not damaged except on bridges.	Not damaged	Not damaged.
12	Gas pipe in buildings	Numerous breaks	Numerous breaks	A few breaks	Probably no breaks.
13	Above ground oil storage tanks.	Mostly destroyed or damaged beyond use.	Mostly destroyed or damaged beyond use.	Partially damaged; not ruptured.	Partially damaged; not ruptured.
14	Overhead electric power lines-poles, wire, and transformers.	Destroyed	Destroyed or severely damaged.	Poles, mostly usable; wires, broken by falling or flying objects; transformers, short circuited.	Poles, mostly intact; wires, broken by falling or flying objects; transformers, may be short circuited.
15	Underground electric power lines.	Intact except where join overhead lines or enter transformer or power stations; some may be short circuited if conduits flood.	Intact except where join overhead lines or enter transformer or power stations; some may be short circuited if conduits flood.	Not damaged; some may be short circuited if conduits flood.	Not damaged; some may be short circuited if conduits flood.
16	Telephone poles and overhead wires.	Destroyed	Destroyed or severely damaged.	Poles, mostly usable; wires, broken by falling or flying objects.	Poles, mostly intact; wires, broken by falling or flying objects.
17	Radio and TV towers	Destroyed	Some destroyed	Some destroyed	Partially damaged but may be operable.

TABLE I.—Continued

Radii and areas of concentric zones of A-, B-, C-, and D-damage

Bomb size	Zone of A-damage		Zone of B-damage		Zone of C-damage		Zone of D-damage	
	Radii (miles)	Areas (square miles)	Radii (miles)	Areas (square miles)	Radii (miles)	Areas (square miles)	Radii (miles)	Areas (square miles)
1(X)	0. 0 to 0. 5	0. 8	0. 5 to 1. 0	2. 3	1. 0 to 1. 5	3. 9	1. 5 to 2. 0	5. 5
2(X)	0. 0 to 0. 6	1. 3	0. 6 to 1. 3	3. 8	1. 3 to 2. 0	6. 2	2. 0 to 2. 5	8. 7
2½(X)	0. 0 to 0. 7	1. 5	0. 7 to 1. 4	4. 2	1. 4 to 2. 0	7. 1	2. 0 to 2. 7	10. 1
3(X)	0. 0 to 0. 7	1. 6	0. 7 to 1. 4	4. 9	1. 4 to 2. 2	8. 1	2. 2 to 2. 9	11. 4
4(X)	0. 0 to 0. 8	2. 0	0. 8 to 1. 6	6. 0	1. 6 to 2. 4	10. 0	2. 4 to 3. 2	14. 0
5(X)	0. 0 to 0. 9	2. 3	0. 9 to 1. 7	6. 9	1. 7 to 2. 6	11. 5	2. 6 to 3. 4	16. 1
6(X)	0. 0 to 0. 9	2. 6	0. 9 to 1. 8	7. 8	1. 8 to 2. 7	13. 0	2. 7 to 3. 6	18. 2
7(X)	0. 0 to 1. 0	2. 9	1. 0 to 1. 9	8. 6	1. 9 to 2. 9	14. 4	2. 9 to 3. 8	19. 4
8(X)	0. 0 to 1. 0	3. 1	1. 0 to 2. 0	9. 4	2. 0 to 3. 0	15. 7	3. 0 to 4. 0	22. 0
50(X)	0. 0 to 1. 8	11. 0	1. 8 to 3. 7	32. 0	3. 7 to 5. 5	53. 0	5. 5 to 7. 4	74. 0

The radii of the zones of blast damage shown in the above table are based on the joint AEC-Department of Defense publication, *The Effects of Atomic Weapons*. For A-bombs between 1(X) and 10(X) sizes, this publication indicates that radii of the zones of blast damage vary with the cube root of the energy release of the bomb. The radii for damage from thermal radiation should approximate this same scale.

In speculating about the effects of atomic bombs of higher yields, this relationship between energy release and extent of damage can be used as a rough guide. Calculations made for such weapons cannot be considered authoritative. The figures for the 50(X) bomb are given merely as an example.

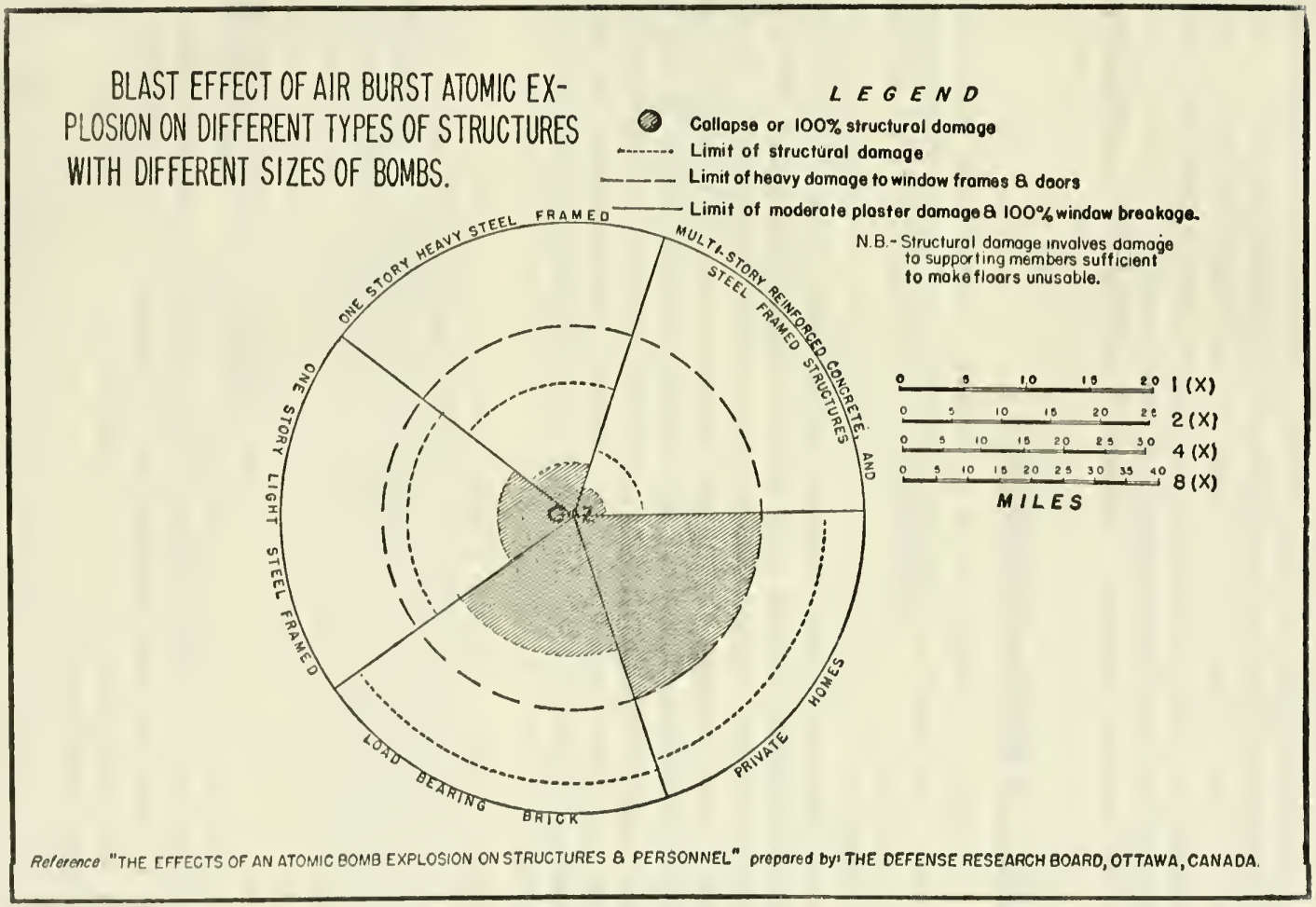
BLAST EFFECT OF AIR BURST ATOMIC EXPLOSION ON DIFFERENT TYPES OF STRUCTURES WITH DIFFERENT SIZES OF BOMBS.
LEGEND
Collapse or 100% structural damage
Limit of structural damage
Limit of heavy damage to window frames & doors
Limit of moderate plaster damage & 100% window breakage.
N.B.- Structural damage involves damage to supporting members sufficient to make floors unusable.
ONE STORY HEAVY STEEL FRAMED
MULTI-STORY REINFORCED CONCRETE AND STEEL FRAMED STRUCTURES
ONE STORY LIGHT STEEL FRAMED
PRIVATE HOMES
LOAD BEARING BRICK
0 5 10 15 20 1 (X)
0 5 10 15 20 25 2 (X)
0 5 10 15 20 25 30 4 (X)
0 5 10 15 20 25 30 35 40 8 (X)
MILES
Reference "THE EFFECTS OF AN ATOMIC BOMB EXPLOSION ON STRUCTURES & PERSONNEL" prepared by: THE DEFENSE RESEARCH BOARD, OTTAWA, CANADA.

FIGURE 1.

4.10 Where building density exceeds 20 percent and a strong wind is present, conflagration will spread from the original area of the fire. In most parts of the country such winds come almost exclusively from northerly and westerly directions and are usually associated with well-developed cold fronts. Conflagrations will spread quickly in the direction of the wind and spread at a lower rate to combustible material at the sides and by radiation to the rear of the fire.

4.11 Local offices of the United States Weather Bureau or local meteorologists can provide information concerning the frequency, direction, and seasonal occurrence of strong winds.

4.12 The best estimates of damage to facilities by fire are based on probable fire damage to enclosing structures.

Method of Making the Estimate

4.13 Mark a tracing paper or acetate map overlay with three concentric circles representing the outer limit of the zone of A-damage, the outer limit of the zone of B-damage, and the middle of the zone of D-damage. (See table I, p. 13.) The A-zone is the area in which the buildings would be almost completely destroyed by blast and the zone of B-damage is the area in which most of the buildings would be damaged beyond repair. The middle of the D-ring represents the outer limit of the area of probable fire incidence. Beyond this circle not only would the chances of fires starting be less, but also the householders would probably be uninjured and capable of effective action in extinguishing small fires. The radii of the three circles will vary according to the size of the bomb, as determined from the target analysis.

Where No Risk of Mass Fires Exists

4.14 If the fire susceptibility map does not have any areas of more than 1 square mile with building density exceeding 20 percent, the blast damage overlay is used in estimating damage. Using the assumed aiming point determined by the target analysis, superimpose the overlay on the various maps representing the location of critical urban features such as fire stations, regular and potential emergency hospitals, doctor's offices, and electric power plants. After determining in this way the effect of blast on the feature being studied, preparation for meeting these dangers can be planned. The possibility of local fires occurring anywhere within the outer ring of the overlay should be considered.

Where Possibility of Fire Storms and Conflagrations Exists

4.15 If the fire susceptibility map has one or more areas with building density exceeding 20 percent for more than 1 square mile, fire storms or conflagrations should be considered probable in addition to damage from blast and local fires.

MASS FIRE POTENTIAL

5.1 Mass fires, consisting of fire storms (great stationary fires which generate their own systems of in-blowing winds) and conflagrations (great fires which move along the ground under the influence of strong winds) have the greatest potential as destroyers of life and property following enemy attack. Initiation and spread of these fires following enemy attack depend on the fire susceptibility of the area and effectiveness of fire control efforts.

5.2 Because of the extensive nature of these large fires, fire risk to an individual building or block is not considered, and analysis is conducted in terms of general conditions extending over large areas.

Factors Influencing Fire Susceptibility

5.3 For purposes of civil defense urban analysis, fire susceptibility may be studied in terms of fuel factors and weather factors.

5.4 Building density and size of area in each building-density category are important fuel determinants which affect fire susceptibility. An analysis of these factors yields results sufficiently accurate for a map which presents graphically the relative hazards from fire in various parts of the city. Other fuel factors include combustibility of structures, firebreaks, continuity of combustible construction, fuel value of building contents, and size of buildings. These factors are treated in detail in *Fire Effects of Bombing Attacks*, TM–9–2, FCDA.

5.5 The pattern of air temperature, relative humidity, wind velocity, and recentness and amount of precipitation as they occur seasonally in addition to their immediate influence are the most important weather variables to be analyzed. A tentative procedure for analyzing fire potential for any given fuel pattern is presented in paragraphs 5.31 to 5.33.

Building Density Categories

5.6 The term "building density" refers to the ratio of roof area to total ground area including streets and small open spaces. The 3 density categories recommended for use in urban analyses are 0–5 percent; 6–20 percent; and more than 20 percent. Some building density studies recognize 1 additional category "more than 40 percent." However, this category is not deemed essential for identification of potential fire storm areas, and has been omitted from this manual to save time and effort. Not only is the 40 percent boundary difficult to identify, but in most cities, areas with density exceeding 40 percent are small and scattered.

5.7 The 0–5 percent category comprises areas in which fires do not generally spread beyond the buildings in which they originate. If this category covers an area of 500,000 square feet with a minimum dimension of 500 feet, the area constitutes a major firebreak and is referred to as an "open area." Included in this category are water bodies, marshes, parks, golf courses, race tracks, cemeteries, airfields, railroad yards, and vacant land. Woodlands should not be included because trees, especially pines, may burn and spread fire.

5.8 The 6–20 percent category comprises areas in which fires may spread beyond their point of origin but do not merge to form fire storms and conflagrations.

5.9 In areas with more than 20 percent building density, fire storms and conflagrations may develop provided this density condition extends over an area of at least 1 square mile. Actually, the lowest value in this category probably affords a factor of safety inasmuch as no fire storm has occurred in an area with less than 27 percent density.

Determination of Building Density

5.10 Building density may be determined from Sanborn maps, either by visual estimation or by measurement. In practice, the former method is used, and the latter more complex procedure is employed only when precise determinations for limited areas are required, or to provide additional sample maps for use in estimation. Figures 2, 3, and 4 show 3 measured maps representing building densities of 11, 22, and 38 percent, respectively. These maps will provide a basis of comparison when building density is determined by the visual estimation method. Building outlines on these maps should be filled in with colored pencils of approximately the same colors and color intensity as those of regular Sanborn maps. Blocking in building outlines in ink is not recommended because it overemphasizes the proportion of map areas occupied by buildings, and may lead to errors in estimation.

Preparation of Building Density Maps

Visual Estimation

5.11 Maps of building density may be prepared most readily by the following method of visual estimation:

(*a*) Cover the index map at the front of each volume of the Sanborn atlas with a sheet of tracing paper of the same size and shape, and attach it with paper clips. The index map indicates relative locations of areas represented by various page maps in the volume.

(*b*) Trace the approximate outline of the entire mapped area and mark it with names of boundary streets and other easily recognizable features, such as rivers and parks. Do not trace the lines representing the boundaries of individual page maps. This is not essential and would merely complicate the work.

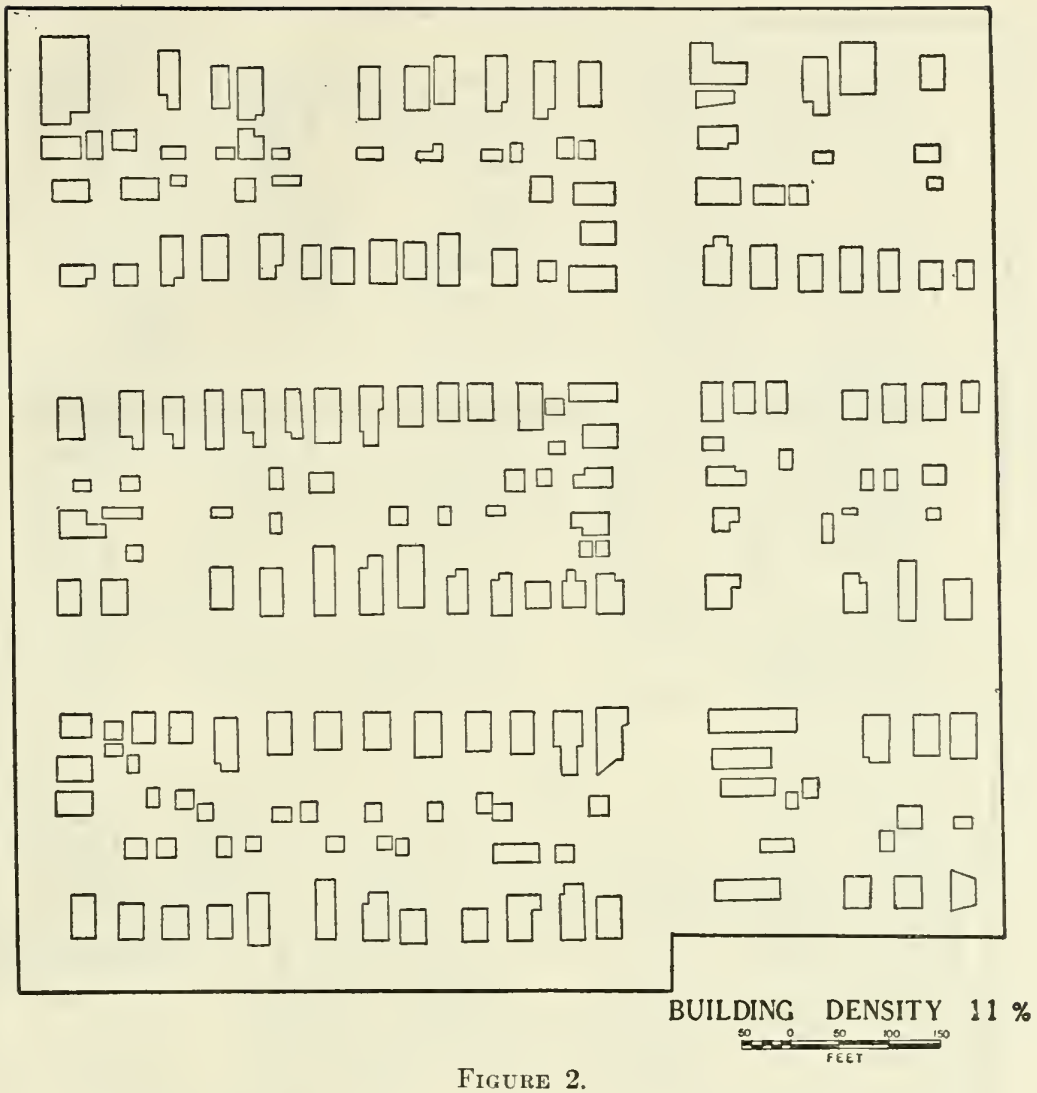

FIGURE 2.

(*c*) Select measured outline maps as close as possible to 5 percent and 20 percent densities. The maps shown in figures 2, 3, and 4 may be used for this purpose. Maps of 5 percent density are very difficult to find; however, this value may be estimated visually by comparison with the next higher density (11 percent).

(*d*) Compare each page map in turn with the measured maps shown in figures 2, 3, and 4. Estimate the density for each and record the value on the cover sheet over the area representing the page map.

(1) Use 0 for the 0–5 percent category; —20 for the 6–20 percent category; and +20 for the more than 20 percent category.

(2) For page maps of almost exactly 20 percent density, record the value tentatively as 20 without either plus or minus.

(3) For page maps which represent a few very large buildings, estimate by eye the part of the total map area which these structures would occupy if fitted together compactly, and record the density accordingly.

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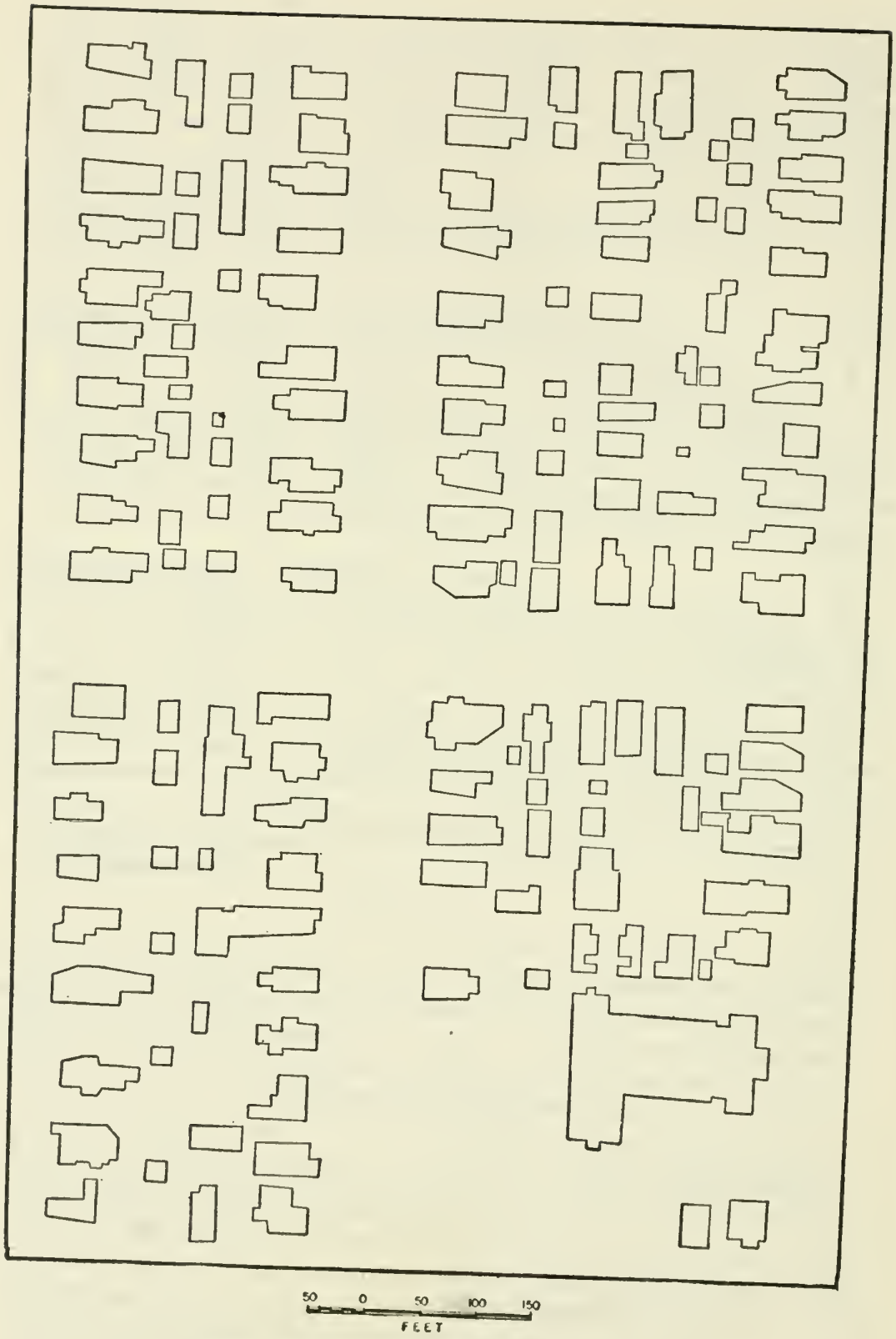

BUILDING DENSITY 22 %

FIGURE 3.

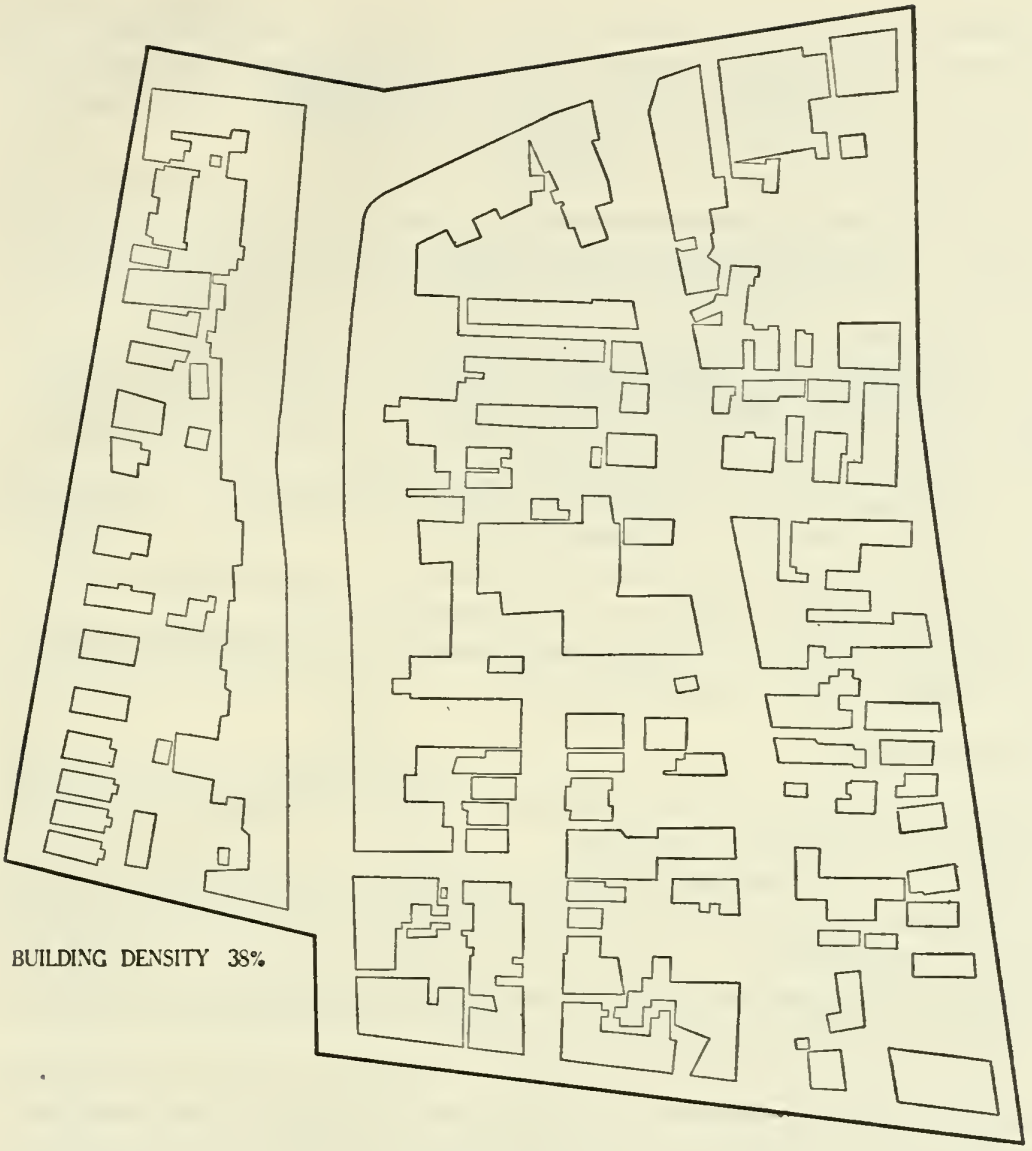

FIGURE 4.

(*e*) When values have been recorded on the cover sheet for all page maps, draw lines on this sheet to separate areas of various density categories. Reclassify map areas which had been recorded tentatively as 20, as +20 or −20 according to densities of adjoining sheets. Then, indicate on the tracing paper, the names of the streets which separate the various density categories.

(*f*) Finally, when the cover sheet has been completed for each atlas, transfer the density category boundaries from it to the standard civil defense base map of the city. Use the marked outline of the index map to locate the area on the base map, but do not copy this outline.

5.12 Use of index maps saves time and labor by eliminating need for laying out, on the city base map, the outlines of the numerous areas that represent the various page maps. Estimation of building density by the method outlined is rapid and simple. On a test under

average conditions, one person with no previous mapping experience estimated the building density for 12 atlas volumes, representing a large city, in 1½ days. The transfer of this material to the base map required the services of a draftsman for ½ day.

5.13 For purposes of civil defense urban analysis, the finished map of building density may be assumed to represent a map of fire susceptibility. However, boundaries of category areas should be shifted to take into account sizeable areas of highly flammable buildings or groups of fire-resistant structures, located near these boundaries.

5.14 When the finished map is used to represent fire susceptibility, the legend should indicate the type of fire that may be expected. The category designations should be:

(*a*) Isolated fires; no significant risk of fire spread. Corresponds to building density of 0–5 percent.

(*b*) Local spreading fires; no fire storms or conflagrations. Corresponds to building density of 6–20 percent.

(*c*) Fire storms or conflagrations possible. Corresponds to building density of more than 20 percent.

Measurement

5.15 If additional measured page maps are considered necessary, they may be prepared as follows:

(*a*) Cover the Sanborn map for which the building density is to be determined with a sheet of tracing paper of the same size and attach it with paper clips.

(*b*) On this cover sheet, draw a map border consisting of the center lines of the bounding street.

(*c*) Outline any large "open areas" (those with either no buildings or with building densities obviously in the 0–5 percent category, such as parks, railroad yards and water bodies). As previously mentioned, the minimum size of such "open areas" should be 500,000 square feet and the minimum length of the smaller side should be not less than 500 feet. This would be approximately two-thirds of the average page map.

(*d*) Compute the total area of the map exclusive of open areas as follows:

(1) Divide the area into rectangles and triangles. Represent small irregular parts by means of triangles of equivalent area.

(2) Add the areas of rectangles and triangles to determine total area.

(*e*) On a second piece of tracing paper, the assembly sheet (fig. 5), draw two guide lines (left and lower) forming a right angle.

(*f*) Place the assembly sheet on the cover sheet and the underlying map in such a way that the outline of one of the larger buildings occupies the angle formed by the guide lines. Adjust nonconforming building outlines as indicated in the figure.

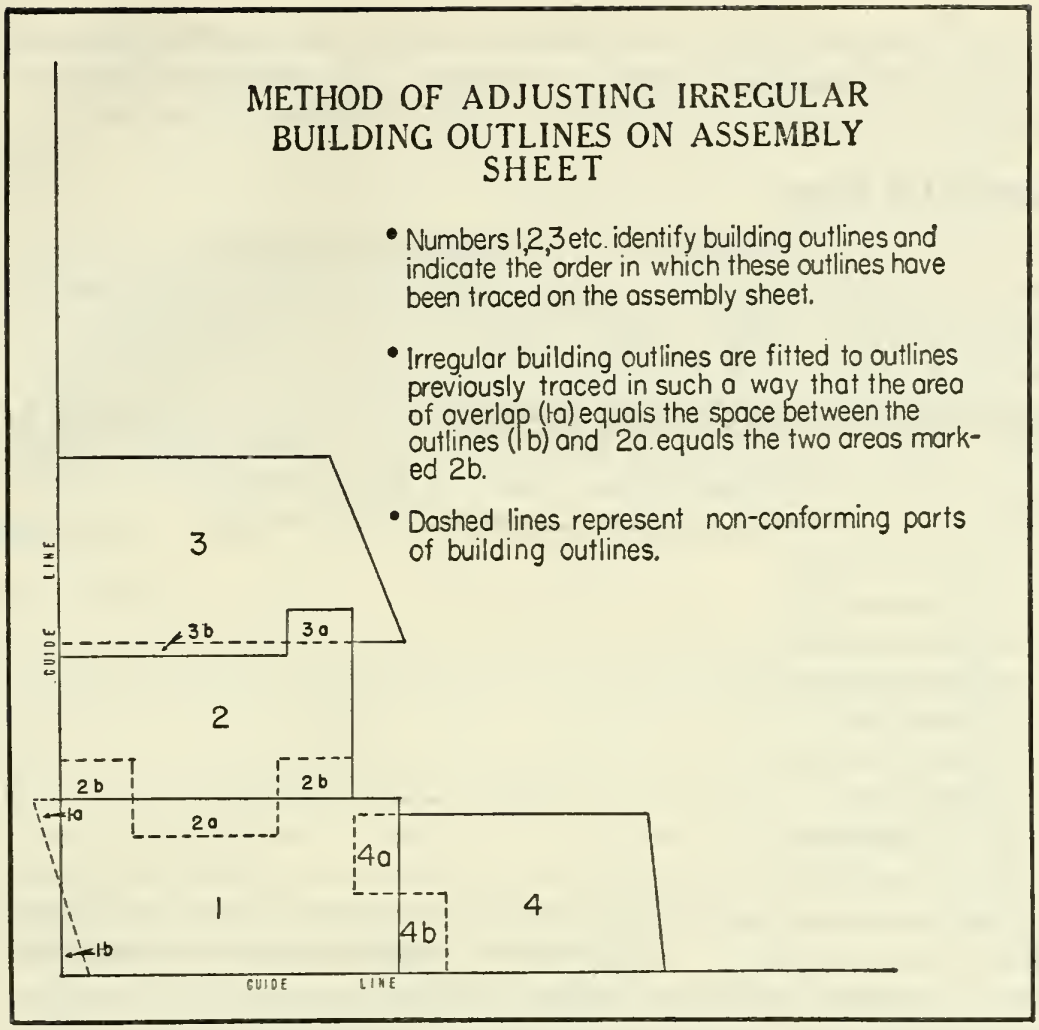

FIGURE 5.

(*g*) Trace free hand the outline of the building in pencil on the assembly sheet and mark with a check on the cover sheet the building that has been traced. Move the assembly sheet to any position which makes the outlines fit, or if convenient, trace some outlines on the back of the sheet.

(*h*) In like manner, transfer outlines of the other buildings to the assembly sheet to form an approximately rectangular composite area. Do not trace outlines of buildings in "open areas."

(*i*) Trace large building outlines first and save small outlines to fill in spaces.

(*j*) When all outlines have been traced, draw straight lines parallel to the guide lines in such a way as to rectify irregular boundaries of the composite building area. That is, draw the lines so that the area of overlap equals the vacant space inside the line. Determine the area of the resulting rectangle to the nearest hundredth of a square inch.

(*k*) From values obtained in steps (*d*) and (*j*), compute the percentage of map area occupied by buildings. This is the building density.

5.16 Measurement of each Sanborn map by this method requires ordinarily 30 minutes to 1 hour, although a few maps may require as much as 3 hours. The work may be done by clerical employees.

Land Use Map

5.17 The land use map provides important supplementary information for detailed studies of fire susceptibility and for estimates of damage by fire or blast. Areas on such a map are differentiated by type of land use. For the area to be identified as having a particular type of land use, approximately 80 percent of the area must be of that type. These maps resemble zoning maps, but differ in being based upon existing conditions rather than conditions permitted by city ordinance. The nine common categories of land use are:

(*a*) Residential.
(*b*) Commercial.
(*c*) Industrial.
(*d*) Transportation.
(*e*) Storage.
(*f*) Institutional.
(*g*) Special.
(*h*) Recreational.
(*j*) Unused land.

5.18 As a rule, the residential category occupies a larger area than all the others combined. Included are a variety of residential building types, detached dwellings, duplexes, row houses, and apartments as well as churches, schools, neighborhood shopping centers, motion picture theaters, hospitals, nursing homes, welfare institutions, police and fire stations.

5.19 The commercial category applies to the congested "commercial core" of the city. Included are retail and wholesale stores, financial institutions, office buildings, public buildings, hotels, garages, and light manufacturing plants. These manufacturing plants, which produce such commodities as clothing, novelties, and light electrical goods, are located on the peripheries of these areas and commonly occupy loft space above wholesale establishments.

5.20 The industrial category comprises plants of heavy manufacturing establishments together with limited storage and transportation facilities normally associated with such plants.

5.21 The transportation category comprises railyards and stations, harbors (ocean, lake, or river), port facilities, truckline terminals, bus and streetcar terminals, garages and carbarns, and airports. It does not include linear features of the transportation system, such as rail lines and waterways. These features are not differentiated from the land use areas in which they are located.

5.22 The storage category comprises warehouses, grain elevators, and facilities for storing such bulk commodities as petroleum, coal, and

ores. This type of land use is associated with transportation facilities (rail, water, or truck).

5.23 The institutional category includes universities, colleges, schools, welfare institutions, such as homes for children and the aged, hospitals, monasteries, convents, and nursing homes.

5.24 The "special" category comprises government offices, military installations, and research facilities.

5.25 The recreational category includes parks, golf courses, parkways, playgrounds, race tracks, baseball parks, and football fields.

5.26 All land use types listed here should be represented on the map by area patterns of widely spaced lines which will not obscure the street pattern.

Weather

Fire Season

5. 27 In general there are predictable periods of the year which, on the basis of rainfall, temperature, and relative humidity occurrence, may be defined as the fire season. During this fire season the probability of mass fires following enemy attack is much higher. Figure 6 shows the normal fire seasons in different parts of the United States as determined by local climate and natural fuel conditions. In general these seasons are related to moisture content of forest fuels, but except for particularly dry periods in midwinter, they may be used as rough guides for civil defense planners.

5.28 In the South and East precipitation occurs in both summer and winter with relatively dry spring and fall seasons. The great belt of deciduous broad-leaf forests (nonevergreens such as oak, maple, and ash) in the East is dangerous only when leaves are off the trees and the weather is dry. Worst conditions occur from March 1 in the spring until new leaves are on, about May 15. A secondary fire season begins when frost kills the leaves in the fall and lasts until wet winter weather sets in. This late season is typically in the months of October and November, but starts 15 to 30 days earlier in New England than in the southern part of the belt. Fire experiences during the fall of 1952 demonstrate how serious conditions can become following drouth.

5.29 Climates with little summer precipitation are typical of the western United States. Consequently fire seasons usually peak in July and August. The season extends to a later date as one moves South, except in Arizona and New Mexico where summer rains terminate fire danger about July 31.

5.30 It should be remembered that these are average dates which fluctuate from year to year. Especially dangerous conditions develop when autumn rains are delayed after a hot, dry summer. A check of fire records, particularly the number of grass, brush, and woodland fires in and around cities, can confirm these general fire season limits.

FIRE SEASONS MAP OF THE UNITED STATES

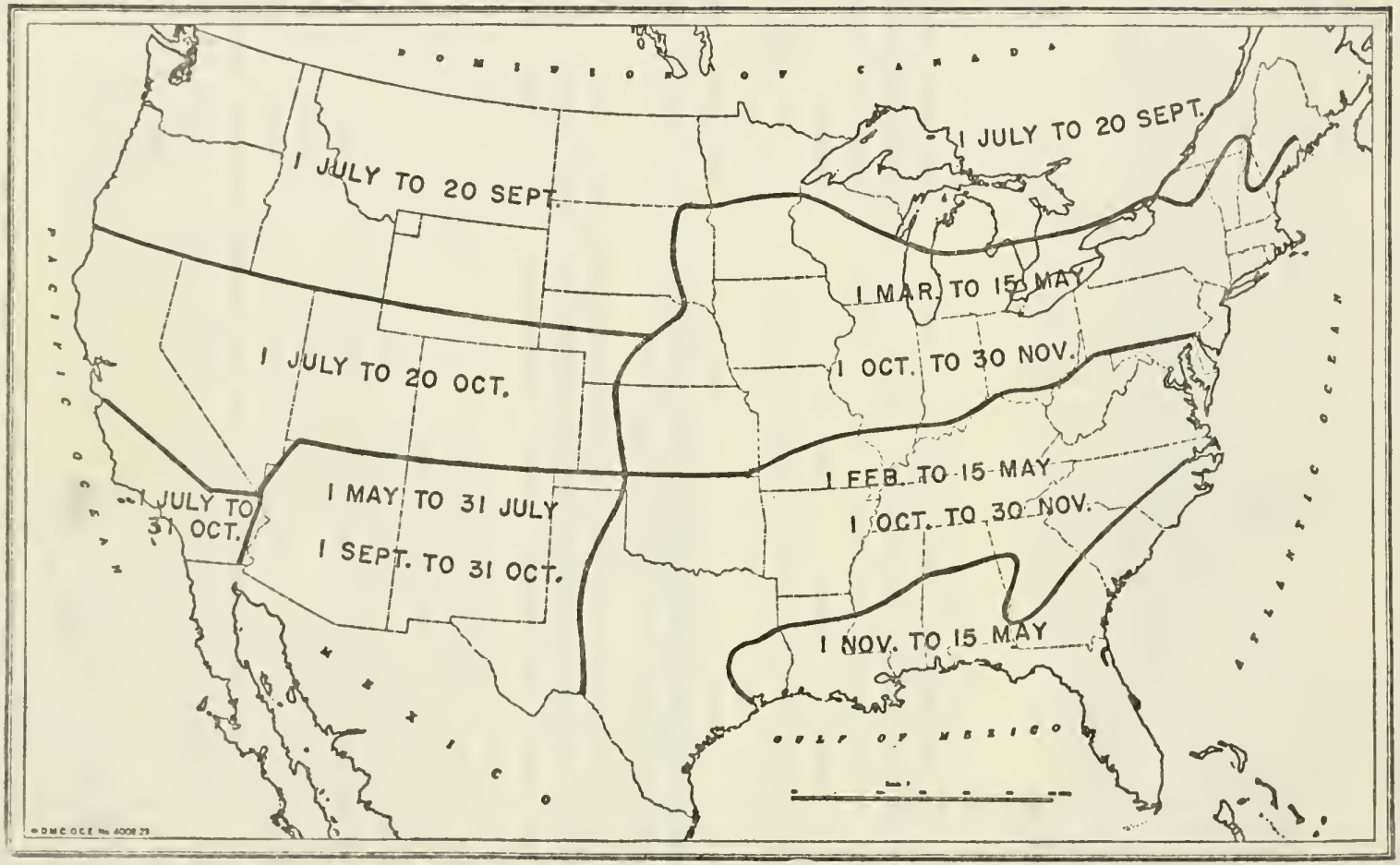

FIGURE 6.

PREDICTION OF BURNING POTENTIAL

5.31 Burning potential is a means of evaluating probable fire behavior and damage based on certain weather conditions. For purposes of civil defense urban analysis, four classes of burning potential are recognized—*low; moderate; dangerous;* and *critical.* In table II, these burning potential classes and the probable fire effects of each are shown.

TABLE II.—*Burning potential and fire effects*

Burning potential	Type and rate of spread	Civil defense requirements
Low	Slow-burning fires, no spotting.	No direct danger; fire can be controlled at will; control action can be on an individual structure basis.
Moderate	Fires burn rapidly, individual building fires combine to form an area fire.	Organized action needed to corral fire and confine to area originally ignited.
Dangerous	Fast-moving fires which spread readily over large areas and throw spot-fires ahead ¼ to ½ mile.	Probability of mass damage high. Aggressive, organized action of all available personnel and equipment is essential to limit mass damage.
Critical	Conflagration-type, fast-moving fire fronts and fire storm highly probable.	Personnel and equipment should be evacuated from in front and from near the flanks of such fires. Organized action only on rear and flanks with plans to attack head when changes in fuel or burning conditions permit.

5.32 Tables III and IV integrate roughly the effects of wind and relative humidity and provide guides to prediction of burning potential when used in conjunction with table II.

TABLE III.—*Burning potential in relation to relative humidity and wind—level terrain (slopes less than 20 percent)*

Wind velocity at 20 feet above ground (miles per hour)	Relative humidity			
	Above 40	26–40	15–25	Below 15
0–12	Low	Moderate	Moderate	Dangerous.
13–24	Moderate	Dangerous	Dangerous	Critical.
Above 24	Dangerous	Dangerous	Critical	Critical.

TABLE IV.—*Burning potential in relation to relative humidity and wind—Steep terrain*

Wind velocity at 20 feet above ground (miles per hour)	Relative humidity			
	Above 40	26–40	15–25	Below 15
0–12	Moderate	Moderate	Dangerous	Critical.
13–24	Dangerous	Dangerous	Critical	Critical.
Above 24	Critical	Critical	Critical	Critical.

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Relation Between Building Density and Burning Potential

5.33 Probability of fire storms and conflagrations following enemy attack varies with building density and other fuel factors on one hand and with burning potential on the other. When burning potential is "dangerous"or "critical" there is greater probability of fire storms. Under such conditions they are possible with a lower building density of about 20 percent. When burning potential is low or moderate, probability of fire storms and conflagrations decreases. Under such conditions, they are possible only with a higher building density of no less than 35 to 40 percent. During protracted drouth periods such as that experienced in the Midwest and East during the fall of 1952, probability of mass fire damage is particularly high, and civil defense urban analysis should provide for recognition of the conditions and evaluation of the potentialities.

TECHNIQUES FOR ESTIMATING CASUALTIES AND UNINJURED-UNHOUSED

6.1 Preattack estimates of casualties and uninjured-unhoused for any size A-bomb and for any possible location of ground zero within the metropolitan area is of the utmost importance in civil defense planning and operations. On the basis of such estimates, a city can be prepared to deal with various problems which may result from enemy attack. In the event of attack, rapid estimation of casualty and uninjured-unhoused will allow appropriate plans to be put into operation with minimum delay.

6.2 A very effective method of estimating casualties and uninjured-unhoused involves the preparation of maps which indicate by means of isorithms (lines of equal value) the number of fatal and nonfatal casualties and uninjured-unhoused persons who will require welfare services. These isorithmic maps should be prepared for at least two sizes of bombs on the basis of both resident population and day population, assuming a condition of warning. For expediency, resident population should be used instead of total night population which includes transients in hotels and other minor population elements. Resident population figures may be obtained in printed form from the Bureau of the Census, whereas figures for total night population must be specially prepared. The difference between these two figures for each of a number of sample cities was less than ½ of 1 percent.

Comparison of Day and Resident Populations

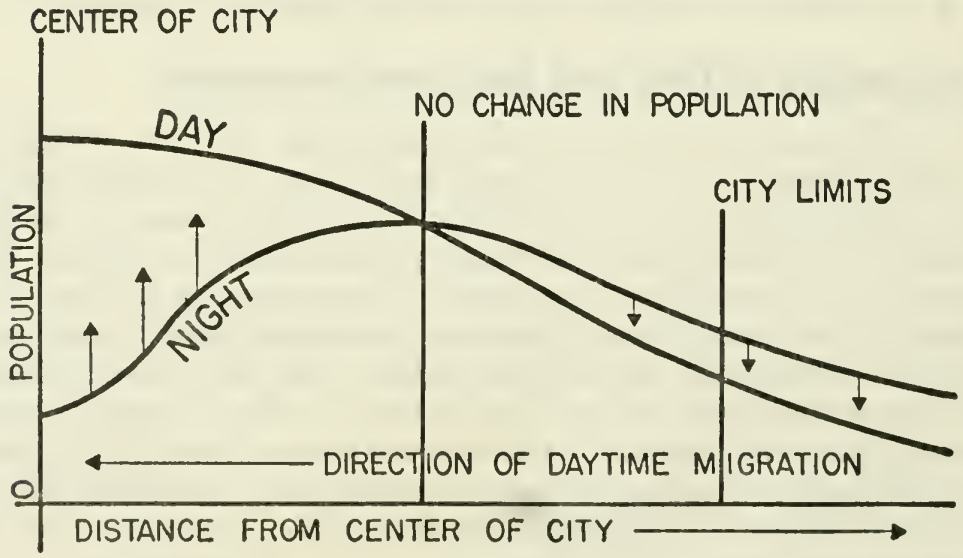
6.3 The day population of the city proper, the part within the corporate limits, is as a rule notably larger than the resident population. For 22 of the principal cities of the United States, the median difference between resident and day populations is 19 percent with extremes of 4 percent and 102 percent. For some cities, the day population of the central area of greatest population density may be 10 times as great as the resident population of the same area, reflecting daily migrations into the city and within the city. The day population of individual tracts in the commercial cores of some cities is more than 80 times as large as the resident population. One industrial city which has a total resident population of less than 300 people has a day population of approximately 60,000. This is an extreme case. Obviously, day populations of most suburban tracts are less than resident populations and the same is true for outlying tracts within city limits. Figure 7 indicates generally population changes from night to day as related to distance from the center of the city.

6.4 Estimates of day population by census tracts must be prepared for each city. However, FCDA has this information for a number of cities and will make it available on request in a form that will not violate the law. Cities for which FCDA does not have estimates of day population may obtain satisfactory figures from their local street departments or from private sources. Appendix D suggests a method which may be used in preparing these estimates.

6.5 Most estimates of day population apply only to the city proper and do not include the suburbs. Since the effects of the bomb do not stop at city limits, estimates should be prepared for suburban areas as well. Because of the relatively low population density in suburbs, especially in daytime, estimates need not be as accurate as for the city proper.

6.6 For an average American city the assumption can generally be made that approximately 33 percent of the residents of the suburbs come to the city in the daytime to work, to shop, to attend school, or for other purposes. This percentage varies somewhat according to how

GENERALIZED DIAGRAM ILLUSTRATING
POPULATION CHANGES FROM NIGHT TO DAY
AS RELATED TO DISTANCE FROM CENTER OF CITY



↑↓ = Increase or decrease in population from night to day.

FIGURE 7.

much of the entire residential area is included within the corporate limits, and according to the amount of employment and the number of stores and schools in outlying suburbs.

6.7 If the limits of a city pass through densely built-up areas, the city will have an abnormally large proportion of its resident population living outside the city limits. The percentage migration to the city will therefore be higher than 33. For city A (see figs. 9 and 10, opposite p. 41) which has inlying limits, the figure is 38 percent. In contrast, another city which includes an abnormally large proportion of its resident population within the city limits and which has well developed industries and shopping and educational facilities in outlying suburbs, the percentage is only 29.

6.8 Within the suburbs of any one city, the percentage of residents who migrate to the city in daytime varies from place to place. Ordinarily percentages are relatively high for inlying areas which have good transportation facilities, no industries, and meager shopping facilities. They are lower for areas where the opposite conditions prevail. For inlying suburbs the presence of industries appears to have little or no effect on the percentage of the residents that migrate to the city. This is because families in industrial suburbs commonly include a larger percentage of wage earners than do families in purely residential suburbs. The men are employed in heavy industries in the suburbs, whereas many of the women and young men go to the city to work in light industries.

6.9 In practice, moderate errors in estimating the percentage migration from small suburban areas will have no significant effect upon the accuracy of the resulting isorithmic maps. This is due in part to the relatively low population density of the suburbs as compared to the city proper, and in part to the fact that the bomb affects a large area and thereby tends to equalize plus and minus errors in estimating population for small suburban areas. Serious errors appear only when incorrect percentages are applied to relatively large areas.

6.10 The specific procedure to be used in estimating suburban daytime population by census tracts is as follows:

(*a*) Determine the daytime population increase for a city proper by subtracting the figure for the total resident population within the city limits from the figure for the total day population for the same area.

(*b*) On a map of census tracts for both the city and its suburbs, draw a tentative boundary that encloses those suburban areas which are known to contribute substantial numbers of people to the city (designated here as suburban A). This boundary should follow the census tract outlines and may conform in many instances to the corporate limits of towns.

(*c*) Add up the resident population figures for the towns and individual tracts composing suburban A.

(*d*) Determine the percentage reduction within suburban A necessary to provide the daytime population increase in the city proper. Example: Resident population of suburban A is 600,000. Daytime population increase for the city proper is 204,000. Average percentage assumed to be contributed by tracts of suburban A is 34.

(*e*) If the percentage is more than 2 or 3 percent above or below 33, determine whether this deviation may be due to inlying or outlying corporate limits or to employment and shopping facilities in outlying suburbs with resulting greater or less than average percentile migration.

(*f*) If the deviation cannot be explained on the basis of these factors, alter the boundary of suburban A by tentatively adding or deleting areas until the percentage is approximately 33.

(*g*) When this percentage has been determined, reduce the resident population figure for each census tract in suburban A by that percentage.

Methods of Obtaining Population Distribution Data for Isorithmic Maps

Equal-Value-Dot Map Method

6.11 Population distribution data for preparing isorithmic maps of casualties or uninjured-unhoused may be obtained by several methods, each of which is desirable under certain conditions. Generally, the most desirable method is the plotting of population on the tract map by means of equal value dots. For this method the procedure is as follows:

(*a*) On a map of census tracts for the city and its suburbs, or on a sheet of tracing paper covering the map, place dots, each of which represents the same number of people (100, 200, 500, or 1,000), to indicate the distribution of either daytime or resident population. The tracing paper should be attached securely and marked with points of reference. If possible, prepare the map for daytime population first. As a preliminary step, outline parks, rail yards, water bodies, and other unpopulated areas. Place dots as accurately as practicable in remaining areas according to known distribution of population. The dots may be made most readily with a pencil-type eraser used as a rubber stamp. The eraser is sharpened in a pencil sharpener and then blunted to proper size with sandpaper. The most suitable value and size for the dot may be determined by plotting the dots tentatively on a scrap of tracing paper placed over the area of densest population on the map. If the dots merge so they cannot be counted, the eraser should be sharpened to a smaller point or the value of each dot should be increased. If the map is of such small scale that a considerable number of the smaller tracts are represented with maximum dimensions of less than 1 inch, a larger scale map should be prepared or the alternate method (par. 6.12) used.

(*b*) On the tract map, or on the attached tracing paper cover sheet, draw a grid composed of equilateral triangles with sides equal to 2, 4, or 6 miles at map scale. (See grid illustration insert, fig. 8, opposite p. 41.) The grid should be drawn in such a way as to cover the entire area of both the city proper and suburban A. Choice between 2-, 4-, or 6-mile intercepts for the grid should be governed by the size of the city. Ordinarily, cities with a combined urban and suburban population not larger than 700,000 can use the 2-mile intercepts whereas larger cities can use 4-mile spacing of grid lines. Six-mile intercepts should be used only in mapping cities whose physical area is large. Large intercepts are used to reduce the number of computations required in preparing isorithmic maps. The triangular grid is preferable to the ordinary square grid because it provides a greater number of points about any given point thus making the plotting of isorithms easier and more accurate. Care should be taken to transfer some of the points of intersection of the grid to the underlying tract map by means of a sharp-pointed instrument and to mark these points to correspond to the letter designations of the grid intersections. This will make possible the transfer of the isorithms to a standard city map.

(*c*) Mark a sheet of tracing paper with concentric circles having radii of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 and 4.5 miles respectively at map scale and draw a single radial line. These circles in combination with the percentage multipliers shown in tables V and VII are used for calculating casualties for any size A-bomb up to and including 8(X). For A-bombs larger than 8(X), the sheet of tracing paper should be marked with concentric circles for the respective damage zones. The zone radii may be determined from table I, page 13. The percentage multipliers which should be used are shown in table VIII.

(*d*) Consider each of the grid intersections as a hypothetical ground zero (the point directly below the bomb) on the assumption of a bomb drop at each one of these points alone (not a multiple drop).

(*e*) Place the sheet of tracing paper with concentric circles on the map or cover sheet on which have been drawn the population dots and the grid, in such a way that the center of the circles corresponds to one of the grid intersections and the radial line coincides with one of the grid lines.

(*f*) Count the dots in the central circle (0.0–0.5-mile radius) and in the enclosed rings (0.5–1.0-mile, etc.) in a clockwise direction starting at the radial line. As the dots are counted, check them off on the tracing paper sheet by pencil lines which connect adjacent dots in groups of three; mark every hundredth dot with an "X." This technique minimizes the chance of errors in counting and provides convenient checks of accuracy. If the hundredth dot is one of a group of two or three instead of appearing singly, the count is in

error. Furthermore, the total count for each ring may be readily checked for gross errors by counting the crosses (hundreds).

(*g*) Multiply the number of dots in the inner circle and in each ring by the number of people represented by each dot to determine the population in each annular zone.

(*h*) Record these population values with 000 omitted in the appropriate spaces of a form like table VI, and record the fatal casualties, nonfatal casualties and uninjured as calculated for each ring and for the various bomb sizes, using the multipliers in table V. Then add the values for the various zones to determine the total number of casualties and of uninjured for the bomb. For A-bombs larger than 8(X), use the percentage multipliers shown in table VIII and the zone radii shown in table I.

(*i*) Prepare additional sheets of tracing paper like that described in step (*c*), and superimpose one on each of the grid intersections (hypothetical ground zero) in turn, with the radial line oriented as before. Compute and record the casualties and uninjured.

Alternate Method

6.12 A second method involving less work than the equal-value-dot method is based on the assumption that the entire population of each census tract is concentrated at the central point of the tract. This method is especially well adapted for use with small-scale maps which represent numerous small census tracts, but has the disadvantage of not providing an equal-value-dot map for other purposes.

6.13 The procedure is as follows:

(*a*) On the map of census tracts, determine by inspection the center of each tract and mark it with a dot. Beside each dot, record the entire population for the tract to the nearest hundred.

(*b*) Draw the triangular grid as before.

(*c*) Superimpose on the map an overlay of tracing paper or acetate marked with concentric circles.

(*d*) Note which dots fall within each zone; add their population values and compute casualties as before. Do not check off the dots on the overlay.

(*e*) In the event that greater accuracy is desired, the following modifications may be introduced:

(1) If a tract includes a large unpopulated area, the dot may be centered in the populated part of the tract; or if the population is concentrated in two separate parts of the tract, two dots may be used and the population arbitrarily divided between them.

(2) If a number of dots lie just outside the boundary of a given zone, alternate dots may be arbitrarily counted as though they were in the zone.

6.14 If tract maps and population figures by tracts are not available either the equal-value-dot or the alternate method may be applied

TABLE V.—*Percentage multipliers for use in determining the number of fatally injured (f) nonfatally injured (n) and uninjured (u) from an attack with warning*

Radius from ground zero (miles)	1(X)			2(X)			2.5(X)			3(X)			4(X)			5(X)			6(X)			7(X)			8(X)		
	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)
0.0–0.5	75	15	10	85	10	5	87	9	4	88	9	3	90	8	2	92	7	1	93	6	1	94	5	1	95	4	1
0.5–1.0	30	20	50	50	25	25	57	22	21	62	19	19	70	15	15	75	13	12	79	12	9	82	11	7	85	10	5
1.0–1.5	5	25	70	15	25	60	19	25	56	23	25	52	30	25	45	36	25	39	41	26	33	46	28	26	50	30	20
1.5–2.0	1	9	90	3	17	80	4	20	76	4	22	74	5	25	70	6	28	66	7	31	62	9	33	58	10	35	55
2.0–2.5	0	5	95	0	10	90	0	12	88	0	13	87	1	14	85	2	15	83	3	16	81	4	18	78	5	20	75
2.5–3.0	0	1	99	0	5	95	0	7	93	0	9	91	0	10	90	0	12	88	0	14	86	1	17	82	1	19	80
3.0–3.5	0	0	100	0	1	99	0	2	98	0	3	97	0	5	95	0	6	94	0	8	92	0	9	91	0	10	90
3.5–4.0	0	0	100	0	0	100	0	0	100	0	0	100	0	1	99	0	1	99	0	2	98	0	4	96	0	5	95
4.0–4.5	0	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0	1	99

TABLE VI.—*Sample casualty estimates for city "A" from A-bomb burst at optimum height from daytime attack with warning*

[All population and casualty figures are in thousands]

Radius from ground zero (miles)	Population	1(X)			2(X)			2.5(X)			3(X)		
		(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)
0.0–0.5	1.5	1.1	0.2	0.2	1.3	0.1	0.1	1.3	0.1	0.1	1.3	0.1	0.
0.5–1.0	14.9	4.4	3.0	7.4	7.5	3.7	3.7	8.5	3.3	3.1	9.3	2.8	2.
1.0–1.5	26.3	1.3	6.6	18.4	3.9	6.6	15.8	5.0	6.6	14.7	6.0	6.6	13.
1.5–2.0	39.6	.4	3.6	35.7	1.2	6.7	31.7	1.6	7.9	30.1	1.6	8.7	29.
2.0–2.5	58.8	0	2.9	55.8	0	5.9	52.9	0	7.1	51.8	0	7.6	51.
2.5–3.0	25.6	0	.3	25.4	0	1.3	24.3	0	1.8	23.8	0	2.3	23.
3.0–3.5	60.7	0	0	60.7	0	.6	60.1	0	1.2	59.5	0	1.8	58.
3.5–4.0	74.1	0	0	74.1	0	0	74.1	0	0	74.1	0	0	74.
4.0–4.5	84.6	0	0	84.6	0	0	84.6	0	0	84.6	0	0	84.
Total	386.1	7.2	16.6	362.3	13.9	24.9	347.3	16.4	28.0	341.8	18.2	29.9	338.

Radius from ground zero (miles)	4(X)			5(X)			6(X)			7(X)			8(X)		
	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)
0.0–0.5	1.4	0.1	0	1.4	0.1	0	1.4	0.1	0	1.4	0.1	0	1.4	0.1	0
0.5–1.0	10.5	2.2	2.2	11.2	1.9	1.8	11.8	1.8	1.3	12.2	1.6	1.1	12.7	1.5	.
1.0–1.5	7.9	6.6	11.8	9.4	6.6	10.3	10.8	6.8	8.7	12.1	7.4	6.8	13.2	7.9	5.
1.5–2.0	1.9	9.9	27.8	2.4	11.1	26.1	2.8	12.3	24.5	3.5	13.1	23.0	4.0	13.9	21.
2.0–2.5	.6	8.2	50.0	1.2	8.8	48.8	1.8	9.4	47.6	2.4	10.5	45.9	2.9	11.8	44.
2.5–3.0	0	2.6	23.0	0	3.1	22.5	0	3.6	22.0	.3	4.3	21.0	.3	4.9	20.
3.0–3.5	0	3.0	57.7	0	3.6	57.1	0	4.9	55.8	0	5.5	55.2	0	6.1	54.
3.5–4.0	0	.7	73.4	0	.7	73.4	0	1.5	72.6	0	3.0	71.1	0	3.7	70.
4.0–4.5	0	0	84.6	0	0	84.6	0	0	84.6	0	0	84.6	0	.8	83.
Total	22.3	33.3	330.5	25.6	35.9	324.6	28.6	40.4	317.1	31.9	45.5	308.7	34.5	50.7	301.

TABLE VII.—*Percentage multipliers for use in determining the numbers of fatally injured (f) non-fatally injured (n) and uninjured (u) from air attack without warning*

Radius from ground zero (miles)	1(X)			2(X)			2.5(X)			3(X)			4(X)			5(X)			6(X)			7(X)			8(X)		
	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)	(f)	(n)	(u)
0.0–0.5	90	10	0	95	5	0	96	4	0	97	3	0	98	2	0	98	2	0	99	1	0	99	1	0	99	1	0
0.5–1.0	50	35	15	70	20	10	74	17	9	80	14	6	85	10	5	89	8	3	91	6	3	94	5	1	95	4	1
1.0–1.5	15	40	45	30	40	30	35	37	28	42	35	23	50	30	20	58	26	16	64	23	13	70	21	9	75	20	5
1.5–2.0	2	18	80	5	25	70	6	28	66	8	31	61	10	35	55	12	37	51	15	38	47	17	39	44	20	40	40
2.0–2.5	0	10	90	1	14	85	2	16	82	3	17	80	5	20	75	7	23	70	8	27	65	9	31	60	10	35	55
2.5–3.0	0	5	95	0	10	90	0	11	89	0	12	88	1	14	85	2	17	81	3	20	77	4	22	74	5	25	70
3.0–3.5	0	1	99	0	5	95	0	6	94	0	8	92	0	10	90	0	12	88	0	13	87	0	13	87	1	14	85
3.5–4.0	0	0	100	0	1	99	0	2	98	0	3	97	0	5	95	0	7	93	0	8	92	0	9	91	0	10	90
4.0–4.5	0	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0	2	98	0	3	97	0	5	95	0	5	95

TABLE VIII.—*Average percentages of deaths and surviving casualties in damage zones*

Zone	Deaths		Surviving casualties		Uninjured	
	Without warning	With warning	Without warning	With warning	Without warning	With warning
A-damage	90	75	10	15	0	10
B-damage	50	30	35	20	15	50
C-damage	15	5	40	25	45	70
D-damage	2	1	18	9	80	90

Limits of each of the 4 zones vary with the size of the bomb. Use these percentages for bomb sizes above 8(X).

to maps and figures for enumeration districts. However, this substitution involves considerably more work and necessitates the procurement of enumeration district maps and figures which are expensive and not readily available.

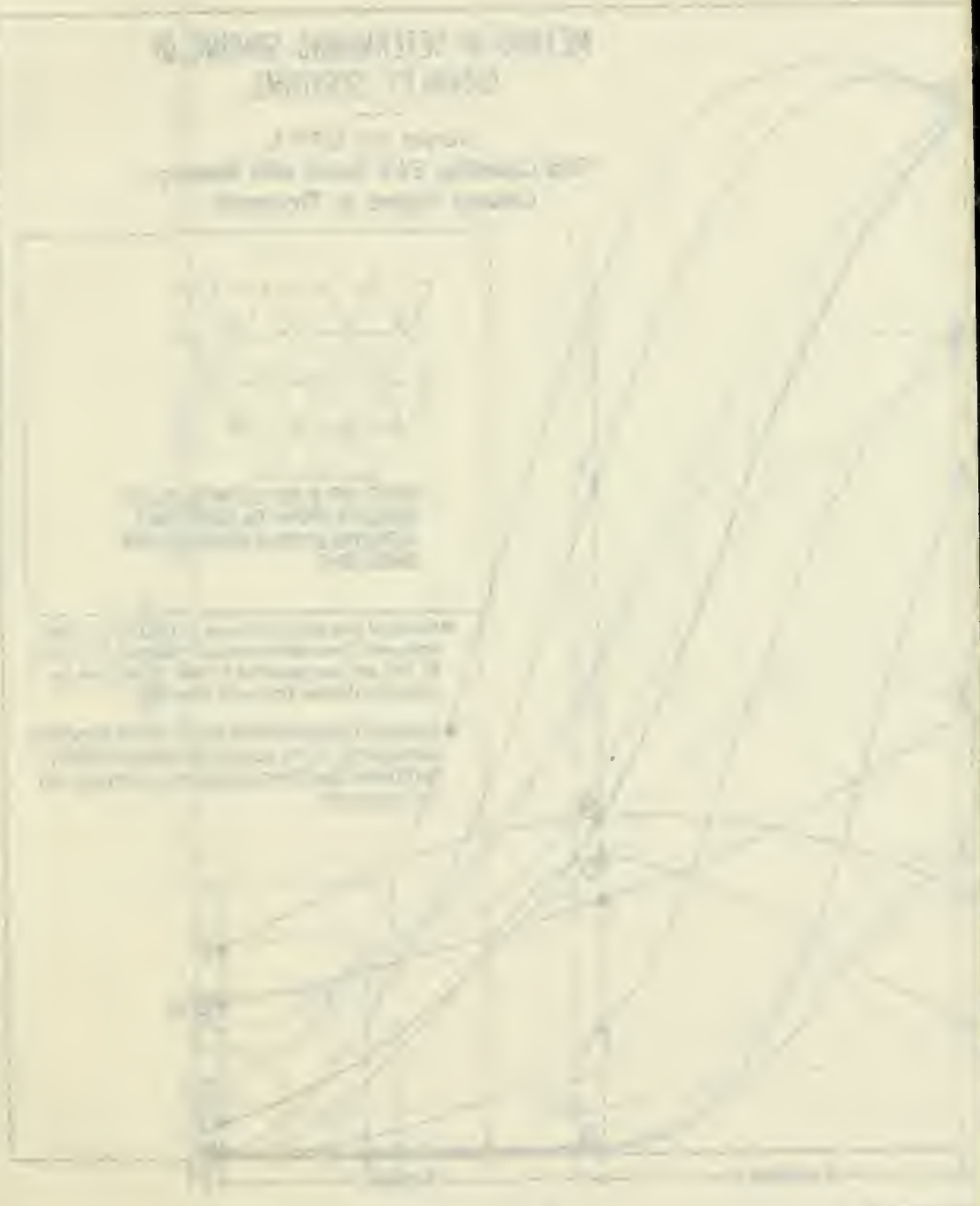
ADVANTAGES OF EQUAL-VALUE-DOT MAP

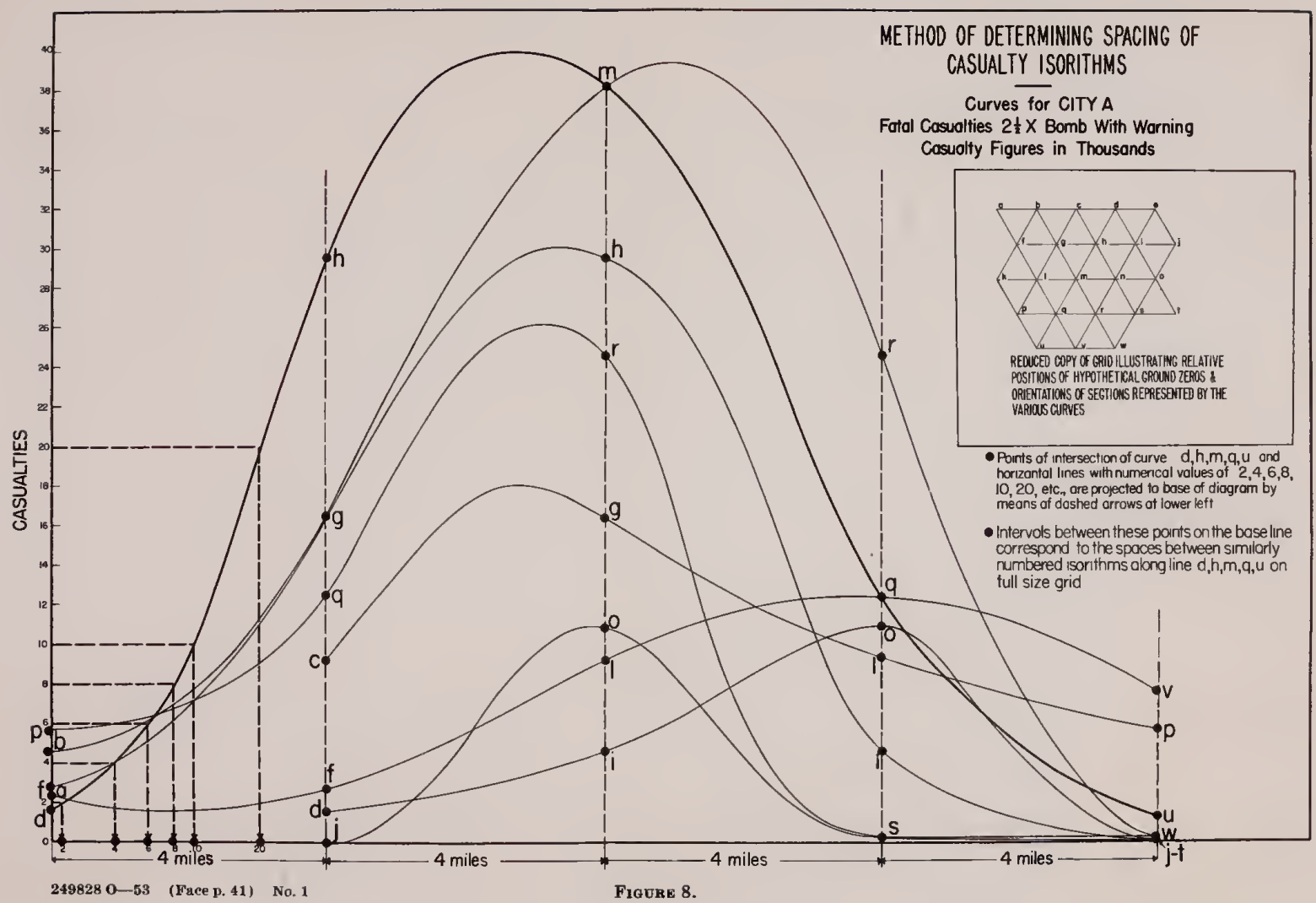
6.15 The equal-value-dot map is believed to be more desirable than the alternate procedure because it is simple, comparatively errorproof, and well suited for use by volunteers and other relatively inexperienced people under minimum supervision. Furthermore, the dot map has other important uses in civil defense planning. It shows at a glance where the people are in the city and is especially valuable for estimating shelter needs and the probable distributon of casualties and uninjured-unhoused. In this latter respect, the dot maps differ from the corresponding isorithmic maps which indicate the probable number of casualties for any given position of ground zero, but do not show the probable distribution of casualties.

6.16 This method requires only a moderate amount of work. For a city of 1½ million population, including suburbs, the entire process of preparing 2 isorithmic maps required 9 man-days. Relatively inexperienced personnel were employed and calculations were performed with an adding machine and slide rule. A considerable saving of time might be effected by the use of a calculator and a trained operator. Additional maps for other bomb sizes and for other conditions of warning may be prepared from the same calculations at less than 1 man-day per map. Most of the work may be performed by personnel of clerical grade under the intermittent supervision of someone who is trained in engineering, architecture, geology, or drafting. The supervisor would also perform the more complicated parts of the process.

Preparing Isorithmic Maps

6.17 After the number of casualties (fatal and nonfatal) and uninjured have been calculated for each of the hypothetical ground





249828 O—53 (Face p. 41) No. 1

FIGURE 8.

FATAL CASUALTIES FOR CITY A (INLAND CITY WITH INDUSTRIAL SUBURBS)

$2\frac{1}{2}$ (X) BOMB-AIRBURST AT OPTIMUM HEIGHT-DAYTIME WITH WARNING

(CASUALTY FIGURES IN THOUSANDS)

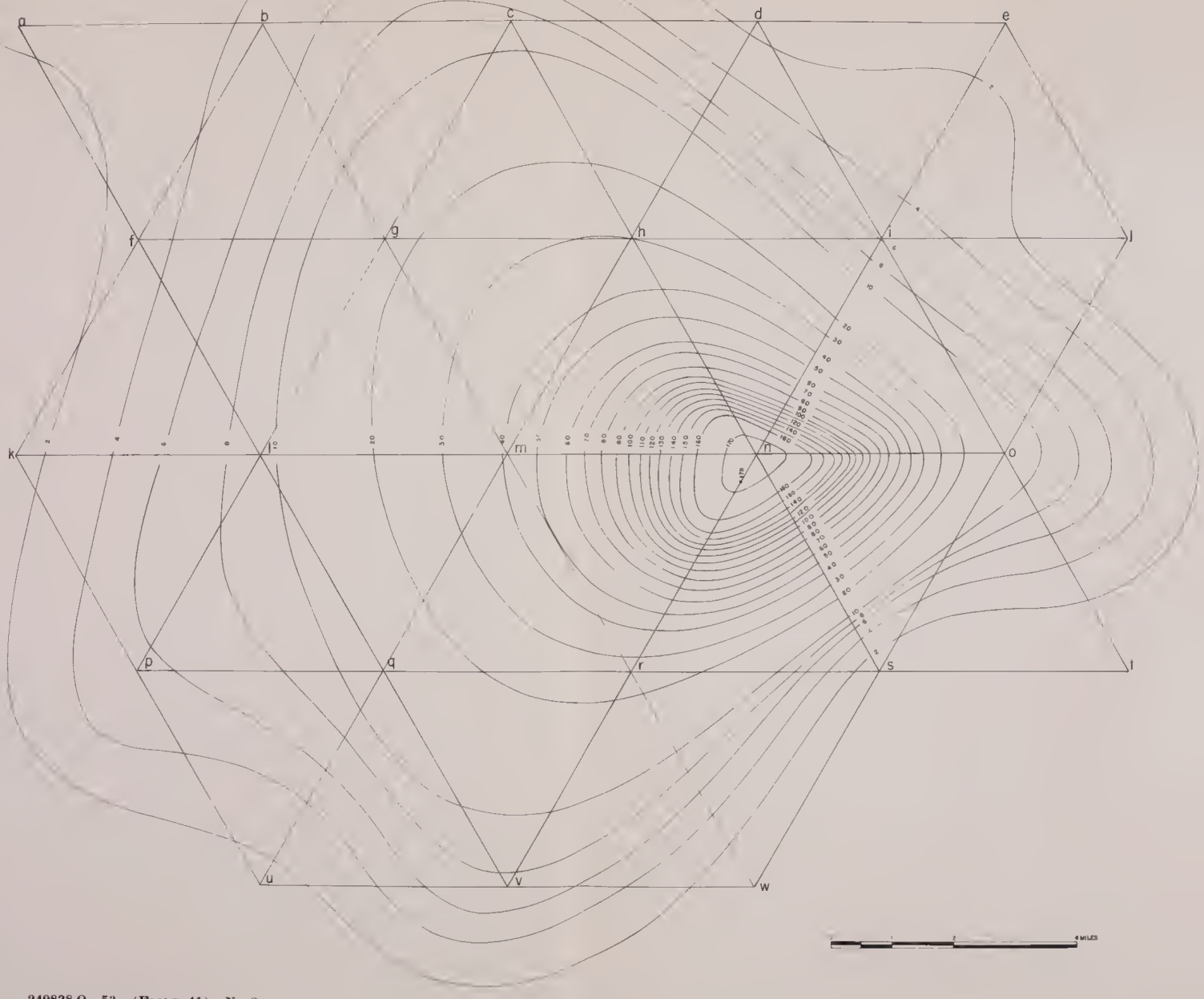


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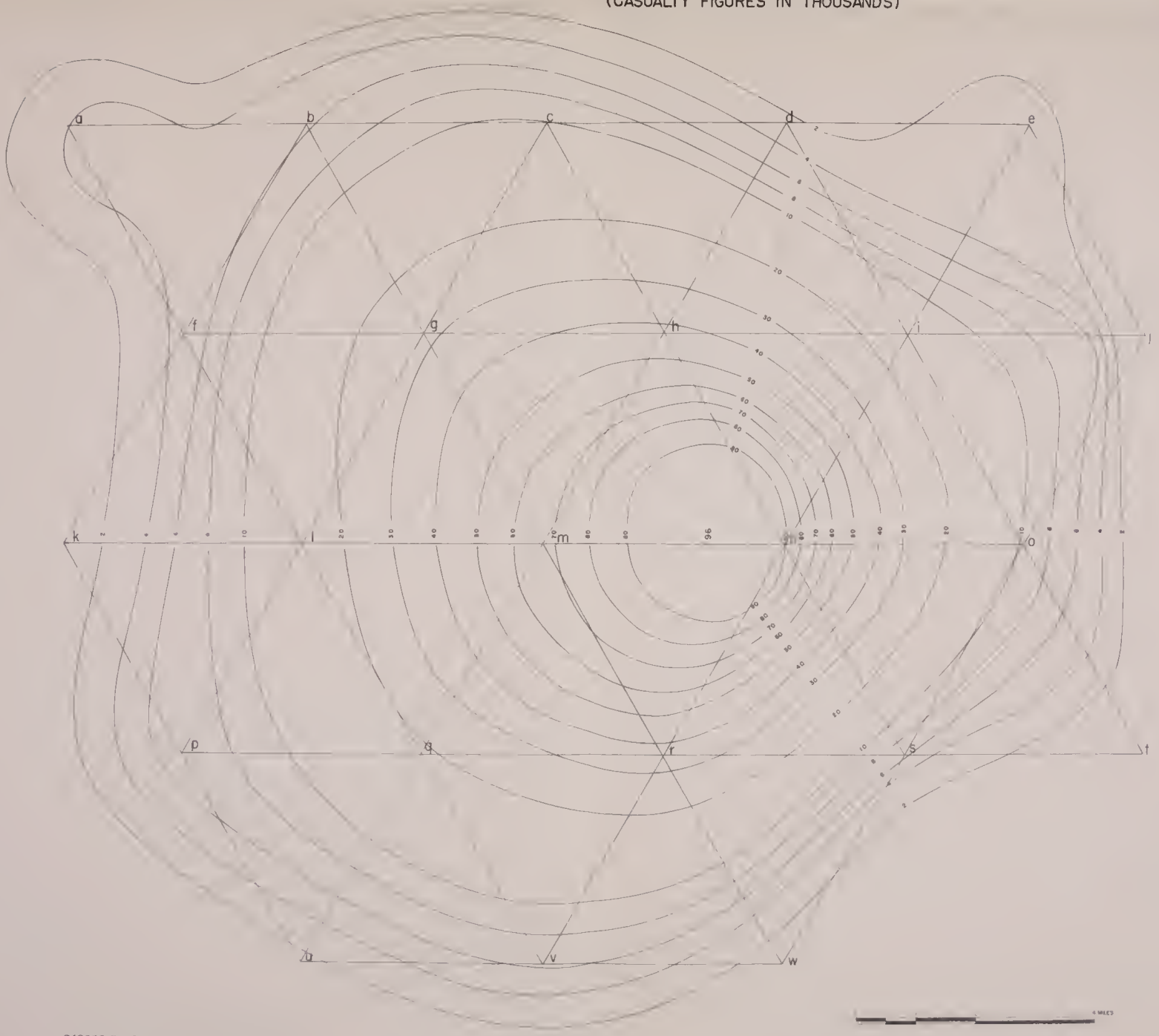
FIGURE-9.

NON-FATAL CASUALTIES FOR CITY A (INLAND CITY WITH INDUSTRIAL SUBURBS)

2½ (X) BOMB - AIRBURST AT OPTIMUM HEIGHT - DAYTIME WITH WARNING

(CASUALTY FIGURES IN THOUSANDS)



249828 O—53 (Face p. 41) No. 3

FIGURE 10.

zeros, isorithmic maps are prepared. The procedure is the same for fatal and nonfatal casualties and uninjured. Fatal casualties are used in the following procedure:

(*a*) Cover the grid (see step (*b*), par. 6.11) with a sheet of tracing paper. Attach securely and trace the grid in ink.

(*b*) At each intersection of the grid, record the total fatal casualties for a bomb located at that particular hypothetical ground zero.

(*c*) On an ordinary sheet of graph paper, plot fatal casualties along the vertical axis on the left side of the graph paper. Start with zero at the bottom and go up the scale using an interval of 2 (000) up to 10 (000) for the suburban or less densely populated areas. An interval of 10 (000) is used in most cases for the city proper. However, for cities with very densely populated areas, intervals of 20 (000) or even more may be required for these central areas. On the horizontal axis, plot distance. Starting at zero, measure off at the same scale a distance equivalent to the side of an equilateral triangle as used in the grid. In the case of city A, figure 8, this distance is 4 miles. At this 4-mile point, draw a dotted vertical line. Figure 8 shows these vertical lines drawn at 4-mile intervals.

(*d*) Starting at intersection "a" on the grid, plot the fatal casualties for the various hypothetical ground zeros along each grid line. For example, consider grid line a-f-l-q-v. For this grid line, the fatal casualties at "a" are plotted on the vertical axis; the fatal casualties at "f," 4 miles away, are plotted on the next vertical line; and so on for "l," "q," and "v." The points on grid line d-h-m-q-u are plotted in the same manner. For city A, there are 16 grid lines.

(*e*) After plotting casualties for grid line a-f-l-q-v, connect the points to form a smoothed bell-shaped curve. In cases such as d-h-m-q-u, it is necessary to locate the maximum number of fatal casualties, since the number of fatal casualties at "m" is not the maximum. This maximum may be determined from visual inspection of the dot map on which the grid is superimposed. Connect the points in a smoothed bell-shaped curve. For each group, any curve which does not conform to the shape of the other curves in its group should be adjusted accordingly. The curves at the highest and lowest points should be tangent to the horizontal lines of the graph paper.

(*f*) To determine the number of fatal casualties at specific points along the grid lines, the number of fatal casualties must be converted into terms of distance. This may be accomplished by drawing horizontal lines from the 2, 4, 6, 8, 10, 20 (000), etc., fatal casualty points on the vertical axis to the curve for the particular grid line. Then from these points of intersection with the curve, drop perpendiculars to the base line. Where these perpendiculars meet the base line, indicate the number of fatal casualties.

(*g*) On a separate strip of paper, mark off the intersection of perpendiculars and base line to make a measuring device for use in mark-

zeros, isorithmic maps are prepared. The procedure is the same for fatal and nonfatal casualties and uninjured. Fatal casualties are used in the following procedure:

(*a*) Cover the grid (see step (*b*), par. 6.11) with a sheet of tracing paper. Attach securely and trace the grid in ink.

(*b*) At each intersection of the grid, record the total fatal casualties for a bomb located at that particular hypothetical ground zero.

(*c*) On an ordinary sheet of graph paper, plot fatal casualties along the vertical axis on the left side of the graph paper. Start with zero at the bottom and go up the scale using an interval of 2 (000) up to 10 (000) for the suburban or less densely populated areas. An interval of 10 (000) is used in most cases for the city proper. However, for cities with very densely populated areas, intervals of 20 (000) or even more may be required for these central areas. On the horizontal axis, plot distance. Starting at zero, measure off at the same scale a distance equivalent to the side of an equilateral triangle as used in the grid. In the case of city A, figure 8, this distance is 4 miles. At this 4-mile point, draw a dotted vertical line. Figure 8 shows these vertical lines drawn at 4-mile intervals.

(*d*) Starting at intersection "a" on the grid, plot the fatal casualties for the various hypothetical ground zeros along each grid line. For example, consider grid line a-f-l-q-v. For this grid line, the fatal casualties at "a" are plotted on the vertical axis; the fatal casualties at "f," 4 miles away, are plotted on the next vertical line; and so on for "l," "q," and "v." The points on grid line d-h-m-q-u are plotted in the same manner. For city A, there are 16 grid lines.

(*e*) After plotting casualties for grid line a-f-l-q-v, connect the points to form a smoothed bell-shaped curve. In cases such as d-h-m-q-u, it is necessary to locate the maximum number of fatal casualties, since the number of fatal casualties at "m" is not the maximum. This maximum may be determined from visual inspection of the dot map on which the grid is superimposed. Connect the points in a smoothed bell-shaped curve. For each group, any curve which does not conform to the shape of the other curves in its group should be adjusted accordingly. The curves at the highest and lowest points should be tangent to the horizontal lines of the graph paper.

(*f*) To determine the number of fatal casualties at specific points along the grid lines, the number of fatal casualties must be converted into terms of distance. This may be accomplished by drawing horizontal lines from the 2, 4, 6, 8, 10, 20 (000), etc., fatal casualty points on the vertical axis to the curve for the particular grid line. Then from these points of intersection with the curve, drop perpendiculars to the base line. Where these perpendiculars meet the base line, indicate the number of fatal casualties.

(*g*) On a separate strip of paper, mark off the intersection of perpendiculars and base line to make a measuring device for use in mark-

ing off the fatal casualties in terms of distance on the grid line. Figure 8 shows this process for d-h. Note that the measuring device is good for only one triangular side—in this case d-h. Similar measuring devices must be developed for h-m, m-q, and q-u.

(*h*) Repeat the same process for each curve.

(*i*) Place each marked strip beside the corresponding line of the grid (see step (*a*)) and transfer the points of 2, 4, 6 (000), etc., to the line. Repeat this process with the other strips and grid lines.

(*j*) Draw smooth curves through points of equal value to develop a pattern of isorithms similar to figures 9 and 10. At first, a few isorithms should be sketched freehand at rather wide intervals. Then sharp bends and minor irregularities should be smoothed out by passing the isorithms through the average position of two or more adjacent points. Finally, intervening isorithms should be drawn approximately parallel to the first isorithms. If the correct shape of the isorithms for some part of the map is in doubt, additional check curves similar to those in step (*d*) may be drawn by connecting points which are not located on the same grid line. For example, points i, m, and p in figure 8 may be connected. Selection of the isorithmic interval (or casualty values for adjoining isorithms) will depend largely on the density and distribution of population as explained in step (*c*) of this paragraph.

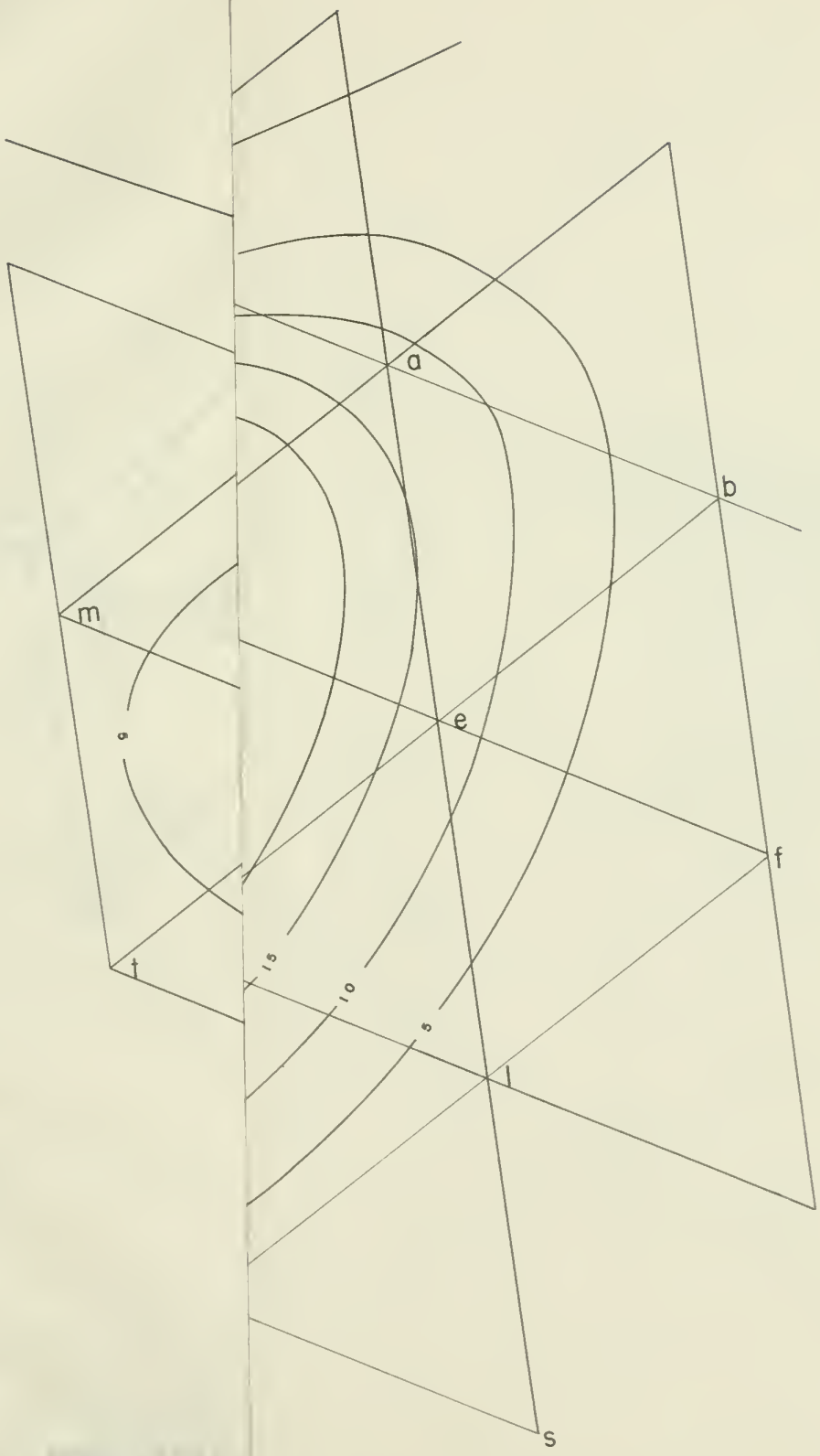
(*k*) For cities which are located directly on the shore of a lake or ocean, an isorithm of no casualties (zero line) may be plotted offshore as indicated for city B, figures 11 and 12. This is easily accomplished by placing the overlay with the concentric circles (step (*c*), par. 6.11) on the isorithmic map (step (*j*), above) which is still attached to the tract map in such a way that the outermost circle in which casualties occur barely touches the shoreline. The location of the center of the pattern of concentric circles is then marked on the isorithmic map. This process is repeated for a number of points along the shore and the centers so located are connected by an isorithm.

(*l*) When the pattern of isorithms has been completed it should be transferred to the standard city base map to indicate the relationships between the isorithms and definite features of the city.

6.18 The patterns of isorithms presented in figures 9, 10 (city A) and 11, 12 (city B) are characteristic of those which may be expected respectively in inland manufacturing cities and in cities located on the shores of the Great Lakes.

Method of Preparing Maps Showing Uninjured-Unhoused

6.19 The method used in preparing isorithmic maps of uninjured-unhoused is basically the same as that for casualties. Figures for uninjured persons are computed at the same time as those for casualties.

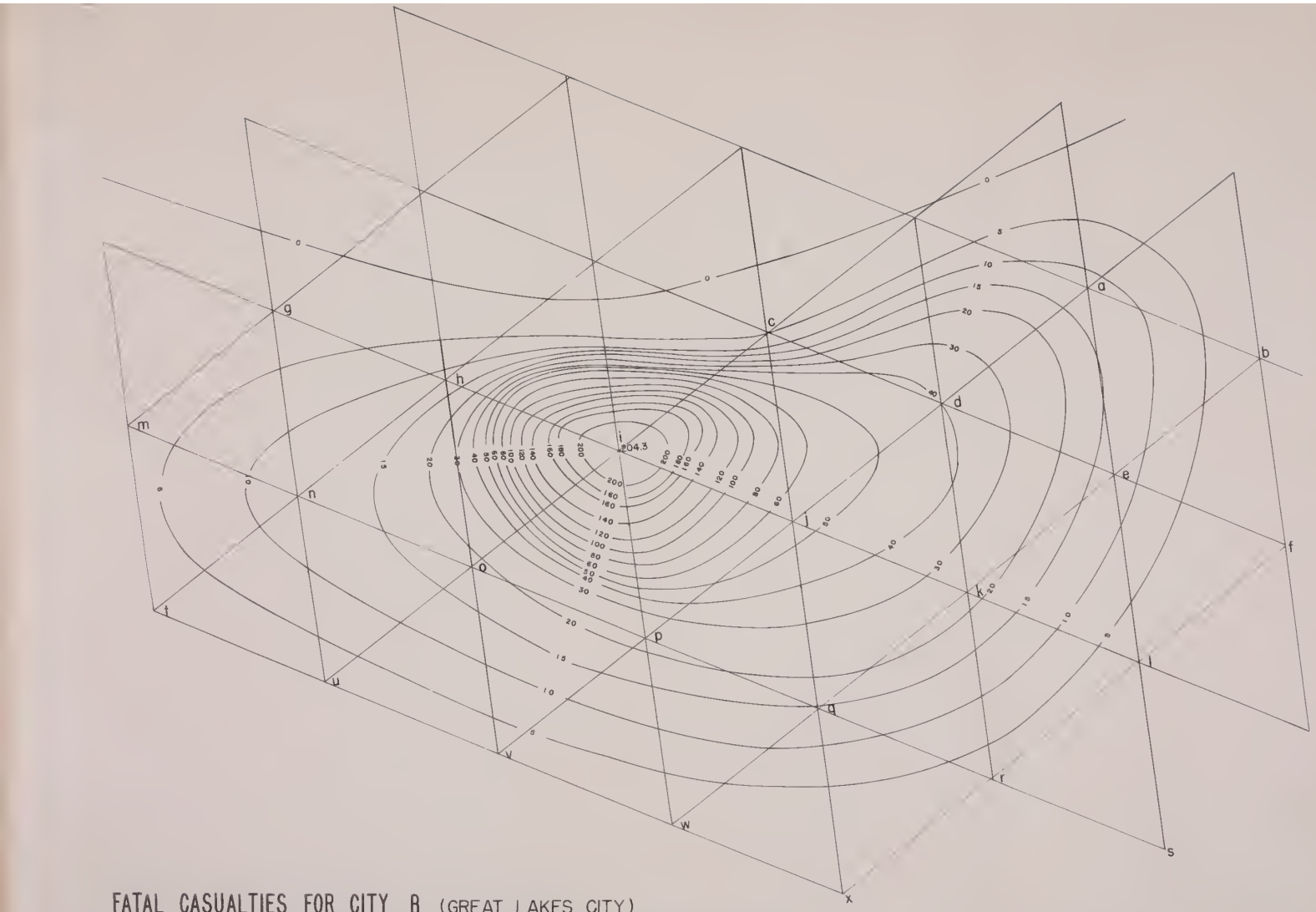


FATAL CASU

$2\frac{1}{2}$ (X) BOMB

2 4

ILES



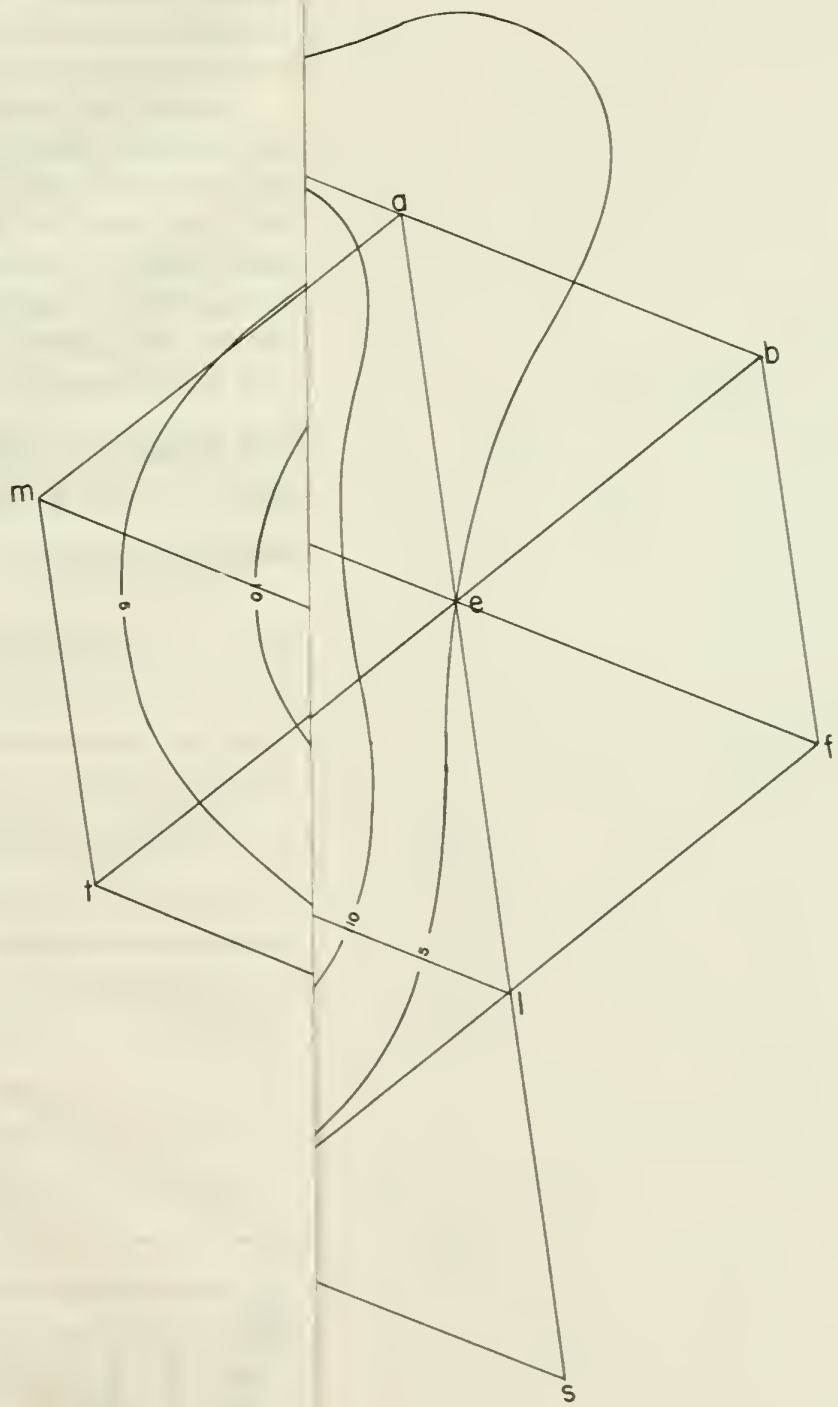
FATAL CASUALTIES FOR CITY B (GREAT LAKES CITY)

2½ (X) BOMB - AIRBURST AT OPTIMUM HEIGHT - DAYTIME WITH WARNING

(CASUALTY FIGURES IN THOUSANDS)

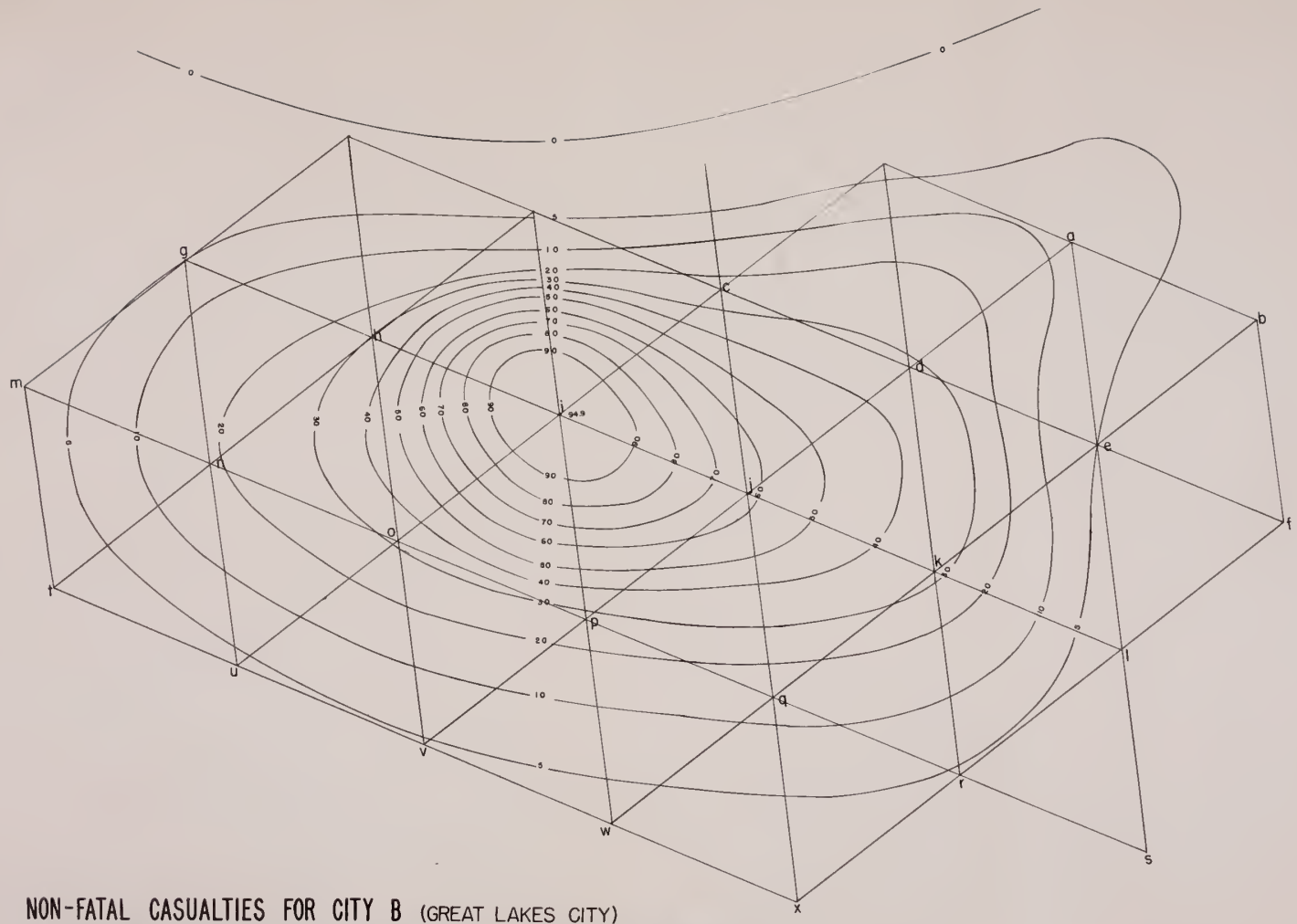
FIGURE 11.

249828 O—53 (Face p. 42) No. 1



NON-FATAL CA

2 1/2 (X) BOMB -



NON-FATAL CASUALTIES FOR CITY B (GREAT LAKES CITY)

2½ (X) BOMB - AIRBURST AT OPTIMUM HEIGHT - DAYTIME WITH WARNING

(CASUALTY FIGURES IN THOUSANDS)

FIGURE 12.

249828 O—53 (Face p. 42) No. 2

6.20 For a night attack, the number of uninjured-unhoused may be estimated readily by determining the number of uninjured who live within the zones of A-, B-, and C-damage. The method for converting the figures for uninjured by concentric half-mile rings to corresponding values for damage zones is illustrated in figure 13.

6.21 For a day attack, it is necessary to determine the uninjured who were at home when their dwellings were rendered uninhabitable and those who escaped injury because they were away from home at the time of the attack.

6.22 The procedure is as follows:

(*a*) Using figures for uninjured by half-mile rings, prepare a graph similar to figure 13. Plot for each ring the number of uninjured in thousands (vertical) against distance from ground zero in miles (horizontal). The figures for uninjured are recorded for radii of 0.5, 1.0, 1.5 miles, etc., to include all half-mile rings in which casualties occur. These figures are cumulative; for example, the value for 1.5

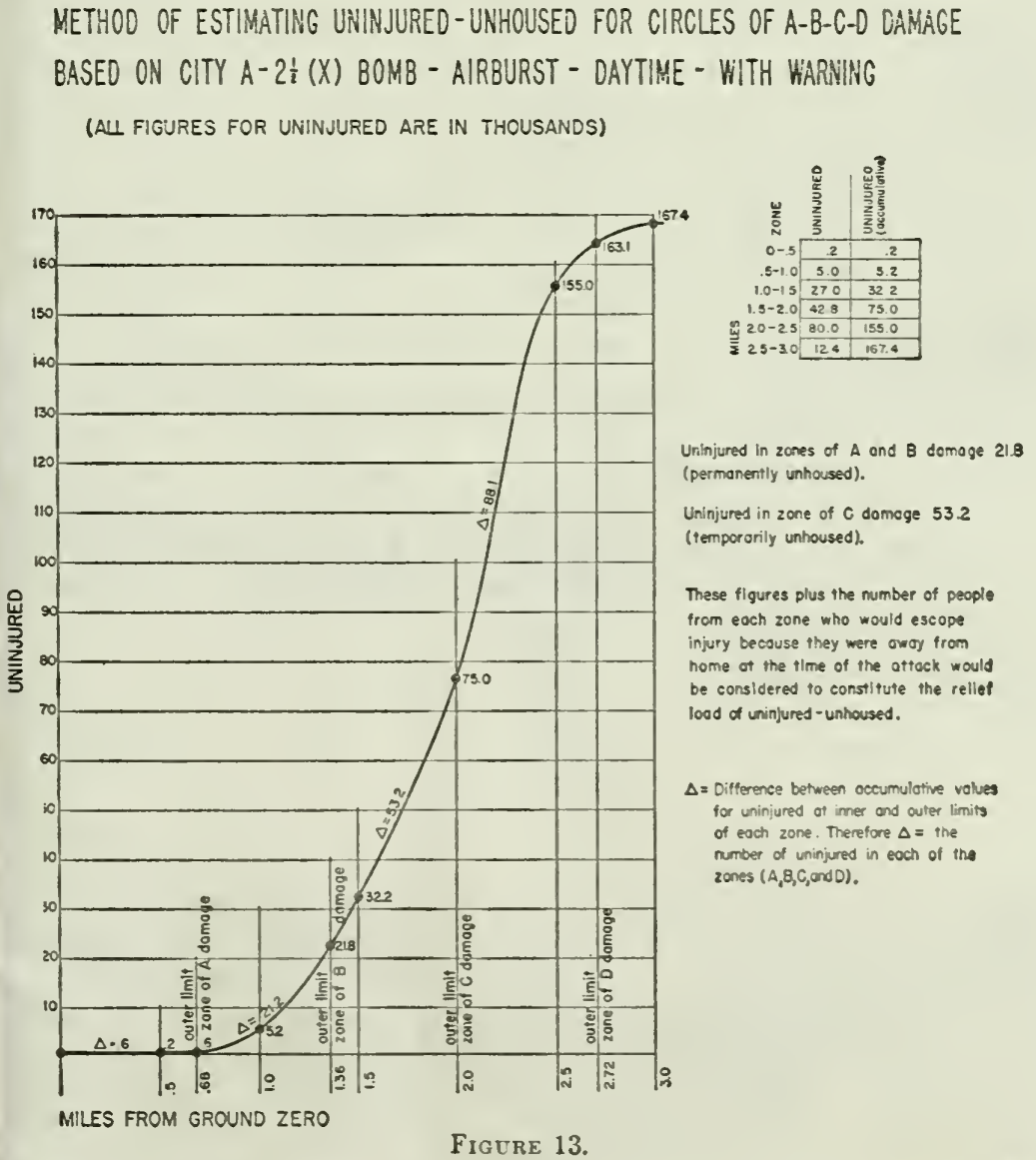


FIGURE 13.

miles represents the total number of uninjured who were present in their homes at the time of the attack in the three concentric rings of 0.0–0.5, 0.5–1.0, and 1.0–1.5 miles. When the points have been plotted, connect them with a smooth curve.

(*b*) On the base line, lay off intervals proportional to the radii of the circles that bound the zones of A-, B-, C-, and D-damage for the predetermined size of the bomb (table I, page 13).

(*c*) Erect perpendiculars to the base line at these points to intersect the curve. Read the number of uninjured for each of these points of intersection and record these values at the points (for example, 0.6 for the outer limit of the zone of A-damage and 21.8 for the outer limit of the zone of B-damage).

(*d*) Determine the number of uninjured (Δ in figure 13) in each of the damage zones in which casualties occur, by subtracting the number for the inner edge of the zone from that for the outer (for the zone of B-damage, $21.8-0.6=21.2$).

(*e*) Add together the uninjured for the zones of A- and B-damage who were at home during the attack. Those people would be homeless because their houses would be either destroyed (A-damage) or damaged beyond repair (B-damage). The uninjured for the zone of C-damage would be unhoused pending extensive repairs to their homes. Buildings in the zone of D-damage are assumed to be habitable; therefore, uninjured from this zone are not considered to be unhoused.

(*f*) Determine for each census tract the number of people who would be away from home at the time of attack and would probably escape death or injury. These figures may be calculated as follows:

(1) Place a sheet of tracing paper over a tract map and grid for the city.

(2) Compare for each tract the resident and day population. For the tracts in which the resident population is larger than the day population, record the difference (number of people away from home) on the tracing paper as though it applied to the central point in the tract.

(3) At each hypothetical ground zero on the grid, superimpose a sheet of tracing paper or acetate marked with circles that bound the zones of A-, B-, and C-damage. Determine for the A plus B zones and for the C zone, the number of people who would be away from home.

(*g*) For each hypothetical ground zero, add these figures to the uninjured who were in their homes in zones A plus B and in C at the time of attack, to obtain the total number of uninjured-unhoused for each grid intersection.

(*h*) Prepare isorithmic maps from this total number in the same manner as for casualties. All uninjured-unhoused (those who live in zones A, B, and C) may be mapped together, or those in zone C whose houses can be repaired may be mapped separately.

6.23 Regarding the above procedure it should be noted that these figures for uninjured-unhoused do not include all persons who will require emergency welfare services. For example, dependents of persons killed or injured may require emergency welfare services such as financial assistance. Persons temporarily unemployed as a result of destruction of their places of work may require assistance in moving their families to a new location. A considerable part of the surviving population of the city may require temporary assistance in the form of lodging, food, and clothing. Many more will require temporary feeding only.

Estimation of Casualties and the Uninjured-Unhoused Following a Single Bomb Attack

6.24 The same procedure is used to estimate the casualties and uninjured-unhoused from a single bomb attack. It is necessary as a first step to determine the bomb size and the location of ground zero. Then the ground zero is marked on the isorithmic map which has been prepared for the same size bomb, the same time of day, and the same conditions of warning. Using figure 9 as an example, if the ground zero for a 2½(X) bomb is located half-way between the isorithms of 80 and 100, the value will be 90 and the fatal casualties will be 90,000.

6.25 Any given isorithmic map presents information for only one size of bomb, for resident population or day population, and for one condition of warning (surprise or alert).

6.26 A map prepared for one condition of warning (surprise) may be used for the other condition (alert) provided the casualty values for all ground zeros are recalculated by using appropriate multipliers. As a result of the recalculation, the numerical values of all isorithms will be changed and many of them will have uneven values, for example 27.3 (000) instead of 29 (000). Even-valued isorithms may be sketched in, if desired.

6.27 On the other hand, maps for a daytime attack cannot be converted to represent nighttime conditions and isorithms for one size of bomb cannot be renumbered to represent casualties for another size. The first conversion is impossible because of the marked shift of population into the urban center in the daytime and out of it at night, and the second because an increase in bomb size may extend the casualty zones for the various hypothetical ground zeros into areas of markedly different population densities. Consequently, not only would the values of the isorithms be altered, but also their shapes.

6.28 However, if isorithmic maps have been prepared for two sizes of bombs, casualties or uninjured-unhoused for other sizes of bombs may easily be determined for any given point on the map by means of a graph similar to figure 14. On this graph both the horizontal and vertical scales are logarithmic. Bomb sizes in (X) values are plotted horizontally and casualties or uninjured-unhoused, in thousands,

vertically. To use this graph, read the casualty figures for the same position of ground zero from isorithmic maps for two different sizes of A-bombs.

6.29 Plot these figures on the graph (104 for 1(X) and 222 for 8(X)) and connect them with a straight line. Then draw a horizontal line through the point of intersection of this straight line and the vertical line representing the bomb size for which the casualty figure is to be determined (2½(X) in the figure) and read the casualties at the left (146,000).

Estimation of Casualties and Uninjured-Unhoused Following Multiple Bomb Attack

6.30 The number of casualties and uninjured-unhoused following a multiple bomb attack may be determined from isorithmic maps by the same procedure that is used for a single drop provided the casualty or damage circles of adjacent bombs do not overlap.

6.31 If the circles overlap, the combined casualties or uninjured-unhoused cannot be determined from the isorithmic maps but can be determined as follows:

(*a*) Cover the map of population distribution which was used in preparing the isorithmic maps with a sheet of tracing paper.

(*b*) On this sheet draw two sets of concentric circles which represent the casualty zones for the two bombs, centering each set at one of the ground zeros.

(*c*) For one bomb, add the population values separately for the part of each zone inside the area of overlap and outside that area.

(*d*) Using the multipliers from table V, compute separately the casualties for the entire area of overlap and the entire area which does not overlap.

(*e*) Repeat steps (*c*) and (*d*) for the second bomb.

(*f*) Average the casualty figures for the two bombs for the area of overlap.

(*g*) Multiply this average value by 1.5 to estimate the combined casualties for this area. The use of this multiplier is based on the assumption that the casualties in the area of overlap would be halfway between the casualties for one bomb alone and the casualties for both if each acted independently of the other.

(*h*) Add the casualty figures for the area of overlap and the two non-overlapping areas to determine the total casualties for both bombs.

Determining Ground Zero and Bomb Size Following Attack

Locating Ground Zero

6.32 Various simple devices for locating ground zero after an attack are being tested. These include:

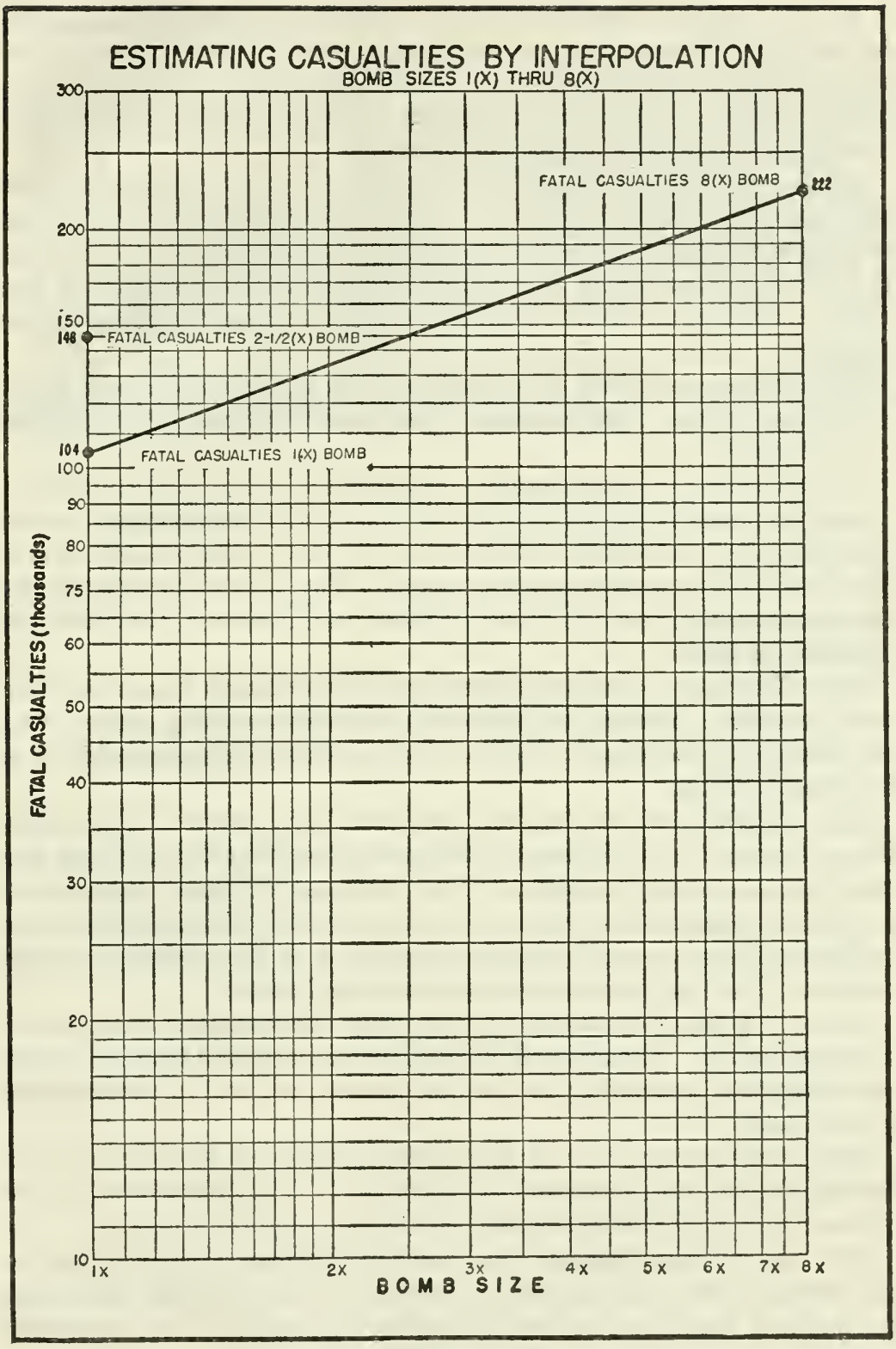

ESTIMATING CASUALTIES BY INTERPOLATION
BOMB SIZES 1(X) THRU 8(X)
FATAL CASUALTIES 8(X) BOMB
222
FATAL CASUALTIES 2-1/2(X) BOMB
148
FATAL CASUALTIES 1(X) BOMB
104
FATAL CASUALTIES (thousands)
300
200
150
100
90
80
75
60
50
40
30
20
10
1x
2x
3x
4x
5x
6x
7x
8x
BOMB SIZE

FIGURE 14.

(*a*) Flash dial—resembles a sun dial, consists of a small perpendicular metal rod mounted in the center of a wooden disk. The circumference of each disk is graduated clockwise into 360° and marked with metal numbers. Heat from the bomb explosion should char the flash dials except where the rod casts its shadow.

(*b*) Lamp shade—a section of a cone which resembles a lamp shade with a vertical rod in the center. The surface to be scorched is on the inner side of the lamp shade. The rod is designed to cast a shadow on this inner surface which is calibrated to locate the direction of the burst. The surface should be charred except where the rod casts its shadow.

(*c*) Sphere—resembles map globe with a heat-sensitive and heat-absorbing surface. The location of the scorch indicates the direction of the burst.

(*d*) Thermal radiation camera—resembles a box camera in which a magnifying lens is placed in front of a box with a calibrated screen placed at the focal point to the rear of the box. The camera should face toward the most probable target. The lens concentrates the thermal radiation so as to scorch a point on the screen, thus locating direction of burst.

6.33 The sphere and the thermal radiation camera types show the most promise. As soon as these devices for determining ground zero are more fully developed, FCDA will distribute the information in a technical bulletin.

6.34 The devices are securely attached to the roofs of large reinforced concrete or steel-framed buildings throughout the city with the zero line accurately oriented. The locations of these devices are marked on a regulation base map for the city and graduated circles or grids are drawn at each point to correspond to the markings on the devices. The map is kept in the main control room.

6.35 If a bomb detonates over the city the resultant heat should char the device. The azimuth of the charred part or of the part which is not charred, depending on the device used, will aid in determining ground zero.

6.36 On the map, draw a line in the direction of the source of the flash at the azimuth indicated by the device. The intersection of two or more such lines will determine the location of ground zero.

6.37 In a similar fashion, the height of the burst (air zero) may be determined from the grids on the various devices which are calibrated for vertical angles as well as for horizontal angles. The horizontal angles give azimuth; the vertical angles give height.

6.38 Following attack, wardens should reach undamaged devices as quickly as possible and transmit the readings to the zone control center through prearranged communications channels.

Determining Size of Bomb

6.39 The size of the bomb may be determined on the basis of reports furnished by wardens. These reports when plotted on the base map and compared with the information on figure 1, page 17, and table I, page 13, will indicate the approximate size of the bomb.

6.40 Air reconnaissance should be used wherever practicable to determine the extent of damage after attack. The cloud which follows an atomic explosion and the dense smoke associated with fire storms may seriously interfere with air reconnaissance and air photography for several hours after an attack.

6.41 All possible methods of reconnaissance should be employed with a view to assessing the extent of damage to a city in the shortest possible time.

MAPS USED IN PLANNING OPERATIONS

7.1 Maps and other information obtained or developed in a civil defense urban analysis should be made available to civil defense services to assist them in preparing their operational maps.

7.2 Each service should be given a map of the overall defense pattern of the city (web defense map or other), and an emergency street and highway map developed by the engineering services which shows the traffic control and evacuation assembly plan. In addition, each service should be furnished specific maps and information pertinent to their operations. The material which follows should be used as a guide for preparing operational maps and not as the final answer.

Fire Services

7.3 Specific maps and pertinent information to be furnished the fire services:

(*a*) Building construction.
(*b*) Fire susceptibility.
(*c*) Firebreaks.
(*d*) Industrial plants.
(*e*) Facilities dealing with highly flammable or explosive materials.
(*f*) Facilities and storage plants which may yield poisonous gases.
(*g*) Water distribution system and auxiliary sources.
(*h*) Sewerage system, garbage collection, and disposal services.
(*i*) Pipelines and storage tanks (gas and petroleum).
(*j*) Port facilities.
(*k*) Fire stations.
(*l*) Garages and used car lots.
(*m*) Barrier terrain.
(*n*) Prevailing winds.
(*o*) Building density.
(*p*) Building heights.

Operational Fire Map

7.4 The fire map, designed both for planning and operational use, should represent most of the principal features and conditions which will affect fire operations in time of alert or attack. The map showing fire susceptibility characteristics is the basic map used for developing the fire map. Fire susceptibility characteristics are represented on the map by area patterns of widely spaced lines which will not

obscure other symbols. Each area should be enclosed by a boundary. To the fire susceptibility map should be added the following:

(*a*) Firebreaks, existing and projected, including steep ridges.

(*b*) Fire stations, existing and projected.

(*c*) Storage places for fire-fighting equipment and supplies.

(*d*) Water distribution system including pumping plants, reservoirs, standpipes, principal mains with service areas for each, cross-connections between service areas, main valves, flumes, river crossings, and other especially vulnerable parts of the system.

(*e*) Location, quantity, and availability of emergency water supplies including high pressure system.

(*f*) Sewer system including main sewers (storm or sanitary sewage) syphons, pumps, or tide gates which may be used in retaining or introducing water in sewers for use in fire fighting.

(*g*) Plants and facilities dealing with highly flammable, explosive, or noxious materials.

7.5 Such features as main valves and highly vulnerable parts of the water system should not be represented on maps intended for wide circulation. They should appear only on key maps in the possession of responsible officials of fire departments, water departments, and civil defense organizations.

Engineering Services

7.6 Specific maps and pertinent information to be furnished the engineering services include:

(*a*) Building density.
(*b*) Building construction.
(*c*) Building heights.
(*d*) Offices of construction and earth-moving contractors.
(*e*) Underground openings.
(*f*) Barrier terrains.
(*g*) Low areas.
(*h*) Firebreaks.
(*i*) Streets and highways.
(*j*) Bridges.
(*k*) Tunnels.
(*l*) Electric power system.
(*m*) Telephone system.
(*n*) Teletype system.
(*o*) Radio and TV facilities.
(*p*) Pipelines and storage tanks (gas and petroleum).
(*q*) Water distribution system and auxiliary sources.
(*r*) Sewerage system, garbage collection and disposal services.
(*s*) Port facilities.

Operational Engineering Maps

7.7 Operational engineering maps are designed for use by different branches of the engineering services. This group of maps includes:

(*a*) Construction map.
(*b*) Emergency street and highway map.
(*c*) Power and communications map.
(*d*) Water, sewerage, gas, and petroleum map.

Construction Map

7.8 The construction map is used in estimating possible damage by blast and fire as well as for engineer planning, training, and operations. This map is basically a map of building types by areas to which has been added other information of value to engineering forces engaged in demolition, rubble clearance, opening of emergency routes, and rescue work. Building types should be represented by area patterns of widely spaced lines or color which will not obscure other features. The following building categories should be recognized:

(*a*) Wood frame—combustible.
(*b*) Masonry wall bearing—combustible.
(*c*) Noncombustible.
(*d*) Fire resistive.

7.9 Wood frame buildings in this category may have wood siding, asbestos or asphalt shingles, sheet metal siding, stucco or brick veneer exteriors. These buildings are most susceptible to fire.

7.10 Masonry wall-bearing buildings have load-bearing walls of brick, stone, or concrete blocks. Floors, roofs, and interior partitions are made of combustible material.

7.11 Noncombustible buildings are built of noncombustible materials which may be damaged by intense heat, such as unprotected steel-framed structures. Most noncombustible buildings are one story high with steel frames and metal or asbestos sheathing. Many modern industrial buildings are of this type.

7.12 Fire-resistive structures are built entirely of noncombustible materials with fireproof protection for the structural members. Such buildings are designed to withstand burning of their contents without damage to structural members. Reinforced-concrete and protected steel-framed structures are included in this category.

7.13 Information relative to building construction may be obtained either from Sanborn atlases or from offices of the building inspector, city engineer, or fire chief. Employees of these offices can be of great assistance in mapping building construction.

7.14 Excessive detail should be avoided in plotting. The object is to block-in areas of greater than ¼ square mile which have one general type of construction. Scattered buildings of other types which comprise less than 20 percent of the total structures within the area should be disregarded unless such buildings are particularly

significant for the engineering or fire services. Such exceptions would be groups of fire-resistive buildings sufficiently large to constitute firebreaks. To complete the construction map the following items should be plotted on the map of building type:

(*a*) Principal shelters.

(*b*) Existing and proposed firebreaks.

(*c*) Location of engineering supplies. (Most engineering equipment is moved directly from job to job.)

7.15 Overlays of building density and building heights may be used with this map for the solution of such problems as the probable type and depth of rubble. The overlay of building heights should represent the following categories in stories: 1–2, 3–5, 6–9, and 10 or more. Individual buildings differing in height from surrounding buildings should be disregarded unless of special significance, as in the case of the map of building types. This information may be obtained from Sanborn atlases or from maps prepared by building inspectors or municipal engineers.

Emergency Street and Highway Map [1]

7.16 This map is intended for use by the engineering services and should be incorporated in the general civil defense transportation map. The first step is to select tentatively on the standard base map, those major streets which lead most directly from the center of the city to the suburbs. These routes should be so spaced that each would serve a part of the city population proportional to the probable capacity of the route under emergency conditions. Similarly, cross routes or belt lines should be selected. Wherever possible, routes should be at least 120 feet wide between buildings on opposite sides of the street.

7.17 Next, a team consisting of an engineer and a driver should follow each of these routes and mark on the map any places which may become blocked in the event of an enemy attack. Potential obstacles which should be noted include:

(*a*) Buildings which may collapse and block the street with rubble.

(*b*) Large trees which may fall into the street.

(*c*) Bridges, elevated lines, overpasses, underpasses, and tunnels which may be damaged.

(*d*) Overhead wires.

7.18 The assumption should be made that walls of wall-bearing structures may fall their full height away from the point of detonation of an A-bomb. Therefore, a street 100 feet wide flanked by buildings 100 feet high may be almost completely blocked. For buildings with steel or concrete frames, rubble probably would fall not more than half of the building height away from the point of detonation. The

[1] *Utilization and Control of Streets and Highways in Civil Defense Emergencies*, TM–13–1, 1953, FCDA.

heights of the buildings as related to the widths of the streets may readily be determined by observation during the field survey.

7.19 In estimating the probability that a given street may be blocked by rubble, consideration should be given to its location with respect to the assumed aiming point or points.

7.20 Following the field examination of the routes, other possible causes of blocking should be studied in the office. For example, a study of topographic maps and records of street and sewer departments will identify low areas which may be flooded by sewer overflow or damage to reservoirs. In these areas, also, poison gas, aerosols, dangerous fumes from burning stocks of paint, plastics, or from damaged refrigeration plants may accumulate.

7.21 Maps of the sewer system will serve to locate large sewers under streets which may explode due to ignition of sewer gas, fuel gas, or gasoline with resultant damage to the street surface.

7.22 Blocking may also result from traffic bottlenecks, both those which exist normally and those which may develop following an attack as a result of damage to a main emergency route. To locate these latter potential obstacles, assume in succession that various parts of the emergency route system are blocked, and plan to re-route the traffic accordingly.

7.23 When all potential obstacles to traffic have been plotted on the map, the final step is to select detours or alternate routes and repeat this procedure for the other main emergency routes.

Power and Communications Map

7.24 This map, which is to be used by emergency electrical repair forces, should represent the following items:

(*a*) Electric power system, including all power plants, substations, transformer stations, primary and secondary power lines (overhead or underground). Voltages (d. c. or a. c. and number of cycles) should be indicated for all lines, plants, and stations as well as parts of the city served by each main trunk line.

(*b*) Telephone system, including exchanges, long distance cables, main trunk cables within the city, indicating which are above ground and which are below. The area served by each exchange should be outlined. If this information can not be obtained indicate the location of all telephone structures.

(*c*) Telegraph system including principal lines (overhead or underground), principal offices, and power supply.

(*d*) Broadcasting system (radio and television), including location of studio and transmitter, normal and auxiliary sources of power.

(*e*) Locations of repair equipment and supplies.

7.25 If several wires follow the same route, more than one map may be necessary to present information regarding power and communications.

Water, Sewage, Gas and Petroleum Map

7.26 This map resembles the previous map in design and intended use. If necessary, two maps may be prepared—water and sewage; gas and petroleum. The following items should be plotted:

(*a*) Water system, including critical features such as pumping plants, principal mains, main control valves, bypasses or loops, reservoirs, dams, flumes, and intakes. Areas served by the various mains should be outlined by an appropriate line symbol.

(*b*) Sewer system, including main sewers, and critical features such as pumps, syphons, tide gates, disposal plants, and discharge points. Areas drained by various main sewers should be outlined by an appropriate line symbol.

(*c*) Gas and petroleum pipelines, including pumping and control stations, storage tanks, and especially vulnerable parts of pipelines (e. g., river crossings).

(*d*) Locations of repair equipment and supplies.

Emergency Welfare Services

7.27 Specific maps and pertinent information to be furnished the welfare services include:

(*a*) Population distribution.
(*b*) Public Buildings.
(*c*) Potential welfare facilities.
(*d*) Sources of supplies for emergency use.
(*e*) Penal institutions.
(*f*) Potential assembly areas.
(*g*) Isorithmic maps for uninjured-unhoused.
(*h*) Land use.
(*i*) Dwelling units.
(*j*) Hospitals.
(*k*) Welfare agencies.
(*l*) Morgues and funeral homes.
(*m*) School population.
(*n*) Fire susceptibility.
(*o*) Number of employed.
(*p*) Distribution of children under 5 years.

Operational Emergency Welfare Map

7.28 On the emergency welfare map should be indicated the welfare service facilities (mass care centers, welfare service centers, evacuation assembly and reception areas) as well as the low areas which may become flooded as a result of an A-bomb attack or in which poison gas or aerosols may accumulate. Welfare service facilities should be plotted as dots with initials. Low areas should be outlined on the map by depression contours (lines passing through points of equal elevation and bordered on the downhill side by short straight lines perpendicular

to the contour). Information for presenting low areas should be obtained from topographic maps or other sources.

7.29 The emergency welfare map should be studied in relation to probable bomb damage and casualties. This procedure will indicate what facilities and what personnel may be expected to survive in a bombing. Two transparencies will be required to make the study. One transparency should show the patterns of concentric circles for A-, B-, C-, and D-damage (one pattern for each size bomb); another transparency should show ½-mile concentric circles for the casualties. These transparencies could then be superimposed on the emergency welfare map and centered at the assumed aiming point or points.

Health Services

7.30 Specific maps and pertinent information to be furnished this service include:

(*a*) Population distribution.
(*b*) Water distribution system and auxiliary sources.
(*c*) Sewerage system, garbage collection, and disposal services.
(*d*) Public buildings.
(*e*) Potential hospitals.
(*f*) Penal institutions.
(*g*) Potential assembly areas.
(*h*) Hospitals.
(*i*) Morgues and funeral homes.
(*j*) Low areas.
(*k*) Isorithmic maps of casualties.

Operational Health Map

7.31 The health map, designed for both planning and operational use, should represent the following features and conditions:

(*a*) Hospitals (existing, projected, and emergency, including contagious and mental).
(*b*) Doctors' offices.
(*c*) Morgues, undertakers, and garages for mortuary vehicles.
(*d*) Low areas which may become flooded as a result of an A-bomb attack or in which poison gas or aerosols may accumulate.
(*e*) Sites for first-aid stations.

7.32 In preparing the health map, information for items (*a*), (*b*), (*c*), and (*e*) should be plotted as points with initials. Low areas should be indicated as described under the emergency welfare map.

7.33 The health map, too, should be studied in relation to probable bomb damage and casualties as was done with the emergency welfare map. This procedure will indicate what facilities and what personnel may be expected to survive in a bombing. As a rule most physicians in a city have their offices near the probable target center. For purposes of making the study, two transparencies similar to those prepared for studying the emergency welfare map will be required.

7.34 The health map also should be compared with a map showing the distribution of population. A dot map wherein each dot represents the same number of people (100, 200, 500, etc.) is the most suitable for this purpose. If making a comparison between these two maps is difficult, a transparent overlay can be prepared. The transparent overlay on which the dots are copied can be of acetate tracing paper, or tracing cloth. The overlay need not represent all the details of street pattern and other city features. The dots plus certain marked points of reference which match those on the health map are sufficient for the purpose.

Police Services

7.35 Specific maps and pertinent information to be furnished the police services include:

(*a*) Industrial plants.

(*b*) Plants and facilities dealing with highly flammable or explosive materials.

(*c*) Industrial and storage plants which may yield poisonous gases as a result of bombing, fire, or sabotage.

(*d*) Electric power system.

(*e*) Telephone system.

(*f*) Teletype system.

(*g*) Radio and TV facilities.

(*h*) Port facilities.

(*i*) Police stations and police broadcasting stations.

(*j*) Airports and airfields.

(*k*) Street and traffic pattern and traffic control facilities.

(*l*) Potential hospitals and welfare centers.

(*m*) Potential assembly areas.

(*n*) Zoos.

(*o*) Penal institutions.

(*p*) Hospitals.

(*q*) Low areas.

Operational Police Map

7.36 On the police map should be shown the following:

(*a*) Police stations (existing and emergency).

(*b*) Police broadcasting stations.

(*c*) Penal and other public institutions.

(*d*) Facilities essential for defense.

(*e*) Important industrial installations.

(*f*) Places where large numbers of people assemble, such as theaters and ball parks.

(*g*) Principal shelters.

(*h*) Welfare centers and evacuation camps.

(*i*) Zoos.

(*j*) Schools.
(*k*) Hospitals.
(*l*) Traffic control points and traffic routes.

7.37 In preparing the police map, all items should be represented by dots or building outlines. To insure speedy identification under emergency conditions, each feature (dot or outline) should be marked with the appropriate initial, such as D for defense installation. This procedure is simpler than employing dots of various sizes, shapes, or colors. In addition, colored dots are very expensive to print on maps for distribution to field teams.

Transportation Services

7.38 Specific maps and pertinent information to be furnished the transportation services include:

(*a*) Firebreaks.
(*b*) Streets and highways.
(*c*) Bridges and tunnels.
(*d*) Electric streetcars.
(*e*) Railroads.
(*f*) Airports and airfields.
(*g*) Port facilities.
(*h*) Street and traffic pattern and traffic-control facilities.
(*i*) Garages and used-car lots.
(*j*) Barrier terrain.
(*k*) Low areas.

Operational Transportation Map

7.39 The transportation map should show the following:

(*a*) Emergency street and highway routes.

(*b*) Streetcar routes; surface, elevated or subway, with overhead wire or third rail, protected or exposed.

(*c*) Railroad lines and terminals.

(*d*) Points where routes may become blocked as a result of enemy action.

(*e*) Airports and airfields.

(*f*) Water routes and terminals.

Warning and Communications Service

7.40 Specific maps and pertinent information to be furnished the warning and communications service include:

(*a*) Electric power system.
(*b*) Telephone system.
(*c*) Teletype system.
(*d*) Radio facilities.
(*e*) TV stations.
(*f*) Police stations and police broadcasting system.
(*g*) State and municipal communications system installations.

Operational Warning and Communications Map

7.41 The warning and communications map should contain all of the above information plus the location of the warning devices as soon as they are installed.

Rescue Service

7.42 Maps and pertinent information to be furnished the rescue service include:

(*a*) Population distribution.
(*b*) Building construction.
(*c*) Electric power system.
(*d*) Rescue units.
(*e*) Sewerage system, garbage collection, and disposal services.
(*f*) Building heights.
(*g*) Water distribution system.
(*h*) Pipeline and storage tanks (gas and petroleum).
(*i*) Plants containing highly flammable or explosive material.
(*j*) Plants capable of generating poisonous gases.

Operational Rescue Map

7.43. The rescue map should contain all information considered necessary by the rescue service.

Warden Service

7.44 The warden service should be furnished with practically all of the maps because of the wide variety of information needed by this service.

The Warden's Block Map

7.45 The warden's block map should contain such information as building construction, building height, location of shelter areas, and number of families.

DESCRIPTION OF SOURCE MAPS AND SUPPLEMENTARY MATERIAL

Census Tract and Enumeration District Maps

Census tract and enumeration district maps define areas for which census information is available. Consequently they are the most practicable for plotting population statistics. They are especially well suited for the preparation of estimates of possible A-bomb casualties. For most purposes census tract maps, because they are readily available, cheaper, and simpler to use, are preferable to enumeration district maps.

Census tracts are areas of varying size and shape, each containing approximately 5,000 residents, although some may contain only a few people, or none at all. Single tracts in a few of the larger cities may contain more than 300,000 people. Maps of these tracts have been prepared for most large and medium-sized cities, and copies are available in the municipalities concerned. Figures for resident population by census tracts together with related information are available in Bureau of the Census bulletins.

Enumeration districts are relatively small units which comprise the tracts and contain approximately 800 people. The districts vary considerably in area; one may consist of part of a single building whereas another may include 50 blocks or more. Maps of enumeration districts have been prepared by the Census Bureau for all United States cities and these may be used where census tract maps and figures cannot be obtained. Enumeration district maps are not available for general distribution. However, a few cities have these maps, and maps for other cities may be ordered from the Census Bureau at a cost of approximately $100 per 500,000 population. As an alternate possibility, descriptions of enumeration district boundaries for various cities may be obtained from the Bureau at moderate cost.

Population figures for enumeration districts may be obtained from the Bureau on special order. Approximate costs are as follows:

(*a*) To hand copy population totals; $25 per 500,000 population.

(*b*) To photostat population totals; $15 per 500,000. (These are less convenient to use than hand copy.)

(*c*) To photostat entire tabulation; $250 per 500,000.

(*d*) To prepare a breakdown by age groups, sex, or other characteristics; as much as $10,000 for a large city.

Sanborn Maps

Sanborn type maps are convenient and readily available sources of detailed information regarding buildings in all United States cities with populations of 2,000 or more. These maps indicate the type of construction, height, roof area, spacing, fire hazards, fire protection, and use. They also represent street plan, widths of streets, location and size of water mains, and routes of railroads and elevated lines within the cities.

This information is the basis for evaluation of fire susceptibility, determination of possible structural damage by atomic bomb blast, selection of buildings suitable for bomb shelters, and choosing of routes least subject to blocking by rubble.

Sanborn maps, which measure approximately 22 by 26 inches, are bound in atlas form. Maps for each of the smaller cities are contained in a single volume, and maps for the larger cities occupy a proportionate number of volumes Representative examples are:

City	*Volumes*	*City*	*Volumes*
Boston (within corporate limits)	13	New Orleans	12
Buffalo	11	New York City	79
Chicago	54	Philadelphia	28
Cleveland	21	Pittsburgh	18
Dallas	8	Portland, Oreg.	12
Detroit	28	St. Louis	20
Hartford	4	San Francisco	11
Kansas City, Mo.	8	Seattle	11
Los Angeles	40	Washington, D C	10
Milwaukee	15	Washington Suburbs	4
Minneapolis	11		

Sanborn maps are available in most cities in the offices of fire underwriters, fire chiefs, building departments, or in libraries. They may be purchased from the Sanborn Map Co., 10 Cedar Street, New York City, for approximately $300 per volume.

Topographic Maps

Topographic maps are the basic source of information concerning city and surrounding area terrain and water features. They also present general information regarding many of the physical features of the city such as street pattern, landmark buildings, parks and other open areas, highways, railroads, bridges, and tunnels. Topographic maps are especially valuable in phases of urban analysis where the vulnerability of a feature depends to some extent upon its location with respect to hills and valleys. For example, a factory which handles highly flammable materials is not a serious fire hazard to an adjoining city if they are separated by a steep ridge without buildings. As another illustration, a major traffic artery within a city may be unsuitable for use by rescue forces if it traverses low areas in which poison gas and aerosols may accummulate.

Topographic maps are published at various scales. Those produced by the Army Map Service have scales of 1/25000 (approximately 2½ inches to the mile) or 1/250000 (approximately ¼ inch to the mile). The former series provides detailed topographic information of the cities mapped, whereas the latter set affords a general view of topography over extensive areas and is limited at present primarily to the east coast. Maps prepared by the United States Geological Survey have scales of 1/24000, 1/31680 (2 inches to the mile), 1/62500 (approximately 1 inch to the mile) and 1/125000 (approximately ½ inch to the mile). Most of the more recent surveys are presented in the 1/24000 and 1/31680 series, although some are published at the scale of 1/62500. This last set also includes some of the older surveys. Maps printed at the scale of 1/125000 are, for the most part, not up to date; many of them are based on reconnaissance surveys made prior to 1900.

The United States Geological Survey has published for each State an index map which outlines the areas covered by the maps of various scales. This index shows both the maps published by the Survey and those produced by the Army Map Service. These index maps may be obtained free form the Map Distribution Section, United States Geological Survey, Washington 25, D. C. Topographic maps may be purchased from this agency.

In selecting maps, be sure that all sheets for the area covered are of the same scale, and that they are based on recent surveys.

All maps should be examined before use to determine the date of the survey or revision—not the date of publication or reprinting.

Special Purpose Maps

Special purpose maps include those produced by municipal offices, utilities companies, and market analysts and other public or private research agencies. Most of these maps represent a single feature, such as the water distribution system or the location of fire stations. Many of them already available in the cities concerned, present material required for civil defense urban analysis in forms either directly applicable or readily adaptable.

In interpreting these maps, care should be taken to differentiate between proposed conditions represented on the map and actual conditions. For example, a city zoning map cannot be taken to represent the current land use of the various parts of the city. An area which is zoned for industrial purposes may include extensive areas of vacant land as well as some low-grade residential districts.

Special purpose maps can be obtained most readily by personal contact with the producing offices. If the person making the contact is familiar with the city and with maps, this method affords an opportunity to screen the material. Personal collection also obviates lengthy delays which may result when selection is left to the office originating the material.

Hydrographic Charts

Hydrographic charts, which are printed at various scales, are the principal source of information regarding harbors, bays, and other near shore waters adjoining our cities. Since one of the features they show is depths of bodies of water, they are useful in estimating the effects of a water burst near the city. Some hydrographic charts also represent, by means of contours, the topography of the land adjacent to the seacoast. These charts may be obtained from the Coast and Geodetic Survey, Washington 25, D. C.

Street Maps

Street maps are produced both by municipalities and private companies. As a rule, maps published by private companies are based on official maps prepared by the municipal surveyor's office. In some instances they may have the advantage of more suitable scale than the official map or they may include desirable detail which does not appear on the official map.

Supplementary Materials

Where information available on maps does not fully meet the requirements of urban analysis, supplementary information may be obtained from air photos and air mosaics (composite air photos).

Ordinarily, individual air photos are more suitable for this purpose than mosaics. These individual photos, which may be obtained from the Department of Agriculture, Washington 25, D. C., afford up-to-date complete coverage for many cities and partial coverage for others. They are relatively easy to read because of their large scale. "Stereo pairs" (photographs made simultaneously at slightly different angles) afford three-dimensional pictures when examined under a special viewer.

Some air mosaics are obtainable from the Department of Agriculture and other Governmental agencies. However, because of their small scale, most are difficult to read without training in photo interpretation. If up-to-date mosaics are not available from governmental agencies, they may be obtained from private companies which will either make complete air surveys or compile mosaics from photos prepared by the Department of Agriculture.

Other sources of supplementary information are municipal files and published reports and the personal knowledge of municipal employees.

For general aspects of urban analysis, the familiarity of municipal employees with specific aspects of the city may be valuable. Some may be able to supply map information by sketching in missing features. Office files and published reports afford detailed information which may either be plotted on maps or used as a basis for operational planning. Such detailed information as the maximum capacities of hospitals or the number of trucks and buses available for emergency use should be presented in lists or tables and not be put on maps.

URBAN FEATURE MAPS NEEDED FOR URBAN ANALYSIS

The following table should serve as a guide in selecting the urban features for which information must be collected. Depending on the requirements of the city making the analysis, additional features may be added and some features may be deleted. The specific information to be placed on the various maps and the supplementary information to be compiled should be determined locally.

No.	Urban feature	Significance	Information on map	Supplementary information	Suggested sources
1	Land use.	Useful in estimating: a. Possible damage to various city functions. b. Distribution of population (in conjunction with building height and census data for tracts and enumeration districts).	Areas: a. Residential. b. Commercial. c. Industrial. d. Transportation. e. Storage. f. Institutional. g. Special. h. Recreational. i. Unused land.	None.	a. Planning commission. b. Building commissioner. c. Municipal center. d. Sanborn maps. e. Field surveys.
2	Building density—percent of total ground area covered by buildings.	a. 0–5-percent density—no significant fire hazard. b. 6–20-percent density—local fires and spreading fire under strong ground wind conditions. c. More than 20-percent density—mass fires of fire storm, and conflagration proportions are possible if areas are at least 1 square mile and buildings contain an average amount of combustible material.	a. 0–5 percent (open areas). b. 6–20 percent. c. More than 20 percent.	None.	Sanborn maps.
3	Building construction.	Useful in estimating: a. Probable character of damage to buildings and radius of damage from ground zero.	a. Wood frame—combustible (including brick veneer). b. Masonry wall-bearing—combustible.	None.	a. Planning commission. b. Building commissioner. c. Municipal engineer. d. Sanborn maps.

		b. Available shelter (general estimate). c. Fuel value of buildings for detailed studies of fire susceptibility. d. Depth and spread of rubble which may affect the passability of streets after a bombing.	e. Noncombustible. d. Fire resistive.		e. Actual field survey.
4	Building heights.	Useful in estimating: a. Fuel value of structure and contents to aid in determining susceptibility b. Probable fire spread. c. Depth and spread of rubble which may affect the passability of streets after a bombing. d. Shielding from radiation and blast. e. Distribution of population f. Available shelter (preliminary estimates).	a. 1–2 stories. b. 3–5 stories. c. 6–9 stories. d. 10 or more stories.	None.	a. Planning commission. b. Building commissioner. c. Municipal engineer. d. Sanborn maps. e. Field survey.
5	Industrial plants.	a. Potential targets for sabotage, high explosive and incendiary bombs, as well as A-bombs. b. Important in police and fire-control planning.	a. Location. b. Number of employees designated by symbols.	a. Name of plant. b. Type of industry. c. Number of employees: 1. Total workers. 2. Production workers per shift. 3. All other workers per shift.	a. Chamber of commerce. b. Board of trade. c. Planning commission. d. Manufacturer's association. e. Building commissioner. f. Sanborn maps. g. Municipal engineer. h. City directory. i. Telephone books.
6	Plants and facilities dealing with highly flammable or explosive materials.	a. May contribute to mass fires. b. Potential targets for sabotage (may be set on fire to divert emergency forces needed elsewhere or to cause panic by false reports of A-bomb attack).	a. Location. b. Type of material.	a. Name of plant. b. Type of industry. c. Number of employees: 1. Total workers. 2. Production workers per shift. 3. All other workers per shift.	a. Fire commissioner. b. Fire underwriters. c. Sanborn maps.

No.	Urban feature	Significance	Information on map	Supplementary information	Suggested source:
7	Industrial and storage plants using or capable of generating poisonous gases.	As a result of blast, fire, or sabotage: a. Chemical plants and chemical storage (typically located away from cities, on main highways, in valleys adjoining water bodies) may hamper civil defense activities, cause casualties, and require evacuation of entire areas. b. Refrigeration plants, paint and plastic storage plants may yield gases which would cause casualties and block routes. Note: These effects would be local and temporary.	a. Location. b. Type: 1. Chemical. 2. Paint. 3. Plastic. 4. Refrigeration.	a. Name of plant. b. Type of industry. c. Number of employees: 1. Total workers. 2. Production workers per shift. 3. All other workers per shift.	a. Chamber of commerce. b. Chemical societies. c. Chemical companies. d. Petroleum companies. e. Dye manufacturers. f. Manufacturers' directories. g. City directory.
8	Public shelters.	a. Reduces the number of casualties. b. Important for planning rescue operations, deployment of fire-fighting equipment, etc.	1. Location. 2. Capacity. 3. Category (See FCDA Manual TM-5-1	None.	Shelter survey.
9	Public buildings.	a. House most municipal offices. b. Contain essential records which must be preserved. c. Possible bomb shelters. d. Possible use for emergency welfare facilities and hospitals.	Location.	a. Name. b. Present use. c. Number of people for which facilities are available. 1. Cooking. 2. Lodging.	a. Planning Commission. b. Building Commissioner. c. Sanborn maps. d. Topographic maps.
10	Population distribution:	Basis for estimating: a. Civil Defense personnel requirements. b. Casualties. c. Shelter requirements.	By census tracts or enumeration districts: a. Resident population b. Day population.	None.	a. Publications and special reports of Bureau of the Census. b. FCDA. c. Actual population counts. d. Traffic studies by: 1. Street or highway departments.

					2. Public transportation companies. 3. Market analysts. 4. Telephone companies.
11	School population.	Basis for estimating: a. Number of school age children.	Schools: a. Location. b. Number of students.	None.	Board of education.
12	Armed Forces installations.	a. Potential targets for sabotage. b. Important features for potential A-bomb targets.	a. Location. b. Branch of service: 1. Army. 2. Air Force. 3. Navy (Marines).	None.	a. Planning commission. b. Building commissioner. c. Police department. d. FCDA.
13	Police stations and police communications system.	a. Bases for police operations. b. Potential targets for sabotage.	a. Location of: 1. All police stations. 2. Police stations with broadcasting facilities. 3. Transmitter. b. Outline of precinct areas.	a. Name and number of precinct. b. Number of men assigned to each station: 1. Total per shift. 2. Total all shifts. c. Power output of radio. d. Frequency.	a. Police department. b. Building commissioner. c. Sanborn maps.
14	Fire stations and fire communications systems.	a. Bases for fire control operations. b. Potential targets for sabotage.	Location of: 1. All fire stations. 2. Fire stations with broadcasting facilities. 3. Transmitter. 4. Switchboard of signal system.	a. Name and number of station. b. Number of men assigned to each station: 1. Total per shift. 2. Total all shifts. c. List of apparatus and eqnipment at each station.	a. Fire department. b. Reports of National Board of Fire Underwriters. c. Building commissioner. d Sanborn maps.
15	Rescue units and location of stored tools.	a. Bases for rescue operations. b. Potential targets for sabotage. c. Important in planning health and welfare operations.	a. Location. b. Number of squads at each location.	a. Name and number of unit. b. Number of men in each unit. c. List of equipment in each unit.	a. Police department. b. Fire department. c. Medical association.

No.	Urban feature	Significance	Information on map	Supplementary information	Suggested sources
16	Water distribution system and auxiliary sources.	a. Basis for fire control plans. b. Source of water for fire control and domestic purposes. c. Potential target for sabotage by damage to facilities or by contamination. d. Subject to damage by bombing. e. Subject to contamination by breaking of sewers or by syphoning of sewage from household fixtures when water pressure is reduced. f. Needed for emergency feeding of attack victims and civil defense workers.	a. Location: 1. Pumping and filter stations. 2. Sources of power. 3. Reservoirs (capacity)—elevated or underground. 4. Dams 5. Flumes, open channels, and exposed conduits. 6. Emergency mains and pumps—source and type of power. b. Principal mains: 1. Location and service areas. 2. Diameters. 3. Pressures. 4. Types of pipe. c. Principal valves: 1. Location. 2. Time of operation. d. Wells and other independent supplies: 1. Location. 2. Capacity. 3. Source and type of power.	a. Number of repair crews: 1. Valve service. 2. Minor repair. 3. Major repair. b. Inventory of major repair equipment: 1. Type. 2. Location. 3. Mobility. c. Inventory of bactericidal facilities: 1. Type. 2. Location. 3. Capacity. 4. Mobility. 5. Amount and location of chemical reserves.	a. Water department or company. b. Publications of National Board of Fire Underwriters. c. Health department.
17	Sewerage system and garbage collection and disposal services.	a. Possible source of water for postattack fire fighting with water coming from storm sewers by: 1. Intentional flooding of sewers. 2. Sewers flooded by innumerable leaks in household plumbing b. Fuel gas from mains broken by bombing or of ignition of leaking gasoline. Fumes may result in serious explosions in sewers. c. Damage of sewer system may contaminate water supplies. d. Gargage collection and disposal services equipment, manpower and organization are important community resources.	a. Location: 1. Sewage disposal plant. 2. Syphons. 3. Pumping stations. 4. Tide or flood gates. b. Main sewers: 1. Location: 2. Storm, sanitary, or combined sewer. 3. Boundary of service area. 4. Diameters. 5. Types of pipe. 6. Capacity at important intersections.	a. Inventory of emergency equipment: 1. Type, capacity, mobility of emergency pumping units. 2. Type, capacity and mobility of emergency chlorination equipment. 3. Type, mobility, capacity of emergency generators or other power units. 4. Storage locations of emergency equipment. b. Inventory of construction	a. Sewer department. b. Municipal engineer. c. Department of sanitation. d. Health department.

			c. Location: 1. Garbage dumps. 2. Incinerators. 3. Storage yards for equipment.	materials, supplies for repairs, location of storage plants. c. Inventory of mobile communications. d. Possible points for emergency disposal of sewage: 1. Bypasses. 2. Emergency discharge points. 3. Emergency lagoon areas.	
18	Electric power system	a. Power stations, transformer stations, and principal transmission lines are potential targets for sabotage. b. Major power stations outside of urban areas may be potential targets.	a. Power plants out of city: Direction and distance. b. Power plants, substations in city. c. Principal transmission lines: 1. To and within city. 2. Overhead or underground. 3. River crossing. d. Service areas of main trunk lines: 1. Boundaries. 2. Loop circuits or cross connections.	a. Power plants. 1. List of equipment. 2. Voltage. 3. A. C. or D. C. b. Substations: 1. Incoming and outgoing voltage. 2. Capacity.	a. Power companies. b. Municipal power commission. c. Public utility commission.
19	Pipelines and storage tanks (gas and petroleum).	a. Storage tanks are fire hazard and may contribute to mass fires. b. Storage tanks, generating plants, pumping and control stations, and river crossings of pipe lines are potential targets for sabotage.	a. Principal pipelines: 1. Location. 2. River crossing or other exposed parts. b. Pumping and compressor stations: Location. c. Fuel gas generating plants: Location. d. Storage tanks: 1. Location. 2. Type (gas, oil, or gasoline). e. Principal gas mains: 1. Location. 2. Diameter. 3. Boundaries of service areas. 4. Loops or cross connections. 5. Main valves.	Capacity.	a. Gas and oil companies. b. Topographic maps. c. Air photos or air mosaics.

No.	Urban feature	Significance	Information on map	Supplementary information	Suggested sources
20	Source of supplies for emergency use.	a. Supplies for subsistence, rescue, emergency welfare cases. b. Possible targets for sabotage.	a. Location: 1. Flour mills. 2. Packing plants. 3. Slaughter houses. 4. Bakeries. 5. Dairies. b. Location of wholesale houses, large retail stores and warehouses for: 1. Food. 2. Clothing. 3. Bedding. 4. Hardware. 5. Plumbing. 6. Medical supplies. 7. Government storage.	Name.	a. Chamber of commerce. b. Business and trade associations. c. Sanborn maps.
21	Streets and highways.	a. Routes for evacuation, mutual aid, mobile support, and local rescue vehicles. b. Critical points (bridges, tunnels, etc.) are potential targets for sabotage. c. Wide streets may serve as firebreaks.	Location: 1. Main highways. 2. Traffic signals. 3. Overpasses and underpasses. 4. Overhead power and trolley wires. 5. Traffic bottlenecks. 6. Road sections subject to flooding.	a. Main highways: Traffic capacity (normal and emergency). b. Overpasses and underpasses: Horizontal and vertical clearance and weight capacity.	a. Municipal street department. b. State highway department c. Traffic engineer. d. Topographic maps. e. Sanborn maps.
22	Streetcars, trolleys, buslines, and vehicle storage yards.	a. Broken or short-circuited trolley wires are a hazard. b. Subways are excellent shelters if precaution is taken as to the third rail and/or the shelter area is restricted to station platforms. c. Streetcars are more vulnerable to sabotage and bombs than motor transportation. Streetcars are less adaptable	a. Routes. b. Type: 1. Surface. 2. Elevated. 3. Underground. c. Power supply: 1. Trolley wire. 2. Third rail: (a) Exposed.	None.	a. Transit company. b. Municipal planning commission. c. Topographic maps. d. Power company.

		and may block streets if power fails or cars are damaged.	(b) Protected.		
23	Railroads.	a. Transportation for evacuees, rescue, supplies, and equipment. b. Terminal facilities and low bridges are vulnerable to damage by A-bomb air burst. Fairly low bridges may be shifted on their foundations by the blast wave reflected from the water. c. Tracks within the city are susceptible to blocking by rubble from neighboring buildings.	a. Main lines and alternate routes. b. Location of yards. c. Type of power (steam, diesel, electric). d. Stations: 1. Location. 2. Type (freight and/or passenger). e. Location of shops. f. Location of bridges and elevated lines. g. Principal crossings: 1. Street or road. 2. Underpass. 3. Overpass.	a. Yards: Amount of rolling stock normally in yard. b. Shops: Wrecking equipment on hand.	a. Railroad offices. b. Municipal planning commission. c. Sanborn maps.
24	Bridges.	a. Bottlenecks in both rail and road routes. b. Highly vulnerable to damage by bombs and sabotage.	a. Location. b. Type of construction (steel truss, suspension, etc.). c. Load capacity.	a. Length of span. b. Clearance: 1. Horizontal. 2. Vertical.	a. Sanborn maps. b. Topographic maps.
25	Tunnels.	a. Railroad tunnels are potential shelter for population, critical rolling stock, and important freight. b. Bottlenecks in both rail and road routes. c. Some tunnels vulnerable to ground bursts; underwater tunnels to water bursts.	Location.	a. Length. b. Width.	a. Sanborn maps. b. Topographic maps. c. Municipal engineer.
26	Airports and airfields.	a. Potential targets for sabotage. b. Potential target for A-bomb, if associated with other strategically important features. c. Bases for aircraft engaged in rescue, welfare, and reconnaissance.	a. Civilian: 1. Location. 2. Type (public or private). b. Military: Location.	a. Length of runways. b. Fuel supplies on hand. c. Availability of repair facilities.	a. National Guard Air Unit. b. Civil Air Patrol c. Topographic maps. d. Municipal planning commission.

No.	Urban feature	Significance	Information on map	Supplementary information	Suggested sources
27	Port facilities.	a. Potential targets for sabotage, especially petroleum, chemical, and explosive storage facilities. b. Critical features of A-bomb target. c. Flammable materials increase the likelihood of mass fire problems d. Petroleum may spread fire across narrow water bodies. e. Facilities are useful for evacuation, mutual aid, and mobile support by water. f. Fireboats available to furnish water supply and pressure to high-pressure systems, portable pipelines and baselines.	a. Piers. b. Storage facilities associated with transshipment. c. Refueling facilities. d. Special handling facilities (ore, grain, or liquids). e. Rail connections.	a. Piers: 1. Length. 2. Depth of water. 3. Types of ships accommodated. b. Type of material stored: 1. Petroleum. 2. Chemicals. 3. Explosives.	a. Port authority. b. Municipal planning board. c. Municipal engineer. d. Steamship lines. e. Maps of U. S. Coast and Geodetic Survey.
28	Telephone system.	a. Poles and wires are susceptible to damage by bombs, fire, and sabotage. b. Underground cables, except where they enter exchanges, are generally safe from the effects of A-bomb air bursts. Susceptible to damage by ground bursts and sabotage. c. Exchanges, especially those handling long distance calls, are potential targets for sabotage and are critical features of A-bomb targets. d. Important means of communication in an emergency. e. Buildings with PBX or private telephone systems may be used as civil defense control centers.	Location: a. Central exchange. b. Main business offices. c. Principal cables: 1. Overhead or underground. 2. Alternate or emergency. d. Service area for each cable. e. Private branch exchanges. f. Private telephone systems. g. Mobile radio control station.	Private branch exchanges: Name and address and code number of company or building where PBX is located.	Telephone company.
29	Teletype system.	Same as telephone system.	Location: a. Teletypewriter Exchange (TWX). b. Western Union stations. c. Cable and wire facilities: 1. Overhead 2. Underground.	Name, address and code number of company or building where TWX is located.	a. Western Union. b. Telephone company. c. Teletypewriter directory.

30	Radio and TV facilities.	a. Extremely important as a means of communication or public information during emergencies. b. Could be used by subversive elements to spread panic. c. Transmitters may be required to stay on the air in emergencies to insure the success of the CONELRAD plan.	Location: 1. AM, FM, and TV (both station and transmitter). 2. Amateur (Ham). 3. Special (utility, taxi, trucking, police, fire). 4. State and municipal communication systems.	AM, FM, and TV: 1. Call letters. 2. Frequency. 3. Normal power (watts). 4. Standby power with engine driven generator.	a. Local broadcasters. b. Local amateur radio clubs. c. Chamber of commerce.
31	Potential assembly areas.	a. May be used for assembling people. b. Enclosed structures may be used for emergency housing, hospitals, or welfare service centers.	Location: 1. Stadiums. 2. Ball parks. 3. Playgrounds. 4. Arenas. 5. Parks. 6. Race tracks. 7. Golf courses. 8. Fair grounds.	a. Area (square feet). b. Floor space of buildings. c. Sanitary and cooking facilities.	a. Sanborn maps. b. Municipal planning commission. c. Police department.
32	Potential hospitals and welfare centers.	Structures may be used hospitals.	Location: 1. Hotels. 2. Theaters. 3. Auditoriums. 4. Schools. 5. Halls. 6. Restaurants. 7. Homes (orphans, old age, convents, monasteries, etc.).	a. Floor area (square feet). b. Elevators. c. Cooking facilities. d. Normal and potential bed capacity. e. Sanitary facilities and water supply.	a. Sanborn maps. b. Municipal planning commission. c. Police department. d. Building commissioner. e. Fire department. f. Board of education. g. Topographic maps. h. Health department. i. Department of welfare.
33	Hospitals.	a. Centers of operations for medical services. b. Problem of evacuation especially for psychiatric hospitals. c. Problem of providing shelter for patients. d. Serious problem because hospitals are often located near probable ground zero.	a. Location. b. Type: 1. Regular. 2. Mental. 3. Special or emergency.	a. Normal and maximum bed capacity. b. Size and composition of staff.	a. Medical association. b. Municipal planning commission. c. Building commissioner. d. Health department. e. Topographic maps. f. Sanborn maps.

No.	Urban feature	Significance	Information on map	Supplementary information	Suggested sources
34	Doctors' offices.	a. Source of doctors, nurses, medical equipment and supplies. b. Problem resulting from local concentrations of offices. Some near probable ground zero.	Location.	Number of doctors and nurses at each location.	a. Classified section of telephone directory. b. City directory. c. Local medical association. d. Hospitals.
35	Zoos.	a. Hazard in case of bombing; liberation of animals may contribute to panic of population. b. Possible target for sabotage.	Location.	None.	a. Zoological board. b. Park commission. c. City maps. d. Topographic maps.
36	Penal institutions.	a. Serious problem of evacuation. b. Possibility of "breaks" during an attack contributing to panicking of population. c. Possibility of looting and violence by escaped or released prisoners. d. Buildings might contain cooking and feeding facilities where food might be prepared for distribution elsewhere.	a. Location. b. Type of prisoners: 1. First offenders. 2. Criminal insane. 3. Others.	None.	a. Prison board. b. Police department. c. Planning commission. d. Building commissioner. e. Topographic maps. f. Department of welfare
37	Firebreaks.	a. Limit the spread of fires. b. Evacuation routes. c. May afford refuge from flames if sufficiently wide.	a. Minor firebreaks (60–120 feet). b. Major firebreaks (120–500 feet). c. Open areas (more than 500 feet): 1. Wide streets and parkways. 2. Parks (not heavily wooded). 3. Vacant land. 4. Water bodies. 5. Golf courses. 6. Cemeteries. 7. Railroad yards. 8. Airfields 9. Race tracks (without large inflammable stands).	None.	a. Municipal planning commission. b. Fire department. c. Street department. d. Park department. e. Sanborn maps.
38	Garages and used-car lots.	a. Potential source of emergency vehicles. b. Repair facilities and parts for emergency vehicles. c. Some buildings may be used as welfare facilities.	Location.	a. Type of vehicles normally on hand. b. Repair facilities	a. Auto dealers association. b. Building commissioner. c. Sanborn maps.

		d. Gasoline in storage tanks and autos increases fire susceptibility.			
39	Offices of construction and earth-moving contractors. State, county, or municipal equipment storage yards and shops.	a. Source of engineering equipment and supplies. b. Source of trained personnel.	Location.	Type of equipment (equipment is commonly moved from job to job).	a. City directory. b. Telephone book. c. Building commissioner. d. Contractors association. e. Street department.
40	Repair and maintenance stations for utilities.	Source of engineering equipment, material, and trained personnel.	Location.	Type: 1. Streetcar. 2. Water. 3. Gas, etc.	a. Utilities company. b. Municipal gas, electric, water, sewer and transit offices.
41	Underground openings—caves and mines.	a. Possible shelters. b. Possible storage places for records and supplies which could be needed immediately after an attack. High humidity and certain types of dust render some caves and mines unsuitable for some kinds of storage.	Location.	a. Floor area (square feet). b. Width and height of passages. c. Types of entrance: 1. Shaft. 2. Tunnel. d. Need for drainage pump. e. Thickness of bedrock.	a. City engineer. b. Geology department of nearby colleges. c. State geological survey.
42	Topography.	a. Barrier terrain: 1. Obstacles to evacuation, mutual aid, and mobile support. 2. Contributes to the development of transportation bottlenecks. 3. Steep hills would shield some areas from A-bomb blast, heat, and radiation. Blast effect would be intensified on the side of the hill facing the burst. 4. Hills would accelerate or retard the spread of fire depending on direction of the slope and wind. b. Low areas: 1. Areas most likely to flood. 2. Areas in which poisonous gases may accumulate.	a. Steep hills. b. Cliffs. c. Marsh land. d. Densely wooded area. e. Manmade embankments and cuts. f. Low areas.	None.	a. Topographic maps. b. Field reconnaissance.

No.	Urban feature	Significance	Information on map	Supplementary information	Suggested sources
43	Prevailing winds.	a. Affect the direction of spread of fire, poison gas, or aerosols. b. Accelerate or retard the spread of fire.	a. Daily reversals (cities near mountains, seashore, or lakes). b. Seasonal reversals; most United States cities— southwest winds most common in summer; northwest winds in winter. Northerly winds more pronounced in north. Southerly winds in south.	None.	a. Local weather bureau. b. Publications of U. S. Weather Bureau.
44	Potential welfare facilities.	May be used for mass care centers and welfare service centers.	Location: 1. Hotels. 2. Theaters. 3. Auditoriums. 4. Halls. 5. Institutions (children's, old age, nursing homes). 6. Motels. 7. Clubs. 8. Community centers.	a. Floor area (square feet). b. Cooking facilities. c. Sanitary facilities. d. Heating facilities.	a. Sanborn maps. b. Field survey.
45	Dwelling units.	May be used for rehousing after attack.	Number of dwelling units by census tract.	None.	a. Census reports. b. Sanborn maps. c. Field survey.
46	Welfare agencies (other than institutional).	Personnel and facilities may be used for civil defense purposes.	Location.	a. Public or private. b. Kind of agency (child care, recreation, family service, etc.). c. Number of employees.	a. Council of social agencies. b. Community planning council. c. Universities. d. Chamber of commerce.
47	Distribution of children under 5 years.	Determining number of preschool age children who will need special care.	By census tract: Number.	None.	Census reports.

48	Number of employed.	In combination with maps showing industrial plants and number of employees can be used to determine the (*a*) number of people whose jobs are lost because of destruction of their places of work (*b*) number of dependents resulting from deaths and injuries by A-bomb.	By census tract: Number.	None.	Census reports.

Forms should be made available for recording the desired supplementary information. The forms should provide columns for recording the code symbol on the map, identification, desired information, and damage zone. In test exercises or following an attack, the damage zone column should be used to record the zone of damage in which the feature or facility is located. Such damage should be indicated by the letters A, B, C, or D, as shown in table I, chapter 4.

METHOD OF ESTIMATING DAY POPULATION

(Based on a procedure developed by the Bureau of the Census)

Operation	*Character and source of data*
Begin with 1950 resident population by census tracts or enumeration districts.	Final figures from the 1950 census of population.
Subtract residents in the labor force	Constructed from final 1950 census data.[1]
Subtract children in school	Constructed from final 1950 census data adjusted to independent total school enrollment.[2]
Subtract residents away from home for reasons other than school attendance or employment.	Constructed from data obtained locally, applied to total resident labor force, and distributed in accordance with nonworking, noninstitutional, nonschool population.[3]
Subtract institutional population	Determined from 1950 census data.
(Result of these subtractions gives an estimate of persons in their own homes during the day.)	
Add estimate of number of persons employed in area.	Estimate based on distribution of 1950 labor force (adjusted to include workers coming from beyond city limits) among districts in accordance with patterns of employment shown by 1947 Census of Manufactures and 1948 Census of Business.[4]
Add estimates of persons in school in area	Assumed equal to estimate of number of residents in area enrolled in school.
Add institutional population	Available in census records.
Add estimates of persons present for reasons other than employment or school attendance (transients in hotels and other visitors, shoppers, etc.).	Persons resident in city and away from home for these reasons adjusted to include groups coming from beyond city limits, and assumed to be in ratio to estimate of persons employed in business establishments.[5]
(Result of this computation is daytime population.)	

Footnotes

[1] For all tracted cities the number of residents in the labor force is directly available by tracts from final 1950 census data. For all untracted cities the method of constructing 1950 labor force estimates for each enumeration district is as follows:

(*a*) Obtain number of residents 14 years old and over in each enumeration district from final 1950 census data.

(*b*) Add figures in (*a*) to obtain total number of residents 14 years old and over in city as a whole.

(*c*) Obtain the number of persons in the labor force for the city as a whole from final 1950 census data.

(*d*) Determine ratio of number of persons in labor force (*c*) to number of persons 14 years old and over (*b*) for city as a whole. This gives adjustment factor.

(*e*) Apply this adjustment factor to number of persons 14 years old and over in each enumeration district (*a*). This gives estimate of number of residents in the labor force in each enumeration district.

[2] Method of constructing estimates of children in school:

(*a*) Obtain number of children 5 to 17 years of age from final 1950 census data, by tracts for tracted cities or by enumeration districts for untracted cities.

(*b*) Add figures in (*a*) to obtain total number of children 5 to 17 years of age in city as a whole.

(*c*) Obtain from 1950 census sample data or from independent sources estimates of elementary and high school enrollment for 1950 for city as a whole.

(*d*) Determine ratio of school enrollment (*c*) to school-age children (*b*) for city as a whole. This gives adjustment factor.

(*e*) Apply this adjustment factor to number of school-age children for each tract or enumeration district (*a*). This gives 1950 estimate of school population for each tract or enumeration district.

[3] Method of estimating number of persons away from home for reasons other than school or employment:

(*a*) From data available locally obtain a factor describing the numerical relationship between such persons and the number of resident workers. (If such data are not available locally, use a factor of 40 percent. This factor was computed from data available in a few cities and may not be as accurate as a factor obtained from local data.)

(*b*) Apply this factor to the estimate of total labor force for the city to obtain estimated total number of persons away from home for other reasons.

(*c*) Distribute the estimate of total persons away from home for other reasons in proportion to the distribution by tracts of the population not in the labor force, in school, or institutions.

[4] Method of constructing estimates of persons employed in city:

(*a*) To allow for persons living outside the city limits who come into the city to work during the day, the following procedure was used:

(1) For a single central city in a standard metropolitan area, add one-half of the labor force residing outside the city limits but within the city's standard metropolitan area to the labor force residing in the city. This yields an estimate of the total number of persons working in the city.

(2) For "twin" central cities in a standard metropolitan area (e. g., St. Paul and Minneapolis), apportion one-half of the labor force residing outside the two cities but within the standard metropolitan area according to the number of persons employed in business establishments in each city (as determined from the 1948 Census of Business). Add these apportioned parts to the labor force residing in each city. This yields an estimate of the total number of persons working in the city.

(3) For clusters of large cities in a standard metropolitan area (e. g., Boston or New York), add to the number of persons employed in manufacturing establishments in the city, (as determined from 1947 Census of Manufactures, three times the number of persons employed in business establishments (as determined from 1948 Census of Business). This yields an estimate of total number of persons working in the city. The ratio of three to one is established as an average ratio of the number of persons working in all nonmanufacturing establishments to the number of persons reported working in those business establishments covered by the Census of Business.

(*b*) Divide this estimate of total persons working in the city into (1) persons employed in manufacturing (assumed to equal the number reported by 1947 Census of Manufactures), and (2) all other workers.

(*c*) Distribute the estimate of the number of persons employed in manufacturing in accordance with the estimated tract distribution of persons employed in manufacturing establishments (the latter estimate is based on data from the 1947 Census of Manufactures).

(*d*) Distribute the estimate of the number of workers not employed in manufacturing in accordance with the estimated tract distribution of persons employed in business establishments as reported by the 1948 Census of Business.

For Washington, D. C., divide the estimated number of workers not employed in manufacturing into government workers and others. Distribute the estimated number of government workers in accordance with a tract distribution estimated from local data. Distribute as in (*d*) above the estimate of the other persons not in government and not in manufacturing.

(*e*) Add the distributions in (*c*) and (*d*) to obtain an estimate of the district distribution for all persons working in the city during the day.

[5] Estimate of persons present for reasons other than employment or school attendance:

(*a*) To allow for "other persons away from home" whose residence is outside the city limits, increase the estimated city total for "other persons away from home" by a 30 percent factor. (This factor is based on data for a few cities.)

(*b*) Distribute the estimated number of "other persons away from home" in the city during the day in accordance with the distribution by tracts of persons employed in business establishments based on data from the 1948 Census of Business.

(*c*) Add to the estimated number of "other persons away from home" an estimate of the transient hotel population by tracts, based on records from the 1950 census showing location of hotels, from data on number of rooms from the Hotel Redbook, and from an assumed rate of occupancy.

Important Assumptions

Certain assumptions had to be made in developing the procedure described in this appendix. Some of these assumptions have little actual supporting evidence but are considered valid. The more important of these are:

(*a*) The total number of residents of the city away from home for reasons other than school attendance and employment approximates 40 percent of the total resident labor force, and an increase in this number by 30 percent provides an adequate estimate of the number of persons in the city during the day who were away from their home outside the city. Since usable field data were obtained from only

3 or 4 cities on these points, the patterns might not apply to all the cities.

(*b*) The net number of persons in the city for reasons of employment approximates the total labor force of the city plus one-half the labor force of the standard metropolitan area outside the city.

(*c*) Employment in other than manufacturing follows the same area distribution as employment in business establishments reported by the 1948 Census of Business.

(*d*) Nonworking and nonschool persons are present in an area in relation to the number of persons employed in business establishments.

(*e*) The current pattern of employment distribution is the same as that of 1947 and 1948.

Offical Civil Defense Publications

The following Federal Civil Defense Administration publications are on sale by the Superintendent of Documents, Washington 25, D. C. On orders of 100 or more of these puplications the Government Printing Office allows a 25 percent discount. (An order blank is supplied for your convenience at the back of this book.)

1. *United States Civil Defense*, 1950, 25 cents, 168 pp. The national plan for organizing the civil defense of the United States.

Administrative Guides

1. *Civil Defense in Industry and Institutions*, Pub. AG–16–1, 1951, 25 cents, 64 pp. Plans for organizing and administering civil defense self-protection programs for the Nation's industrial plants, office and apartment buildings, and other institutions.
2. *The Clergy in Civil Defense*, Pub. AG–25–1, 1951, 10 cents, 12 pp. Guide for the clergy of all faiths for determining their place and function in civil defense.
3. *Emergency Welfare Services*, Pub. AG–12–1, 1952, 20 cents 62 pp. Guide for developing a program to meet the multiple welfare problems that would arise from enemy attack.
4. *Engineering Services*, Pub. AG–13–1, 1952, 15 cents, 25 pp. Assists State and local civil defense directors in planning and establishing their engineering services.
5. *Fire Services*, Pub. AG–9–1, 1951, 15 cents, 27 pp. Basic guide to assist States and communities in planning, organizing, staffing, and operating an expanded fire-fighting service during periods of war emergency.
6. *Health Services and Special Weapons Defense*, Pub. AG–11–1, 1950, 60 cents, 264 pp. Methods for organization of all basic health and special weapons defense (atomic, biological, and chemical warfare) for State and local civil defense programs.
7. *Police Services*, Pub. AG–10–1, 1951, 20 cents, 50 pp. Basic guide for State and local civil defense officials in organizing and directing police civil defense services.
8. *Principles of Civil Defense Operations—Web Defense—Mutual Aid—Mobile Support*, Pub. AG–8–1, 1951, 20 cents, 48 pp. Basic guide in planning and organizing for web defense, mutual aid, and mobile support operations.
9. *The Rescue Service*, Pub. AG–14–1, 15 cents, 32 pp. Basic guide for State and local civil defense officials in organizing rescue services and training rescue teams.
10. *The Supply Service*, Pub. AG–6–1, 1952, 20 cents, 50 pp. Assists State and local civil defense directors and supply officials in establishing adequate supply programs.
11. *The Warden Service*, Pub. AG–7–1, 1951, 20 cents, 48 pp. Basic guide for civil defense directors and supervisory wardens in selecting, organizing, training, and equipping the warden service.

Public Booklets, Handbooks, and Leaflets [1]

1. *Air-Raid Alert Card*, 1951, $1.50 per 100 copies. Instruction card on what to do in case of an atomic bomb attack.
2. *Atomic Blast Creates Fire*, Leaflet, 1951, $1.50 per 100 copies. Instruction to householders on how to reduce fire hazards and prevent fires in the home.

[1] On leaflets the discount of 25 percent applies to orders of 1,000 or more only.

3. *Civil Defense Household First-Aid Kit,* Leaflet, 1951, $1.50 per 100 copies. Lists first-aid items for a family of four or less; gives items to be stocked, quantity, substitutes, and uses.
4. *Duck and Cover,* Pub. PA–6, 1951, 5 cents, 14 pp. Cartoon instruction for children on what to do in case of atomic attack.
5. *Emergency Action to Save Lives,* Pub. PA–5, 1951, 5 cents, 32 pp. Practical instructions for the untrained person on the emergency care of injured people.
6. *Fire Fighting for Householders,* Pub. PA–4, 1951, 5 cents, 32 pp. Basic information for the householder on how fires start, how they can be prevented, and how to fight fires.
7. *Signs of Our Times,* Leaflet, 1952, 5 cents, $3.50 per 100 copies. Portrays twelve Alert America color posters and ten recruiting posters which may be purchased from the Superintendent of Documents. These posters aid official and public service civil defense programs in public education and recruiting activities.
8. *Survival Under Atomic Attack,* 1950, 10 cents, 32 pp. Techniques of personal survival under atomic bomb attacks.
9. *This Is Civil Defense,* Pub. PA–3, 1951, 10 cents, 32 pp. Highlights of the national civil defense program and the part the volunteer must play to make civil defense a success.
10. *The Warden's Handbook,* Pub. H–7–1, 1951, 15 cents, 34 pp. Basic reference aid for the block warden.
11. *What About You and Civil Defense?* Booklet, 1953, 5 cents, 16 pp. Uses the twelve Alert America color posters to give to the public in picture form the story of the need for civil defense and what each person can do.
12. *What You Can Do Now!* Leaflet, 1953, $1.25 per 100 copies. Outlines steps for preparing the home and the family against enemy attack.
13. *What You Should Know about Biological Warfare,* Pub. PA–2, 1951, 10 cents, 32 pp. Techniques of personal survival under biological warfare attacks.

Technical Manuals

1. *Blood and Blood Derivatives Program,* Pub. TM–11–5, 1952, 40 cents, 179 pp. Describes Federal, State, and local organization and operation of a civil defense blood program.
2. *Civil Defense in Schools,* Pub. TM–16–1, 1952, 15 cents, 32 pp. A guide and reference for local and State superintendents of schools in organizing and operating programs for the self-protection of schools, their physical facilities, staff, and students.
3. *Emergency Medical Treatment,* Pub. TM–11–8, 1953, 25 cents, 70 pp. Summarizes treatment recommended for large numbers of casualties in disasters, such as atomic bombing, intense high-explosive or incendiary bombing, as well as munitions explosions in populated areas.
4. *Fire Effects of Bombing Attacks,* Pub. TM–9–2, 1952, 20 cents, 42 pp. Summarizes data on World War II bombing attacks and suggests a method of appraising fire susceptibility of cities to minimize the effect of mass fires.
5. *Interim Guide for the Design of Buildings Exposed to Atomic Blast,* Pub. TM–5–3, 1952, 15 cents, 34 pp. Suggests to architects and engineers methods of increasing the strength of new buildings to resist atomic blast, and points out hazards which should be considered in the design of shelter areas in buildings.
6. *Organization and Operation of Civil Defense Casualty Services,* Part III—*Medical Records for Casualties,* Pub. TM–11–3, 1952, 15 cents, 31 pp. Recommends medical records and forms for uniform use by all States in the handling of casualties resulting from enemy attack.
7. *Organization and Operation of Civil Defense Casualty Services,* Part I—*The First-Aid System,* Pub. TM–11–1, 1953, 20 cents, 52 pp. Recommends

general principles designed to assist key civil defense professional medical personnel in planning and operating a first-aid system.

8. *Outdoor Warning Device Systems*, Pub. TM–4–1, 1951, 15 cents, 36 pp. Data for planning, procuring, and installing public warning device systems for civil defense.
9. *Radiological Decontamination in Civil Defense*, Pub. TM–11–6, 1952, 15 cents, 31 pp. Provides information for all radiological defense personnel and serves as an operations manual for decontamination crews.
10. *Shelter from Atomic Attack in Existing Buildings*, Part I—*Method for Determining Shelter Needs and Shelter Areas*, Pub. TM–5–1, 1952, 20 cents, 53 pp. Instructions, forms, and recommendations for use of civil defense directors, survey teams and their supervisors, and technically qualified personnel in conducting a shelter survey
11. *Shelter from Atomic Attack in Existing Buildings*, Part II—*Improvement of Shelter Areas*, Pub. TM–5–2, 1952, 15 cents, 28 pp. Offers suggestions to architects and engineers for improving certain shelter areas.
12. *The Dentist in Civil Defense*, Pub. TM–11–9, 1953, 15 cents, 20 pp. Describes the role of dentists in the civil defense casualty services program, and recommends the training they will need to perform their duties.
13. *The Nurse in Civil Defense*, Pub. TM–11–7, 1952, 20 cents, 52 pp. Assists key civil defense nurses in planning and operating State and local nursing services.
14. *Utilization and Control of Streets and Highways in Civil Defense Emergencies*, Pub. TM–13–1, 1953, 15 cents, 24 pp. Describes the problems involved in keeping selected urban streets and rural highways free from serious congestion in civil defense emergencies and suggests methods of solving these problems.
15. *Water Supplies for Wartime Fire Fighting*, Pub. TM–9–1, 1951, 10 cents, 16 pp. Program for increasing available water supplies to meet the needs of emergency water-supply operations during wartime.
16. *Windowless Structures—A Study in Blast-Resistant Design*, Pub. TM–5–4, 1952, $1.00, 165 pp. Describes methods and procedures for designing windowless structures or windowless portions of conventional structures, based on the dynamic properties of loading; presents principles, methods and formulas for determining the magnitude, duration, and distribution of atomic blast loads on windowless structures.

Technical Bulletins

1. *Construction and Adaptation of Structures for Rescue Training*, Pub. TB–14–1, 1952, 5 cents, 4 pp.
2. *Development Status of Personal Dosimeters*, Pub. TB–11–4, 1952, 5 cents, 4 pp.
3. *Emergency Blood Grouping Laboratory Techniques*, Pub. TB–11–6, 1952, 5 cents, 3 pp.
4. *Emergency Blood Transfusion*, Pub. TB–11–5, 1952, 5 cents, 5 pp.
5. *Emergency Exposures to Nuclear Radiation*, Pub. TB–11–1, 1952, 5 cents, 1 p.
6. *Emergency Measurement of Radioactivity in Food and Water*, Pub. TB–11–9, 1952, 5 cents, 2 pp.
7. *Engineering Equipment Stockpiled for Emergency Water Supply Use*, Pub. TB–13–1, 1952, 5 cents, 2 pp.
8. *Permissible Emergency Levels of Radioactivity in Water and Food*, Pub. TB–11–8, 1952, 5 cents, 1 p.
9. *Personal Dosimeters for Radiological Defense*, Pub. TB–11–2, 1952, 5 cents, 1 p.
10. *The Most Promising Personal Dosimeters for Civil Defense Use*, Pub. TB–11–3, 1952, 5 cents, 4 pp.
11. *Responsibilities for Production and Distribution of Potable Water During Disaster*, Pub. TB–11–10, 1953, 5 cents, 2 pages.

Other Publications

1. *Alert America Color Poster Series.* 12 posters designed for official and public service civil defense exhibit and display needs to increase public understanding of the need for an Alert America. Available from the Superintendent of Documents in two sizes: large size 26 x 37 inches, each 20 cents, set $2.00; small size 13 x 18 inches, each 10 cents, set 70 cents.
2. *Annual Report for 1952,* 1953, 40 cents, 138 pp. Comprehensive report to the President and Congress on the FCDA program during 1952.
3. *Annotated Civil Defense Bibliography for Teachers,* Pub. TEB–3–2, 1951, 20 cents, 28 pp. Aid for teachers in locating publications for use in civil defense planning and instruction in schools.
4. *Civil Defense in Outline,* 1951, 35 cents, 41 pp. Guide for the use of organizations in their national and State civil defense programs.
5. *Civil Defense Nursing Needs,* Pub. VM–1, 1952, 15 cents, 17 pp. Outlines program for increasing nursing services to insure an adequate supply of nurse power in the event of attack or disaster.
6. *Interim Civil Defense Instructions for Schools and Colleges,* Pub. TEB–3–1, 1951, 30 cents, 32 pp. Guide for educational administrators in planning immediate civil defense training and education programs.
7. *Recruiting Poster Series.* 10 posters designed to assist State and local civil defense groups in the recruitment of volunteers. The posters in this set depict the duties of the 10 basic civil defense services. Available from the Superintendent of Documents in two sizes: large size 26 x 37 inches, each 10 cents, set 70 cents; small size 13 x 18 inches, each 5 cents, set 20 cents.
8. *Women in Civil Defense,* Pub. VM–2, 1952, 15 cents, 20 pp. Emphasizes the importance of women's participation in the civil defense program.

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