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CHEMICAL CORPS, U. S. ARMY

BEHAVIOR OF AEROSOL CLOUDS WITHIN CITIES

Joint Quarterly Report No. 4

April - June 1953

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AERIAL VIEW OF MINNEAPOLIS, WINTER

C O N T E N T S

L I S T O F T A B L E S

LIST OF TEXTUAL ILLUSTRATIONS

I. SUMMARY

A. OPERATIONAL AND ADMINISTRATIVE PROGRESS

1. Field Test Cities

In Minneapolis, the winter aerosol-test program for 1952-53 was brought to a close upon completion of the twenty-third field test (and the associated sixty-third mesometeorological survey), in which the sixty-third release of fluorescent-particulate material (NJZ 2266) was made since the inception of current studies in aerosol-cloud behavior.

Necessary equipment was shipped from Minneapolis to St. Louis, and, at the close of the present quarterly period, 10 independent temperature surveys had been completed, 4 wiresonde sites had been selected, and 35 releases constituting 17 field tests, with their complementary measurements of the horizontal and vertical temperature gradients, had been made. These tests were conducted in How and Item Areas, two sites selected from a general five-square-mile test area to serve as the counterparts of Able and Dog Areas in Minneapolis, respectively residential-commercial and downtown. Of the 35 releases which comprised afternoon, predawn, and mostly nighttime operations, two were made on a citywide scale.

Cooperative action on the part of the Canadian Defence Research Board, Civil Defence authorities, and municipal officials enabled establishment of field quarters in Winnipeg. From the results of four mesometeorological surveys, a characteristic temperature structure was determined, wiresonde stations were established, and sites suitable for aerosol-cloud studies employing the fluorescent-tracer technique were tentatively selected.

2. Plans

A summer aerosol-test program is scheduled for Minneapolis. In St. Louis, where additional quarters have been made available, tentative arrangements have been made for possible fluorescent-particle releases within the St. Louis industrial complex during the fall of 1953. Field testing is also contemplated for Winnipeg, field-test personnel to include 62 part-time workers. Data obtained from the St. Louis and Winnipeg operations will be processed in the Minneapolis office.

B. EVALUATION OF WINTER PROGRAM IN MINNEAPOLIS

Of the 63 releases (23 field tests) constituting the winter aerosol-test program in Minneapolis, 34 releases have been selected from 14 tests for evaluation in the present report. These releases of NJZ 2266, comprising both point and line-source dispersals from a surface-mounted blower disperser, and including four releases on a citywide scale, were made in four selected areas of varying topographical and land-use characteristics. In the evaluation of wintertime aerosol-cloud behavior, some consideration has been given to St. Cloud raob soundings and to associated measurements of the horizontal and vertical temperature gradients. Primary consideration has been given to the results obtained from samplers exposed at surface level, for studying horizontal distribution of aerosol dosages; at varying heights, for investigating vertical distribution of aerosol dosages; at different locations within buildings, for ascertaining the degree of cloud penetration; and with filter units exposed sequentially both inside and outside buildings, for verifying (along with several time-resolution samplers) that the length of the sampling periods was sufficient to ensure complete sampling of the aerosol cloud.

Pending further confirming data, the following observations may be made:

1. Dosage patterns are similar for releases made from a given point within a three or four-hour period, provided there are no marked changes in wind or stability conditions. When a release is made in or upwind of a river gorge, the aerosol cloud is displaced laterally and the dosage pattern, therefore, is somewhat altered.

2. For comparing the areas covered by given dosages, compensation for the effects of wind velocity by simple multiplication of Ct/gm by mph appears to be satisfactory for wind speeds up to 6 mph, but gives values which are too large at higher velocities.

3. Comparison of CWID values (crosswind integrated dosages computed for releases at regular intervals of distance downwind to the limits of the sampling arrays) indicates significant differences only when daytime releases are made in a residential area (with resulting low values) and when nighttime releases are made in an open area (with resulting higher values). CWID values for releases from points and short lines are more nearly comparable than those for point and long line releases.

4. Where comparisons are possible for tests conducted under similar conditions, there are no apparent significant differences between the values expressing the relationship of area and dosage per gram for point-source releases of 1.5 to 13.3 grams and for short line releases of 14.3 to 23.5 grams.

5. Within the height ranges of buildings used in studies of cloud attenuation and at the given downwind distances from the source, there seems to be no significant decrease of dosage with height in built-up areas.

6. Results from one test indicate that under generally unstable conditions, increased instability due to high building density can cause a rapid dissipation of the aerosol cloud.

7. Penetration of downtown buildings by the aerosol cloud does not appear to be a function of height and does not differ appreciably from that noted within structures located in a residential area.

II. FIELD OPERATIONS AND MANAGEMENT

A. ADMINISTRATION

1. Organization

There were no additions to the full-time field office personnel during the current report period. The organization remains at 14 full-time employees in Minneapolis and one in St. Louis.

As of 31 March, the total number of part-time employees in Minneapolis was 180. During the current period, only two aerosol tests and the corresponding meteorological surveys were performed in Minneapolis. Several part-time employees normally assigned to perform field work were trained for and utilized in laboratory analysis work. In Minneapolis the major portion of the field force was inactive pending resumption of test activity in the summer. During the period, eight people were hired and 25 were separated, leaving a total of 163 on record as of 30 June.

At the start of the current quarter, as reported in JQR 3, the part-time force in St. Louis numbered 53. Some 157 people were hired, and 13 were terminated, leaving 197 employees on record at the end of the quarter.

In Winnipeg, 62 part-time workers were hired in the month of June, representing mainly the men used in preliminary meteorological surveys but including those initially hired for the field test crew.

Tables II-1, II-2, and II-3 show both full-time and part-time manhours expended in the current period in Minneapolis, St. Louis, and Winnipeg, respectively, broken down by months and activities.

TABLE II-1

FIELD OFFICE MANHOURS

MINNEAPOLIS

		April	May	June	Total for Period	Total to June 30
Administration	Full-time	702	403	335	1440	6127
	Part-time	19	209	201	429	481
Meteorological	Full-time	942	727	422	2091	6477
	Part-time	1796	702	1265	3762	13870
Tracer Test	Full-time	494	88	258	840	3523
	Part-time	933	45	12	990	7821
Laboratory	Full-time	291	160	227	678	1605
	Part-time	1216	161	779	2156	3635
Instrumentation	Full-time	181	0	16	197	1044
	Part-time	196	92	153	441	980
Totals	Full-time	2610	1378	1258	5246	18776
	Part-time	4160	1209	2410	7779	26787
					13025	45563

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TABLE II-2

FIELD OFFICE MANHOURS

ST. LOUIS

		April	May	June	Total for Period	Total to June 30
Administration	Full-time	92	363	280	735	735
	Part-time	0	231	163	394	394
Meteorological	Full-time	192	355	407	954	1698
	Part-time	649	1443	2521	4613	7051
Tracer Test	Full-time	0	348	608	956	956
	Part-time	0	2704	3092	5796	5796
Laboratory	Full-time	0	164	40	204	204
	Part-time	0	0	210	210	210
Instrumentation	Full-time	0	168	213	381	381
	Part-time	0	42	24	66	66
Totals	Full-time	284	1398	1648	3330	4074
	Part-time	649	4420	6010	11079	13517
					14409	17591

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SECURITY INFORMATION

TABLE II-3

FIELD OFFICE MANHOURS

WINNIPEG

		April	May	June	Total for Period	Total to June 30
Administrative	Full-time	0	0	73	73	73
	Part-time	0	0	176	176	176
Meteorological	Full-time	0	0	269	269	269
	Part-time	0	0	799	799	799
Tracer Test	Full-time	0	0	0	0	0
	Part-time	0	0	0	0	0
Laboratory	Full-time	0	0	0	0	0
	Part-time	0	0	0	0	0
Instrumentation	Full-time	0	0	0	0	0
	Part-time	0	0	0	0	0
Totals	Full-time	0	0	342	342	342
	Part-time	0	0	975	975	975
					1317	1317

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SECURITY INFORMATION

2. Facilities

For performance of aerosol tests in St. Louis, additional space of approximately 3500 square feet was procured on a month-to-month rental basis. This additional space adjoins the existing field office in the second-floor garage at 5589 Pershing Avenue, and includes 500 square feet of office space to accommodate the functions of aerosol-test administration. The balance of the space is open-garage area for the equipment assembly area, crew assembly area, battery-charging room, instrument and tool crib, and the laboratory. The latter three rooms are of light knock-down construction, with wall and ceiling panels prefabricated in Minneapolis. It was anticipated that these enclosures would be utilized at field offices remote from Minneapolis, and, therefore, were constructed to permit easy assembly, disassembly, and transportation. The only addition to the St. Louis office to permit initiation of aerosol tests, other than mentioned above, was a 220-volt, 3-phase electrical power service to the battery-charging generators.

Some 12,000 pounds of equipment and facilities were shipped by one motor van from Minneapolis to St. Louis. Included in the shipment were all sampling units, two battery-charging generators, meteorological instruments, tools, supplies on hand, prefabs, and office equipment. The complete move and re-establishment of this sizeable amount of equipment and facilities was accomplished in less than a week without significant damage to the transported goods. At the end of the current period, with St. Louis tests completed, facilities and equipment were in the process of transfer directly to Winnipeg by a similar type of transportation.

For project operations in Winnipeg, quarters were procured by the Director of Civil Defence of Winnipeg. The space consists of approximately 3000 square feet in two adjacent temporary buildings at Stevenson Air Field, some 3½ miles west of downtown Winnipeg. These buildings are occupied in part by the Air Cadet League of Canada to which the buildings are assigned. Various store rooms and assembly rooms are used for administration, equipment preparation and assembly, and laboratory functions. The arrangement has been extremely satisfactory. Adequate parking space is available adjacent to the buildings, facilitating loading of sampling equipment and car-mounting of meteorological instruments. A 220-volt, 3-phase electrical service was installed from an outside pole line to one of the buildings for the battery chargers.

3. Security

No special security measures were instituted in connection with the Winnipeg operation, inasmuch as all evaluation of filters and computing of meteorological and field-test data are performed in Minneapolis.

B. METEOROLOGICAL SURVEYS

1. General

The purpose of the mesometeorological surveys conducted during the current period was to determine the horizontal and vertical temperature distributions to serve as a basis for the selection of aerosol-test sites in St. Louis and Winnipeg, and to obtain data both for determining any possible effect of these distributions on the diffusion of aerosol clouds in Minneapolis and St. Louis and for investigating the changing distributions in various weather situations in Minneapolis and St. Louis.

In order to obtain the temperature data, traverse routes in all three cities were designed to include the business area, most of the residential area, and sufficient undeveloped area to enable the establishment of the characteristic distributions which affect aerosol diffusion. It was found that eight routes were necessary for minimum coverage in St. Louis, and the routes were redesigned accordingly prior to starting the aerosol-cloud tests. Only five instruments were available for the Minneapolis tests, although a minimum of six routes will be necessary for summer tests. It was found necessary to design six routes for Winnipeg tests. As in the past, four to eight circuits were made on each route in accordance with the requirements of each field test. Wiresonde ascents were also conducted in both business and undeveloped-area locations, ascents being made once each hour to coincide with traverse operations.

2. Test Data

Table II-4 lists the three mesometeorological surveys conducted in Minneapolis in the current period, the four surveys conducted in Winnipeg, and the 25 surveys in St. Louis. This table shows the pertinent statistics on the number of routes, runs, wiresonde ascents, maps obtained, and manhours expended during the period for various phases of the operation in connection with these surveys. The manhours expended during the current period on surveys conducted in previous periods are not included.

3. Public Relations

Meetings were held with various city officials of St. Louis for the purpose of completing arrangements for wiresonde and field-test operations. Minor difficulties with the Park Commissioner were ironed out with the completion of the change in city administration. The St. Louis police department was quite cooperative at all times, and the fire department aided in the recovery of a kytoon and thermistor which had become entangled in a tree during gusty winds. The public showed considerable interest when Forest Park had to be used for the undeveloped-area wiresonde site. However, no incidents of consequence occurred.

Civil Defence and city officials of Winnipeg and surrounding municipalities were exceptionally cooperative in helping to initiate mesometeorological operations in that city. As a result, considerable interest was shown by the press and the public. Traverse car operations evoked little interest. However, the first wiresonde ascents drew quite a large crowd, one teenage

TABLE II-4

MESOMETEOROLOGICAL SURVEYS

MINNEAPOLIS - ST. LOUIS - WINNIPEG

GENERAL				2-METER TEMPERATURE SURVEYS							WIRESONDE SURVEYS						COMPUTING AND ANALYSIS					
Survey No.	Date 1953	Map Times CST	Field Test FT No.	No. Routes Used	No. Runs Per Route	No. Traverse Men	No. Cars	Traverse Car Miles	Total Traverse Mhrs (P)	Traverse Mhrs per Run (P)	No. Urban Sites	No. Rural Sites	No. Special Sites	Total No. Ascents	No. Wiresonde Operators	Total Wiresonde Mhrs	Mhrs Per Ascent	No. 2-Meter Survey Maps	Traverse Data Reduction Mhrs (P)	Total Map Plotting and Drafting Mhrs (P)	2-Meter Survey Analysis Mhrs (F)	No. Wiresonde Charts	Wiresonde Data Reduction and Drafting Mhrs (P & F)
MINNEAPOLIS																							
M-61	1 Apr	2000-2200		5	4	15	5	314	68	3.4	1	1	0	6	6	27	4.5	3	30	33	15	5	20
M-62	6 Apr	2000-2200		5	4	11	5	299	50	2.5	1	1	0	6	6	25	4.2	3	23	34	15	5	20
M-63	28 Apr	1900-2300	0023	5	6	10	5	451	70	2.3	0	0	0	0	0	0	0	5	31	52	15	0	0
ST. LOUIS																							
M-1036	2 Apr	2000-2200		5	4	17	5	393	88	4.4	0	0	0	0	0	0	0	3	32	12*	*	0	0
M-1037	3 Apr	2000-2200		5	4	15	5	390	79	4.0	0	0	0	0	0	0	0	3	30	13*	*	0	0
M-1038	10 Apr	2000-2200		5	4	11	5	348	61	3.1	0	0	0	0	0	0	0	3	31	12*	*	0	0
M-1039	16 Apr	2000-2200		6	4	18	6	480	95	4.0	0	0	1	3	18	90	30.0	3	35	16*	*	1	11
M-1040	20 Apr	2000-2200		6	4	18	6	479	93	3.9	0	0	1	3	6	34	11.3	3	36	15*	*	1	11
M-1041	22 Apr	2000-2200		6	4	18	6	463	95	4.0	0	0	1	4	4	22	5.5	3	37	15*	*	1	12
M-1042	7 May	1930-2130		6	4-1	20	6	399	126	6.0	0	0	1	3	3	19	6.3	3	35	14*	*	1	6*
M-1043	8 May	1930-2130		6	4-3	22	6	418	127	5.5	0	0	0	0	0	0	0	3	36	15*	*	0	0
M-1044	11 May	1900-2100		8	4	24	8	592	128	4.0	1	1	0	3	5	30	10.0	3	35	18*	*	2	*
M-1045	14 May	1900-2100		5	4	22	5	359	123	6.2	1	1	0	5	6	35	7.0	3	29	13*	*	4	*
M-1046	20 May	1900-2100	1002	8	4-1	29	8	527	152	5.2	0	0	0	0	0	0	0	3	36	42	15	0	0
M-1047	22 May	1900-2200	1003	7	5	22	7	617	140	4.0	1	1	0	0	5	23	0	4	45	26*	*	0	0
M-1048	25 May	1900-2100	1004	8	4	28	8	555	168	5.2	1	1	0	6	6	37	6.2	3	39	23*	*	5	19
M-1049	28 May	1900-2100	1005	8	4	26	8	595	144	4.5	1	1	0	2	7	46	23.0	3	38	24*	*	1	7
M-1050	30 May	0000-0400	1006	7	6	24	7	585	173	4.1	1	1	0	9	5	36	4.0	5	56	33*	*	6	27
M-1051	7 June	1300-1600	1008	5	5	17	5	456	102	4.1	0	0	2	7	5	35	5.0	4	37	21*	*	5	*
M-1052	9 June	2000-2300	1009	8	5	25	8	725	164	4.1	1	1	0	8	6	45	5.6	4	5	30*	*	6	*
M-1053	11 June	2000-2300	1010	8	5	27	8	734	183	4.6	1	1	0	6	6	44	7.3	4	50	31*	*	5	*
M-1054	13 June	2300-0300	1011	6	6	19	6	631	141	3.9	1	1	0	10	6	45	4.5	5	40	34*	*	7	*
M-1055	15 June	1900-2200	1012	7	5	22	7	643	142	4.1	1	1	0	7	6	44	6.3	4	35	27*	*	5	*
M-1056	18 June	2000-2300	1013	8	5	23	8	736	158	4.1	1	1	0	4	6	44	11.0	4	46	31*	*	3	*
M-1057	20 June	0000-0400	1014-15	8	6	21	8	837	165	3.4	1	1	0	11	5	43	3.9	5	49	15*	*	7	*
M-1058	21 June	1300-1600	1016	5	5	17	5	454	101	4.0	1	0	1	7	6	41	5.8	4	33*	*	*	5	*
M-1059	23 June	2000-2300	1017	8	5	26	8	736	173	4.3	0	1	1	7	6	43	6.1	4	*	*	*	5	*
M-1060	25 June	2000-2300	1007	8	5	25	8	724	171	4.3	1	1	0	7	6	44	6.3	4	*	*	*	5	*
WINNIPEG																							
M-2001	22 June	2100-2300		5	4	23	5	356	123	24.0	0	0	1	3	10	59.5	5.9	3	70	13*	6*	1	7*
M-2002	26 June	2100-2300		5	4	19	5	368	105	21.0	1	0	0	1	9	40	4.4	3	33	8*	6*	1	1*
M-2003	29 June	2100-2300		5	4	17	5	396	86.5	17.3	1	1	0	6	10	51.0	5.1	3	26	14*	10*	5	2*
M-2004	30 June	2100-2300		5	4	11	4	364	55	13.7	1	1	0	5	6	30.0	5.0	3	2*	*	*	4	*

* Work not complete as of 30 June 1953 (P) Part-time personnel (F) Full-time personnel

member of which had to be restrained from using the kytoon as a target for his bow and arrow. Subsequent use of more remote locations eliminated this difficulty.

4. Traverse-Route Planning

The general principles of traverse-route planning, as discussed in JQR 3, applied directly to all route planning completed during the current period. Additional factors exerting considerable influence on such planning in Winnipeg were the number of unpaved streets, which became impassable during and after rainstorms, the existence of traffic bottlenecks at bridges and railroad underpasses, and the large number of mapped streets that did not exist. The routes as finally designed averaged 17 to 20 miles, but the coverage of each route was not as comprehensive as similar routes in Minneapolis because of the aforementioned factors.

The new routes designed for St. Louis early in the current period were based largely on experience to date. Because of street patterns and traffic conditions, it was necessary to limit these routes to 12 to 17 miles in length.

5. Traverse Scheduling

The scheduling of traverses during the current period was conducted in accordance with the policy outlined in JQR 3.

6. Selection of Wiresonde Sites

In accordance with the principles discussed in JQR 3, wiresonde sites were selected in both St. Louis and Winnipeg during the current period. The St. Louis business-area location was established on top of a two-story building on the northwest corner of Eighth and Delmar, very near the center of the heat island. The undeveloped-area location was established in Forest Park in the lowest accessible spot. An alternate undeveloped-area location for use on Sundays or holidays was found at Wilmore Park on the south edge of the city. An additional site was located in the aerosol-test area on a three-story building on the northwest corner of Benton and Leffingwell.

The business-area location selected in Winnipeg was the roof of the three-story Dominion Motors Building on the northwest corner of Fort and Graham, about 1000 feet from the center of the heat island and on the edge of the high building area. A satisfactory undeveloped-area location was found in an open field on the northwest corner of Watt and Melrose in East Kildonan, three miles north-northeast of the heat island. The coldest point in the area seems to be one-half mile further out, but trees preclude the use of wiresonde equipment there.

7. Wiresonde Scheduling

The scheduling of wiresonde operations during the current period was strictly in accordance with the policy outlined in JQR 3.

8. Mobile Meteorological Stations

The organization, equipment, and function of mobile meteorological stations as used during the current period were covered in JQR 3. Various criteria for locating the surface-level stations were tried in an effort to obtain the most representative data for use in evaluating the aerosol-test patterns. None of these criteria has given completely satisfactory results, and efforts are being continued to improve them. Wind directions taken at the rooftop stations have been found to be much more reliable both for planning dispersal operations and for evaluating the results.

9. Data Reduction and Analysis

The procedures outlined in JQR 3 were followed in the current period. Data reduction and map plotting were in progress at the end of the period. However, the analysis of many of the tests was not completed because of the immediate pressure of operating duties. With the completion of most of the organizational work, more time will be available for analysis in coming months.

10. Personnel

As was anticipated, the tight labor market in St. Louis made it difficult to obtain adequate personnel, particularly responsible personnel. The scope of several of the tests was limited by failure of employees to report for duty. It was necessary to discard some data because of obvious poor quality and incompleteness. The rapid personnel turnover, coupled with the generally

disinterested attitude, made it extremely difficult to retain even a nucleus of trained people.

In contrast, the Winnipeg situation was considerably better. An adequate number of people was available and a generally good attitude was exhibited. Through the cooperation of the Official in Charge of the Weather Office, the services of trained observers were obtained who served as wiresonde captains and Mobile Met crews.

C. FIELD TESTS

1. General

During the current period, tests to determine the behavior of aerosol clouds within cities were conducted principally in St. Louis. In Minneapolis, on 28 April 1953, two releases were made on a citywide scale, representing final winter operations in that city.

From the general five-square-mile area selected for St. Louis aerosol tests as outlined in JQR 3, two separate testing sites were selected. A detailed description of these sites will be included in a subsequent quarterly report covering summer operations in St. Louis. The two areas consisted essentially of a densely populated residential area including some commercial and manufacturing areas (designated How Area, the counterpart of Able Area in Minneapolis), and a downtown section encompassing most of the tall buildings in St. Louis (designated Item Area, the counterpart of Dog Area in Minneapolis).

A total of 17 field tests were conducted in which tracer material was released 35 times. The initial test in which no tracer material was released consisted of two runs and was performed to train operating personnel and to obtain samples of background particulates in the St. Louis area. In the residential area 20 releases were made, and in the downtown area 13 releases were made. Two releases were made on a citywide basis.

Operations for the period in St. Louis represent a total of 50 field experiment hours (during which aerosol clouds were being sampled), representing

an expenditure of 7511 manhours of full-time and part-time personnel to accomplish the field and laboratory phases of the program. It is noted that the field work was completed in the current period, but the laboratory work was only partially complete as of 30 June. Field tests were conducted predominantly in the evening hours between 2000 and 2300 CST, with several supporting experiments being conducted in each area during the afternoon hours between 1300 and 1600 CST, and during the early morning hours between 0000 and 0500 CST.

2. Test Data

Table II-5 enumerates all field tests conducted in St. Louis during the period covered by this report. Pertinent statistics are given relative to the several main phases of a field operation and the attendant analysis work. Total manhour expenditure figures in various operations and manhour figures per unit operation are presented. The test data for the one field test conducted in Minneapolis during the current period will be included in a subsequent report with other Minneapolis tests.

3. Public Relations

As previously outlined in JQR 1, advance meetings with St. Louis city officials were held in the fall of 1952 in preparation for conducting aerosol tests in that city. In April of 1953 meetings were again held with representatives of the Mayor's office, with the Chief of Police and his representatives, and with members of the Park Board, during which the various phases of the summer test program were outlined.

GENERAL				TEST PREPARATION						AEROSOL GENERATION						SAMPLING					
Field Test FT No.	Date 1953	Type Area	Period Hrs CST	Test Planning MHrs (F)	Filter Prep. MHrs (P)	Flow Rate MHrs (P)	Equip. Prep. MHrs (P)	Total Prep. MHrs (F & P)	Prop. MHrs per Sampler (F & P)	Time Hrs CST	Type Source	Elev.	Number Operators (P)	Total Operator MHrs (P)	Vehicle Miles	Samplers Used	Exposed Outdoors El.1-6 ft.	Exposed Outdoors El.≥6 ft.	Exposed Indoors	Number Operators (P)	Total Operator MHrs (P)
1001a	18 May	Resid.	1930-2030	16	5	0	33	54	.75	None						72	72	0	0	57	295
1001b	"	"	2100-2200							"											
1002a	20 May	Resid.	2000-2100	10	4	20	35	69	.95	2011	Pt.	Veh.	3	20	14	72	72	0	0	61	312
1002b	"	"	2130-2230							2140	"	"									
1003a	22 May	Resid.	2000-2100	10	4	18	35	67	.93	2017	Pt.	Veh.	3	18	13	72	72	0	0	66	320
1003b	"	"	2130-2230							2205	"	"									
1004a	25 May	Resid.	1945-2045	12	7	24	40	83	.80	1956	Pt.	Roof	3	20	12	105	105	0	0	65	397
1004b	"	"	2105-2205							2110	"	Veh.									
1004c	"	"	2225-2325							2235	"	"									
1005a	28 May	Resid.	1945-2045	15	7	16	45	83	.80	2006	Pt.	Veh.	3	25	14	104	104	0	0	64	391
1005b	"	"	2105-2205							2117	"	"									
1005c	"	"	2225-2325							2235	Line	"									
1006a	30 May	Resid.	2330-0100	14	6	19	30	69	.68	2335	Pt.	Veh.	3	25	33	102	102	0	0	54	410
1006b	"	"	0115-0245							0126	Line	"									
1006c	"	"	0330-0500							0335	"	"									
1007a	25 June	All City	2030-2200	16	4	16	34	70	.82	2056	Line	Veh.	3	27	33	85	68	17	0	44	289
1007b	26 June	"	2230-2400							2251	Pt.	"									
1008a	7 June	Resid.	1300-1400	15	5	10	44	74	1.07	1309	Pt.	Veh.	3	20	14	69	69	0	0	36	221
1008b	"	"	1420-1520							1437	"	"									
1008c	"	"	1540-1640							1555	"	"									
1009a	9 June	City	2030-2130	10	6	15	30	61	.63	2036	Pt.	Veh.	3	22	18	97	67	17	13	48	230
1009b	"	"	2200-2300							2219	"	"									
1010a	11 June	City	2030-2130	12	6	11	35	64	.64	2101	Pt.	Veh.	3	21	20	100	64	14	22	52	251
1010b	"	"	2200-2300							2243	"	"									
1011a	13 June	City	2330-0030	12	4	12	29	57	.56	2350	Pt.	Veh.	3	18	19	101	71	14	16	41	217
1012a	15 June	City	2030-2130	10	6	10	39	65	.70	2045	Pt.	Veh.	3	21	22	93	63	12	18	47	228
1012b	"	"	2200-2300							2227	Line	"									
1013a	18 June	City	2100-2200	10	6	10	38	64	.69	2115	Dual Pt.	Veh.	3	22	40	93	63	13	17	50	302
1013b		"	2230-2330							2247	"	"									
1014a	20 June	Resid.	2330-0030	8	5	8	15	36	.50	2340	Dual Pt.	Veh.	3	13	37	71	71	0	0	37	140
1014b	"	"	0045-0145							0100	"	"									
1015a	20 June	City	0245-0345	10	5	8	15	38	.53	0300	Dual Pt.	Veh.	3	13	42	71	61	5	5	37	140
1015b	"	"	0400-0500							0410	"	"									
1016a	21 June	City	1400-1500	12	5	9	36	62	1.00	0410	Dual Pt.	Veh.	3	20	43	63	43	13	7	29	171
1016b	"	"	152 -1630							1540	"	"									
1017a	23 June	Resid.	2000-2100	24	6	14	32	76	1.02	2017	Dual Pt.	Veh.	3	22	30	74	63	0	11	45	232
1017b	"	"	2115-2215							2146	"	"									

(F) Full-time hours; (P) Part-time hours

TABLE II-5

SUMMARY OF DATA ON ST. LOUIS TRACER TESTS

SAMPLING							ANALYSIS								METEOROLOGICAL						
posed tdoors >6 ft.	Exposed Indoors	Number Operators (P)	Total Operator MHrs (P)	Operator MHrs per Sampler per Release (P)	Number Sampler Cars	Total Sampler Car Miles	Number Slides	Slide Prep. MHrs (P)	Prelim. Eval. MHrs (F)	Slide Counting MHrs (P)	Counting MHrs (P) per Slide	Total Computing MHrs (F)	Drafting MHrs (P & F)	Plotting MHrs (F)	Met. Survey Number	Met. Station Street Level	Met. Station Rooftop	Mobile Met. MHrs (P)	Number Operators	Total Met. Car Miles	Field Test FT No.
0	0	57	295	2.05	45	510	144	10	3	123	.85	26	5	5		2 1	0 0	36	9	12	1001a 1001b
0	0	61	312	2.16	54	698	181	8	3	115	.64	28	22	11	1046	3	0	31	6	41	1002a 1002b
0	0	66	320	2.22	52	660	189	8	3						1047	3	1	30	5	34	1003a 1003b
0	0	65	397	1.26	64	801	315	14	4						1048	3	0	52	8	88	1004a 1004b 1004c
0	0	64	391	1.25	62	793	390	14	4						1049	2	1	46	7	59	1005a 1005b 1005c
0	0	54	410	1.31	48	948	325	12	4						1050	3	1	42	6	48	1006a 1006b 1006c
17	0	44	289	1.70	44	1212	260	8	3						1060	2	2	43	6	77	1007a 1007b
0	0	36	221	1.07	35	746	261	10	2						1051	2	1	32	5	56	1008a 1008b 1008c
17	13	48	230	1.17	42	752	260	12	2						1052	2	1	43	7	88	1009a 1009b
14	22	52	251	1.25	44	772	266	12	2						1053	2	2	44	6	114	1010a 1010b
14	16	41	217	2.17	37	776	227	8	2						1054	2	1	26	4	88	1011a
12	18	47	228	1.22	42	714	238	14	2						1055	2	2	41	6	101	1012a 1012b
13	17	50	302	1.62	42	744	336	12	2						1056	2	2	49	7	97	1013a 1013b
0	0	37	140	.98	37	400	142	10	1						1057	2	1	9	2	12	1014a 1014b
5	5	37	140	.98	37	499	142	10	1						1057	2	1	9	2	12	1015a 1015b
13	7	29	171	1.41	29	594	189	10	1						1058	2	1	13	2	49	1016a 1016b
0	11	45	232	1.57	45	780	231	8	2						1059	2	1	32	5	72	1017a 1017b

In preparation for the conduct of aerosol-cloud tests in industrial complexes in the St. Louis area in the fall of 1953, meetings were held during the current period with officials of Monsanto Chemical Company, Socony-Vacuum Oil Company, Granite City Steel Corp., and the Board of Aldermen of Granite City, Illinois. As a result of these meetings, the full cooperation of these industrial firms was extended to The Ralph M. Parsons Company in the prosecution of the testing program, with permission being granted by all firms for use of company properties for field-test sites. Tests are planned at a Monsanto plant located in St. Louis proper, representing a large chemicals manufacturing complex; at the Socony-Vacuum refinery in East St. Louis, Illinois, representing a large petroleum refining complex; and at the Granite City Steel Corporation, representing a large steel manufacturing complex, including blast furnaces, open hearth furnaces, and blooming and rolling facilities.

Much less public interest and curiosity was aroused by the field-test phase of the program in St. Louis than was experienced in Minneapolis. How Area consists principally of a densely populated slum district, and initial operations in this area were planned with particular precautions being taken in the arrangement of equipment and scheduling of manpower to minimize the possibility of loss of equipment. The Police Department requested that it be notified prior to each test in this area in order to be prepared to quell any disturbance resulting from the presence of the test crew in the area. While the nature of the district justified such precautions for each operation, the whole program was conducted without a single case of vandalism or disturbance. Those residents in the How Area

contacted for location of sampling equipment in homes were found to be extremely cooperative.

Although the St. Louis press was cognizant of the test program being conducted, only a few small articles were printed during the period. Public interest was at a minimum.

In preparation for conducting meteorological and aerosol-cloud tests in Winnipeg, representatives of the Chemical Corps, Stanford University, and The Ralph M. Parsons Company met in May of 1953 with a member of the Canadian Defence Research Board in Ottawa. The operating phases of the program were outlined, and at this time formal authorisation was given to conduct the aerosol study in Winnipeg.

The field office received the utmost cooperation from cognizant representatives of the Defence Board in setting up operations in Canada. Extremely valuable guidance and assistance were received from Civil Defence authorities and municipal officials in Winnipeg. Only with such cooperation could the field testing program have been initiated in a foreign country in the short time available.

4. Test Planning

Field-test arrays in St. Louis have been devised generally in accordance with principles discussed in JQR 3. As previously stated, the extent to which a change in sampler array may be made in the field to accommodate a general wind shift is controlled by time available for moving the equipment and by the adequacy of field communications.

5. Sampling

Part-time employees hired as sampler attendants in St. Louis were predominantly family men normally engaged in various private and civil occupations, in contrast to Minneapolis crews which consisted largely of college students. Because of the greater maturity of men available for hire, it was found possible in the initial job interviews to select qualified men for field crew captains to supervise the sampler field crews.

This group of crew chiefs was given instruction in operating procedures prior to initial assembly of the remaining members of the crew, and these supervisors were delegated the responsibility of disseminating such operational information to men under their cognizance at the initial training session. The advantages of this procedure offset the generally uninterested attitude prevalent among St. Louis part-time employees and permitted the organization of an efficient working force at the outset of the testing program.

Remaining aspects of the air-sampling operation are described in JQR 3.

During the latter part of the St. Louis series of aerosol tests, in addition to the usual detailed sampling of the airborne cloud, clean glass plates for the measurement of fall-out were placed at five to six points up to 1500 feet downwind from the release point. These measurements were desired to obtain an estimate of the nature and magnitude of the fall-out of FP material occurring during the St. Louis aerosol tests and to compare

these data with similar studies made in connection with the Stanford field experiments (SQR 1856-4). Results of this phase of the program will be treated in a subsequent joint quarterly report on the St. Louis tests.

6. Aerosol Generation

Organization of the aerosol-generator crew remained as described in JQR 3.

A procedure calculated to preclude the possibility of contamination by fluorescent-tracer material of field office premises, in addition to those outlined in JQR 3, involved the storing and charging of the generator battery power pack at the location of generator storage, remote from the field office. This procedure will be maintained during all forthcoming test periods.

It was first noted in St. Louis that the finely powdered bulk NJZ 2266 material has a tendency to clump badly under high humidity conditions, thus causing the material to feed poorly from the metering mechanism into the disperser generator. Unless special precautions are taken when operating under high humidity conditions, the feed rates fall below those calibrated for given operating voltages. To remedy this condition, the fluorescent material is heated in an oven until "fluffy" and is then stored in an air tight container until ready for use in the field.

7. Test Direction

The field test direction procedures have remained as indicated in JQR 3.

8. Equipment Preparation

An operational problem in St. Louis which did not arise in Minneapolis was the high ambient temperatures which limited the rate at which sampler batteries could be charged. With room temperatures consistently above 90° F day and night, the temperature of the electrolyte on the batteries was found to reach the manufacturer's recommended maximum of 110° F after only two hours of charging, and would then increase to 130° F and above if allowed. In the interests of preserving battery life, it was necessary in such cases to shut down the charging generators after only a few hours of charging to permit the electrolyte to cool before resuming the charging operation. This procedure effectively limited the number of samplers available for certain tests.

9. Laboratory Analysis and Data Processing

During the current period of field testing in St. Louis, all microscope analysis of exposed filters, computation of total dosages, and plotting of dosage distribution and wind-flow maps were performed in the Minneapolis office. Exposed membrane filters were mounted on slides and identified in the St. Louis laboratory and were then shipped to Minneapolis for preliminary evaluation within a few days after a field test. Pertinent results were then communicated to the field test director. In this manner, all work of a possibly classified nature was performed by cleared personnel away from the St. Louis office, and no special security measures incident to handling of classified material were required.

Filters exposed in certain tests in St. Louis have shown a high percentage of fluorescent particles of a green hue as contrasted with the distinctly yellow hue of the tracer material. Evaluation to date indicates that the locations at which the green particles are found bear no relation to the path of the tracer aerosol and represent background contamination from one to several unknown sources in the St. Louis area.

General analysis procedures are outlined in JQR 3.

III. WINTER AEROSOL TESTS IN MINNEAPOLIS

A. SUMMARY AND SCOPE OF OPERATIONS

The extensive winter aerosol-test program completed in the present quarterly period consisted of 23 field tests, in which 63 independent releases of fluorescent-particulate material, from either point or line sources, were made in four selected areas of varying topographical and land-use characteristics. In addition to Able Area, essentially residential as described in JQR 3, Baker, Charlie, and Dog Areas--respectively residential, open, and business--were employed in the aerosol-cloud studies. Descriptions of the latter three areas are given below in Section III-B.

Eighteen of the 63 releases constituting the winter aerosol-diffusion program were reported in JQR 3; the remaining 45 releases (comprising 15 tests) may be catalogued as follows, by number of tests, corresponding number of releases, and testing site:

2 tests (consisting of 6 releases) conducted in Able Area;

5 tests (14 releases) in Baker Area;

3 tests (12 releases) in Charlie Area;

3 tests (9 releases) in Dog Area; and

2 tests (4 releases) on a citywide scale.

Of these 45 releases, 34 have been selected from 14 tests for evaluation in the present report. They are summarized below (Table III-1) in terms of aerosol-generation data, meteorological conditions, and dosage-area information. For each test, whenever warranted, the applicable isotherm map for an associated temperature survey, the synoptic meteorological

TABLE III-1

SUMMARY OF DATA FOR SELECTED WINTER AEROSOL-TRACER TESTS IN MINNEAPOLIS

				TEST AREA METEOROLOGICAL CONDITIONS									AEROSOL-GENERATION DATA			AEROSOL-CLOUD COVERAGE			
				Wind Flow												Areas (sq yds) Within Indicated Dosage Isopleths (particle-minutes per liter)			
				Street Level		Roof Level		Treetop Level		2-Meter Ambient Temp (°F)	Sky Cover	Depth of Snow (inches)	Amount Released (grams)	Period of Emission (min)	Type of Release*	10,000	1,000	100	10
Area	Test No.	Date 1953	Time of Release CST	Vel (mph)	Dir	Vel (mph)	Dir	Vel (mph)	Dir										
Able	FT 0014a	3 Mar	2022	2.7	SW	3.0	SW	8-10	WNW-SW	17	Clear	12	8.9	5	Point	4.92×10^3	2.14×10^4	1.04×10^5	$>3.43 \times 10^5$
	FT 0014b	3 Mar	2125	2.9	WSW	4.1	SSW	8-10	WNW-SW	16	Clear	12	14.3	4.5	Line	-	1.39×10^4	2.09×10^5	$>8.24 \times 10^5$
	FT 0014c	3 Mar	2245	3.6	WSW	10.1	WSW	8-10	WNW-SW	15	Clear	12	18.2	5.17	Line	-	2.49×10^4	2.01×10^5	$>7.93 \times 10^5$
	FT 0020a	18 Mar	2005	3.8	WSW	9.8	W	10-15	W	35	Low brkn	2-4	68.5	8.23	Line	-	-	-	-
	FT 0020b	18 Mar	2125	3.8	WNW	11.2	WNW	10-15	W	34	Low brkn	2-4	9.7	5	Point	-	1.23×10^4	4.91×10^4	3.70×10^5
	FT 0020c	18 Mar	2245	3.2	WSW	14.8	W	10-15	W	30	Low sctd	2-4	163	8.83	Line	-	-	-	-
Baker	FT 0005a	26 Jan	2022	4.9	SSW	-	-	-	-	29	Low Brkn	6	10.4	5	Point	-	2.74×10^4	$>1.20 \times 10^5$	-
	FT 0005b	26 Jan	2138	4.2	S	-	-	-	-	27	Clear	6	8.9	5	Point	-	1.26×10^4	6.86×10^4	-
	FT 0006a	28 Jan	2015	1.3	NW	-	-	6-7	NW	9	Clear	4	9.0	5	Point	-	-	1.48×10^5	$>4.69 \times 10^5$
	FT 0006b	28 Jan	2148	1.6	NW	-	-	6-7	NW	8	Clear	4	9.6	5	Point	1.14×10^3	8.78×10^3	8.11×10^4	$>8.00 \times 10^5$
	FT 0007a	30 Jan	2012	3.8	S	-	-	5-6	S-SE	24	Low ovc	4-6	8.7	5	Point	1.76×10^3	2.98×10^4	1.41×10^5	7.88×10^5
	FT 0007b	30 Jan	2137	3.0	S	-	-	5-6	S-SE	24	Low ovc	4-6	8.7	5	Point	-	1.50×10^4	4.39×10^4	$>7.95 \times 10^5$
	FT 0007c	30 Jan	2305	2.4	SSE	-	-	5-6	S-SE	25	Mid. ovc	4-6	8.3	5	Point	-	1.56×10^4	1.44×10^5	$>8.16 \times 10^5$
	FT 0019a	4 Mar	2005	3.4	WSW	-	-	15	W	19	Mid. sctd	12	23.5	5.17	Line	-	2.95×10^4	2.51×10^5	$>1.21 \times 10^6$
	FT 0019b	4 Mar	2125	3.4	WSW	-	-	15	W	19	Low sctd	12	19.3	5.50	Line	-	3.35×10^4	2.23×10^5	$>1.46 \times 10^6$
	FT 0019c	4 Mar	2305	3.9	W	-	-	15	W	19	Low sctd	12	21.3	6	Line	-	-	1.64×10^5	$>1.09 \times 10^6$
	FT 0021a	21 Mar	0045	9.8	E	-	-	-	-	42	Low sctd	2-3	8.2	5	Point	-	-	5.95×10^4	$>5.35 \times 10^5$
	FT 0021b	21 Mar	0235	11.6	ESE	-	-	-	-	41	High brkn	2-3	12.8	5	Point	-	-	8.50×10^4	$>6.52 \times 10^5$
	FT 0021c	21 Mar	0350	12.0	ESE	-	-	-	-	41	High sctd	2-3	8.9	5	Point	-	8.78×10^3	2.25×10^4	$>3.12 \times 10^5$
	FT 0021d	21 Mar	0515	8.0	ESE	-	-	-	-	42	High ovc	2-3	1.5	5	Point	-	-	2.97×10^4	1.43×10^5
Charlie	FT 0012b	16 Feb	2254	1.8	SW	-	-	-	SW	-4--7	Clear	4	9.7	5	Point	2.11×10^4	$>1.04 \times 10^5$	-	-
	FT 0018a	23 Feb	2015	1.7	S	-	-	-	SW-WSW	21-25	Clear	12	11.7	5	Point	2.74×10^4	4.62×10^5	-	-
	FT 0018d	23 Feb	2308	1.3	SW	-	-	-	SW-WSW	19-22	Clear	12	8.0	5	Point	-	4.63×10^4	-	-
Dog	FT 0015a	24 Feb	2006	2.5	WNW	9.3	WNW	-	-	25	Clear	12	11.0	5	Point	-	-	1.36×10^5	$>5.61 \times 10^5$
	FT 0015b	24 Feb	2155	1.7	WNW	9.8	W	-	-	21	Low ovc	12	9.8	5	Point	-	2.08×10^4	6.15×10^4	$>7.18 \times 10^5$
	FT 0015c	24 Feb	2235	2.2	W	9.8	WNW	-	-	20	Low ovc	12	10.6	5	Point	-	1.49×10^4	1.13×10^5	$>6.75 \times 10^5$
	FT 0016c	27 Feb	2235	2.7	SW	15.8	WNW	-	-	27	Low brkn	12	11.6	5	Point	-	-	8.40×10^4	$>3.95 \times 10^5$
	FT 0017a	7 Mar	0053	2.8	NNW	3.8**	NE	-	-	6	High ovc	10	9.0	5	Point	-	-	1.60×10^4	$>2.64 \times 10^5$
	FT 0017b	7 Mar	0211	1.9	NE	1.3**	ENE	-	-	6	High ovc	10	11.3	5	Point	-	-	3.02×10^4	6.80×10^4
	FT 0017c	7 Mar	0340	2.4	E	5.0**	E	-	-	6	High ovc	10	10.4	5	Point	-	-	4.14×10^4	1.03×10^5
Citywide	FT 0022a	24 Mar	1958:40	13.2	W	16.8	NW	-	-	45	Clear	0	404.0	27.67	Line	-	2.05×10^6	5.64×10^6	5.91×10^7
	FT 0022b	24 Mar	2300	13.7	NW	17.4	WNW	-	-	39	Low ovc	0	822.6	30	Line	-	2.35×10^6	6.26×10^6	$>4.21 \times 10^7$
	FT 0023a	28 Apr	2000	10.2	ESE	16.1	ESE	-	-	47	Mid. ovc	0	693.3	28.17	Line	-	-	6.03×10^6	7.44×10^7
	FT 0023b	28 Apr	2205	9.7	E	18.2	ESE	-	-	46	Mid. ovc	0	388.0	30.50	Line	-	-	5.72×10^6	2.95×10^7

* All releases were made from either stationary or moving vehicles.

** Additional roof-level measurements for FT's 0017a, 0017b, and 0017c are respectively 6.8, NNW; 6.7, NE; and 8.2, ENE.

summary, St. Cloud raob sounding, wiresonde graphs, adjusted dosage-area relationships, isodosage charts, time-resolution graphs, and building summaries are given in the appropriate appendix devoted to the presentation of data for all tests conducted in a given area (see Appendices A-E). Evaluation of the complementary temperature surveys, in terms of D_T, $[R/\Delta T]_{min}$, and other quantitative values, will be made in a later report.

Unlike JQR 3, which described only point-source releases in one area (Able), the present report evaluates 11 line-source releases, as well as 23 point-source releases from a vehicle-mounted blower disperser.* The length of line release varied from 1500 feet, as in the case of FT 0019, to 7 miles, as in the case of the citywide test FT 0023. Not only was Clinton School used for studies of aerosol-cloud penetration, as in Able test FT 0014, but Pioneer Hall, a dormitory on the campus of the University of Minnesota (in Baker Area, FT 0019),** and seven downtown buildings (in Dog Area,

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*Not included are FT's 0016a and 0016b, which were made from a roof-mounted disperser, as were the four releases (FT's 0009b, 0010a, 0011a, and 0011b) reported in JQR 3.

**On the isodosage charts for FT's 0005a, 0005b, 0006a, and 0006b (Appendix B), there is no indication of the sampler array at Pioneer Hall, since the building was not in the path of the prevailing wind direction and hence of the aerosol cloud.

FT's 0015, 0016, and 0017) were also employed. In addition, roof-located samplers were arrayed on some 20 buildings, in the four line-source releases of FT's 0022 and 0023 (Table E-1).

Like the tests evaluated in the last quarterly report, those described in the present were conducted at night and included predawn releases (FT's 0017 and 0021). Sampler-array procedures for these tests were essentially unchanged from those reported in JQR 3. For example, samplers in each of the downtown buildings, as in Clinton School and selected residences (JQR 3), were placed at different heights, some with holders extending beyond the windows for measuring vertical attenuation of the aerosol cloud, others completely inside for measuring cloud penetration, and including those with filter units sequentially exposed during a given release. In Charlie, the open area used as site for one series of tests, samplers were located on the ground, with filter holders generally fixed to stakes at the four-foot level. Though several samplers in certain tests had to be relocated outside the stake area and hence were placed at the sampling-unit level, all units are nonetheless considered within the usual classification, as outside samplers at the one to six-foot elevation. Procedures for estimating the fluorescent-particle count were likewise unaltered, though some difficulty in arriving at a more definite count resulted when melted ice or snow crystals on the filters exposed in the Charlie releases caused some particles to move to the edges of the filters. Dosages presented with the symbol W (see Figs. C-3, C-10, C-11, and also B-28) should therefore be regarded as conservative low values.

Despite the broader scope of the aerosol tests presently considered, their specific objectives are essentially the same as those listed for the tests evaluated in JQR 3. They, too, were designed:

1. to study horizontal distribution of the aerosol dosages near the surface under various regional and meteorological conditions;
2. to ascertain the reproducibility of isodosage patterns under given meteorological conditions;
3. to determine the relationship between point and line-source releases in a given area, i.e., to determine whether the point-source data from these tests are additive and may be converted to line-source or multiple-point source data in any desired combination for estimating munitions requirements;
4. to study, on a limited scale, vertical distribution of the aerosol dosages;
5. to investigate, on a limited scale, penetration of buildings by the aerosol cloud; and
6. to verify that the length of the sampling periods was sufficient to ensure complete sampling of the aerosol cloud.

B. TEST SITES*

1. Baker Area

Baker Area, bisected by the Mississippi River meandering in an S-shaped course from the northwest to the southwest corners, was selected for the investigation of possible specific effects of the river on the local airflow patterns and hence on the aerosol-dosage patterns, as compared with those obtained in Able Area. The Baker testing site is located approximately two miles southeast of the downtown area (Dog). East of Cedar Avenue Bridge are the St. Anthony Falls, and below these are the locks presently under construction. Along both sides of the river there is extensive deciduous tree cover which is particularly dense south of the Washington Avenue Bridge. During the winter, the Mississippi is usually frozen over for approximately two to three months, though such was not the case during the period covered by this report.

The ground surface on either side of the river varies from 820 to 846 feet above sea level. Steep cliffs are located north of Washington Avenue Bridge, on the east side of the river. The river surface, as represented on the topographic map of the area (Fig. III-2), is approximately 80 to 100 feet below the general ground level.

The University of Minnesota is located on the east side of the Mississippi and on both sides of Washington Avenue. The campus is tree covered and includes large old brick buildings, and several buildings under construction

*See Figure III-1 for map showing location of test sites in relation to each other.

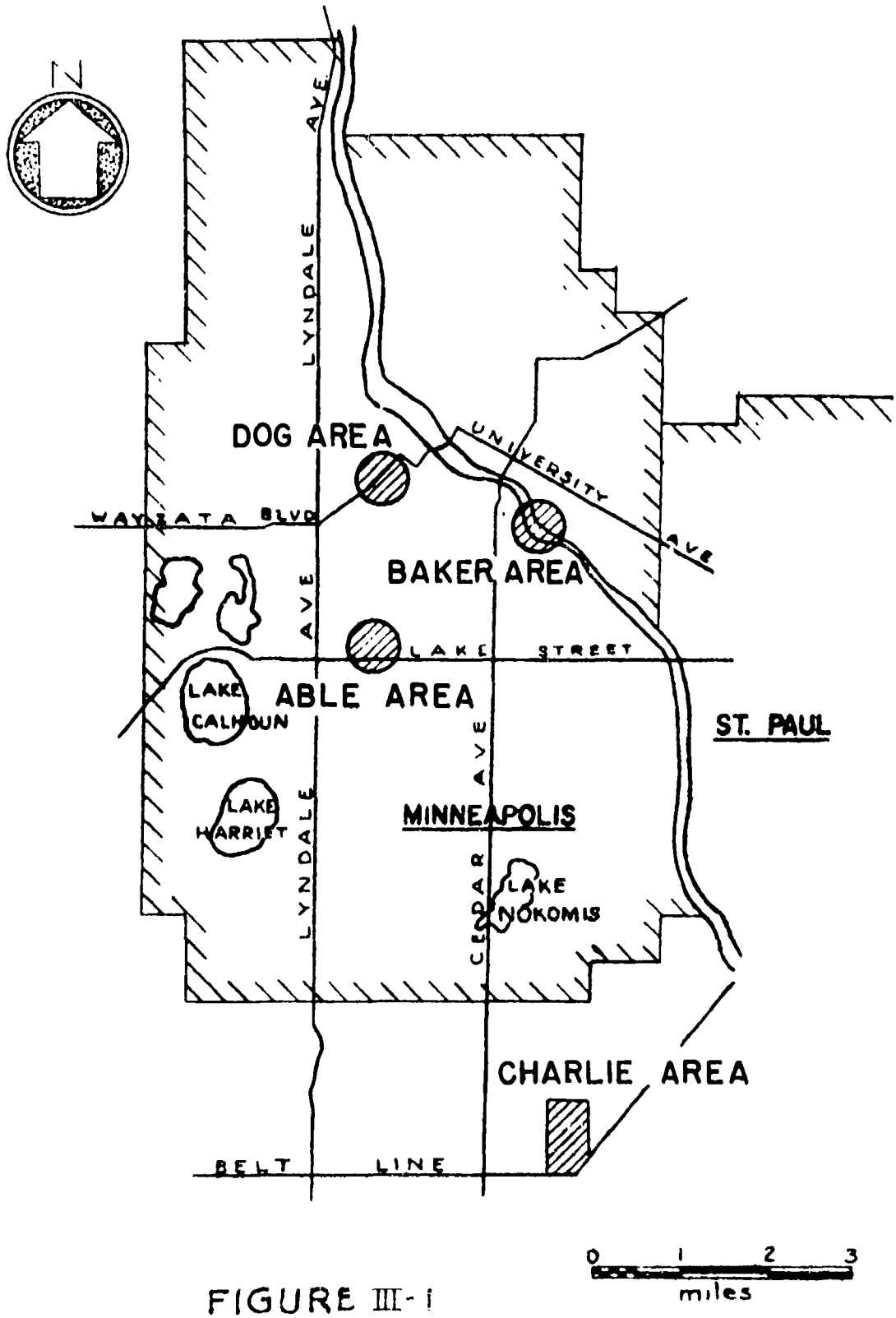

FIGURE III-1

TEST-AREA LOCATIONS IN MINNEAPOLIS

in the southern section. The central heating plant is located on the river. Only the newer buildings are air conditioned and equipped with steel-sash casement windows; double-hung, wooden-sash windows are generally found in the remaining buildings.

Railroads form part of the industrial complex north of Washington Avenue and west of the river. Only the Great Northern Line, running north of the University area, is depressed beneath the street and the general ground surface. In addition, the industrial complex consists of coal docks, tank farms, steel and brick warehouses, steel mill buildings, and grain elevators of reinforced concrete (Fig. III-3).

Beyond the industrial structures are residences and commercial buildings. The latter are generally two stories high, of brick construction, and are located along the main streets, predominantly at the intersections of poorly maintained asphalt roads. The first floor of a commercial building is typically employed for business activities, while the second floor is put to residential use. The typical home is a two-story wooden-frame structure, approximately 30 years old. Apartment buildings are usually brick structures from three to eight stories high.

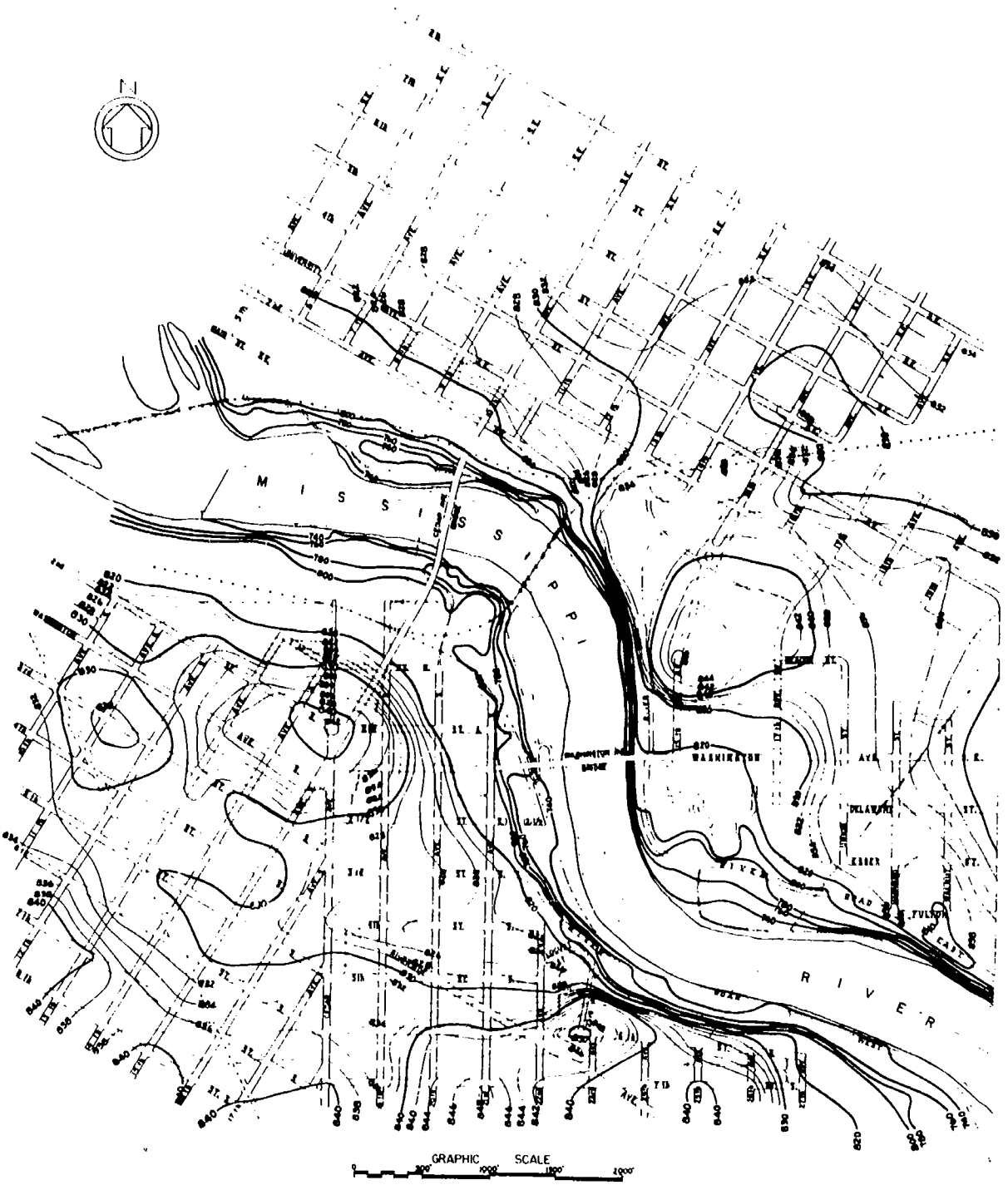

FIGURE III-2

TOPOGRAPHIC MAP OF BAKER AREA, MINNEAPOLIS

FIGURE III-3

AERIAL VIEW OF BAKER AREA, MINNEAPOLIS

2. Charlie Area

Charlie Area was selected as a test site to represent open flat terrain subject to the same meteorological influences as the adjacent built-up area. It is located approximately eight miles south of downtown Minneapolis, and is bounded by Highways 5 and 100 on the south, by Thirty-fourth Avenue South and Fort Snelling National Cemetery on the east, by Seventieth Street on the north, and by Twenty-fourth Avenue South on the west. These boundaries are the heaviest traveled roads affording access to the Wold-Chamberlain Municipal Airport to the northeast.

The area consists of relatively flat terrain, with gradual variations in elevation from 806 to 840 feet above sea level. The lowest depressions are found in the south-central portion adjoining the nominal Belt Line; highest elevations are found in the southwest corner. The relative evenness of the terrain is further indicated by the A cross-section line (Fig. III-4); the deviation from the general level, either above or below, is not much greater than two feet. Variation in the B cross-section does not exceed 14 feet (818 - 832).

In winter, snow depth over the area averages about one foot. The low spots are sometimes filled to a depth of 10 feet or more, while the relatively high section in the center averages about 10 inches in depth. The lake in the north-central portion of the area (Fig. III-5) commonly freezes over during the season.

Buildings are scattered and few, and therefore have negligible effect on the air-flow and temperature conditions. Grain and truck farming constitutes the main activity in Charlie Area.

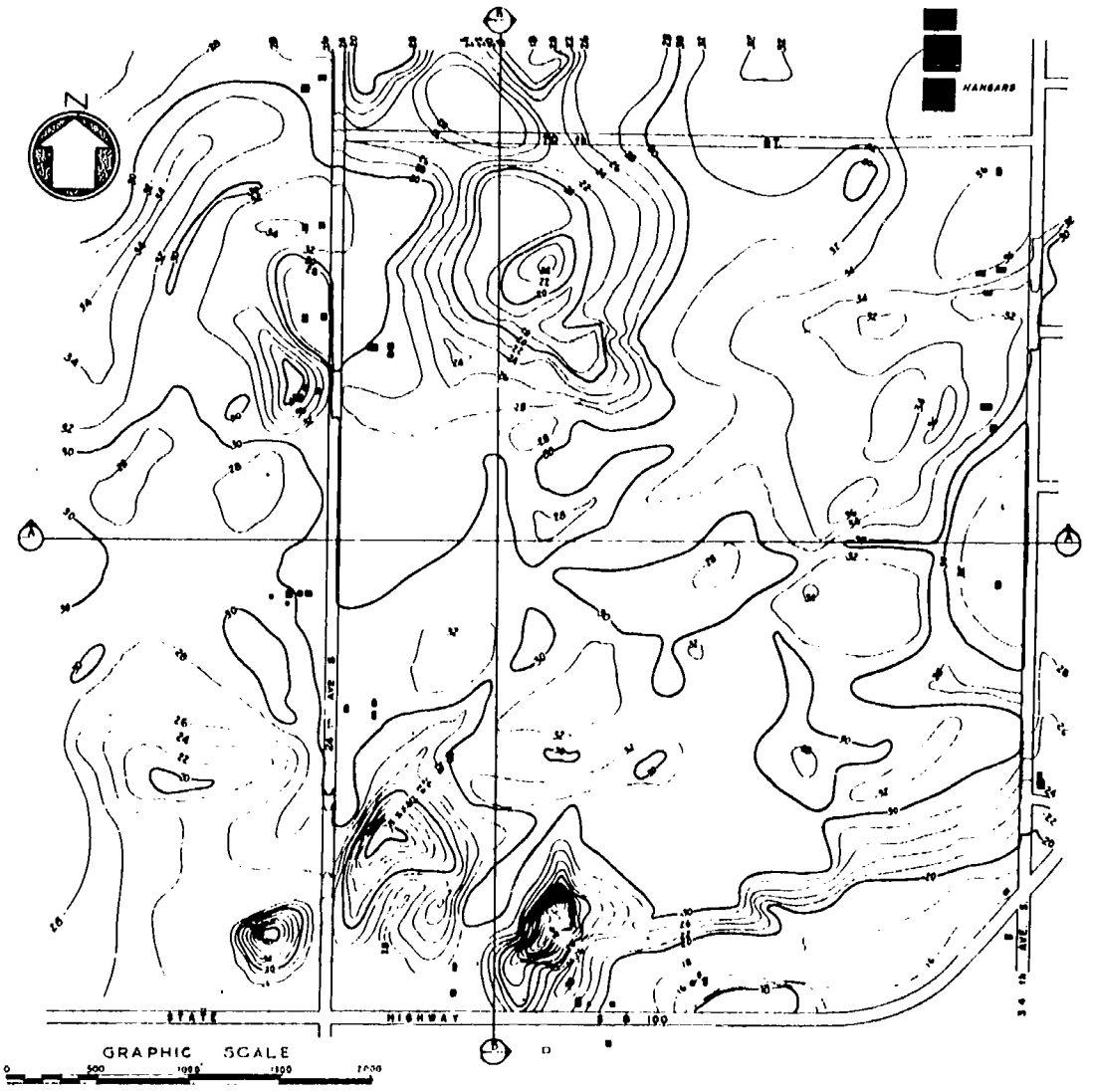

FIGURE III-4

TOPOGRAPHIC MAP OF CHARLIE AREA, MINNEAPOLIS

FIGURE III-5

AERIAL VIEW OF CHARLIE AREA, MINNEAPOLIS

3. Dog Area

Dog Area, north of Able Area and northwest of Baker, is located in the densely commercial segment of Minneapolis (Fig. III-1). It is bounded essentially by Third Avenue and the outlying railroad complex on the northwest, by the Mississippi River on the northeast, by Park Avenue on the southeast, and by Eleventh Street on the southwest. The center of the downtown section is traversed by asphalt streets; and the periphery, by streets combining brick and asphalt. Main business thoroughfares include Hennepin Avenue, Marquette Avenue, and Nicollet Avenue between Washington Avenue and Twelfth Street.

The ground surface varies in elevation from 854 feet above sea level, at Nicollet and Sixth Street, to 818 feet at First Street North and Portland Avenue. As evidenced by the A cross-section line on Figure III-6, the gently rolling land tends to slope toward the Mississippi. The railroads, which are most heavily concentrated along the northern and eastern edges of Dog Area, run along the river; only at the northern edge are they somewhat depressed below the general ground surface.

Tree cover is particularly extensive along the southern and western edges of the area (Fig. III-7). No trees can be found in the downtown section.

Along the railroad tracks are factories and warehouses, and northwest of First Avenue North are old brick and steel warehouses. Garages, gas stations, small manufacturing plants, and other types of commercial buildings are scattered throughout Dog Area.

Office buildings are predominant in the downtown section, from First Avenue North to Third Avenue South, and from Washington Avenue to Tenth Street. Those toward the center of town, at Hennepin and Washington Avenues, are old; those at Marquette Avenue and Sixth Street are of comparatively recent construction. Structures range from one-story to multistoried buildings such as Foshay Tower, 32 stories high. Descriptions of individual buildings used in the Dog Area field tests are given with Figure III-8, the oblique aerial view which ... these downtown buildings.

In the southern and western portion of the area are residences representing some of the oldest structures in Minneapolis. The typical house is two or three stories high, of frame or stucco construction, and has an attic. It is generally 50 years old, in poor condition, and equipped with storm windows in the winter and with screens in the summer. The numerous brick apartment buildings are approximately 20 years old.

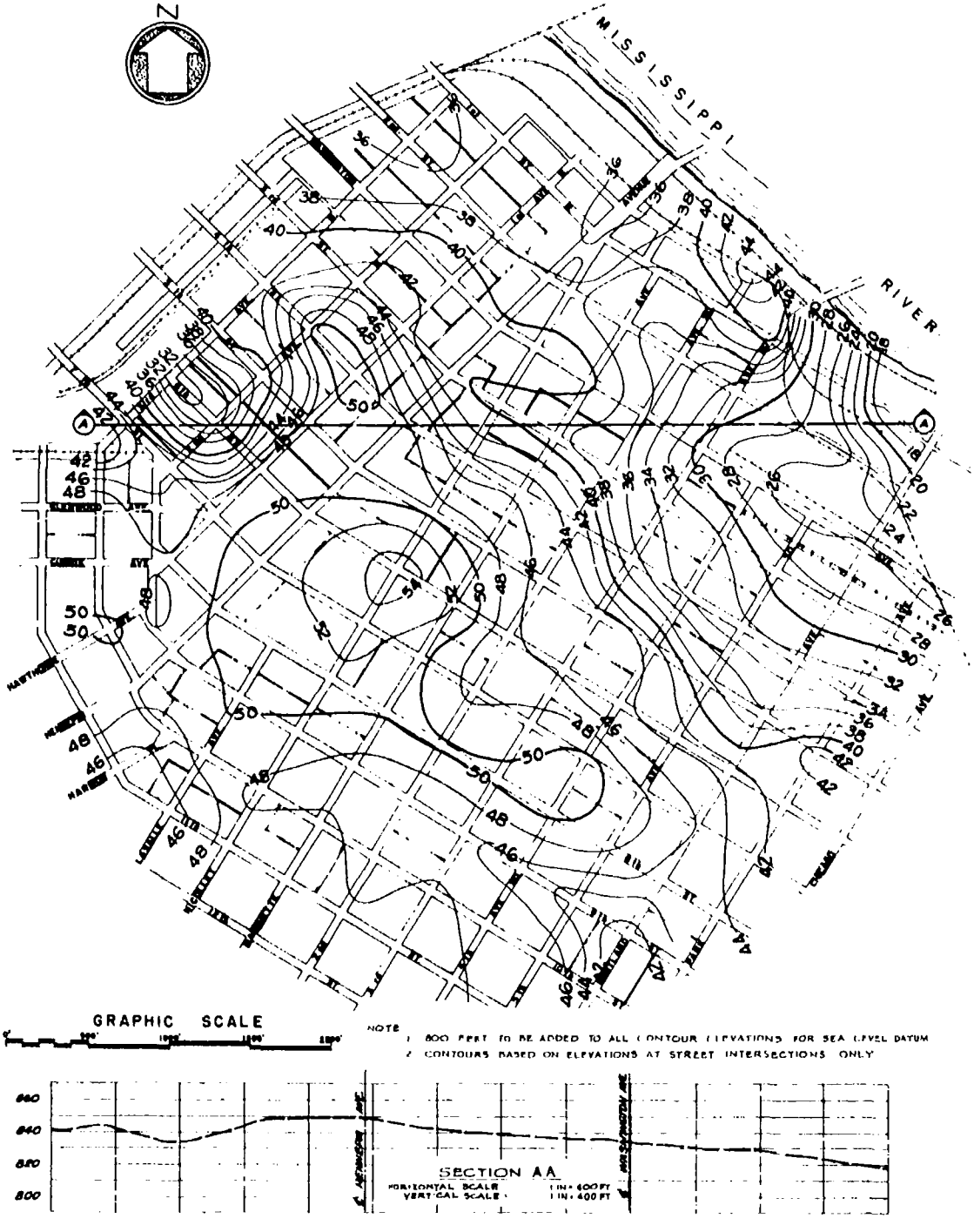

FIGURE III-6

TOPOGRAPHIC MAP OF DOG AREA, MINNEAPOLIS

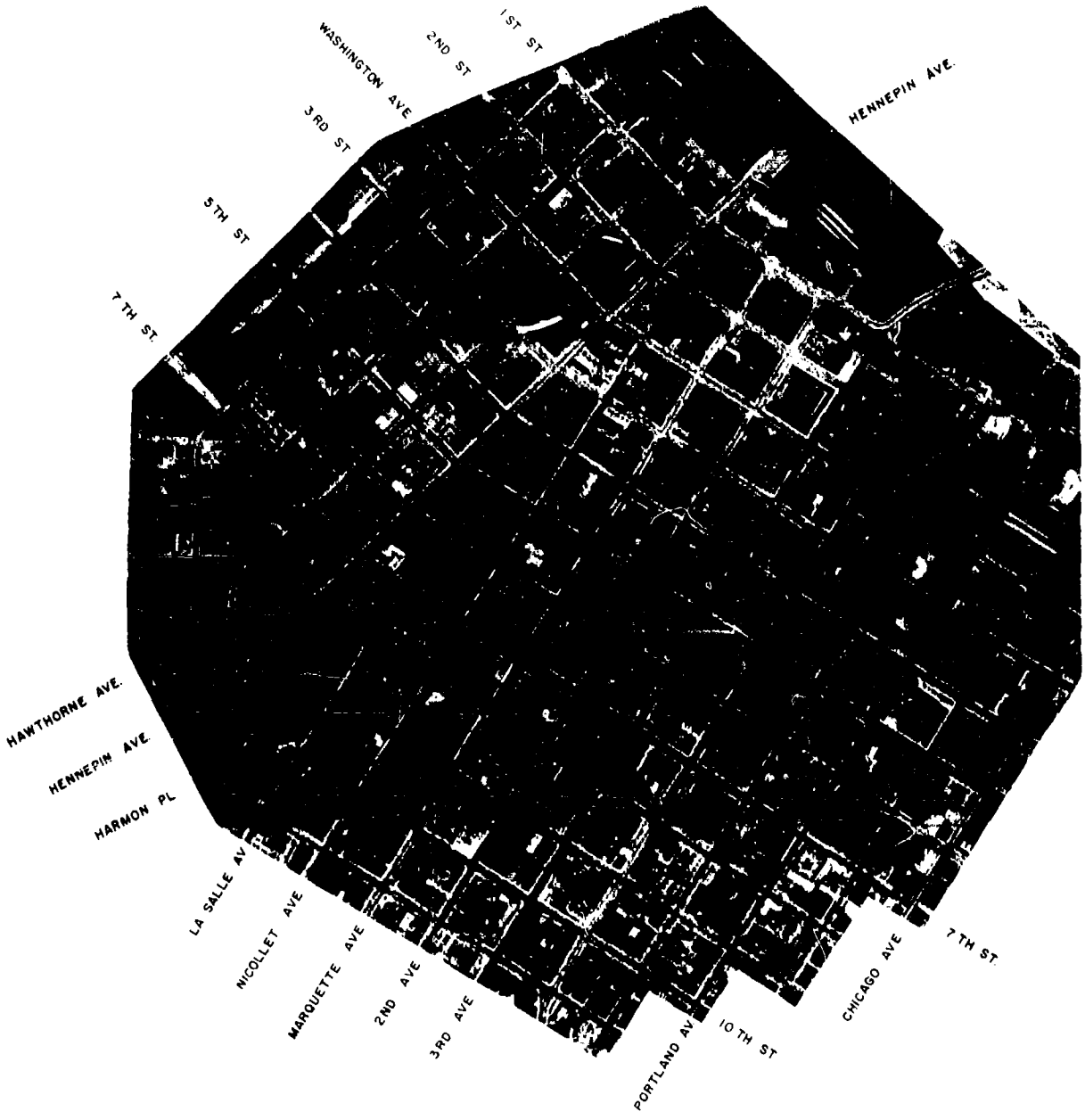

FIGURE III-7

AERIAL VIEW OF DOG AREA, MINNEAPOLIS

Figure III-8

Oblique aerial view of downtown Minneapolis showing array of buildings used in the Dog Area releases. Values obtained from samplers placed within the individual buildings are tabulated in Appendix D (Figs. D-7, D-19, and D-33). See also Appendix E (Table E-1).

1. ANDRUS BUILDING, at 512 Nicollet Avenue, is a commercial, ten-story building of steel and brick construction. Built in 1900, it has one full floor basement and double-hung, wood-sash windows. Storm windows are not used, nor is there air conditioning on the upper floors. Steam heating is supplied from an outside source located in the Plymouth Building.

2. FIRST NATIONAL BANK BUILDING, a steel and concrete structure built in 1924, is located at Fifth and Marquette Avenue. It is 19 stories high, with an average floor space of 10,000 square feet. Banking activities are conducted only on the first four floors; the remaining floors are used commercially. In addition to two full basements, the building has a smaller basement for use as the power room. Coal is used to heat the premises. The fourth floor is the only floor that is air conditioned throughout; on all other floors single-room units are placed at windows. These windows are of the double-hung, steel-sash type. There are no storm windows in the building.

3. NORTH-WESTERN BELL TELEPHONE BUILDING, located at Third and Sixth Streets, is a reinforced concrete structure, 26 stories high. It is built in two sections: the first, comprising 11 floors, is the older, while the second is approximately 25 years old. Average floor space for the first 12 floors is 20,600 square feet; for the next five floors, 19,365 square feet; and for the 18th floor to the roof, 20,600 square feet. It has three full basements and steel-sash, double-hung windows, but no storm windows. Air-conditioning units are employed only in the cafeteria; in the telephone-operator rooms, fans are used.

4. NORTHWESTERN NATIONAL BANK BUILDING, located at Sixth Street and Marquette Avenue, consists of 16 floors, although several penthouses give it a height approximating 19 stories. Average floor space is 25,000 square feet. Twenty-three years old, the building is of concrete and steel construction to the eighth floor and of reinforced concrete to the sixteenth floor. The first five floors are used for banking activities and the upper 11 stories for commercial purposes. Of the two basements in the building, one is used for shops, bank vaults and storage, and the second for housing the heating and power facilities. For these basements and the first five floors only, a central air-conditioning unit is employed. Small individual units are installed on other floors. Two large fresh-air ducts are located on the roof but were not used during the Dog Area releases. Gas is the primary fuel used to heat the premises, while oil is available on a stand-by basis. The building employs two types of windows--the double-hung, wood sash and the out-swung steel casement. For the latter type, approximately 175 storm windows are provided.

5. BAKER BUILDING, located at 733 Marquette Avenue, is constructed of reinforced concrete, with brick exterior. Erected in 1928, this commercial building has 12 full floors, each consisting of approximately 8500 square feet. In the basement, which extends beyond the floor space of the building, is located the central power plant servicing several large structures within the area. Steam heating is supplied by the central heating plant located behind Baker Building. There is no air conditioning; however, fresh-air ducts are located on the roof. The building is also equipped with Riche Browne windows, which are similar to steel casements.

6. MEDICAL ARTS BUILDING, located at 325 Ninth Street South, consists of two sections: the first, built in 1925, is 10 stories high, averaging 11,000 square feet per floor, and the second section, built in 1929, is 19 stories high, each averaging 5000 square feet. The building is constructed of reinforced concrete, with a brick exterior, and has one small basement and a sub-basement. It is well-maintained and heated by vacuum steam. A fresh-air duct on the second floor is used in the basement. There are no storm windows in the building.

7. FOSHAY TOWER, at 821 Marquette Avenue, is a steel and concrete building constructed in 1929. It consists of 32 stories, each averaging 4500 square feet. It is 447 feet high, with an antenna extending another 160 feet. Of the four basements in the building, the first and second are used as garages, the third as the power plant, and the fourth as a pump room. Steam heating is supplied from an outside source located in the rear of the Baker Building. There is no overall air-conditioning system in this commercial building, though single air-conditioning units are installed in several offices. The Riche Browne windows are out-swung, steel-sash casements.

Figure III-8

C. EVALUATION OF AEROSOL-CLOUD BEHAVIOR IN MINNEAPOLIS

1. Dosage Areas

The areas within selected dosage isopleths (particle-minutes/liter) have been measured for all releases except in those cases where the disposition of the samplers with respect to the cloud path was such that little confidence could be placed in the areas derived from uncompleted isopleths.* The areas enclosed by the selected isopleths have been plotted against adjusted dosage values obtained from multiplication of the dosage by wind speed and division by the number of grams of FP material released. The resulting graphs of "Adjusted Dosage-Area Relationships" are presented in the appropriate portions of Appendices A through E.

The consistent use of one set of dosage values in the isopleth analyses precludes having the same set of Ct·mph per gram values for all releases. Since the area values are also non-uniform, exact comparisons of the adjusted dosages and related areas cannot be made between different releases. The isopleth values used are powers of 10; the areas enclosed within these isopleths are listed in Table III-1, along with wind speeds, amounts of FP material released, and other data pertinent to the individual release.

Despite the lack of a standard set of Ct·mph per gram values, comparison of the results of different releases may be made in a general way. When the areas included within the dosage isopleths are plotted on log log paper as functions of the corresponding adjusted dosages, it is found that the

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*Releases not included, therefore, are FT's 0012a, 0012c, 0012d, 0013a - 0013d, 0016a, 0016b, 0018b, and 0018c.

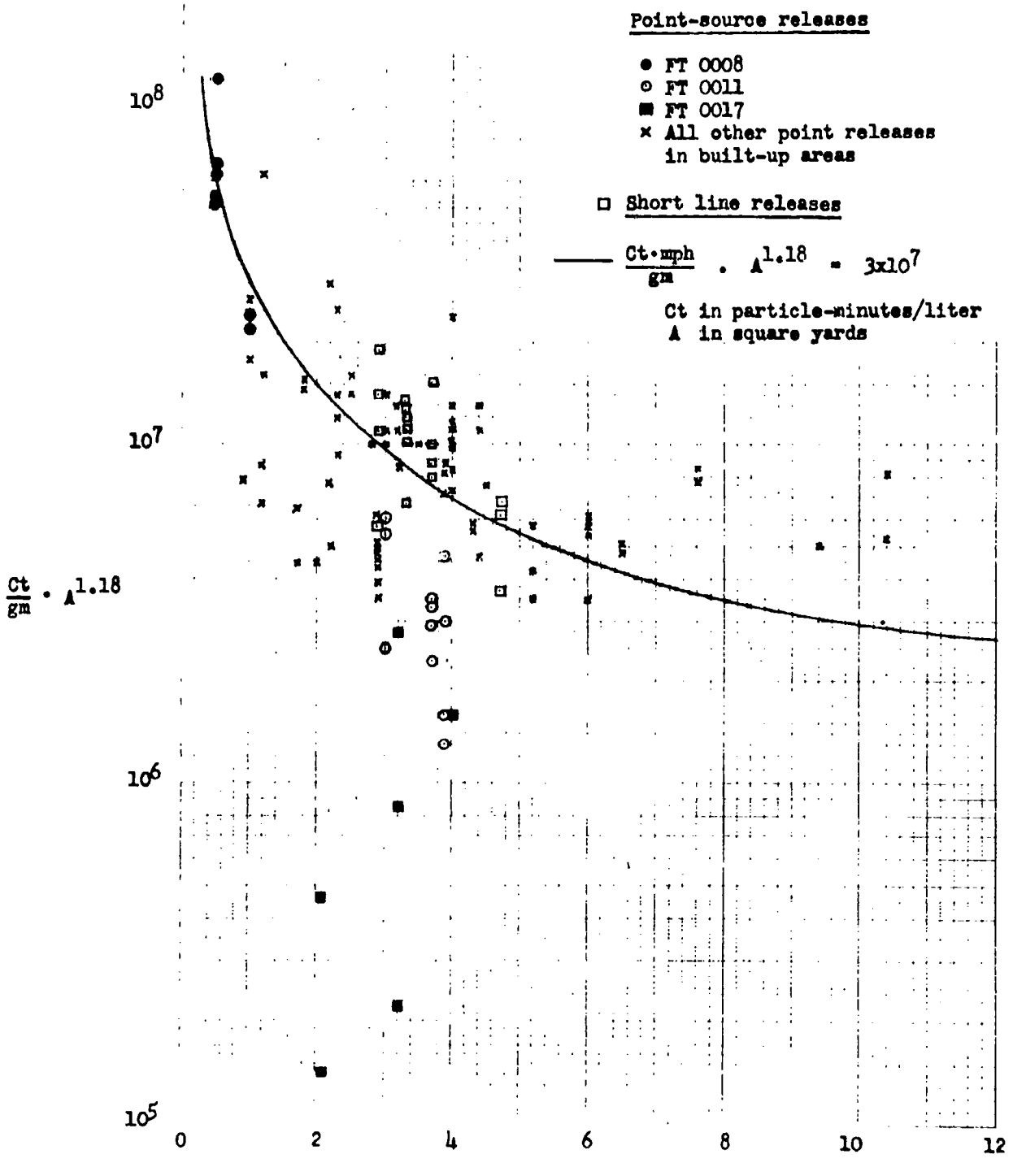
plotted points for both short line and point releases approximate a straight line. Therefore, the relationship for a given dosage per gram, wind speed, and area enclosed within the given dosage isopleth may be expressed $\frac{Ct \cdot mph}{gm} \cdot A^k = C$. The lines obtained from the plot of values for different releases have similar slopes; in general, a decrease of Ct·mph per gram by a factor of 10 is associated with an increase of area by a factor of 7. The exponent for A in the expression above is thus established as 1.18.

To investigate the effect of wind speed as a possible explanation for the lack of coincidence of the plotted values for different releases, the expression $\frac{Ct}{gm} \cdot A^{1.18}$ has been evaluated for all corresponding values of Ct/gm (particle-minutes per liter per gram) and A (square yards) and has been plotted against wind speed (miles per hour) in a scatter diagram (Fig. III-9). In addition to the tests included in this report, this diagram includes points obtained from FT's 0003-0011, which were reported in JQR 3. The amounts of FP material released ranged from 1.5 grams to 13.3 grams for point releases, and from 14.3 grams to 23.5 grams for short line releases, i.e., for lines less than 1000 yards in length. A plotting code has been used to distinguish certain releases from the others. FT 0008 is the only test run under inversion conditions in the city, and, as might be anticipated, the values are relatively high. FT 0017, which was run in Dog Area, under very unstable conditions (Figs. D-27, D-28, and D-29), shows the lowest values.

FT 0011 is also plotted distinctively. It is a daytime test with winds of 3-4 mph over snow-covered ground. It is interesting to note that the

FIGURE III-9

RELATIONSHIP BETWEEN WIND SPEED AND THE PRODUCT
OF DOSAGE PER GRAM AND AN EXPONENTIAL POWER
OF THE AREA ENCLOSED WITHIN THE GIVEN DOSAGE ISOPLETH



points for this test on the 3.0 mph vertical line were obtained from FT 0011c, for which the release was made at surface level. The other two releases, FT's 0011a and 0011b, were made from a roof 35 feet above the ground, and yet all three groups of plotted points are consistent.

A curve, based on a value of 3×10^7 for C in the formula $\frac{Ct \cdot mph}{gm} \cdot A^{1.18} = C$, has been fitted visually to the points of the scatter diagram (Fig. III-9). The suitability of this value for C is indicated by the median values presented in Table III-2. The data included in this table are only from those tests run under nighttime lapse conditions.

TABLE III-2

MEDIAN VALUES AND RANGE OF VALUES OF C*
FOR SELECTED WIND SPEED RANGES

Wind Speed (mph)	Number of Cases	Median	Range
0.6 - 1.5	7	1.8×10^7	7.1×10^6 - 7.6×10^7
1.6 - 2.5	14	2.7×10^7	7.6×10^6 - 6.6×10^7
2.6 - 3.5	26	3.1×10^7	1.0×10^7 - 5.5×10^7
3.6 - 4.5	21	3.4×10^7	2.1×10^7 - 9.6×10^7
4.6 - 5.5	6	2.2×10^7	1.7×10^7 - 3.2×10^7
5.6 - 6.5	7	3.3×10^7	2.1×10^7 - 3.7×10^7
6.6 - 7.5	0	----	----
7.6 - 8.5	2	6.2×10^7	5.8×10^7 - 6.5×10^7
8.6 - 9.5	1	4.7×10^7	----
9.6 - 10.5	2	7.0×10^7	5.5×10^7 - 8.5×10^7

*$C = \frac{Ct \cdot mph}{gm} \cdot A^{1.18}$; Ct in particle-minutes per liter, A in square yards.

The 0.0 - 1.5 mph wind speed range is the only one for which the extreme range of values of C exceeds a factor of 10. This range is also the only one below 6.5 mph for which the median value differs from the visually fitted value of 3×10^7 by more than 27 per cent.

The premise that the effects of the wind on the dosage within a given area can be compensated for by multiplying the dosage per gram by the wind speed seems open to question when the wind exceeds six mph. For the limited number of cases in which the wind exceeded six mph, the proportional application of wind speed to obtain adjusted values of dosage per gram gives products which are consistently higher than the average of the products in the lower wind speed ranges. This evidence of non-proportionality supports the findings of tests conducted in Salisbury, England.* These tests, performed with winds ranging from 5 to 10 mph, showed some increase in area with an increase in wind speed.

A comparison was presented in AQR 3 (Fig. V-21, p. 152) of average dosage-area relationships for daytime tests in Minneapolis and Salisbury. A revised presentation is given here in Figure III-10, where the Minneapolis data have been converted to the units used in the original presentation of the Salisbury data. Recent tests show that for each gram of FP material released, 3.0×10^{10} particles have become airborne. Thus, one particle-minute per liter is equivalent to 3.3×10^{-5} microgram-minutes per liter. Since the Salisbury flow rates are expressed in cubic meters per minute,

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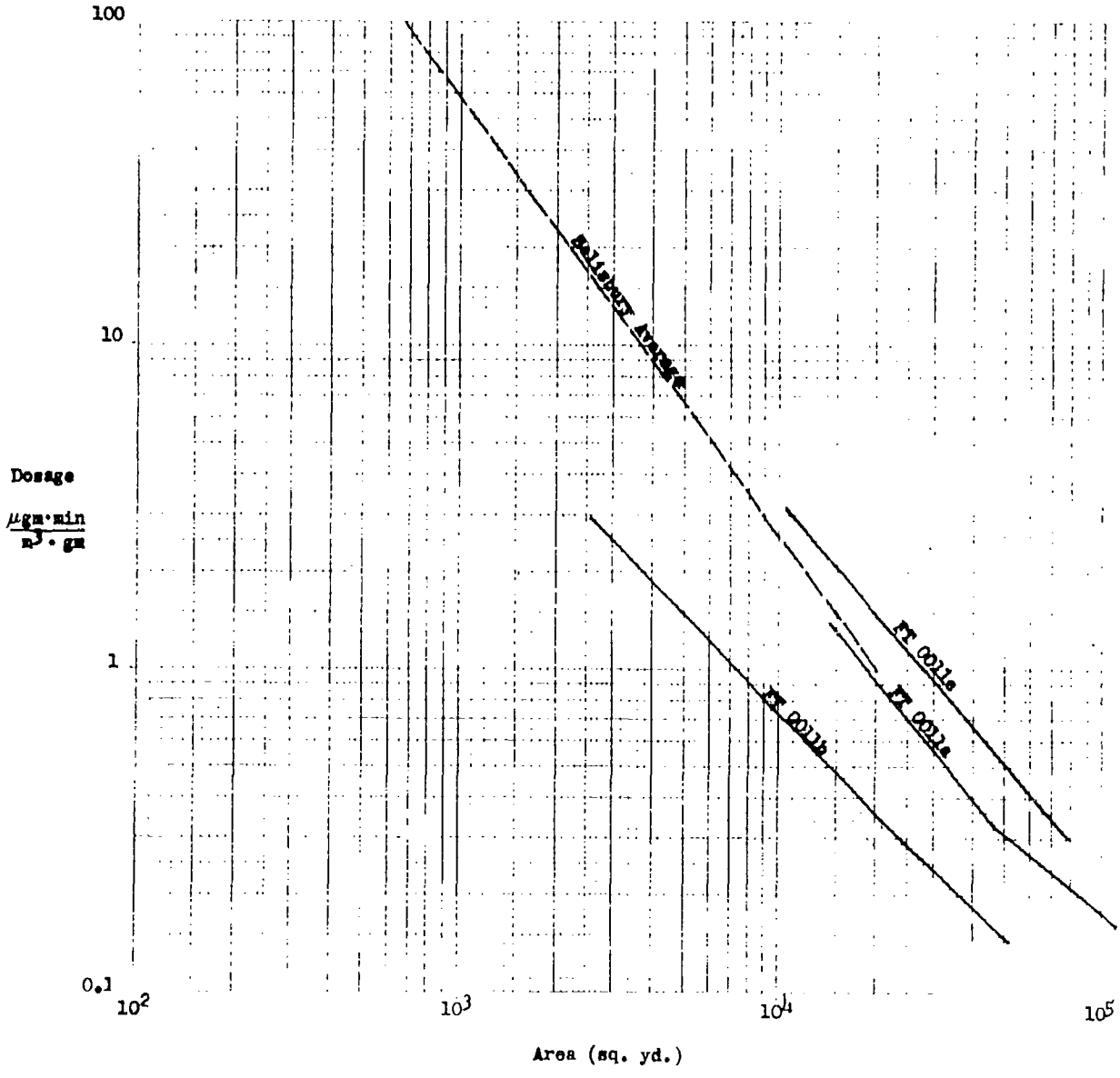
*C. J. M. Aanensen, "Diffusion of Smoke in a Built-up Area," Porton Technical Paper No. 193, 1950.

FIGURE III-10

DOSAGE-AREA RELATIONSHIPS FOR DAYTIME RELEASES
IN MINNEAPOLIS AND IN SALISBURY, ENGLAND



the conversion factor applied to the Minneapolis values stated in particle-minutes per liter becomes 3.3×10^{-2}. These converted dosage values, divided by the number of grams released, then become comparable to the Salisbury dosage values, which are expressed in microgram-minutes per cubic meter per gram.

2. Crosswind Integrated Dosages (CWID)

CWID's were obtained by taking the area under the curve expressing the dosages interpolated from the isopleths along selected crosswind lines expressed in yards. To enable comparisons to be made between releases, the CWID values, in $\frac{\text{particle-minutes}}{\text{liter}}$. yards, have been divided by the number of grams of FP material released and multiplied by the wind speed in mph.

Table III-3 shows median values and the range of values for CWID·mph per gram at a distance of 1000 yards downwind from the aerosol source. The prevailing wind speeds indicate that the aerosol cloud should have completely passed the 1000-yard crosswind line in each case before the end of the sampling period. Some substantiating evidence is provided by the use of time-resolution samplers in a few releases. In the final sampling period, the maximum count shown on any of these samplers was five particles (Figs. D-30 and D-31) or an incremental dosage of less than one.

TABLE III-3

VALUES OF CWID·MPH PER GRAM* AT 1000-YARD DOWNWIND DISTANCE BY AREAS, BY TIME OF DAY, AND BY TYPE OF SOURCE

Area	Time of Day	Type of Source	Number of Cases	CWID·mph per Gram	
				Median	Range
Able	Day	Point	2	1.8×10^3	9.9×10^2 - 2.6×10^3
	Night	Point	9	4.2×10^3	2.2×10^3 - 7.7×10^3
	Night	Line	4	4.6×10^3	2.1×10^3 - 7.3×10^3
Baker	Night	Point	8	5.4×10^3	1.8×10^3 - 2.1×10^4
	Night	Line	3	3.1×10^3	2.5×10^3 - 4.8×10^3
Charlie	Night	Point	2	7.8×10^4	7.8×10^4 - 7.9×10^4
Dog	Night	Point	6	4.4×10^3	0 - 8.8×10^3
Citywide	Night	Line	4	1.3×10^4	6.7×10^3 - 1.8×10^4

*CWID is the value of the area under the curve expressing the dosages along the selected crosswind line expressed in yards.

Comparison of median values shows the highest value in Charlie Area and the lowest during the daytime in Able Area. Except for these and the citywide tests, no significant difference is apparent either between testing sites or between different types of source.

The spacing of samplers in the arrays for the citywide tests was necessarily greater than for the smaller area tests. Therefore, the confidence that can be put in the computed CWID values for the citywide tests is correspondingly less.

FT 0020 in Able Area is of particular interest since it was designed to compare the CWID values at downwind distances obtained from a point

release and from two line releases of sufficient length to have the effect of an infinite line with respect to the sampling array. Figure III-11 shows the plot of the CWID·mph per gram values with downwind distance in yards for the three releases. It will be noted that the difference between the values for the point release and either line release is generally less than the difference between the values for the two line releases.

This relative agreement of CWID·mph per gram values between the point source and either line release of FT 0020 emphasizes the similarity between the results obtained from the other point releases of 1.5 to 13.3 grams and the short line releases of 14.3 to 23.5 grams. No significant differences were found to exist between the two types of releases when the area-dosage per gram relationship was investigated for the short line releases (FT's 0014 and 0019). The relationship could not be evaluated for FT 0020 since the line releases were of infinite length with respect to the sampling array.

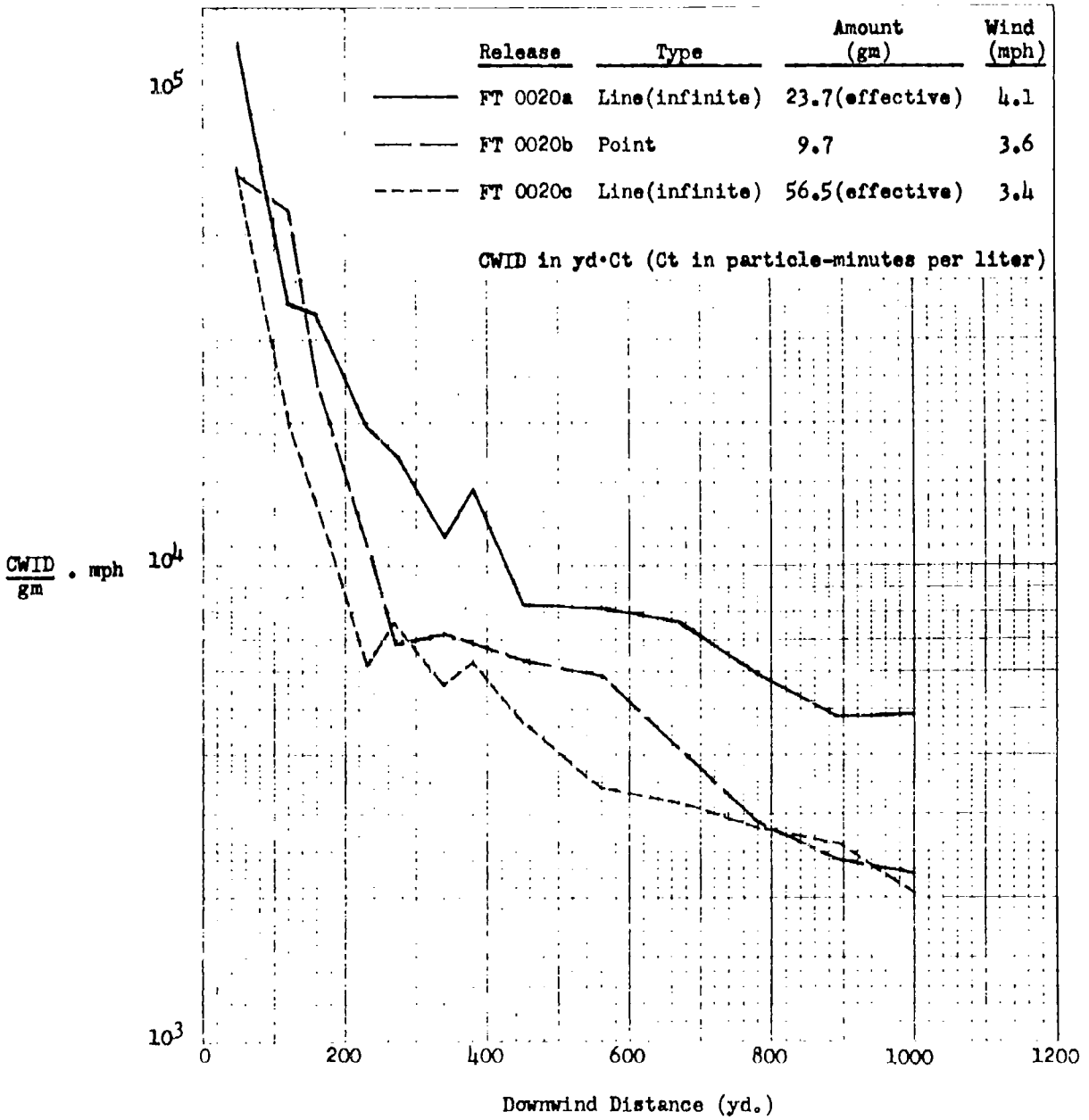
Point-source releases on a large scale, comparable to citywide tests FT's 0022 and 0023, in which 400 to 800 grams were dispersed, may be desirable to investigate the extent of the agreement between the results for line and point-source releases.

3. Reproducibility of Dosage Patterns

The general appearance of the dosage isopleth patterns is quite similar for releases made from a given point within a period of three or four hours, provided there are no marked changes in wind or stability conditions.

FIGURE III-11

RELATIONSHIP BETWEEN CWID·MPH PER GRAM AND DOWNWIND DISTANCE FOR FT 0020



This similarity can be seen by comparing the analyzed charts for given releases of a particular test, especially those in Appendix A for the two line releases of FT 0014; those in Appendix B either for the two releases of FT 0006 or for the three releases of FT 0019; or those in Appendix D for the three releases of FT 0015.

The dosage patterns for FT 0007 (Figs. B-17, B-18, and B-19) were somewhat different from those for the releases named above because of the indicated marked diversion of the cloud by a river gorge. The first of the three releases was made below the general terrain level at the edge of the Mississippi River, and the others were made well back from the edge of the 100-foot gorge. All releases were made from the south side of the river with the wind blowing from the south. In all cases there is strong evidence that the cloud was displaced along the river gorge in a direction nearly perpendicular to the general wind direction. It appears that the lee area of the bank on the side from which the wind came contributed more to the lateral displacement of the cloud than did the exposed bank on the opposite side.

4. Variations of Dosage with Height

Seven office buildings in Dog Area were used in FT's 0015, 0016, and 0017 to obtain data on dosage attenuation with elevation above the ground.*

*Dosage values obtained from samplers placed within the individual buildings are tabulated in Appendix D (Figs. D-7, D-19, and D-33). See also Appendix E (Table E-1).

Filters were exposed outside of windows at different heights above the ground and, in most cases, samplers were also operated on roofs. The greatest height at which filters were exposed was 27 floors above the ground.

When expressed as percentages of the ground-level dosages, a considerable range of values was obtained. Table III-4 shows ranges for selected height ranges. The median values and the ranges within which the middle half of the cases fall are also shown.

TABLE III-4

VARIATION OF RELATIVE DOSAGES WITH HEIGHT
(Relative Dosages Expressed as Percentages of Ground-level Dosages)

Height Range (floors)	Number of Samples	Relative Dosages		
		Median Value (%)	Range of Middle 50% of Samples (%)	Extreme Range (%)
1 - 4	33	112	76 - 144	19 - 347
5 - 8	21	67	20 - 97	0 - 143
9 - 12	35	99	77 - 126	0 - 196
13 - 16	16	84	61 - 102	7 - 136
17 - 20	24	98	68 - 156	31 - 191
21 - 27	8	86	78 - 98	54 - 114

Another treatment of these data shows an interesting difference between FT 0017 and the other two Dog Area tests. The mean of the outside values at all levels for a particular building in a given release is used as a base figure in terms of which all dosages are expressed as percents. For the releases of a given test, mean values have been computed for selected

height ranges. These means are based on all buildings which showed positive dosages on any release during a given test. These data (Table III-5) show that dosages for FT 0017 were relatively greater at the higher levels than near the ground, a relationship which was the reverse of that indicated to exist for FT's 0015 and 0016. The suspicion thus seems to be confirmed that a "bonfire" condition existed during the conduct of FT 0017, particularly during the last two releases.

TABLE III-5

MEAN RELATIVE DOSAGES IN SELECTED HEIGHT RANGES
FOR THREE DOG AREA TESTS

Height Range (floors)	Number of Samples			Mean Relative Dosages (%)		
	FT 0015	FT 0016	FT 0017	FT 0015	FT 0016	FT 0017
1 - 4	13	8	12	131	171	79
5 - 12	24	18	15	98	74	94
13 - 20	16	8	15	85	75	117

5. Penetration

The degree that the aerosol cloud penetrates buildings has been investigated by the comparison of dosages obtained from outside and inside samplers.* As shown above for the Dog Area releases, there are considerable variations in dosage with height above the ground. Hence caution is required in computing penetration values at heights well above street level.

*Dosages for these inside samplers (Figs. D-7, D-19, and D-33) indicate that the values should be considered conservative, since in some cases the second of the sequentially exposed filter units showed a higher incremental dosage than the first. A longer total sampling period might have given a greater total dosage.

Percentages of penetration at the higher levels will generally be lower when based on an outside ground-level dosage than when based on an outside dosage at the level of the inside sample. The comparison of the inside and outside dosages at the same level appears to be a more valid procedure for determining the percentage of penetration and has been used to obtain the data in Table III-6. This procedure has required the frequent use of interpolated values since outside values often were not available at the level of the inside sample. Outside ground-level values were used as bases in determining basement penetration.

TABLE III-6

INSIDE DOSAGES RELATIVE TO OUTSIDE DOSAGES
AT THE SAME HEIGHT LEVEL FOR SELECTED HEIGHT RANGES

Height Range (floors)	Number of Samples	Relative Dosages		
		Median Value (%)	Range of Middle 50% of Samples (%)	Extreme Range (%)
Sub-basement*	27	13	0 - 31	0 - 173
Basement*	31	11	0 - 30	0 - 143
1 - 4	20	24	14 - 52	0 - 834
5 - 8	32	16	4 - 34	0 - 1400
9 - 12	27	10	0 - 25	0 - 652
13 - 17	10	38	12 - 76	0 - 124
GROSS	147	15	0 - 37	0 - 1400

*Dosages at this level were compared to outside ground-level dosages.

"Sub-basement," as listed in the "Height Range" column of the table, refers to levels two or more floors beneath the ground floor. The lowest

level at which samples were taken was three floors below the ground floor. "Basement" refers to the first floor below the ground floor. The highest inside samples were taken on the seventeenth floor.

The gross median value of 15% for 147 samples taken during nine releases is of the same order of magnitude as those reported in JQR 3 for Clinton School and a number of residences. Clinton School had a gross median value of 23% based on 71 samples taken during 12 releases. The gross median value for the residences was 11.5% for 42 samples during seven releases.

To obtain an indication of the frequencies with which various amounts of penetration were achieved at the various height ranges, the data upon which Table III-6 was based have been treated differently and presented in Table III-7.

Table III-7 shows the percentage frequencies of inside dosages expressed as percentages of outside dosages at the same level within the ranges indicated by the column headings under "Penetration Ranges." For example, 28% of the total 147 samples showed no inside dosages when outside dosages were obtained at the same level, and 11% of the 147 samples showed inside dosages from 1 to 10% of the corresponding outside dosages. Addition of the gross values of the last two columns shows that 20% of the inside samples were greater than 50% of the corresponding outside dosages.

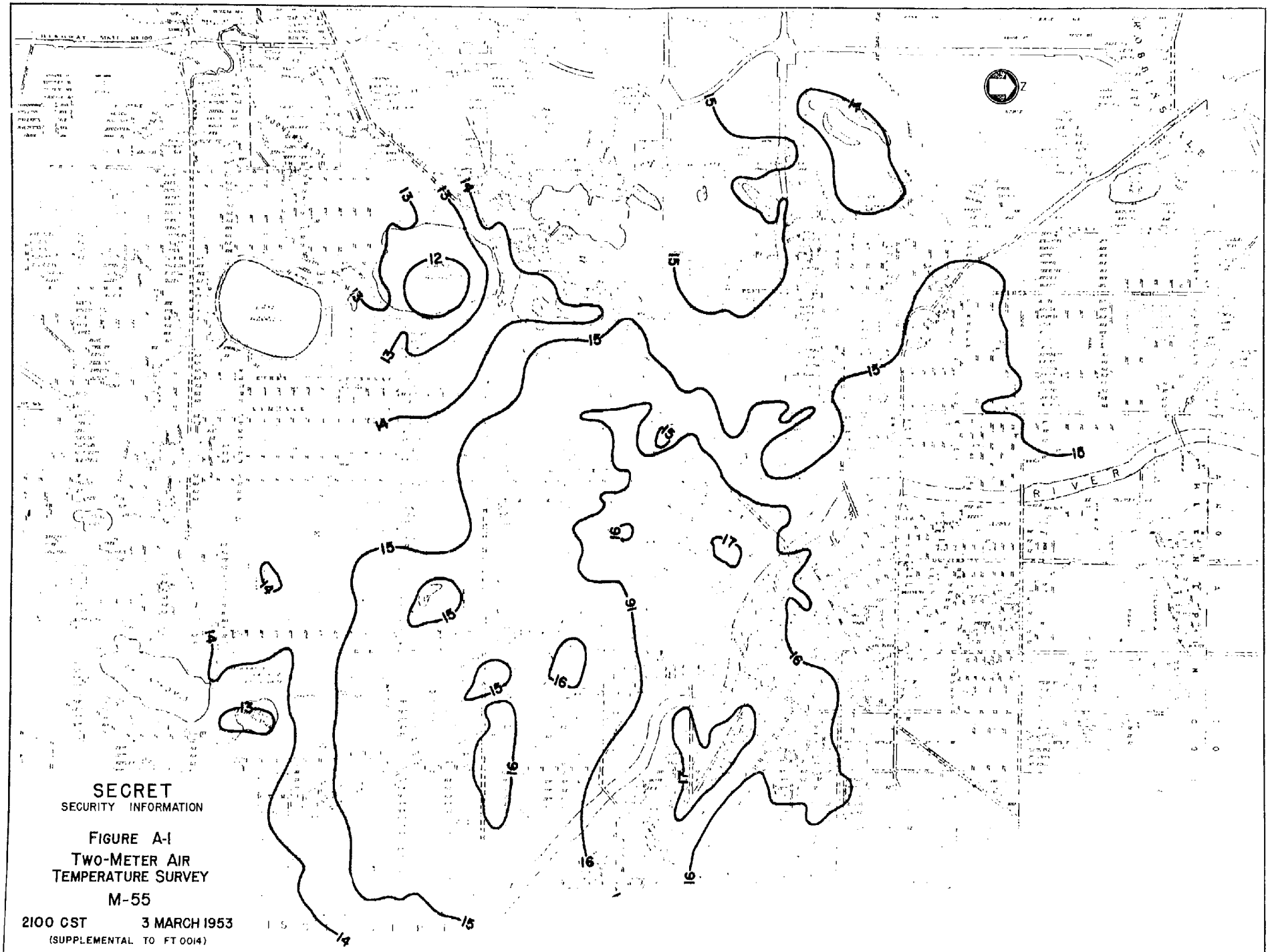
TABLE III-7

PERCENTAGE FREQUENCIES OF INSIDE DOSAGES RELATIVE TO OUTSIDE DOSAGES AT THE SAME HEIGHT LEVEL FOR SELECTED PERCENTAGE RANGES AND SELECTED HEIGHT RANGES

Height Range (floors)	Number of Samples	Percent of Cases in Each Indicated Penetration Range (%)					
		0	1-10	11-20	21-50	51-100	>100
Sub-Basement*	27	44	0	15	26	11	4
Basement*	31	39	10	13	29	3	6
1 - 4	20	10	10	25	30	10	15
5 - 8	32	22	16	22	19	9	12
9 - 12	27	26	22	19	11	15	7
13 - 17	10	20	0	10	30	30	10
GROSS	147	28	11	18	23	11	9

*Dosages at this level were compared to outside ground-level dosages.

APPENDIX "A"


SECRET
SECURITY INFORMATION
FIGURE A-1
TWO-METER AIR
TEMPERATURE SURVEY
M-55
2100 CST 3 MARCH 1953
(SUPPLEMENTAL TO FT 0014)

SUMMARY OF REGIONAL AND LOCAL WEATHER
3 March 1953
(Survey M-55, Supplemental to FT 0014)

SYNOPTIC SITUATION

A strong ridge of high pressure extended from the Pacific Northwestern states eastward to the Great Lakes, bringing relatively cold air across Minnesota. An intensifying low centered over Lake Erie served to increase the surface gradient. There was some evidence of a very weak cold frontal passage at Minneapolis on the evening of the test. At the 700-mb level, a broad slow-moving trough extended from Saskatchewan southward to Texas and long-wave ridges lay just off the Atlantic and Pacific coasts. The resulting gradient wind over Minneapolis was westerly at 35 mph.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	20,000	Broken	15	-	17	12	W	11
1930	20,000	Scattered	15+	-	14	8	WSW	7
2030	None	Clear	15+	-	13	9	WSW	10
2130	None	Clear	15+	-	13	9	WSW	10
2230	None	Clear	15+	-	14	9	W	15
2330	None	Clear	15+	-	13	8	W	16

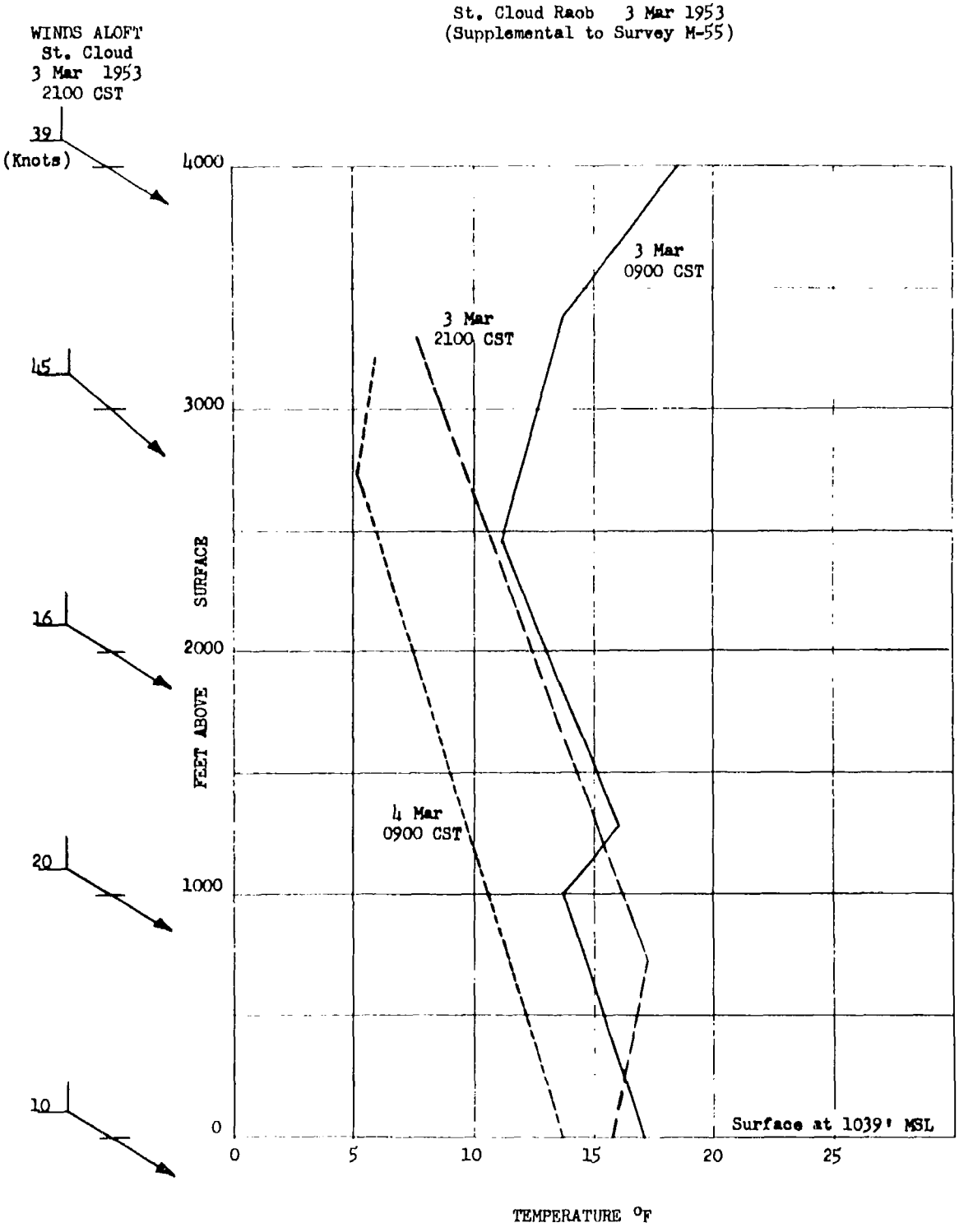
* Average cloudiness sunrise to sunset: 100%
** And/or restriction to visibility

Sea-level pressure at 2130 CST: 1009.5 mb
Ground condition: Twelve-inch packed snow; main streets clear; side streets clear but 50% ice from daytime melting; lake frozen
Tree cover: None

Figure A-2

TEMPERATURE SOUNDINGS

St. Cloud Raob 3 Mar 1953
(Supplemental to Survey M-55)



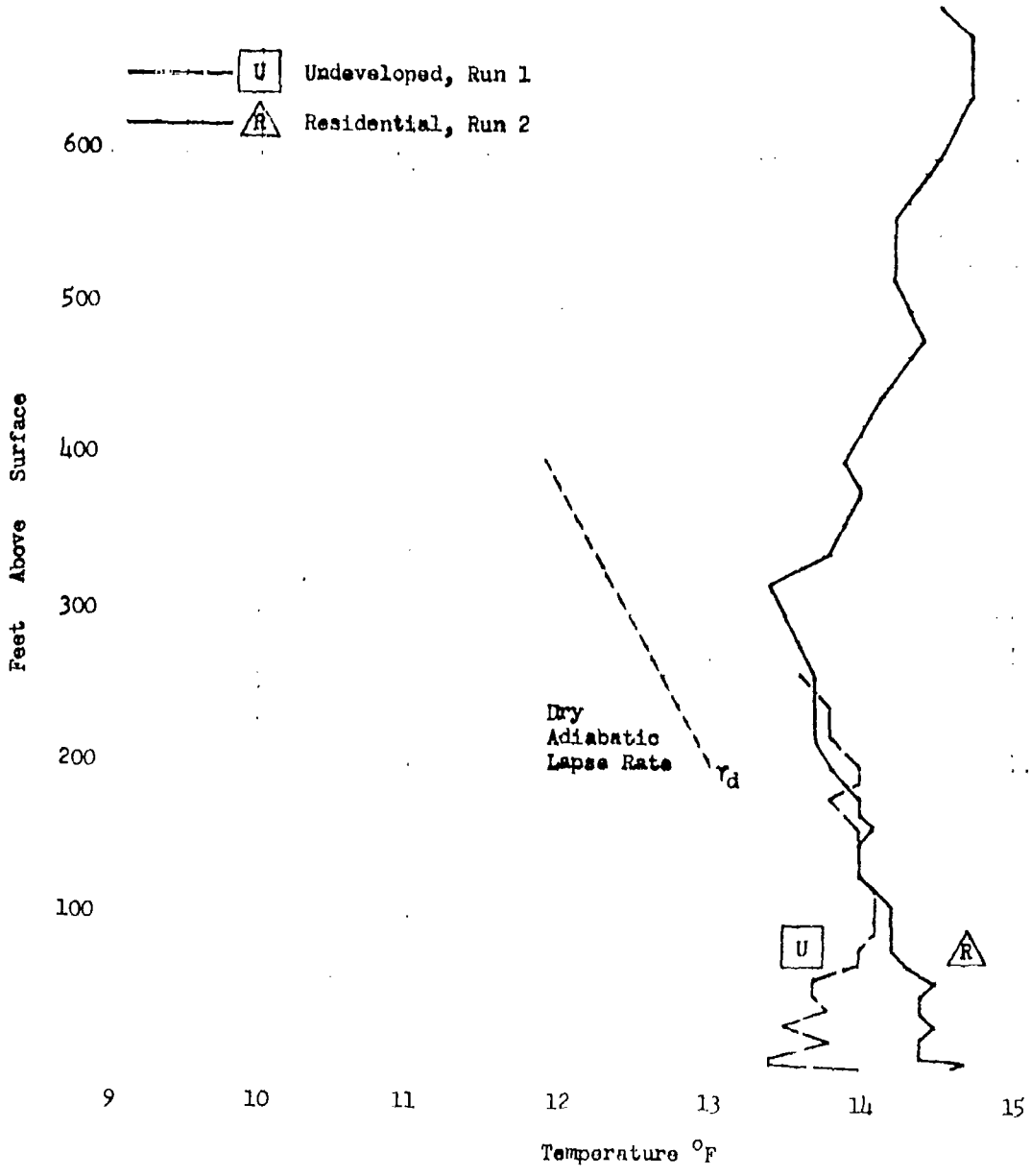


FIGURE A-3

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Residential Area
2100 CST 3 Mar 1953

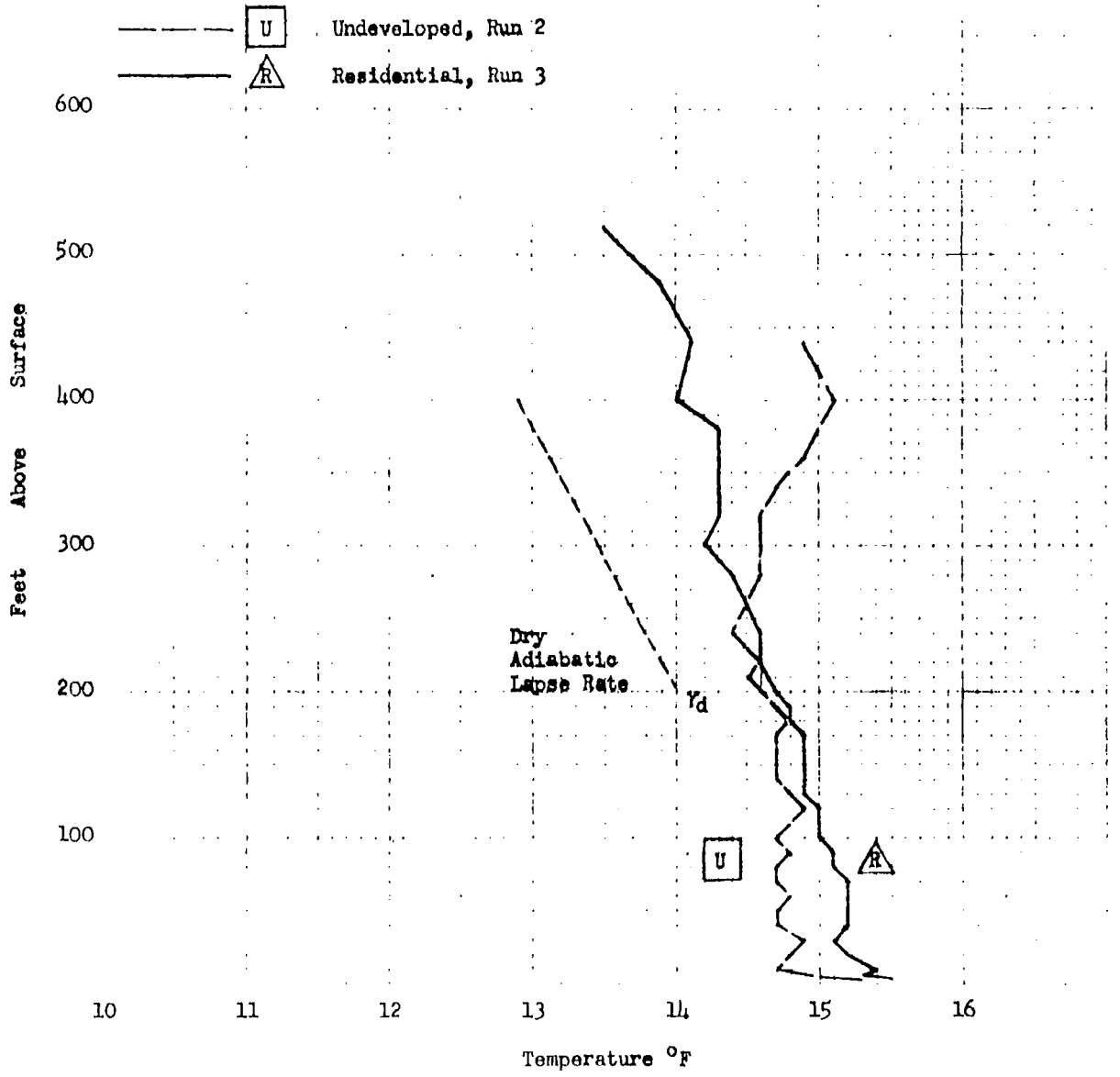


FIGURE A-4

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Residential Area
2:00 CST 3 Mar 1953

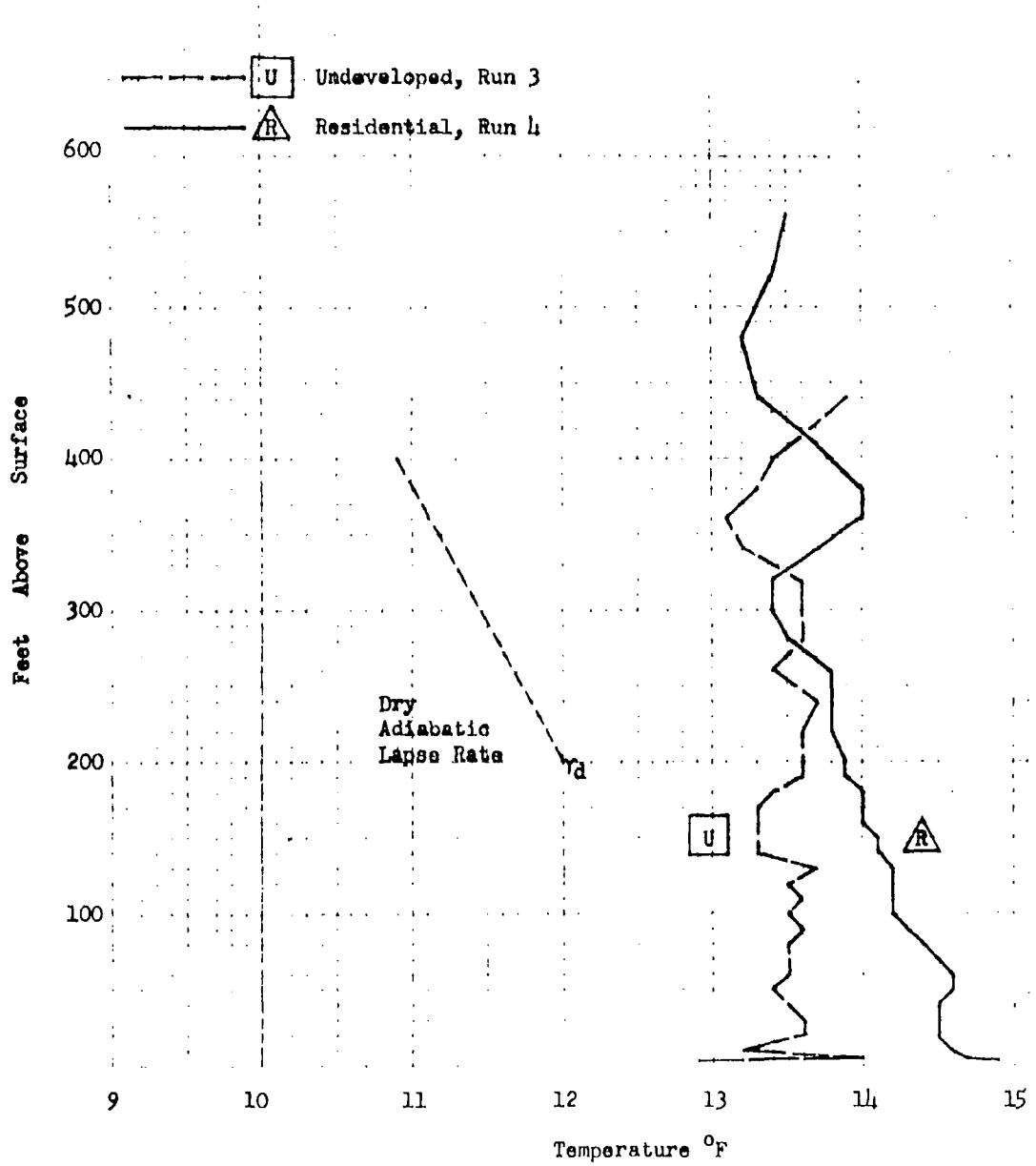


FIGURE A-5

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Residential Area
2300 CST 3 Mar 1953

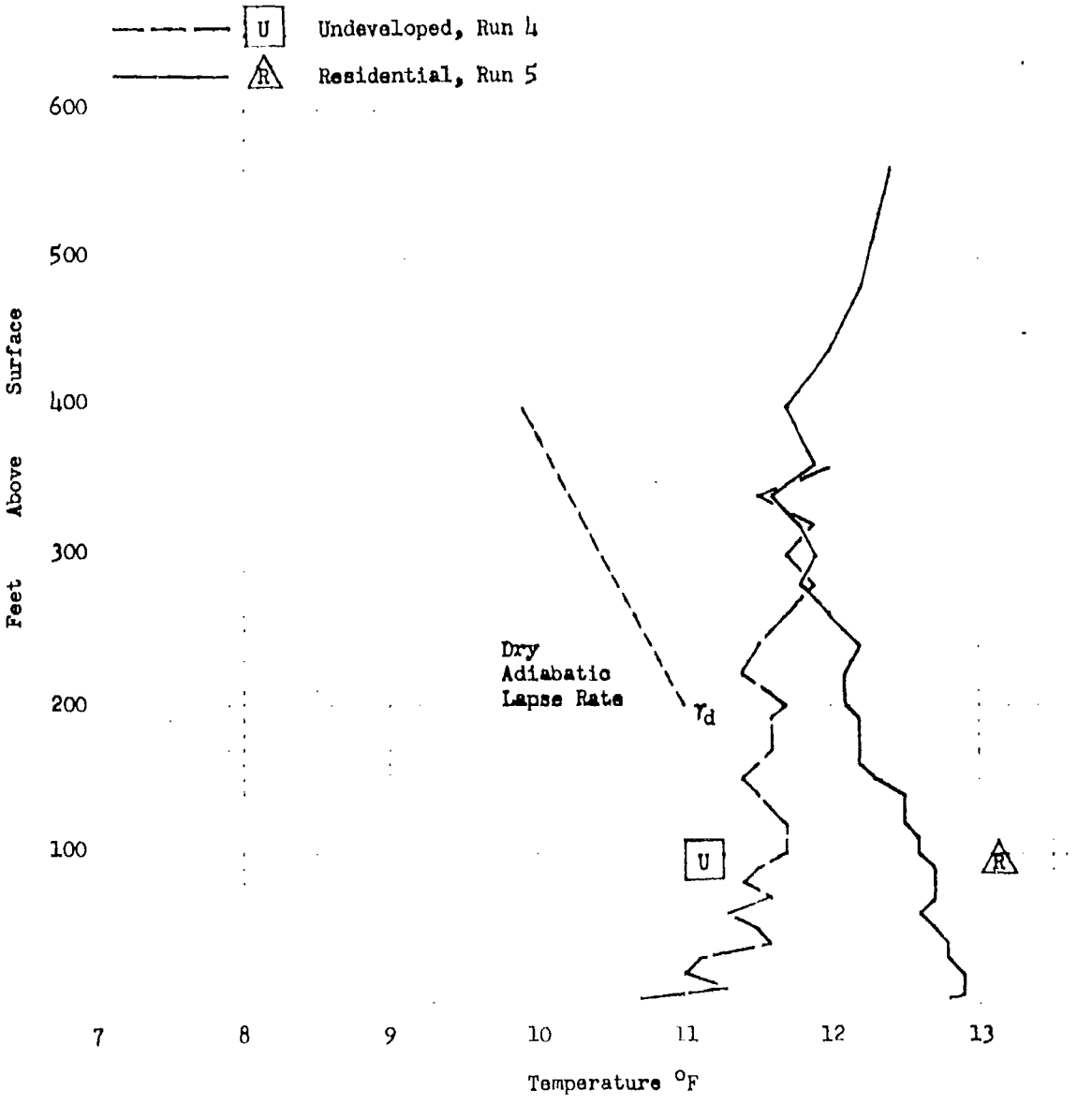


FIGURE A-6

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Residential Area
2400 CST 3 Mar 1953

Figure A-7

TIME RESOLUTION DATA

FT 0014b 3 Mar 1953
Sampler No. 1

Total No. of Particles:	1.79×10^3
Flow Rate:	10.2 liters/min
Dosage:	176 part-min/liter

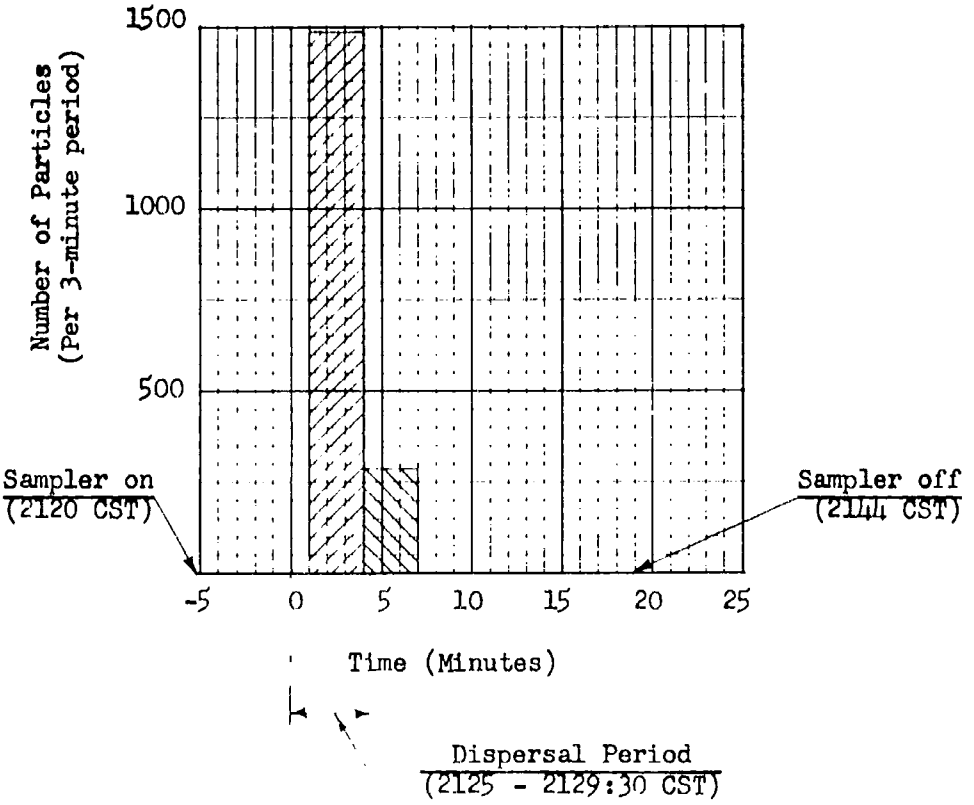


Figure A-8

TIME RESOLUTION DATA

FT 0014b 3 Mar 1953
Sampler No. 2

Total No. of Particles: 943
Flow Rate: 10.6 liters/min
Dosage: 89 part-min/liter

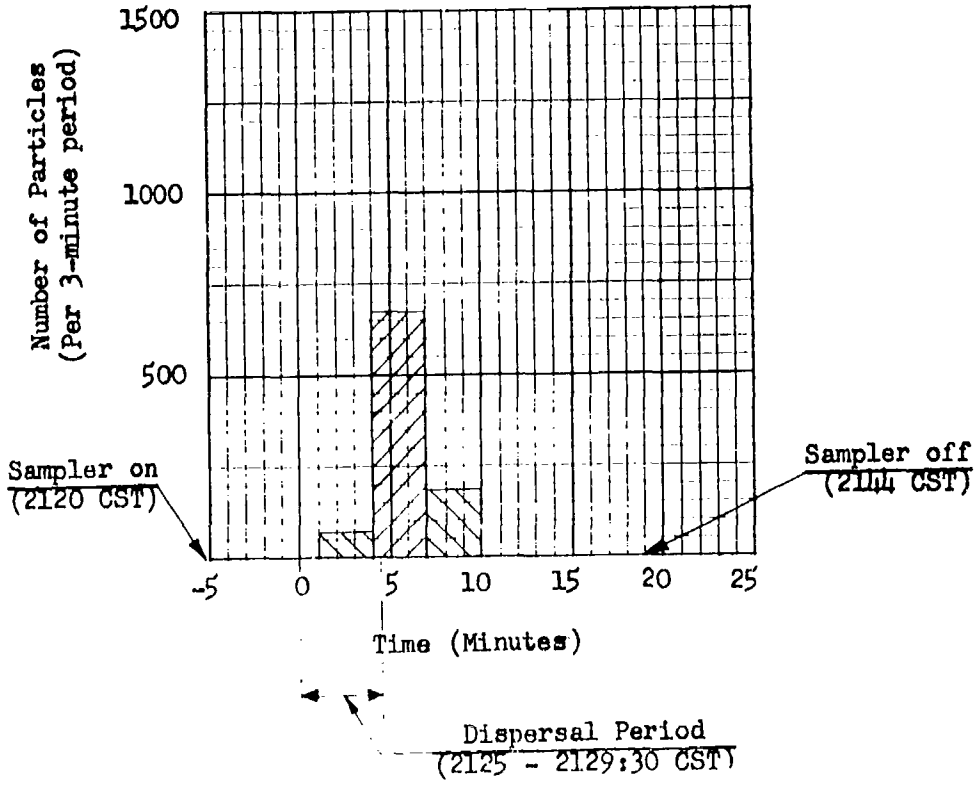


Figure A-9

TIME RESOLUTION DATA

FT 0014c 3 Mar 1953
Sampler No. 1

Total No. of Particles: 3.09×10^3
Flow Rate: 10.8 liters/min
Dosage: 286 part-min/liter

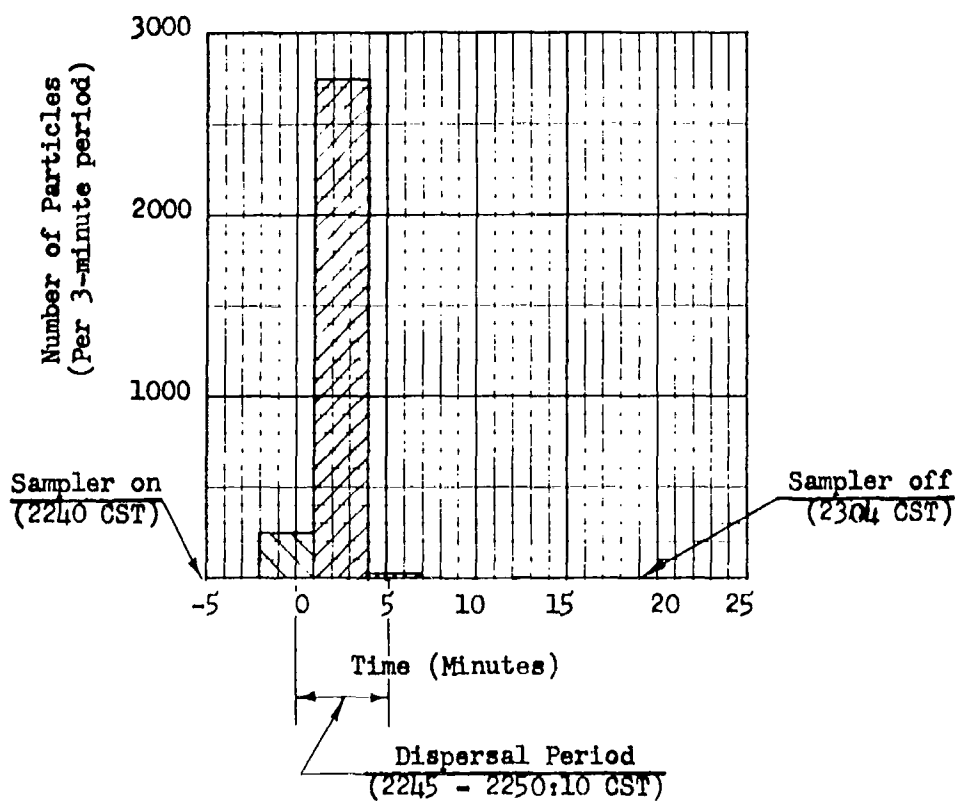
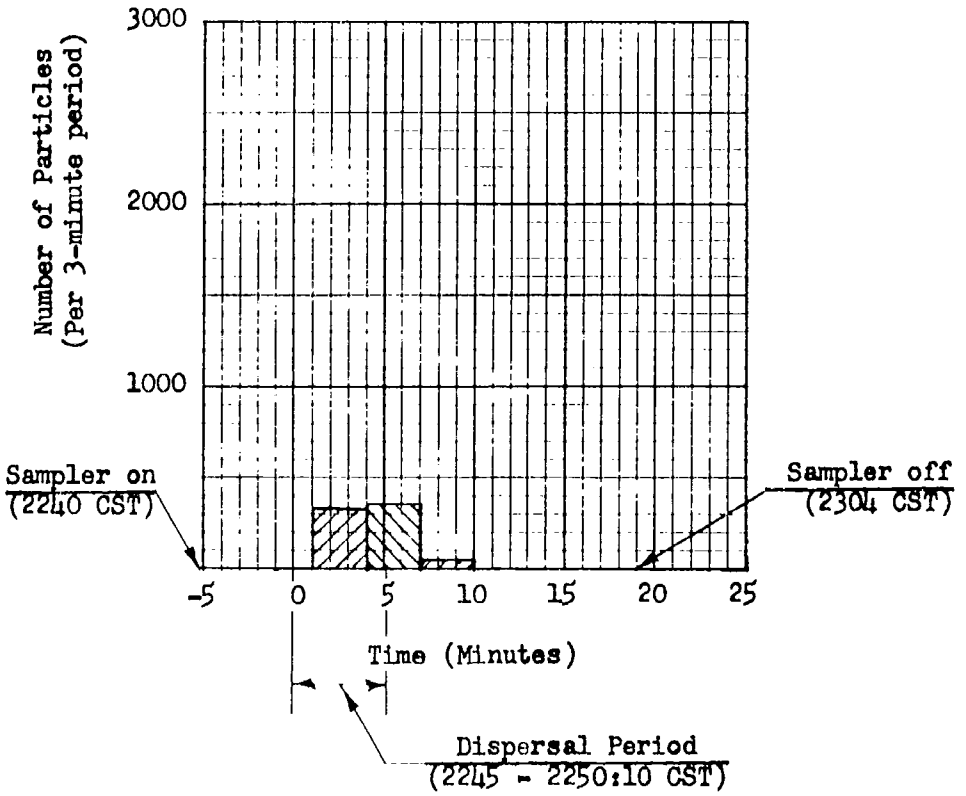


Figure A-10

TIME RESOLUTION DATA

FT 0014c 3 Mar 1953
Sampler No. 2

Total No. of Particles: 773
Flow Rate: 10.3 liters/min
Dosage: 75 part-min/liter



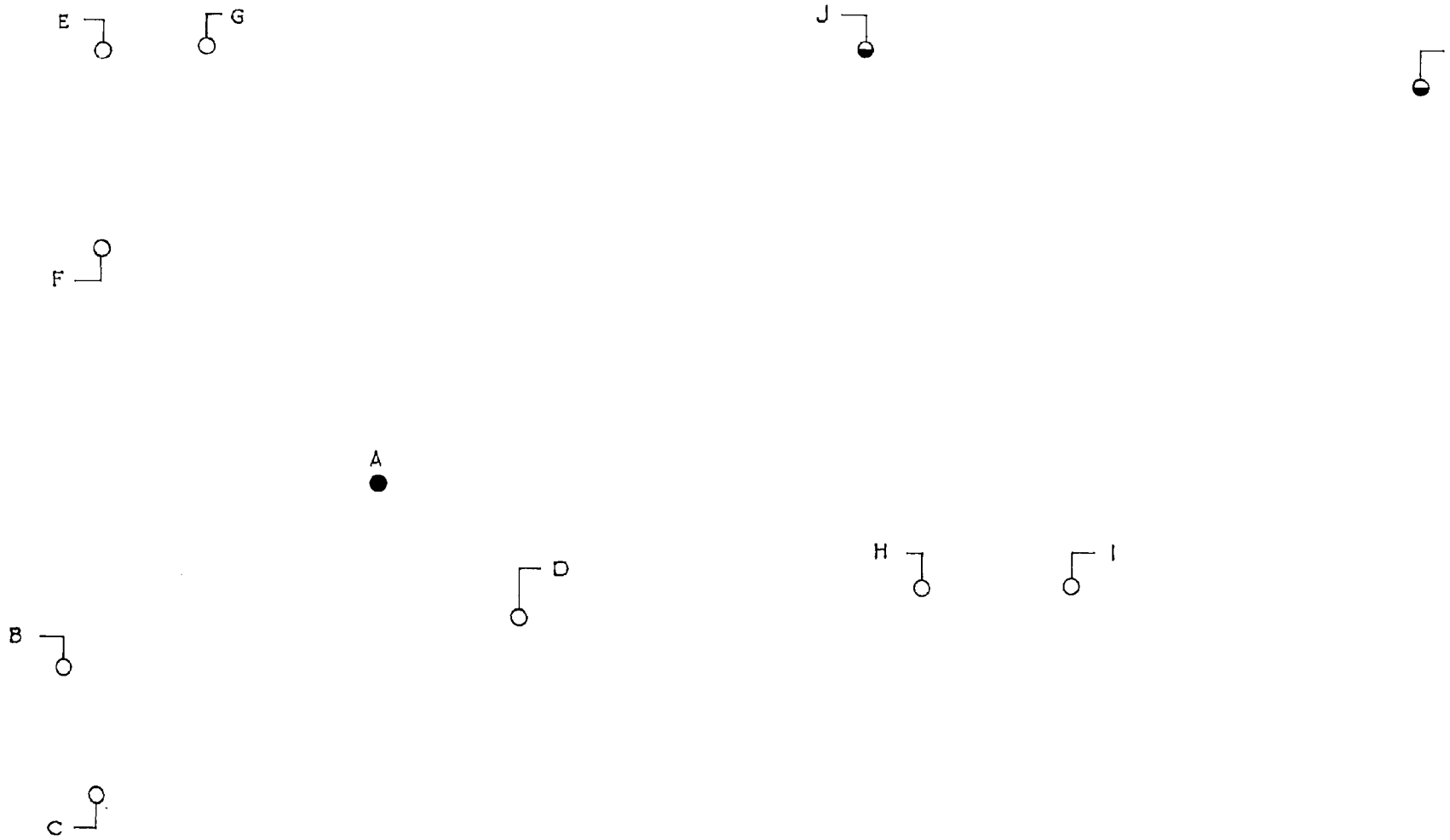


FIGURE A-1

CLINTON SCHOOL SAMPLER ARRAY AND RESULTS

FT 0014 3 Mar 1953

SECRET
SECURITY INFORMATION

● Outside sampler on ground.

◒ Outside sampler at height above the general terrain level or with filter holder extending beyond window.

○ Inside sampler.

CLINTON SCHOOL DOSAGES*

Sampler	Dosages for a Given Release		
	FT 0014a	FT 0014b	FT 0014c
A	24	93	62
B	3-2	13-4	10-4
C	T-T	16-10	9-T
D	2-T	10-14	26-6
E	6	90	57
F	2	23	13
G	0-T	16-4	9-3
H	15	111	64
I	3-3	16-16	2-0
J	12	105	49
K	18	75	65

* Dosages are expressed in particle-minutes per liter; T represents trace dosage, i.e., a count not exceeding 15 fluorescent particles. A single entry expresses the dosage obtained from a filter unit exposed during the entire sampling period of a particular release. Double entries for a given column represent incremental dosages obtained with sequentially exposed filter units. Applicable incremental periods for each sampler, as well as full sampling periods for each release, are as follows:

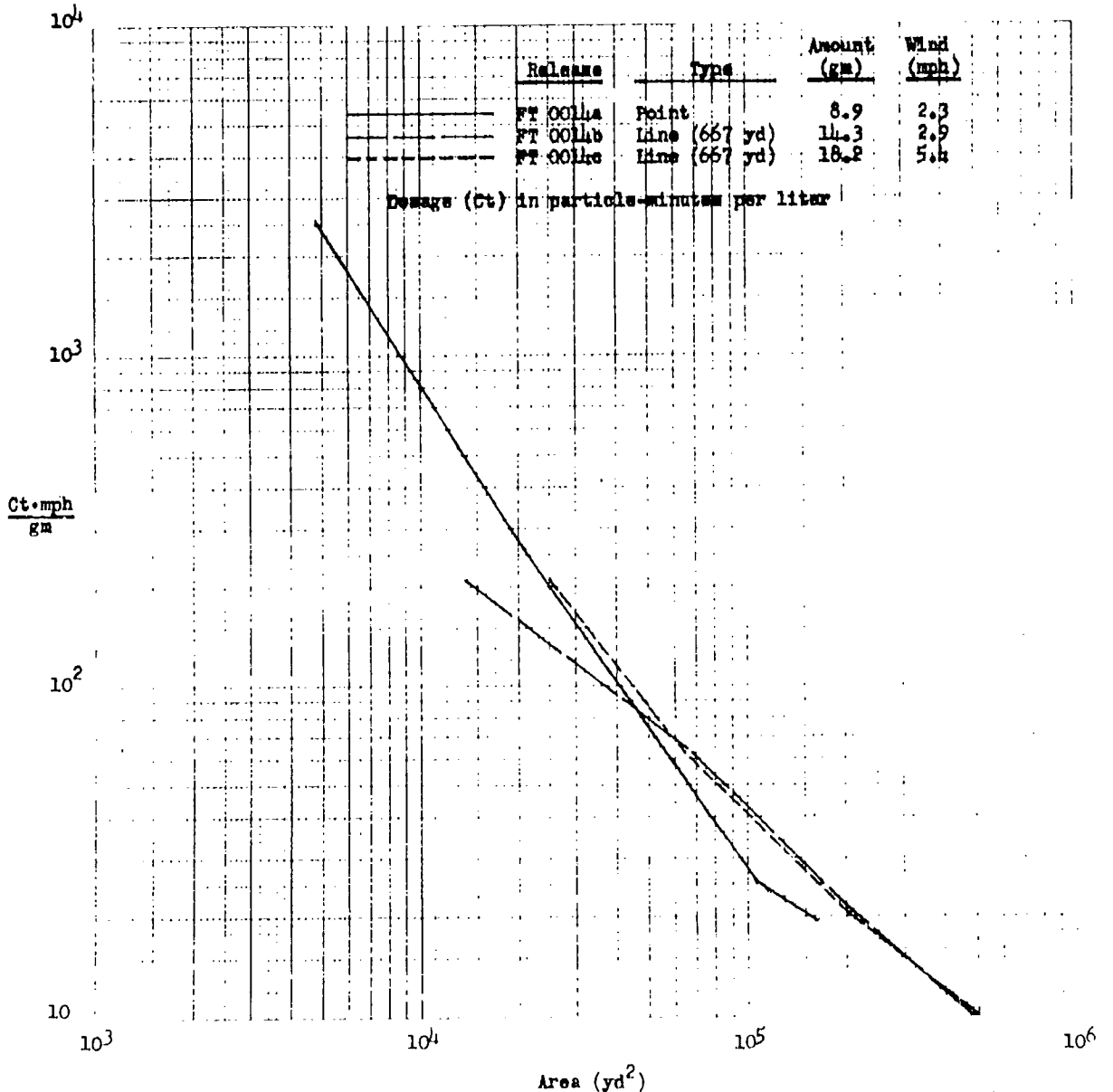
Release	Sampling Period	Incremental Periods
FT 0014a	2000-2100 CST	2000-2045 CST 2045-2120 CST
FT 0014b	2120-2220 CST	2120-2205 CST 2205-2240 CST
FT 0014c	2240-2340 CST	2240-2325 CST 2325-2340 CST

Figures A-13, A-14, and A-15 (Appendix A) show Building No. 11, Clinton School, in relation to the grid complex and the dosage pattern for the indicated releases.

FIGURE A-12

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0011₄ 3 Mar 1953



TEST ARRAY AND RESULTS
FT 00Ll1a

3 Mar 1953
2022 CST

AEROSOL GENERATION

Point-source release of 8.9 gms of NJZ 2266 over a period of 5 minutes starting at 2022 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 102 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Results

All samplers operated to measure total dosages. In addition, samplers in Clinton School were operated incrementally; sampler array, full sampling periods, and applicable incremental dosages are presented in Figure A-11.

Total Dosage (particle-minutes/liter)

T = trace dosage

58 M = malfunction or data missing

100 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) , (M2) , and (M3) .

Similar observations at rooftop level (35 feet above surface) and wiresonde ascents made at meteorological station (M1) .

2100 2105 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2100 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds southwesterly at 2.7 mph, roof-level winds southwesterly at 3.0 mph, and treetop winds west-northwest to southwest at 8-10 mph.

Stability

1.4° F lapse from 6-300 ft.

Sky

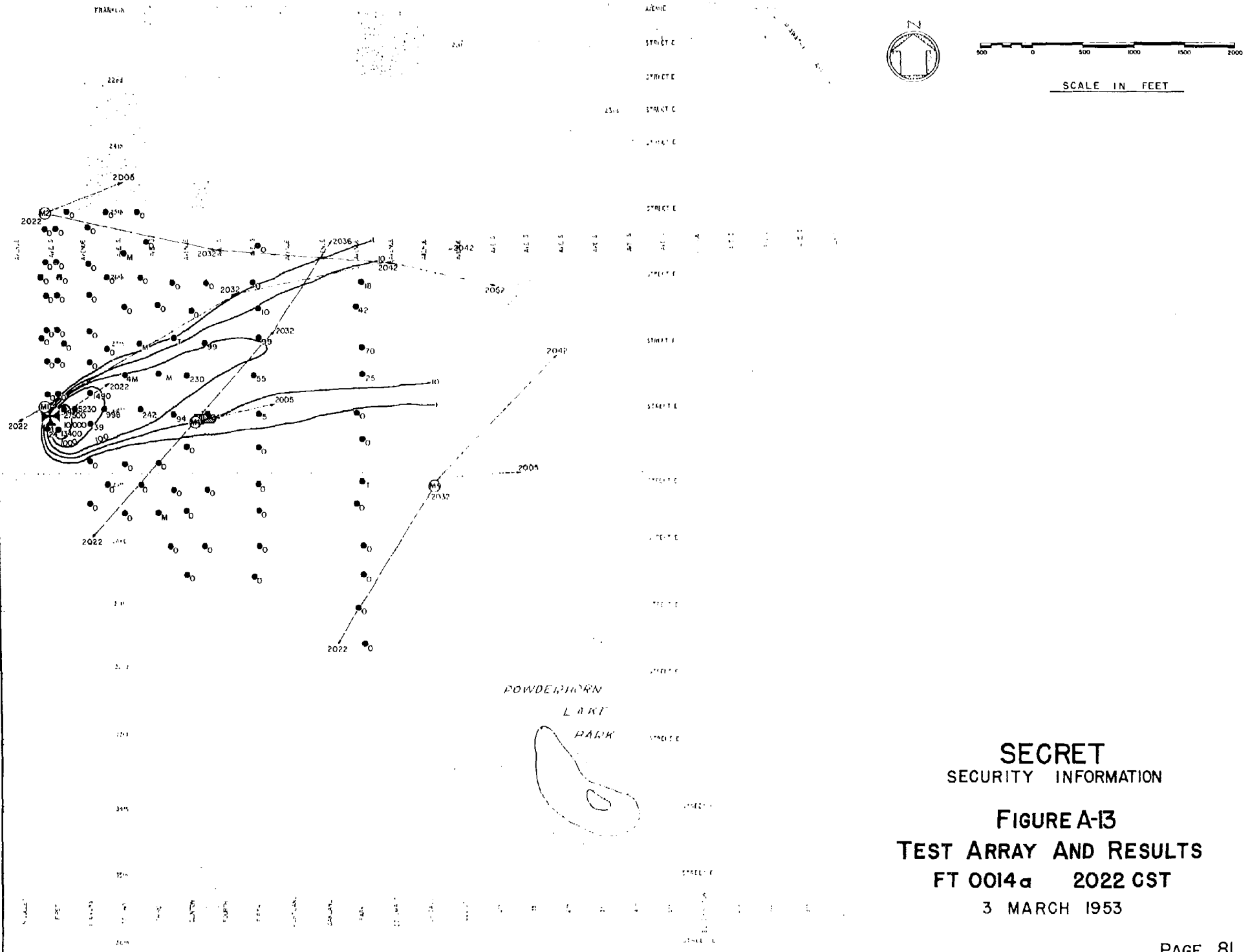
Clear during test period.

Temperature

16-17° F at 2 meters in the test area.

Moisture

Mixing ratio of 1.4 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE A-13
TEST ARRAY AND RESULTS
FT 0014a 2022 CST
3 MARCH 1953

TEST ARRAY AND RESULTS
FT 0014b

3 Mar 1953
2125 CST

AEROSOL GENERATION

Line-source release of 14.3 gms of NJZ 2266 (at a rate of 38.7 gms/mile) over a period of 4.5 minutes starting at 2125 CST, from a blower disperser mounted on a moving vehicle.

START ⟶ END (2125 CST) (2129:30 CST) 2000-ft track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 102 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

△ Time-resolution sampler with station number.

Results

All samplers operated to measure total dosages. In addition, samplers in Clinton School were operated incrementally; sampler array, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure A-11. Time-resolution data are given in Figures A-7 and A-8.

Total Dosage (particle-minutes/liter)

58 T = trace dosage

M = malfunction or data missing

100 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1), (M2), and (M3).

Similar observations at rooftop level (35 feet above surface) and wiresonde ascents made at meteorological station (M1).

2000 2005 2010 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-southwesterly at 2.9 mph, roof-level winds south-southwesterly at 4.1 mph, and treetop winds west-northwest to southwest at 8 - 10 mph.

Stability

1.2° F lapse from 6-300 ft.

Sky

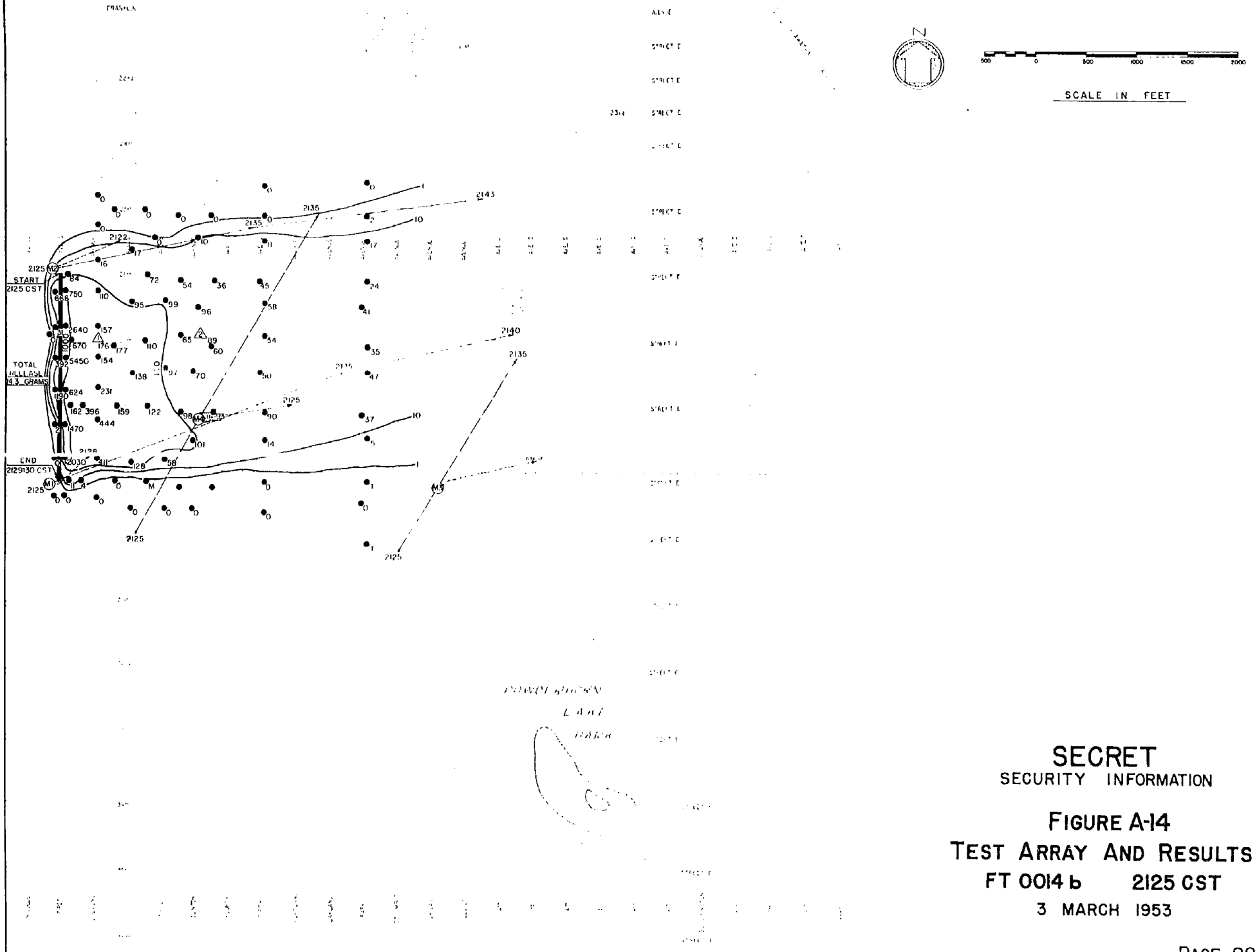
Clear during test period.

Temperature

15° to 16° F at 2 meters in the test area.

Moisture

Mixing ratio of 1.4 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE A-14
TEST ARRAY AND RESULTS
FT 0014 b 2125 CST
3 MARCH 1953

Figure A-15

TEST ARRAY AND RESULTS
FT 0014c

3 Mar 1953
2245 CST

AEROSOL GENERATION

Line-source release of 18.2 gms of NJZ 2266 (at a rate of 49.2 gms/mile) over a period of 5.17 minutes starting at 2245 CST, from a blower disperser mounted on a moving vehicle.

START (2245 CST) ——→ END (2250:10 CST) 2000-ft track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 102 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

△ Time-resolution sampler with station number.

Results

All samplers operated to measure total dosages. In addition, samplers in Clinton School were operated incrementally; sampler array, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure A-21. Time-resolution data are given in Figures A-9 and A-10.

Total Dosage (particle-minutes/liter)

●58

T = trace dosage

M = malfunction or data missing

100 —— 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M0) , (M2) , and (M3) .

Similar observations at rooftop level (35 feet above surface) and wiresonde ascents made at meteorological station (M1) .

2000 —— 2005 —— 2010 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

- - - - - - - - - → 2000 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-southwesterly at 3.6 mph, roof-level winds west-southwesterly at 10 mph, and treetop winds west-northwest to southwest at 8-10 mph.

Stability

1.5° F lapse from 6-300 ft.

Sky

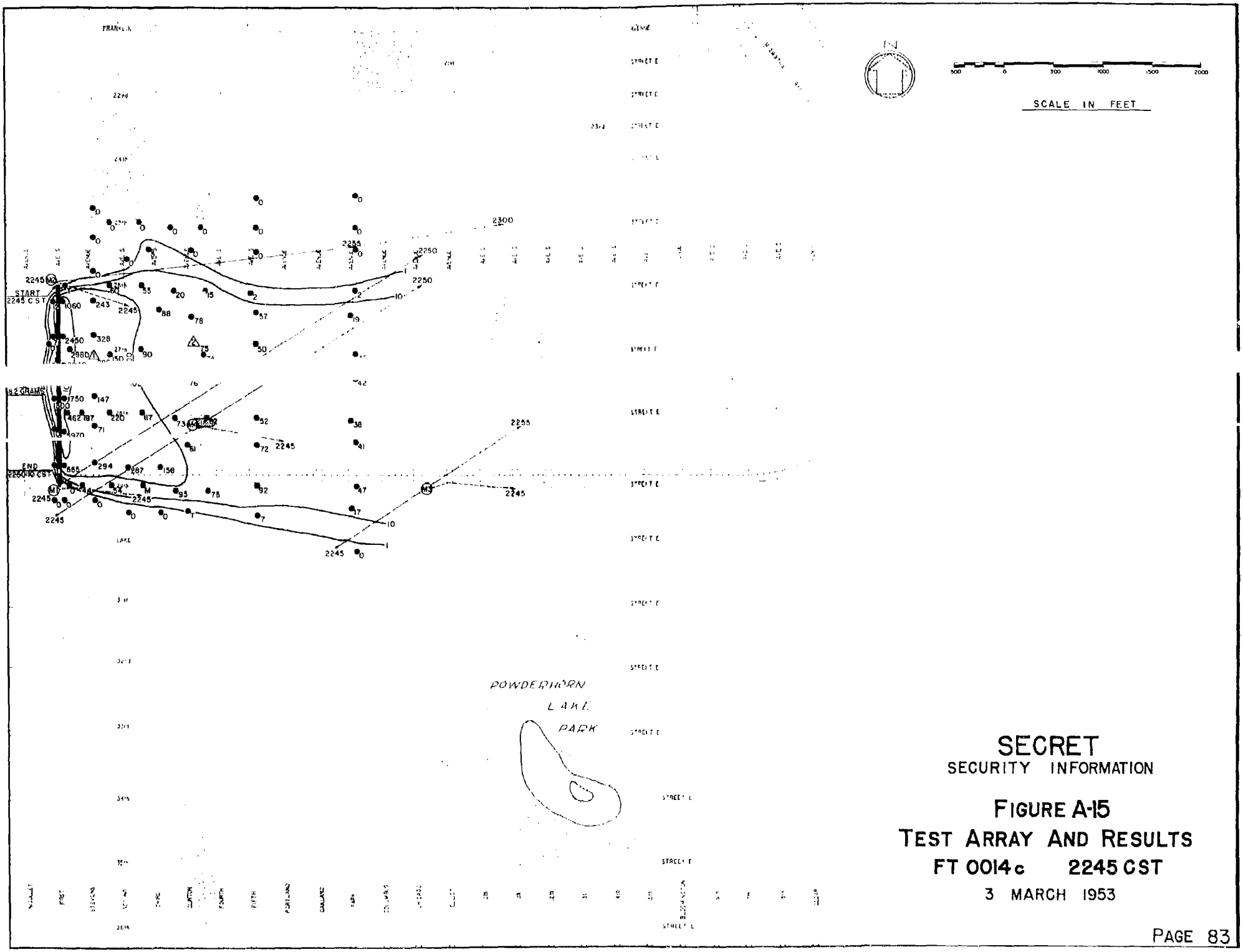
Clear during test period.

Temperature

44.7° to 45.7° F at 2 meters in the test area.

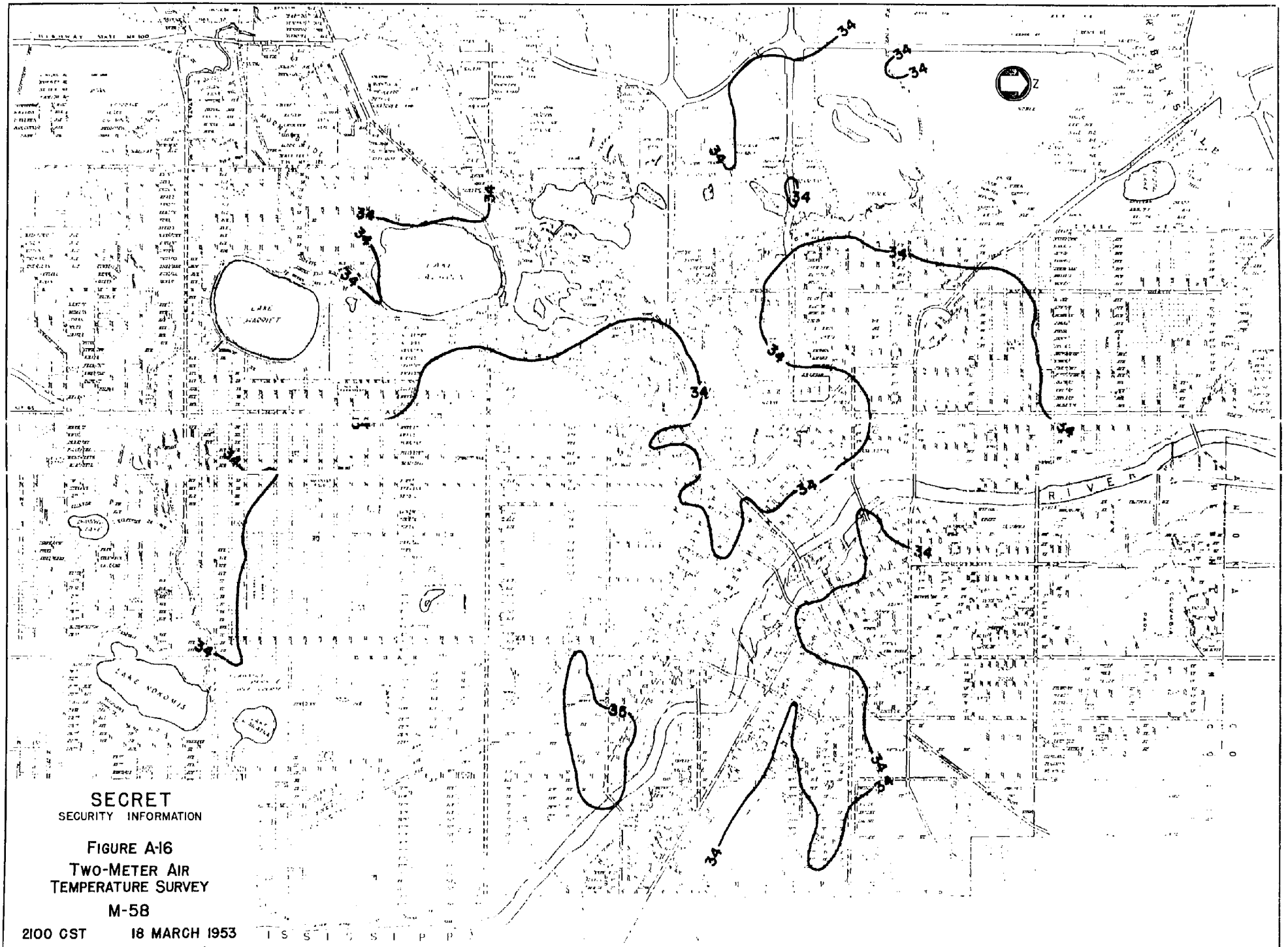
Moisture

Mixing ratio of 1.4 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE A-15
TEST ARRAY AND RESULTS
FT 0014c 2245 CST
3 MARCH 1953



SECRET
SECURITY INFORMATION

FIGURE A-16
TWO-METER AIR
TEMPERATURE SURVEY
M-58
2100 CST 18 MARCH 1953
(SUPPLEMENTAL TO FT0020)

SUMMARY OF REGIONAL AND LOCAL WEATHER
18 March 1953
(Survey M-58, Supplemental to FT 0020)

SYNOPTIC SITUATION

Associated with a 996-mb low center 300 miles northeast of Duluth, a weak dissipating cold front passed Minneapolis the night before the test with no precipitation. Light snowfall accompanied the passage of a secondary cold front one hour prior to the test period. Following the secondary front, a fresh mass of cold air in a weak high moved rapidly from the northwest. At the 700-mb level, a rapidly moving trough passed from Lake Superior through Indiana and Arkansas to Texas, and ridges lay over the Rockies and the Appalachians. The 700-mb gradient wind over Minneapolis was northwesterly at 40 mph.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	1900	Broken	15	-	35	33	W	24
1930	1900	Scattered	15	-	35	31	W	20 (gusty)
2030	2100	Broken	15	-	35	31	WNW	24 (gusty)
2130	2200	Broken	15+	-	33	27	WNW	20
2230	2500	Scattered	15+	-	32	25	WNW	24 (gusty)
2330	None	Clear	15+	-	30	20	WNW	20

* Average cloudiness sunrise to sunset: 50%
** And/or restriction to visibility

Sea-level pressure at 2130 CST: 1006.8 mb
Ground condition: Two to four-inch packed snow and ice; 40% of snow gone; streets clear; lake frozen
Tree cover: None

Figure A-17

TEMPERATURE SOUNDINGS

St. Cloud Raob 18 Mar 1953
(Supplemental to Survey M-58)

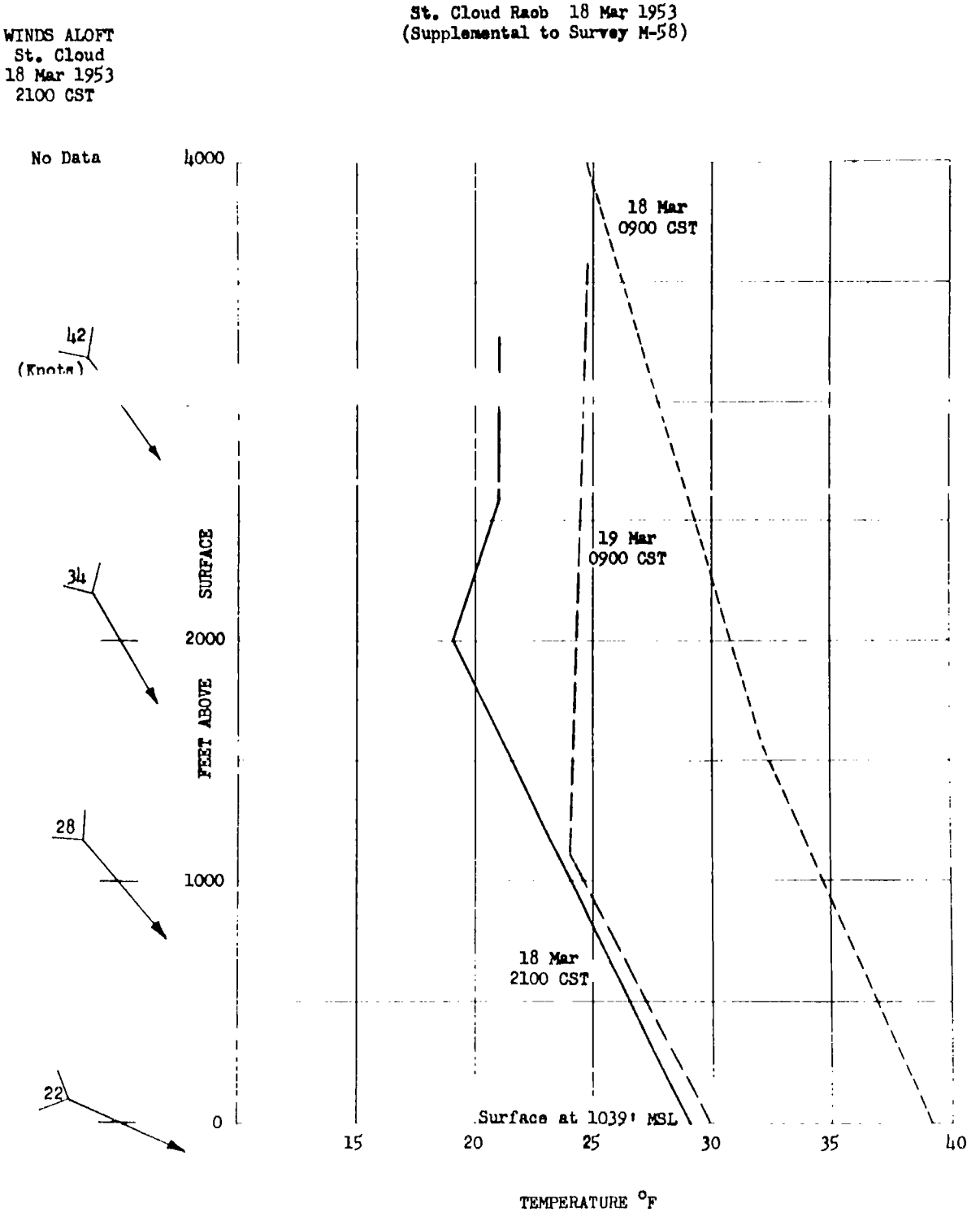
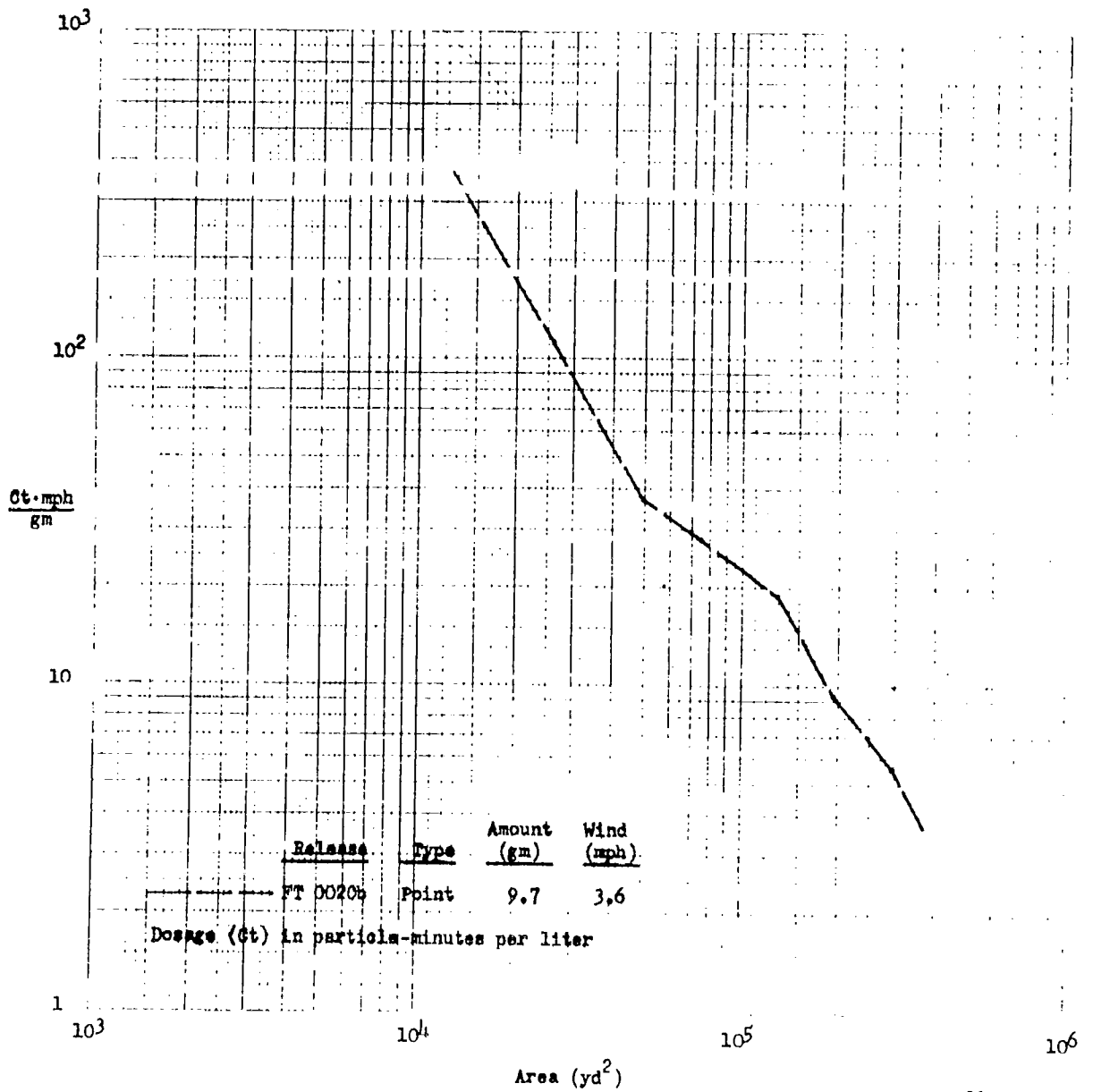


FIGURE A-18

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0020 18 Mar 1953



TEST ARRAY AND RESULTS
FT 0020a

18 Mar 1953
2005 CST

AEROSOL GENERATION

Line-source release of 68.5 gms of NJZ 2266 (at a rate of 39 gms/mile) over a period of 8.23 minutes starting at 2005 CST, from a blower disperser mounted on a moving vehicle.

START ⟶ END (2005 CST) (2013:14 CST) 9000-ft track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 104 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 2000-2100 CST.

Total Dosage (particle-minutes/liter)

●56 T = trace dosage

M = malfunction or data missing

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) and (M3).

Similar observations at rooftop level (35 feet above surface) made at meteorological station (M2), where equipment was also set up for wiresonde measurements.

2000 → 2005 → 2010 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

- - - - - - - 2000 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-southwesterly at 3.8 mph, roof-level winds westerly at 9.8 mph, winds at treetop westerly at 10-15 mph, and above treetop level westerly at 20-30 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. A-17) indicate adiabatic conditions.

Sky

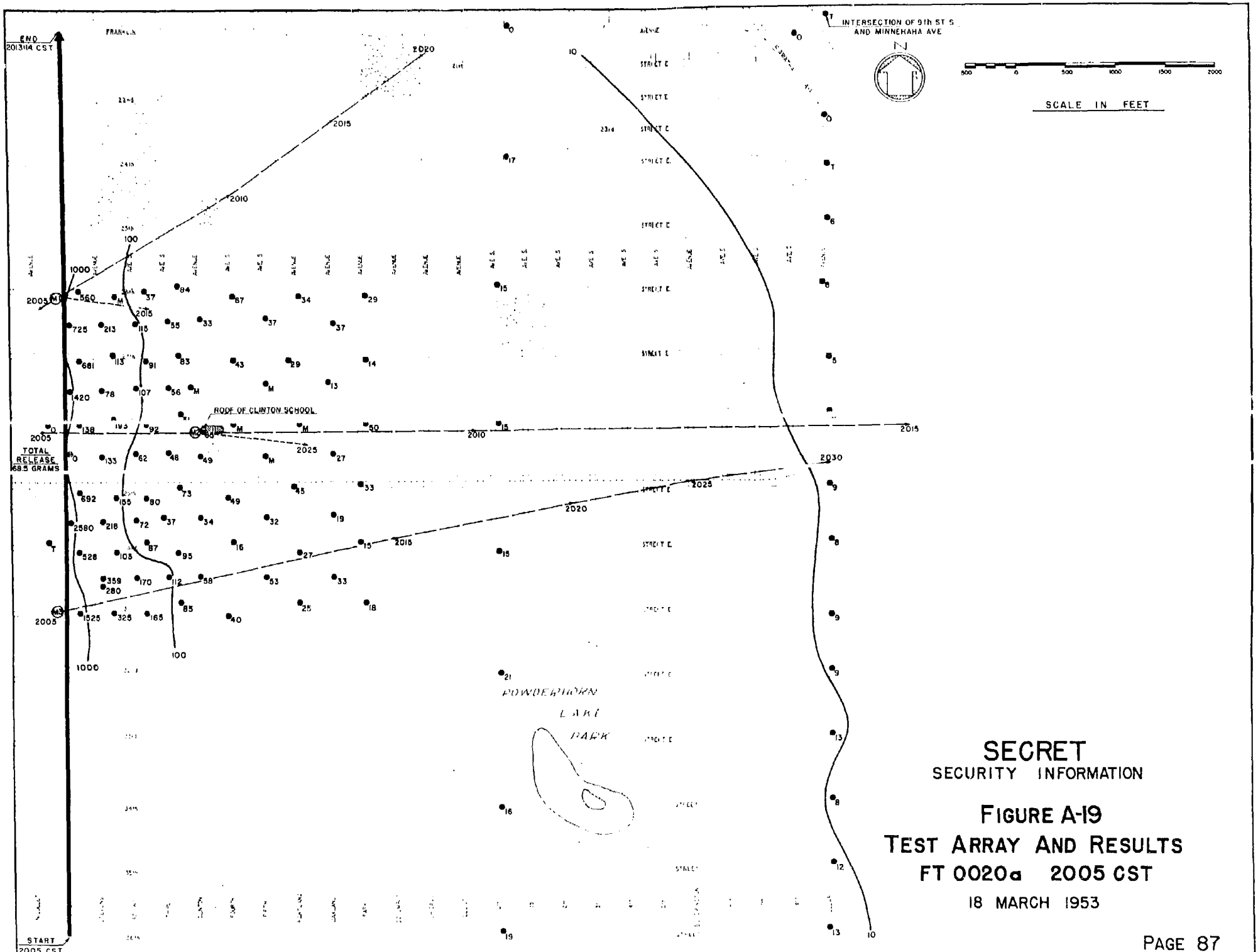
Broken clouds with bases 2100 ft above the surface.

Temperature

35° to 35.5° F at 2 meters in the test area.

Moisture

Mixing ratio of 3.6 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE A-19
TEST ARRAY AND RESULTS
FT 0020a 2005 CST
18 MARCH 1953

AEROSOL GENERATION

Point-source release of 9.7 gms of NJZ 2266 over a period of 5 minutes starting at 2125 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 104 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 2120-2220 CST.

Total Dosage (particle-minutes/liter)

T = trace dosage

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) and (M3) .

Similar observations at rooftop level (35 feet above surface) made at meteorological station (M2) , where equipment was also set up for wiresonde measurements.

2100 — 2105 — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2100 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-northwesterly at 3.8 mph, roof-level winds west-northwesterly at 11.2 mph, winds at treetop westerly at 10-15 mph, and above treetop level westerly at 20-30 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. A-17) indicate adiabatic conditions.

Sky

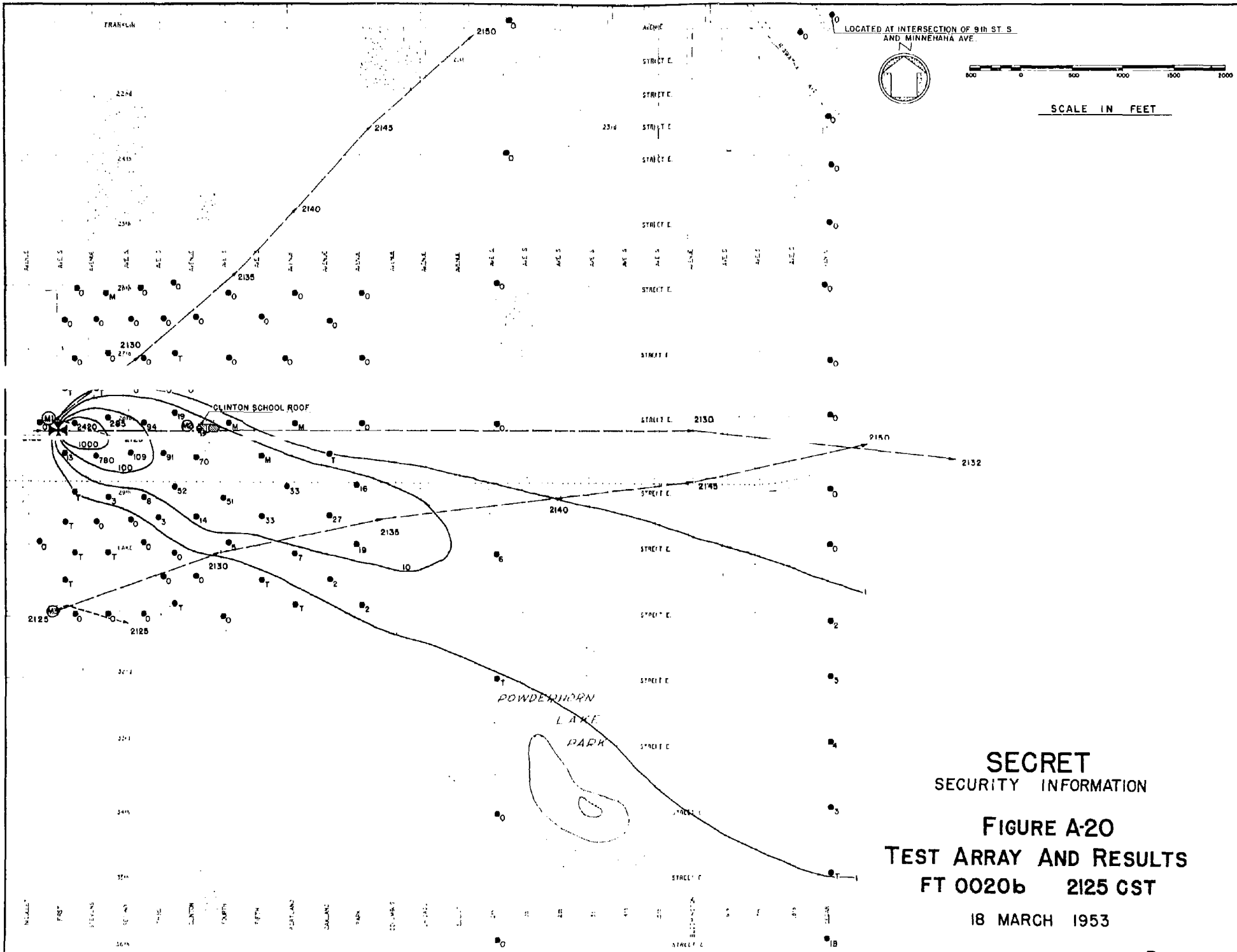
Broken clouds with bases 2200 ft above the surface.

Temperature

34.2° to 34.8° F at 2 meters in the test area.

Moisture

Mixing ratio of 3.1 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE A-20
TEST ARRAY AND RESULTS
FT 0020b 2125 CST
18 MARCH 1953

AEROSOL GENERATION

Line-source release of 163 gms of NJZ 2266 (at a rate of 92.8 gms/mile) over a period of 8.83 minutes starting at 2245 CST, from a blower disperser mounted on a moving vehicle.

START (2245 CST) ⟶ END (2253:50 CST) — 9000-ft track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 104 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⊖ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 2240 - 2340 CST.

Total Dosage (particle-minutes/liter)

T = trace dosage

58 — M = malfunction or data missing

100 — 100 — Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) and (M3).

Similar observations at rooftop level (36 feet above surface) made at meteorological station (M2), where equipment was also set up for wiresonde measurements.

2000 — 2005 — 2010 — Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000 — Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-southwesterly at 3.2 mph, roof-level winds westerly at 14.8 mph, winds at treetop westerly at 10-15 mph, and above treetop level westerly at 20-30 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. A-17) indicate adiabatic conditions.

Sky

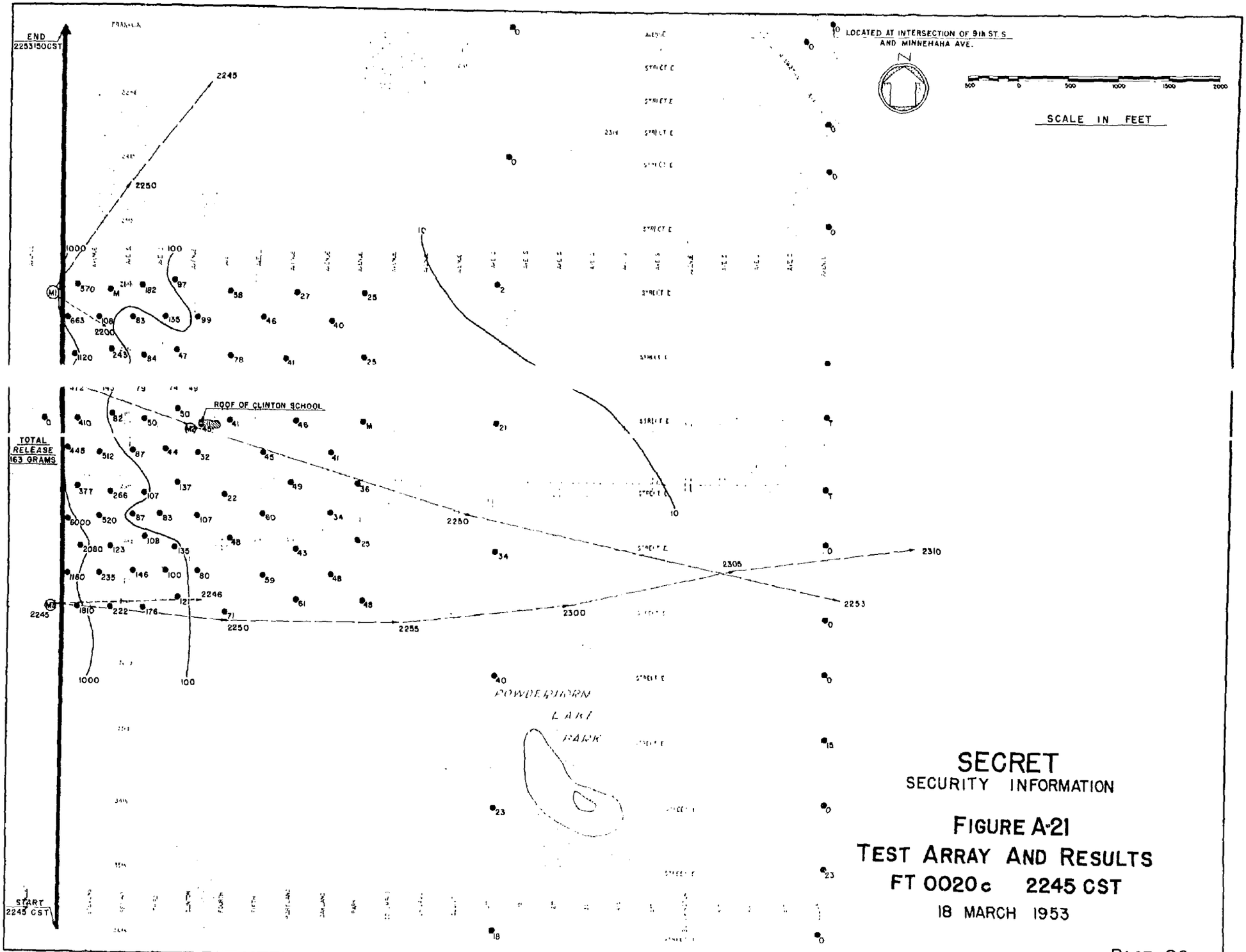
Scattered clouds with bases 2500 ft above the surface.

Temperature

29.8° to 30.5° F at 2 meters in the test area.

Moisture

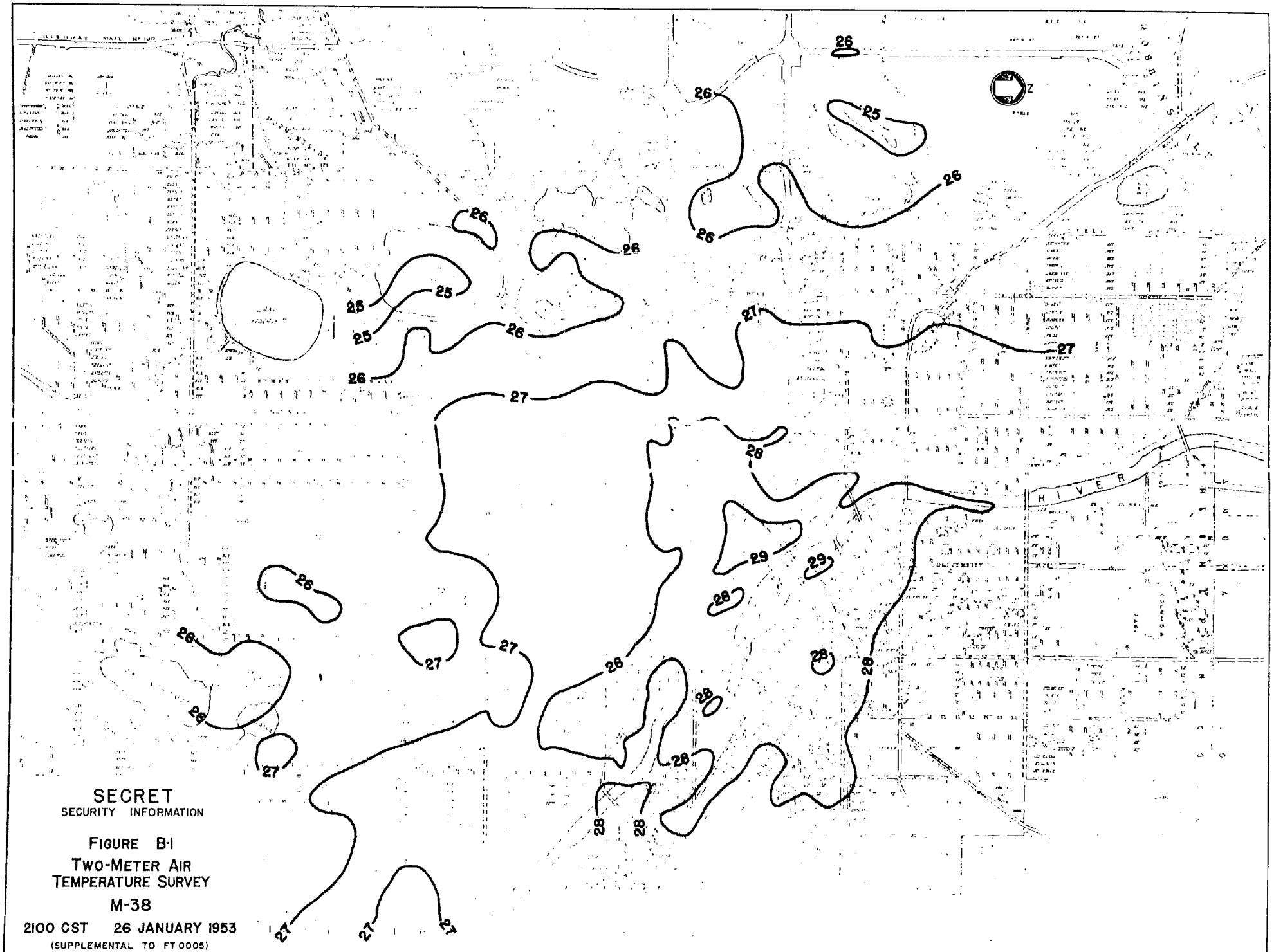
Mixing ratio of 2.8 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE A-21
TEST ARRAY AND RESULTS
FT 0020c 2245 CST
18 MARCH 1953

APPENDIX "B"



SECRET
SECURITY INFORMATION

FIGURE B-I
TWO-METER AIR
TEMPERATURE SURVEY
M-38
2100 CST 26 JANUARY 1953
(SUPPLEMENTAL TO FT 0005)

SUMMARY OF REGIONAL AND LOCAL WEATHER
26 January 1953
(Survey M-38, Supplemental to FT 0005)

SYNOPTIC SITUATION

A 1000-mb low-pressure area, centered 400 miles north-northwest of Minneapolis, was moving east at 20 mph. An associated warm front with scattered snow showers was just past Minneapolis at test time. The cold front, extending northeast-southwest over northwestern Minnesota, was approaching at about 30 mph. In the warm sector covering the test area, light westerly winds prevailed. At the 700-mb level, a weak low system north of Duluth produced only slight perturbation in strong westerly flow across the country. The 700-mb gradient wind over Minneapolis was westerly at 40 mph.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	1400	Overcast	6	Haze	28	25	SSW	11
1930	1000	Overcast	6	Haze	28	25	SSW	9
2030	1400	Broken	6	Haze	29	26	SW	7
2130	None	Clear	6	Haze	27	25	SSW	8
2230	None	Clear	4	Fog	25	23	S	10
2330	None	Clear	4	Fog	24	22	E	3

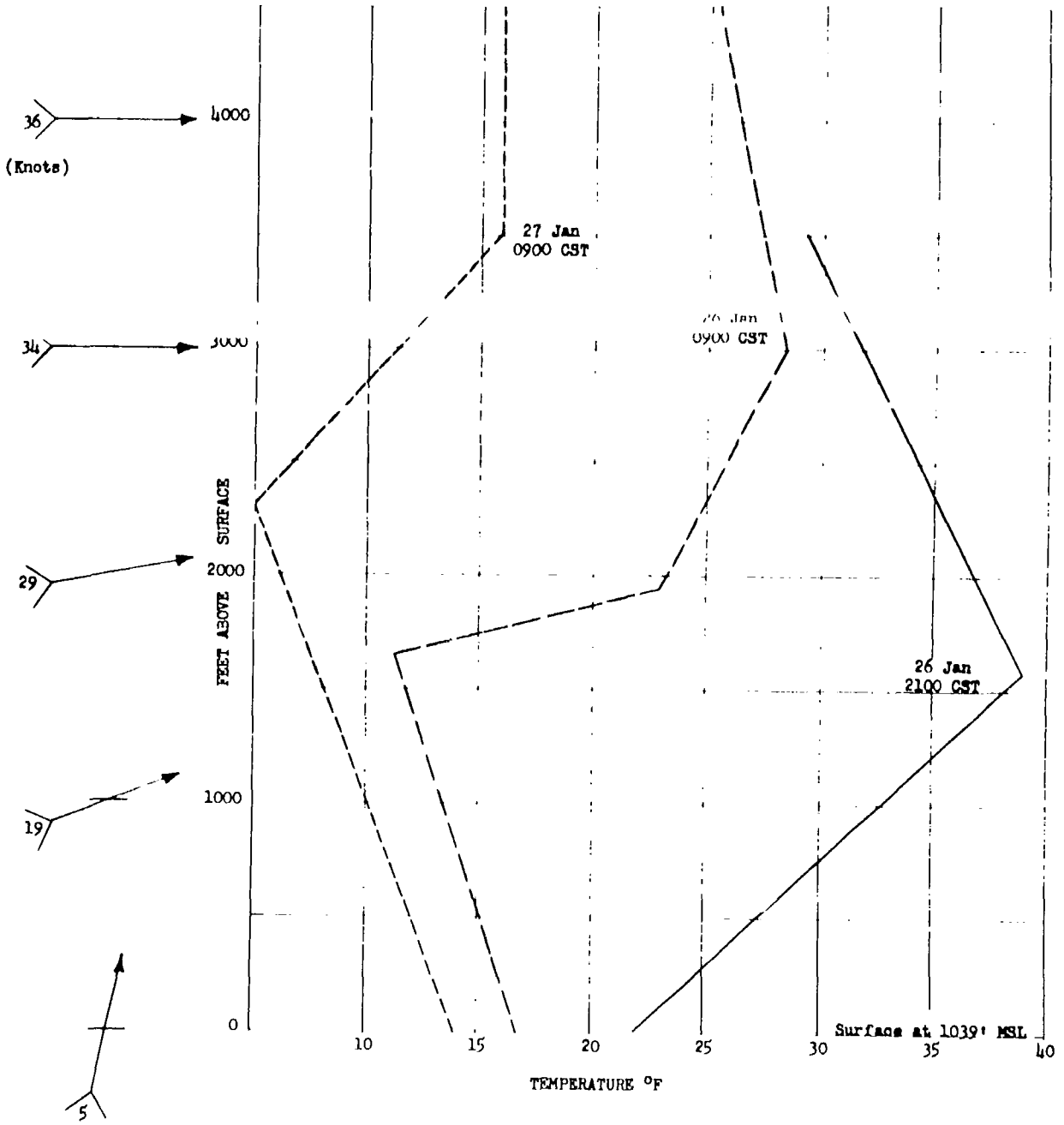
* Average cloudiness sunrise to sunset: 100%
** And/or restrictions to visibility

Sea-level pressure at 2130 CST: 1012.5 mb
Ground condition: Frozen six-inch base; snow dirty; streets two-inch packed snow and ice; river free running, open water; lake frozen, snow covered
Tree cover: Bare

Figure B-2

TEMPERATURE SOUNDINGS

St. Cloud Raob 26 Jan 1953
(Supplemental to Survey M-38)



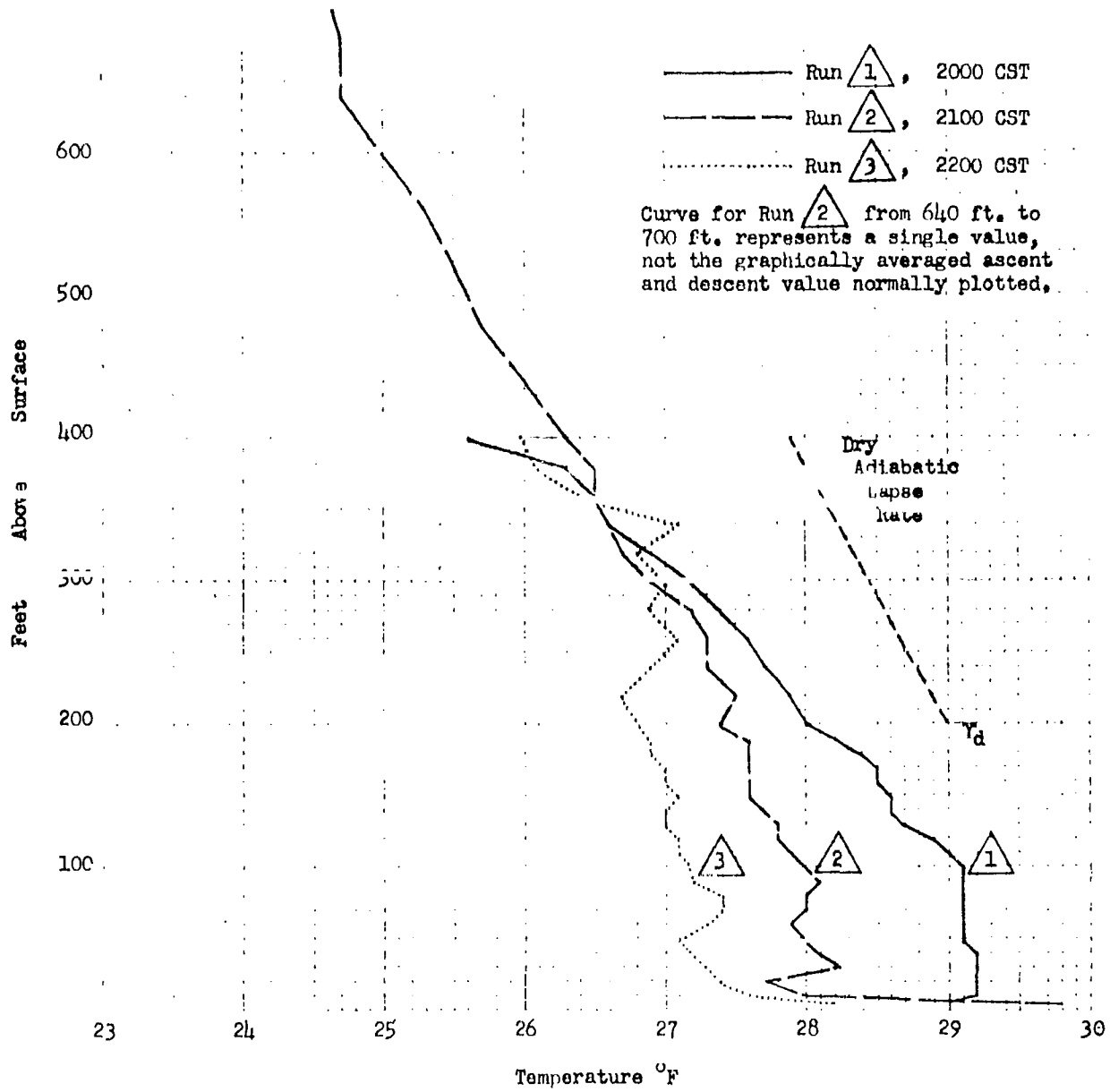


FIGURE B-3

TEMPERATURE SOUNDINGS

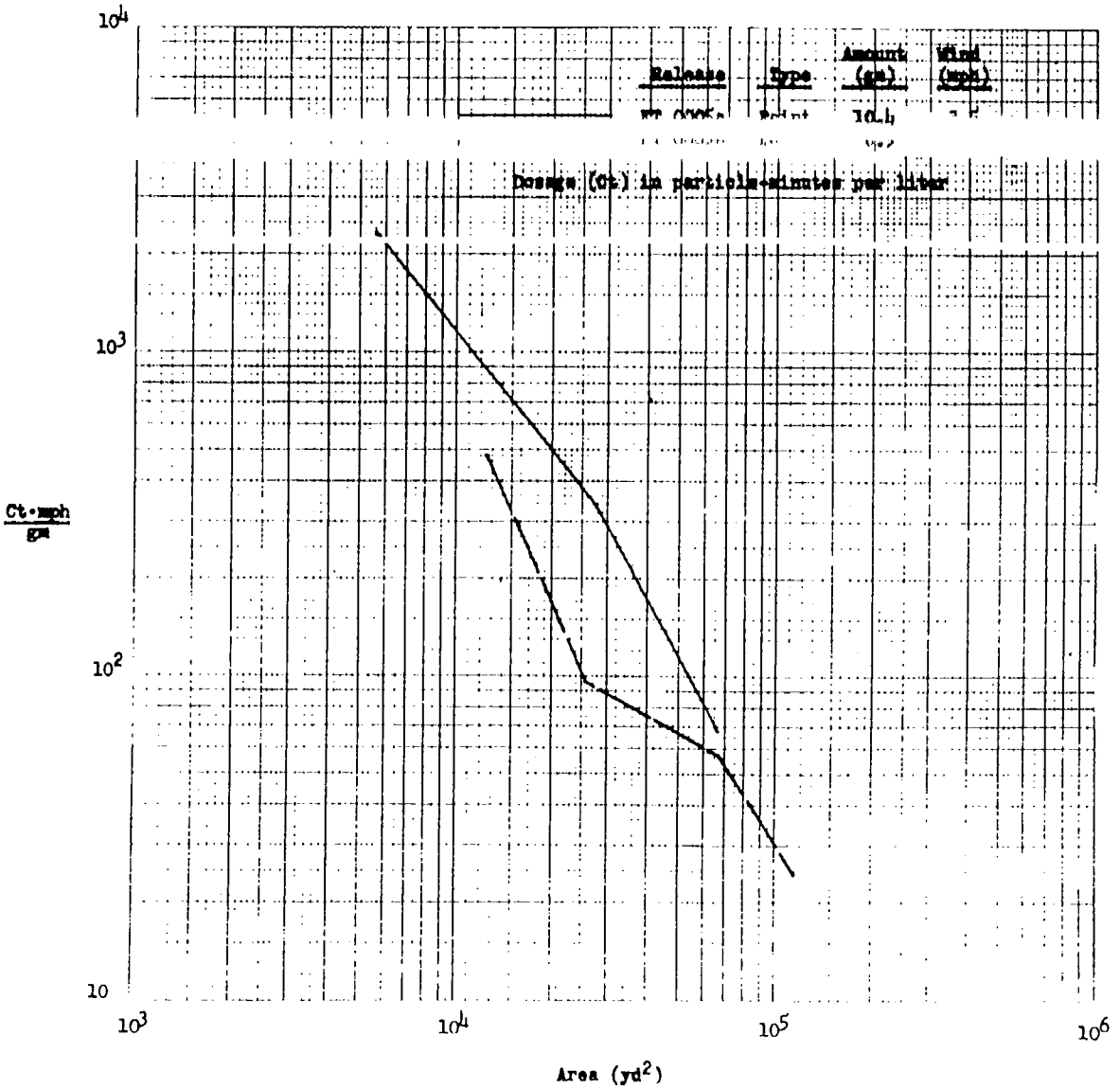
Minneapolis

Residential-Area Wiresonde
M-38 26 Jan 1953

FIGURE B-4

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0005 26 Jan 1953



AEROSOL GENERATION

Point-source release of 10.4 gms of NJ7 2266 over a period of 5 minutes starting at 2022 GST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 55 stations as shown on test-array map by the following symbols:

● Out door sampler at height between 1 and 6 feet.

⊖ Out-door sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 2000-2100 GST.

Total Dosage (particle-minutes/liter)

.. Malfunction or data missing

100 } Isodose contour with values expressed in particle-minutes per liter.
100

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated (M) , (M) , and (M) .

Wiresonde ascents made at meteorological station (M) , at the University parking lot.

2105 — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow
2100 representing the virtual wind travel between the times indicated.

2100 Balloon track representing the wind-drift observation at the time indicated.

Winds

Street-level winds south-southwesterly at 4.9 mph.

Stability

1.8° F lapse from 6 - 300 ft.

Sky

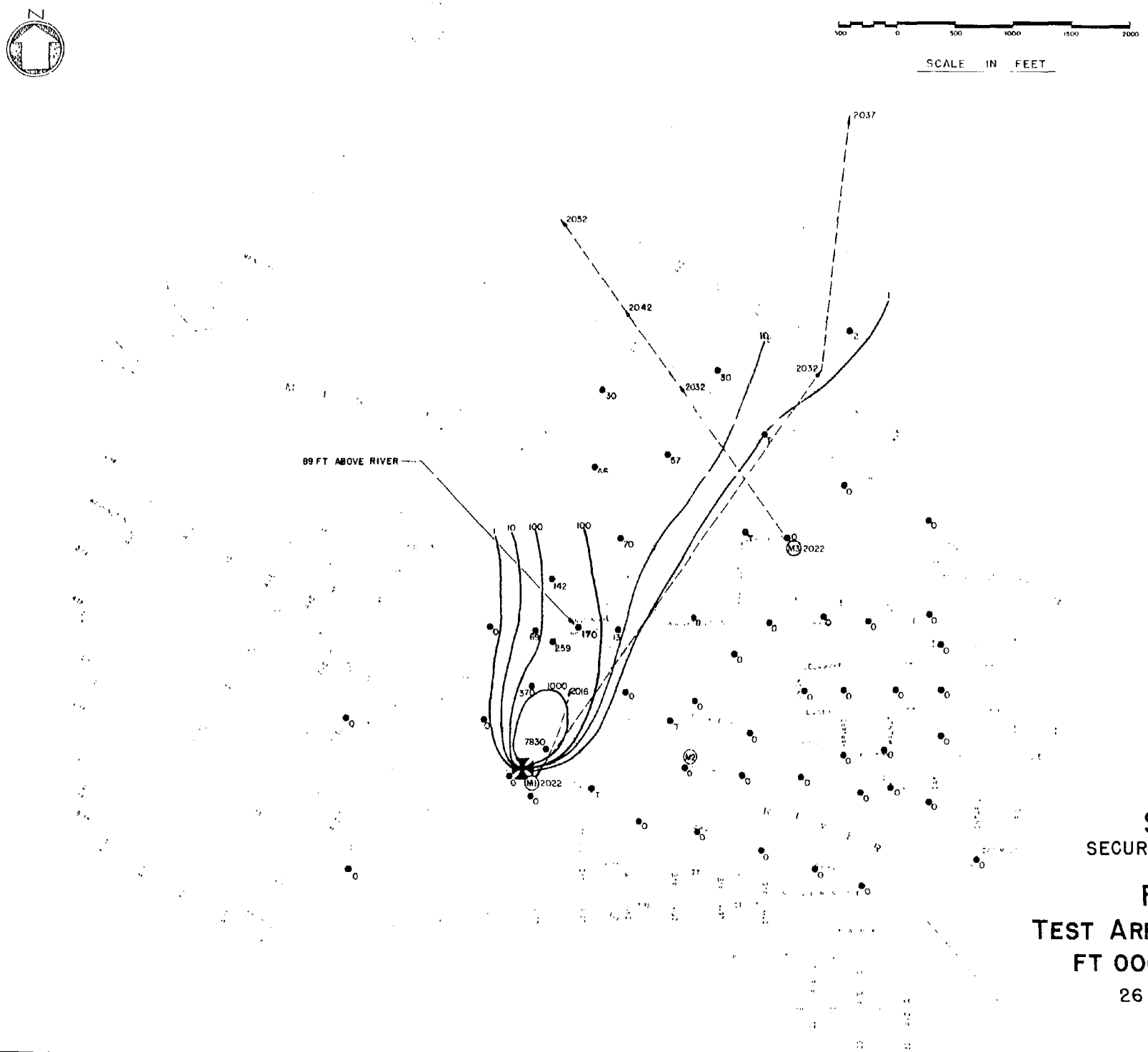
Broken clouds with bases 4400 ft above the surface.

Temperature

28.5° to 29.5° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.9 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-5
TEST ARRAY AND RESULTS
FT 0005a 2022 CST
26 JANUARY 1953

Figure B-6

TEST ARRAY AND RESULTS
FT 0005b

26 Jan 1953
2138 CST

AEROSOL GENERATION

Point-source release of 8.9 gms of NDT 2266 over a period of 5 minutes starting at 2138 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 58 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 2130-2230 CST.

Total Dosage (particle-minutes/liter)

●58 T = trace dosage

M = malfunction or data missing

100 Dosage contour with values expressed in particle-minutes per liter

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated (M1) , (M2) , and (M3) .

Wiresonde ascents made at meteorological station (M2) , at the University parking lot.

2100 — 2105 — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

Winds

Street-level winds southerly at 4.2 mph.

Stability

2.2° F lapse from 6-300 ft.

Sky

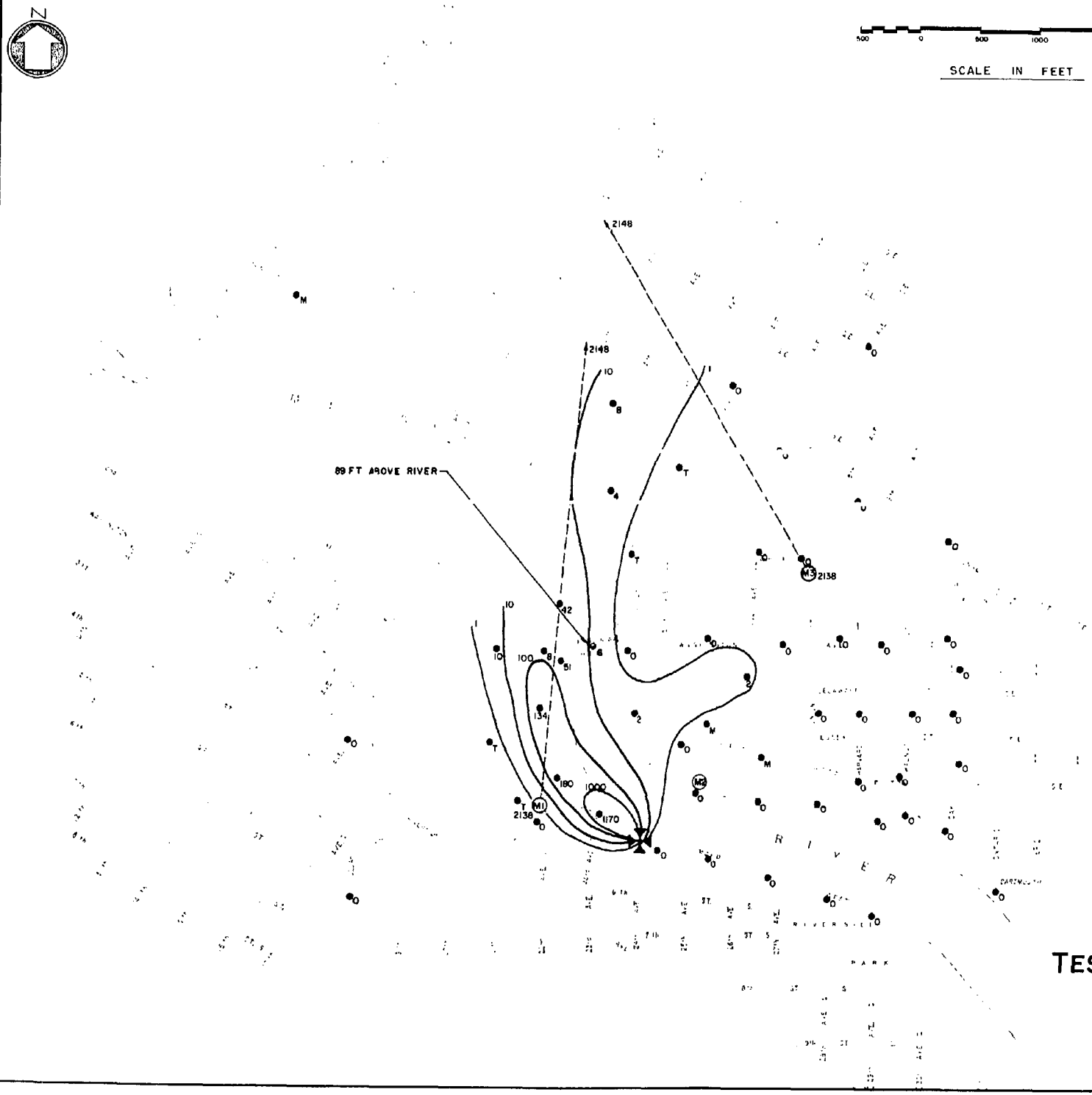
Clear during test period.

Temperature

26° - 27° F at 2 meters in the test area.

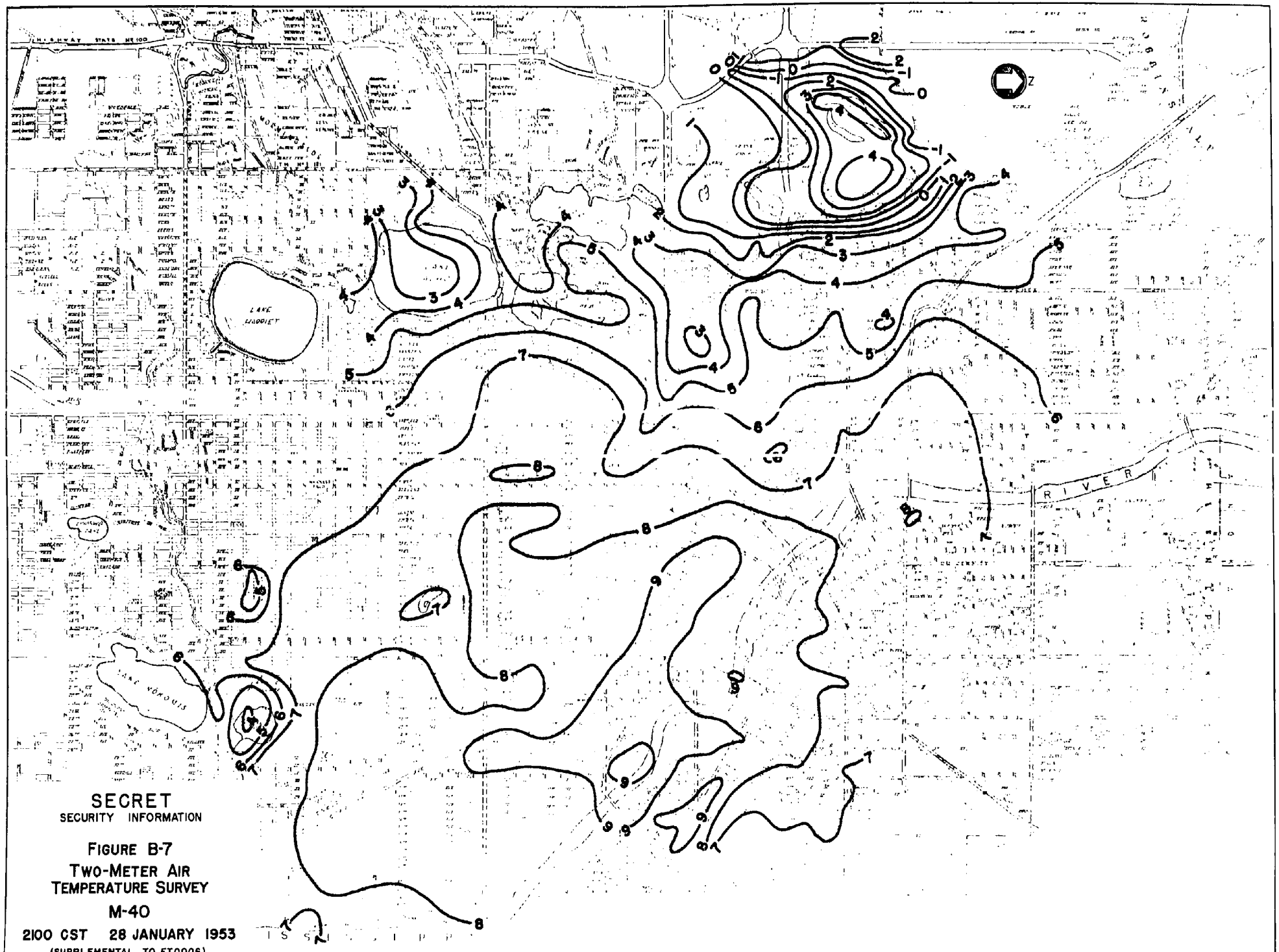
Moisture

Mixing ratio of 2.8 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-6
TEST ARRAY AND RESULTS
FT 0005 b 2138 CST
26 JANUARY 1953



SECRET
SECURITY INFORMATION

FIGURE B-7
TWO-METER AIR
TEMPERATURE SURVEY
M-40
2100 CST 28 JANUARY 1953
(SUPPLEMENTAL TO FT0006)

SUMMARY OF REGIONAL AND LOCAL WEATHER
28 January 1953
(Survey M-40, Supplemental to FT 0006)

SYNOPTIC SITUATION

A filling, stationary frontal system extended from British Columbia east-southeast to eastern Iowa, and shallow waves along this system were accompanied by widespread snowfall. A weak 1020-mb high-pressure area, centered 600 miles north-northwest of Minneapolis, supplied cold continental Arctic air across Minnesota. At the 700-mb level, a long-wave ridge over the Rockies and trough over the Appalachians resulted in a west-northwesterly gradient at 22 mph over Minneapolis.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	6,000	Scattered	15	-	10	1	NW	7
1930	20,000	Scattered	15+	-	8	0	WNW	7
2030	None	Clear	15+	-	7	-3	WNW	6
2130	None	Clear	15+	-	6	-3	WNW	8
2230	None	Clear	15+	-	5	-4	W	7
2330	4,100	Scattered	15+	-	5	-4	WNW	6

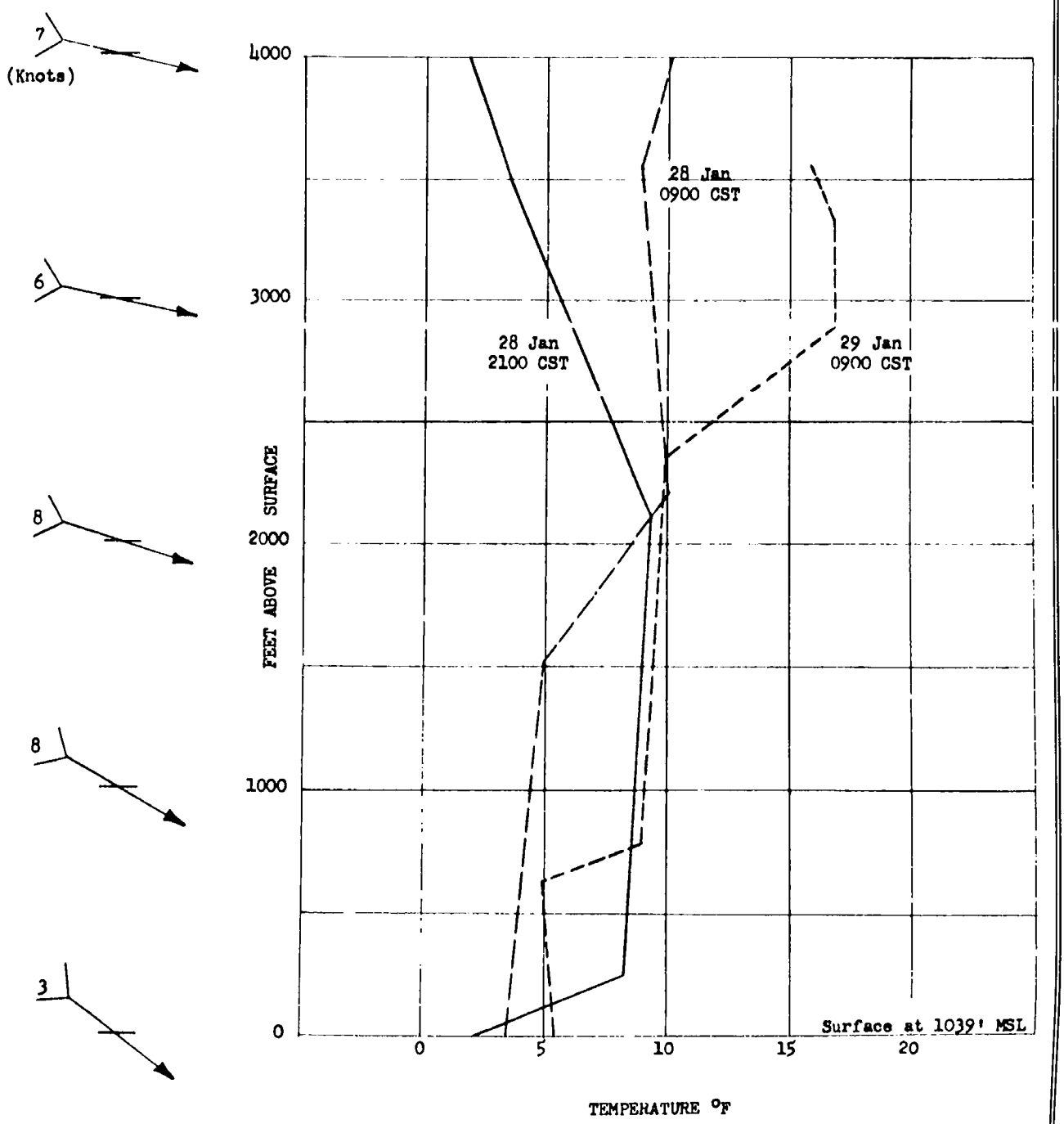
* Average cloudiness sunrise to sunset: 90%
** And/or restrictions to visibility

Sea-level pressure at 2130 CST: 1021.0 mb
Ground condition: Four-inch packed snow; main streets clear; secondary streets packed snow and ice; lake frozen
Tree cover: None

Figure B-8

TEMPERATURE SOUNDINGS

St. Cloud Raob 28 Jan 1953
(Supplemental to Survey M-40)



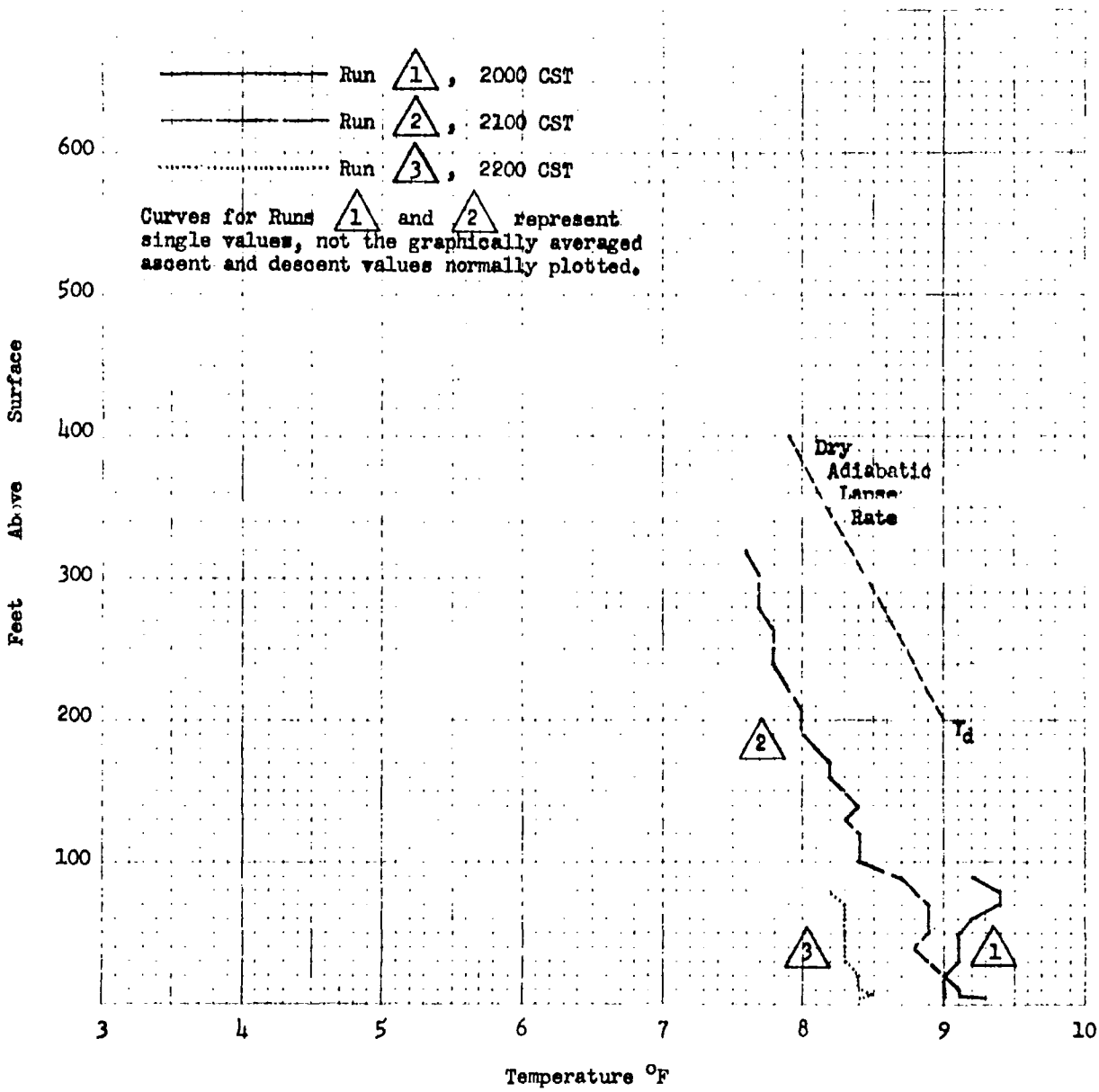


FIGURE B-9

TEMPERATURE SOUNDINGS

Minneapolis

Residential-Area Wiresonde
M-40 28 Jan 1953

FIGURE B-10

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0006 28 Jan 1953

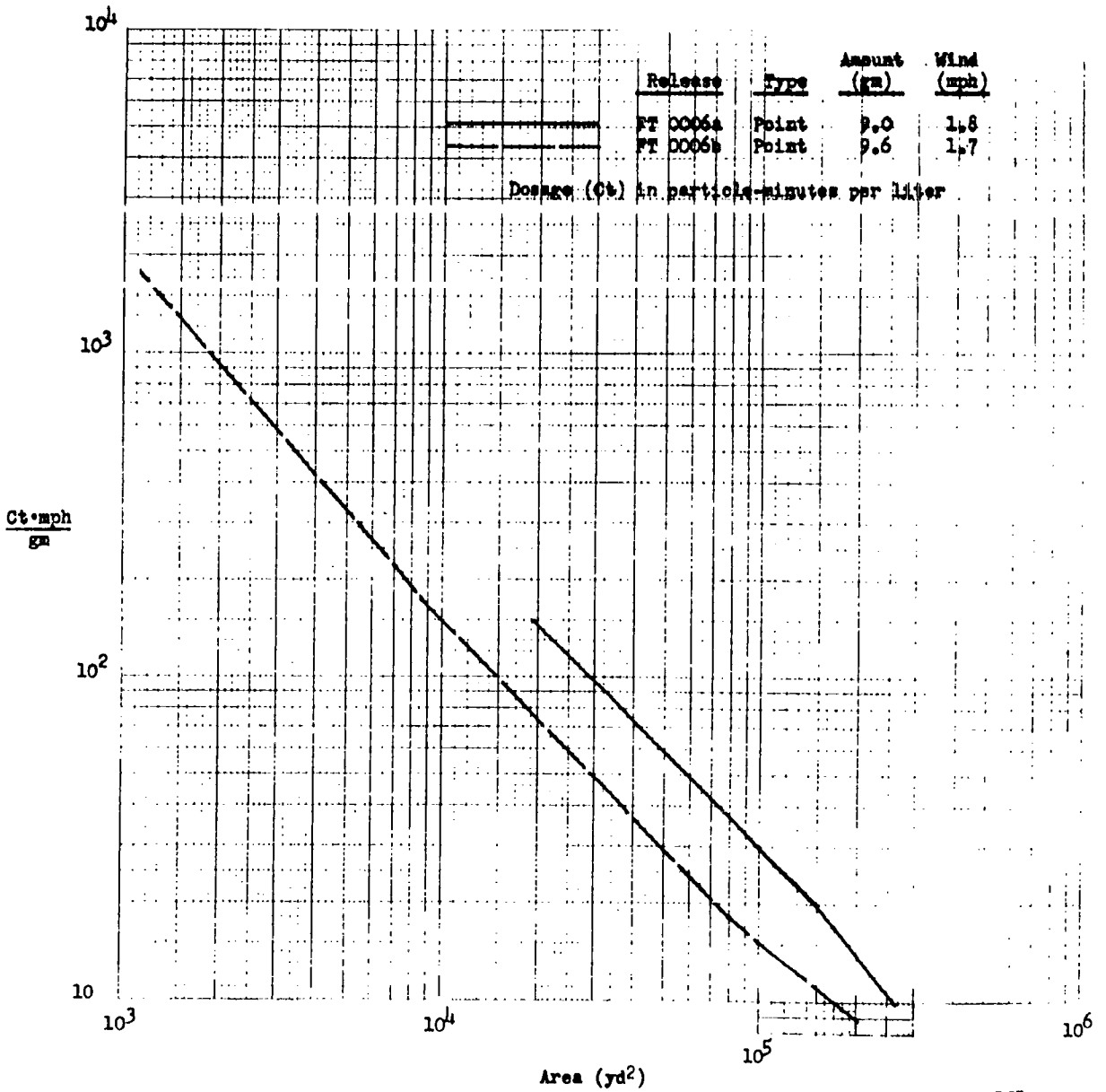


Figure B-11

TEST ARRAY AND RESULTS
FT 0006a

28 Jan 1953
2015 CST

AEROSOL GENERATION

Point-source release of 9.0 gms of NJZ 2266 over a period of 5 minutes starting at 2015 CST from a vehicle-mounted blower disperser located at point ✱ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 83 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⊖ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosage during full sampling period, 2000-2100 CST.

Total Dosage (particle-minutes/liter)

T = trace dosage

M = malfunction or data missing

100 — Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated ⑪ , ⑫ , and ⑬ .

Wiresonde ascents made at meteorological station ⑫ , at the University parking lot.

2100 — 2105 — — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

---------- 2100 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds northwesterly at 1.3 mph, and treetop winds predominately northwesterly at 6-7 mph.

Stability

1.2° F lapse from 6-300 ft.

Sky

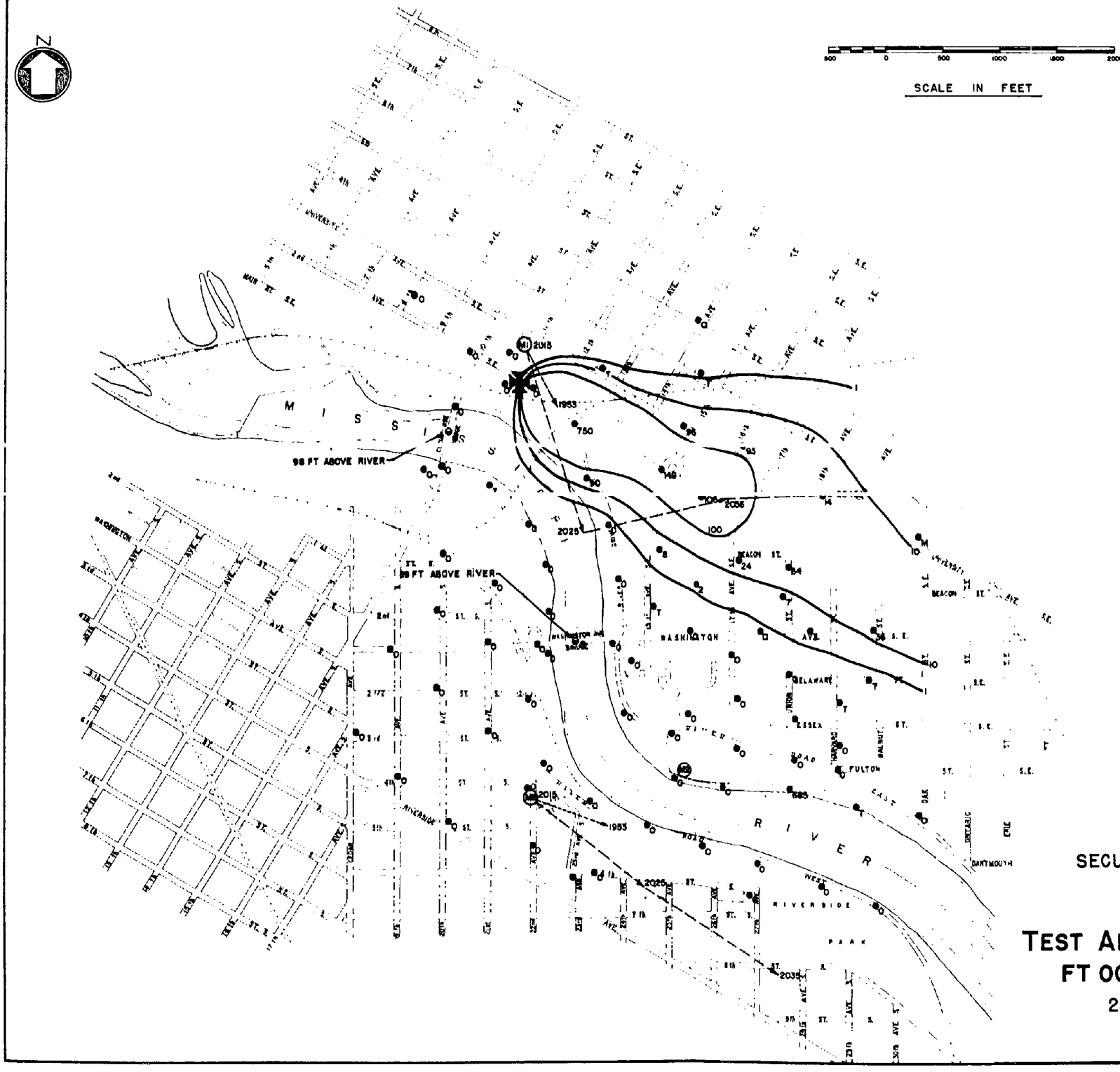
Clear during test period.

Temperature

8.5° to 10° F at 2 meters in the test area.

Moisture

Mixing ratio of 0.8 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-11
TEST ARRAY AND RESULTS
FT 0006a 2015 CST
28 JANUARY 1953

Figure B-12

TEST ARRAY AND RESULTS
FT 0006b

28 Jan 1953
2148 CST

AEROSOL GENERATION

Point-source release of 9.6 gms of NJZ 2266 over a period of 5 minutes starting at 2148 CST from a vehicle-mounted blower disperser located at point ✠ , approximately 5 feet above the river level.

SAMPLING

Location and Exposure

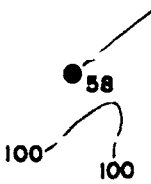
Membrane-filter sampling equipment located at 83 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⊖ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 2130-2230 CST.



T = trace dosage

M = malfunction or data missing

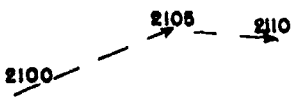
Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated (M1) , (M2) , and (M3) .

Wiresonde ascents made at meteorological station (M2) , at the University parking lot.



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds northwesterly at 1.6 mph, and treetop winds predominately northwesterly at 6-7 mph.

Stability

1.3° F lapse from 6 to 300 ft.

Sky

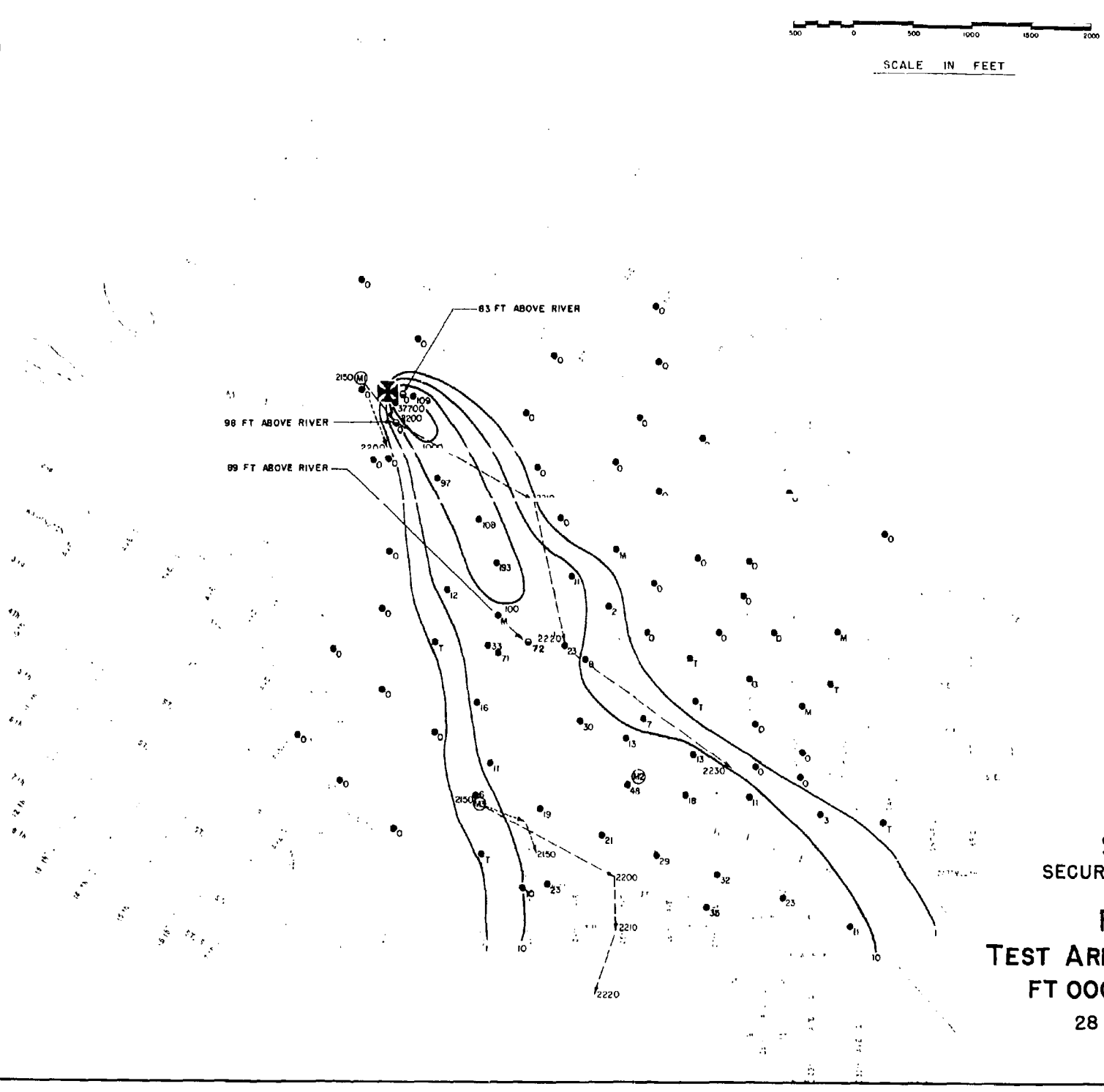
Clear during test period.

Temperature

7.5° to 8.5° F at 2 meters in the test area.

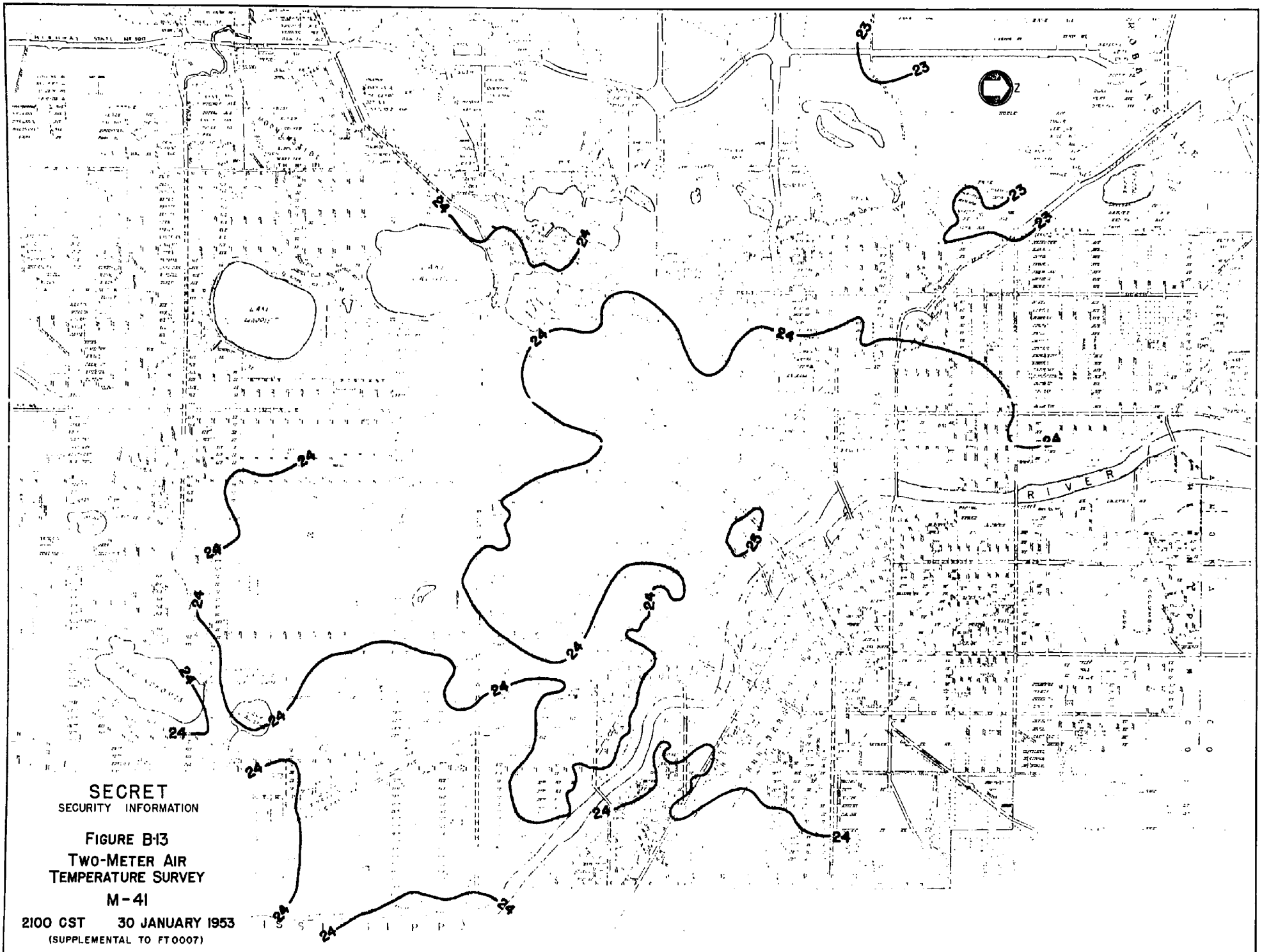
Moisture

Mixing ratio of 0.8 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-12
TEST ARRAY AND RESULTS
FT 0006 b 2148 CST
28 JANUARY 1953



SECRET
SECURITY INFORMATION

FIGURE B-13
TWO-METER AIR
TEMPERATURE SURVEY
M-41
2100 CST 30 JANUARY 1953
(SUPPLEMENTAL TO FT 0007)

SUMMARY OF REGIONAL AND LOCAL WEATHER
30 January 1953
(Survey M-41, Supplemental to FT 0007)

SYNOPTIC SITUATION

A deepening low-pressure system, moving rapidly eastward, passed 200 miles to the north of Minneapolis during the test period. The associated warm front extended to the south-southeast, and the cold front to the west-southwest. Neither front passed the station during the test period, but very light intermittent snow was observed. A strong high-pressure cell, 1000 miles north-northwest of the station was supplying cold continental Arctic air to the north side of the system. At the 700-mb level, a weak ridge along the Atlantic coast, a stronger ridge along the Pacific coast, and a shallow trough extending from Wisconsin to Texas produced a west-northwesterly gradient wind of 38 mph over Minneapolis.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	700	Overcast	3	Snow grains and fog	25	22	S	11
1930	500	Overcast	3	Snow grains and fog	25	22	SW	10
2030	300	Overcast	2½	Snow grains and fog	24	22	SSW	12
2130	400	Overcast	2½	Snow grains and fog	25	23	S	12
2230	7500	Overcast	3	Fog	25	23	SSW	6
2330	9500	Broken	4	Fog	26	23	SSW	8

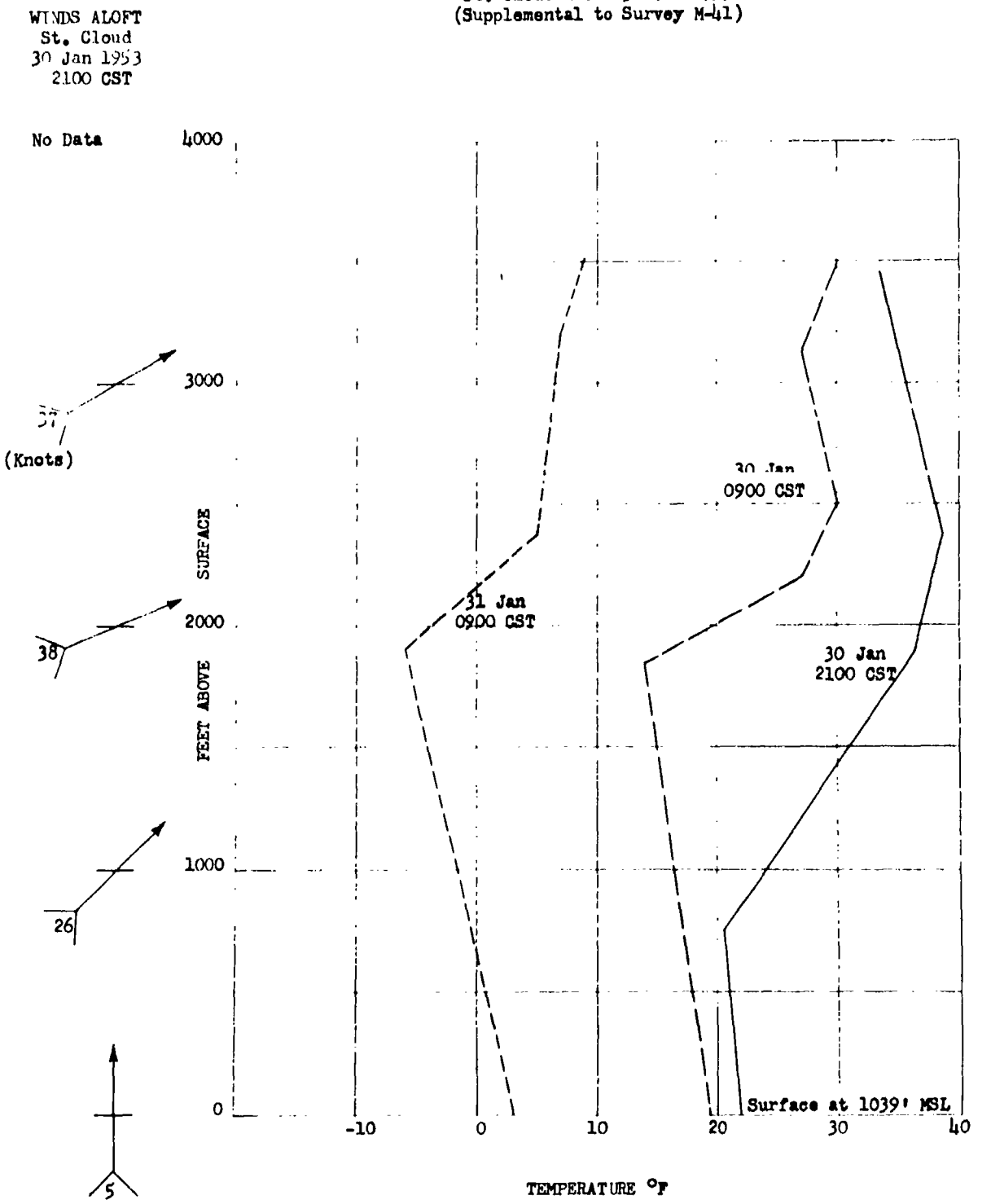
* Average cloudiness sunrise to sunset: 100%
** And/or restrictions to visibility

Sea-level pressure at 2130 CST: 1011.2 mb
Ground condition: Four-inch to six-inch base snow; main roads clear; ice in spots; residential and side streets two-inches packed snow and ice; river open
Tree cover: None

Figure B-14

TEMPERATURE SOUNDINGS

St. Cloud Raob 30 Jan 1953
(Supplemental to Survey M-41)



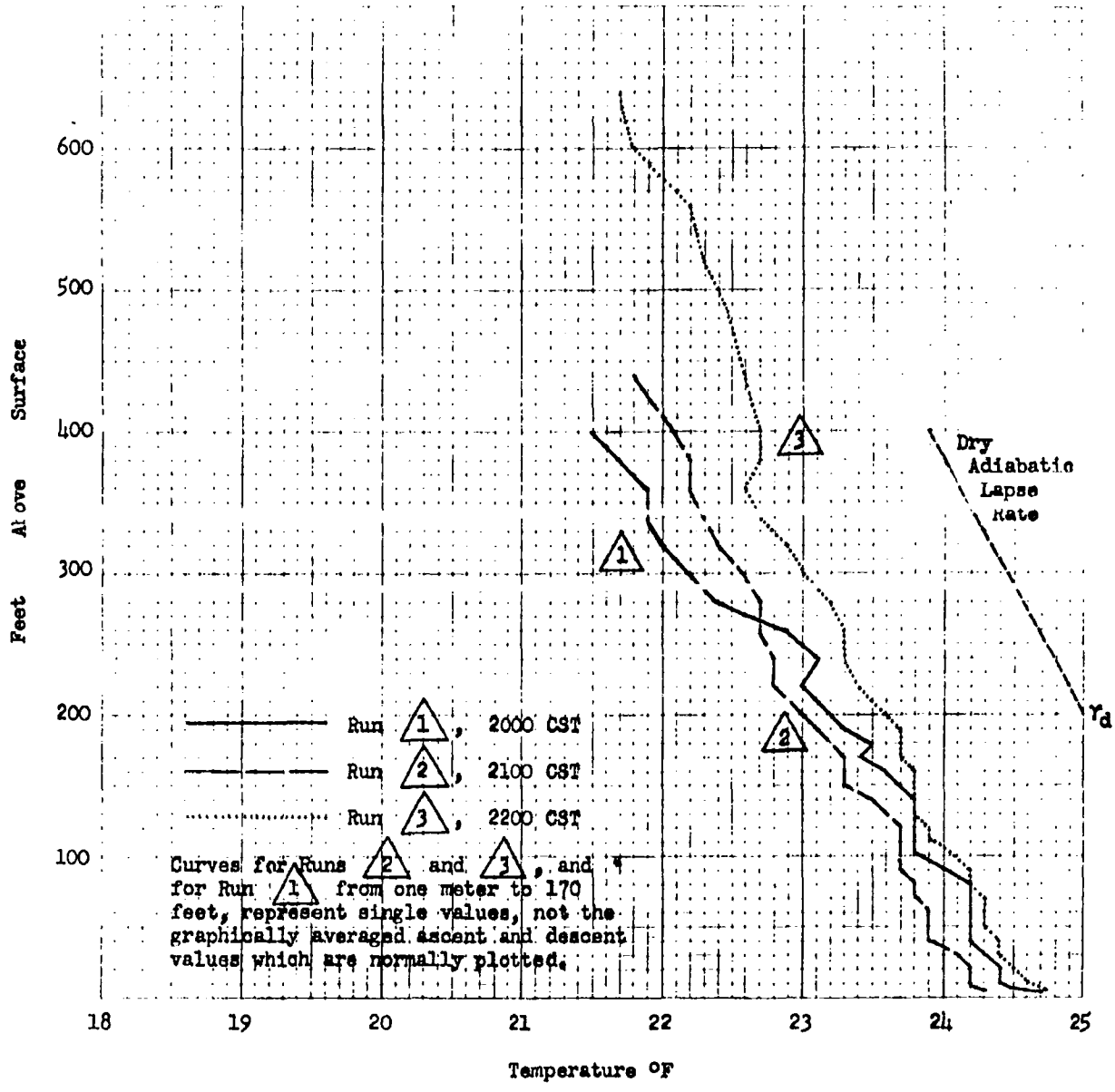


FIGURE B-15

TEMPERATURE SOUNDINGS

Minneapolis

Residential-Area Wiresonde
M-41 30 Jan 1953

FIGURE B-16

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0007 30 Jan 1953

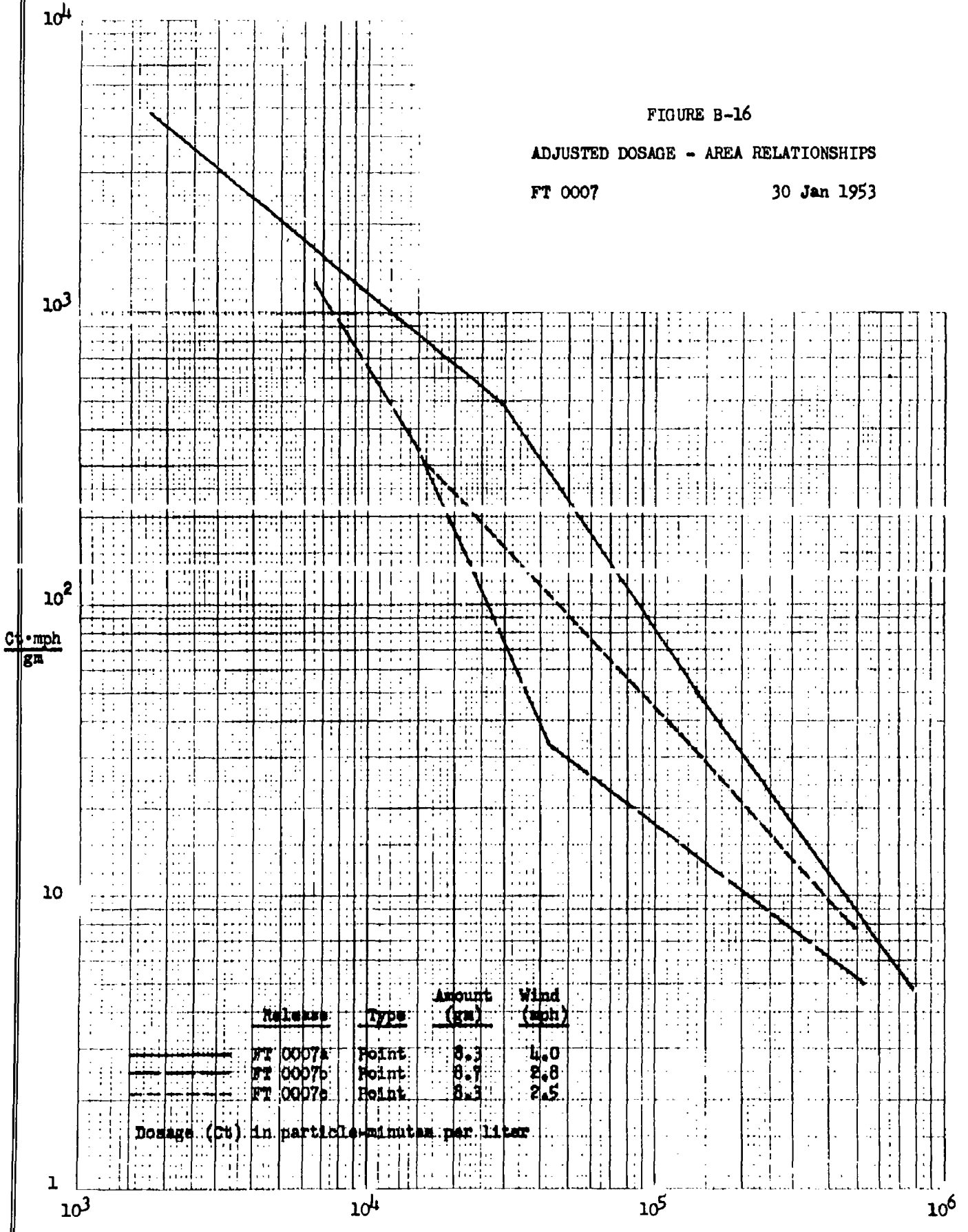


Figure B-17

TEST ARRAY AND RESULTS
FT 0007a

30 Jan 1953
2012 CST

AEROSOL GENERATION

Point-source release of 8.3 gms of NJZ 2266 over a period of 5 minutes starting at 2012 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 75 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⊖ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 2000-2100 CST.

Total Dosage (particle-minutes/liter)

T = trace dosage

M = malfunction or data missing

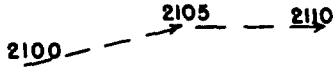
Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

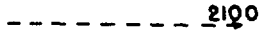
Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) and (M2) .

Wiresonde ascents made at meteorological station (M2) , at the University parking lot.



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.



Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds southerly at 3.8 mph, and treetop winds south to southeasterly at 5-6 mph.

Stability

2.3° F lapse from 6-300 ft.

Sky

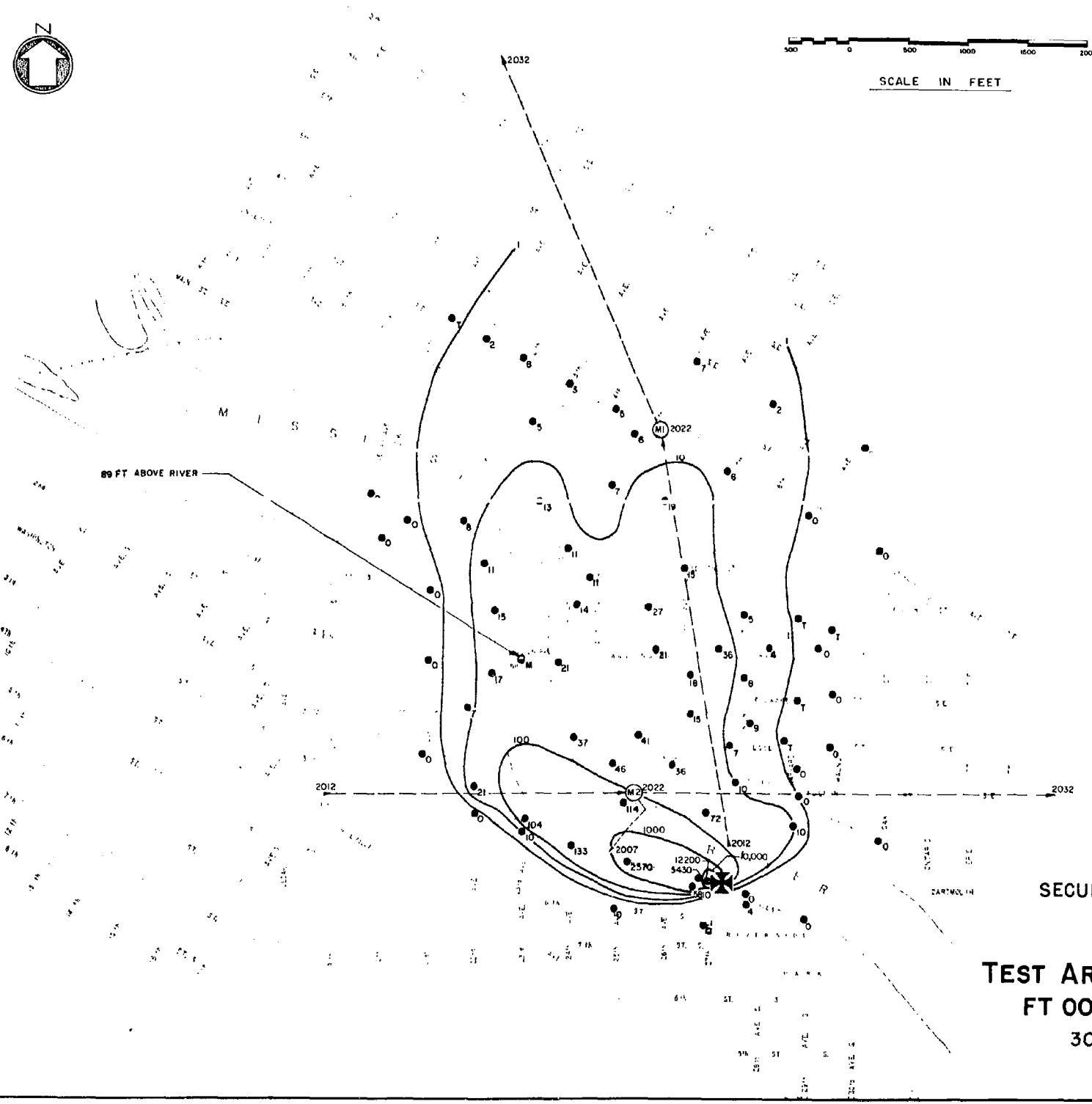
Overcast clouds with bases 300 ft above the surface.

Temperature

23.9° to 24.9° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.4 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-17
TEST ARRAY AND RESULTS
FT 0007a 2012 CST
30 JANUARY 1953

Figure B-18

TEST ARRAY AND RESULTS
FT 0007b

30 Jan 1953
2137 CST

AEROSOL GENERATION

Point-source release of 8.7 gms of NJZ 2266 over a period of 5 minutes starting at 2137 CST from a vehicle-mounted blower disperser located at point ✱.

SAMPLING

Location and Exposure

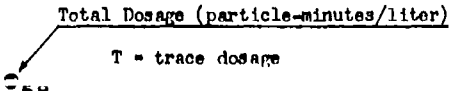
Membrane-filter sampling equipment located at 75 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⊖ Outdoor sampler at height above or below general terrain level as indicated by note.

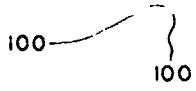
Results

All samplers operated to measure total dosages during full sampling period, 2130-2230 CST.



T = trace dosage

M = malfunction or data missing



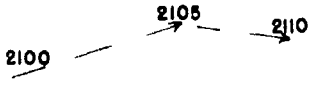
Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) and (M2).

Wiresonde ascents made at meteorological station (M2), at the University parking lot.



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

Winds

Street-level winds southerly at 3.0 mph, and treetop winds south to southeasterly at 5-6 mph.

Stability

1.6° F lapse from 6-300 ft.

Sky

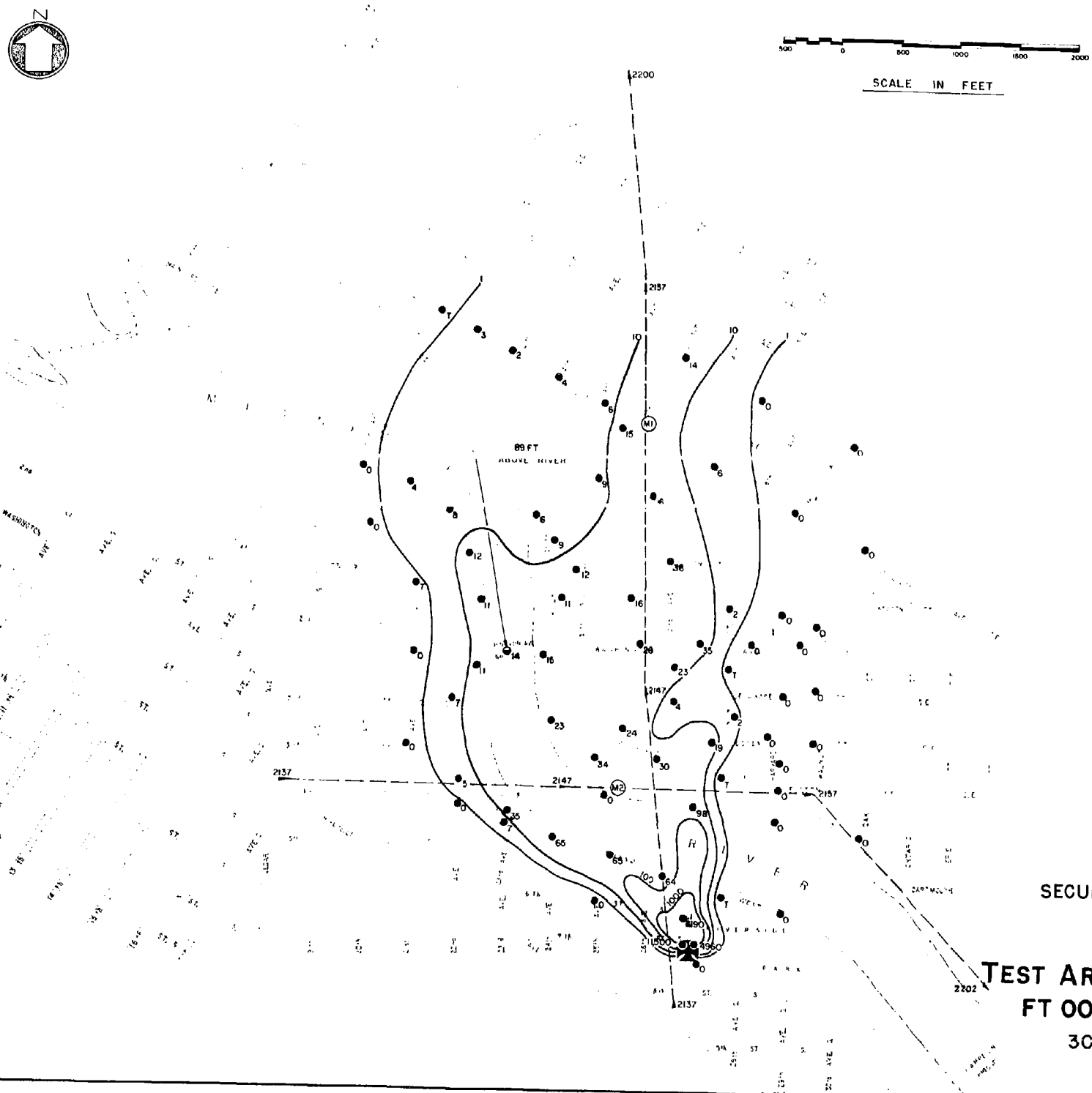
Overcast clouds with bases 400 ft above the surface.

Temperature

23.9° to 24.3° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.6 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-18
TEST ARRAY AND RESULTS
FT 0007b 2137 CST
30 JANUARY 1953

Figure B-19

TEST ARRAY AND RESULTS
FT 0007c

30 Jan 1953
2305 CST

AEROSOL GENERATION

Point-source release of 8.3 gms of NJZ 2266 over a period of 5 minutes starting at 2305 CST from a vehicle-mounted blower disperser located at point [redacted].

SAMPLING

Location and Exposure

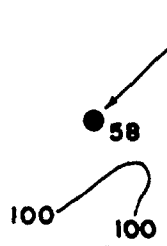
Membrane-filter sampling equipment located at 75 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⊖ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosage during full sampling period, 2300-2400 CST.



T = trace dosage

M = malfunction or data missing

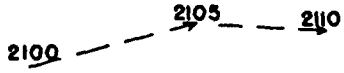
Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated ⑪, ⑫, and ⑮.

Wiresonde ascents made at meteorological station ⑫, at the University parking lot.



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds south-southeasterly at 2.4 mph, and treetop winds south to southeasterly at 5-6 mph.

Stability

1.7° F lapse from 6-300 ft.

Sky

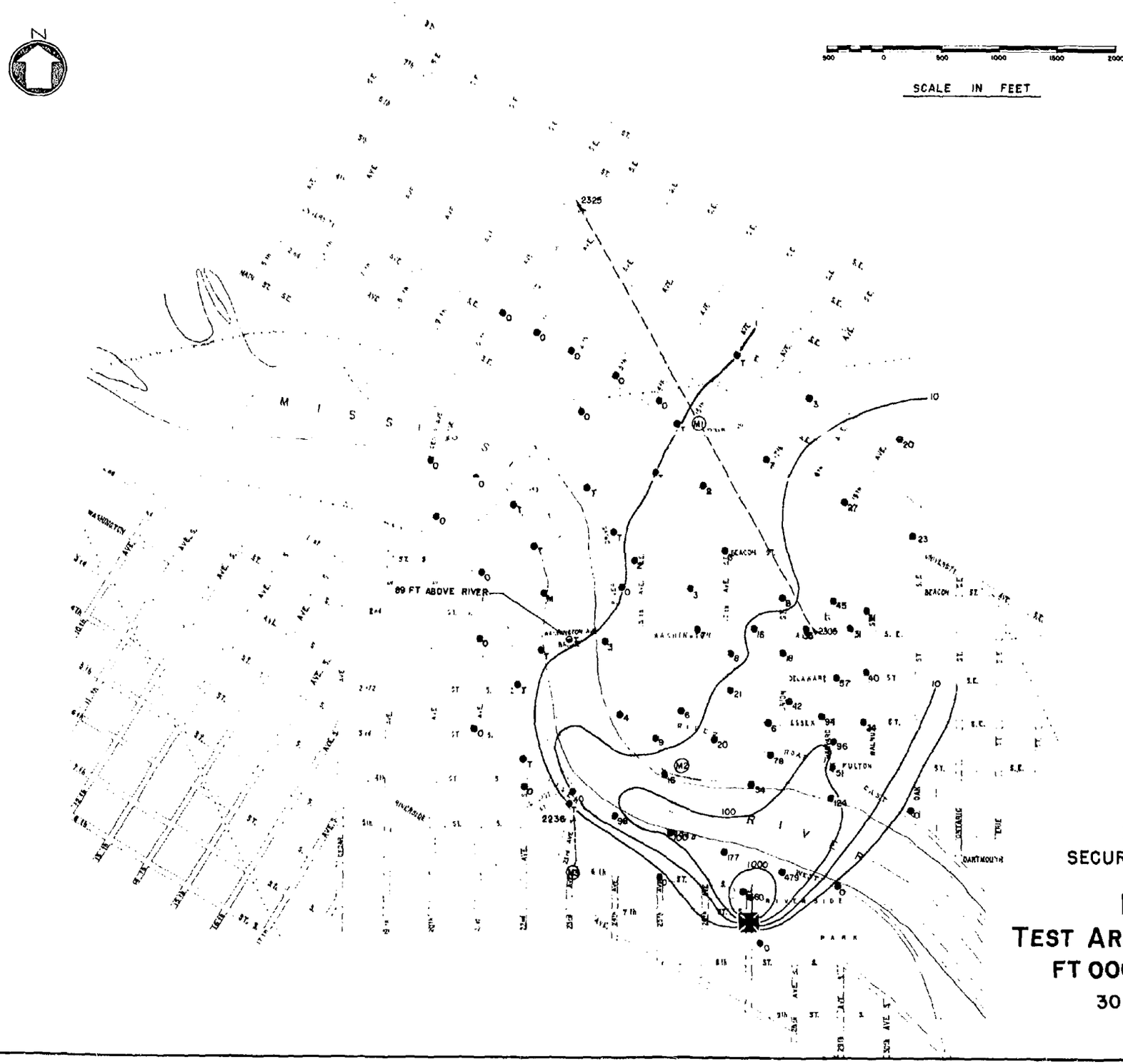
Overcast clouds with bases 7500 ft above the surface.

Temperature

24.3° to 24.9° F at 2 meters in the test area.

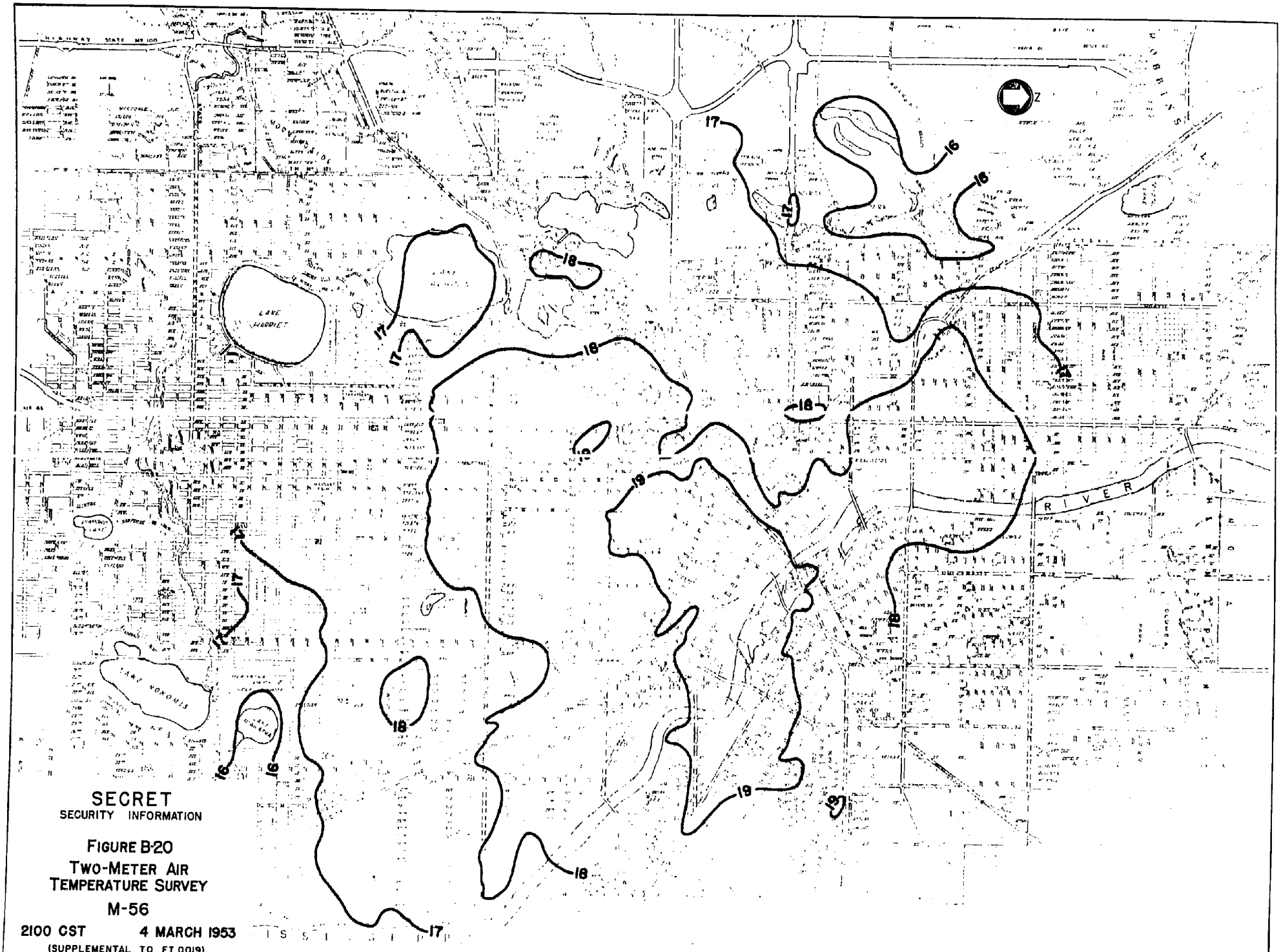
Moisture

Mixing ratio of 2.6 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-19
TEST ARRAY AND RESULTS
FT 0007c 2305 CST
30 JANUARY 1953



SECRET
SECURITY INFORMATION

FIGURE B-20
TWO-METER AIR
TEMPERATURE SURVEY
M-56
2100 CST 4 MARCH 1953
(SUPPLEMENTAL TO FT 0019)

SUMMARY OF REGIONAL AND LOCAL WEATHER
4 March 1953
(Survey M-56, Supplemental to FT 0019)

SYNOPTIC SITUATION

Most of Minnesota was covered by a cyclonic stream of cold air associated with a 978-mb low-pressure center over Quebec. Rapidly variable cloudiness and infrequent light snow showers accompanied a moderate wind, which varied considerably in speed during the test period. At the 700-mb level, a northwesterly gradient wind of 45 mph was due to a long wave-length pattern consisting of a broad trough extending from Quebec to Florida and of a strong ridge over the Pacific coast.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	12,000	Broken	15+	-	19	10	WSW	13
1930	11,000	Broken	15+	-	18	11	WSW	11
2030	11,000	Scattered	15+	-	17	9	WSW	12
2130	4,200	Scattered	15+	-	17	11	WSW	12
2230	3,500	Scattered	15+	-	17	10	WSW	15
2330	4,000	Scattered	15+	-	16	10	W	15

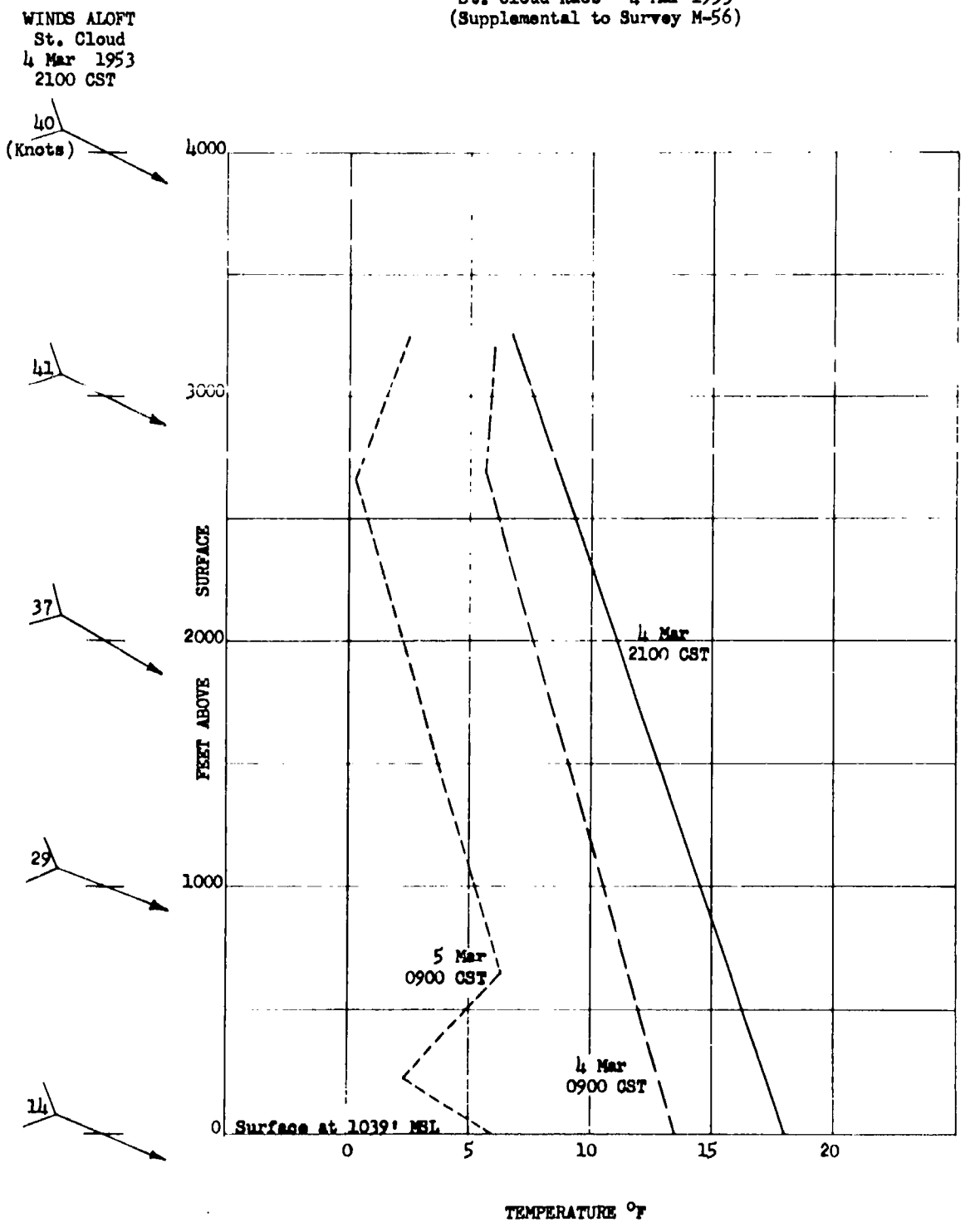
* Average cloudiness sunrise to sunset: 60%
** And/or restriction to visibility

Sea-level pressure at 2130 CST: 1009.8 mb
Ground condition: Twelve-inch packed snow; main street clear; side streets clear, but icy 50% because of melted snow; river temperature 34° F
Tree cover: None

Figure B-21

TEMPERATURE SOUNDINGS

St. Cloud Raob 4 Mar 1953
(Supplemental to Survey M-56)



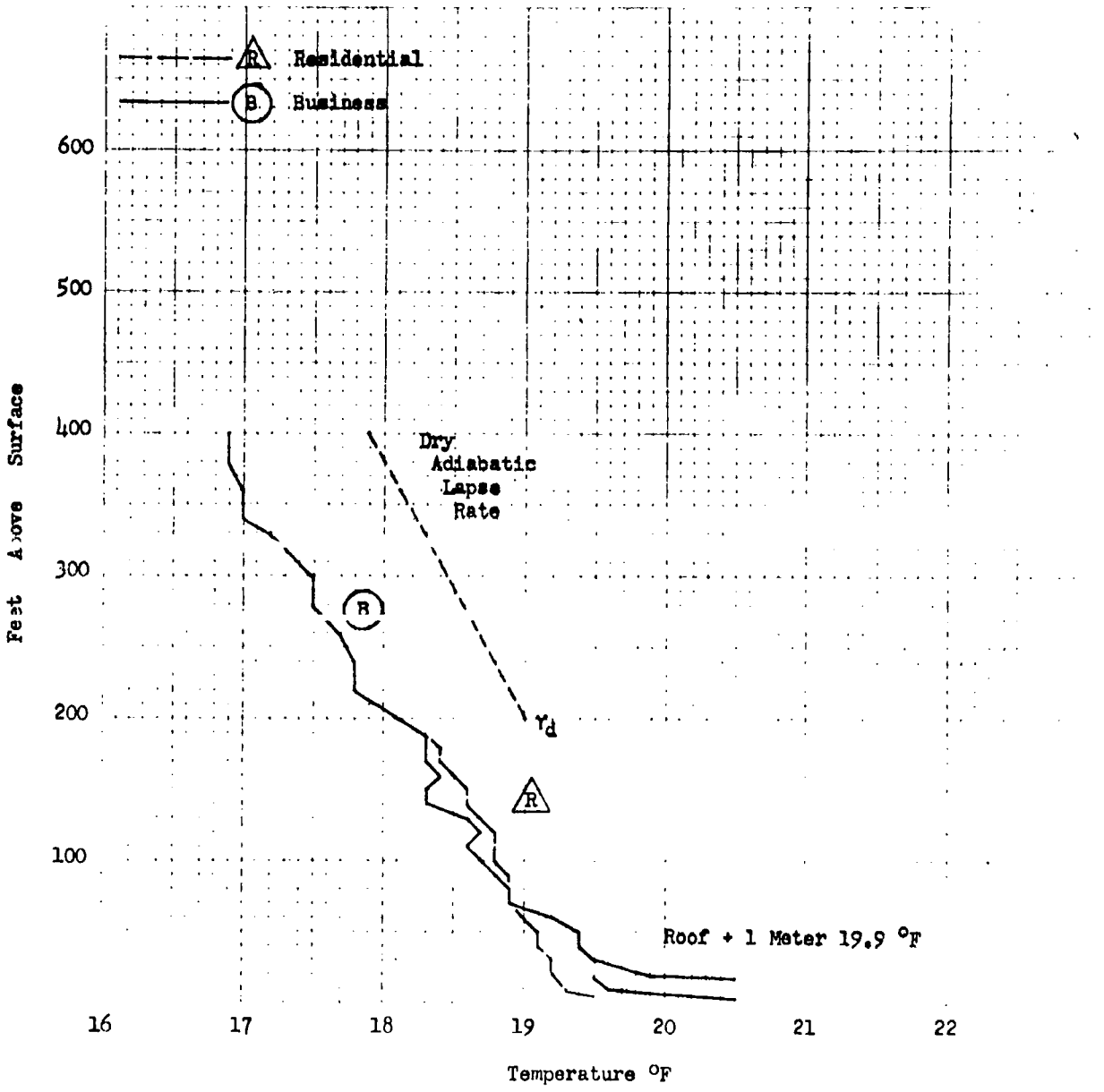


FIGURE B-22

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Residential Vs Business Area
Run 1, 1900 CST 4 Mar 1953

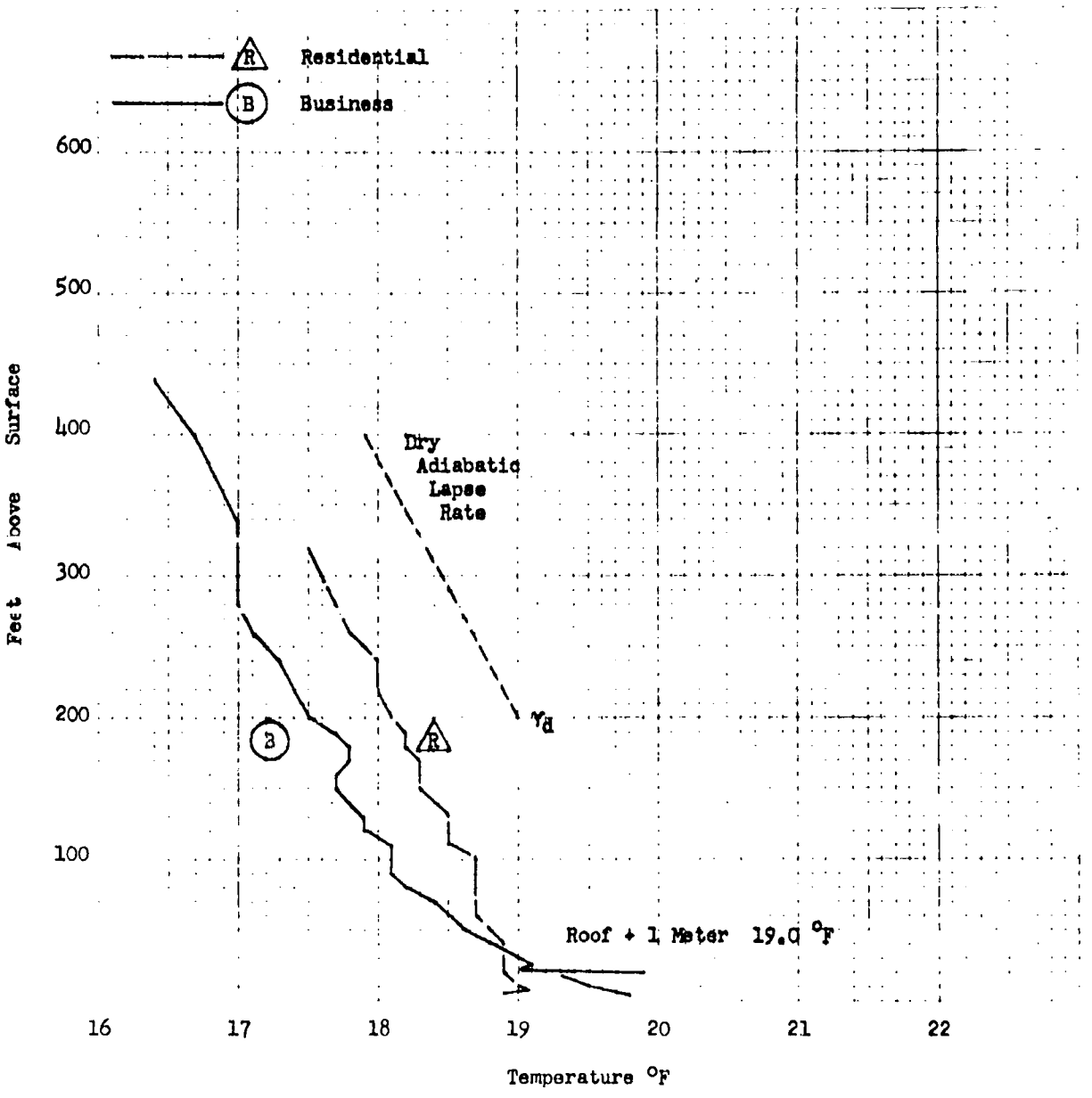


FIGURE B-23

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Residential Vs Business Area
Run 2, 2000 CST 4 Mar 1953

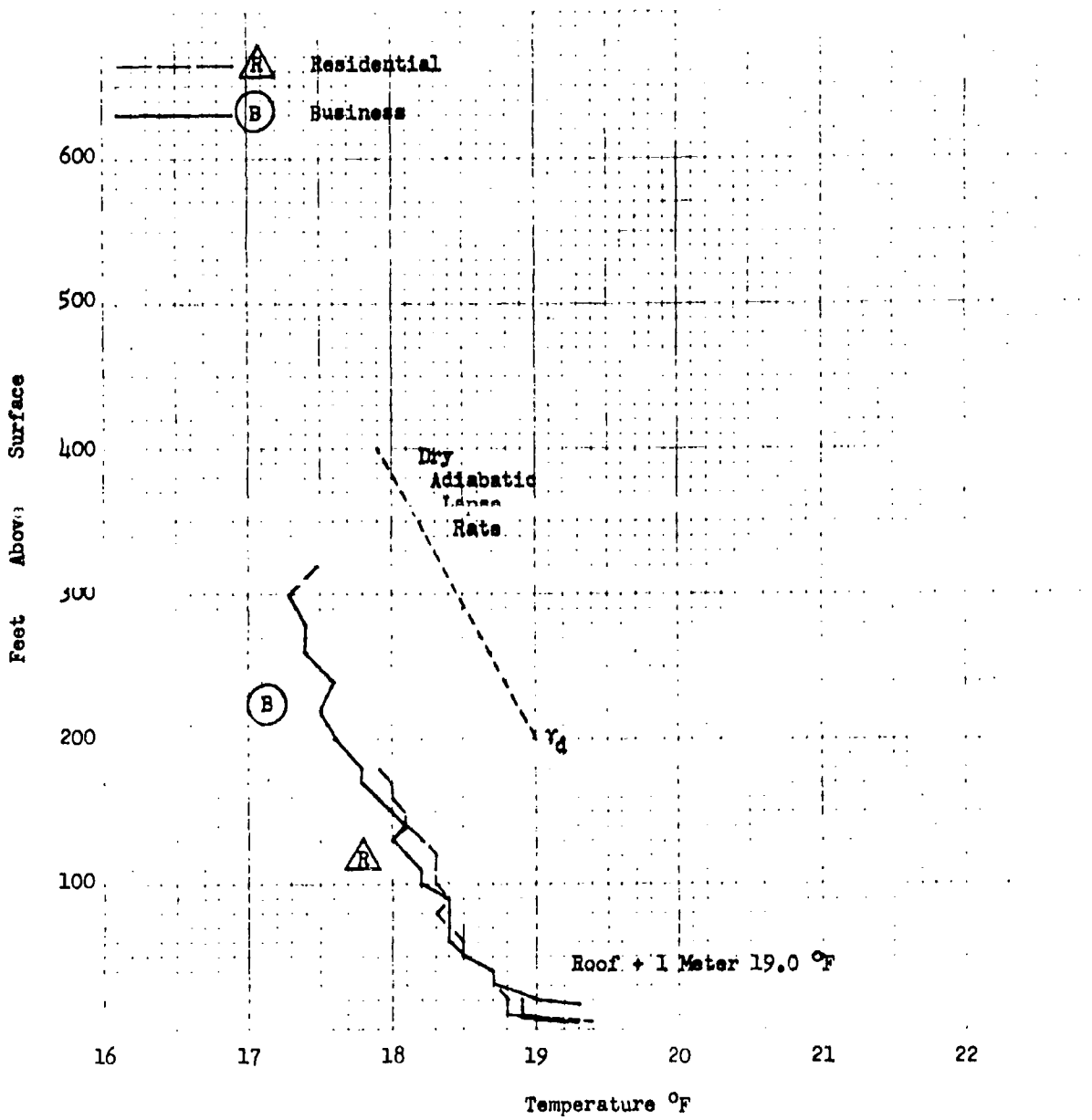


FIGURE B-24

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Residential Vs Business Area
Run 3, 2100 CST 4 Mar 1953

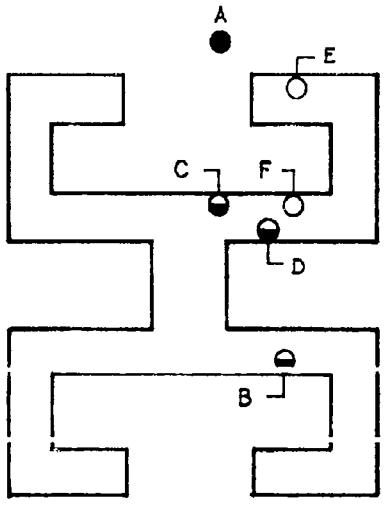
Building No. 21

PIONEER HALL

Pioneer Hall, at Essex and Harvard, is a men's dormitory located on the campus of the University of Minnesota. Completed in 1932, it is built of reinforced concrete, with brick exterior, and consists of four floors, one full basement, and an attic. It has double-hung, wood-sash windows, some of which are kept open for ventilation during winter nights. There is no air conditioning in the building. Steam heating is supplied from the University power plant.

Figures B-27, B-28, and B-29 (Appendix B) show Building No. 21, Pioneer Hall, in relation to the grid complex and the dosage pattern for the indicated releases.

SAMPLER ARRAY



● Outside sampler on ground (see second footnote to the summary table on the right).

◒ Outside sampler at height above general terrain level or with filter holder extending beyond window.

○ Inside sampler.

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SECURITY INFORMATION

FIGURE B-25

Building No. 21
PIONEER HALL
SAMPLER ARRAY AND RESULTS

FT 0019 4 Mar 1953

PIONEER HALL DOSAGES*

Sampler	Location	Dosages for a Given Release FT 0019a	FT 0019b	FT 0019c
A	Surface**	5	13	23
B	1st Floor	5-0	12-0	0-15
C	2nd Floor	2-0	6-0	4-0
D	2nd Floor	5-T	0-0	0-T
E	Basement	T-0	T-T	T-T
F	1st Floor	T-0	5-0	6-0

* Dosages are expressed in particle-minutes per liter; T represents trace dosage, i.e., a count not exceeding 15 fluorescent particles. Double entries for a given column represent incremental dosages obtained with sequentially exposed filter units. Applicable incremental periods for each sampler, as well as full sampling periods for each release, are as follows:

Release	Sampling Period	Incremental Periods
FT 0019a	2000-2100 CST	2000-2100 CST 2100-2120 CST
FT 0019b	2120-2220 CST	2120-2220 CST 2220-2300 CST
FT 0019c	2300-2400 CST	2300-2345 CST 2345-2400 CST

** In the absence of an adjacent outside sampler (●), at the one to six-foot level, a value has been estimated, based on the analysis of the overall isodosage pattern for a given release. The estimate has been made in order to obtain the base value needed to establish the percentage of aerosol-cloud penetration.

FIGURE B-26

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0019 4 Mar 1953

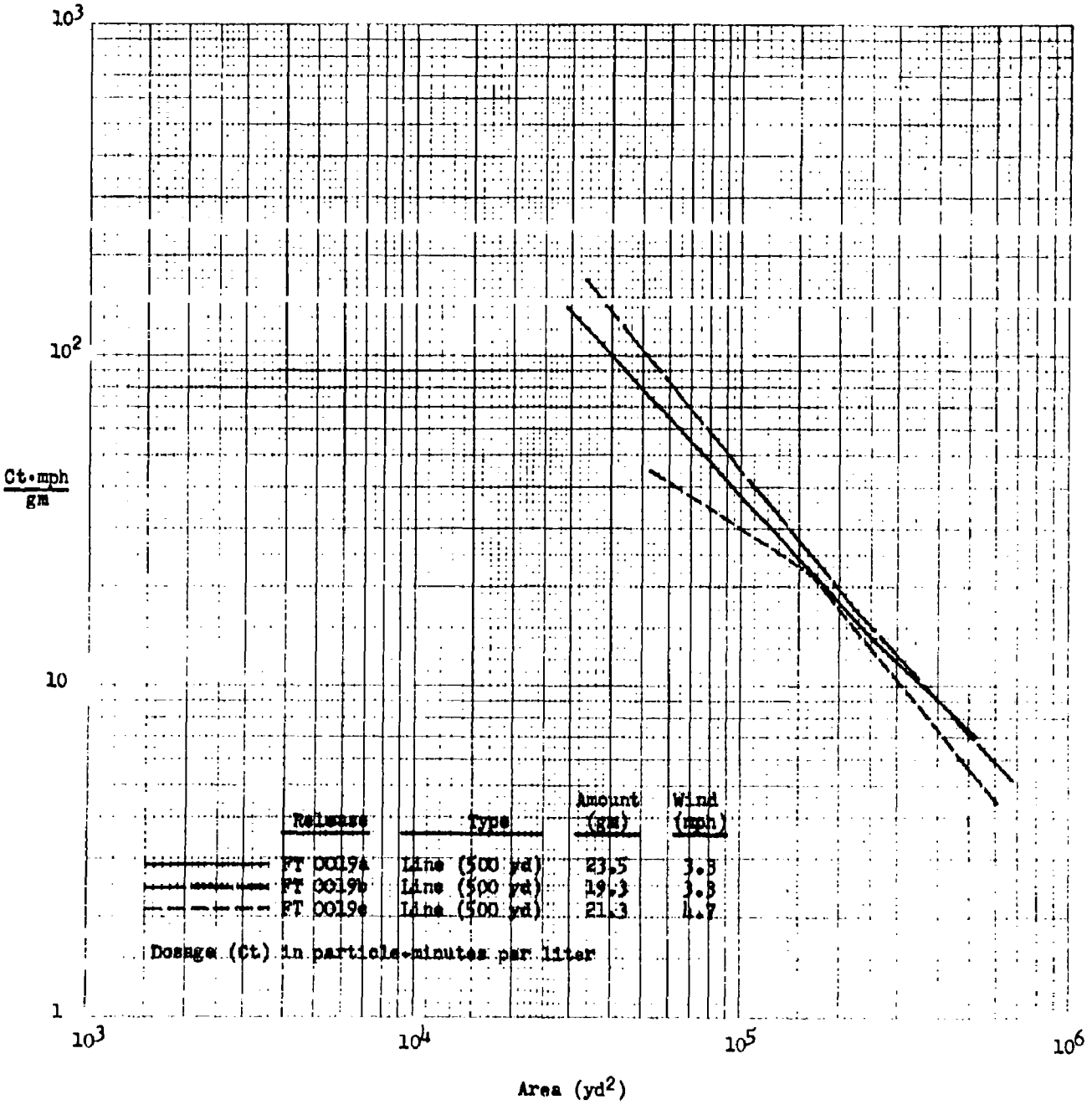


Figure B-27

TEST ARRAY AND RESULTS
FT 0019a

4 Mar 1953
2005 CST

AEROSOL GENERATION

Line-source release of 23.5 gms of NJZ 2266 (at a rate of 78.9 gms/mile) over a period of 5.17 minutes starting at 2005 CST, from a blower disperser mounted on a moving vehicle.

START ——————→ END (2005 CST) (2010:10 CST) 1500-ft track (along high-ground elevation) of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

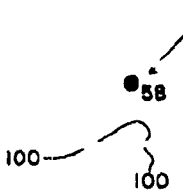
Membrane-filter sampling equipment located at 101 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

● Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages. In addition, samplers in Pioneer Hall were operated incrementally; sampler array, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure B-25.



T = trace dosage

M = malfunction or data missing

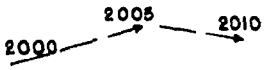
Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1), (M2), (M3), and (M4).

Wiresonde ascents made at meteorological station (M4), at the University parking lot. Business-area wiresondes (see Figs. B-22, B-23, and B-24) obtained at 210 South Tenth Street, approximately 2 miles west of (M4).



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-southwesterly at 3.4 mph, and treetop winds westerly at 15 mph.

Stability

1.5° F lapse from 6-300 ft.

Sky

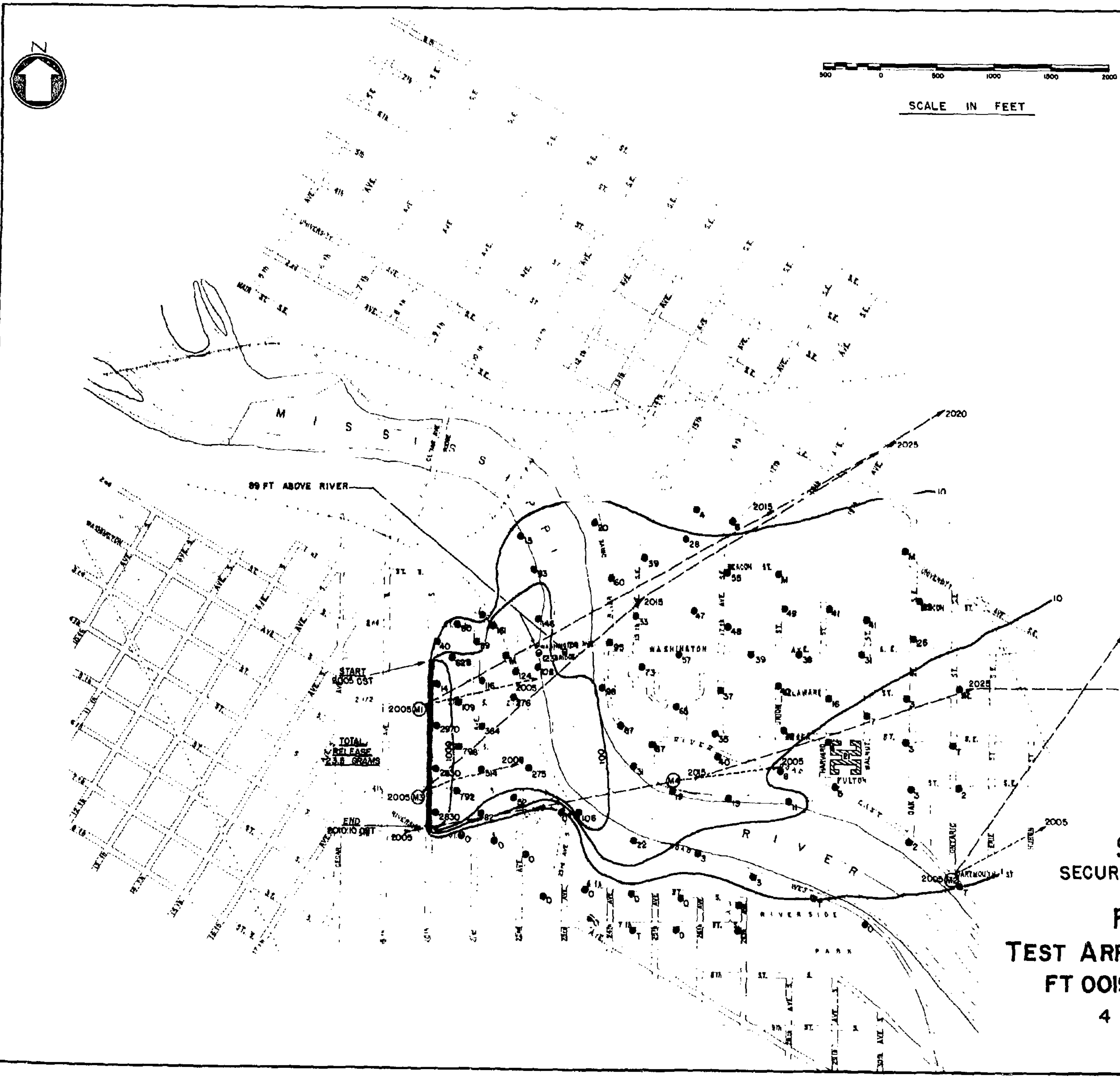
Scattered clouds with bases 11,000 ft above the surface.

Temperature

18.9° to 19.8° F at 2 meters in the test area.

Moisture

Mixing ratio of 1.4 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-27
TEST ARRAY AND RESULTS
FT 0019a 2005 CST
4 MARCH 1953

Figure B-28

TEST ARRAY AND RESULTS
FT 0019b

4 Mar 1953
2125 CST

AEROSOL GENERATION

Line-source release of 19.3 gms of NJZ 2266 (at a rate of 64.6 gms/mile) over a period of 5.5 minutes starting at 2125 CST, from a blower disperser mounted on a moving vehicle.

START (2125 CST) ⟶ END (2130:30 CST) 1500-ft track (along high-ground elevation) of a vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 101 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages. In addition, samplers in Pioneer Hall (Building No. 21) were operated incrementally; sampler array, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure B-25.

liter)

T = trace dosage

M = malfunction or data missing

w = formation of ice on filter

* = evidence of contamination

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1), (M2), (M3), and (M4).

Wiresonde ascents made at meteorological station (M4), at the University parking lot. Business-area wiresondes (see Figs. B-22, B-23, and B-24) obtained at 210 South Tenth Street, approximately 2 miles west of (M4).

2000 — 2005 — 2010 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-southwesterly at 3.4 mph, and treetop winds westerly at 15 mph.

Stability

2.1° F lapse from 6-300 ft.

Sky

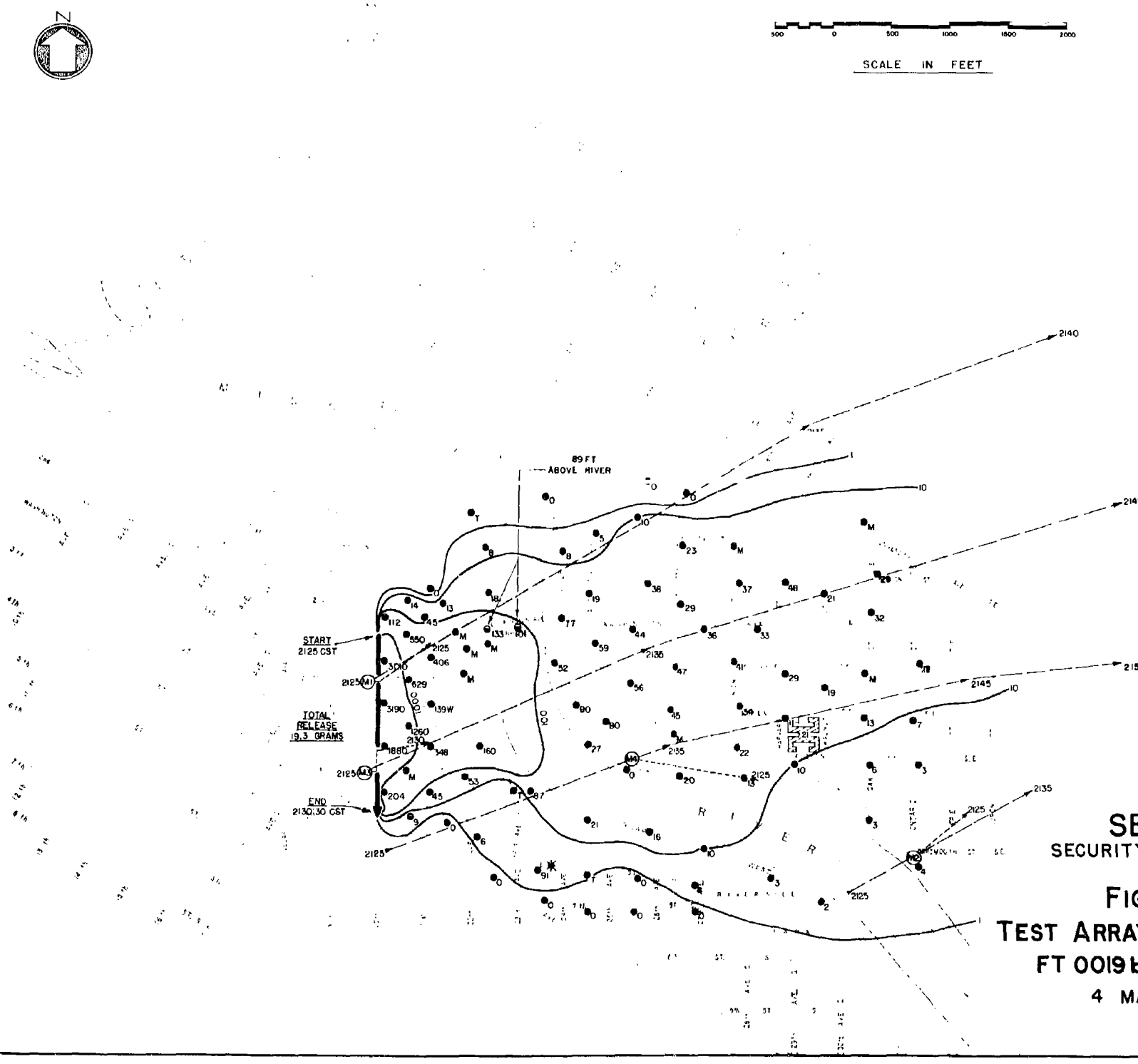
Scattered clouds with bases 4200 ft above the surface.

Temperature

18.7° to 19.5° F at 2 meters in the test area.

Moisture

Mixing ratio of 1.0 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-28
TEST ARRAY AND RESULTS
FT 0019b 2125 CST
4 MARCH 1953

TEST ARRAY AND RESULTS
FT 0019c

4 Mar 1953
2305 CST

AEROSOL GENERATION

Line-source release of 21.3 gms of NJZ 2266 (at a rate of 85.0 gms/mile) over a period of 6 minutes starting at 2305 CST, from a blower disperser mounted on a moving vehicle.

START (2305 CST) ⟶ END (2311 CST) 1500-ft track (along the river level) of a vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 101 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages. In addition, samplers in Pioneer Hall (Building No. 21) were operated incrementally; sampler array, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure B-25.

Total Dosage (particle-minutes/liter)

● 58 T = trace dosage

M = malfunction or data missing

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M0), (M2), (M3), and (M4).

Wiresonde ascents made at meteorological station (M4), at the University parking lot. Business-area wiresondes (see Figs. B-22, B-23, and B-24) obtained at 210 South Tenth Street, approximately 2 miles west of (M4).

2000 — 2005 — 2010 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

- - - - - - - - 2000 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds westerly at 3.9 mph, and treetop winds westerly at 15 mph.

Stability

1.7° F lapse from 6-300 ft.

Sky

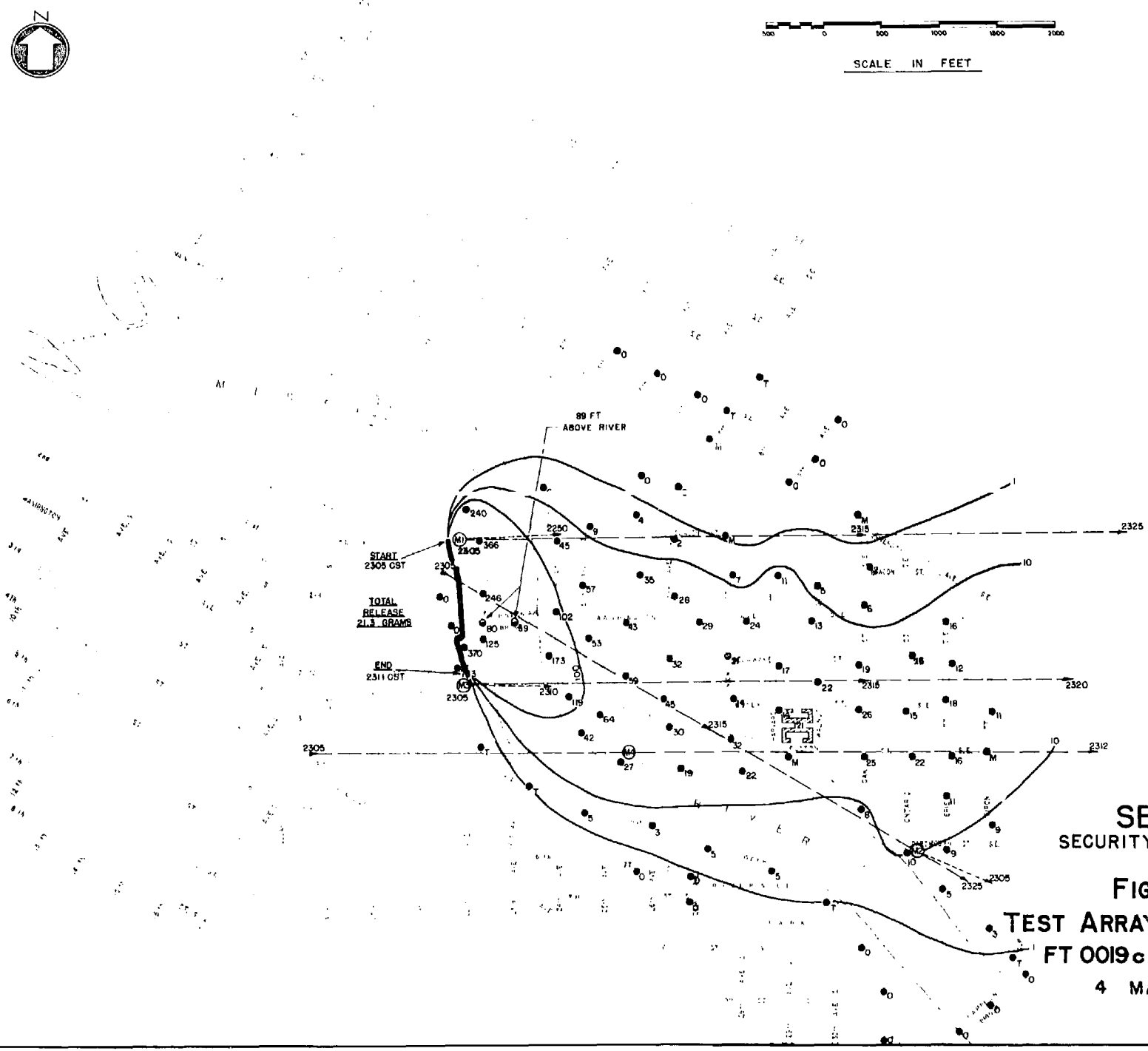
Scattered clouds 3500 ft above the surface.

Temperature

18.8° to 19.5° F at 2 meters in the test area.

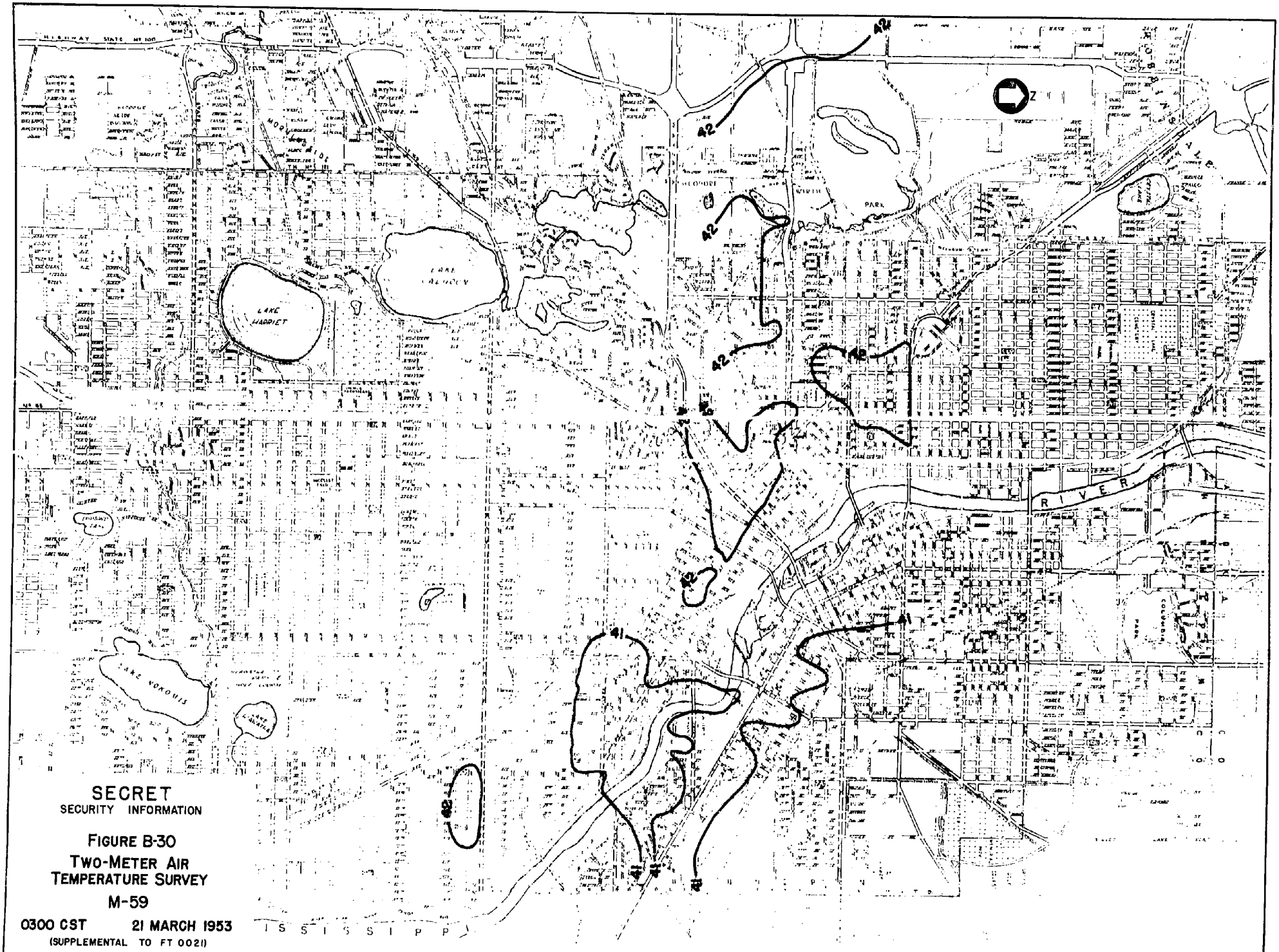
Moisture

Mixing ratio of 1.5 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-29
TEST ARRAY AND RESULTS
FT 0019c 2305 CST
4 MARCH 1953



SECRET
SECURITY INFORMATION

FIGURE B-30
TWO-METER AIR
TEMPERATURE SURVEY
M-59
0300 CST 21 MARCH 1953
(SUPPLEMENTAL TO FT 0021)

SUMMARY OF REGIONAL AND LOCAL WEATHER
21 March 1953
(Survey M-59, Supplemental to FT 0021)

SYNOPTIC SITUATION

During the test period, a deepening 986-mb low center over western Nebraska, moving northeast at 20 mph, and a 1020-mb high over Quebec combined to produce a flow of warm air with a southeasterly gradient of 35 mph. The low passed Minneapolis the following day with one-half inch of rain. At the 700-mb level, a moderate ridge extended from Georgia to eastern Lake Superior and a deepening trough extended from Montana to New Mexico, producing a southerly gradient wind of 35 mph.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
2230	6,000	Overcast	15+	-	47	33	ESE	19
2330	5,500	Overcast	15+	-	46	32	E	15
0030	5,500	Scattered	15	-	45	34	ESE	19
0130	5,500	Scattered	12	-	41	35	ESE	16
0230	20,000	Broken	10	-	41	34	ESE	22
0330	20,000	Scattered	10	-	41	35	ESE	23
0430	20,000	Broken	12	-	41	36	ESE	20
0530	20,000	Overcast	12	-	41	36	ESE	23
0630	5,000	Scattered	10	-	42	37	ESE	21

* Average cloudiness sunrise to sunset: 80%
** And/or restrictions to visibility

Sea-level pressure at 0230 CST: 1000.3 mb
Ground condition: Two-tenths snow remaining (two to three inches); streets clear; lake frozen
Tree cover: None

Figure B-31

TEMPERATURE SOUNDINGS

St. Cloud Raob 21 Mar 1953
(Supplemental to Survey M-59)

WINDS ALOFT
St. Cloud
21 Mar 1953
0300 CST

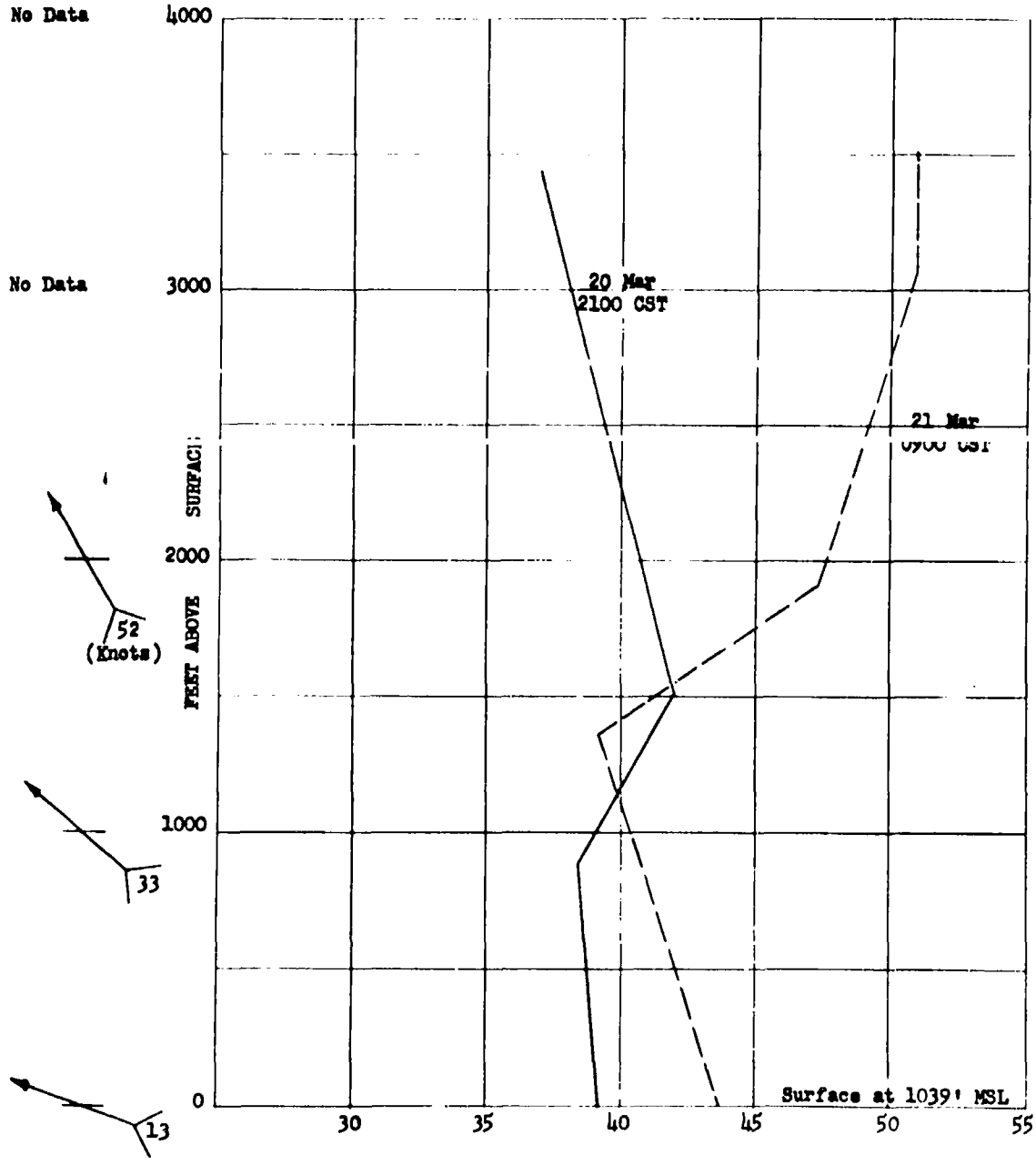


FIGURE B-32

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0021 21 Mar 1953

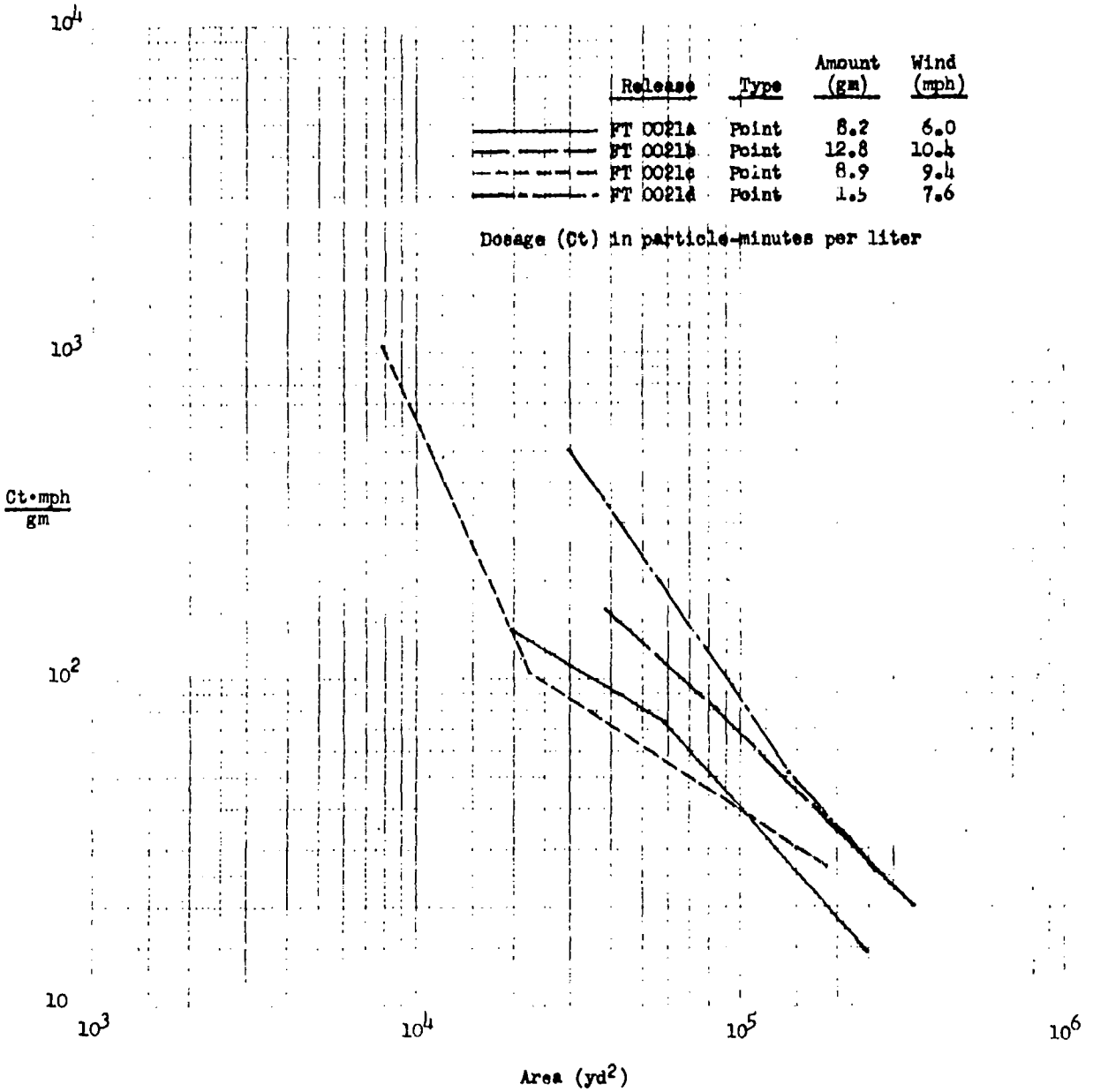


Figure B-33

TEST ARRAY AND RESULTS
FT 0021a

21 Mar 1953
0045 CST

AEROSOL GENERATION

Point-source release (92 ft above river level) of 8.2 gms of NJZ 2266 over a period of 5 minutes starting at 0045 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

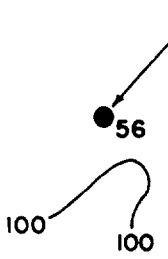
Membrane-filter sampling equipment located at 104 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosages during full sampling period, 0030-0130 CST.



Total Dosage (particle-minutes/liter)

T = trace dosage

M = malfunction or data missing

* = evidence of contamination

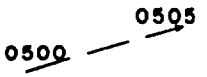
Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) , (M2) , and (M3) .

Wiresonde equipment located at meteorological station (M2) , at the University parking lot.



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds easterly at 9.8 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. B-31) indicate adiabatic conditions.

Sky

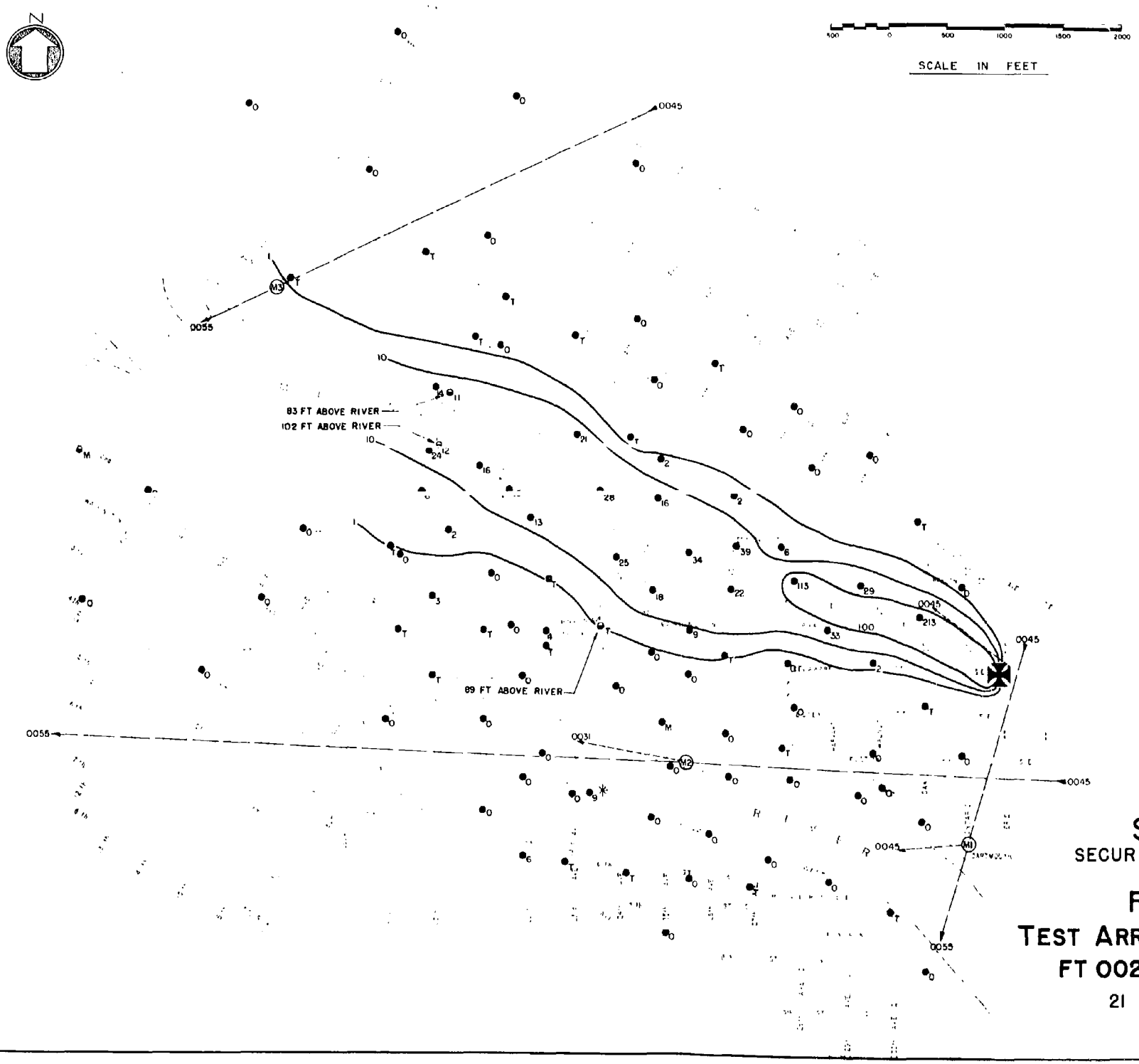
Scattered clouds with bases 5500 ft above the surface.

Temperature

41.6° to 42.2° F at 2 meters in the test area.

Moisture

Mixing ratio of 4.1 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-33
TEST ARRAY AND RESULTS
FT 0021a 0045 CST
21 MARCH 1953

TEST ARRAY AND RESULTS
FT 0021b

21 Mar 1953
0235 CST

AEROSOL GENERATION

Point-source release at river level of 12.8 gms of NJZ 2266 over a period of 5 minutes starting at 0235 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 104 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosage during full sampling period, 0200-0300 CST.

Total Dosage (particle-minutes/liter)

●58

T = trace dosage

M = malfunction or data missing

= evidence of contamination

100 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated as ⑪ , ⑫ , and ⑬ .

Wiresonde equipment located at meteorological station ⑫ , at the University parking lot.

0500 — 0505 — — 0510 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

0500 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds east-southeasterly at 11.6 m.p.h.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. B-31) indicate adiabatic conditions.

Sky

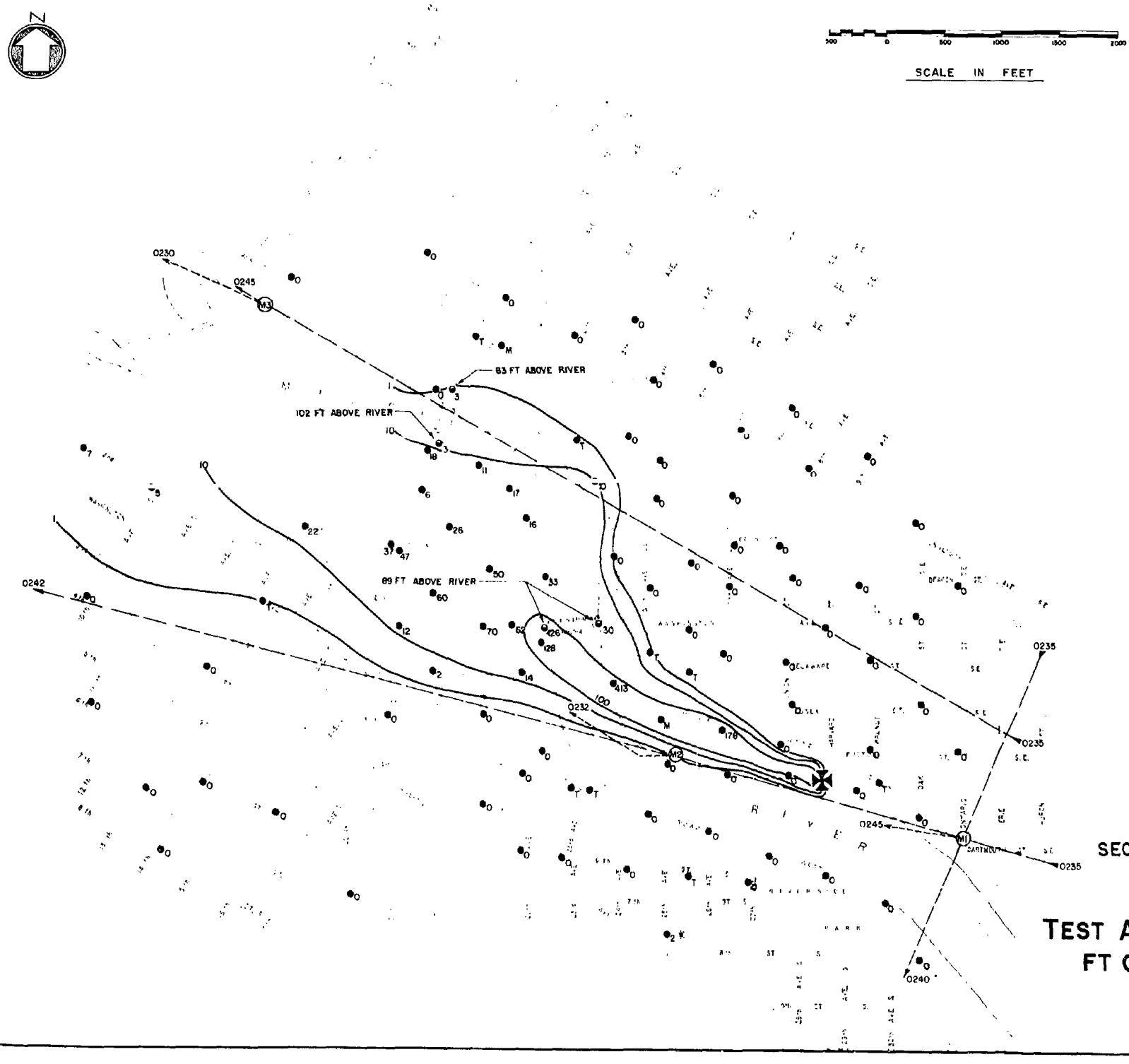
Broken clouds with bases 20,000 ft above the surface.

Temperature

40.9° to 41.9° F at 2 meters in the test area.

Moisture

Mixing ratio of 4.3 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-34
TEST ARRAY AND RESULTS
FT 0021 b 0235 CST
21 MARCH 1953

Figure B-35

TEST ARRAY AND RESULTS
FT 0021c

21 Mar 1953
0350 CST

AEROSOL GENERATION

Point-source release (50 ft above river level) of 8.9 gms of NJZ 2266 over a period of 5 minutes starting at 0350 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 104 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

◒ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosage during full sampling period, 0330-0430 CST.

Total Dosage (particle-minutes/liter)

●58 T = trace dosage

M = malfunction or data missing

100 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) , (M2) , and (M3) .

Wiresonde equipment located at meteorological station (M2) , at the University parking lot.

0500 0505 0510 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

0500 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds east-southeasterly at 12 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. B-31) indicate adiabatic conditions.

Sky

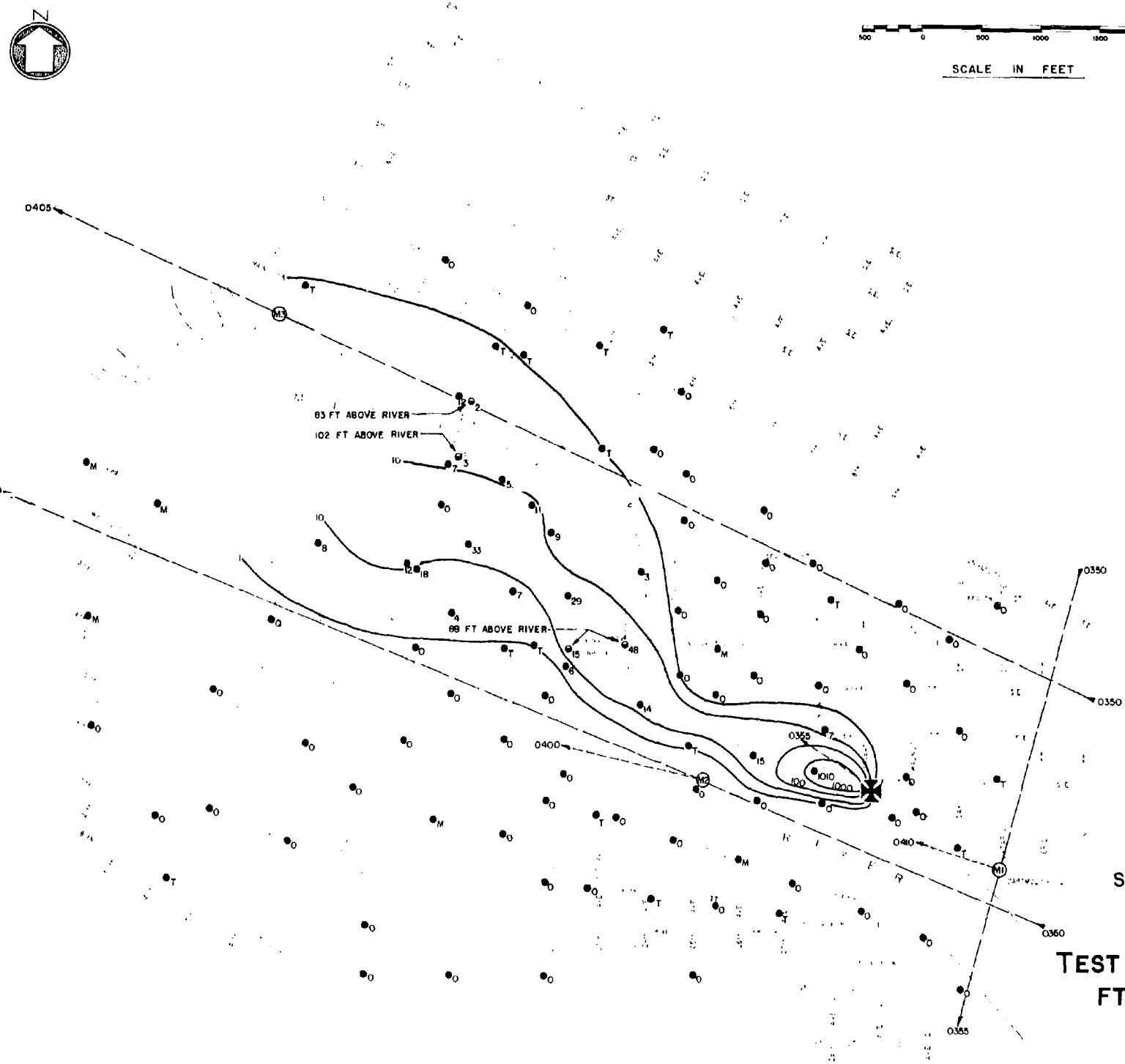
Scattered clouds with bases 20,000 feet above the surface.

Temperature

41.3° to 41.7° F at 2 meters in the test area.

Moisture

Mixing ratio of 4.3 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE B-35
TEST ARRAY AND RESULTS
FT 0021c 0350 CST
21 MARCH 1953

AEROSOL GENERATION

Point-source release at river level of NJZ 2266 over a period of 5 minutes starting at 0515 CST from a vehicle-mounted blower disperser located at point ✠ . Because of disperser malfunction, only 1.5 gms released.

SAMPLING

Location and Exposure

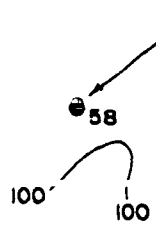
Membrane-filter sampling equipment located at 104 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⊖ Outdoor sampler at height above or below general terrain level as indicated by note.

Results

All samplers operated to measure total dosage during full sampling period, 0500-0600 CST.



T = trace dosage

M = malfunction or data missing

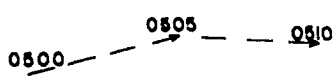
Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

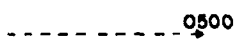
Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) , (M2) , and (M3) .

Wiresonde equipment located at meteorological station (M2) , at the University parking lot.



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.



Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds east-southeasterly at 8.8 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. B-31) indicate adiabatic conditions.

Sky

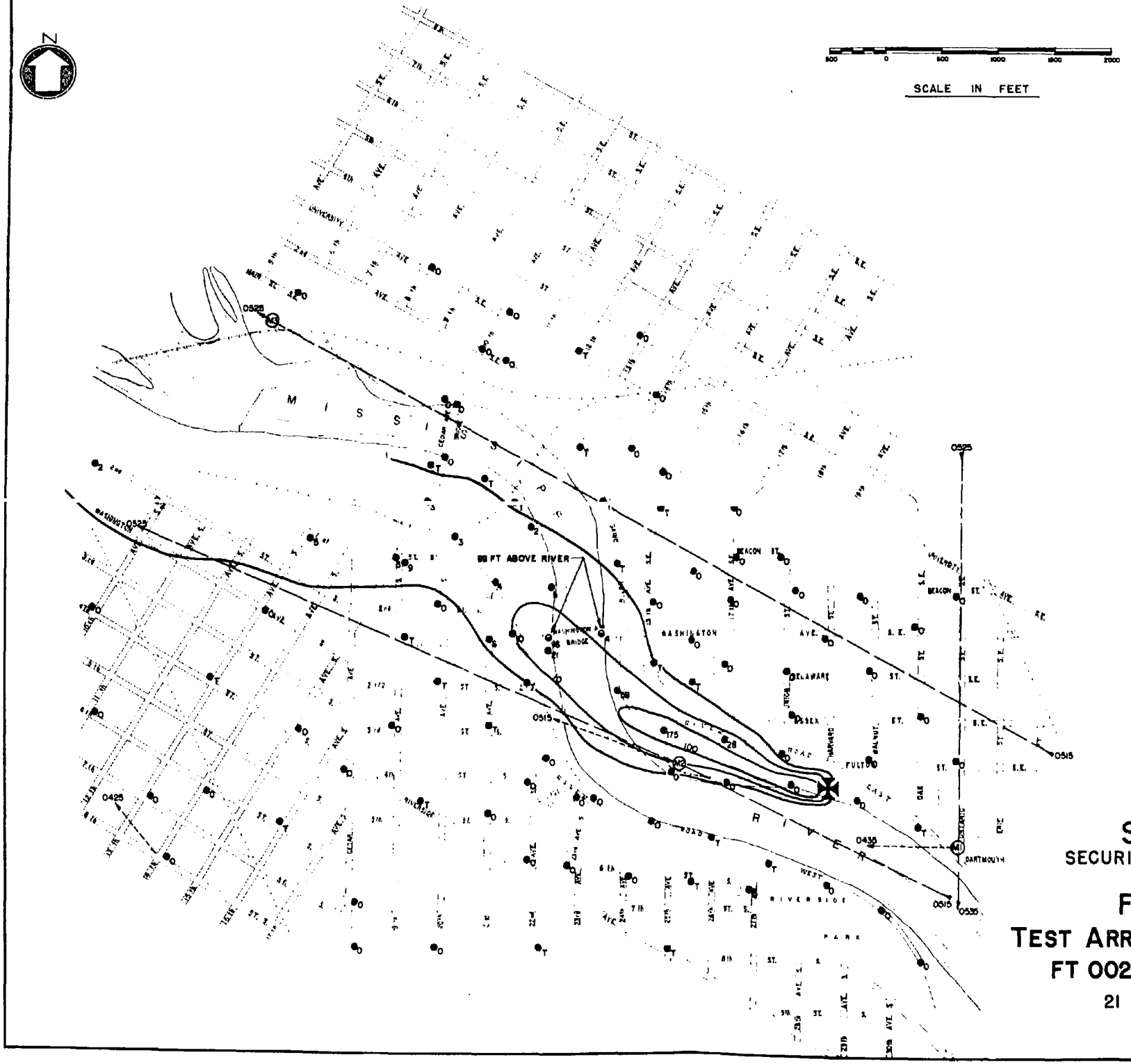
Overcast clouds with bases 20,000 ft above the surface.

Temperature

41.6° to 42.4° F at 2 meters in the test area.

Moisture

Mixing ratio of 4.5 gm/kgm dry air.



SECRET
SECURITY INFORMATION

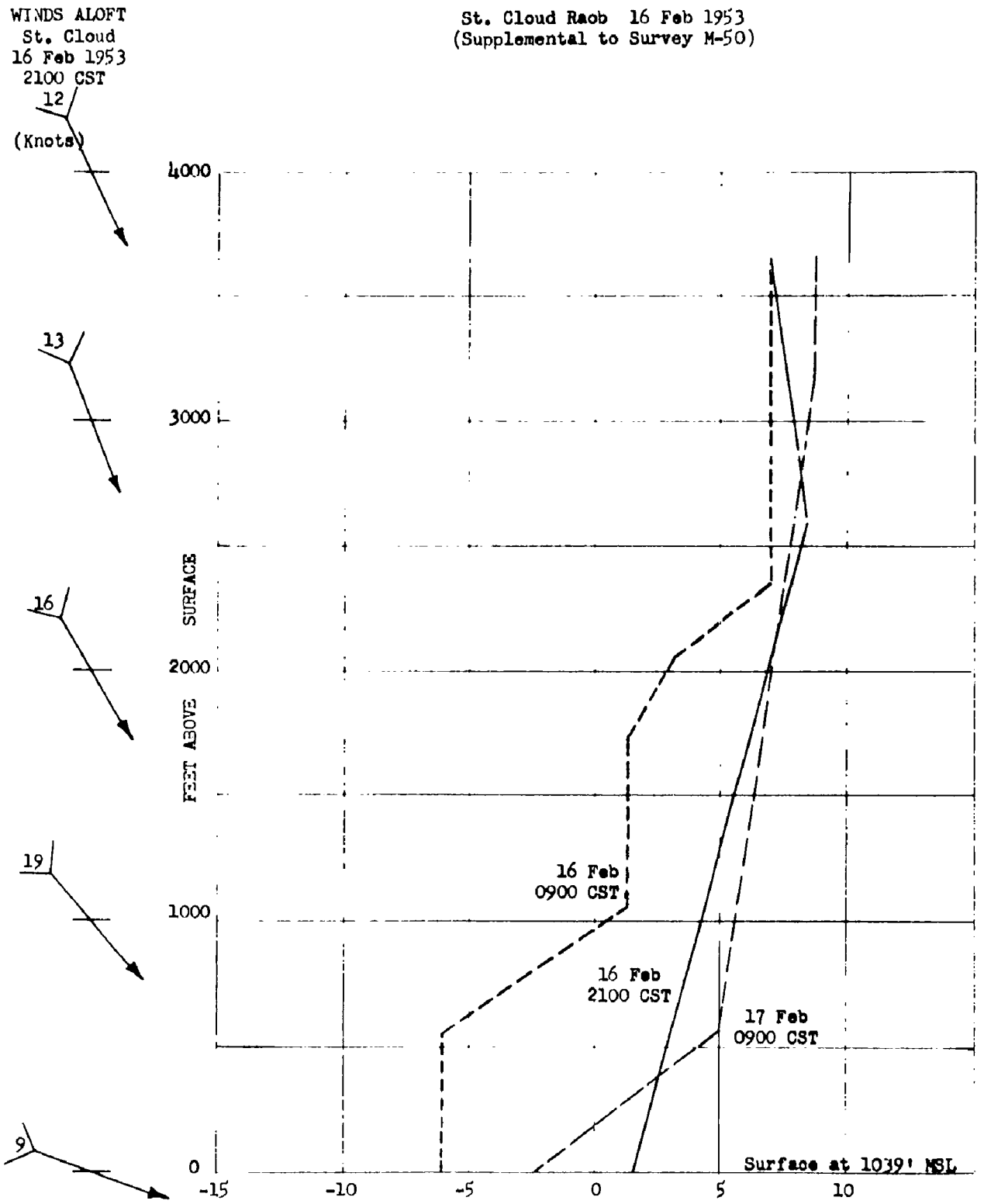
FIGURE B-36
TEST ARRAY AND RESULTS
FT 0021d 0515 CST
21 MARCH 1953

A P P E N D I X " C "

Figure C-1

TEMPERATURE SOUNDINGS

St. Cloud Raob 16 Feb 1953
(Supplemental to Survey M-50)



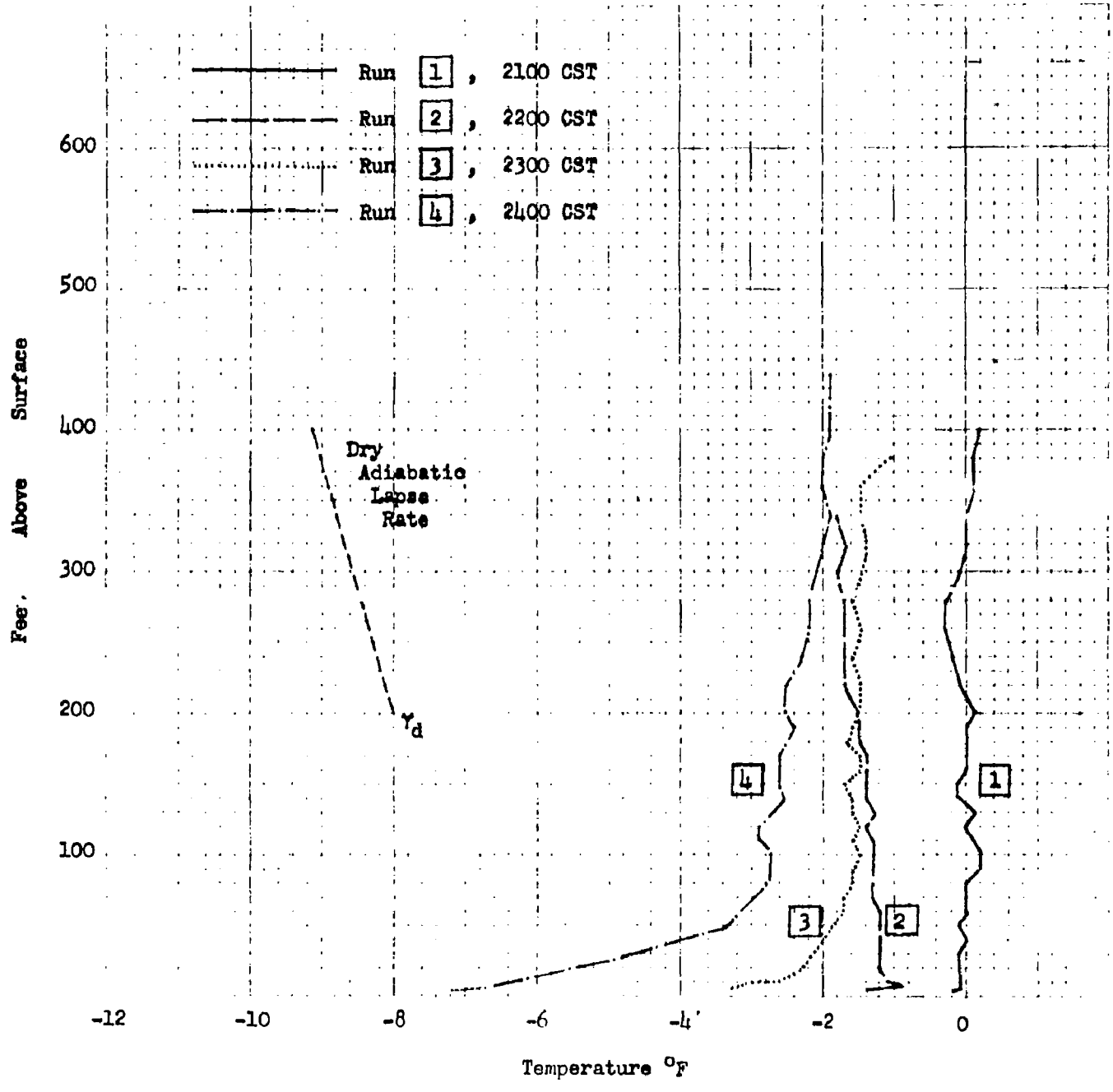


FIGURE C-2

TEMPERATURE SOUNDINGS

Minneapolis

Undeveloped-Area Wiresonde
M-50 16 Feb 1953

Figure C-3

TEST ARRAY AND RESULTS
FT 0012b

16 Feb 1953
2254 CST

AEROSOL GENERATION

Point-source release of ^.7 gms of NJZ 2266 over a period of 5 minutes starting at 2254 CST from a vehicle-mounted blower disperser located . oint .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 101 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Results

All samplers operated to measure total dosage during full sampling period, 2240-2320 CST.

Total Dosage (particle-minutes/liter)

58

T = trace dosage

M = malfunction or data missing

W = formation of ice on filter

100 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) and (M2) .

2105 2110 2100 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2100 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds southwesterly at 1.8 mph.

Stability

1.9° F of inversion from 6-300 ft measured approximately 9 miles away at Wirth Park (see Fig. C-2), over open terrain comparable to Charlie Area, at the western rather than at the southeastern periphery of Minneapolis.

Temperature

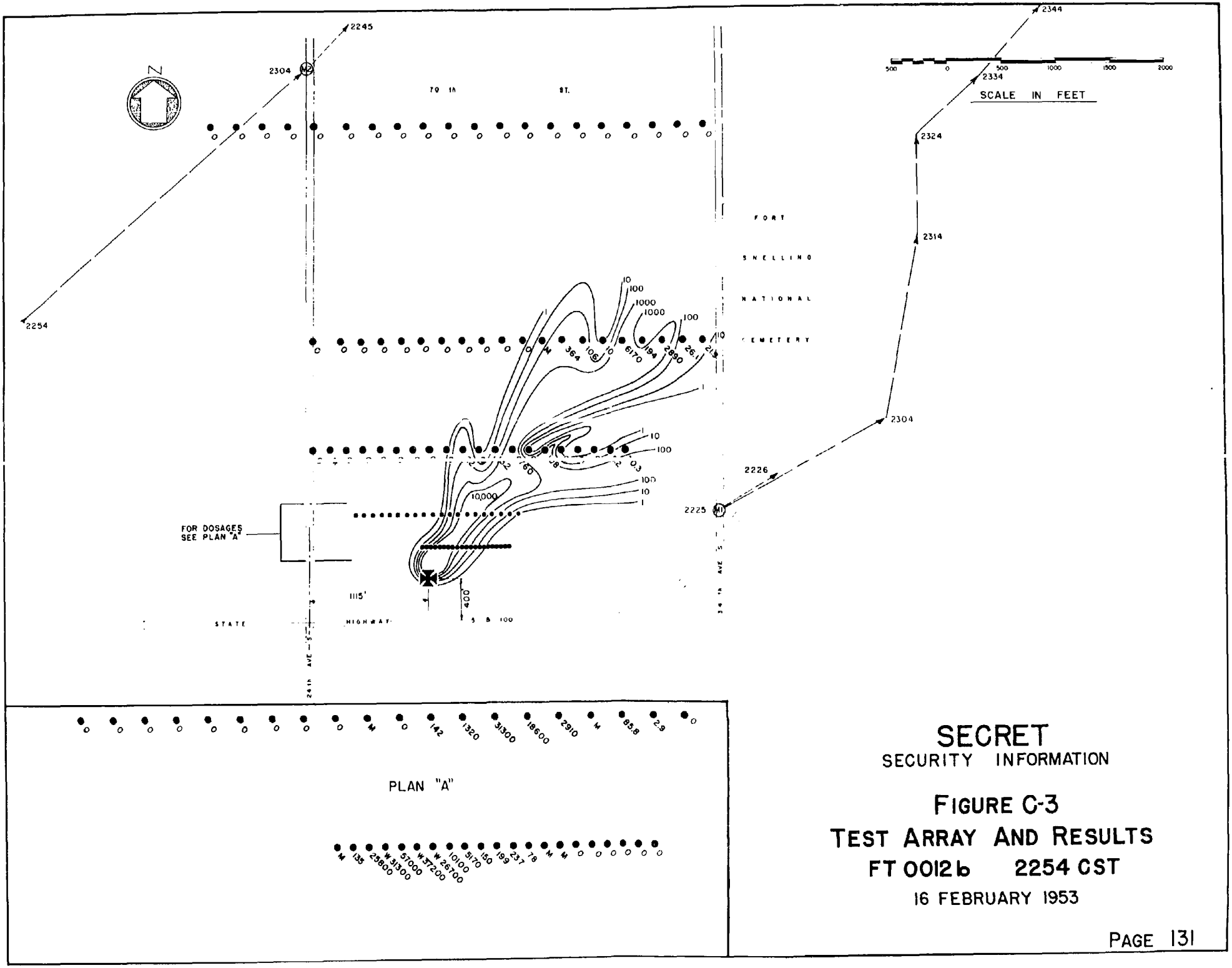
-4° to -7° F at 2 meters in the test area.

Sky

Clear during test period.

Moisture

Mixing ratio of 0.6 gm/kgm dry air.



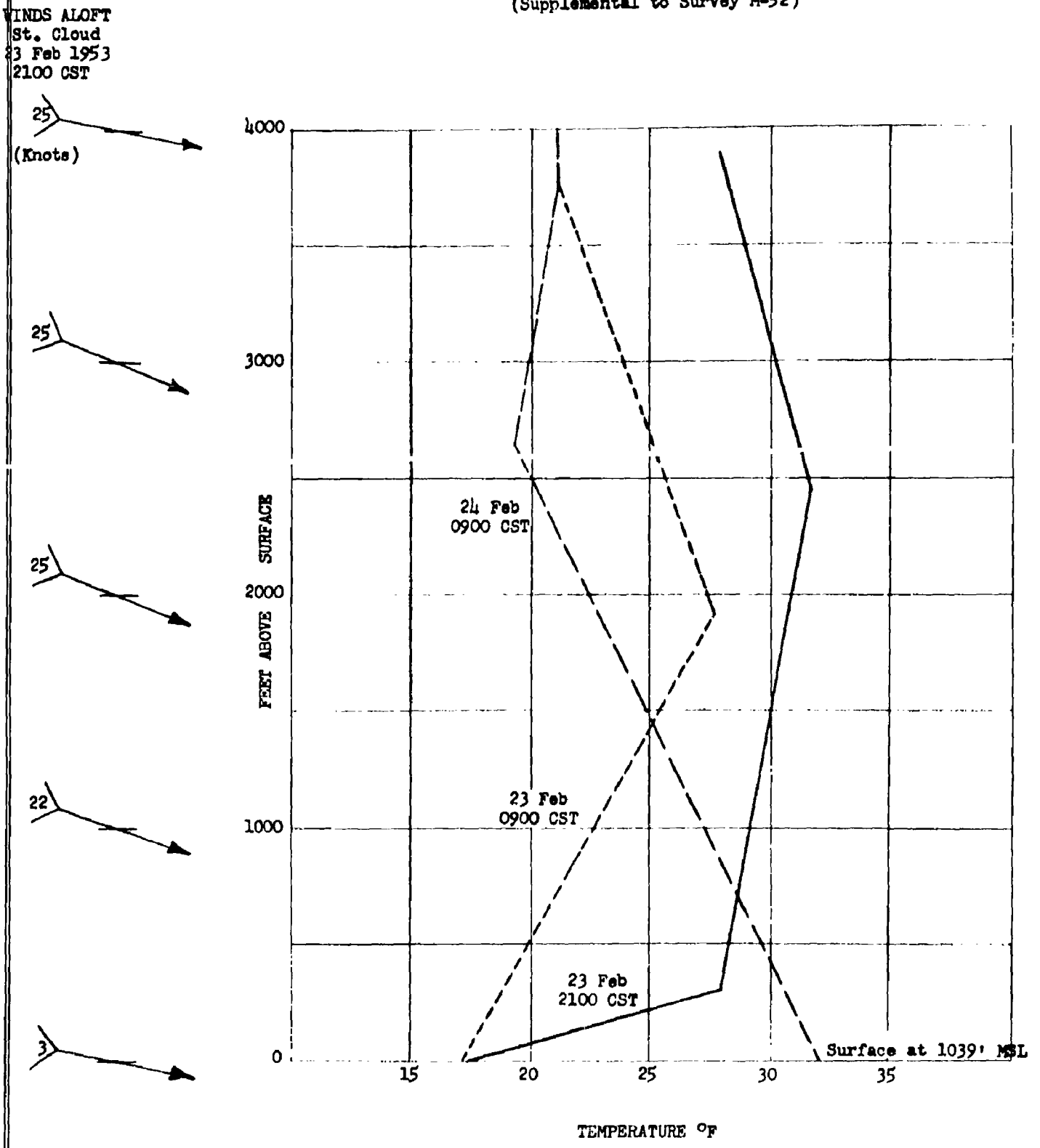
SECRET
SECURITY INFORMATION

FIGURE C-3
TEST ARRAY AND RESULTS
FT 0012b 2254 CST
16 FEBRUARY 1953

Figure C-4

TEMPERATURE SOUNDINGS

St. Cloud Raob 23 Feb 1953
(Supplemental to Survey M-52)



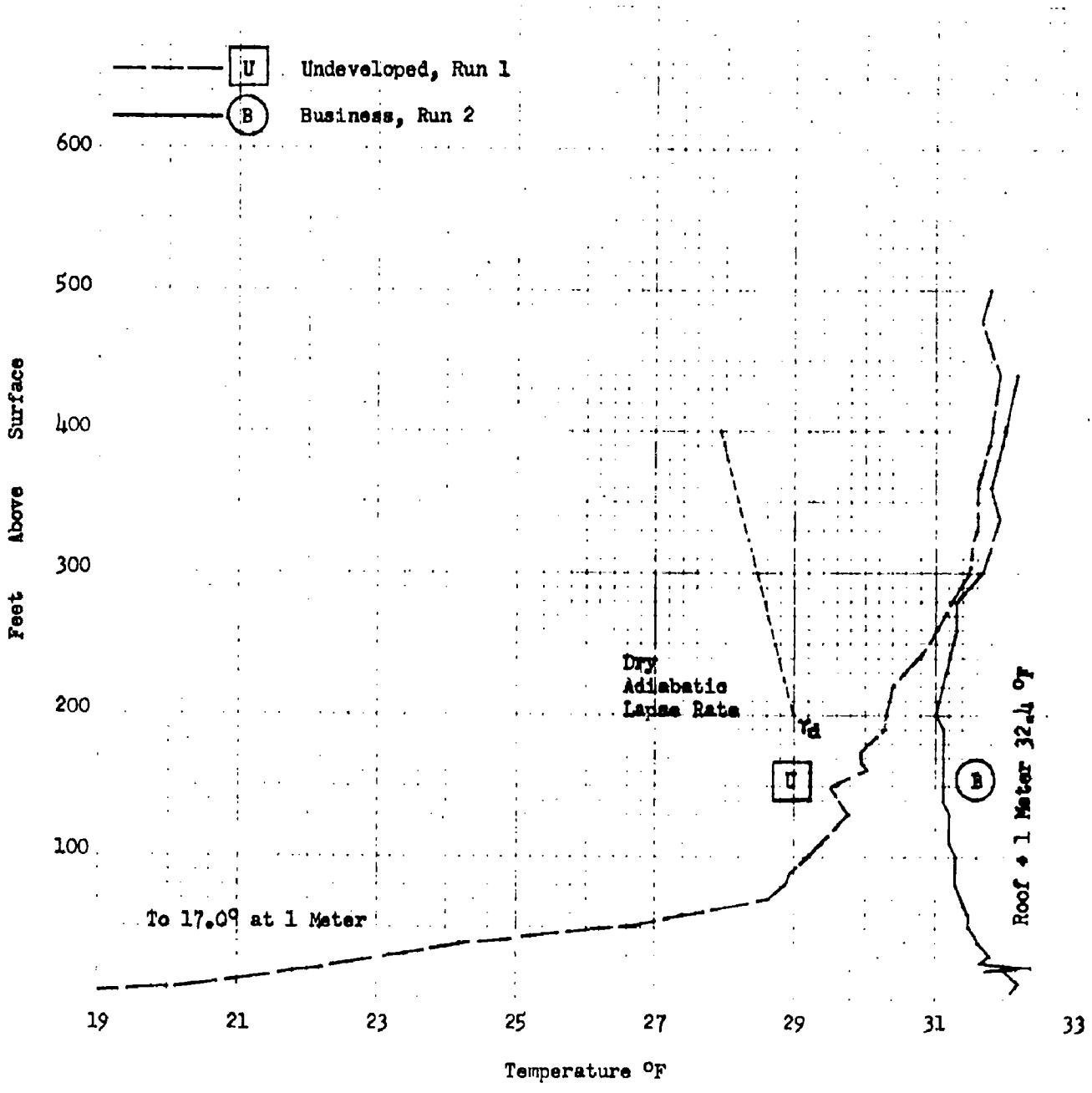


FIGURE C-5

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
2000 CST 23 Feb 1953

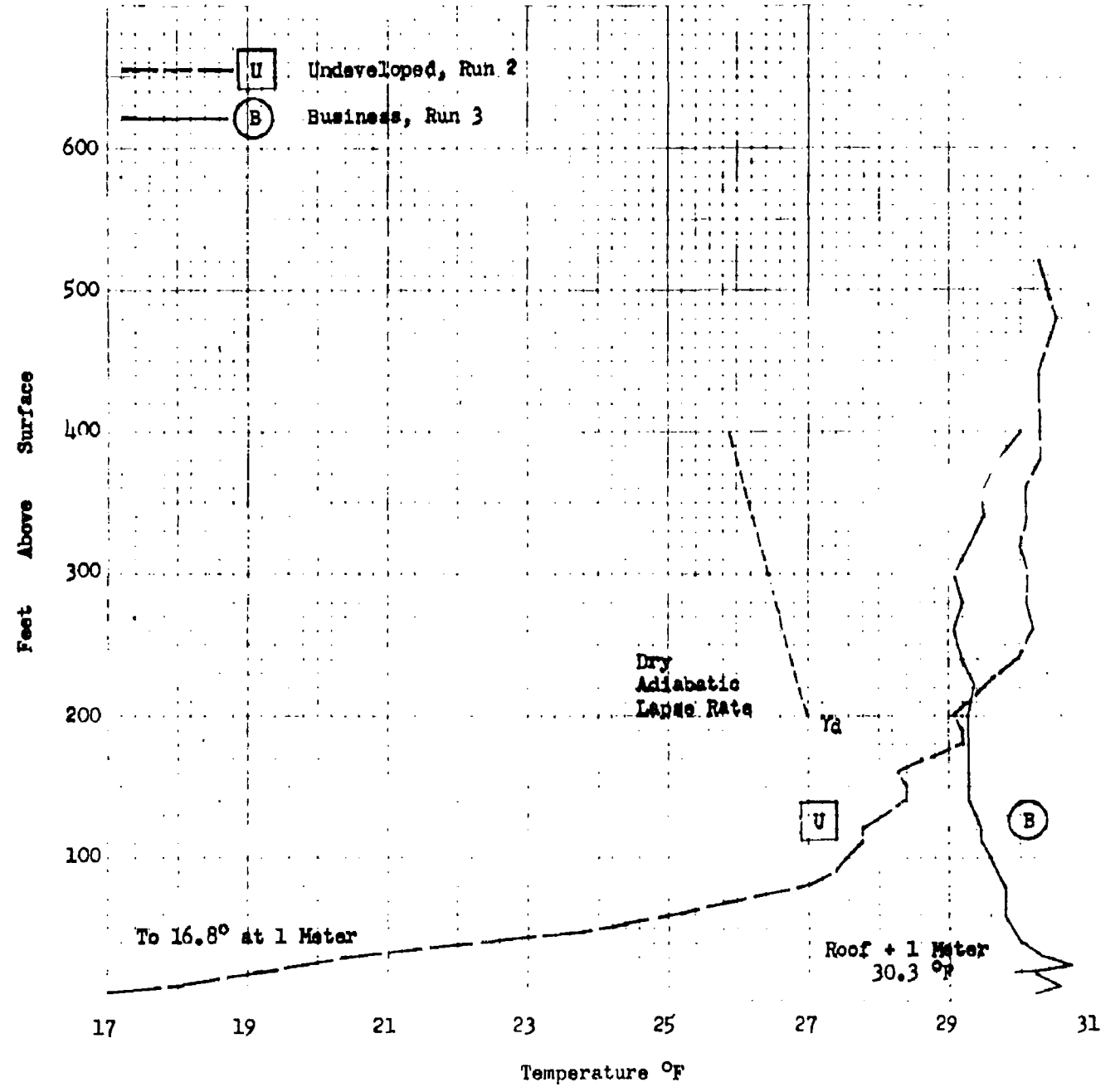


FIGURE C-6

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
2100 CST 23 Feb 1953

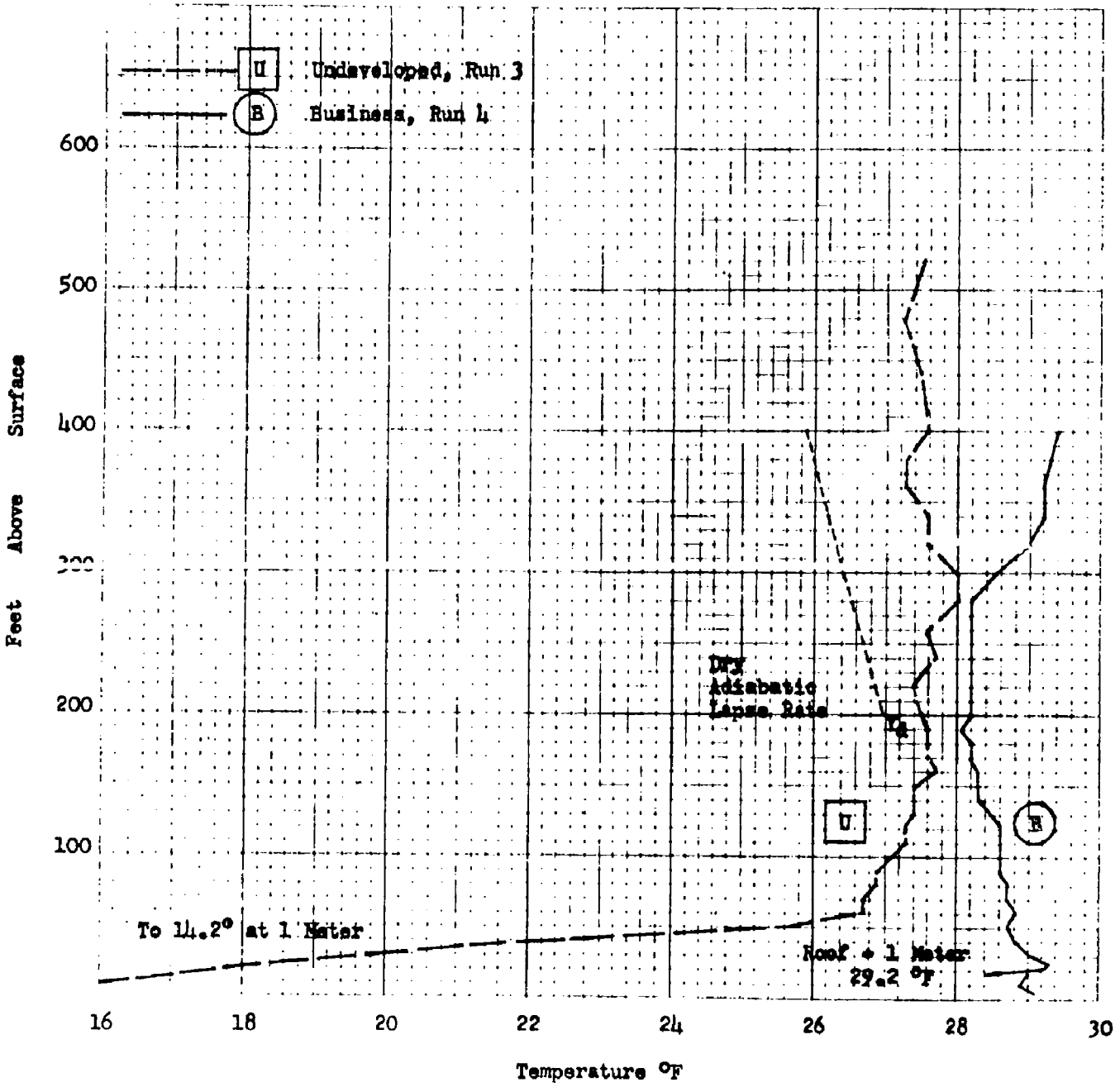


FIGURE C-7

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
2200 CST 23 Feb 1953

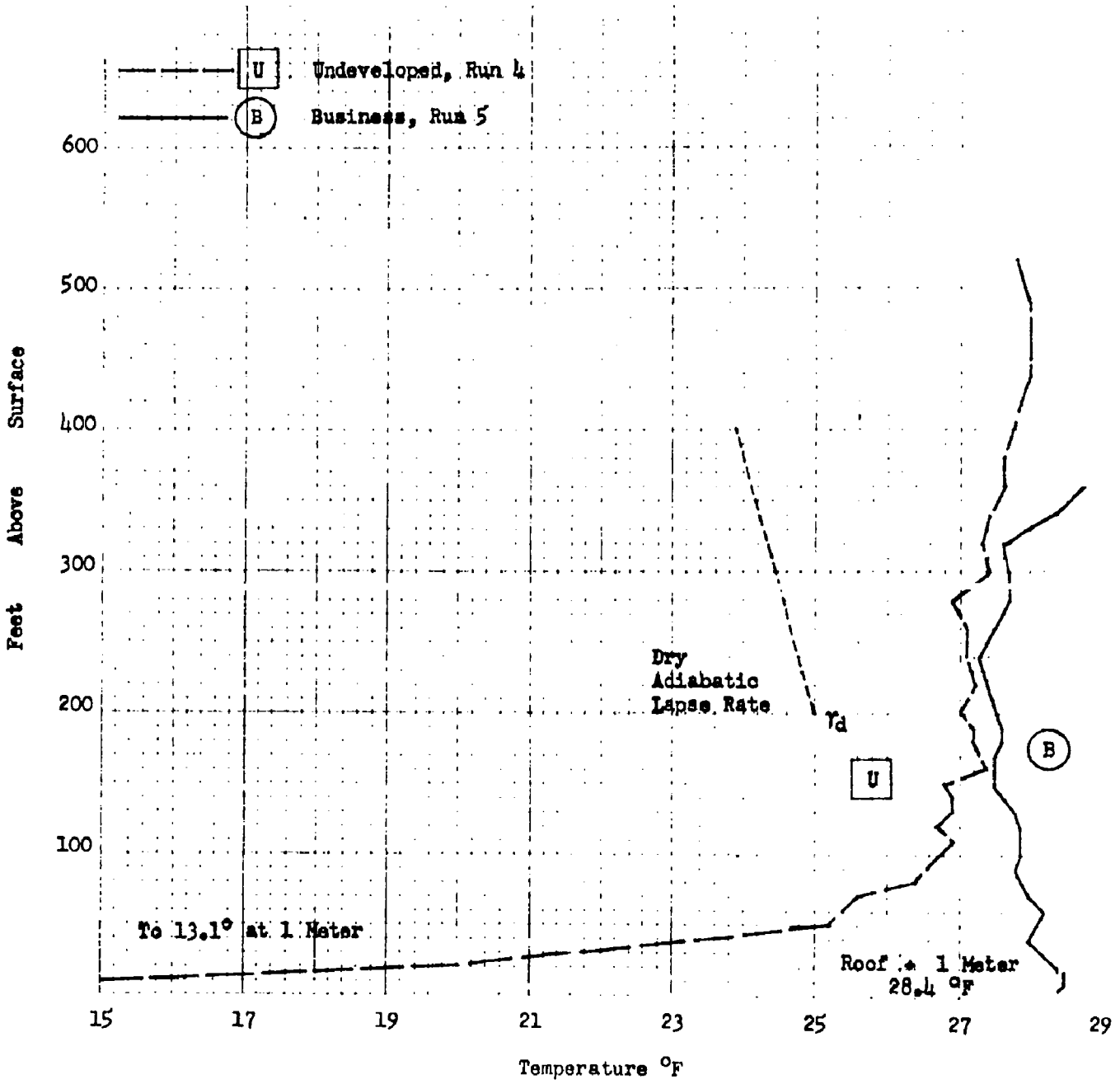


FIGURE C-8

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
2300 CST 23 Feb 1953

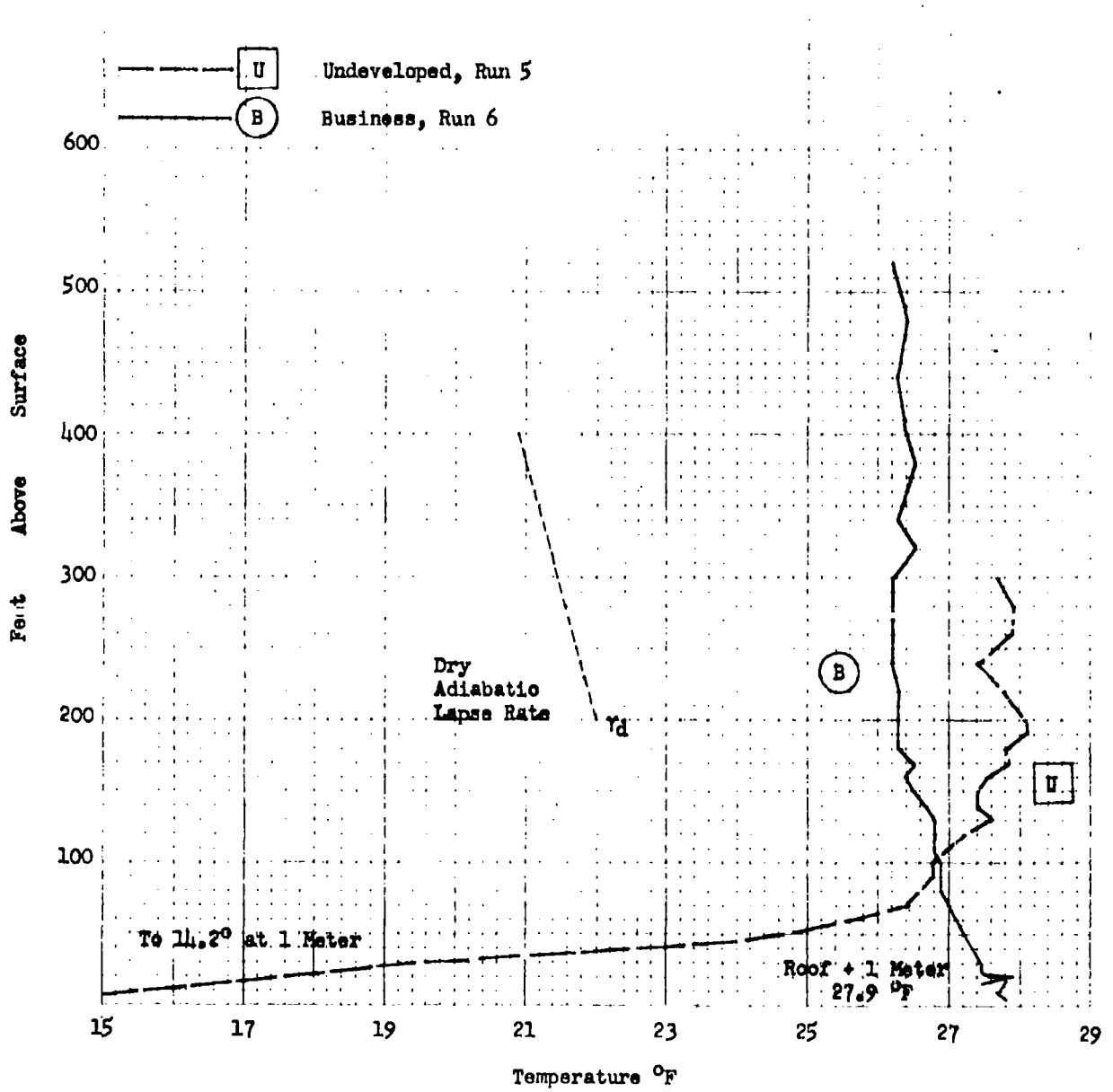


FIGURE C-9

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
2400 CST 23 Feb 1953

Figure C-10

TEST ARRAY AND RESULTS
FT 0018a

23 Feb 1953
2015 CST

AEROSOL GENERATION

Point-source release of 11.7 gms of NJZ 2266 over a period of 5 minutes starting at 2015 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

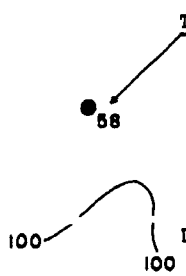
Location and Exposure

Membrane-filter sampling equipment located at 101 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Results

All samplers operated to measure total dosage during full sampling period, 2000-2100 CST.



T = trace dosage

M = malfunction or data missing

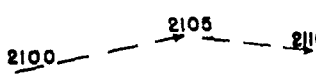
W = formation of ice on filter

Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) , (M2) , (M3) , and (M4) .



Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds southerly at 1.7 mph, veering to southwesterly at treetop level.

Stability

12.3° F of inversion from 6-300 ft measured approximately 9 miles away at Wirth Park (see Figs. C-5 through C-9), over open terrain comparable to Charlie Area, at the western rather than at the southeastern periphery of Minneapolis. Business-area wiresondes obtained at 210 South Tenth Street.

Sky

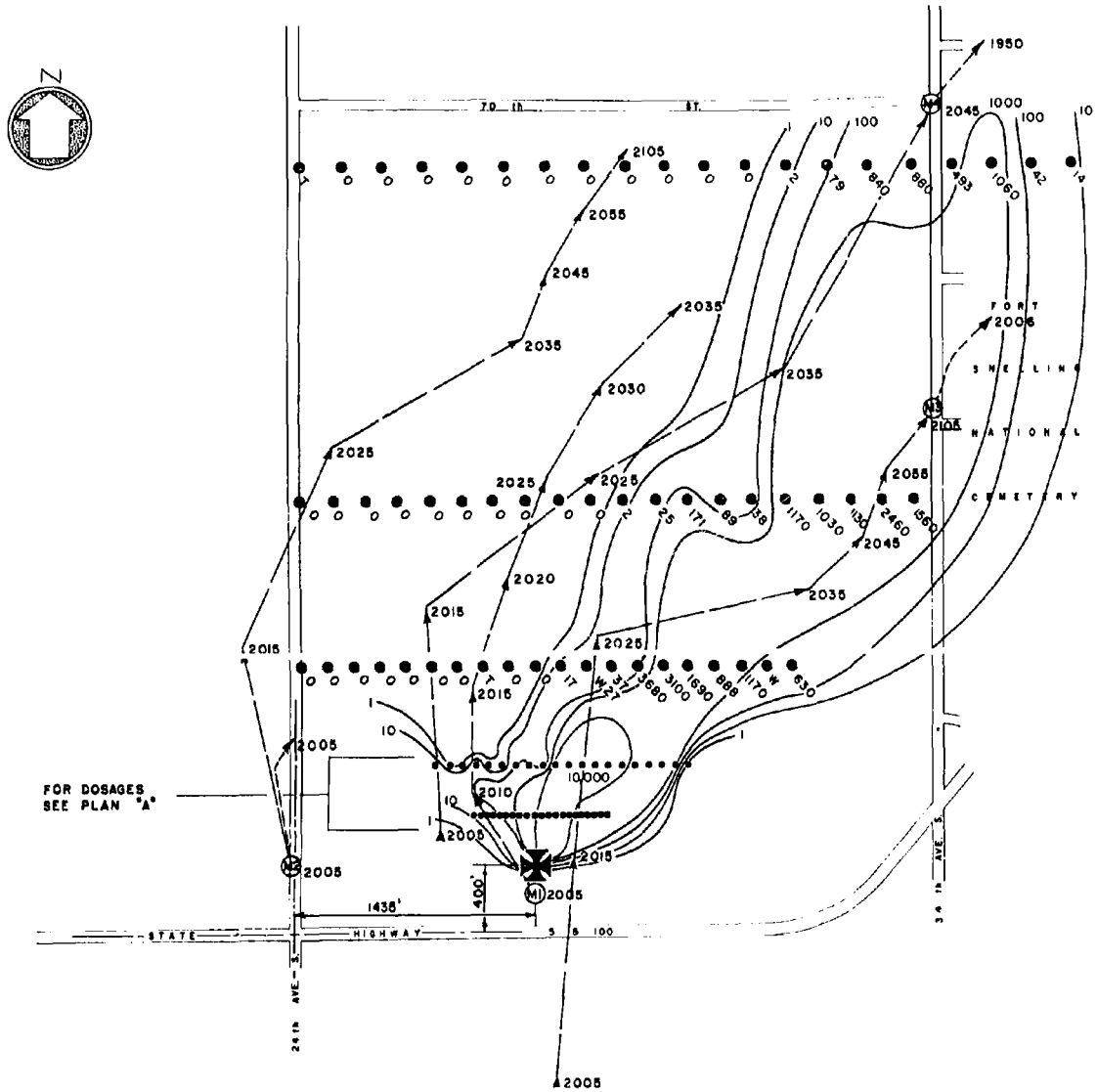
Clear during test period.

Temperature

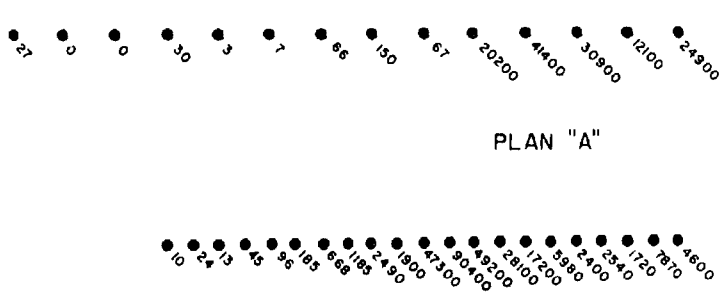
21° to 25° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.7 gm/kgm dry air.



SCALE IN FEET



SECRET
SECURITY INFORMATION

FIGURE C-10
TEST ARRAY AND RESULTS
FT 0018a 2015 CST
23 FEBRUARY 1953

Figure C-11

TEST ARRAY AND RESULTS
FT 0018d

23 Feb 1953
2308 CST

AEROSOL GENERATION

Point-source release of 8.0 gms of NJZ 2266 over a period of 5 minutes starting at 2308 CST from a vehicle-mounted blower disperser located at point ✚ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 101 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Results

All samplers operated to measure total dosage during full sampling period, 2300-2400 CST.

Total Dosage (particle-minutes/liter)

T = trace dosage

M = malfunction or data missing

W = formation of ice on filter

● 58

100 — 100 Dosage contour with values expressed in particle-minutes per liter

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) , (M2) , (M3) , and (M4) .

2100 — 2105 — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2100 Balloon track representing the wind-drift observation at the time indicated.

Winds

Street-level winds southwesterly at 1.3 mph; winds at treetop level also southwesterly.

Stability

12.4° F inversion from 6-300 ft measured approximately 9 miles away at Wirth Park (see Figs. C-5 through C-9), over open terrain comparable to Charlie Area, at the western rather than at the southeastern periphery of Minneapolis. Business-area wiresondes obtained at 210 South Tenth Street.

Sky

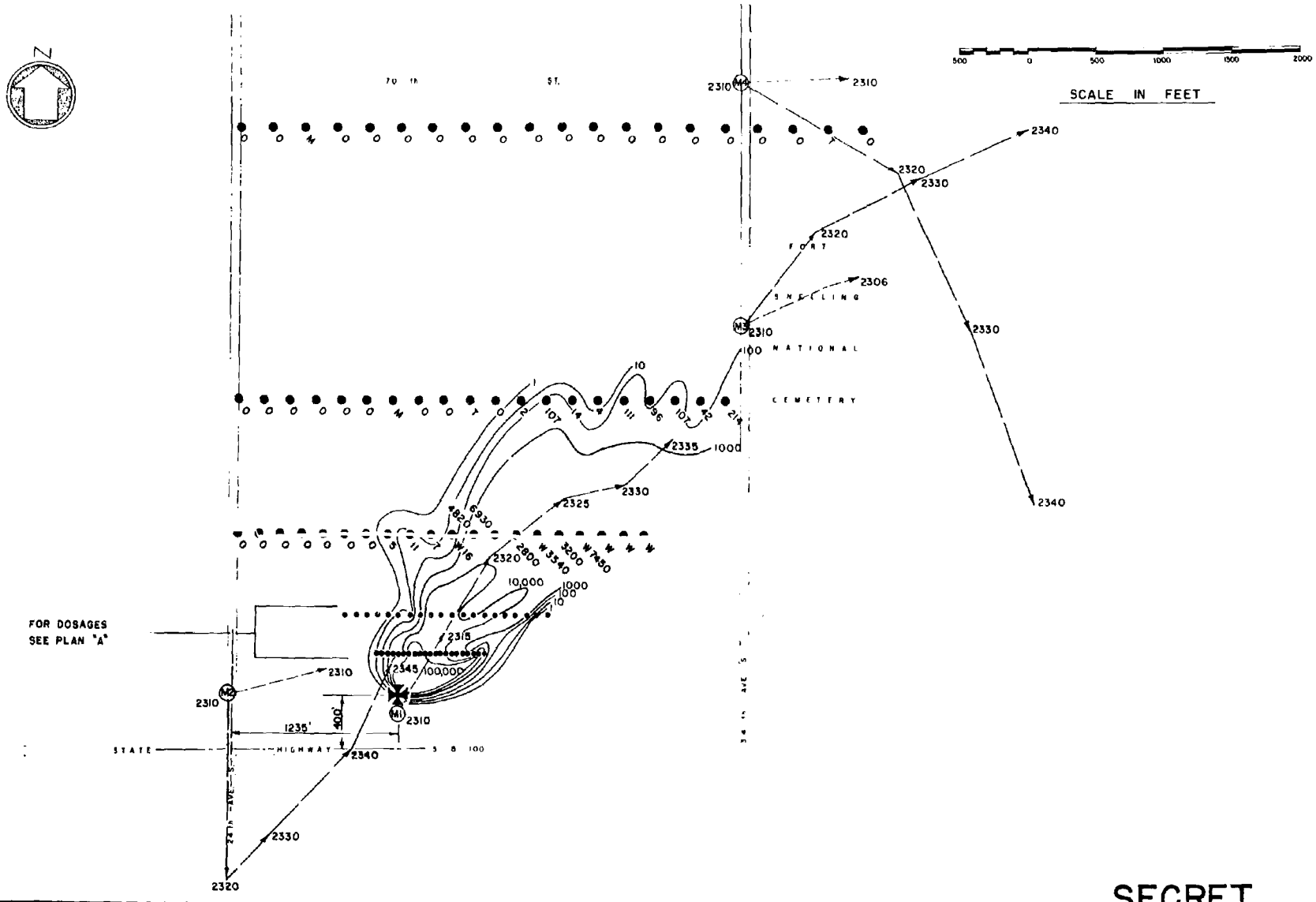
Clear during test period.

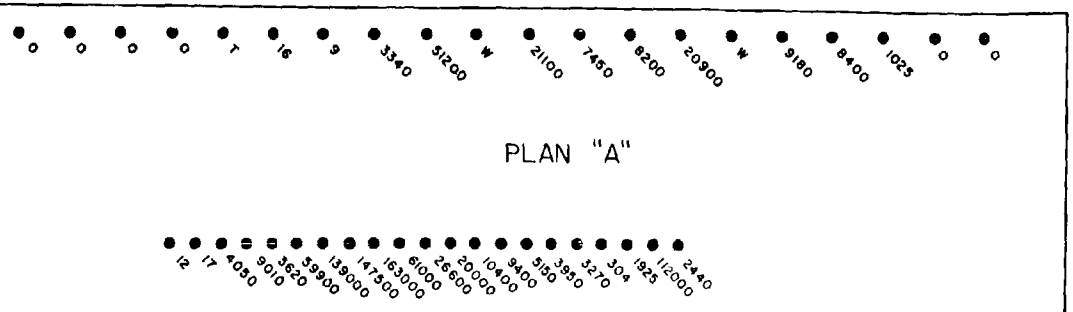
Temperature

19° to 22° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.6 gm/kgm dry air.

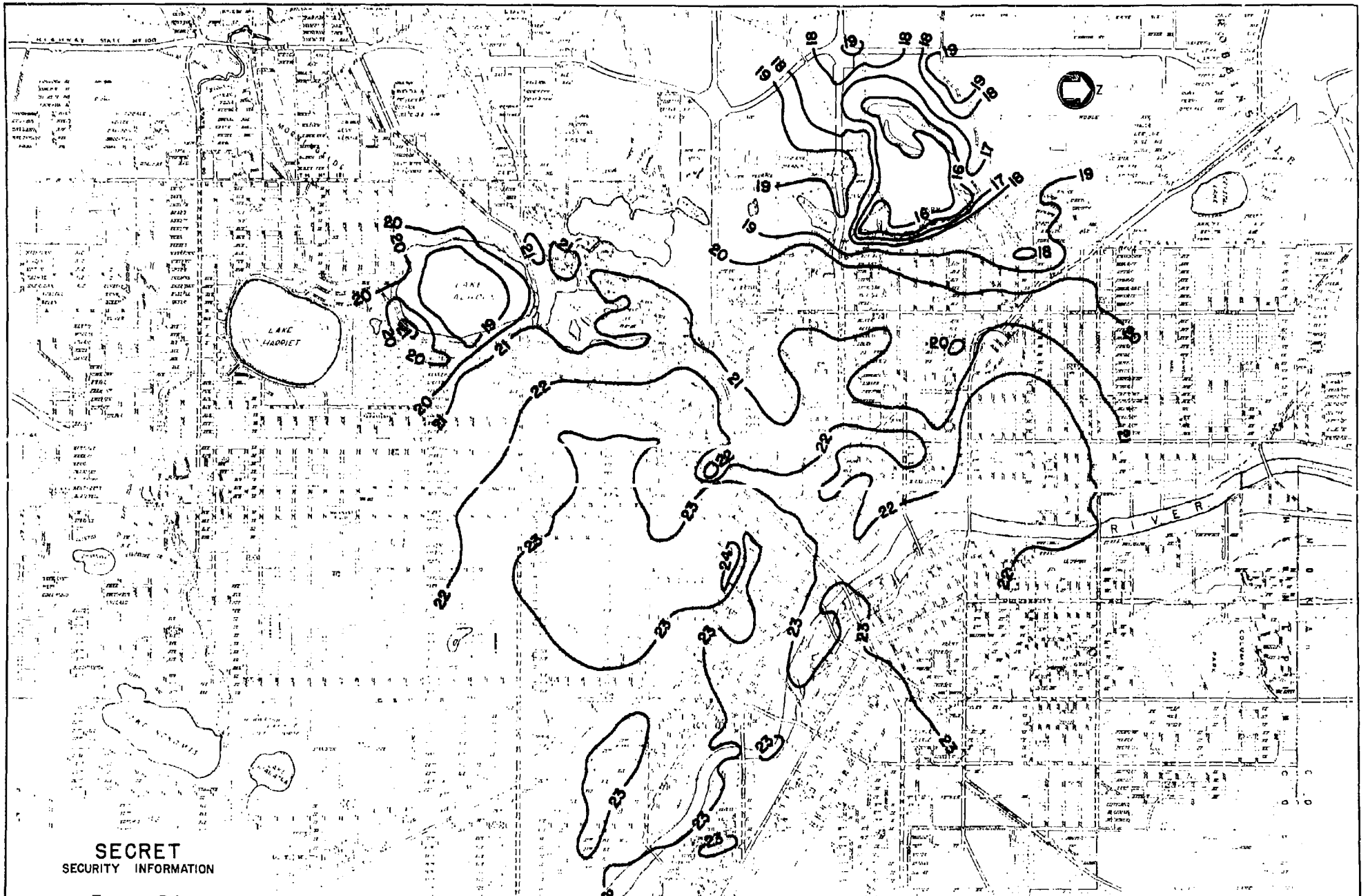




SECRET
SECURITY INFORMATION

FIGURE C-11
TEST ARRAY AND RESULTS
FT 0018d 2308 CST
23 FEBRUARY 1953

APPENDIX "D"



SECRET
SECURITY INFORMATION

FIGURE D-1
TWO-METER AIR
TEMPERATURE SURVEY
M-53
2100 CST 24 FEBRUARY 1953
(SUPPLEMENTAL TO FT 0015)

SUMMARY OF REGIONAL AND LOCAL WEATHER
24 February 1953
(Survey M-53, Supplemental to FT 0015)

SYNOPTIC SITUATION

A small 1020-mb high cell, centered in southeastern Minnesota, carried continental polar air over Minneapolis. An occluded front at the Montana-Dakota border was not yet close enough to affect the test area, although an air-mass stratus deck did appear during the period. At the 700-mb level, the northern portion of a trough was sheared off over Canada, and the balance of this trough extended from South Dakota to Arizona. A strong northwesterly flow persisted over central Canada, but the gradient over Minnesota was relatively flat, resulting in a northwest 700-mb wind of 10 mph for Minneapolis.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	None	Clear	15	-	30	23	NW	8
1930	None	Clear	15+	-	25	20	WNW	7
2030	None	Clear	15+	-	22	17	WSW	7
2130	1700	Broken	15+	-	20	16	W	8
2230	1500	Overcast	15+	-	19	15	WSW	7
2330	1700	Overcast	15+	-	18	15	WSW	10

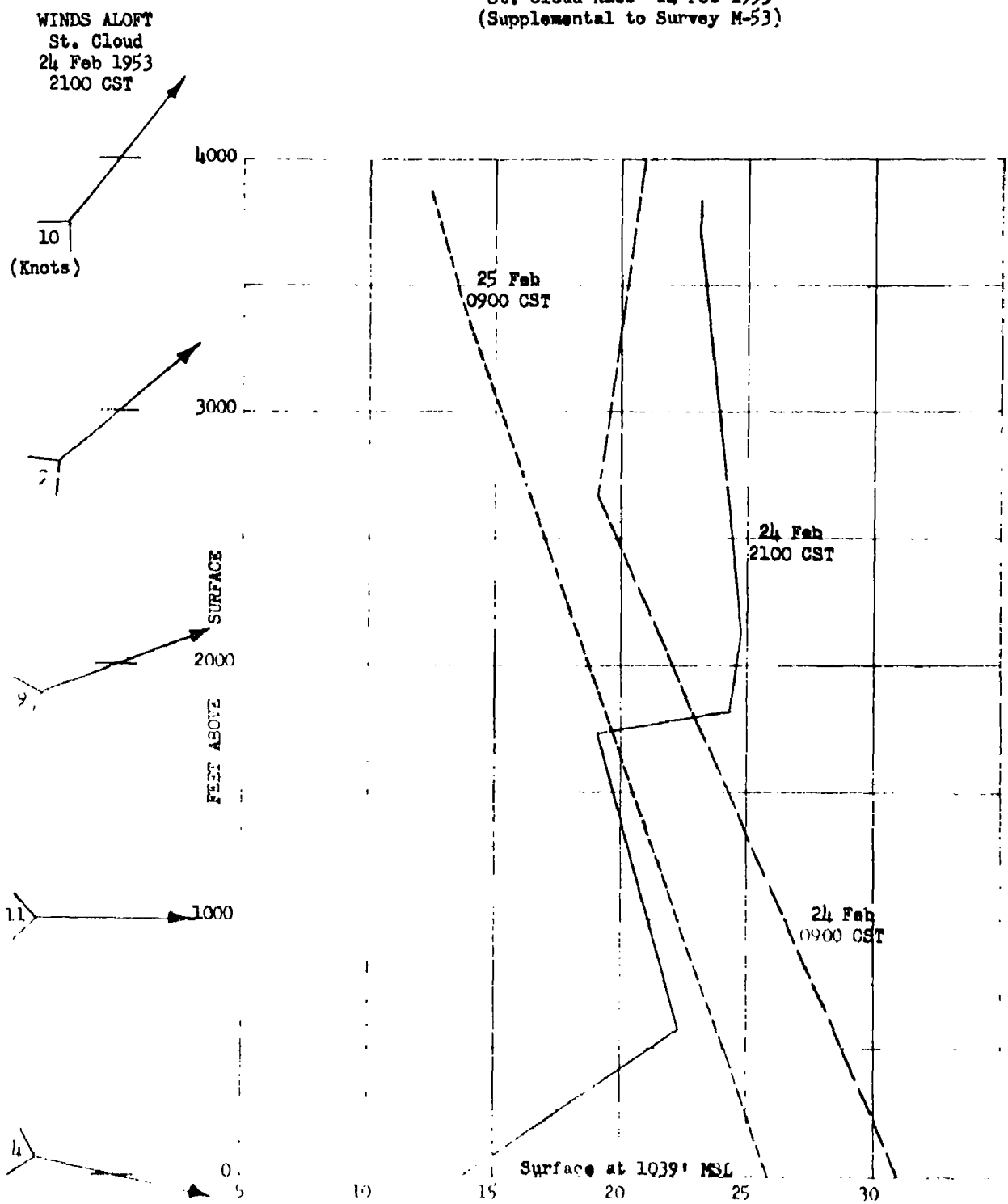
* Average cloudiness sunrise to sunset: 80%
** And/or restriction to visibility

Sea-level pressure at 2130 CST: 1022.0 mb
Ground condition: Twelve-inch snow; main streets clear of snow but thin ice in spots; side streets 50% clear; two-inch packed snow and ice; lake frozen
Tree cover: None

Figure D-2

TEMPERATURE SOUNDINGS

St. Cloud Raob 24 Feb 1953
(Supplemental to Survey M-53)



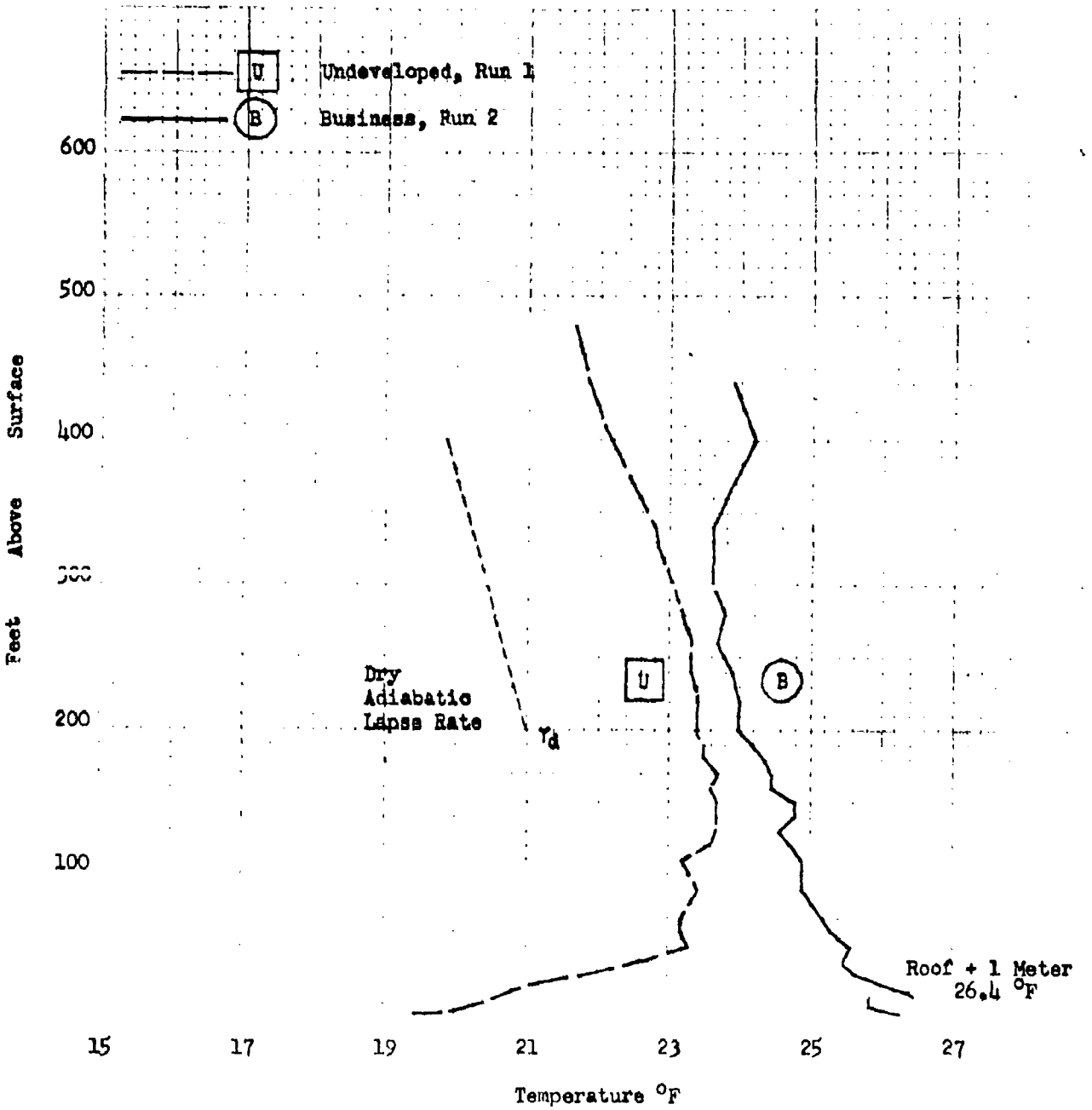


FIGURE D-3

COMPARATIVE TEMPERATURE SOUNDINGS

Undeveloped Vs Business Area
2000 CST 24 Feb 1953

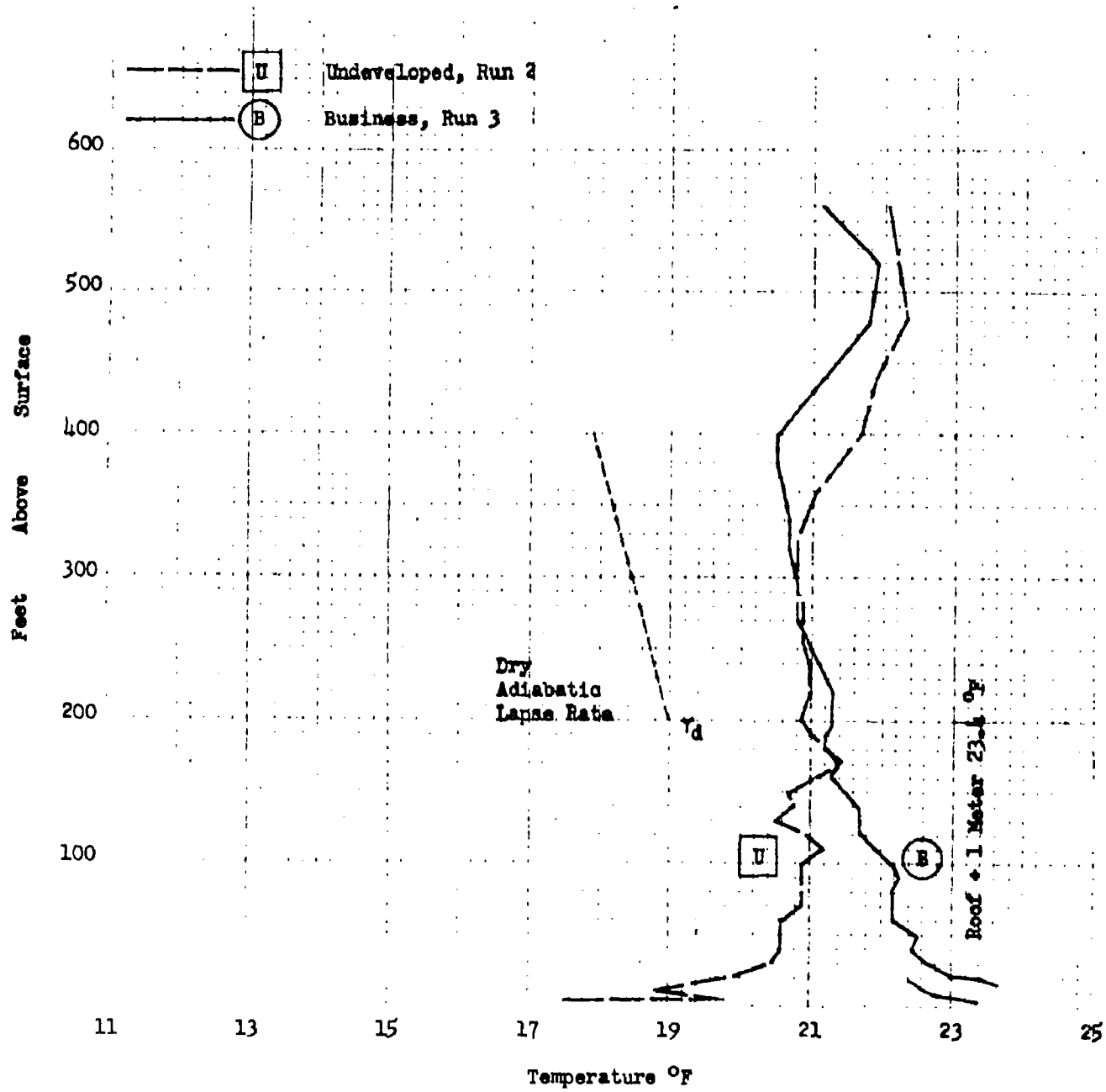


FIGURE D-4

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
2100 CST 24 Feb 1953

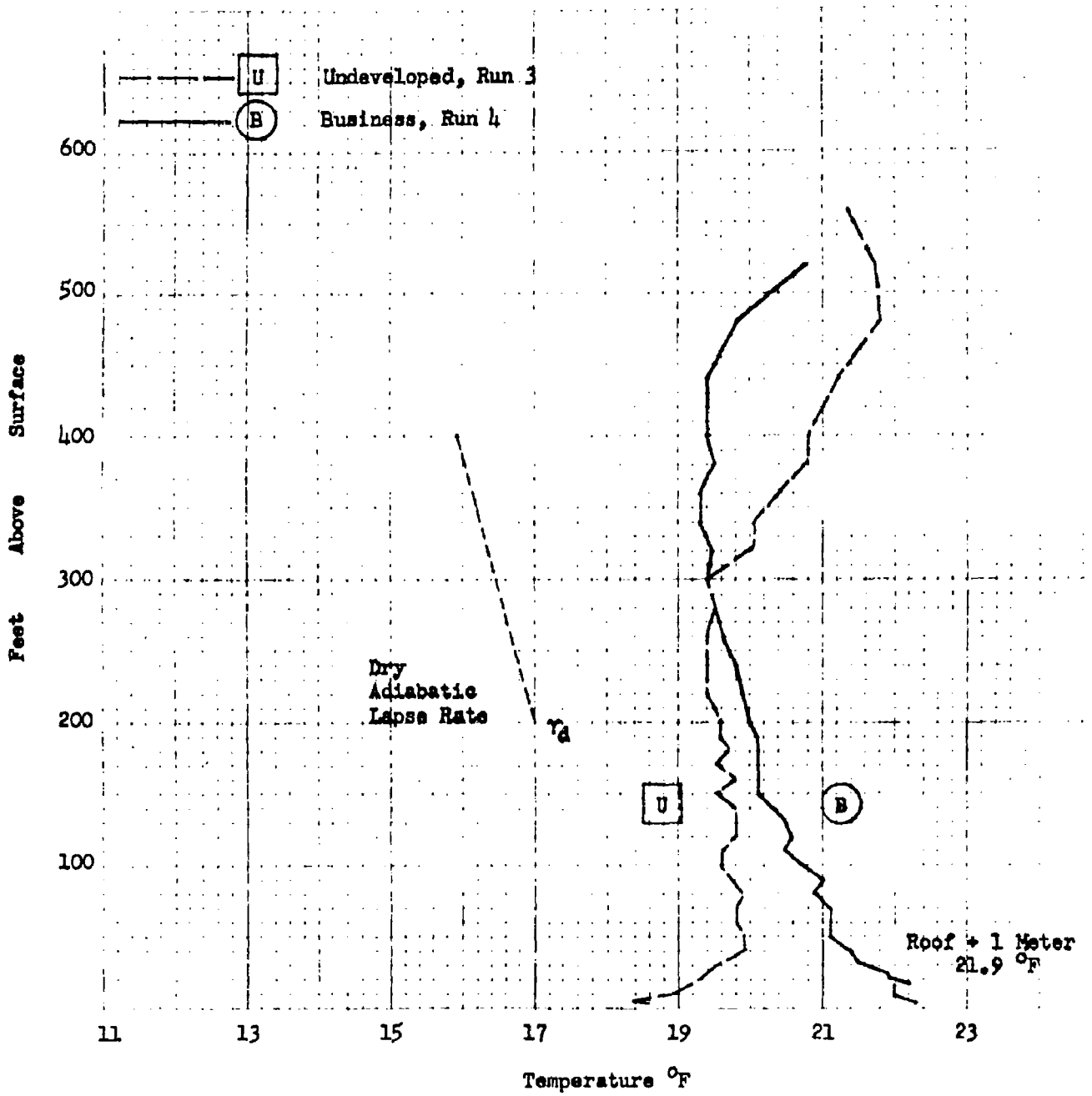


FIGURE D-5

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
2200 CST 24 Feb 1953

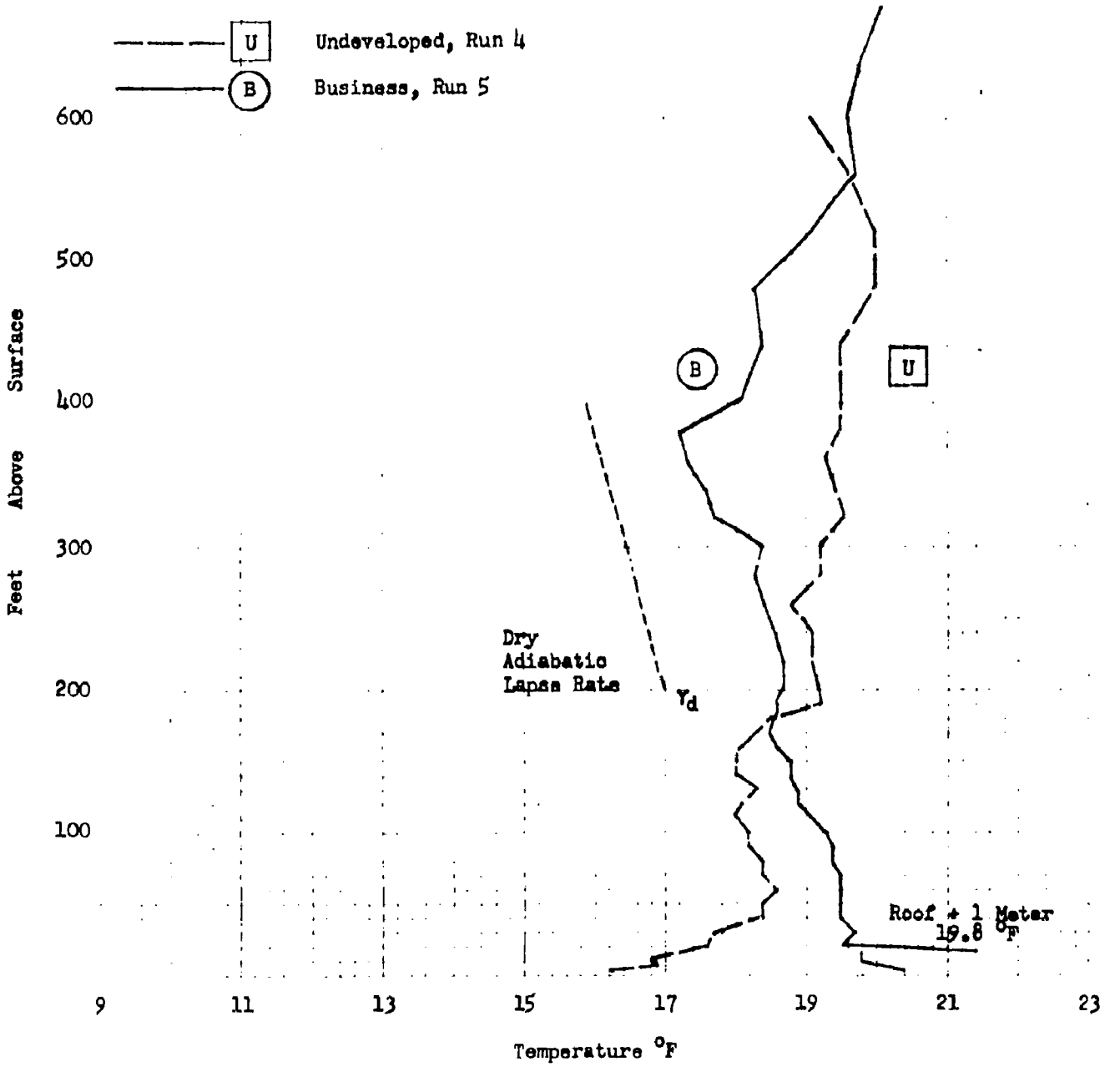


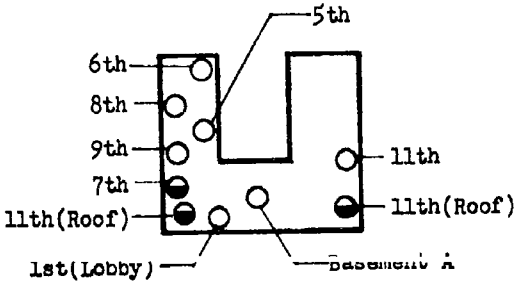
FIGURE D-6

COMPARATIVE TEMPERATURE SOUNDINGS

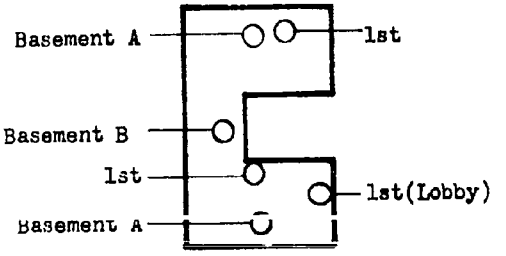
Minneapolis Wiresonde

Undeveloped Vs Business Area
2300 CST 24 Feb 1953

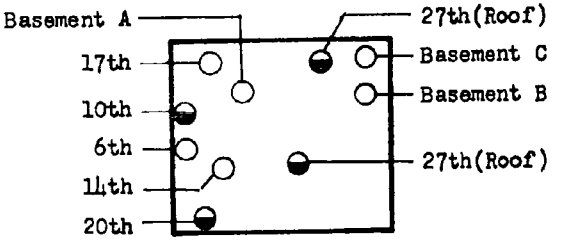
BUILDING NO. 1
ANDRUS BUILDING



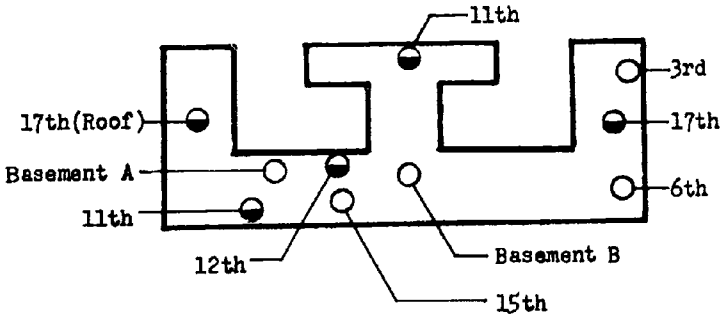
BUILDING NO. 2
FIRST NATIONAL BANK BUILDING



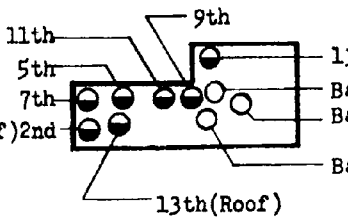
BUILDING NO. 3
NORTHWESTERN BELL TELEPHONE BUILDING



BUILDING NO. 4
NORTHWESTERN NATIONAL BANK BUILDING



BUILDING NO. 5
BAKER BUILDING



BUILDING NO. 6
MEDICAL ARTS BUILDING

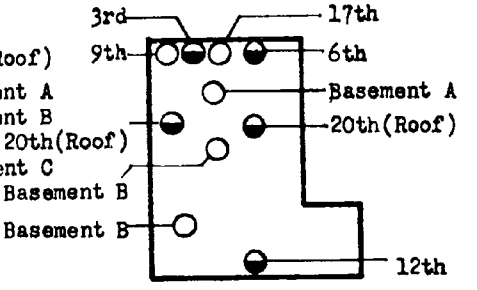


FIGURE D-7

BUILDING SAMPLER ARRAYS AND RESULTS

FT 0015 24 Feb 1953

● Outside sampler at height above the general terrain level or with filter holder extending beyond window.

○ Inside sampler.

SUMMARY OF BUILDING DOSAGES(1)
FT 0015 24 Feb 1953

BUILDING NO. 1
ANDRUS BUILDING

Sampler Location (floor)(2)	Outside Dosages for Given Release(3) FT 0015a	FT 0015b	FT 0015c
Surface(4)	130	60	55
7th	T	92	122
11th(Roof)	73	74	96
11th(Roof)	39	76	121
Inside			
Basement A	28	29	51
1st(Lobby)	64	76	83
5th	5-3	2-19	58-9
6th	10-5	4-10	29-9
8th	5-9	3-10	15-12
9th	35-6	8-5	4-6
11th	6-4	5-13	17-8

BUILDING NO. 2
FIRST NATIONAL BANK BUILDING

Sampler Location (floor)(2)	Outside Dosages for Given Release(3) FT 0015a	FT 0015b	FT 0015c
Surface(4)	52	95	The building was not used in this release
Inside			
Basement A	6-2	T	
Basement A	T-T	3	
Basement B	4-3	T	
1st(Lobby)	6-2	T	
1st	7	23	
1st	19	53	

BUILDING NO. 3
NORTHWESTERN BELL TELEPHONE BUILDING

Sampler Location (floor)(2)	Outside Dosages for Given Release(3) FT 0015a	FT 0015b	FT 0015c
Surface(4)	11	50	35
10th	29	64	18
20th	8	28	14
27th(Roof)	14	33	16
27th(Roof)	17	21	18
Inside			
Basement A	0-0	T-11	6-2
Basement B	19-0	0-31	14-0
Basement C	0-0	0-0	0-0
6th	T-T	T-3	7-14
14th	8	13	10
17th	4-T	T-0	11-4

BUILDING NO. 4
NORTHWESTERN NATIONAL BANK BUILDING

Sampler Location (floor)(2)	Outside Dosages for Given Release(3) FT 0015a	FT 0015b	FT 0015c
Surface(4)	30	80	70
11th	12	14	40
11th	20	31	44
15th	19	57	36
17th(Roof)	30	72	16
17th(Roof)	23	30	55
Inside			
Basement A	T-T	2-3	6-3
Basement B	9-T	0-12	15-2
3rd	5-T	2-7	13-3
6th	3-T	T-3	8-2
12th	2-0	0-3	T-2

BUILDING NO. 5
BAKER BUILDING

Sampler Location (floor)(2)	Outside Dosages for Given Release(3) FT 0015a	FT 0015b	FT 0015c
Surface(4)	1	7	10
2nd	T	13	11
5th	T	5	12
7th	T-0	M	8-0
9th	0	10	8
11th	3-0	M	T-0
13th(Roof)	0	4	9
13th(Roof)	3	6	9
Inside			
Basement A	T-T	2-T	3-4
Basement B	0-0	0-T	3-T
Basement C	0-0	0-0	0-0

BUILDING NO. 6
MEDICAL ARTS BUILDING

Sampler Location (floor)(2)	Outside Dosages for Given Release(3) FT 0015a	FT 0015b	FT 0015c
Surface(4)	0	4	1
3rd	0	T	T
6th	0	T	T
12th	0	0	0
20th(Roof)	0	0	0
20th(Roof)	0	0	0
Inside			
Basement A	0-T	T-0	T-0
Basement B	0-0	29-2	0-0
Basement B	0-0	0-0	0-0
9th	0-0	0-0	0-0
17th	T-0	0-0	T-T

(1) See Figure III-8 for oblique aerial view of downtown Minneapolis showing array of buildings used in studies of aerosol-cloud penetration. A description of each building is given with Figure III-8. For the indicated releases, Figures D-9, D-10, and D-11 (Appendix D) show the buildings in relation to the grid complex and the dosage pattern.

(2) Samplers located on the same floor are listed according to their counterclockwise positions.

(3) Dosages are expressed in particle-minutes per liter. M indicates malfunction, and T represents trace dosage, i.e., a count not exceeding 15 fluorescent particles. A single entry expresses the dosage obtained from a filter unit exposed during the entire sampling period of an indicated release. Double entries for a given column represent incremental dosages obtained with sequentially exposed filter units. Applicable incremental periods for each sampler, as well as full sampling periods for each release, are as follows:

Release	Sampling Period	Incremental Periods
FT 0015a	2000-2100 CST	2000-2045 CST 2045-2115 CST
FT 0015b	2115-2215 CST	2115-2200 CST 2200-2230 CST
FT 0015c	2230-2400 CST	2230-2315 CST 2315-2345 CST

(4) In the absence of an adjacent outside sampler (●), at the one to six-foot level, a value has been estimated, based on the analysis of the overall isodosage pattern for a given release. The estimate has been made in order to obtain the base value needed to establish the percentage of aerosol-cloud penetration.

FIGURE D-8

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0015 24 Feb 1953

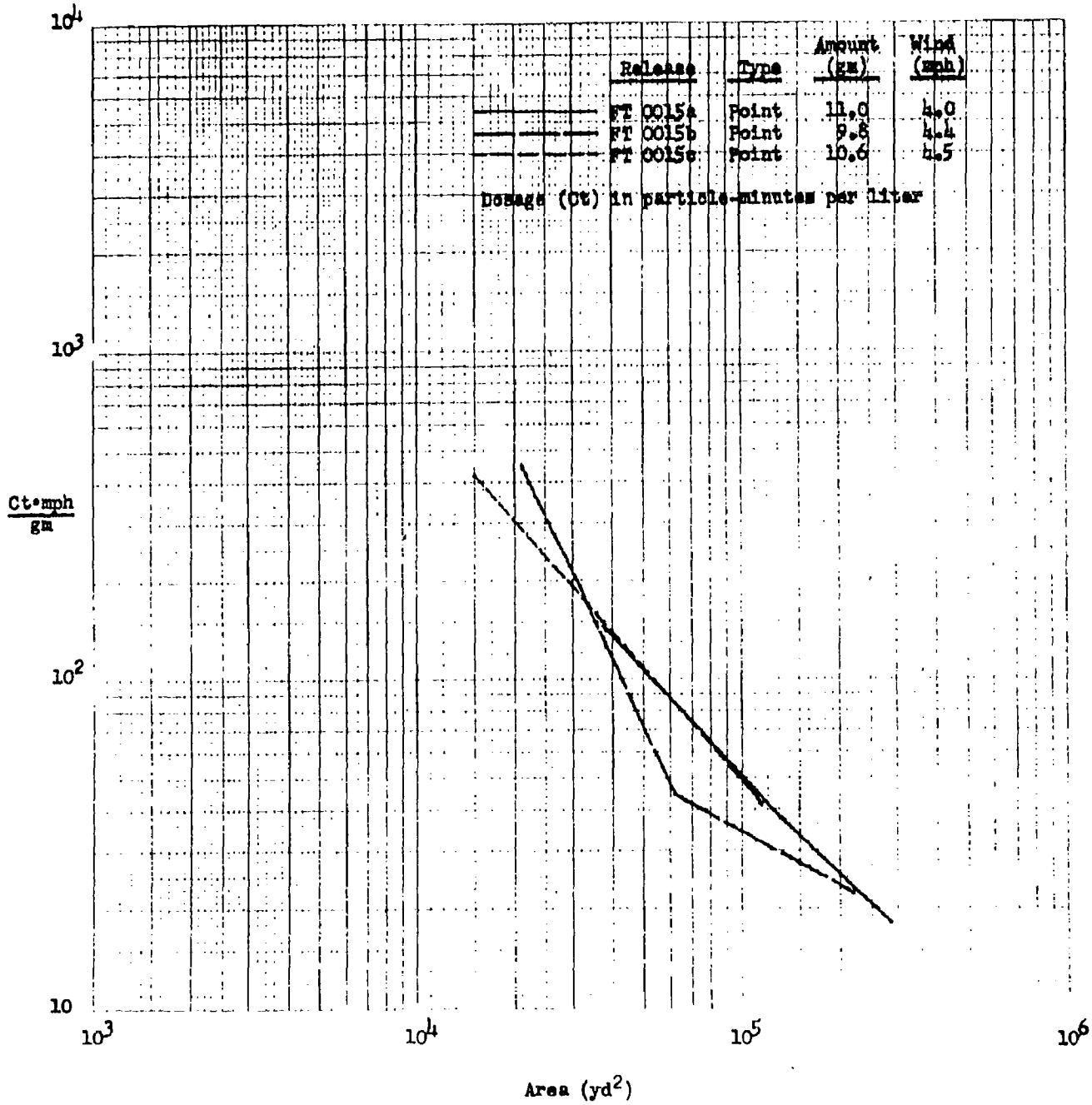


Figure D-9

TEST ARRAY AND RESULTS
FT 0015a

24 Feb 1953
2006 CST

AEROSOL GENERATION

Point-source release of 11.0 gms of NJZ 2266 over a period of 5 minutes starting at 2006 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 110 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Sampling stations included in buildings represented by numbered building outlines, identified as follows:

- Andrus Building
- First National Bank Bldg
- Northwestern Bell Telephone Bldg
- Northwestern National Bank Bldg
- Baker Building
- Medical Arts Building

Results

All samplers operated to measure total dosages. In addition, samplers in given buildings were operated incrementally; sampler arrays, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure D-7.

Total Dosage (particle-minutes/liter)

T = trace dosage

●58

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated M1 , M2 , M3 , and M4 .

Similar observations at rooftop level made at meteorological station M5 , located 17 stories high on 5 , Northwestern National Bank Building.

Wiresonde ascents made at meteorological station M4 , at 210 South Tenth Street. Undeveloped-area wiresondes (see Figs. D-3 through D-6) obtained at Wirth Park, approximately 3 miles west of M4 .

2100 — 2105 — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

- - - - - - - - → 2100 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-northwesterly at 2.5 mph, and roof-level winds west-northwesterly at 9.3 mph.

Stability

3.0° F lapse from 6-300 ft.

Sky

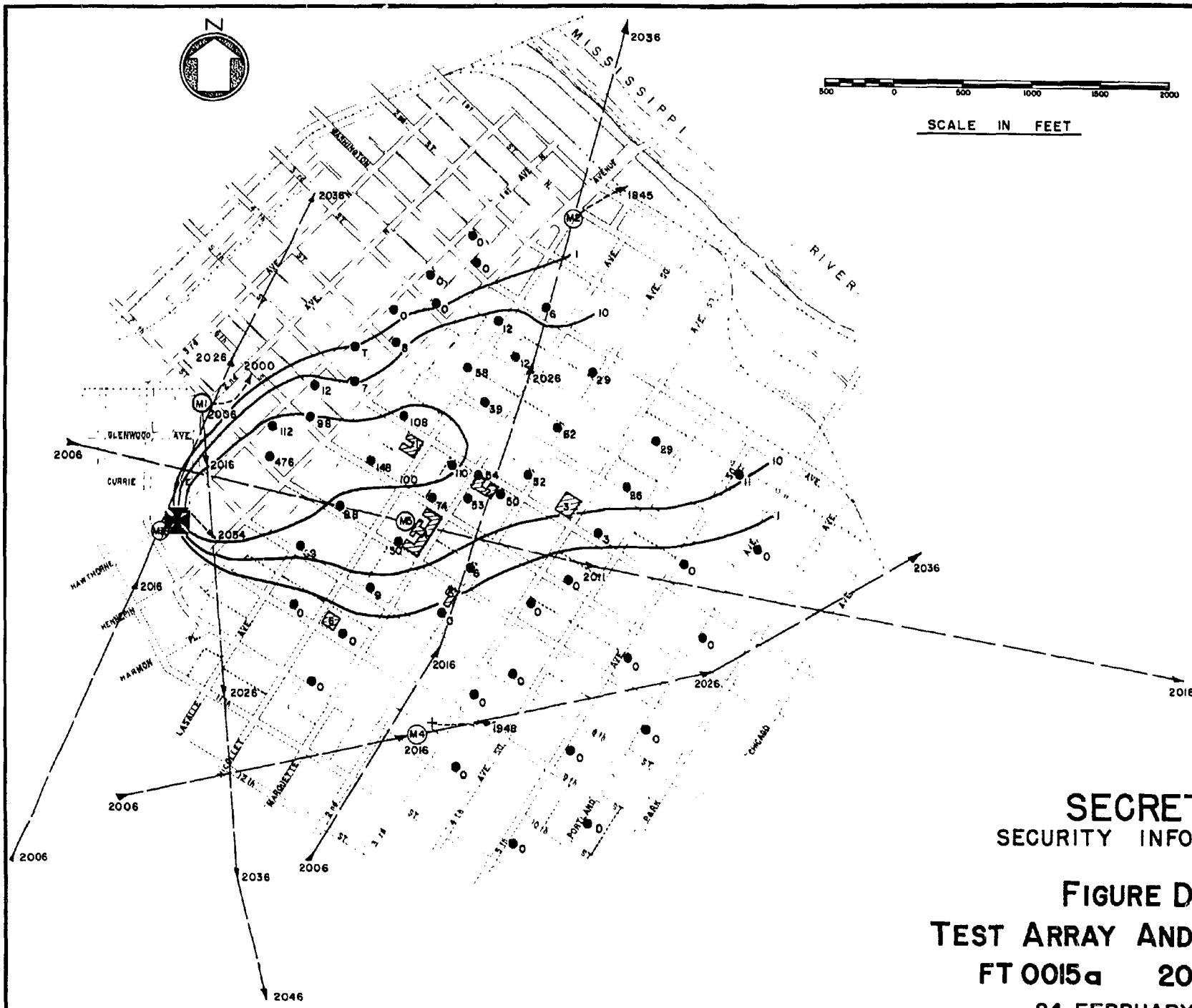
Clear during test period.

Temperature

24.8° to 26.5° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.0 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE D-9
TEST ARRAY AND RESULTS
FT 0015a 2006 CST
24 FEBRUARY 1953

Figure D-10

TEST ARRAY AND RESULTS
FT 0015b

24 Feb 1953
2155 CST

AEROSOL GENERATION

Point-source release of 9.8 gms of NJZ 2266 over a period of 5 minutes starting at 2155 CST from a vehicle-mounted blower disperser located at point [redacted] .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 110 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Sampling stations included in buildings represented by numbered building outlines, identified as follows:

- Andrus Building
- First National Bank Bldg
- Northwestern Bell Telephone Bldg
- Northwestern National Bank Bldg
- Baker Building
- Medical Arts Building

Results

All samplers operated to measure total dosages. In addition, samplers in given buildings were operated incrementally; sampler arrays, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure D-7.

Total Dosage (particle-minutes/liter)

●58

T = trace dosage

* = evidence of contamination

100 — 100

Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated M1 , M2 , M3 , and M4 .

Similar observations at rooftop level made at meteorological station M5 , located 17 stories high on [redacted], Northwestern National Bank Building.

Wiresonde ascents made at meteorological station M4 , at 210 South Tenth Street. Undeveloped-area wiresondes (see Figs. D-3 through D-6) obtained at Wirth Park, approximately 3 miles west of M4 .

2105 — 2110
2100

Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2100

Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds west-northwesterly at 1.7 mph, and roof-level winds westerly at 9.8 mph.

Stability

2.8° F lapse from 6-300 ft.

Sky

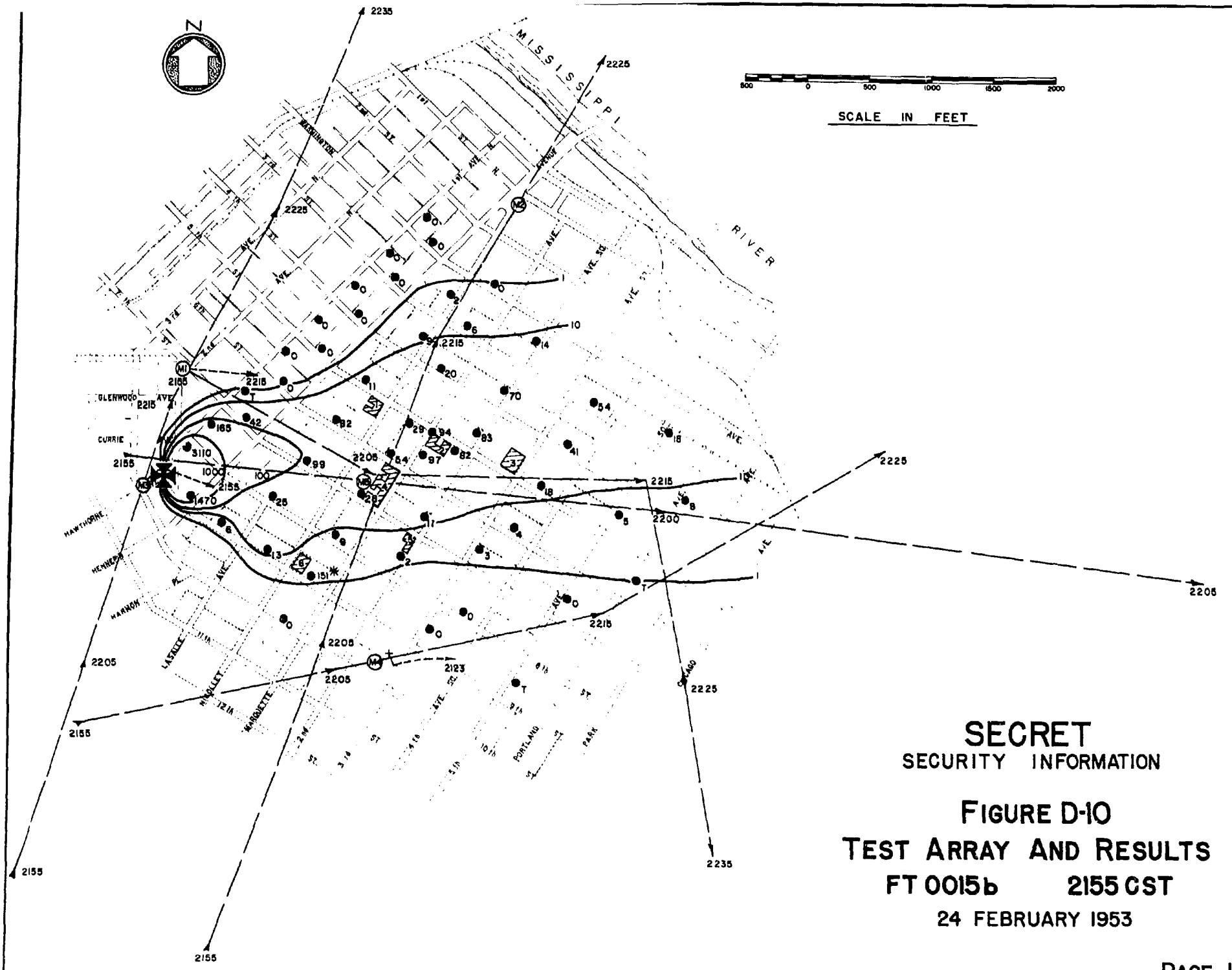
Overcast clouds with bases 1500 ft above the surface.

Temperature

20° to 22° F at 2 meters in the test area.

Moisture

Mixing ratio of 1.9 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE D-10
TEST ARRAY AND RESULTS
FT 0015b 2155 CST
24 FEBRUARY 1953

AEROSOL GENERATION

Point-source release of 10.6 gms of NJZ 2266 over a period of 5 minutes starting at 2235 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 110 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Sampling stations included in buildings represented by numbered building outlines, identified as follows:

1. Andrus Building
2. Northwestern Bell Telephone Bldg
3. Northwestern National Bank Bldg
5. Baker Building
6. Medical Arts Building

Results

All samplers operated to measure total dosages. In addition, samplers in given buildings were operated incrementally; sampler arrays, full sampling periods, incremental periods, and applicable incremental dosages are presented in Figure D-7.

Total Dosage (particle-minutes/liter)

T = trace dosage

* = evidence of contamination

58

100

100

Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated M1 , M2 , M3 , and M4 .

Similar observations at rooftop level made at meteorological station M5 , located 17 stories high on 3, Northwestern National Bank Building.

Wiresonde ascents made at meteorological station M4 , at 210 South Tenth Street. Undeveloped-area wiresondes (see Figs. D-3 through D-6) obtained at Wirth Park, approximately 3 miles west of M4 .

2100 — 2105 — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2100 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds westerly at 2.2 mph, and roof-level winds west-northwesterly at 9.8 mph.

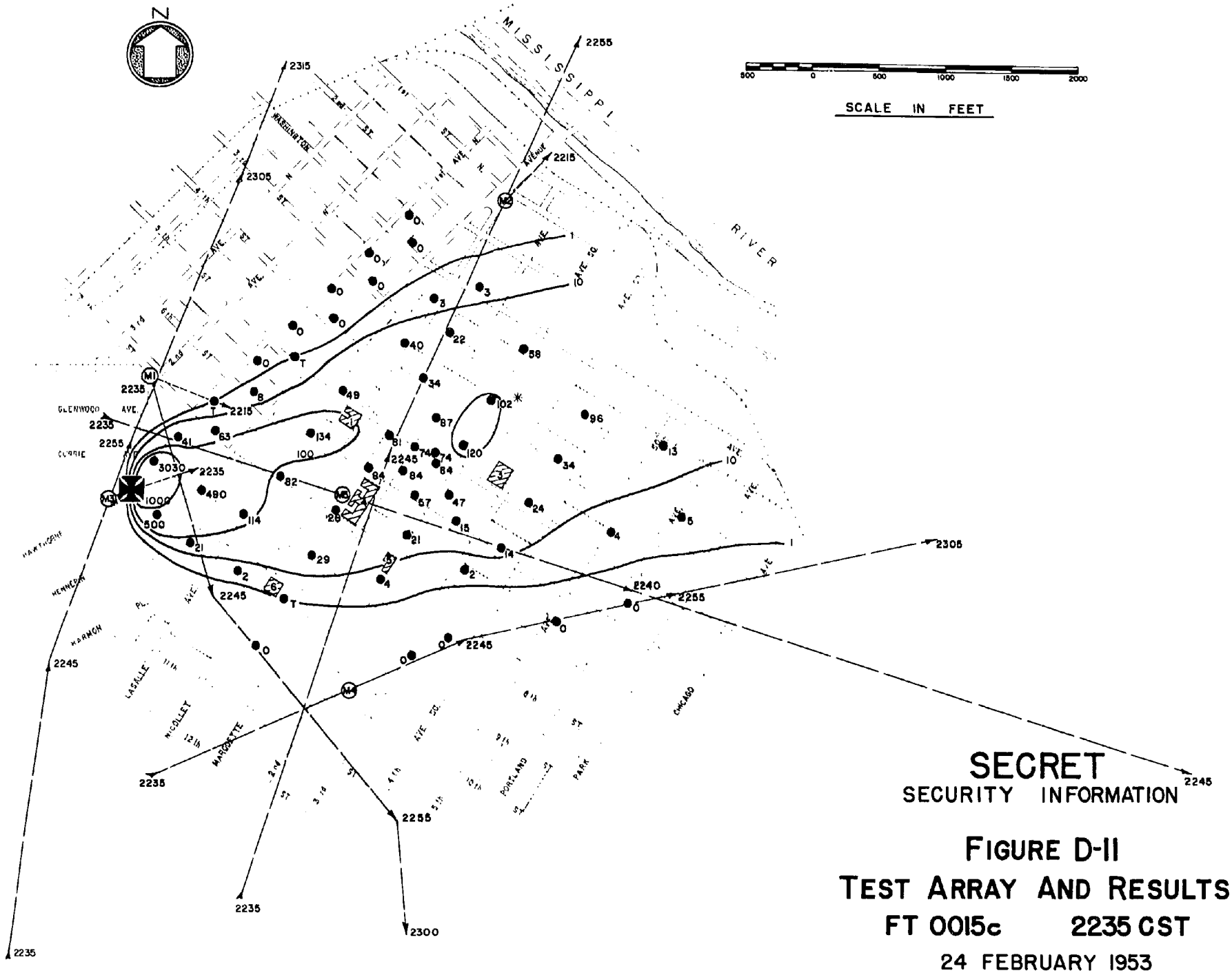
Stability

2.4° F lapse from 6-300 ft.

Sky

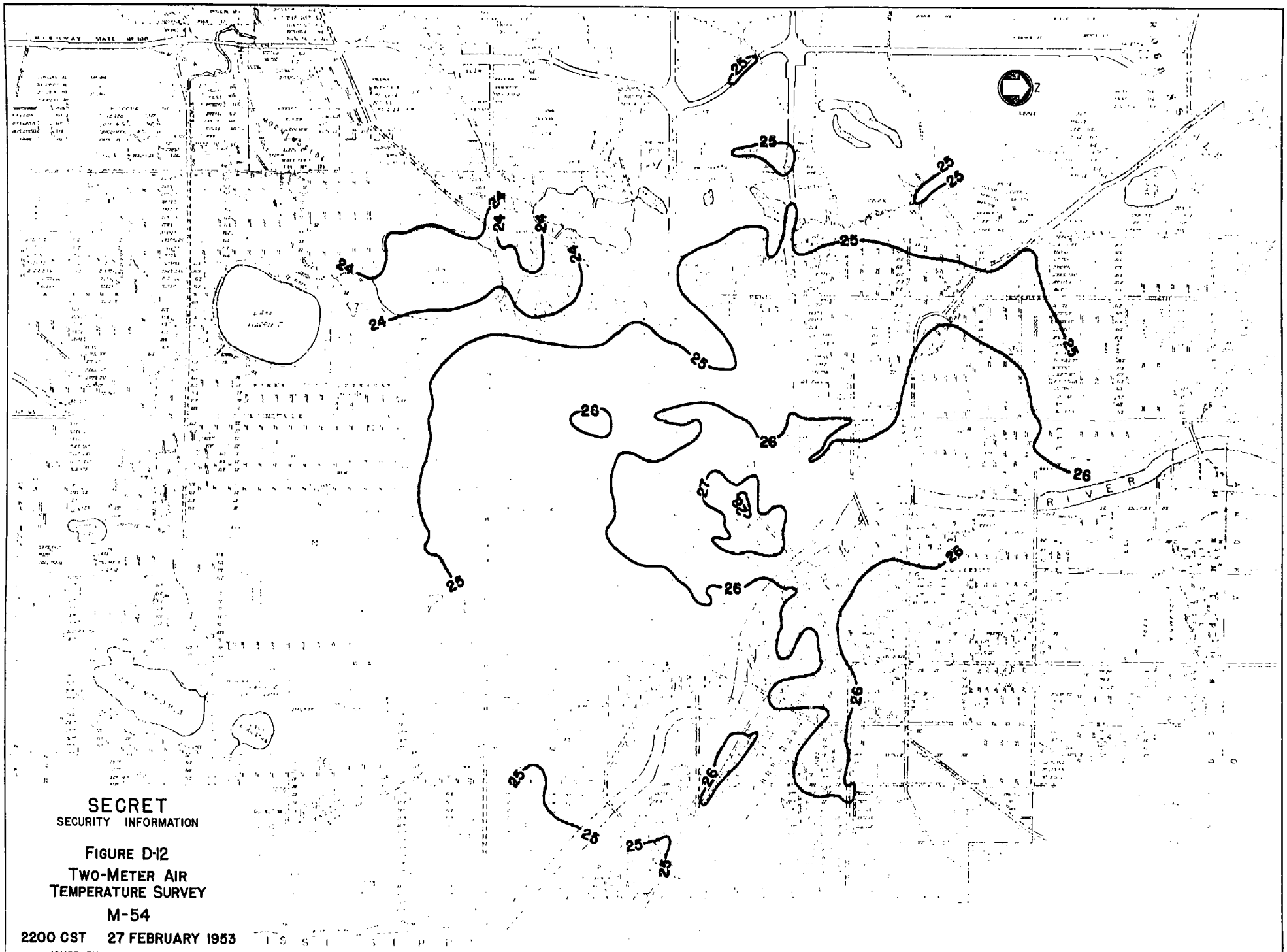
Overcast clouds with bases 1500 ft above the surface.

Temperature



SECRET
SECURITY INFORMATION

FIGURE D-11
TEST ARRAY AND RESULTS
FT 0015c 2235 CST
24 FEBRUARY 1953



SECRET
SECURITY INFORMATION

FIGURE D-12
TWO-METER AIR
TEMPERATURE SURVEY
M-54
2200 CST 27 FEBRUARY 1953
(SUPPLEMENTAL TO FT 0016)

SUMMARY OF REGIONAL AND LOCAL WEATHER
27 February 1953
(Survey M-54, Supplemental to FT 0016)

SYNOPTIC SITUATION

A nearly stationary cold front trailing from the weak system that passed Minneapolis the previous day was oriented southeast-northwest through Minnesota and western North Dakota. What appeared to be a weak stable wave moved southeast along this front, its crest passing Minneapolis during the test period. Multiple cloud decks and occasional snow flurries accompanied this passage and a fresh surge of colder air followed the temporary warming prior to its passage. A weak Polar continental high cell was centered over Kansas and a moderately strong Arctic continental high was centered over northern Saskatchewan. At the 700-mb level, a west-northwesterly gradient wind of 45 mph resulted from a broad trough extending from Ontario to Florida and from a wide weak ridge over the Rocky Mountain states.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	4400	Broken	15	-	24	13	W	5
1930	3700	Overcast	15+	-	24	14	SSW	5
2030	2900	Overcast	15+	-	25	18	SSW	5
2130	3500	Broken	15+	-	25	20	SSE	6
2230	3600	Broken	15+	-	25	20	SSW	4
2330	4000	Broken	15+	-	26	23	WSW	8

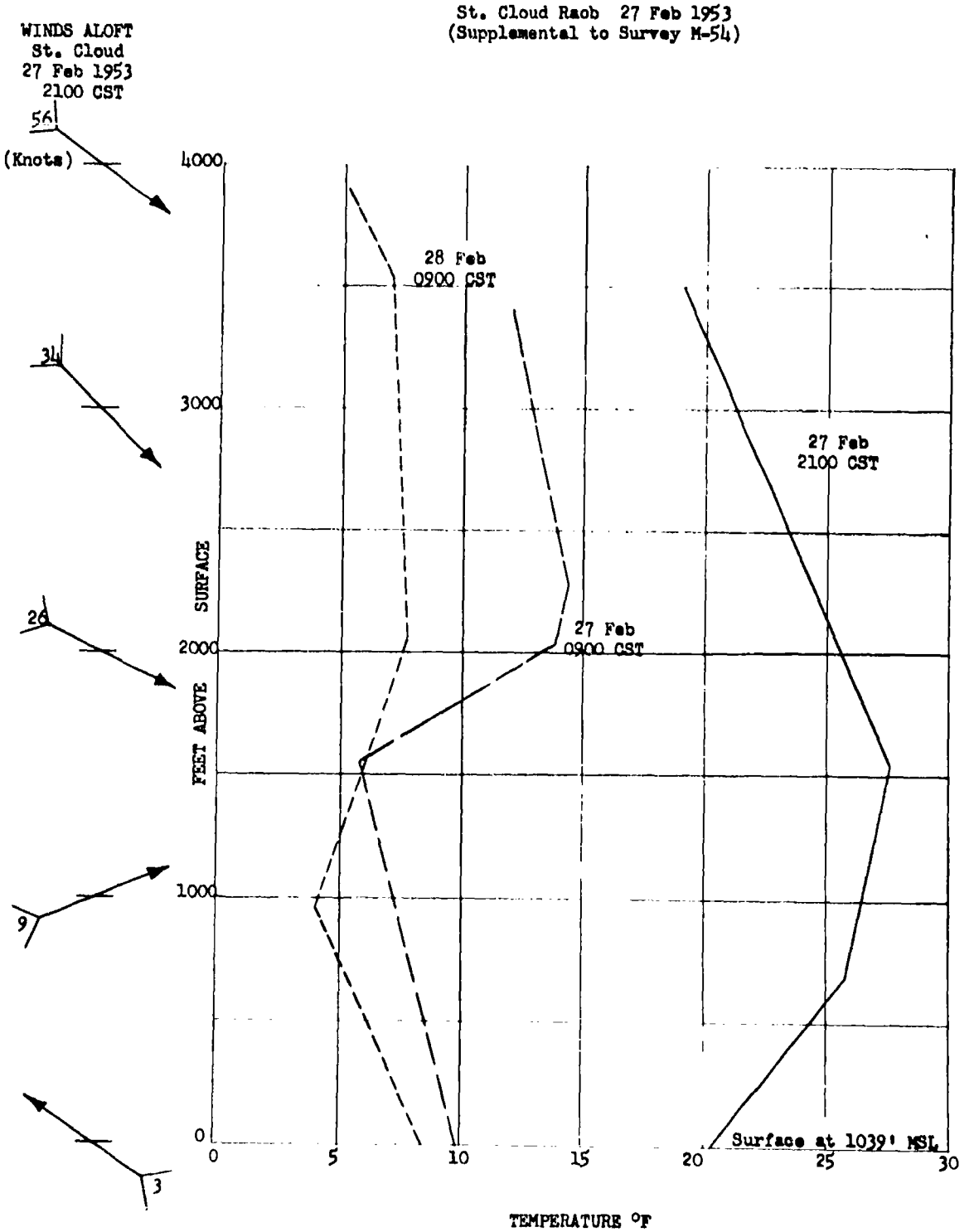
* Average cloudiness sunrise to sunset: 0%
** And/or restriction to visibility

Sea-level pressure at 2130 CST: 1014.9 mb
Ground conditions: Twelve-inch snow; main streets clear of snow; thin ice in spots; side streets 50/50 clear and two-inch packed snow and ice; lake frozen
Tree cover: None

Figure D-13

TEMPERATURE SOUNDINGS

St. Cloud Raob 27 Feb 1953
(Supplemental to Survey M-54)



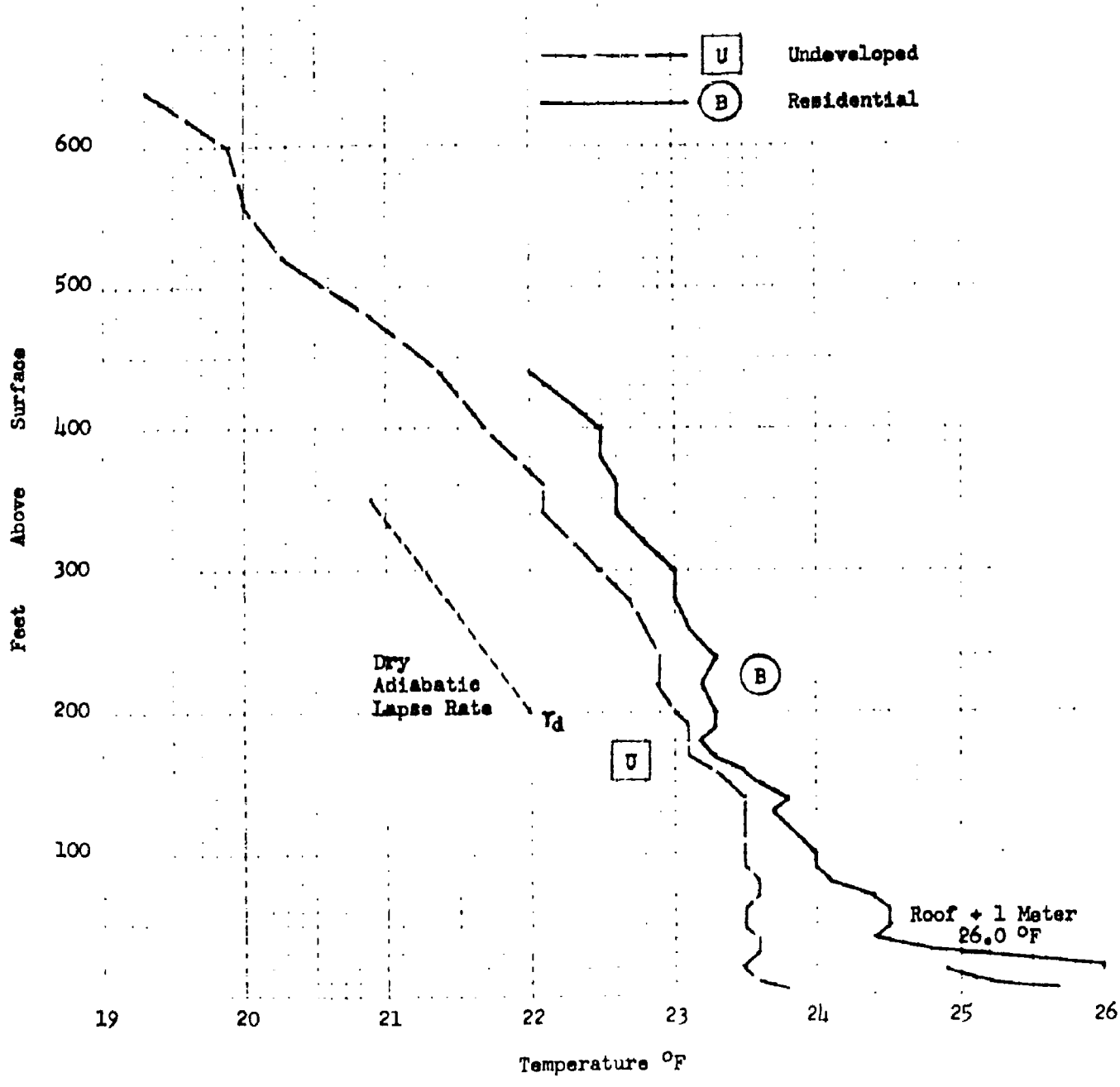


FIGURE D-14

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
Run 1, 1900 CST 27 Feb 1953

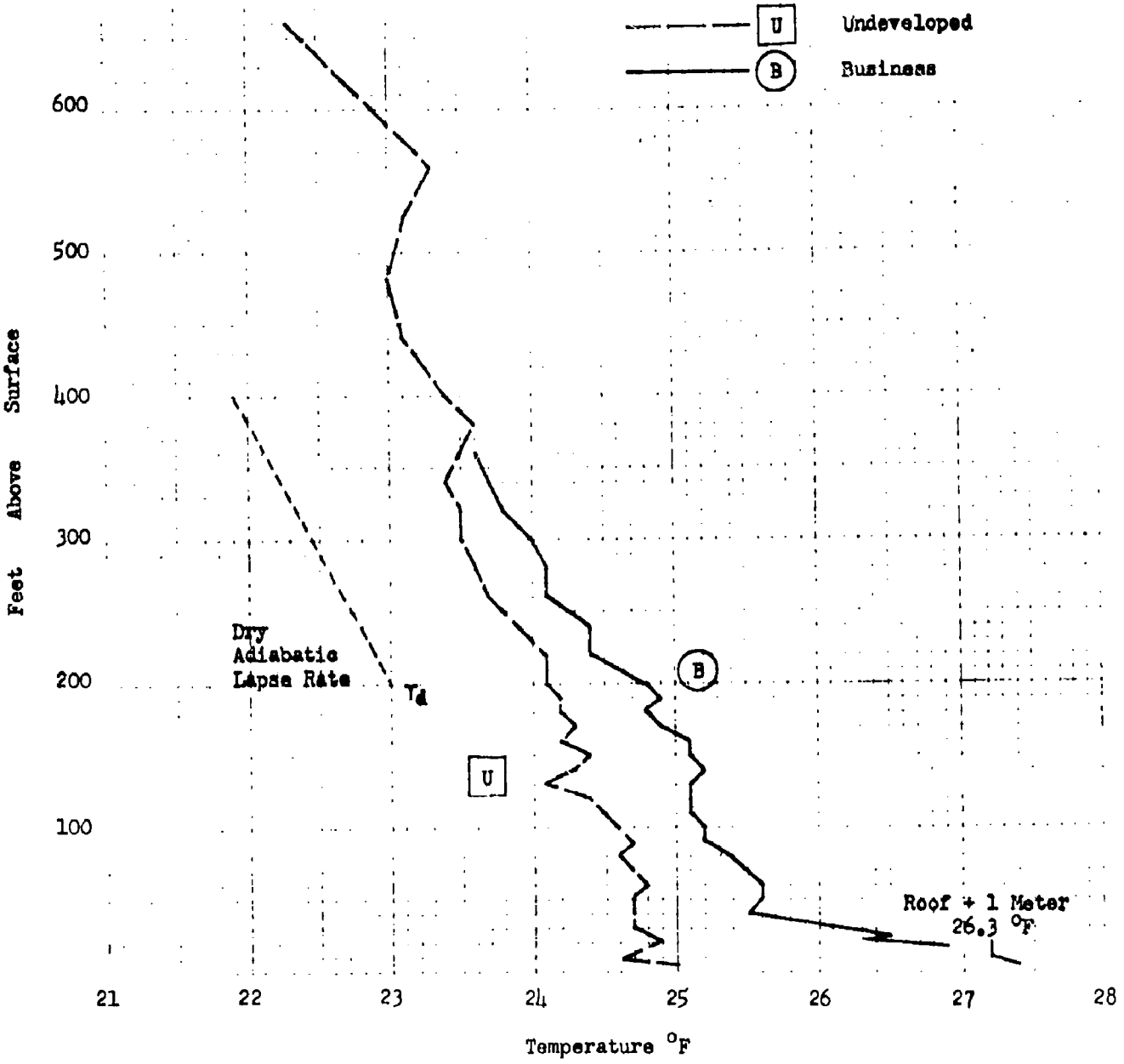


FIGURE D-15

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
Run 2, 2000 CST 27 Feb 1953

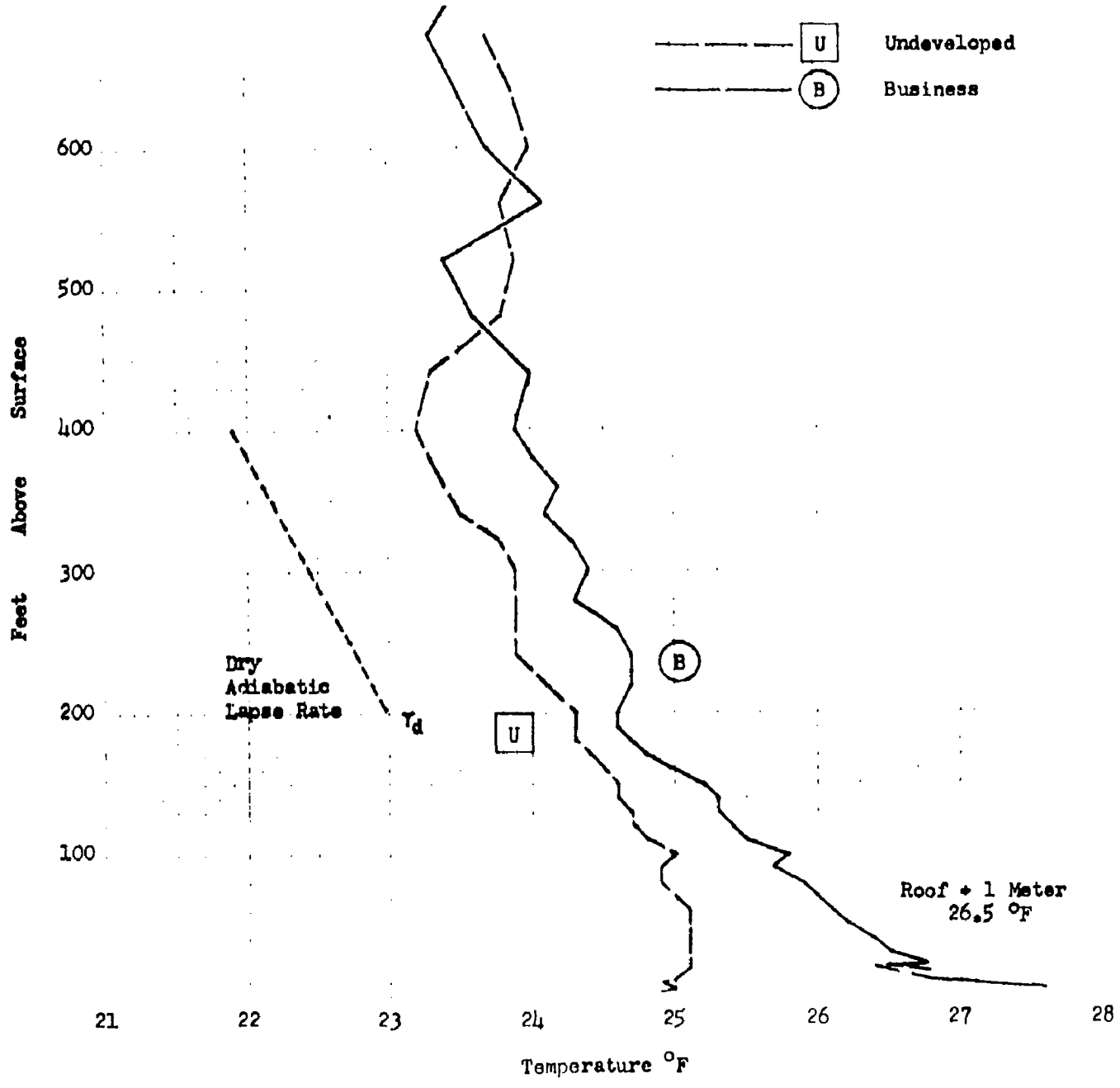


FIGURE D-16

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
Run 3, 2100 CST 27 Feb 1953

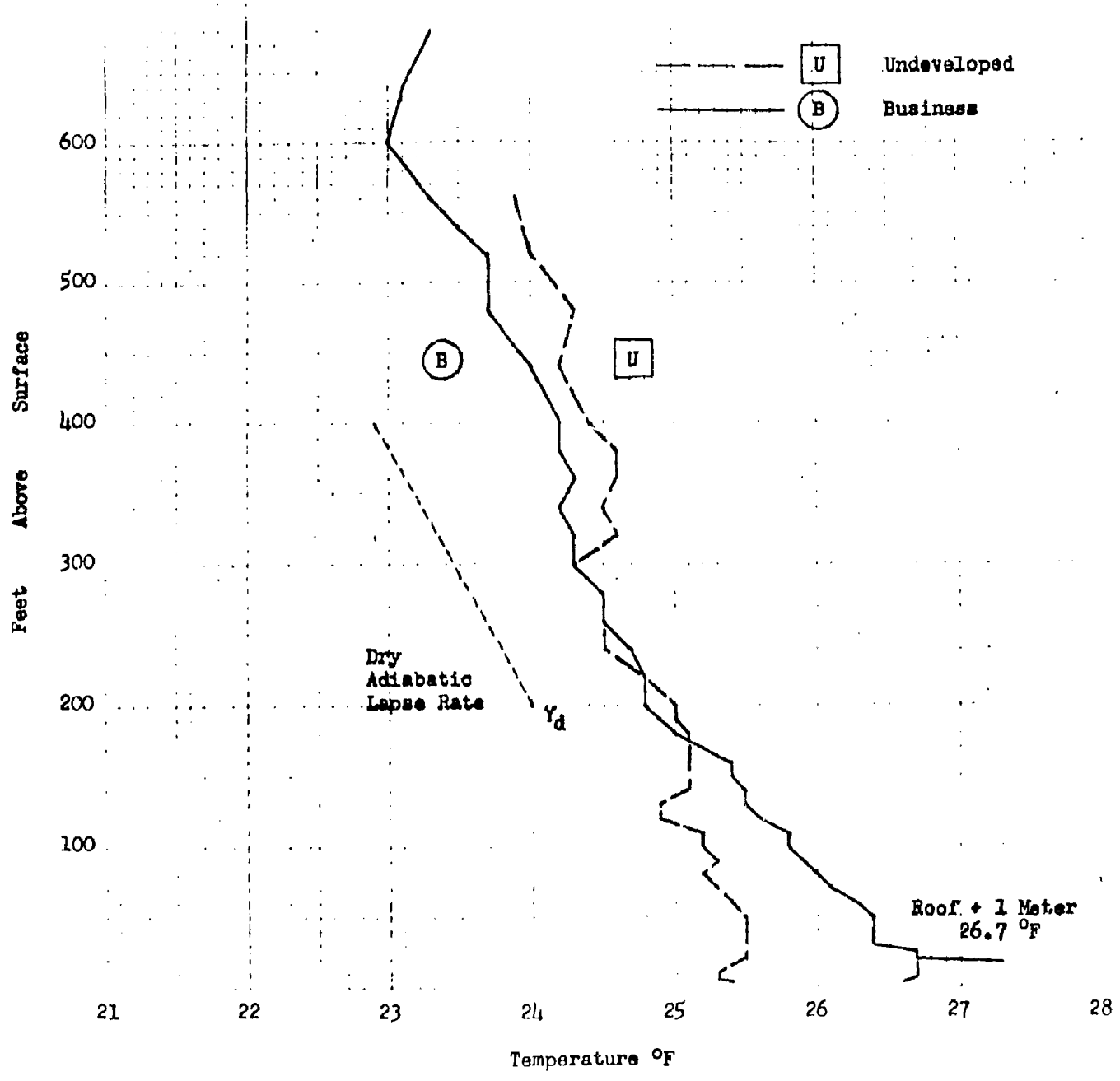


FIGURE D-17

COMPARATIVE TEMPERATURE SOUNDINGS

Minneapolis Wiresonde

Undeveloped Vs Business Area
Run 4, 2200 CST 27 Feb 1953

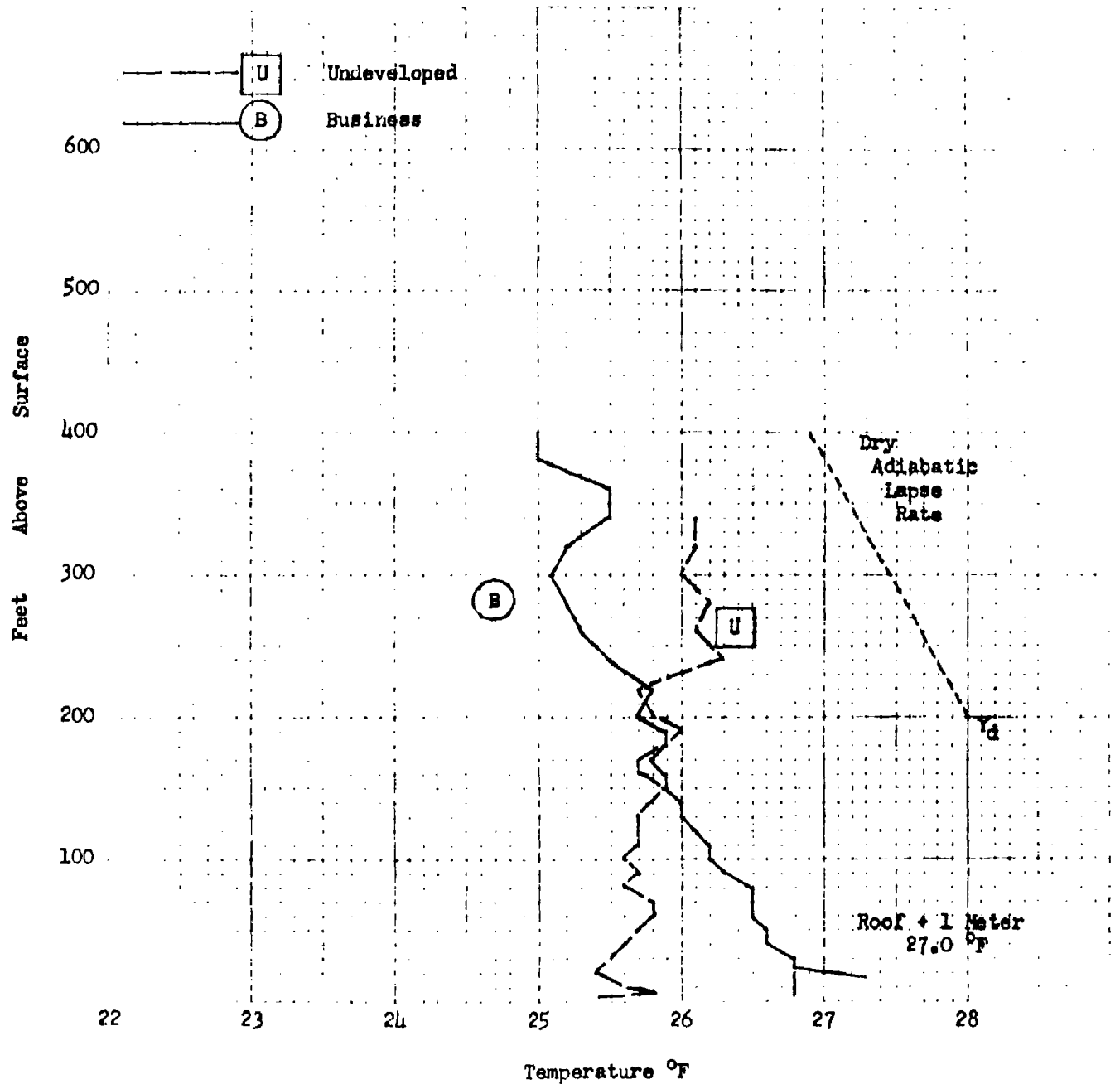


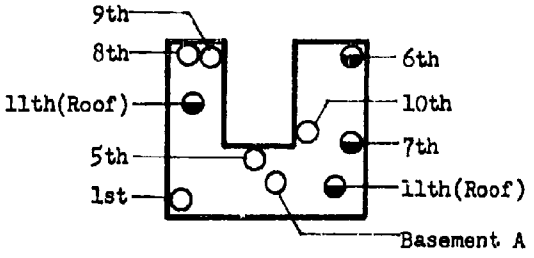
FIGURE D-18

COMPARATIVE TEMPERATURE SOUNDINGS

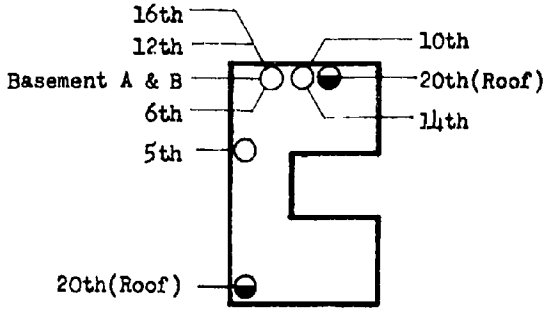
Minneapolis Wiresonde

Undeveloped Vs Business Area
Run 5, 2300 CST, 27 Feb 1953

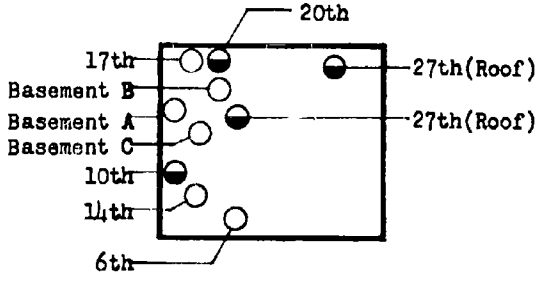
BUILDING NO. 1
ANDRUS BUILDING



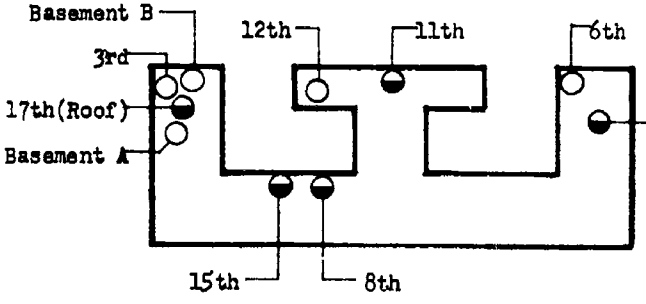
BUILDING NO. 2
FIRST NATIONAL BANK BUILDING



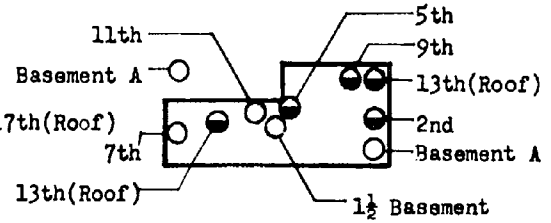
BUILDING NO. 3
NORTHWESTERN BELL TELEPHONE BUILDING



BUILDING NO. 4
NORTHWESTERN NATIONAL BANK BUILDING



BUILDING NO. 5
BAKER BUILDING



BUILDING NO. 7
FOSHAY TOWER

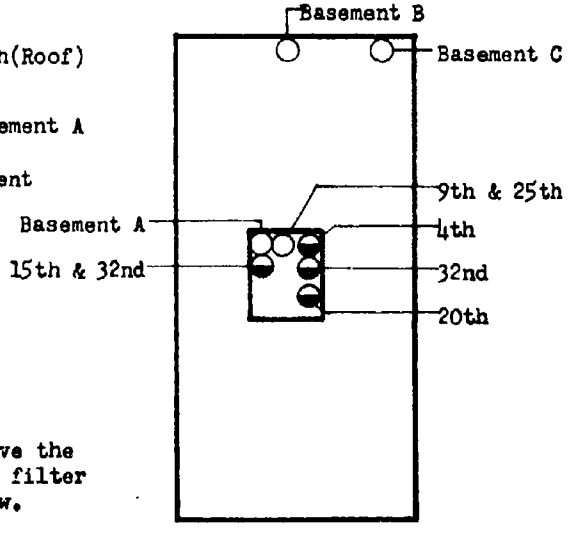


FIGURE D-19

BUILDING SAMPLER ARRAYS AND RESULTS

FT 0016c 27 Feb 1953

● Outside sampler at height above the general terrain level or with filter holder extending beyond window.

○ Inside sampler.

SUMMARY OF BUILDING DOSAGES[1]
FT 0016c 27 Feb 1953

BUILDING NO. 1
ANDRUS BUILDING

Outside		Inside	
Sampler Location (floor)[2]	Dosage[3]	Sampler Location (floor)[2]	Dosage[3]
Surface[4]	7	Basement A	30-T
6th	2	1st	50
7th	T	5th	2-T
11th(Roof)	2	8th	3-T
11th(Roof)	4	9th	3-2
		10th	0-?

BUILDING NO. 2
FIRST NATIONAL BANK BUILDING

Outside		Inside	
Sampler Location (floor)[2]	Dosage[3]	Sampler Location (floor)[2]	Dosage[3]
Surface[4]	120	Basement A	20-4
20th(Roof)	84	Basement B	9-4
20th(Roof)	71	5th	220
		6th	30-9
		10th	96
		12th	11-5
		14th	120
		16th	3-8

BUILDING NO. 3
NORTHWESTERN BELL TELEPHONE BUILDING

Outside		Inside	
Sampler Location (floor)[2]	Dosage[3]	Sampler Location (floor)[2]	Dosage[3]
Surface[4]	7	Basement A	9-T
10th	31	Basement B	T-T
20th	43	Basement C	0-0
27th(Roof)	21	6th	2-T
27th(Roof)	31	14th	14
		17th	0-T

BUILDING NO. 4
NORTHWESTERN NATIONAL BANK BUILDING

Outside		Inside	
Sampler Location (floor)[2]	Dosage[3]	Sampler Location (floor)[2]	Dosage[3]
Surface[4]	200	Basement A	20-11
8th	238	Basement B	106-5
11th	179	3rd	8-5
15th	173	6th	6-T
17th(Roof)	172	12th	2-T
17th(Roof)	121		

BUILDING NO. 5
BAKER BUILDING

Outside		Inside	
Sampler Location (floor)[2]	Dosage[3]	Sampler Location (floor)[2]	Dosage[3]
Surface[4]	90	Basement A	6-3
2nd	140	Basement A	T-T
5th	2	1½ Basement	7-3
9th	3	7th	T-0
13th(Roof)	3	11th	0-T
13th(Roof)	4		

BUILDING NO. 7
FOSHAY TOWER

Outside		Inside	
Sampler Location (floor)[2]	Dosage[3]	Sampler Location (floor)[2]	Dosage[3]
Surface[4]	0	Basement A	T-0
4th	2	Basement B	0-0
15th	0	Basement C	0-M
20th	0	9th	0-0
32nd	0	25th	0-0
32nd	0		

(1) See Figure III-8 for oblique aerial view of downtown Minneapolis showing array of buildings used in studies of aerosol-cloud penetration. A description of each building is given with Figure III-8. For the indicated releases, Figure D-21 (Appendix D) shows the buildings in relation to the grid complex and the dosage pattern.

(2) Samplers located on the same floor are listed according to their counterclockwise positions.

(3) Dosages are expressed in particle-minutes per liter. M indicates malfunction, and T represents trace dosage, i.e., a count not exceeding 15 fluorescent particles. A single entry expresses the dosage obtained from a filter unit exposed during the entire sampling period of an indicated release. Double entries for a given column represent incremental dosages obtained with sequentially exposed filter units. Applicable incremental periods for each sampler, as well as full sampling period for the release, are as follows:

Sampling Period	Incremental Periods
2230-2330 CST	2230-2315 CST
	2315-2345 CST

(4) In the absence of an adjacent outside sampler (●), at the one to six-foot level, a value has been estimated, based on the analysis of the overall isodosage pattern for a given release. The estimate has been made in order to obtain the base value needed to establish the percentage of aerosol-cloud penetration.

FIGURE D-20

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0016 27 Feb 1953

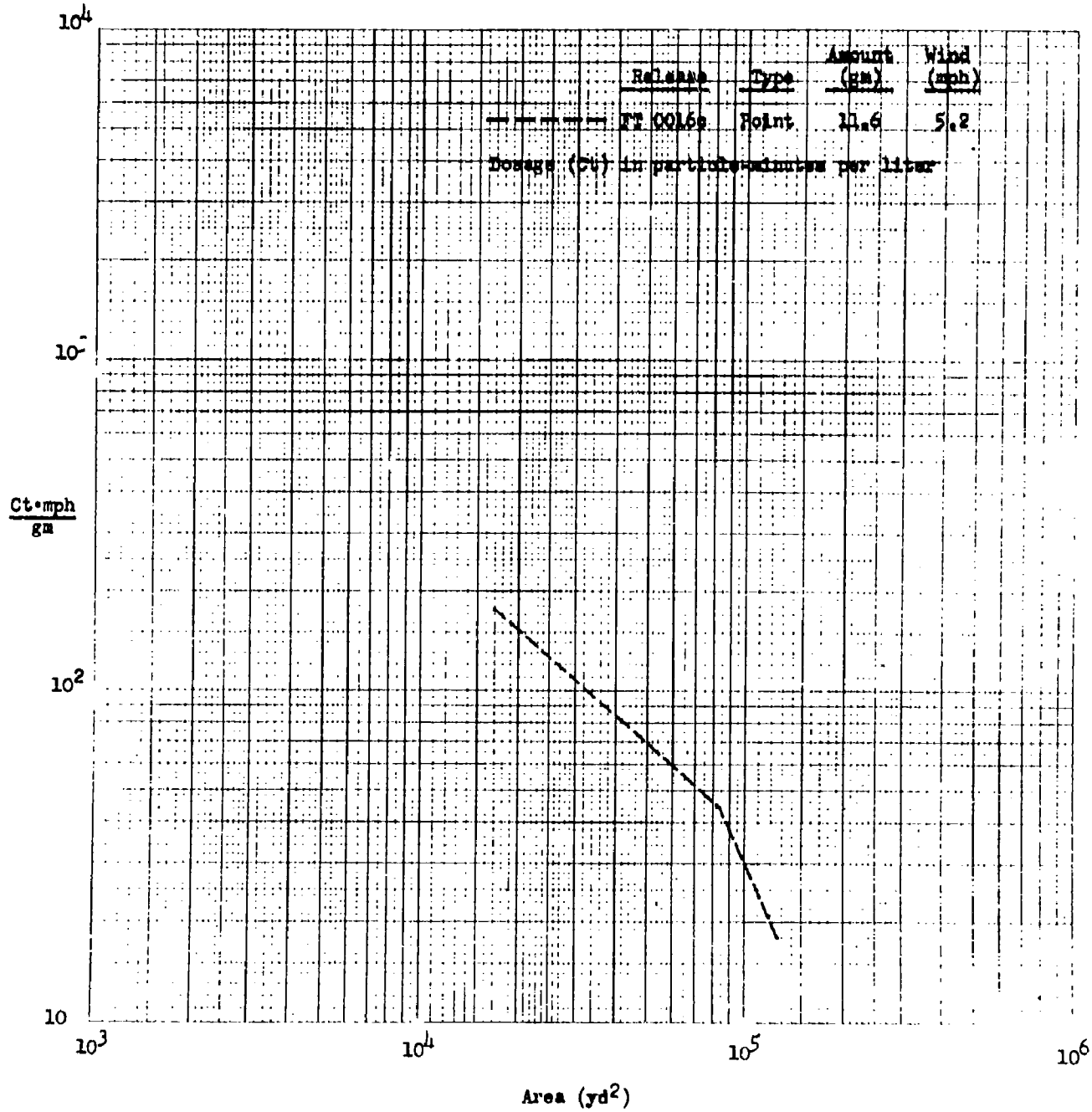


Figure D-21

TEST ARRAY AND RESULTS
FT 0016c

27 Feb 1953
2235 CST

AEROSOL GENERATION

Point-source release of 11.6 gms of NJZ 2266 over a period of 5 minutes starting at 2235 CST from a vehicle-mounted blower disperser located at point ✠

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 110 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Sampling stations included in buildings represented by numbered building outlines, identified as follows:

1. Andrus Building
2. First National Bank Bldg
3. Northwestern Bell Telephone Bldg
4. Northwestern National Bank Bldg
5. Baker Building
6. Foshay Tower

Results

All samplers operated to measure total dosages. In addition, samplers in given buildings were operated incrementally; sampler arrays, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure D-19.

Total Dosage (particle-minutes/liter)

T = trace dosage

●58

100 —— 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1), (M2), (M3), and (M4).

Similar observations at rooftop level made at meteorological station (M3), located 17 stories high on 4, Northwestern Bank Building, and at station (M2), located 13 stories high on the Northern States Power Company Building.

Wiresonde ascents made at meteorological station (M4), at 210 South Tenth Street. Undeveloped-area wiresondes (see Figs. D-11 through D-18) obtained at Wirth Park, approximately 3 miles west of (M4).

2100 — 2105 — — — 2110 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

- - - - - - - - - - 2100 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds southwesterly at 2.7 mph, and roof-level winds west-northwesterly at 15.8 mph.

Stability

2.1° F lapse from 6-300 ft.

Sky

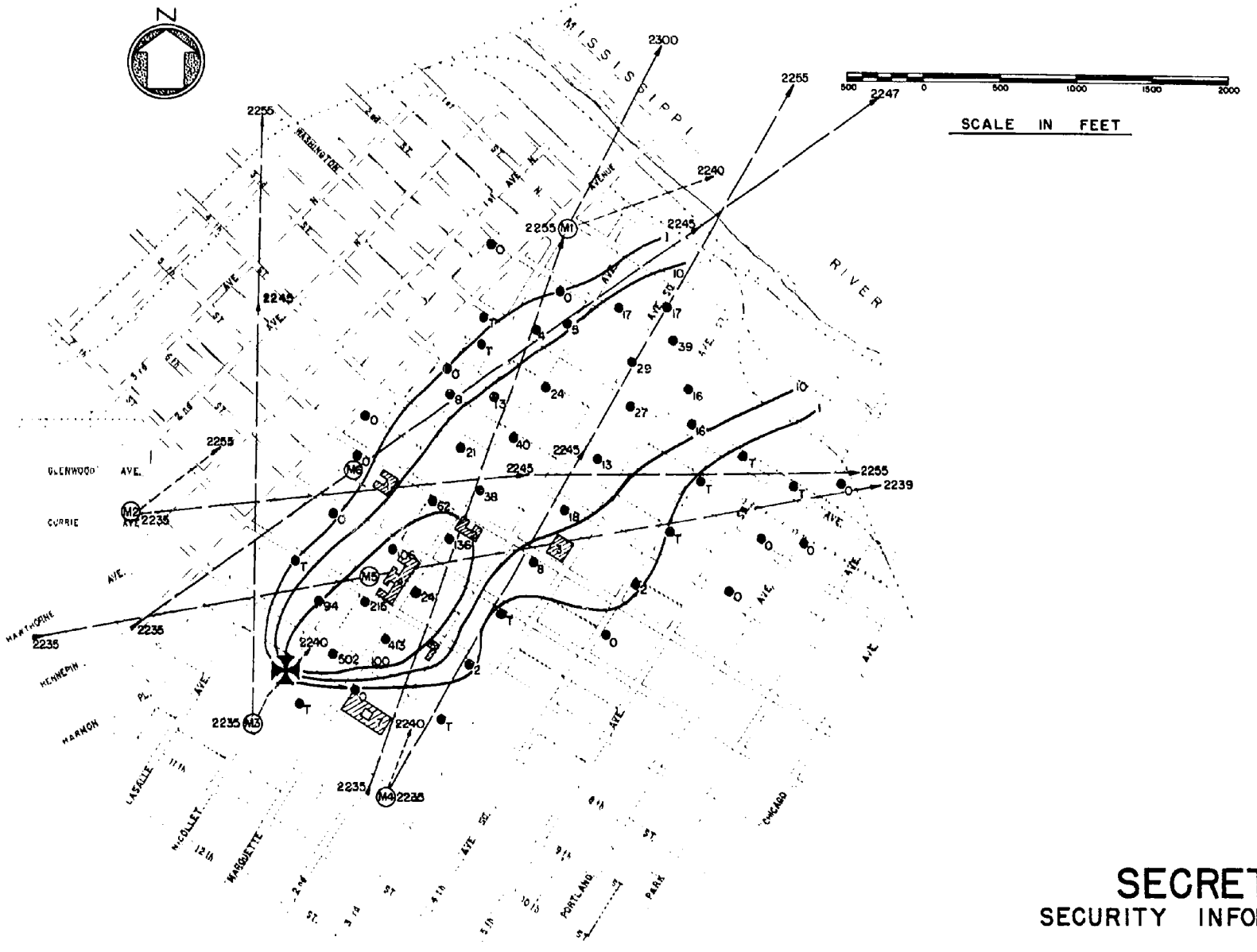
Broken clouds with bases 3600 ft above the surface.

Temperature

26.3° to 28.3° F at 2 meters in the test area.

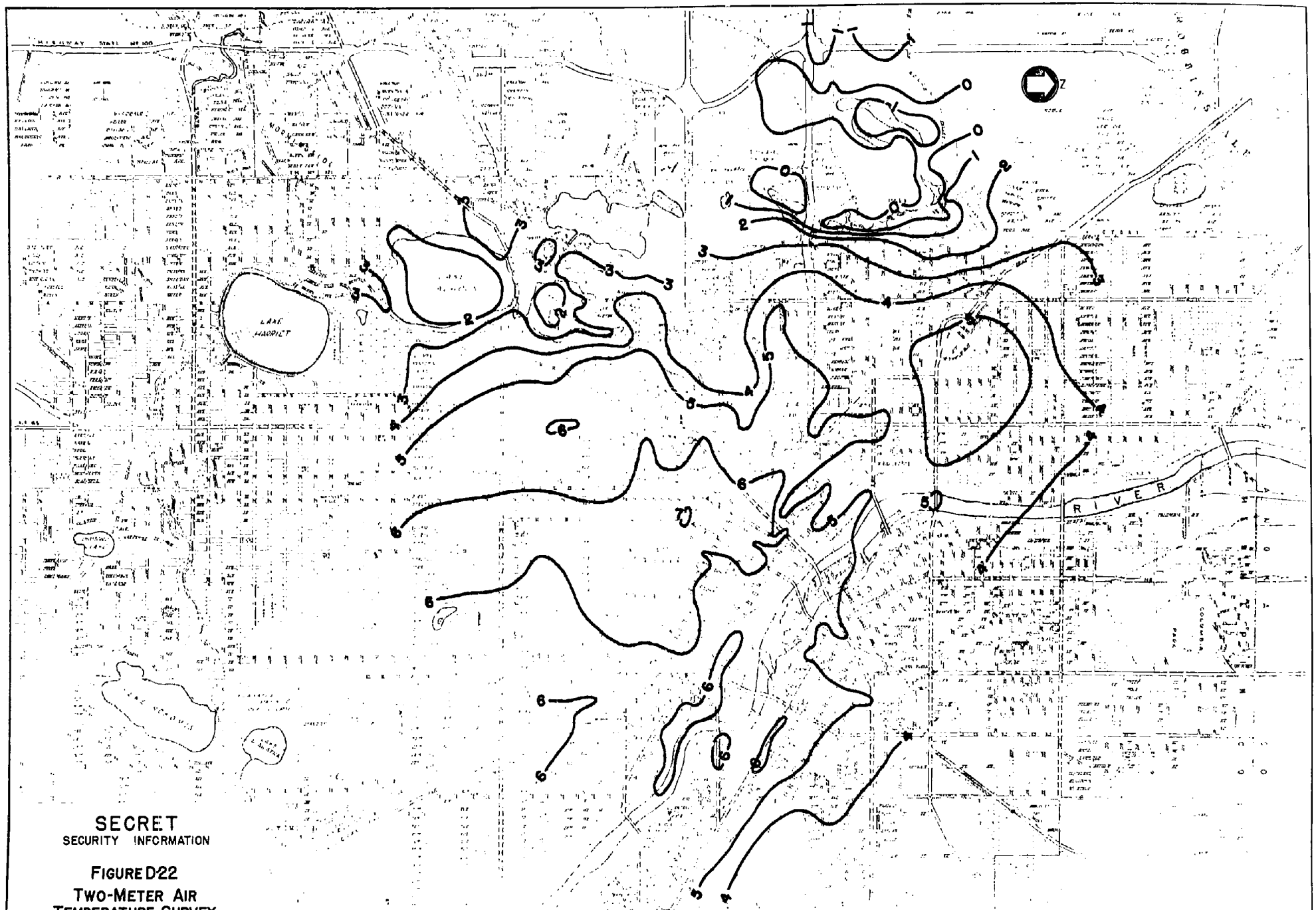
Moisture

Mixing ratio of 2.3 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE D-21
TEST ARRAY AND RESULTS
FT 0016c 2235 CST
27 FEBRUARY 1953



SECRET
SECURITY INFORMATION

FIGURE D-22
TWO-METER AIR
TEMPERATURE SURVEY
M-57
0100 CST 7 MARCH 1953
(SUPPLEMENTAL TO FT 0017)

SUMMARY OF REGIONAL AND LOCAL WEATHER
6-7 March 1953
(Survey M-57, Supplemental to FT 0017)

SYNOPTIC SITUATION

A 1035-mb high cell, oriented northwest-southeast and moving east-northeast at 20 mph, was centered in northwestern Minnesota, its ridge line just west of Minneapolis at the start of the test period. The ridge line passed the station during the period, bringing warmer and more moist air over the station and resulting in low cloud cover. At the 700-mb level, a slow-moving, long wave-length pattern with a ridge off the Pacific coast and a broad trough off the Atlantic coast resulted in a northwesterly gradient wind of 50 mph over Minneapolis.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
2330	20,000	Scattered	15	-	4	-11	WNW	6
0030	20,000	Broken	15	-	4	-11	NNW	5
0130	20,000	Overcast	15	-	6	-5	SSE	6
0230	20,000	Overcast	15	-	5	-6	SE	3
0330	20,000	Overcast	15	-	6	-6	SSE	5
0430	6,000	Broken	15	-	6	-6	SE	8
0530	6,000	Broken	15	-	5	-8	E	10

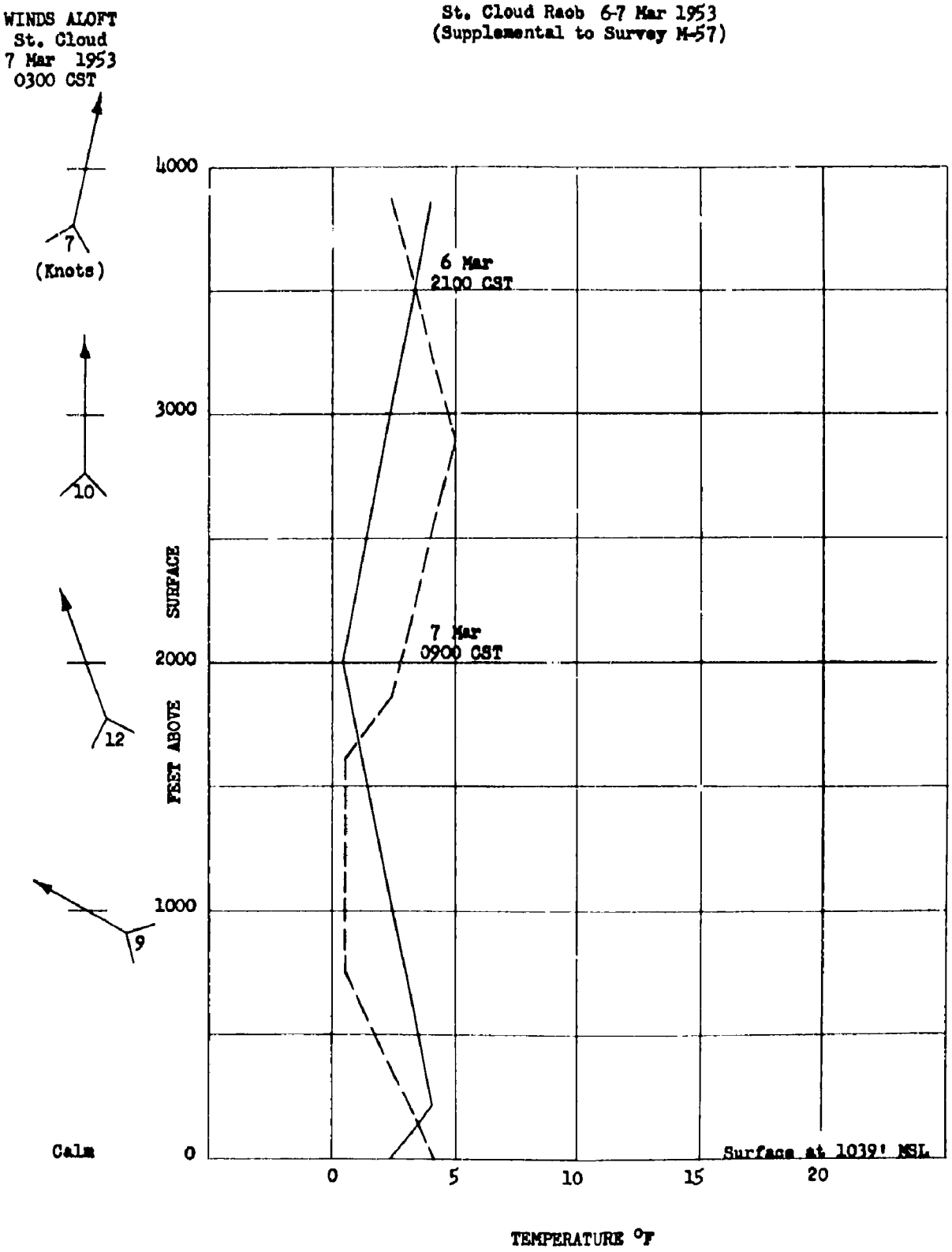
* Average cloudiness sunrise to sunset: 0%
** And/or restriction to visibility

Sea-level pressure at 0230 CST: 1037.6 mb
Ground condition: Ten-inch packed snow; main streets clear; secondary streets 50/50 clear and packed ice and snow; lake frozen
Tree cover: None

Figure D-23

TEMPERATURE SOUNDINGS

St. Cloud Raob 6-7 Mar 1953
(Supplemental to Survey M-57)



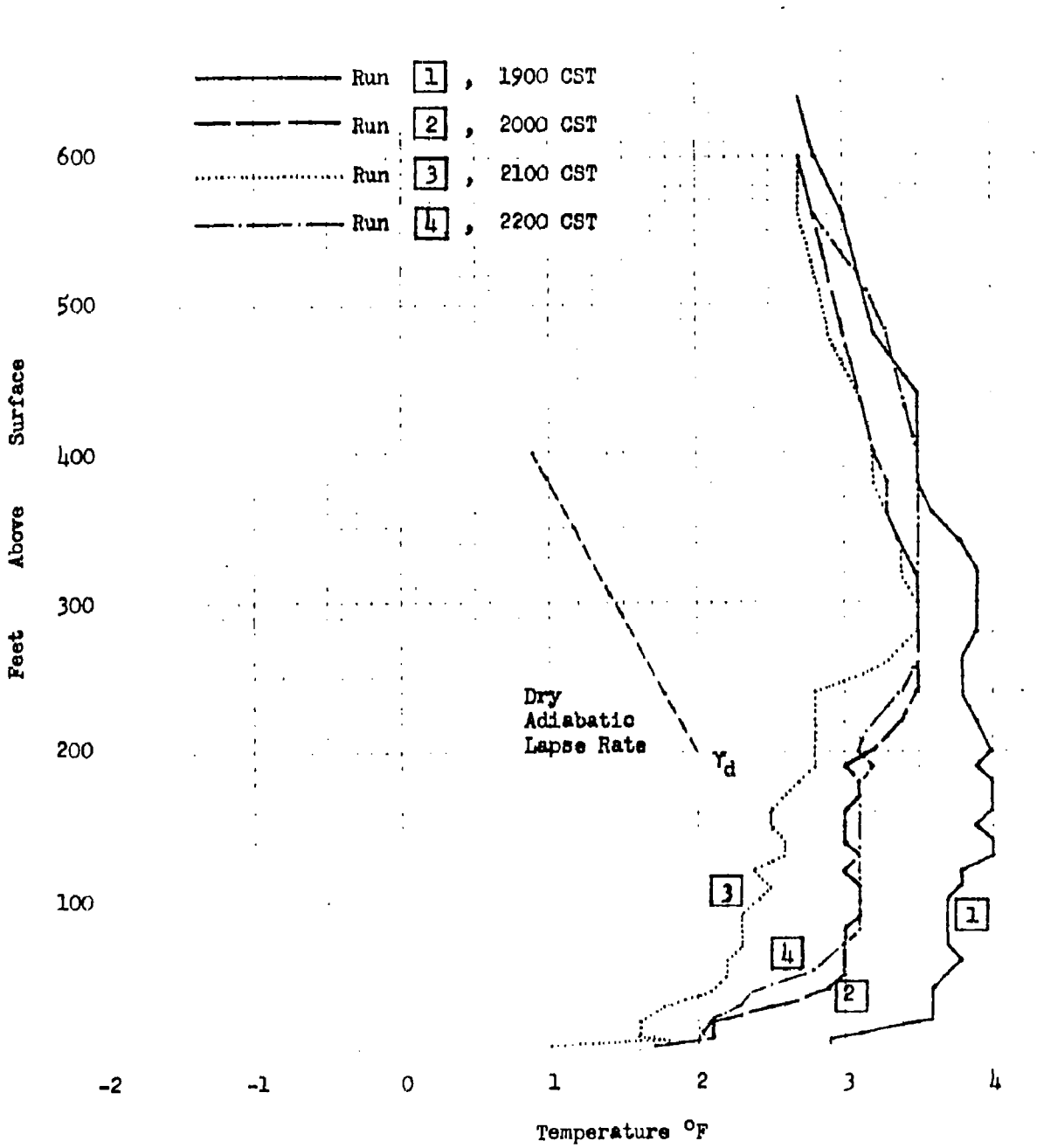


FIGURE D-24

TEMPERATURE SOUNDINGS

Minneapolis

Undeveloped-Area Wiresonde
M-57 6 Mar 1953

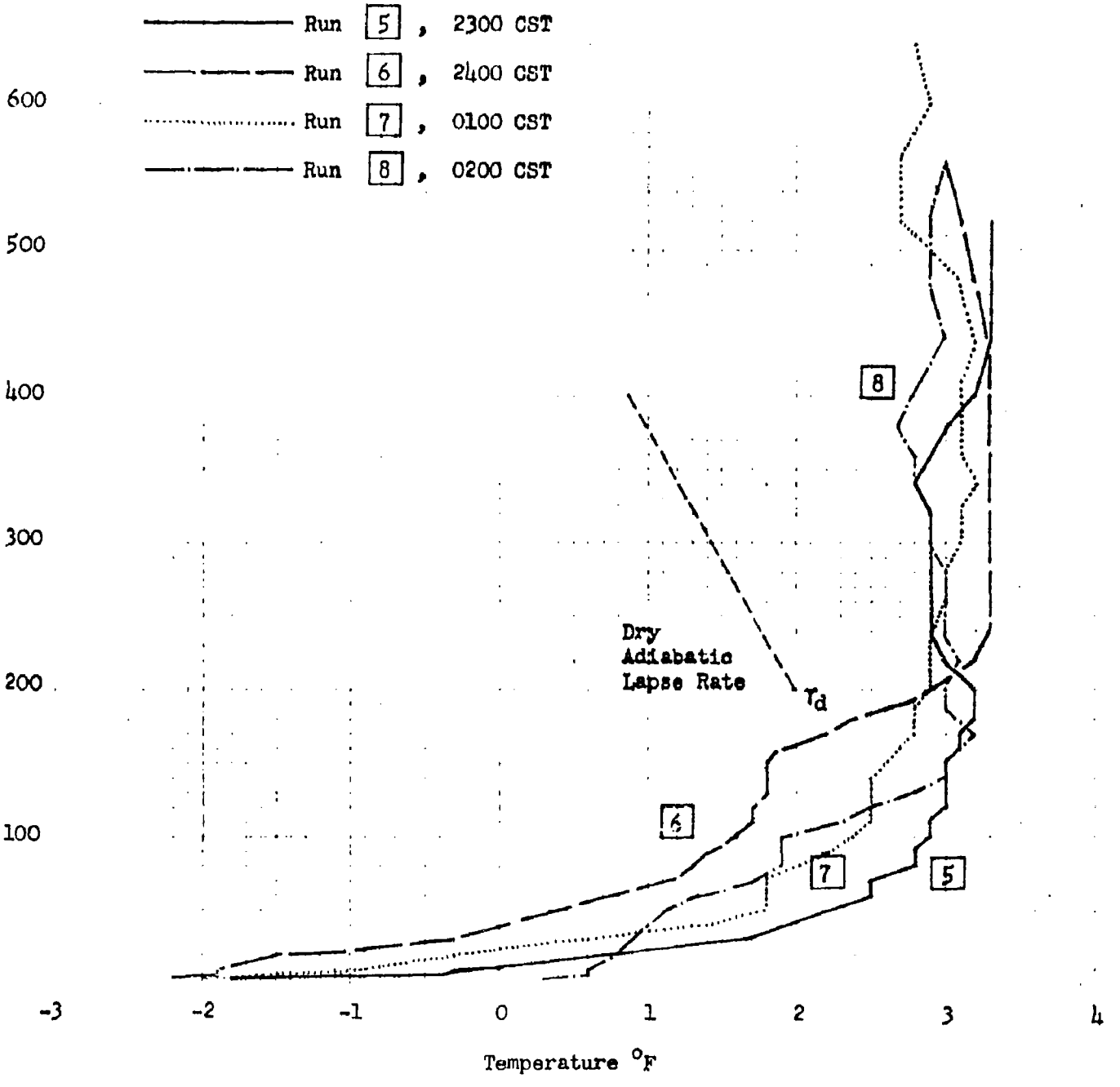


FIGURE D-25

TEMPERATURE SOUNDINGS

Minneapolis

Undeveloped-Area Wiresonde
M-57 6-7 Mar 1953

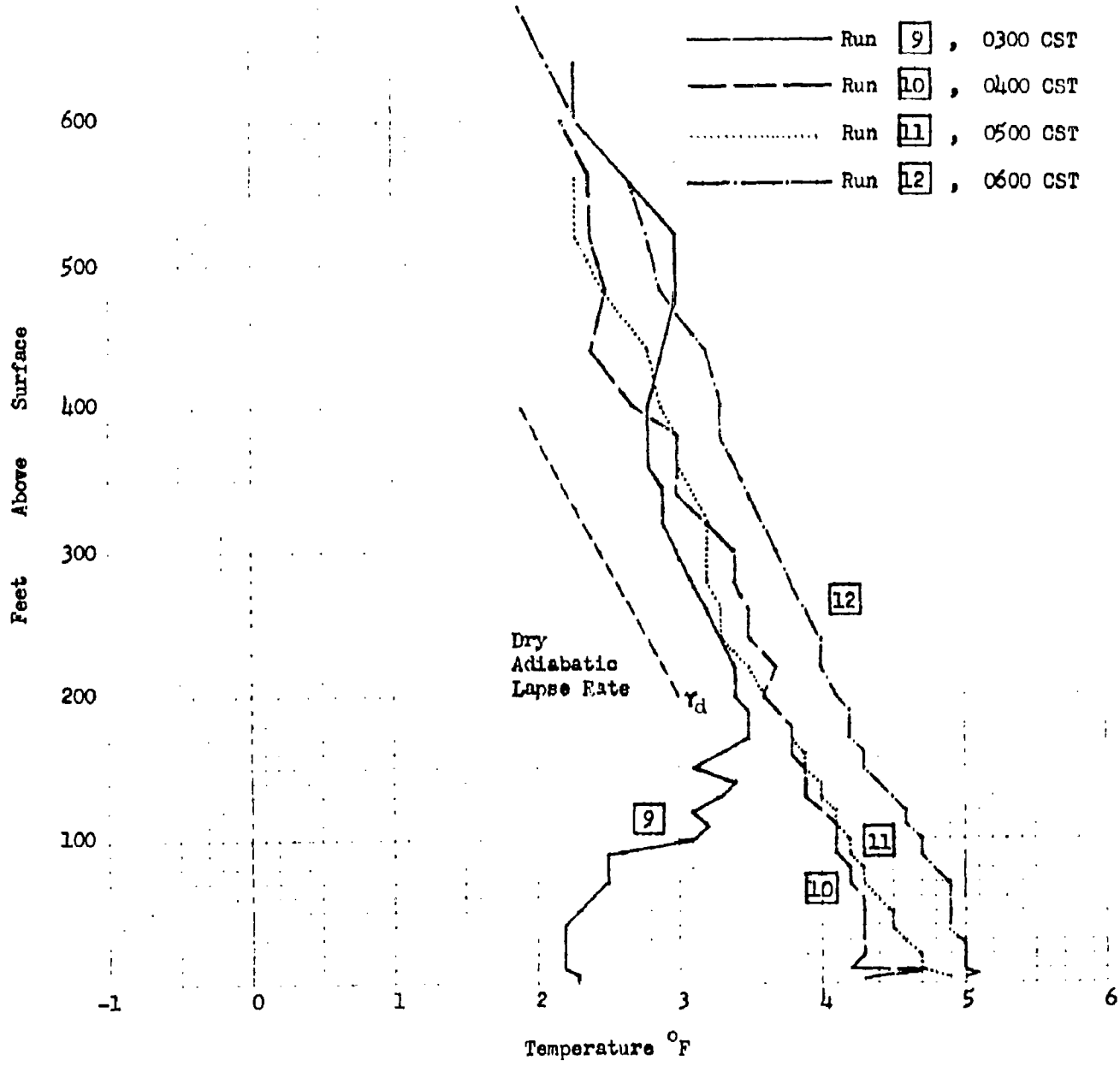


FIGURE D-26

TEMPERATURE SOUNDINGS

Minneapolis

Undeveloped-Area Wiresonde
M-57 7 Mar 1953

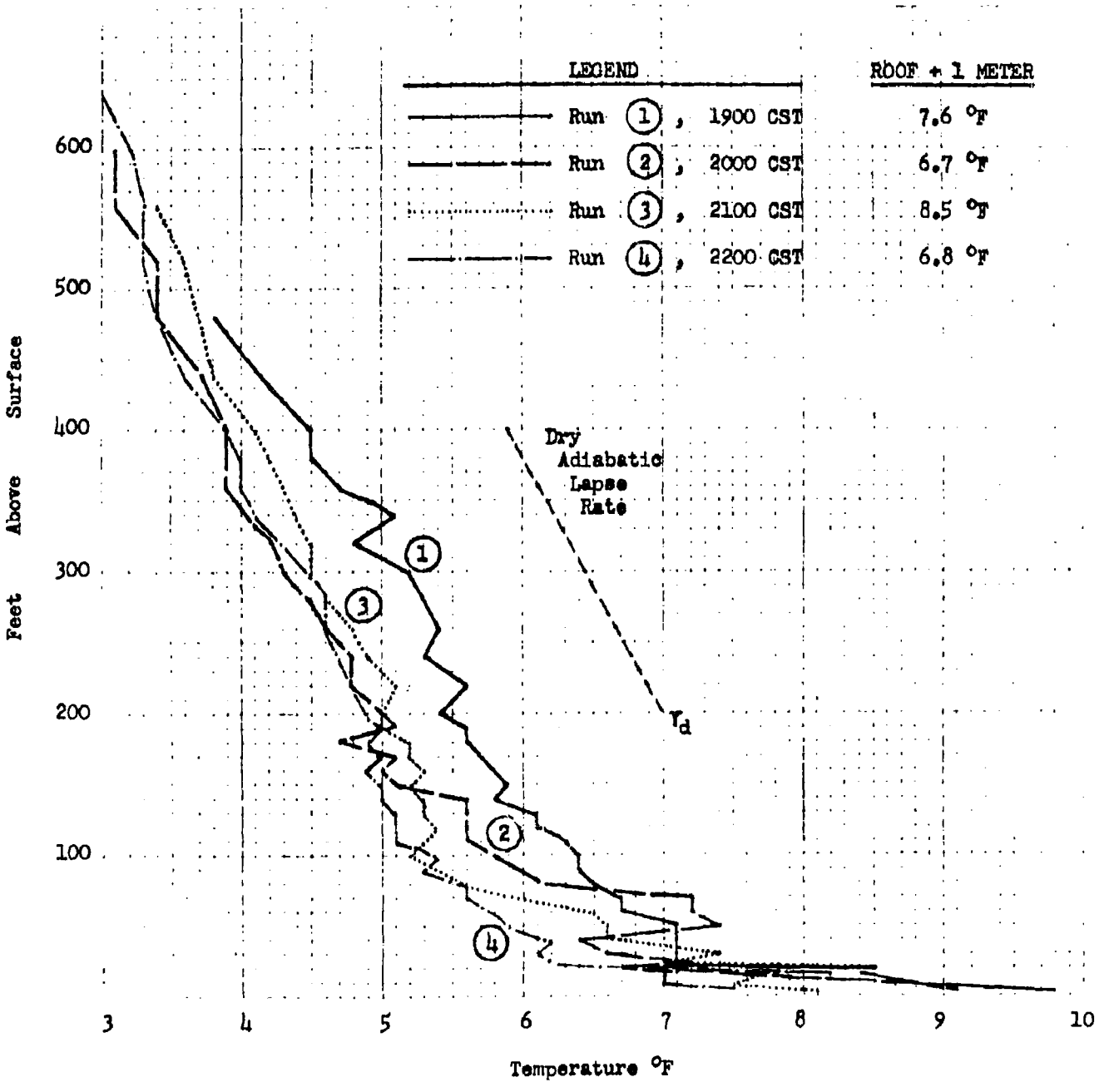


FIGURE D-27

TEMPERATURE SOUNDINGS

Minneapolis

Business-Area Wiresonde
M-57 6 Mar 1953

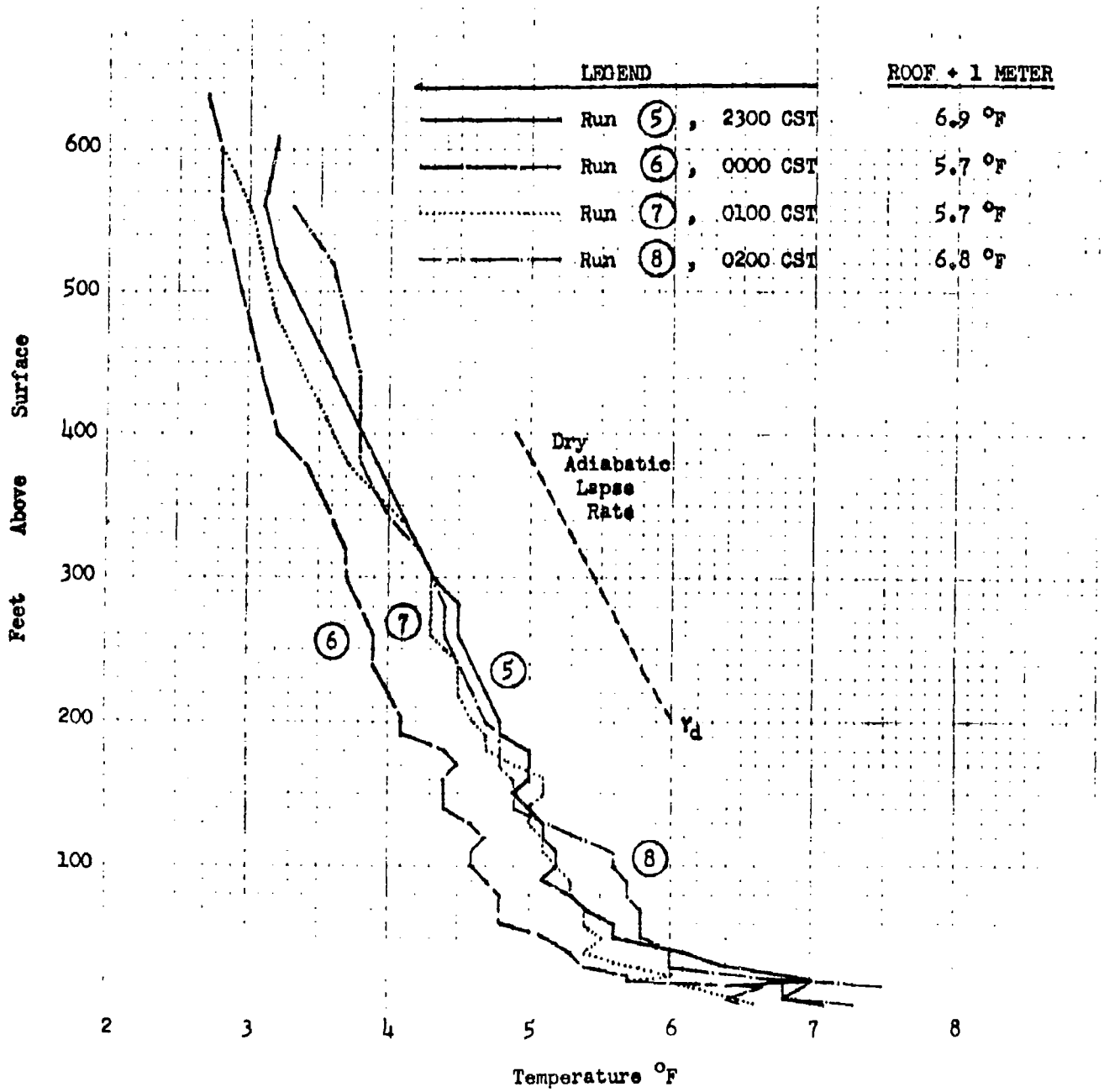


FIGURE D-28

TEMPERATURE SOUNDINGS

Minneapolis

Business-Area Wiresonde
M-57 6-7 Mar 1953

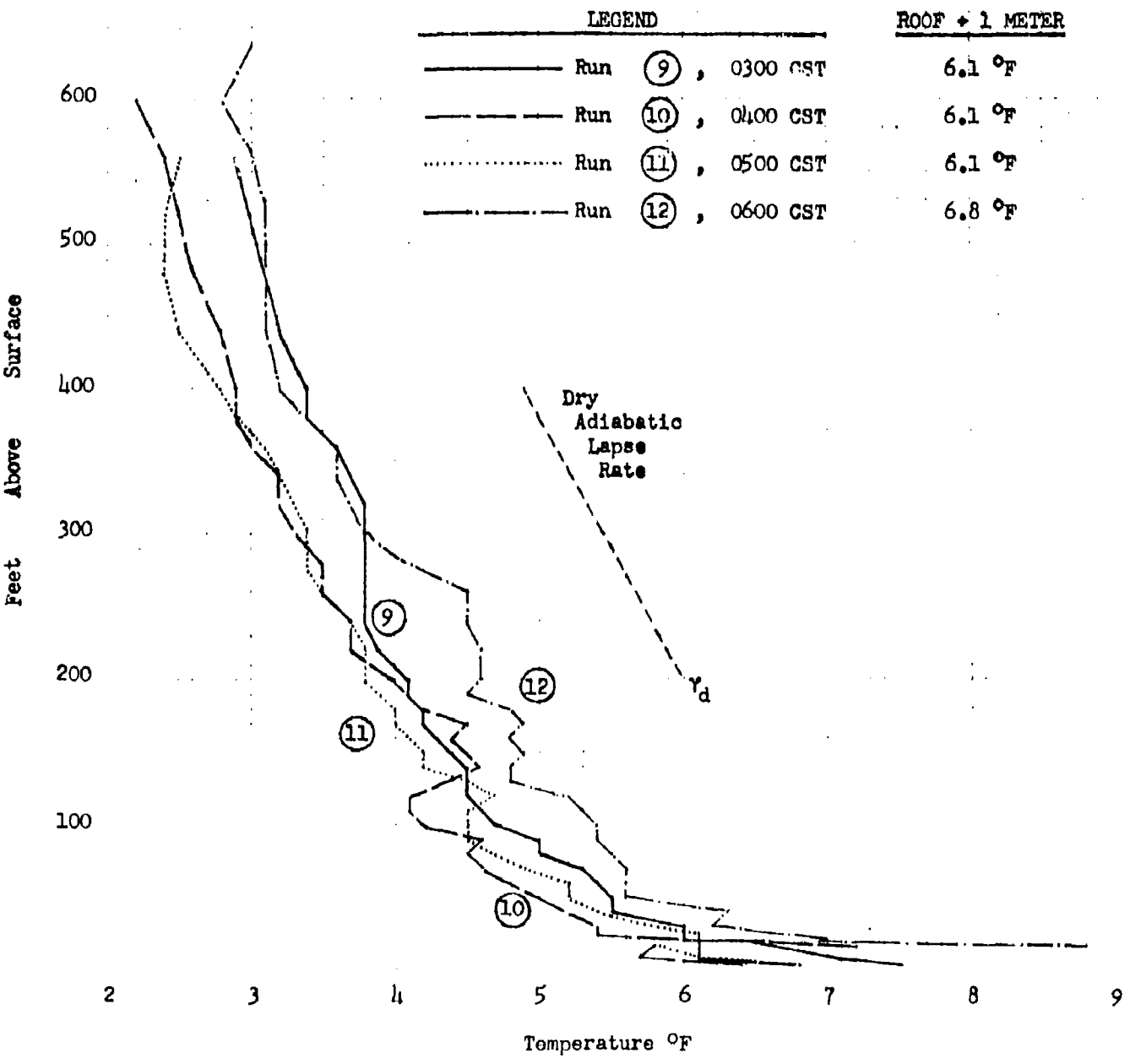


FIGURE D-29

TEMPERATURE SOUNDINGS

Minneapolis

Business-Area Wiresonde
M-57 7 Mar 1953

Figure D-30

TIME RESOLUTION DATA

FT 0017a 7 Mar 1953
Sampler No. 1

Total No. of Particles: 13
Flow Rate: 6.9 liters/min
Dosage: 1.9 part-min/liter

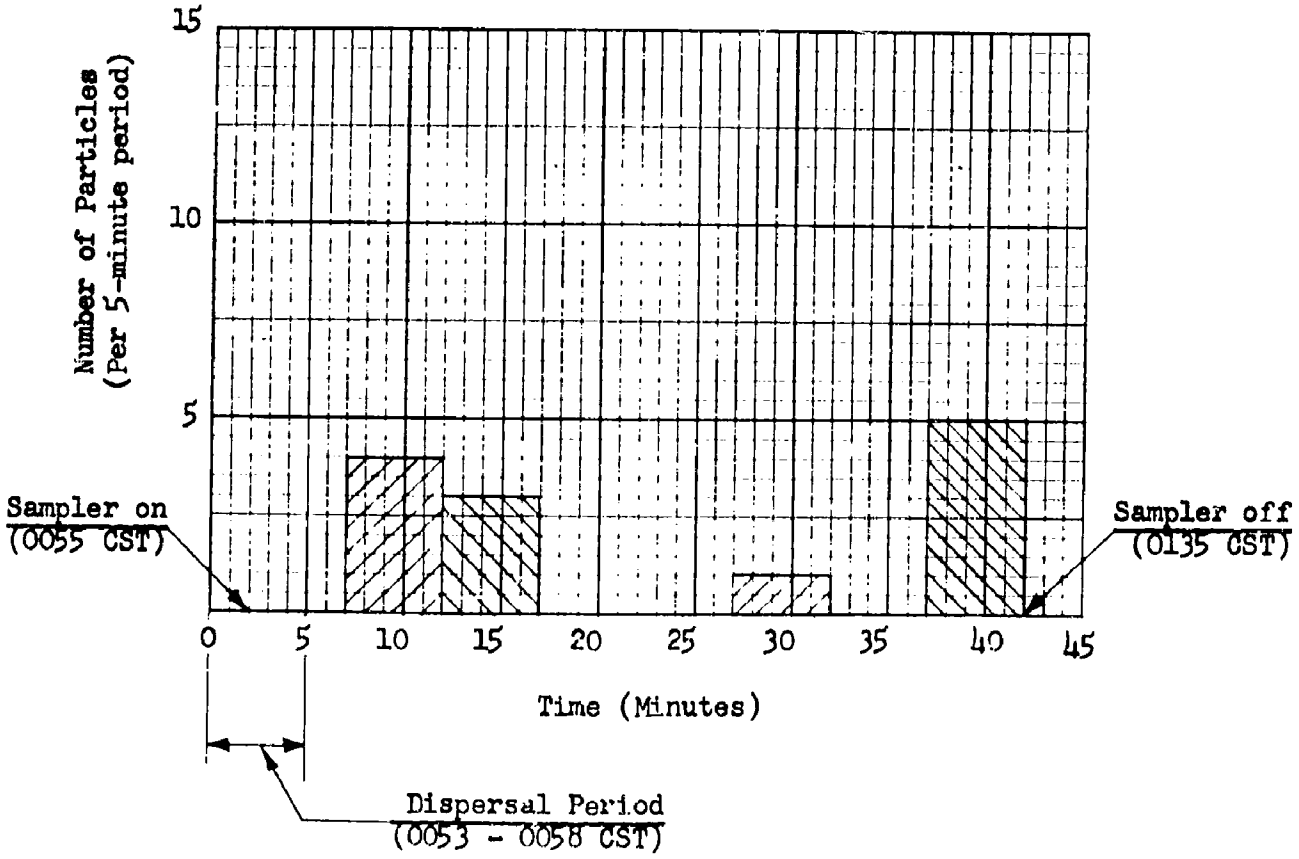


Figure D-31

TIME RESOLUTION DATA

FT 0017b 7 Mar 1953
Sampler No. 1

Total No. of Particles: 52
Flow Rate: 6.8 liters/min
Dosage: 7.6 part-min/liter

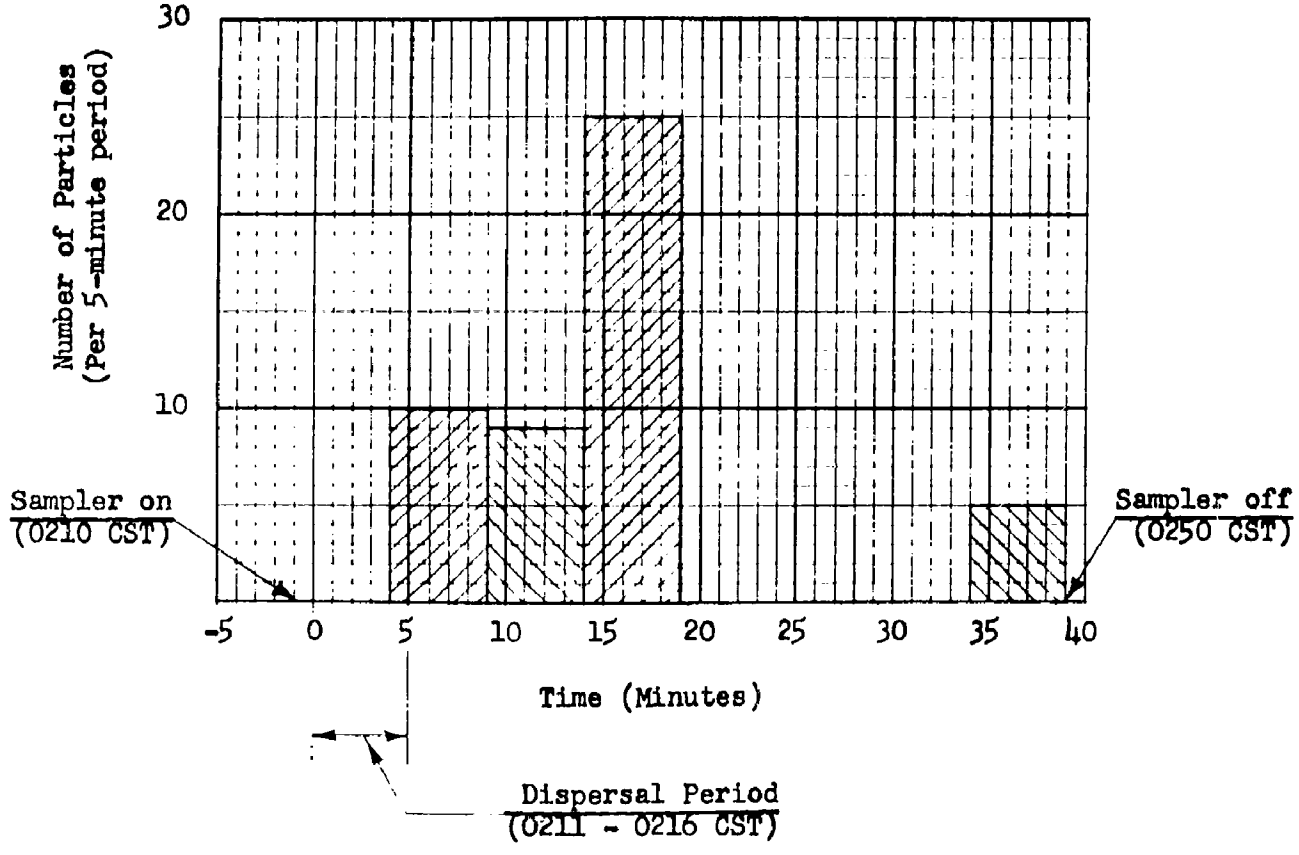
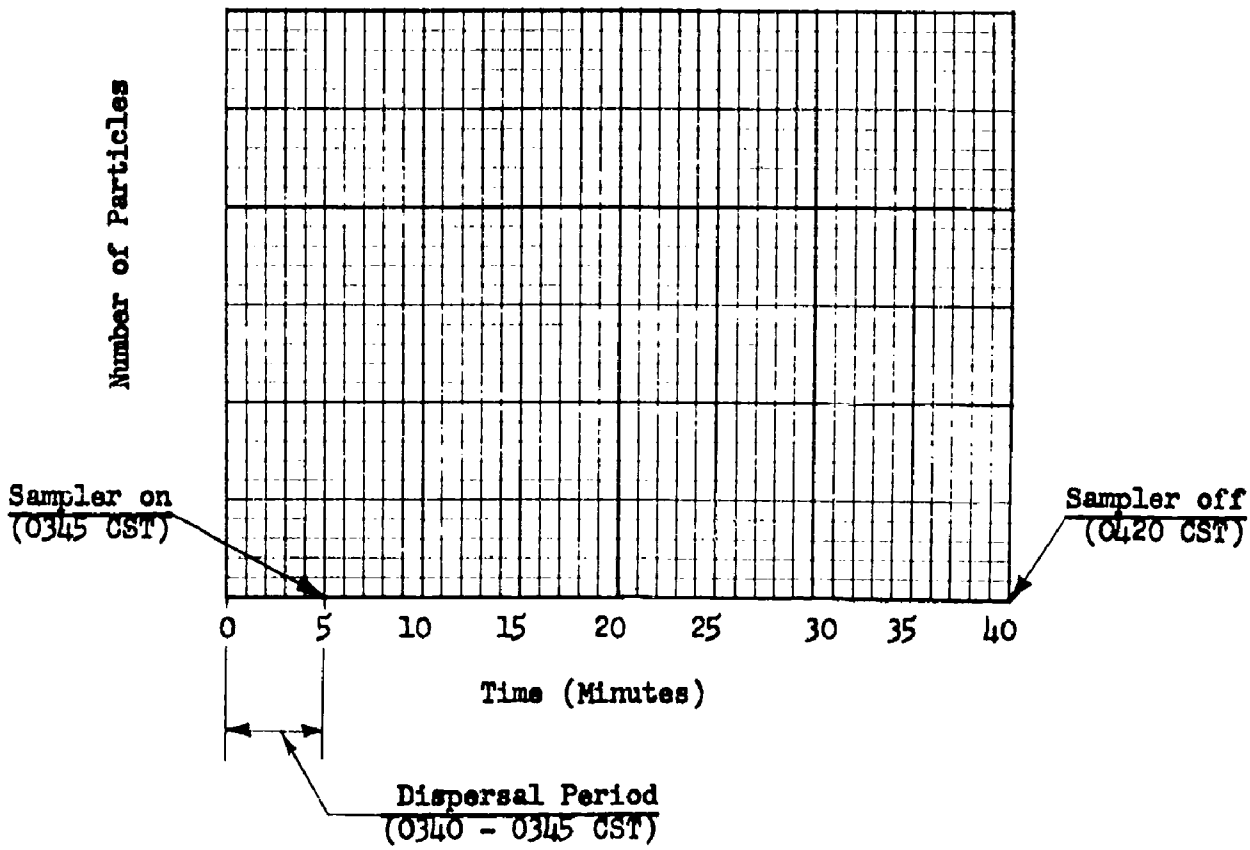


Figure D-32

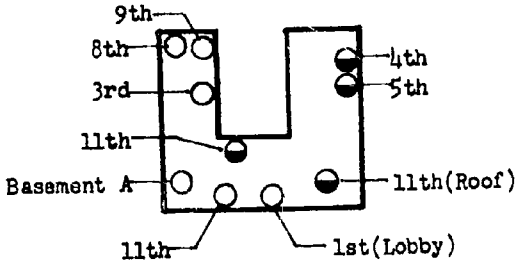
TIME RESOLUTION DATA

FT 0017c 7 Mar 1953
Sampler No. 1

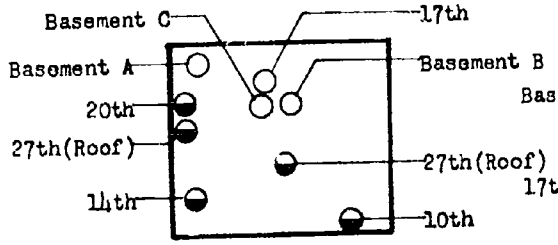
Total No. of Particles: 0
Flow Rate: 6.9 liters/min
Dosage: 0 part-min/liter



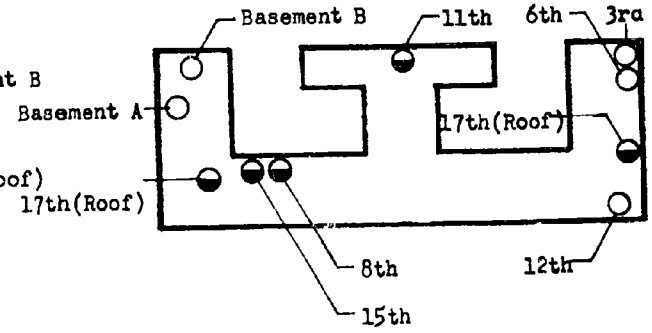
BUILDING NO. 1
ANDRUS BUILDING



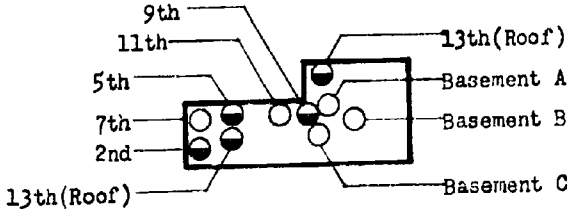
BUILDING NO. 3
NORTHWESTERN BELL TELEPHONE BUILDING



BUILDING NO. 4
NORTHWESTERN NATIONAL BANK BUILDING



BUILDING NO. 5
BAKER BUILDING



BUILDING NO. 6
MEDICAL ARTS BUILDING

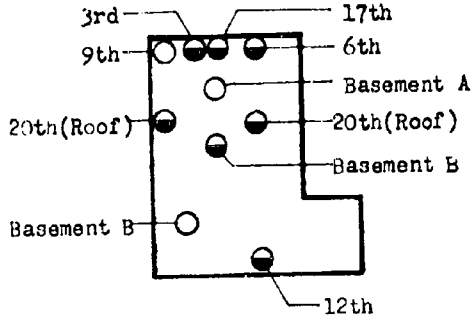


FIGURE D-33

BUILDING SAMPLER ARRAYS AND RESULTS

FT 0017 7 Mar 1953

● Outside sampler at height above the general terrain level or with filter holder extending beyond window.

○ Inside sampler.

SUMMARY OF BUILDING DOSAGES[1]
FT 0017 7 Mar 1953

BUILDING NO. 1
ANDRUS BUILDING

Sampler Location (floor)[2]	Outside: Dosages for Given Release[3] FT 0017a	FT 0017b	FT 0017c
Surface[4]	26	0	0
4th	3-3	0-0	0-0
5th	8-3	T-0	0-T
11th(Roof)	52	T	0
11th(Roof)	61	T	0
Inside			
Basement A	10	T	0
1st(Lobby)	0	0	0
3rd	7	T	0
8th	T-8	6-T	T-0
9th	0-T	4-T	T-0
11th	0-5	0-0	0-0

BUILDING NO. 3
NORTHWESTERN BELL TELEPHONE BUILDING

Sampler Location (floor)[2]	Outside: Dosages for Given Release[3] FT 0017a	FT 0017b	FT 0017c
Surface[4]	0	0	0
10th	0	0	0
14th	0	0	0
20th	0	0	0
27th(Roof)	0	0	0
27th(Roof)	0	0	T
Inside			
Basement A	0-0	0-0	0-M
Basement B	0-0	0-0	0-0
Basement C	0-0	0-0	0-0
17th	T-0	0-T	T-T

BUILDING NO. 4
NORTHWESTERN NATIONAL BANK BUILDING

Sampler Location (floor)[2]	Outside: Dosages for Given Release[3] FT 0017a	FT 0017b	FT 0017c
Surface[4]	16	10	4
8th	6	5	2
11th	13	4	0
15th	12	6	T
17th(Roof)	7	14	0
17th(Roof)	22	0	T
Inside			
Basement A	0-T	T-T	T-T
Basement B	2-3	2-T	0-0
3rd	2	3	2
6th	T-0	T-0	T-0
12th	0-0	0-0	0-0

BUILDING NO. 5
BAKER BUILDING

Sampler Location (floor)[2]	Outside: Dosages for Given Release[3] FT 0017a	FT 0017b	FT 0017c
Surface[4]	8	0	12
2nd	7	0	11
5th	7	T	10
9th	9	9	15
13th(Roof)	7	T	17
13th(Roof)	6	0	19
Inside			
Basement A	T-T	T-0	T-0
Basement B	T-T	0-0	T-T
Basement C	T-2	T-0	T-T
7th	0-T	0-0	0-T
11th	0-0	T-0	0-0

BUILDING NO. 6
MEDICAL ARTS BUILDING

Sampler Location (floor)[2]	Outside: Dosages for Given Release[3] FT 0017a	FT 0017b	FT 0017c
Surface[4]	16	0	2
3rd	16	T	2
6th	19	0	3
12th	21	0	6
17th	10-6	8-7	3-5
20th(Roof)	40	0	3
20th(Roof)	37	0	9
Inside			
Basement A	T-T	T-M	T-0
Basement B	2-4	T-T	2-0
Basement B	2-3	0-0	T-0
9th	2-3	T-T	T-0

(1) See Figure III-8 for oblique aerial view of downtown Minneapolis showing array of buildings used in studies of aerosol-cloud penetration. A description of each building is given with Figure III-8. For the indicated releases, Figures D-35, D-36, and D-37 (Appendix D) show the buildings in relation to the grid complex and the dosage pattern.

(2) Samplers located on the same floor are listed according to their counterclockwise positions.

(3) Dosages are expressed in particle-minutes per liter. M indicates malfunction, and T represents trace dosage, i.e., a count not exceeding 15 fluorescent particles. A single entry expresses the dosage obtained from a filter unit exposed during the entire sampling period of an indicated release. Double entries for a given column represent incremental dosages obtained with sequentially exposed filter units. Applicable incremental periods for each sampler, as well as full sampling periods for each release, are as follows:

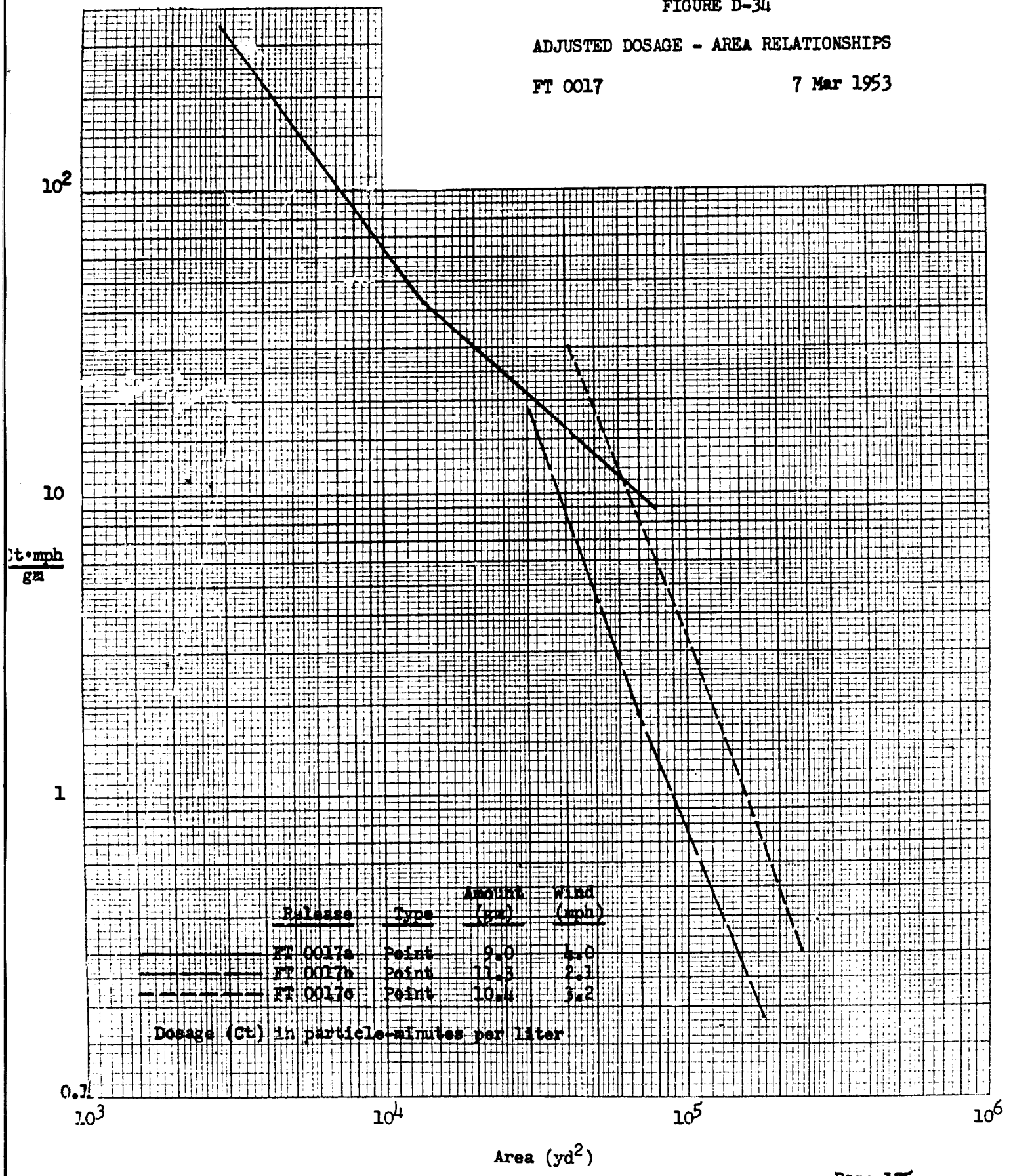
Release	Sampling Period	Incremental Periods
FT 0017a	0030-0145 CST	0030-0115 CST 0115-0145 CST
FT 0017b	0200-0315 CST	0200-0245 CST 0245-0315 CST
FT 0017c	0330-0445 CST	0330-0415 CST 0415-0445 CST

(4) In the absence of an adjacent outside sampler (●), at the one to six-foot level, a value has been estimated, based on the analysis of the overall isodosage pattern for a given release. The estimate has been made in order to obtain the base value needed to establish the percentage of aerosol-cloud penetration.

FIGURE D-34

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0017 7 Mar 1953



TEST ARRAY AND RESULTS
FT 0017a

7 Mar 1953
0053 CST

AEROSOL GENERATION

Point-source release of 9.0 gm of NJZ 2266 over a period of 5 minutes starting at 0053 CST from a vehicle-mounted blower disperser located at point ✚.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 111 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⚠ Time-resolution sampler with station number.

Sampling stations included in buildings represented by numbered building outlines, identified as follows:

A1 Andrus Building
B1 Baker Building
C1 Northwestern Bell Telephone Building
D1 Medical Arts Building
E1 Northwestern National Bank Building

Results

All samplers operated to measure total dosages. In addition, samplers in given buildings were operated incrementally; sampler arrays, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure D-33. Time-resolution data are given in Figure D-30.

Total Dosage (particle-minutes/liter)

T = trace dosage

● 58

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated M1, M2, M3, and M5.

Similar observations at rooftop level made at meteorological station M4, located 17 stories high on A1, Northwestern National Bank Building, and at station M5, located 13 stories high on the Northern States Power Company Building.

Wiresonde ascents (Figs. D-27, D-28, and D-29) made at meteorological station M2, at 210 South Tenth Street. Undeveloped-area wiresondes (Figs. D-24, D-25, and D-26) obtained at Wirth Park, approximately 3 miles west of M2.

0500 — 0505 — 0510 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

0500 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds north-northwesterly at 2.8 mph, M3 roof-level winds north-northwesterly at 5.8 mph, and M4 roof-level winds northeasterly at 3.8 mph.

Stability

2.2° F lapse from 6-300 ft.

Sky

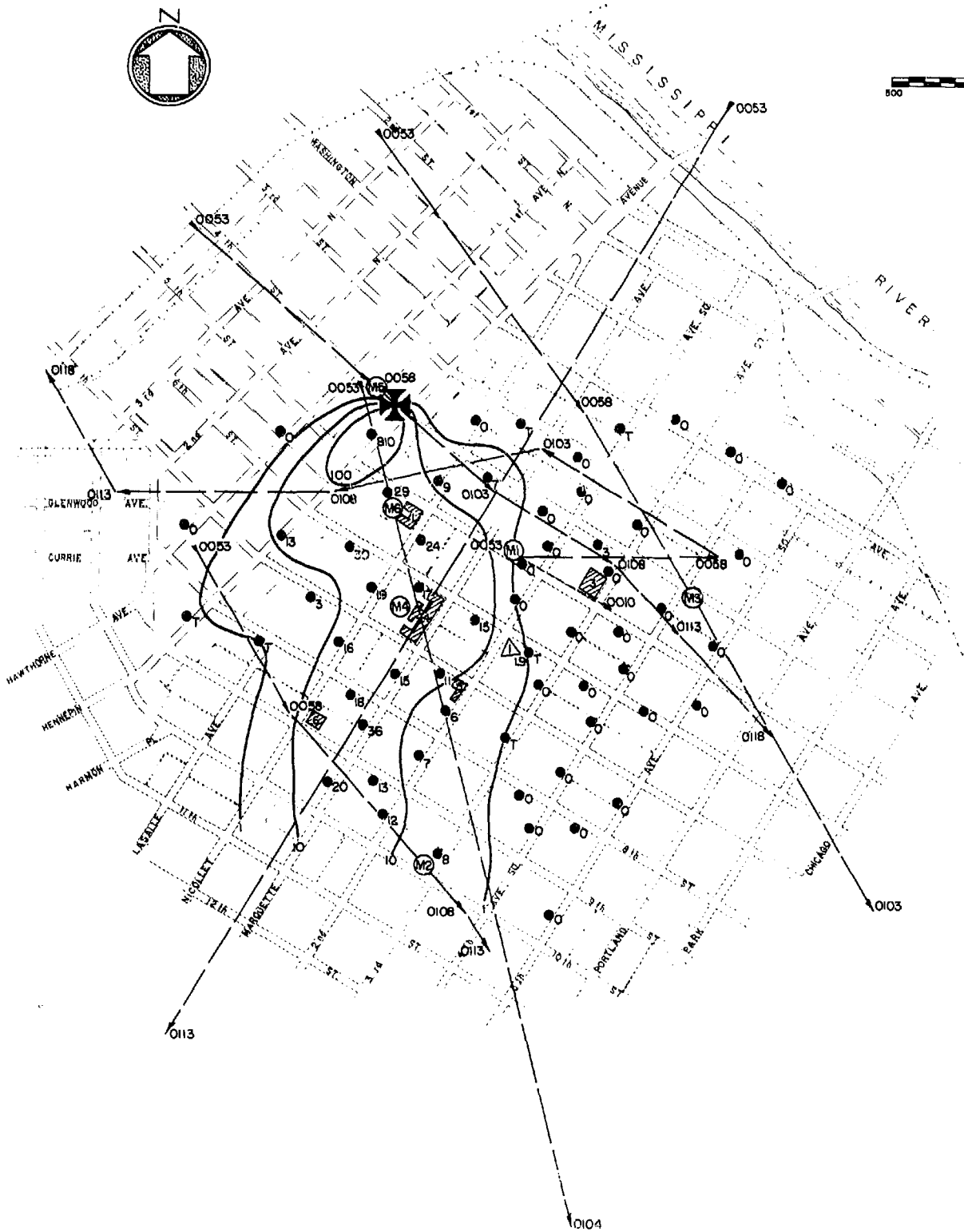
Overcast clouds with bases 20,000 ft above the surface.

Temperature

5.1° to 7.1° F at 2 meters in the test area.

Moisture

Mixing ratio of 0.8 gm/kgm dry air.



SECRET
SECURITY INFORMATION

FIGURE D-35
TEST ARRAY AND RESULTS
FT 0017a 0053 CST
7 MARCH 1953

Figure D-36

TEST ARRAY AND RESULTS
FT 0017b

7 Mar 1953
0211 CST

AEROSOL GENERATION

Point-source release of 11.3 gms of NJZ 2266 over a period of 5 minutes starting at 0211 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 111 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⚠ Time-resolution sampler with station number.

Sampling stations included in buildings represented by numbered building outlines, identified as follows:

1 Andrus Building
2 Baker Building
3 Northwestern Bell Telephone Building
4 Medical Arts Building
5 Northwestern National Bank Building

Results

All samplers operated to measure total dosages. In addition, samplers in given buildings were operated incrementally; sampler arrays, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure D-33. Time-resolution data are given in Figure D-31.

Total Dosage (particle-minutes/liter)

●58 T = trace dosage

M = malfunction or data missing

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated M1 , M2 , M3 , and M5 .

Similar observations at rooftop level made at meteorological station M1 , located 17 stories high on 3, Northwestern National Bank Building, and at station M3 , located 13 stories high on the Northern States Power Company Building.

Wiresonde ascents (Figs. D-27, D-28, and D-29) made at meteorological station M2 , at 210 South Tenth Street. Undeveloped-area wiresondes (Figs. D-24, D-25, and D-26) obtained at Wirth Park, approximately 3 miles west of M2 .

0500 — 0505 — 0510 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

0500 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds northeasterly at 1.9 mph, M1 roof-level winds east-northeasterly at 1.3 mph, and M3 roof-level winds northeasterly at 5.7 mph.

Stability

2.3° F lapse from 6-300 ft.

Sky

Overcast clouds with bases 20,000 ft above the surface.

Temperature

5.8° to 6.8° F at 2 meters in the test area.

Moisture

Mixing ratio of 0.7 gm/kgm dry air.

SECRET
SECURITY INFORMATION

FIGURE D-36
TEST ARRAY AND RESULTS
FT 0017b 0211 CST
7 MARCH 1953

Figure D-37

TEST ARRAY AND RESULTS
FT 0017c

7 Mar 1953
0340 CST

AEROSOL GENERATION

Point-source release of 10.4 gms of NJZ 2266 over a period of 5 minutes starting at 0340 CST from a vehicle-mounted blower disperser located at point ✠ .

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 111 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⚠ Time-resolution sampler with station number.

Sampling stations included in buildings represented by numbered building outlines, identified as follows:

1 Andrus Building
2 Baker Building
3 Northwestern Bell Telephone Building
4 Medical Arts Building
5 Northwestern National Bank Building

Results

All samplers operated to measure total dosages. In addition, samplers in given buildings were operated incrementally; sampler arrays, full sampling period, incremental periods, and applicable incremental dosages are presented in Figure D-33. Time-resolution data are given in Figure D-32.

Total Dosage (particle-minutes/liter)

●58 — T = trace dosage; M = malfunction or data missing

100 — 100 — Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at stations designated (M1) , (M2) , (M3) , and (M5) .

Similar observations at rooftop level made at meteorological station (M4) , located 17 stories high on 5, Northwestern National Bank Building, and at station (M6) , located 13 stories high on the Northern States Power Company Building.

Wiresonde ascents (Figs. D-27, D-28, and D-29) made at meteorological station (M2) , at 210 South Tenth Street. Undeveloped-area wiresondes (Figs. D-24, D-25, and D-26) obtained at Wirth Park, approximately 3 miles west of (M2) .

0500 — 0505 — 0510 — Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

0500 ---------- Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds easterly at 2.4 mph, (M1) roof-level winds easterly at 5 mph, and (M6) roof-level winds east-northeasterly at 8.2 mph.

Stability

3.4° F lapse from 6-300 ft.

Sky

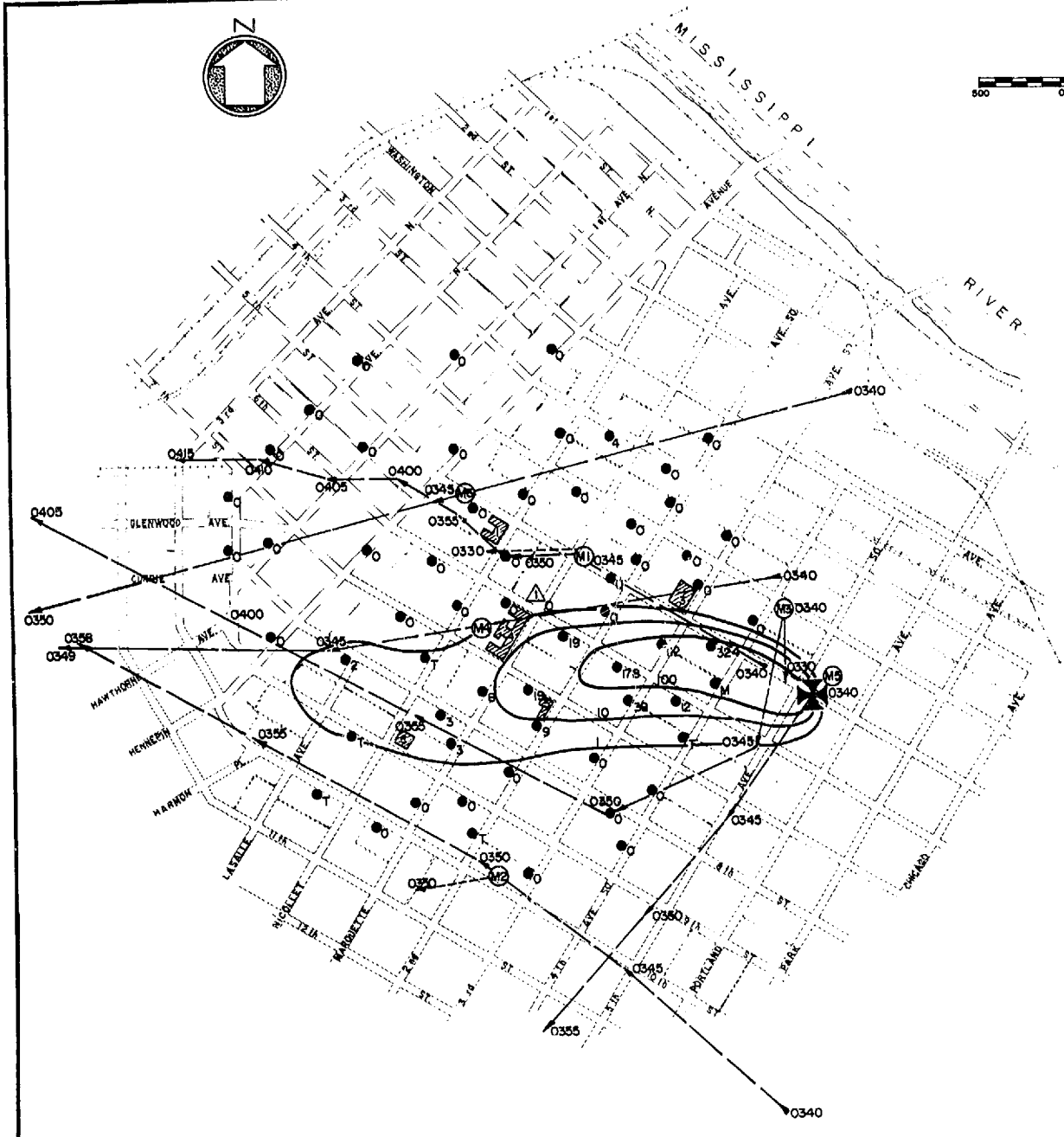
Overcast clouds with bases 20,000 ft above the surface.

Temperature

5.5° to 6.4° F at 2 meters in the test area.

Moisture

Mixing ratio of 0.7 gm/kgm dry air.



SCALE IN FEET

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FIGURE D-37
TEST ARRAY AND RESULTS
FT 0017c 0340 CST
7 MARCH 1953

APPENDIX "E"

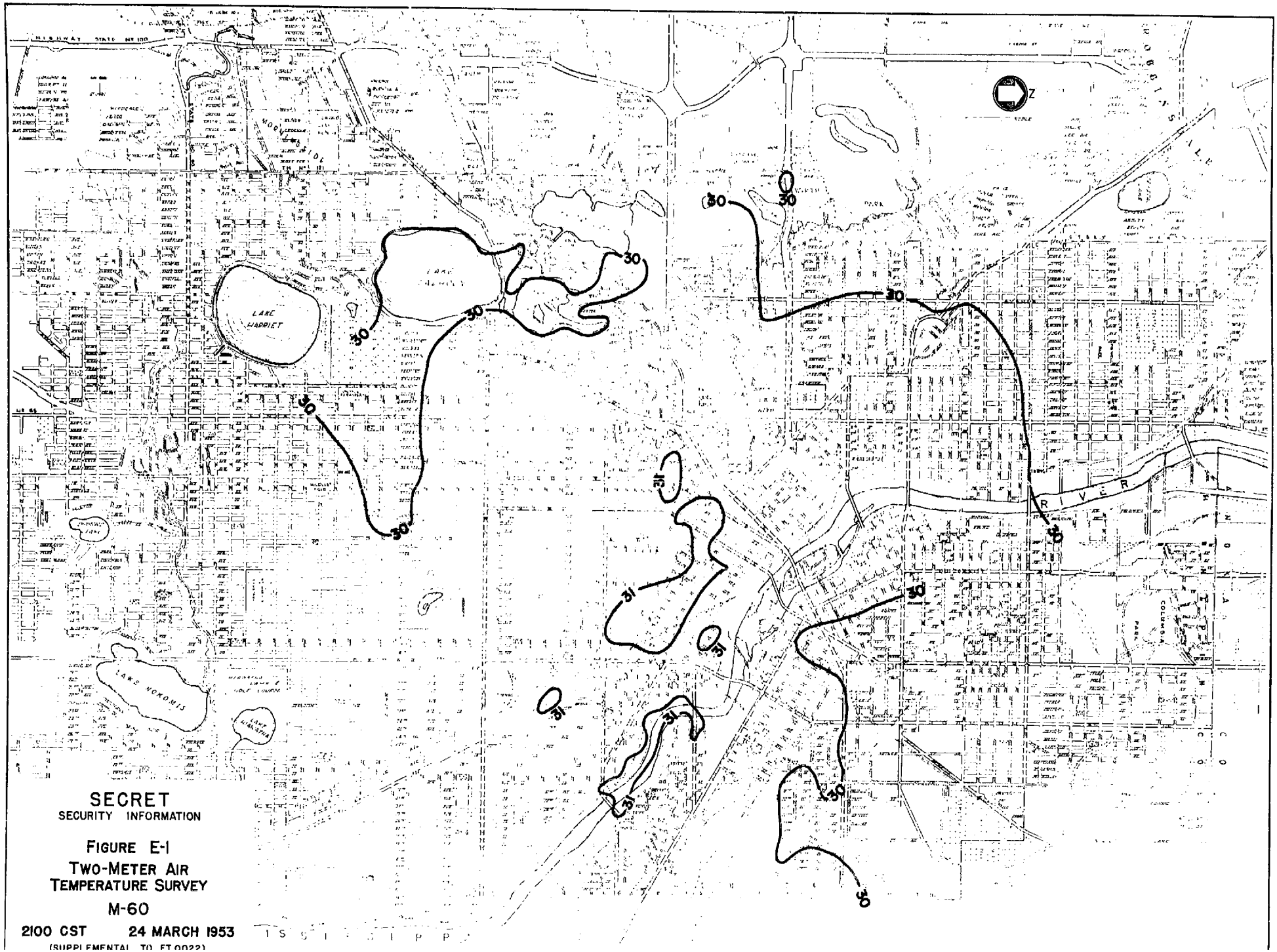

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FIGURE E-1
TWO-METER AIR
TEMPERATURE SURVEY

M-60

2100 CST 24 MARCH 1953

(SUPPLEMENTAL TO ET-0022)

SUMMARY OF REGIONAL AND LOCAL WEATHER
24 March 1953
(Survey M-60, Supplemental to FT 0022)

SYNOPTIC SITUATION

A secondary cold front preceding a fresh outbreak of continental polar air passed Minneapolis several hours before the test. A light snowfall accompanied and followed this passage. A 1029-mb high system, centered over Saskatchewan, dominated the upper Midwest, and resulted in moderate north-northwesterly gradient winds over Minnesota. At the 700-mb level, a sharp ridge off the Atlantic coast, a deep trough from Hudson Bay south to Florida, and a narrow ridge from New Mexico to Saskatchewan, all slow-moving, gave a 50 mph northerly gradient wind over Minneapolis.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (F)	Dew Point (F)	Wind Dir	Wind Speed (mph)
1830	3000	Overcast	15+	-	34	27	NW	14
1930	4000	Scattered	15+	-	32	27	WNW	20
2030	None	Clear	15+	-	31	25	WNW	17
2130	None	Clear	15+	-	30	24	NW	17
2230	1800	Overcast	15+	-	28	23	NW	19 (gusty)
2330	1800	Overcast	15+	-	27	21	NW	17

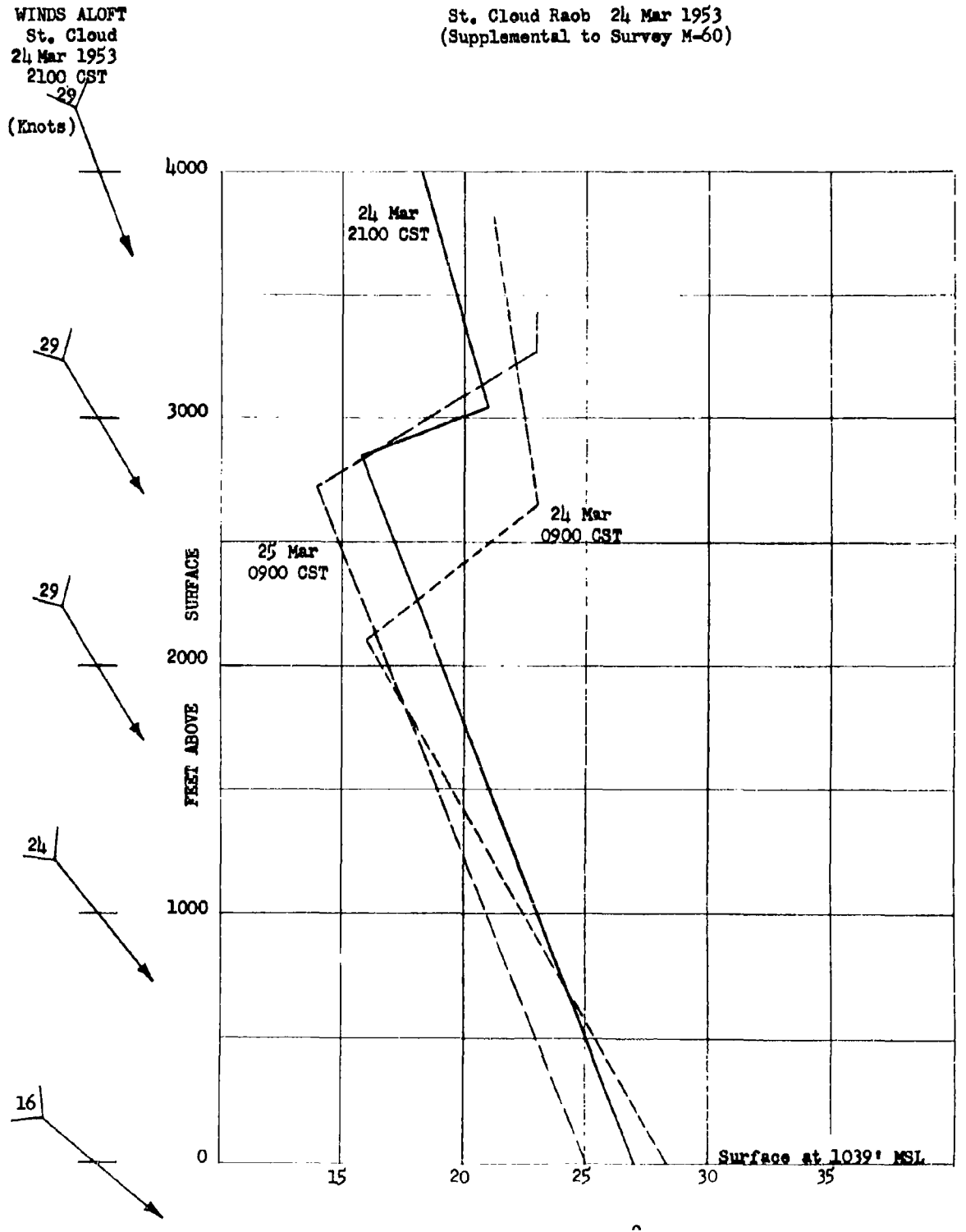
* Average cloudiness sunrise to sunset: 100%
** And/or restriction to visibility

Sea-level pressure at 2130 CST: 1017.3 mb
Ground condition: Snow all gone; light flurries of snow during the evening; streets clear, but damp; lake frozen
Tree cover: None

Figure E-2

TEMPERATURE SOUNDINGS

St. Cloud Raob 24 Mar 1953
(Supplemental to Survey M-60)



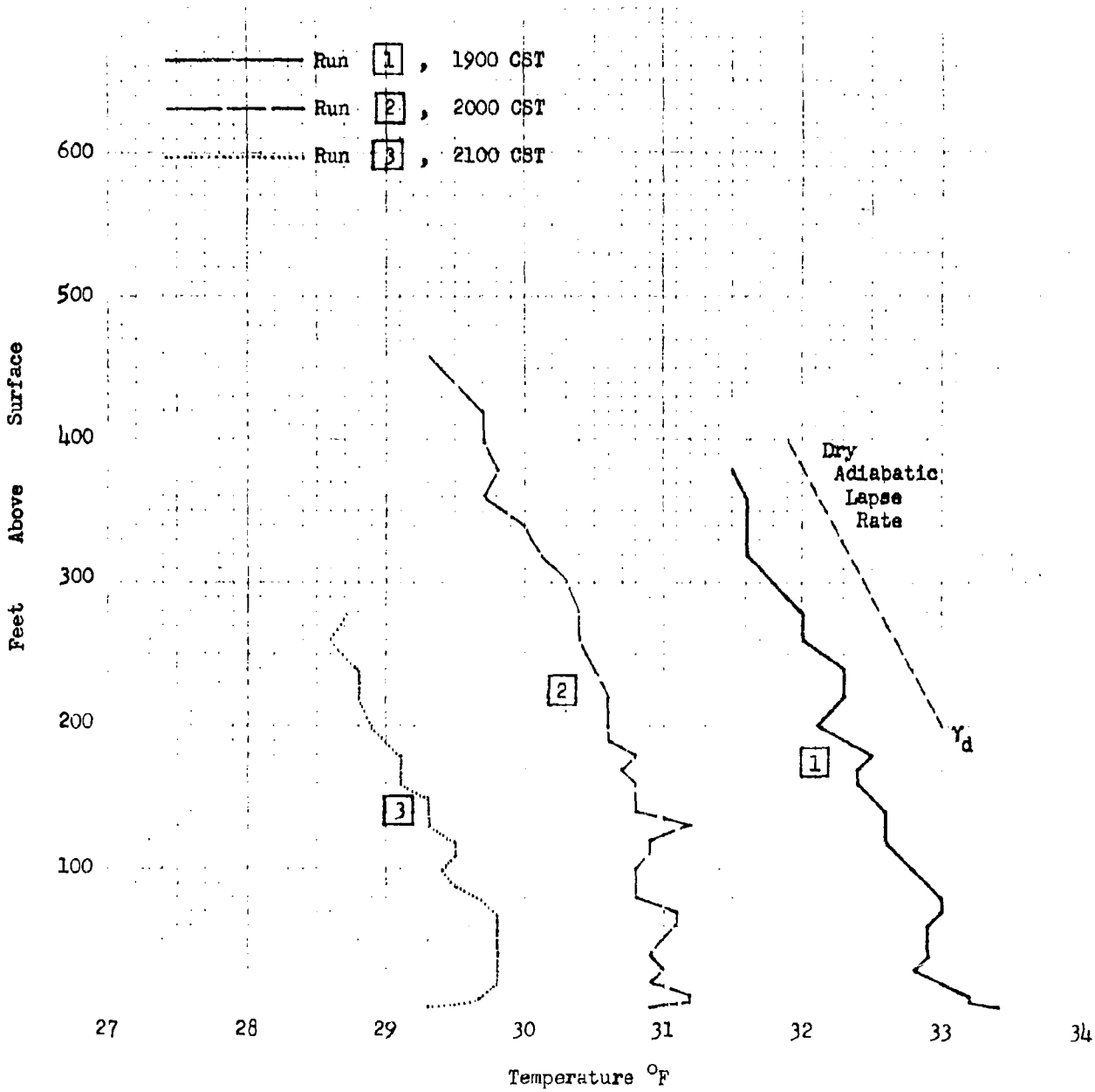


FIGURE E-3

TEMPERATURE SOUNDINGS

Minneapolis

Undeveloped-Area Wiresonde

Figure E-4

TIME RESOLUTION DATA

FT 0022b 24 Mar 1953

Total No. of Particles: 169 (Contamination Excluded)
Flow Rate: 11.6 liters/min
Dosage: 14.6 part-min/liter

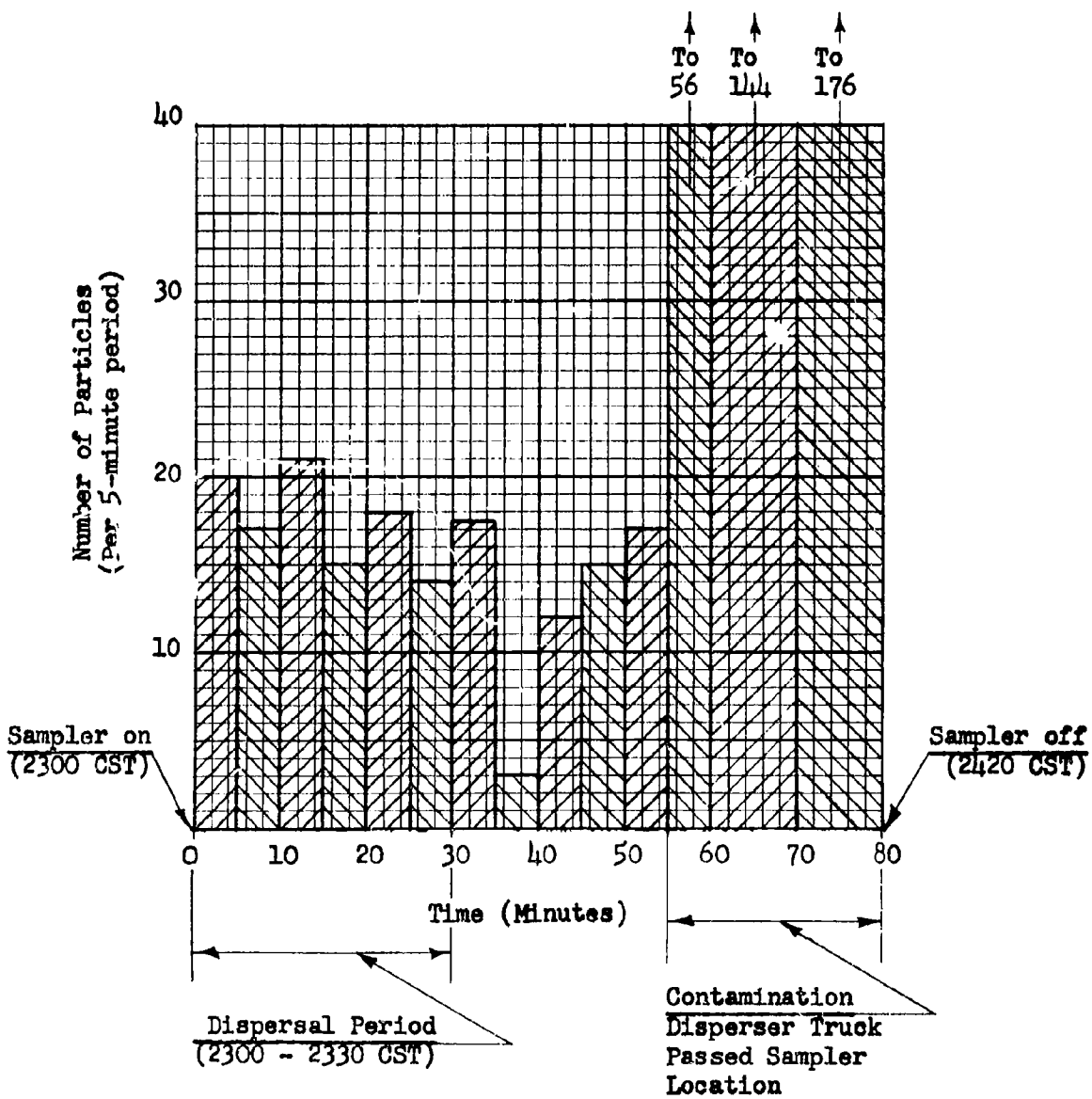
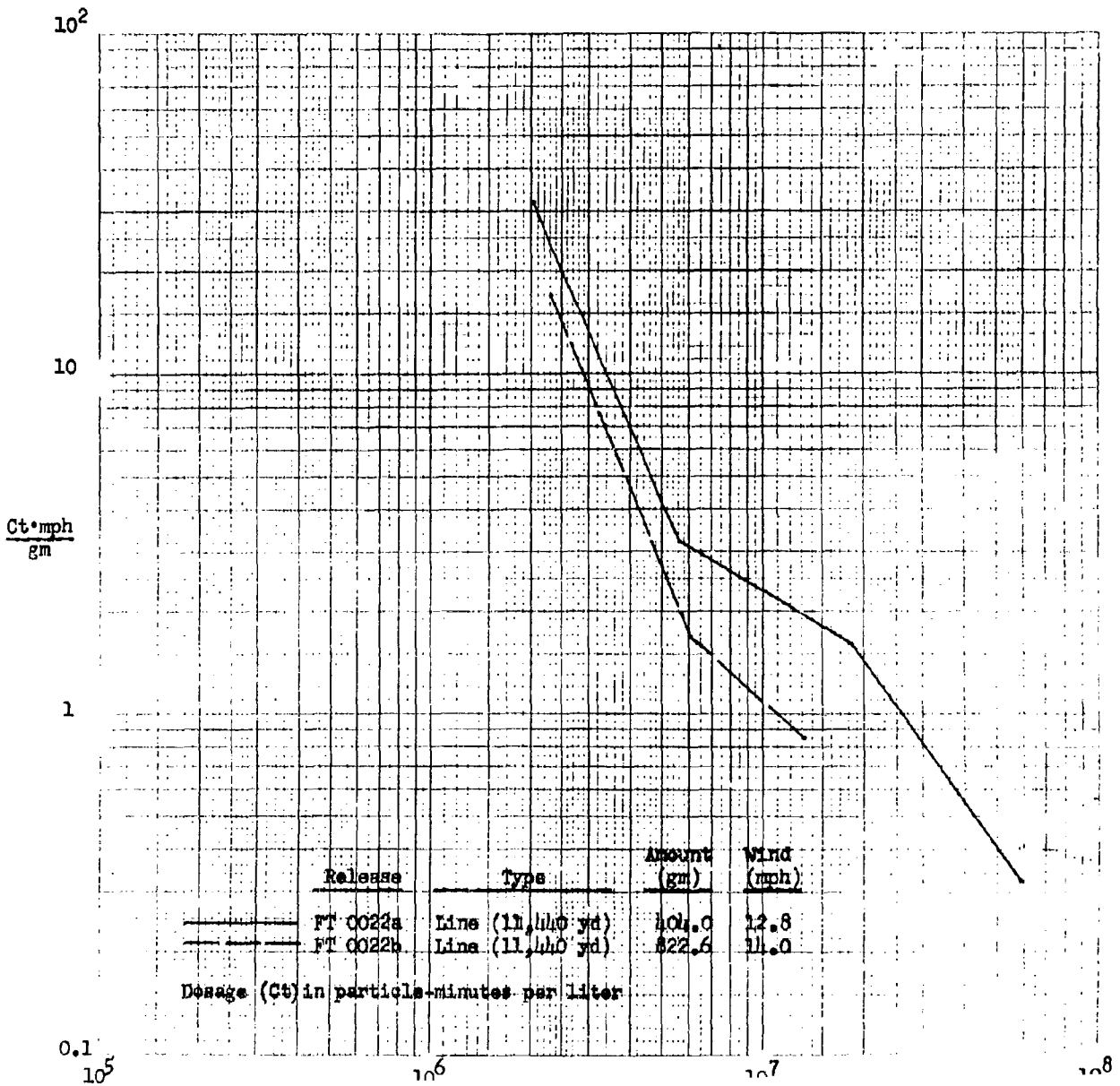


FIGURE E-5

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0022 24 Mar 1953



AEROSOL GENERATION

Line-source release of 404 gms of NJZ 2266 (at a rate of 62.3 gms/mile) over a period of 27.67 minutes starting at 1958:40 CST, from a blower disperser mounted on a moving vehicle.

START ⟶ END
(1958:40 CST) (2026:20 CST)

6.5-mile track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 103 stations as shown on test-array map by the following symbol:

● Outdoor sampler at height between 1 and 6 feet.

Sampling stations included on top of buildings represented as follows:

[N] Numbered building with sampler located on roof.

Results

All samplers operated to measure total dosages during full sampling period, 1930-2300 CST. Values obtained from roof-located samplers are summarized in Table E-1.

Total Dosage (particle-minutes/liter)

T = trace dosage

●58

100 ⟶ 100

Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated (M1), (M2), (M3), and (M5).

Similar observations at rooftop level made at meteorological station (M1), located atop the Northwestern National Bank Building, and at (M5), located atop The Ralph M. Parsons Company Building. Undeveloped-area wiresonde (Fig. E-3) obtained at meteorological station (M5).

2000 ⟶ 2005 ⟶ 2010

Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000 ⇢

Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds westerly at 13.2 mph, and (M1) roof-level winds northwesterly at 16.8 mph.

Stability

0.9° F lapse from 6-300 ft.

Sky

Clear during test period.

Temperature

45° to 46° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.8 gm/kgm dry air.

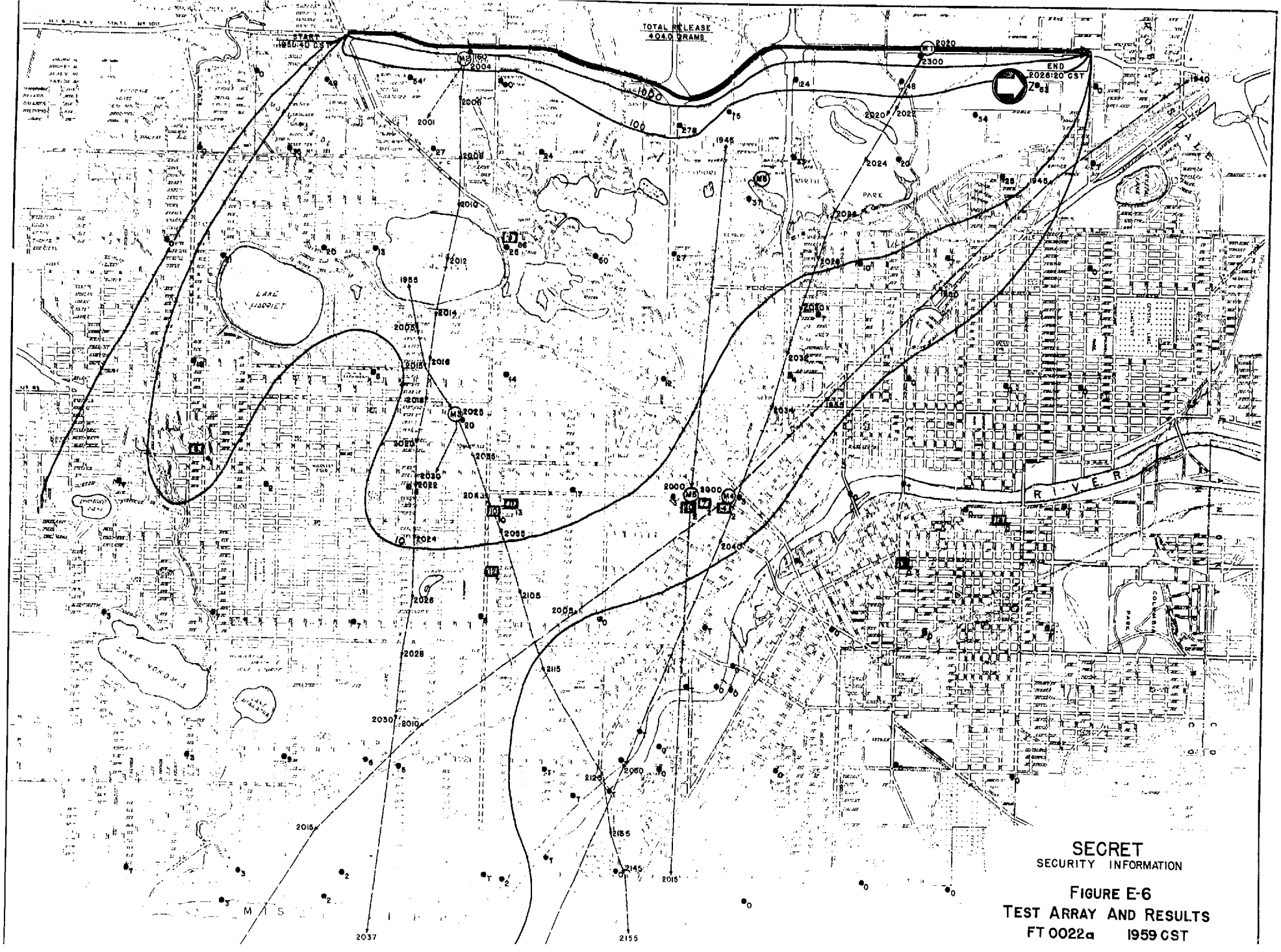


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FIGURE E-6
TEST ARRAY AND RESULTS
FT 0022a 1959 CST

Figure E-7

TEST ARRAY AND RESULTS
FT 0022b

24 Mar 1953
2300 CST

AEROSOL GENERATION

Line-source release of 822.6 gms of NJZ 2266 (at a rate of 126.3 gms/mile) over a period of 30 minutes starting at 2300 CST, from a blower disperser mounted on a moving vehicle.

START (2300 CST) ⟶ END (2330 CST) 6.5-mile track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 103 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

△ Time-resolution sampler with station number.

Sampling stations included on top of buildings represented as follows:

[N] Numbered building with sampler located on roof.

Results

All samplers operated to measure total dosages during full sampling period, 2300-0230 CST. Values obtained from roof-located samplers are summarized in Table E-1. Time-resolution data are presented in Figure E-4.

Total Dosage (particle-minutes/liter)

● 58

T = trace dosage

M = malfunction or data missing

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated M1, M2, M3, and M4.

Similar observations at rooftop level made at meteorological station M1, located atop the Northwestern National Bank Building, and at M5, located atop The Ralph M. Parsons Company Building. Undeveloped-area wiresonde (Fig. E-3) obtained at meteorological station M4.

2000 → 2005 → 2010 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000 Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds northwesterly at 13.7 mph, and M1 roof-level winds west-northwesterly at 17.4 mph.

Stability

At 2100 CST, 1.1° F lapse from 6-300 ft.

Sky

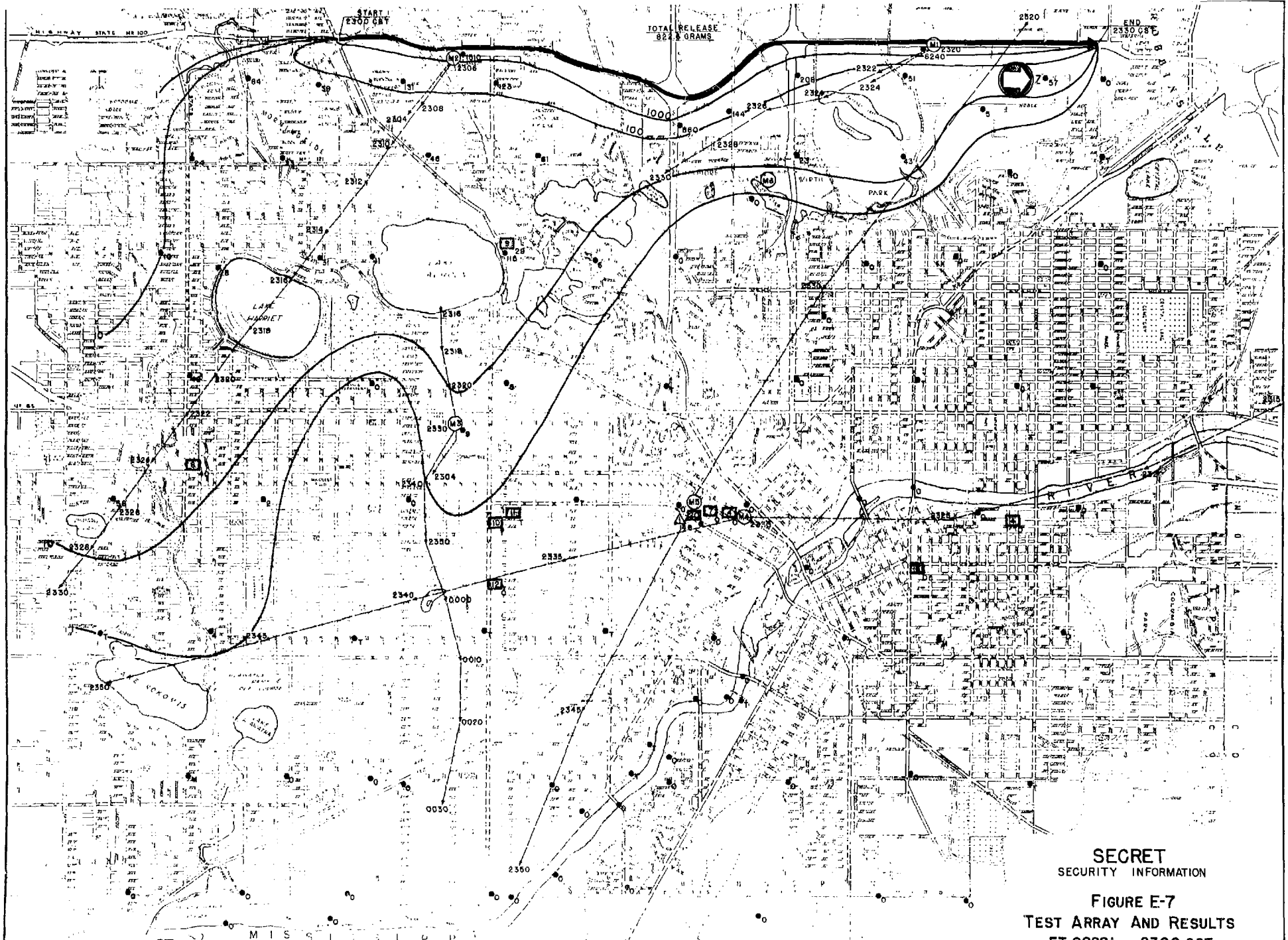
Overcast clouds with bases 1800 ft above the surface.

Temperature

38° to 40° F at 2 meters in the test area.

Moisture

Mixing ratio of 2.4 gm/kgm dry air.



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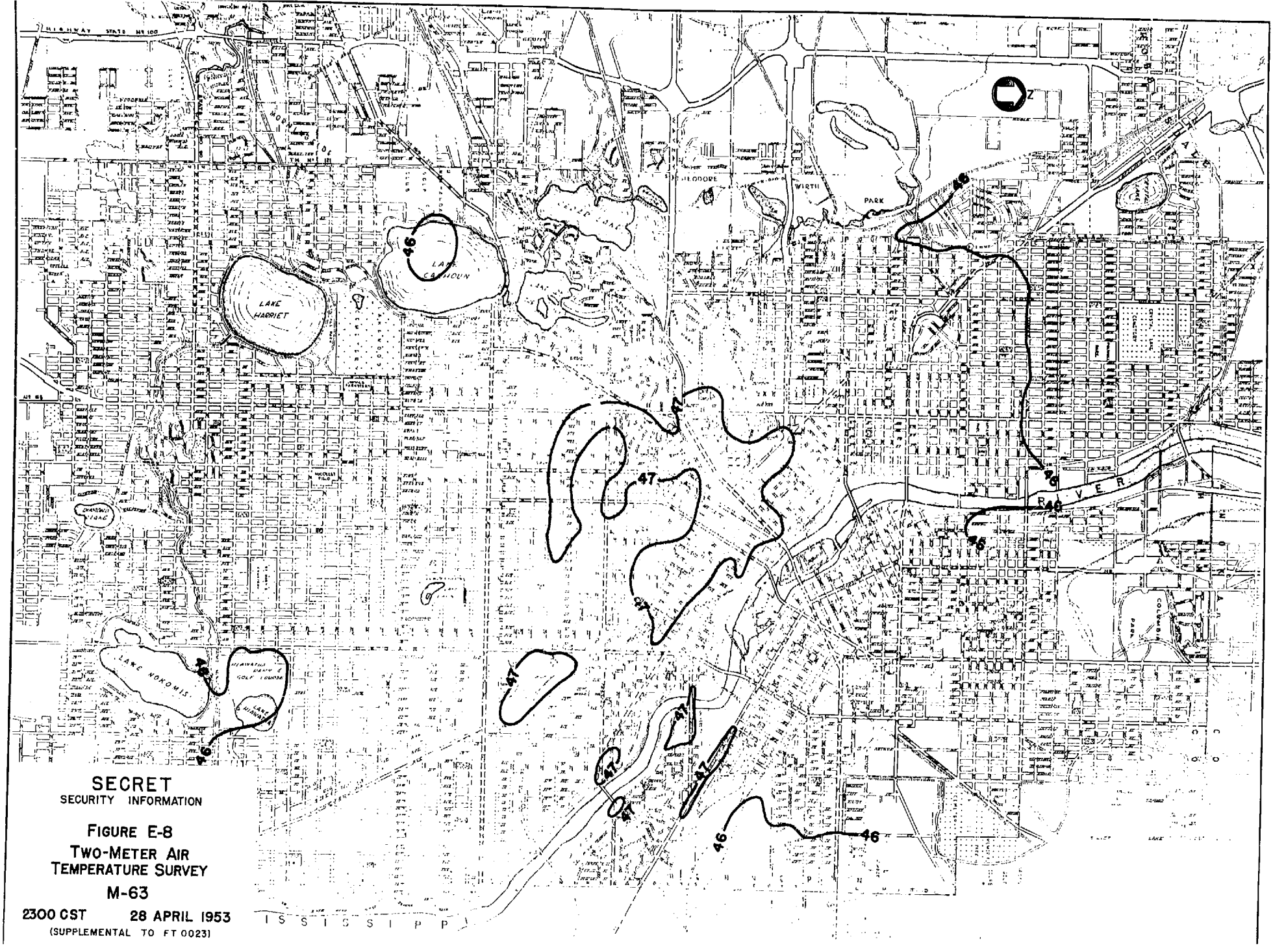
SECURITY INFORMATION

FIGURE E-7
TEST ARRAY AND RESULTS
FT 0022b 2300 CST
24 MARCH 1953



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SECURITY INFORMATION

FIGURE E-8
TWO-METER AIR
TEMPERATURE SURVEY
M-63
2300 CST 28 APRIL 1953
(SUPPLEMENTAL TO FT 0023)

SUMMARY OF REGIONAL AND LOCAL WEATHER
28 April 1953
(Survey M-63, Supplemental to FT 0023)

SYNOPTIC SITUATION

A deepening 981-mb low, moving southeastward at 12 mph, was centered over eastern Colorado, and a ridge of high pressure extended from northern Canada to Ohio. From this pattern a strong southeasterly gradient wind resulted over Minnesota and neighboring states. The overrunning from a warm front, which extended from Colorado eastward to Virginia, produced intermittent rain in the test area. At the 700-mb level, a slowly deepening low center over Colorado and a weakening ridge from Florida to Lake Michigan resulted in a weak southerly gradient wind of 5 mph over Minneapolis.

WEATHER REPORTS FROM WOLD-CHAMBERLAIN FIELD (MINNEAPOLIS)

Time (CST)	Cloud Height (feet)	Sky Cover*	Visibility (miles)	Weather**	Temp (°F)	Dew Point (°F)	Wind Dir	Wind Speed (mph)
1830	8000	Overcast	15+	-	48	35	ESE	17
1930	7000	Overcast	15+	-	47	34	ESE	17
2030	8000	Overcast	15+	-	47	32	E	21
2130	7000	Overcast	15+	-	47	32	E	21
2230	6000	Overcast	15+	-	46	31	ESE	22
2330	5500	Overcast	15+	-	45	31	ESE	20

* Average cloudiness sunrise to sunset: 90%
** And/or restrictions to visibility

Sea-level pressure at 2130 CST: 1012.2 mb
Ground condition: Grass showing, not fully green; Wirth Lake 42° F; Calhoun Lake 52° F
Tree cover: None

Figure E-9

TEMPERATURE SOUNDINGS

St. Cloud Raob 28 Apr 1953
(Supplemental to Survey M-63)

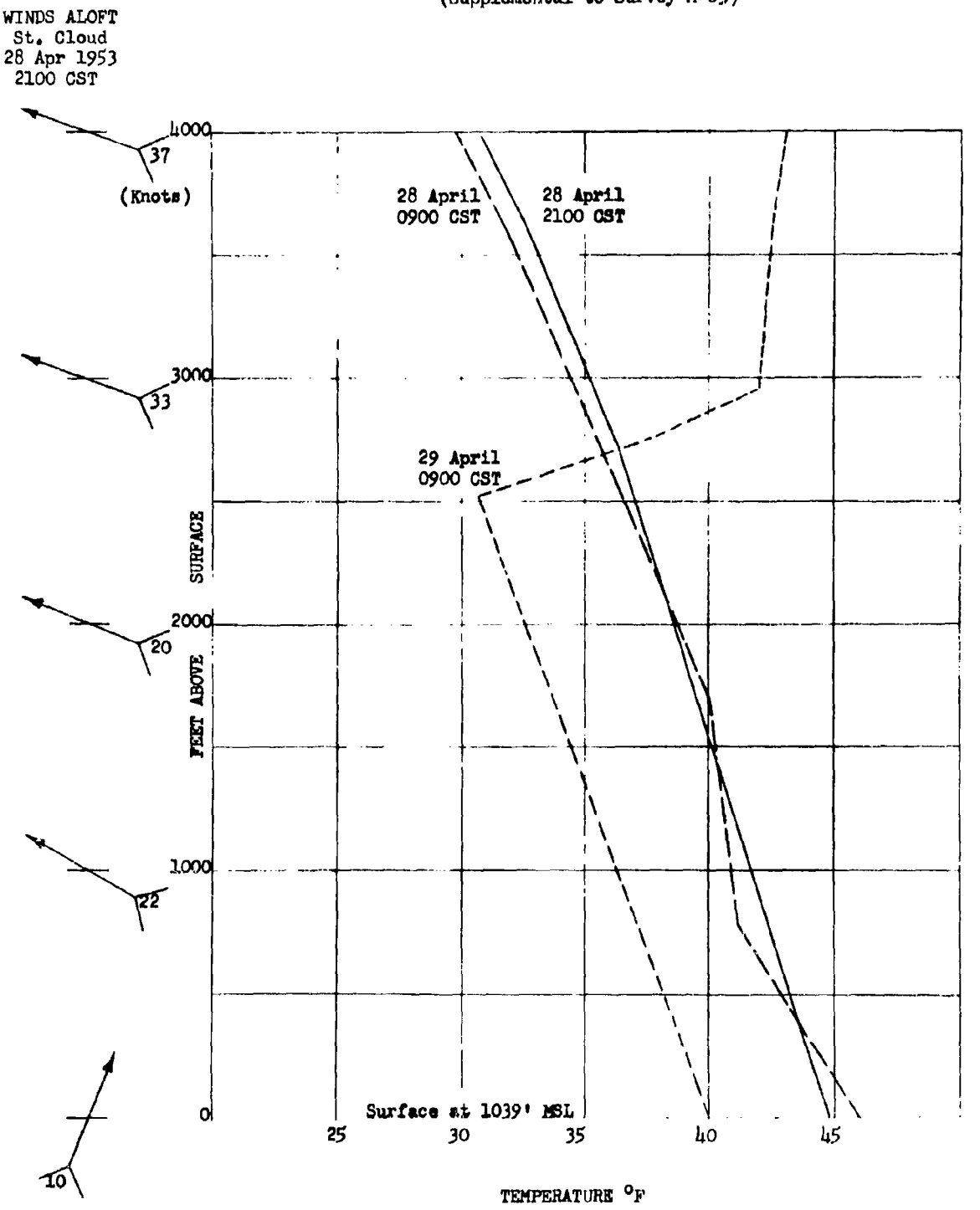

Figure E-10

TIME RESOLUTION DATA

FT 0023a 28 Apr 1953
Sampler No. 1

Total No. of Particles: 257
Flow Rate: 9.7 liters/min
Dosage: 26.5 part-min/liter

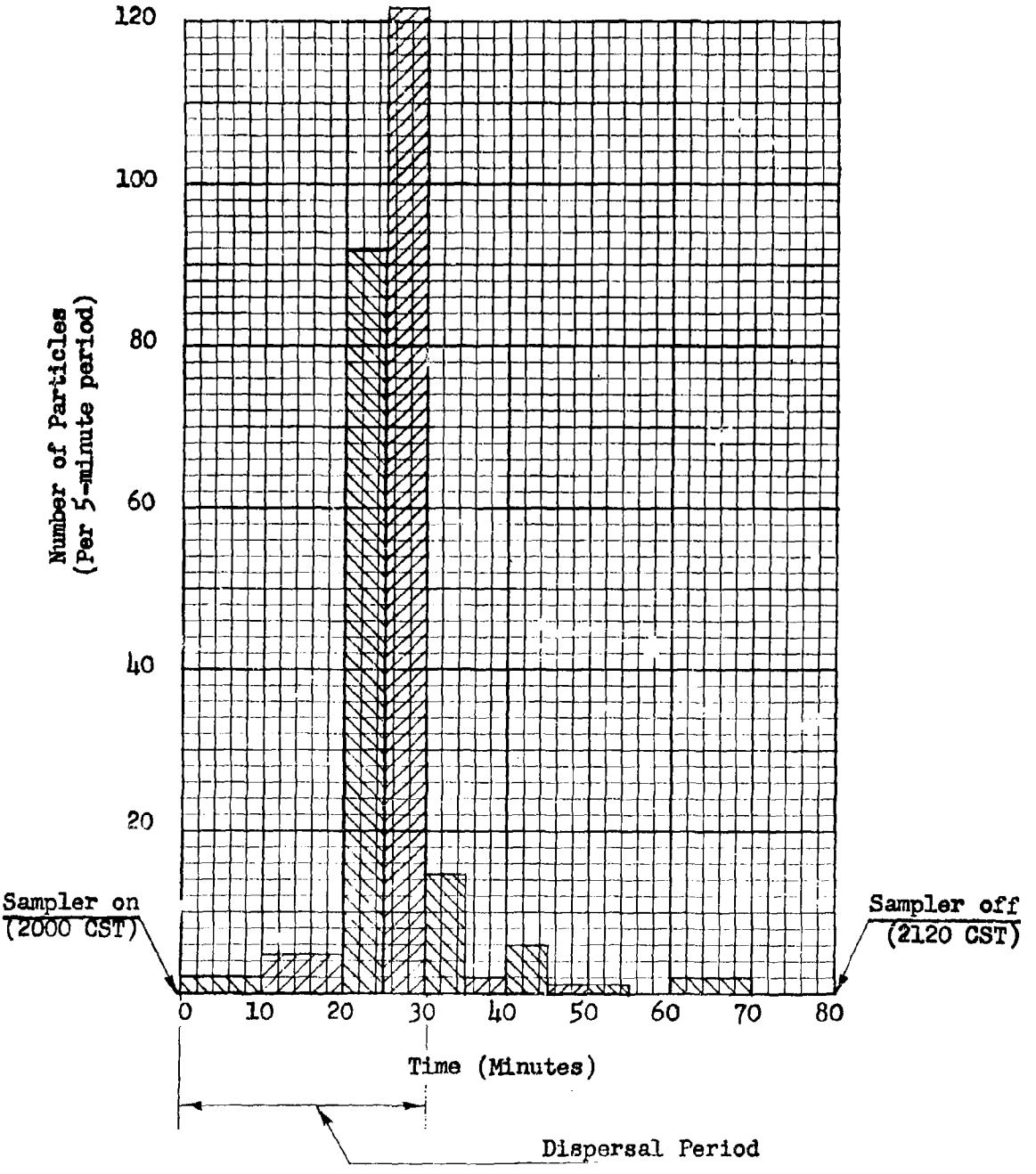

Figure E-11

TIME RESOLUTION DATA

FT 0023a 28 Apr 1953
Sampler No. 2

Total No. of Particles: 164
Flow Rate: 10.0 liters/min
Dosage: 16.4 part-min/liter

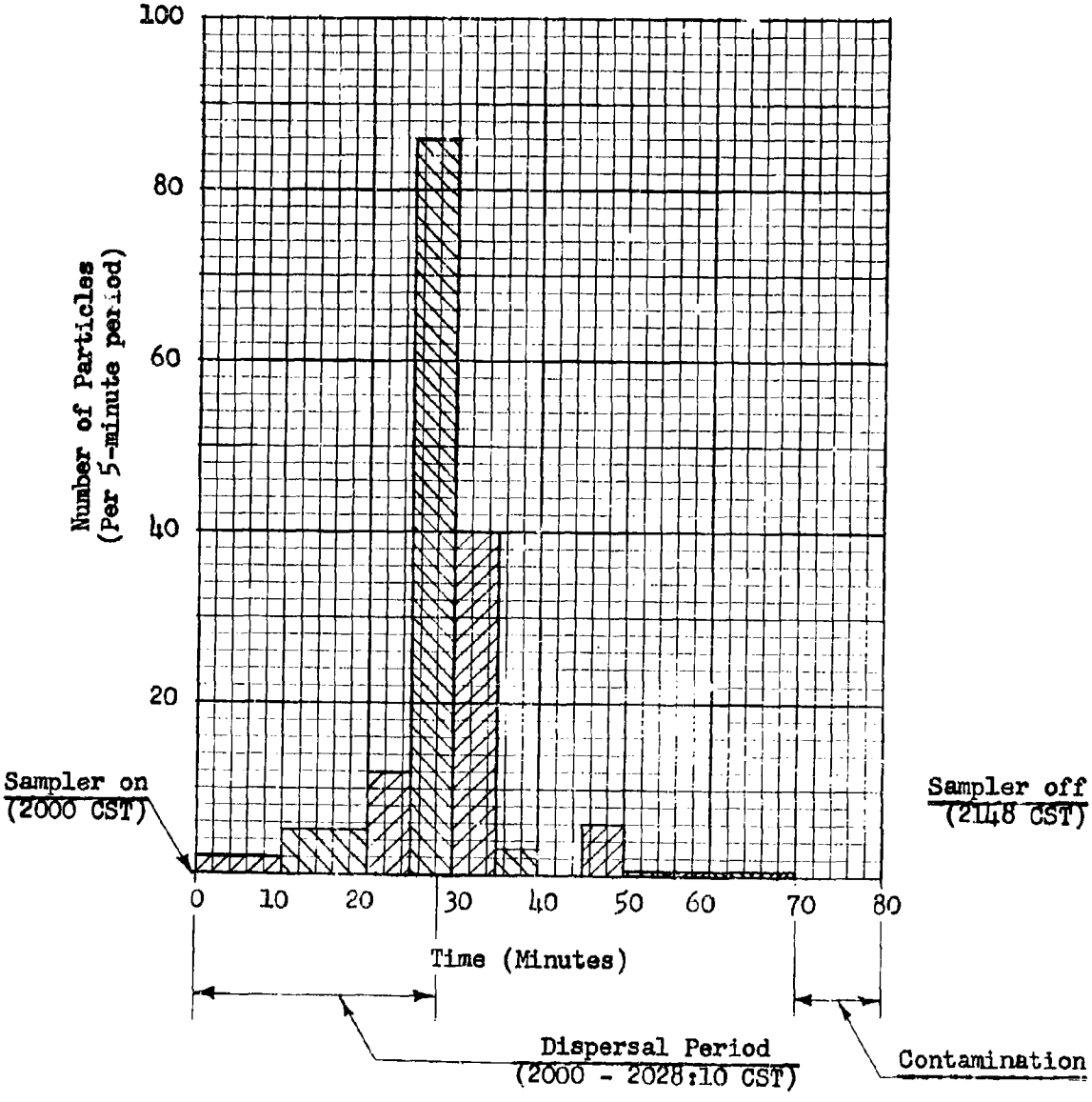

Figure E-12

TIME RESOLUTION DATA

FT 0023b 28 Apr 1953
Sampler No. 1

Total No. of Particles: 113
Flow Rate: 10.0 liters/min
Dosage: 11.3 part-min/liter

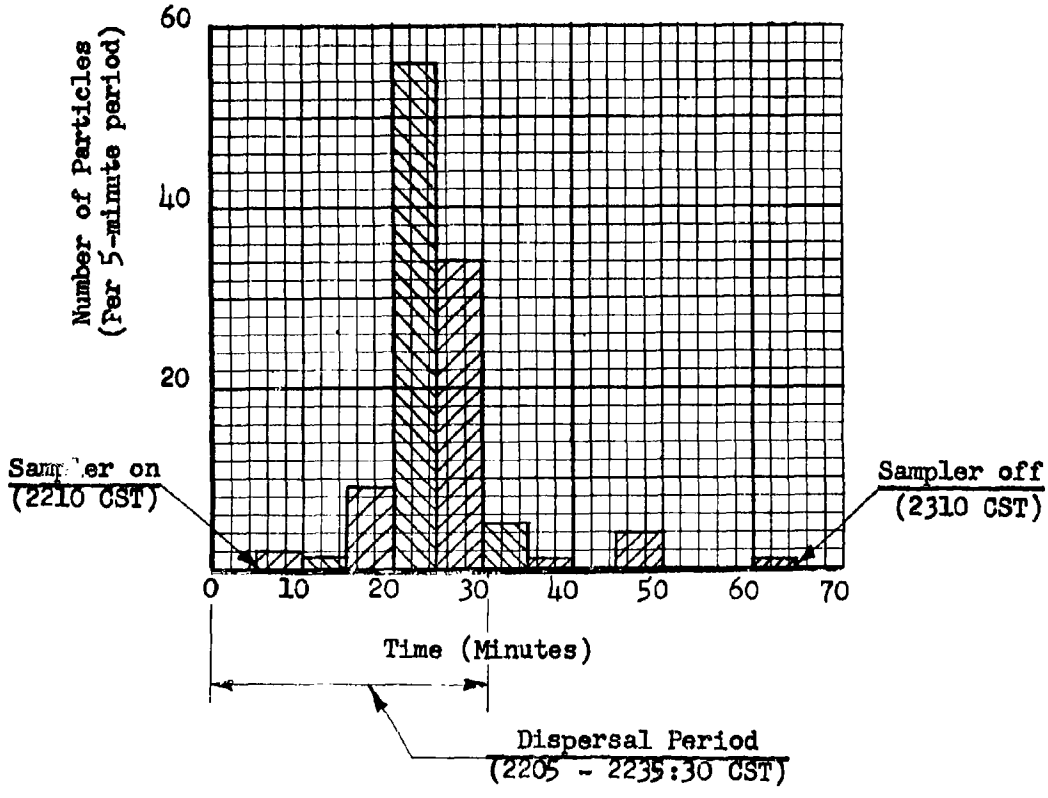

Figure E-13

TIME RESOLUTION DATA

FT 0023b 28 Apr 1953
Sampler No. 2

Total No. of Particles: 100
Flow Rate: 10.0 liters/min
Dosage: 10 part-min/liter

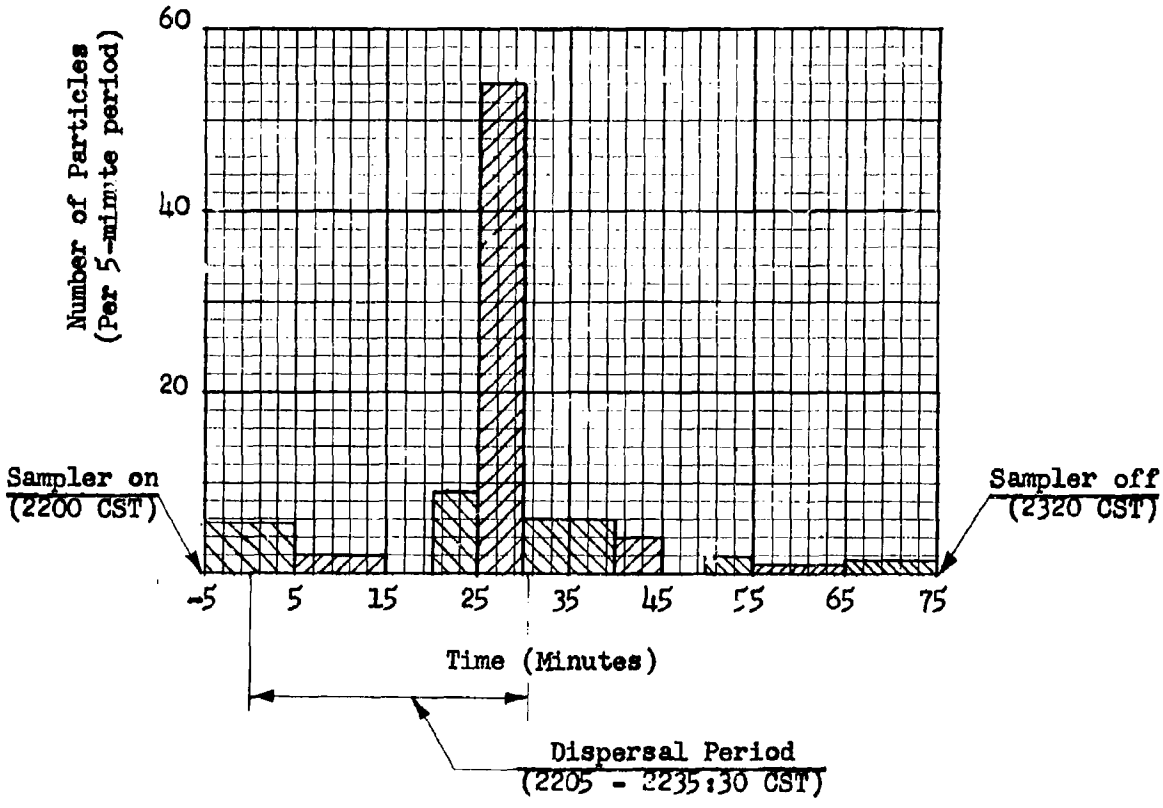

FIGURE E-14

ADJUSTED DOSAGE - AREA RELATIONSHIPS

FT 0023 28 Apr 1953

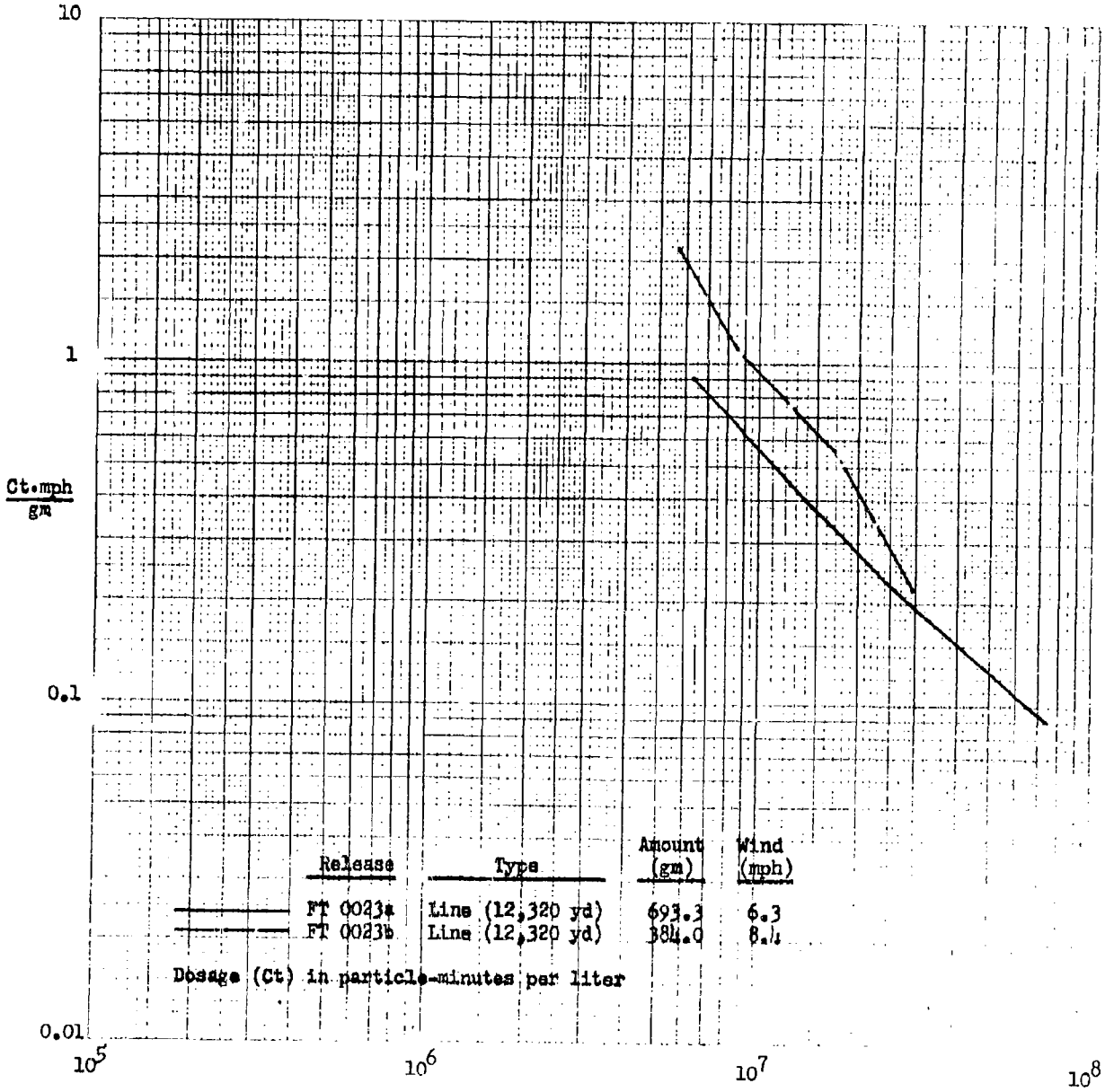

Figure E-15

TEST ARRAY AND RESULTS
FT 0023a

28 Apr 1953
2000 CST

AEROSOL GENERATION

Line-source release of 693.3 gms of NJZ 2266 (at a rate of 99.0 gms/mile) over a period of 28.17 minutes starting at 2000 CST, from a blower disperser mounted on a moving vehicle.

START ⟶ END
(2000 CST) (2028:10 CST)

7-mile track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 99 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⚠ Time-resolution sampler with station number.

Sampling stations included on top of buildings represented as follows:

[N] Numbered building with sampler located on roof.

Results

All samplers operated to measure total dosages during full sampling period, 2000-2200 CST. Values obtained from roof-located samplers are summarized in Table E-1. Time-resolution data are presented in Figures E-10 and E-11.

Total Dosage (particle-minutes/liter)

●58

T = trace dosage

M = malfunction or data missing

100 100

Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated (M1), (M2), (M3), (M4), and (M7).

Similar observations at rooftop level made at meteorological station (M1), located atop the Northwestern National Bank Building, and at (M5), located atop the Northern States Power Company Building.

Wiresonde equipment located at meteorological station (M7).

2000 2005 2010

Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000

Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds east-southeasterly at 10.2 mph, and (M1) roof-level winds east-southeasterly at 16.1 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. E-9) indicate adiabatic conditions.

Sky

Overcast clouds with bases 8000 ft above the surface.

Temperature

47° to 48° F at 2 meters in the test area.

Moisture

Mixing ratio of 3.8 gm/kgm dry air.

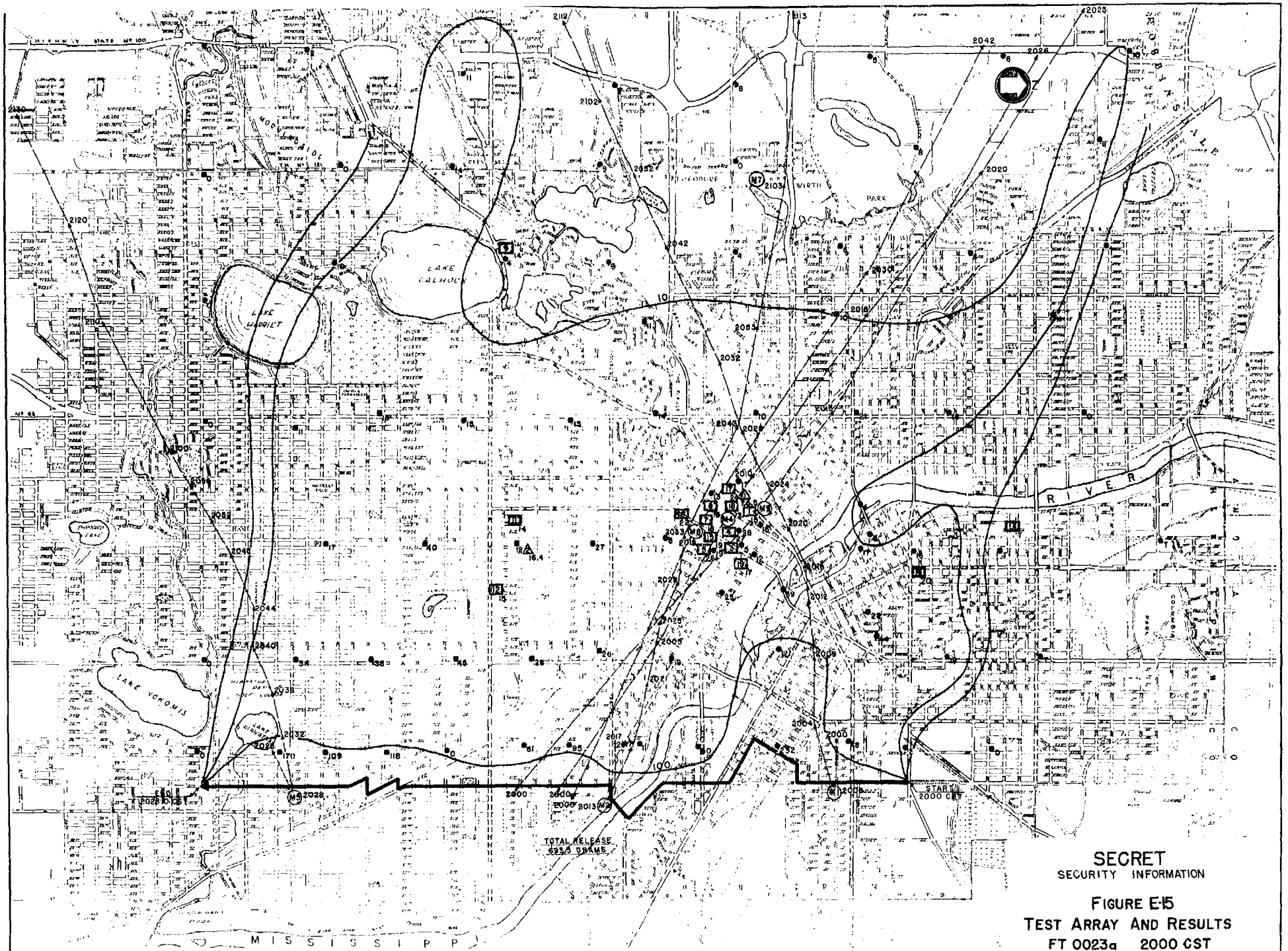

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FIGURE E-15
TEST ARRAY AND RESULTS
FT 0023a 2000 CST

Figure E-16

TEST ARRAY AND RESULTS
FT 0023b

28 Apr 1953
2205 CST

AEROSOL GENERATION

Line-source release of 384 gms of WJZ 2266 (at a rate of 54.8 gms/mile) over a period of 30.5 minutes starting at 2205 CST, from a blower disperser mounted on a moving vehicle.

START (2205 CST) ⟶ END (2235:30 CST) 7-mile track of vehicle-mounted blower disperser at the indicated starting and stopping times.

SAMPLING

Location and Exposure

Membrane-filter sampling equipment located at 99 stations as shown on test-array map by the following symbols:

● Outdoor sampler at height between 1 and 6 feet.

⚠ Time-resolution sampler with station number.

Sampling stations included on top of buildings represented as follows:

[NN] Numbered building with sampler located on roof.

Results

All samplers operated to measure total dosages during full sampling period, 2200-2330 CST. Values obtained from roof-located samplers are summarized in Table E-1. Time-resolution data are presented in Figures E-12 and E-13.

Total Dosage (particle-minutes/liter)

T = trace dosage

●58

100 — 100 Dosage contour with values expressed in particle-minutes per liter.

METEOROLOGY

Equipment and Measurement

At street level, wind direction continuously recorded, and air and surface temperatures, wind velocity, and other meteorological observations taken at one or more of the stations designated (M1), (M2), (M3), (M5), and (M7).

Similar observations at rooftop level made at meteorological station (M4), located atop the Northwestern National Bank Building, and at (M6), located atop the Northern States Power Company Building.

Wiresonde equipment located at meteorological station (M7).

2000 → 2005 → 2010 Virtual wind track, the length (drawn to map scale) and direction of each arrow representing the virtual wind travel between the times indicated.

2000 ⇢ Balloon track representing wind-drift observation at the time indicated.

Winds

Street-level winds easterly at 9.7 mph, and (M4) roof-level winds east-southeasterly at 18.2 mph.

Stability

No direct measurement; wiresonde operations precluded by relatively strong winds. These winds and supporting raob data (Fig. E-9) indicate adiabatic conditions.

Sky

Overcast clouds with bases 6000 ft above the surface.

Temperature

46° to 47° F at 2 meters in the test area.

Moisture

Mixing ratio of 3.6 gm/kgm dry air.

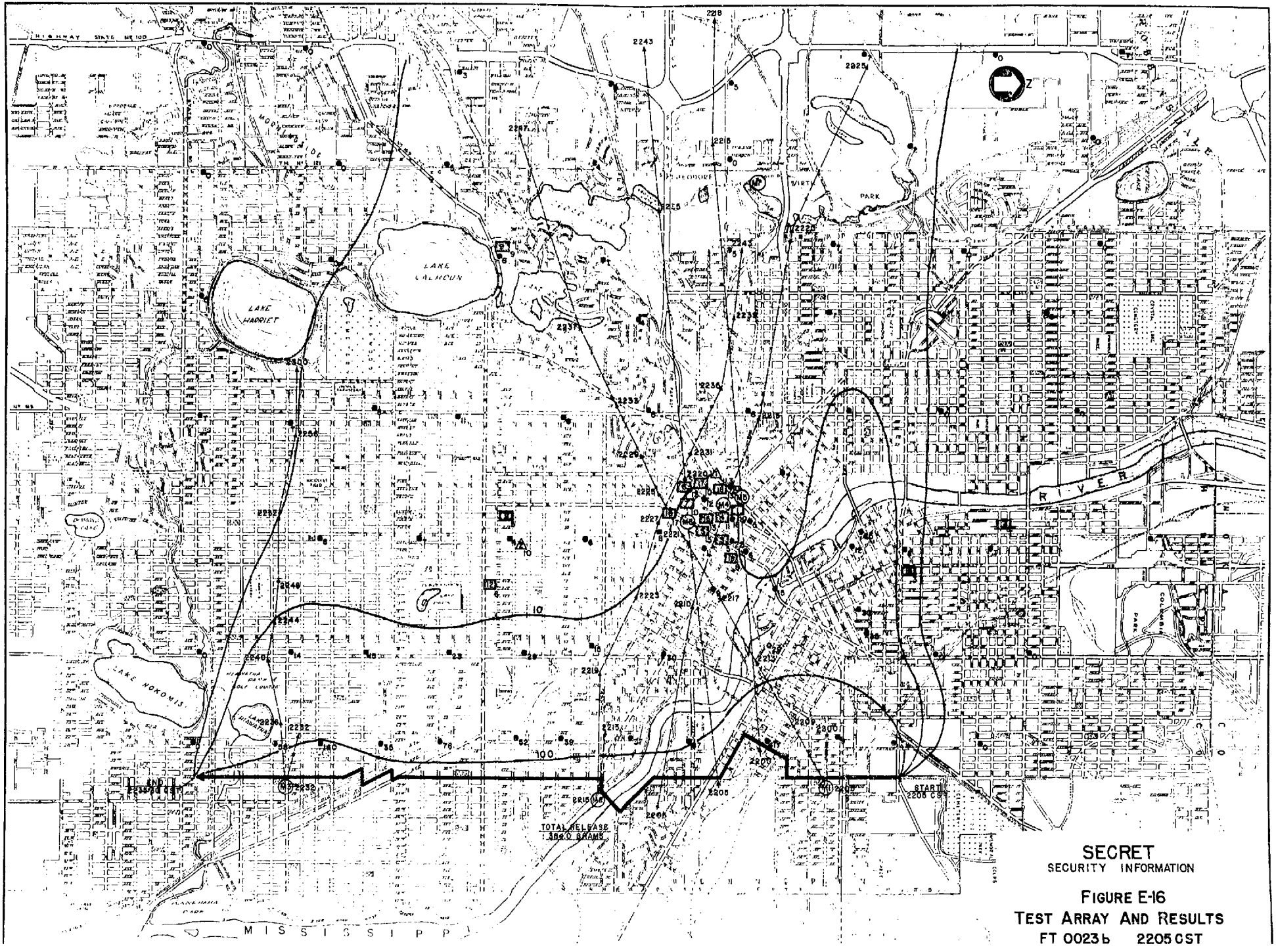

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FIGURE E-16
TEST ARRAY AND RESULTS
FT 0023b 2205 CST

TABLE E-1

BUILDING DATA FOR CITYWIDE TESTS, FT'S 0022 AND 0023
(Values Obtained from Roof-located Samplers)(1)

Bldg. No.(2)	Name of Building	No. of Floors(3)	Approximate Height (ft)	Dosages for a Given Release(4) FT 0022a	FT 0022b	FT 0023a	FT 0023b
1	Andrus Building	10	125	-	-	15	10
2	First National Bank Building	19	247	-	-	-	-
3	Northwestern Bell Telephone Building	26	350	-	-	T	5
4	Northwestern National Bank Building	17	220	2	0	27	11
5	Baker Building	13	150	-	-	22	15
6	Medical Arts Building	19	250	-	-	16	13
7	Foshay Tower(1)	31	400	2	0	18	10
8	Ramsey School	3	40	14	40	-	-
9	Calhoun Beach Hotel	10	175	89	29	14	4
10	Boyd Transfer and Storage Company	10	130	10	T	-	-
11	Clinton School	2½	40	13	T	14	5
12	Sears Roebuck and Company	14	150	7	0	15	6
13	Sheridan School	3½	45	0	0	20	3
14	Franklin Transformer Company	6	90	0	0	T	T
15	Roanoke Building	13	150	-	-	19	13
16	Curtis Hotel	13	200	-	-	22	17
17	Radison Hotel	15	210	-	-	24	10
18	Dyckman Hotel	11	160	-	-	12	13
19	Flour Exchange Building	12	200	-	-	17	8
20	The Ralph M. Parsons Company	1	13	2	0	-	-

(1) The sampler at Foshay Tower was actually located at the southeast corner of the observation platform.
(2) For location of numbered buildings in relation to a given grid complex and the prevailing isodosage pattern, see Figures E-6, E-7, E-15, and E-16. Buildings 1-7, in which samplers were exposed during FT's 0015, 0016, and 0017 (see Appendix D) are described in Section III.
(3) For studies of vertical attenuation of the aerosol cloud, roof-located samplers may be considered one floor above the top floor. See summary tables on Figures D-7, D-19, and D-33.
(4) Dosages are expressed in particle-minutes per liter; T represents trace dosage, i.e., a count not exceeding 15 fluorescent particles.

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