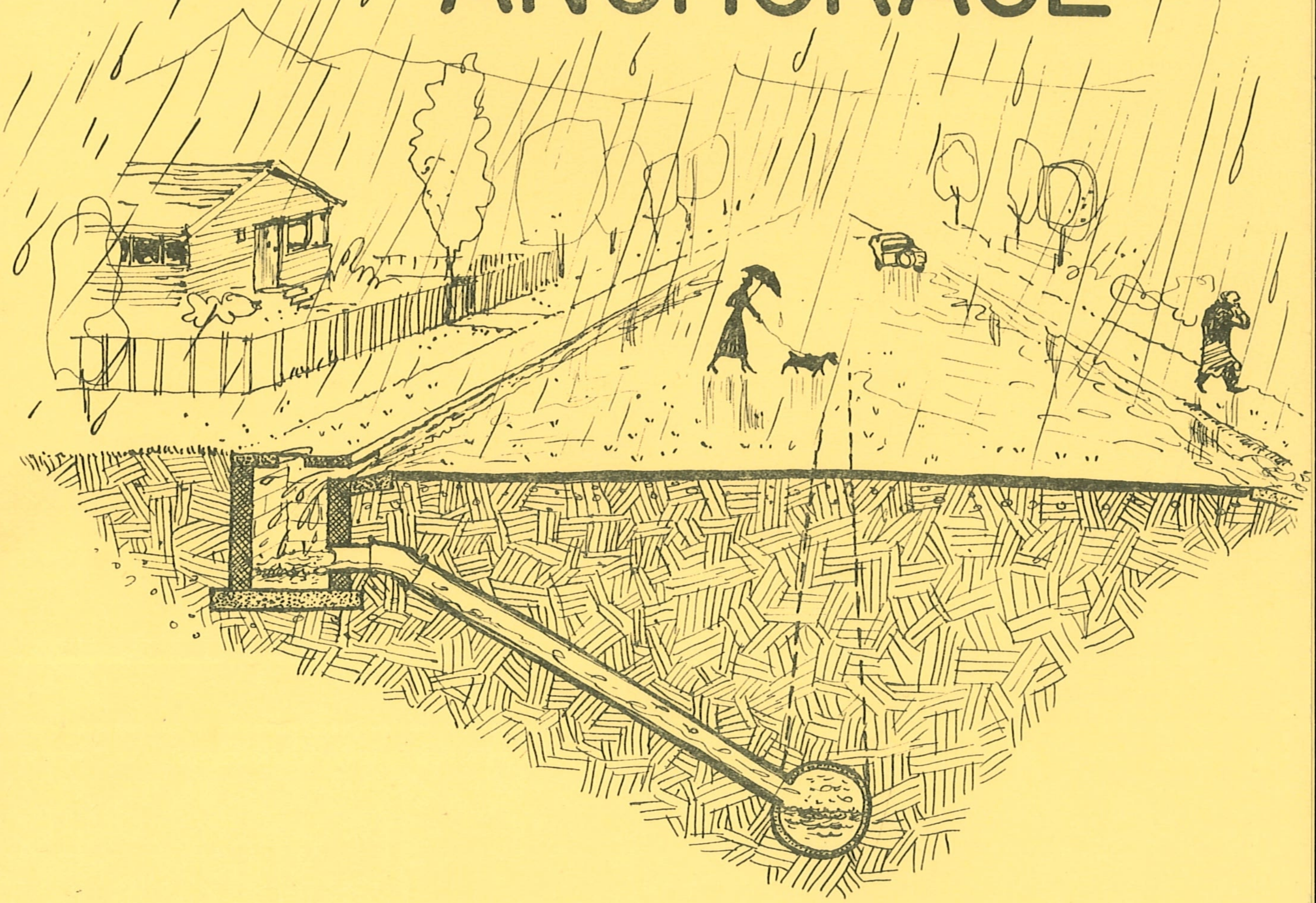
preliminary plan

STORM DRAINAGE FOR ANCHORAGE



city planning commission

ANCHORAGE ALASKA · JULY 1955

preliminary plan

STORM DRAINAGE

The Storm Drainage Plan is one of a series of master plan reports being prepared under the general direction of the City Planning Commission. Other studies will eventually cover all phases of municipal life, making recommendations for the meeting of current needs and guiding future development.

Most phases of the planning program are being developed through citizens' committees composed of representatives of the entire community. Some technical phases, such as covered by this report are handled directly by the Commission with consultation by the concerned City officials. Upon the preparation of individual planning reports, they will be consolidated by the Planning Commission into a master plan, which will be based on the expressed desires, as well as the best judgement, of the people of Anchorage.

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Sanitary Engineer	Frank E. Nyman

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

STORM SEWERS

Storm drainage serves a number of important functions:

- it prevents flooding
- it prevents damage to private property
- it helps eliminate deterioration of streets
- it eliminates unhealthy stagnant water

Storm drainage, therefore, helps protect private and public property and promotes public health and convenience. As such, it has been assumed as a basic municipal responsibility in most cities.

Surface-Underground

Storm drainage can be undertaken through surface or underground channeling of waste waters, or through a combination of both.

While many stateside communities utilize the surface drainage method, due to climatic conditions it is not considered feasible in most of Alaska. In order to prevent the conditions caused by night-time freezing of surface-waters during spring and fall, it is essential that the water be removed from the streets as quickly as possible. In most cases, this can best be accomplished by diverting the runoff into underground sewers.

Separate-Combined

Sewers for surface-water disposal can be of two types - separate or combined. In the latter case, sanitary sewage is carried in the same system as surface-water.

The combined system consists of only one set of pipes, but these must be of a size to take care of maximum storm runoff. Such a system is not considered desirable for Anchorage because surface runoff can be taken care of through relatively short runs of storm sewer by discharging into various creeks in the area. Sanitary sewage, on the other hand, has to be carried all the way to Knik Arm. A combined system would, therefore, require long runs of oversize sewer pipe, which in turn could cause plugging during periods of no storm runoff.

Drainage and Street Improvement

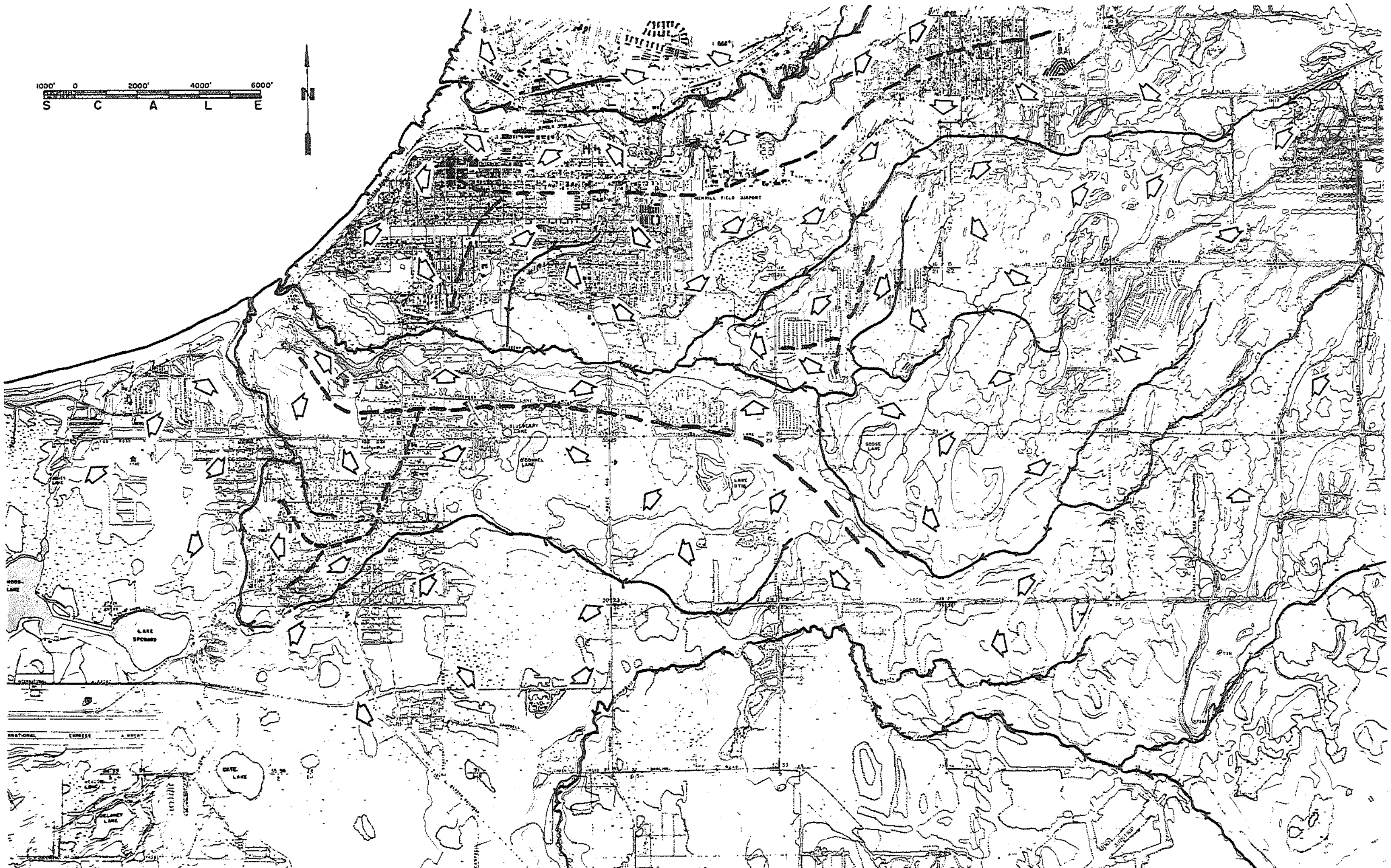
The provision of storm drainage is particularly important at this time because Anchorage is engaged in an active street improvement program. Paving projects are scheduled in various parts of town and these must of necessity be preceded by the installation of storm sewers. Delay in the provision of storm drainage would mean that any attempts at improving living conditions in Anchorage through street improvements would be postponed until such time as storm drainage were provided. (This subject is discussed further on page 12.)

DRAINAGE PATTERNS

The layout of a storm drainage system is controlled primarily by topographic considerations, since natural drainage patterns must be followed. It is, therefore, approached on a functional basis, rather than through consideration of political boundaries.

Anchorage is particularly fortunate in having major natural drainage channels penetrating all portions of the area. Most of the developed portions are located on high and fairly level land which drains into various creeks and Knik Arm. The map on the next page shows the general drainage pattern for the Anchorage area.

As can be seen from the map, storm drainage can be provided through the construction of relatively short outfall sewers discharging into natural drainage channels. In some instances it may even be feasible to provide surface drainage, due to very short runoff distances to nearby creeks.



DRAINAGE PATTERNS IN THE ANCHORAGE AREA

NATURAL DRAINAGE CHANNELS; DRAINAGE DIVIDES; DIRECTION OF FLOW

STORM SEWER DESIGN

Design standards for a drainage system have to be calculated for each community on the basis of local conditions. The facts required to evaluate design criteria for this area were recently assembled and analyzed by Frank E. Nyman, Sanitary Engineer in the office of the City Engineer. His report, "Storm Drain Design Criteria for Anchorage, Alaska," was presented at the Alaska Science Conference on June 3, 1955.

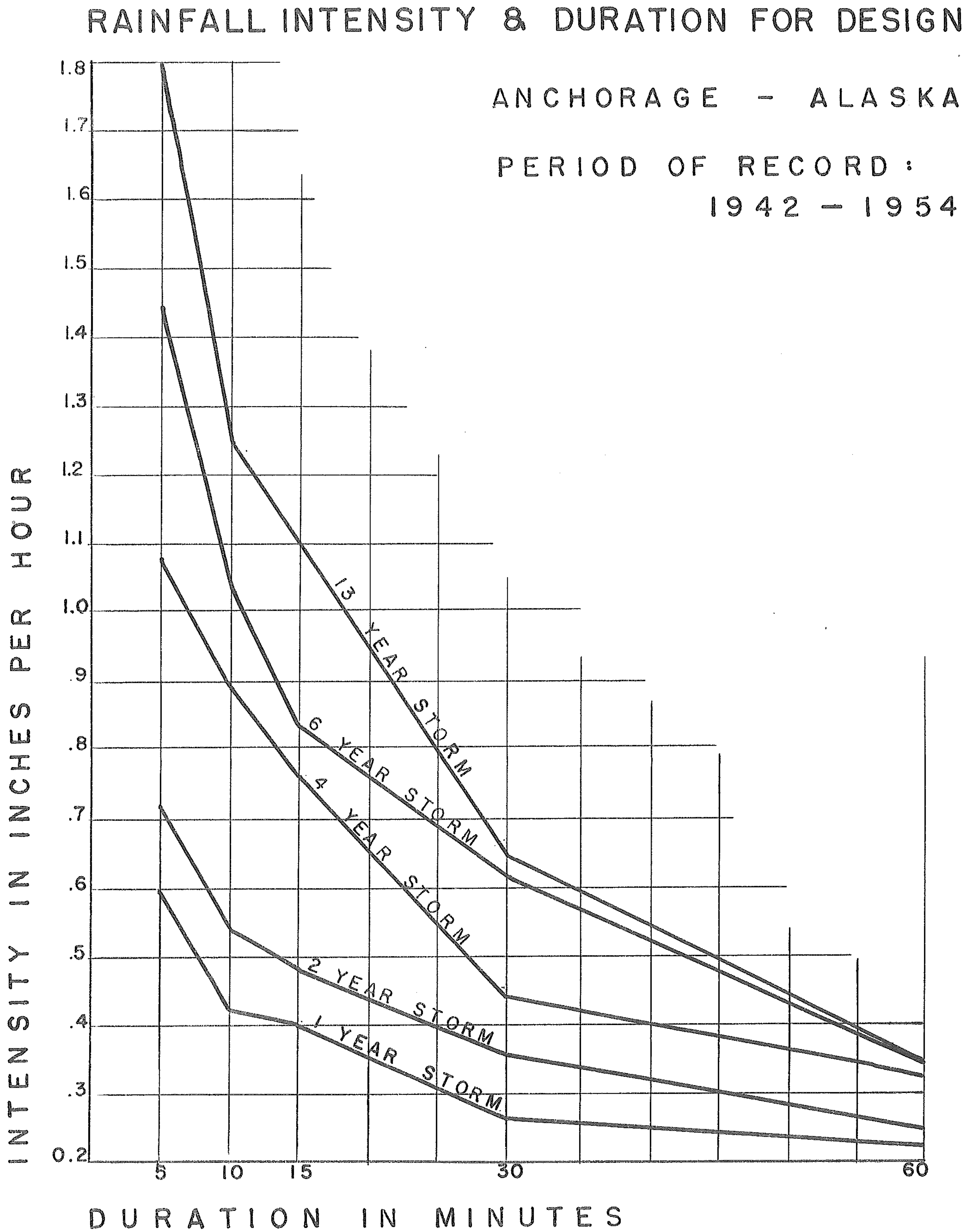
This section is devoted to a review of the most pertinent portion of the Nyman study. (Numbers in parenthesis refer to pages in the report.)

1. General Approach of Study

"Storm water runoff from all areas is calculated by the rational methods. This method takes into account rainfall intensity and duration, the frequency of heavy storms, and the imperviousness of ground surface and the extent of built-up areas. It considers, also, the time of concentration of large flows throughout the drainfall system. Measurements of intensity, duration, and frequency of rainfall in the Anchorage area have been made for the past thirteen years by the U. S. Weather Bureau and are used as a basis for computation."

2. Use of "Four Year Storm" in Design

"The severity of a storm; i.e., the rainfall and intensity frequency relationship to be provided for in any given case depends on a number of controlling factors. In most of the areas in the United States, good engineering practice is believed to be represented by the design of facilities capable of handling maximum storm runoff which may be expected to occur once in every ten to fifteen years. While storms of greater intensity and less frequency may be expected to cause inconveniences, discomfort, and possible damage, the construction of works capable of handling such storms ordinarily involves such an expense that it would be out of proportion to the benefits obtained. On the other hand, to provide for only storms of an intensity occurring at relatively frequent intervals may not provide the desired degree of comfort, convenience, and restriction of damage to which the community is entitled and can properly afford. In the Anchorage area storm drainage intensities are


RAINFALL INTENSITY & DURATION FOR DESIGN
ANCHORAGE - ALASKA
PERIOD OF RECORD:
1942 - 1954
INTENSITY IN INCHES PER HOUR
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
0.2
5
10
15
30
60
DURATION IN MINUTES
13 YEAR STORM
6 YEAR STORM
4 YEAR STORM
2 YEAR STORM
1 YEAR STORM

relatively low when compared to the United States as a whole. An intensity of 2 inches per hour has not occurred in the Anchorage area as far as the records show. Storm intensities of 3, 4, and 5 inches per hour during the first 15-minute period of a storm are quite common in many areas in the United States. It has been concluded in the Anchorage area that if a 4-year storm were used in design criteria, period of overflow of this system would occur only once every five or six years. While resulting in some inconvenience, particularly to pedestrian traffic, these overflows could not be expected to result in an appreciable amount of damage because of the low intensity of rainfall and the small drainage area involved. The distance to natural drainage courses is relatively short, and it is not to be expected that a serious flooding problem would occur." (8, 9)

Rainfall intensity and duration are shown on the preceding page. The curves on the chart represent the greatest rainfall that may be expected over the specified number of years. The data is based upon records kept by the U. S. Weather Bureau.

3. Runoff Coefficients

"The validity of computations of storm water runoffs depends in a large degree on accuracy of selecting the runoff coefficient "C". Stated briefly, this coefficient must reflect the degree of imperviousness of any drainage area under consideration during the period of concentration of the greatest storm runoff from this area. The period of concentration, according to the rational methods, is defined as the length of time required for rain falling upon the most remote point of the drainage area to reach the point or place at which the rate of runoff is being determined by calculations or by actual measurements. The value of "C" is determined by the percentages of highly impervious substances, such as roofed and paved areas, and those which are more or less impervious such as lawns and gardens. Allowance must also be made for the possibility that relatively pervious surfaces may become almost impervious by reason of saturation caused by heavy rainfall immediately preceding the rate for which this design of storm drainage is being undertaken, or by reason of being frozen at the time of a heavy rainfall. The author of this report (Mr. Nyman) has made several observations of the conditions of runoff during the breakup period in the Anchorage area, and it is the considered opinion of the author, based upon rough measurements and calculations that the runoff during periods of thawing does not exceed the runoff that occurs during the summer months during a heavy storm. The runoff coefficient expressed as a decimal represents that portion of the rainfall which is expected to run off a given area at a point of calculation or measurement...." (10-11)

Runoff coefficients were applied to specific areas on the basis of use zoning. For design purposes, Mr. Nyman proceeded on the basis 100 percent build-up under the conditions for which the various areas of the city are presently zoned. Runoff coefficients were assigned in accordance with the following table:

AVERAGE RUNOFF COEFFICIENTS

Type of Area	Coefficient of Runoff
Business district, densely built	0.7 - 0.9
Residence district, densely built	0.5 - 0.7
Residence district, sparsely built	0.3 - 0.5
Parks and open ground	0.1 - 0.3
Lawns, gardens, meadows, and cultivated areas, depending on slope and character of soil	0.05-0.25

In the application of the above coefficients to the Zoning Map, Two-Family Residential Districts were assigned a runoff coefficient of 0.4. The same classification was put on most of the Multiple-Family Residential Districts although some were assigned a rate of 0.5. A coefficient of 0.5 was also applied to areas zoned for industrial purposes. The Central and General Business Districts and several areas of densely developed multiple-family structures were assigned a runoff coefficient of 0.6 to 0.8.

4. Frost Protection

"Ordinarily, in most cities the minimum depth of cover is not an important factor in considering storm sewer design. In the Anchorage area, however, it has been found through experience that storm sewerage entering shallow sewer lines tends to glacier until the sewer is frozen solid, if sufficient cover is not maintained. This is particularly true during the spring breakup period when the ground is still frozen to considerable depth while the surface is thawing."

A study of ground temperatures has been made over the last three winters by use of thermocouples. Results show that due to frost penetration, a depth of bury of 9 to 10 feet would have to be maintained if reasonable frost protection were to be insured.

Surveys of the worst storm sewer freezing conditions indicated that the main trouble spots occur in concrete sewers of less than 6 foot bury. On the other hand, it was also found that asbestos-bonded corrugated metal pipe appeared not to freeze even though buried at a depth of only 4 or 5 feet. Mr. Nyman states that "since it is the bottom of the pipe, in contact with frozen soil, where glaciation of the sewers occurs, it appears that insulation of this portion of the pipe might prove advantageous in the prevention of glaciation within the sewers. Further study of this possibility is indicated."

He goes on to recommend that:

"Wherever possible, minimum depths of bury should be 6 feet, with 9 to 10 feet depth of bury desirable for frost protection. Additional research on the possibility of securing frost protection through insulation is indicated. Minimum size of lines should be 10 inches to delay complete stoppage of sewer lines through glaciation during spring runoff period." (15)

STORM DRAINAGE PROGRAM

Much progress has been made since the first major storm sewer construction was undertaken in 1949 in connection with the paving of Fifth Avenue. The map on the next page shows the coverage that has been provided since that time.

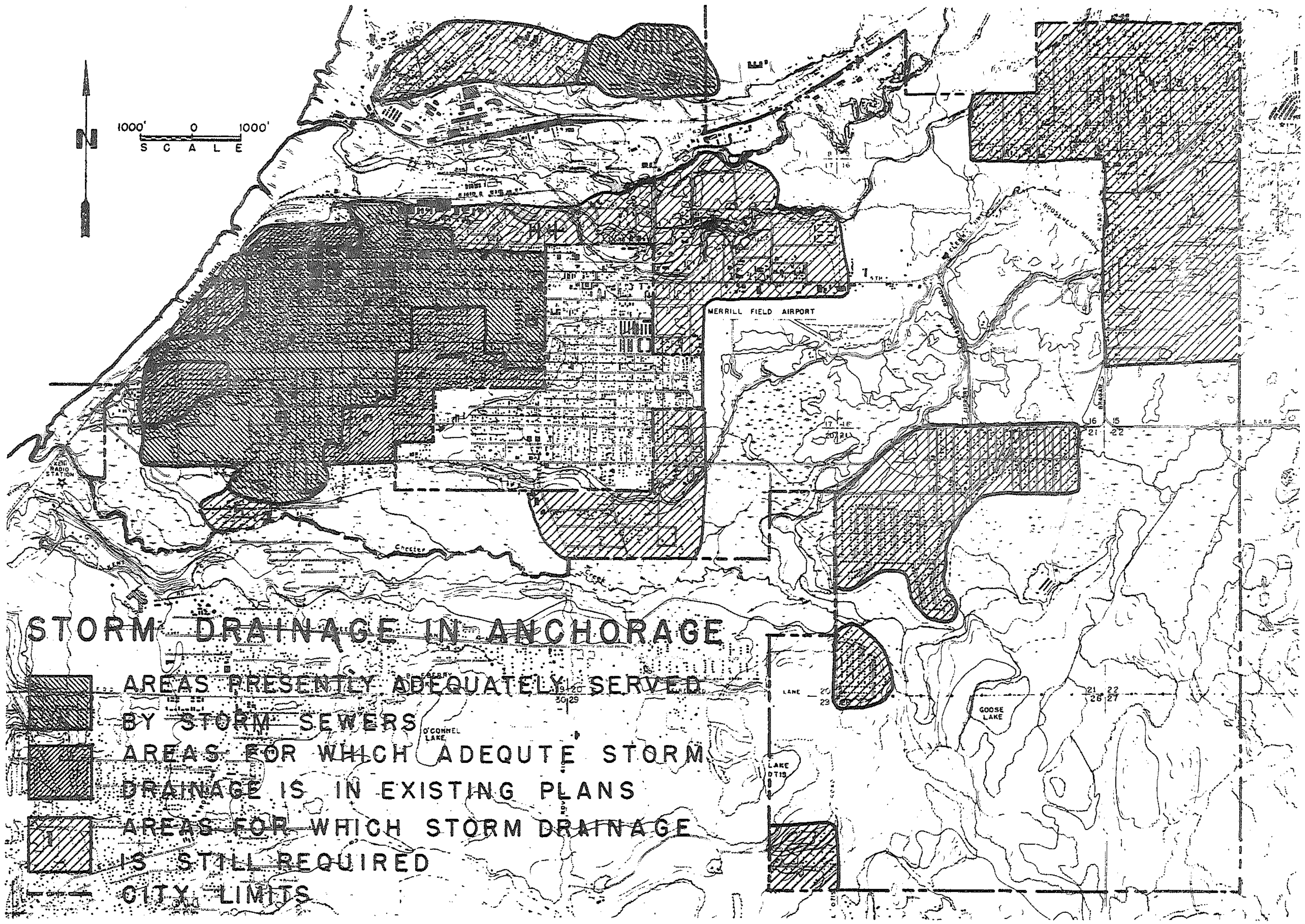
In addition to setting out areas currently served and those included under completed designs, the map also clearly demonstrates that major portions of the city are not as yet served by storm drainage. Most of these are located in areas recently annexed to Anchorage. The need in some of these areas is particularly great as they contain poorly-drained or low-lying land.

Two major factors must be considered in providing drainage for portions of the city not adequately served --- degree of need and relationship to other public improvements, particularly street paving.

While generally it can be said that all areas need storm drainage, the degree of need may vary from one section of town to another. Where extremely poor surface drainage exists, the condition is not only detrimental to adjacent property owners, but is costly to the city as a whole. For inadequate drainage is one of the main causes of the poor condition of unimproved or gravel streets. High street maintenance costs may, therefore, justify drainage projects where such might not be warranted by the scheduling of paving projects.

Due to its very nature, storm drain construction must be very closely coordinated with municipal paving programs. Installation of pipes must, of course, precede the street improvement. And while paving can be accomplished on an individual block basis, storm sewerage has to be based upon area-wide needs and usually must be provided on a drainage-area basis. Thus, storm sewer projects may have to cover larger areas than are included in the related paving district.

This basic relationship between drainage and street improvement has given rise to a specific policy of programming and financing both improvements --- the provision of storm sewers has now been assumed as a general municipal function. This policy was decided upon primarily due to two factors: (1) the fact that while adjacent property benefits from storm sewer construction, the layout of drains is such that benefits could not be feasibly apportioned due to intricacies and large coverage of drainage areas, and (2) because it was deemed that better coordination with street improvements could be achieved if the city could


N
1000' 0 1000'
SCALE
MERRILL FIELD AIRPORT
GOOSE LAKE
LAKE OTIS
O'CONNEL LAKE
STORM DRAINAGE IN ANCHORAGE
AREAS PRESENTLY ADEQUATELY SERVED BY STORM SEWERS
AREAS FOR WHICH ADEQUTE STORM DRAINAGE IS IN EXISTING PLANS
AREAS FOR WHICH STORM DRAINAGE IS STILL REQUIRED
CITY LIMITS

plan and execute the program without need for petitions and improvement districts in each case. As a result, the construction of storm drains is supported by all taxpayers of the community. Since all areas of the city will at some time be provided with storm drains, the method now in operation is equitable as well as practical.

A priority schedule for storm drain construction is difficult to establish. Because street paving is undertaken upon petition by property owners, the provision of drainage is indirectly tied to the desire of citizens for street improvement.

While the drainage program can move far ahead of the paving program, under no circumstances can it be outdistanced by the paving. Therefore, every effort must be made to provide storm drainage in all areas of the city as quickly as possible within the financial means of the city. Not only would the problems caused by lack of drainage then be eliminated, but the people in any part of Anchorage could proceed with the improvement of their streets.