FINAL REPORT

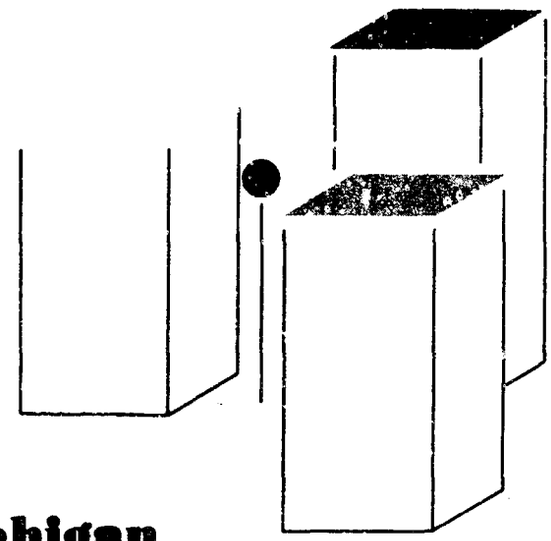
Radiological Recovery Requirements, Structures, and Operations Research

Volume IV,

Decontamination

Analysis of Selected Sites

and Facilities in Detroit, Michigan



by

J. T. Ryan

PREPARED FOR THE
OFFICE OF CIVIL DEFENSE
DEPARTMENT OF THE ARMY
WASHINGTON, D. C. 20310
OCD WORK UNIT NO. 3233B

UNDER

TECHNICAL MANAGEMENT OFFICE
U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO, CALIFORNIA 94135
CONTRACT N228 (62479)-68153
RTI PROJECT OU-214

6 June 1966

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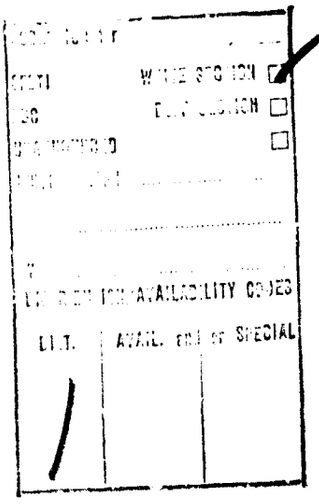

THE RESEARCH TRIANGLE INSTITUTE

Operations Research and Economics Division

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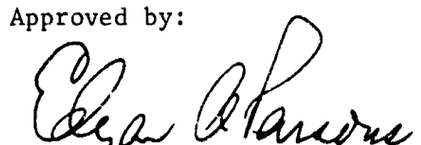

Edgar A. Parsons
Director

Robert S. Titchen
Deputy Director

6 June 1966

PREFACE

The conclusions given in this report are based upon the "Engineering Manual (PM 100-1)" method for calculation of "protection factors". Since an error analysis is not presently available, the conclusions should be regarded as tentative, pending the development of such an analysis. In addition, a redistribution of fallout and/or changes in the γ-ray spectrum emitted by the fallout may introduce further uncertainties into these conclusions.

ACKNOWLEDGEMENTS

Appreciation is extended to Mr. Walter A. Jenkins, Operations Coordinator, Office of Civil Defense, City of Detroit, for the great amount of time and effort that he spent scheduling and participating in the field surveys which were necessary to conduct this study. Mr. Philip Rasberry is also acknowledged for his valuable photographic assistance while accompanying the author in the field surveys.

ABSTRACT

This is Volume IV of four separately bound volumes that report the research completed under the general terms of the Office of Civil Defense Subtask No. 3233B, "Radiological Recovery Requirements, Structures, and Operations Research". This volume contains the supporting data related to decontamination analyses of twelve sites and facilities from Detroit, Michigan. Volume I describes the general aspects of the investigations and presents the conclusions and recommendations.

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Decontamination Analysis of Selected Sites and Facilities in Detroit, Michigan

I. INTRODUCTION

A. Objectives

This report presents the results of an analysis of the cost and effectiveness of decontaminating selected sites and facilities in Detroit, Michigan. The purpose of this analysis is to:

1. determine the extent to which decontamination can accelerate a postattack recovery;
2. determine the reduction in dose-rate at several detector locations for various strategies of decontamination;
3. determine the reduction in dose for persons performing operations in the activity area; and
4. compute cost estimates in time and manpower for practical decontamination operations.

B. Approach

The method of analysis in this report is basically the same as that used in Initial Considerations for an Analysis of Decontamination Effectiveness in Municipal Areas, (Ref. 1).[1/]

The two basic assumptions underlying the calculation of all of the decontamination effectiveness data remain:

1. the intensity at a specified detector location is linearly and independently related to the intensity contributions from the various contaminated planes. That is, if I_j is the intensity at detector location j, then one may write:

$$I_j = C_1 + C_2 + \ldots + C_n \qquad (1)$$

where the C_i's are the individual contributions from the n contaminated

[1/] J. T. Ryan, Research Triangle Institute, (1965)

planes which contribute to the intensity at detector location j; and

2. the intensity due to the i^{th} contaminated plane is directly proportional to the amount of fallout material on the i^{th} contaminated plane.

Therefore, the intensity at location j after only the k^{th} area is decontaminated, I_j^k, is given by Eq. (2).

$$I_j^k = I_j - CF_{k,j} I_j \qquad (2)$$

where I_j is the intensity at location j prior to decontamination of plane k; F_k is the fraction of fallout removed from the k^{th} contaminated plane; and $CF_{k,j}$ is the fraction of the total intensity prior to decontamination at detector j due to contaminated plane k. In other words,

$$CF_{k,j} = \frac{\text{pre-decontamination intensity at detector j from } k^{th} \text{ area}}{\text{total pre-decontamination intensity at detector j}} \qquad (3)$$

Other parameters and symbols used are

1. RN_j = the intensity reduction factor. This is the fraction of pre-decontamination dose-rate remaining at detector location j after decontamination has been accomplished.

2. RN_A = the activity dose reduction factor. This is the fraction of pre-decontamination dose accumulated by person performing activity A after decontamination has been accomplished. (4)

The values needed to determine the objectives set forth in I.A. above were determined by use of two computer programs. The C_i values were obtained through the use of the program described in Computer Program for Analysis of Building Protection Factors Parts I and II, (Ref. 2).[2/] This is a FORTRAN program, based on fallout radiation shielding techniques, which is designed to accurately describe the doses within real structures. The remaining values were determined through the use of the program described in A FORTRAN Program for Decontamination Analysis, (Ref. 3).[3/] This

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[2/] E. L. Hill, T. Johnson, and K. O. Lyday, Jr., Research Triangle Institute, (1965)

[3/] C. Dillard and J. Ryan, Research Triangle Institute, (1965)

program, also written in FORTRAN, is a debugged and tested program for computing the effectiveness parameters used to analyze municipal decontamination. The C_i values were inputs to the latter program. Also, values taken from Figures 2 through 8 of Initial Considerations for an Analysis of Decontamination Effectiveness in Municipal Areas, (Ref. 1) [1/] were inputs to determine costs in time and manpower to decontaminate.

Because the data on Detroit was limited in many cases to Sanborn maps and photographs, it was necessary to assume certain pertinent information such as roof and floor PSF, percent of apertures, etc. in some of the case studies. However, it is believed that the assumptions made are realistic, and do not bias the results of the analysis to any appreciable degree.

On some of the case studies fallout shelters are assumed to exist and are given an arbitrary PF. This is because Sanborn maps do not indicate basements and we were unable to gain entrance to some of the facilities studied. Therefore, although they are considered as detector locations, the location of fallout shelters are not generally shown on the figures.

C. Contents

This report contains the compiled results of an analysis of the application of decontamination efforts to numerous sites and facilities in Detroit, Michigan. Figure 1 shows the location of the sites and facilities considered, and the accompanying legend identifies them.

For each of the activity areas, the intensity reductions at a number of detector locations are determined for various levels of practical decontamination procedures. Dose reductions for specified activity patterns within the activity area are also shown. In addition cost data is presented for a number of the studies corresponding to the effectiveness achieved.

1/ J. T. Ryan, Research Triangle Institute, (1965)

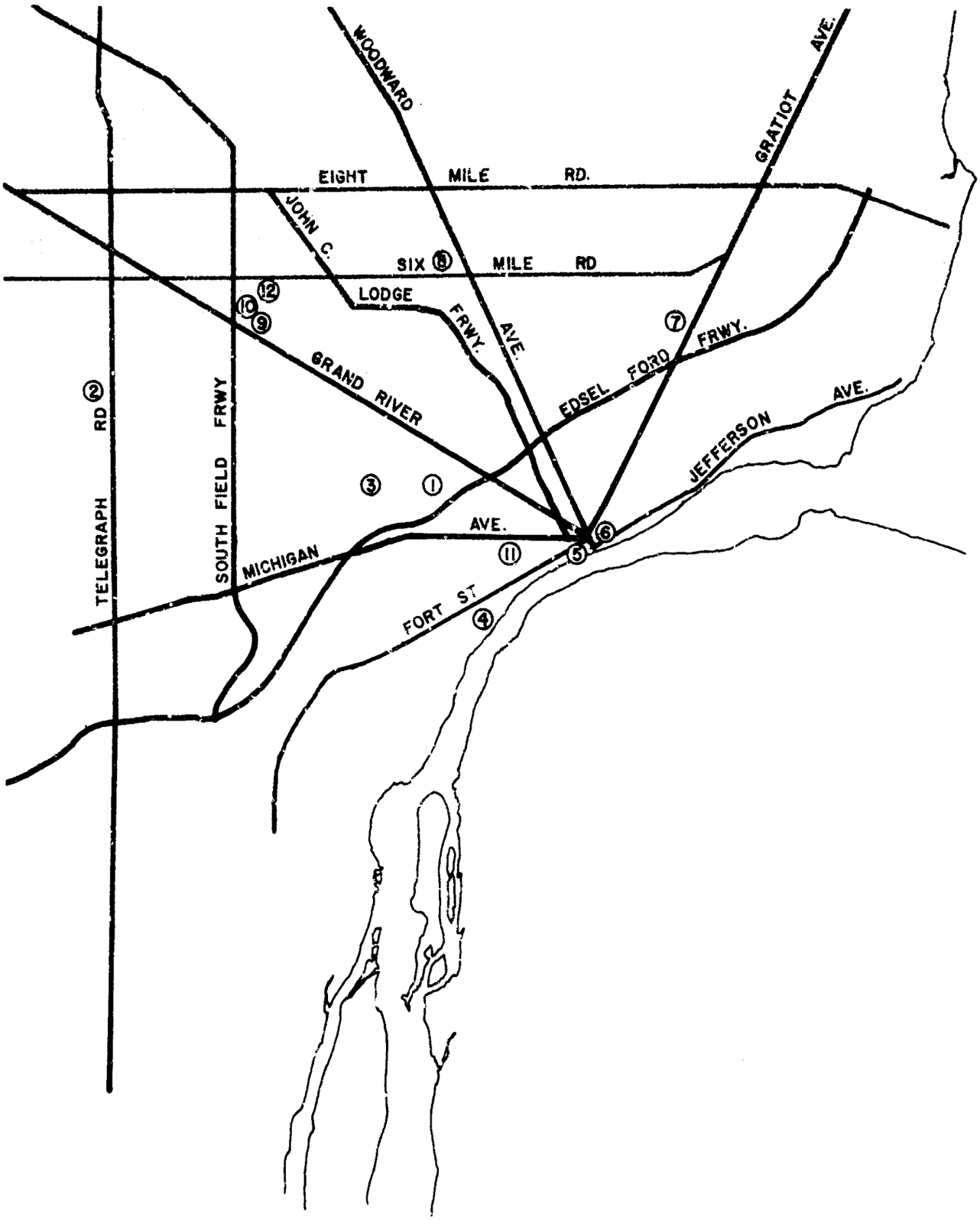


Figure 1

A Map of the Greater Detroit Area Showing the
Locations of the Sites and Facilities Considered in this Analysis

Legend for Figure 1

1. Mercy Hospital
2. E. J. Korvette Department Store
3. Springwells Water Pumping Station
4. Mistersky Power Plant
5. Cobo Convention Hall
6. City-County Building
7. Detroit City Airport
8. Detroit Office of Civil Defense Building
9. Saint Mary's High School and Elementary School
10. Isaac Crary Elementary School
11. Cadillac Motor Car Division of General Motors Corporation
12. Pure Oil Gasoline and Service Station

II. DECONTAMINATION ANALYSIS OF MERCY HOSPITAL

A. Discussion

Mercy Hospital at 2929 West Boston Boulevard is located in a semi-residential area. It is surrounded by two and three story apartment houses. A school playground is directly behind the building.

Figure 2 is a simplified diagram of the hospital, showing the locations of detectors and indicating the locations, sizes, and surface materials of some of the contributing planes of contamination to the activity area. Figures 3 through 14 are a number of photographs taken in and around the hospital, showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 15 is a map indicating the locations and directions of the photographs.

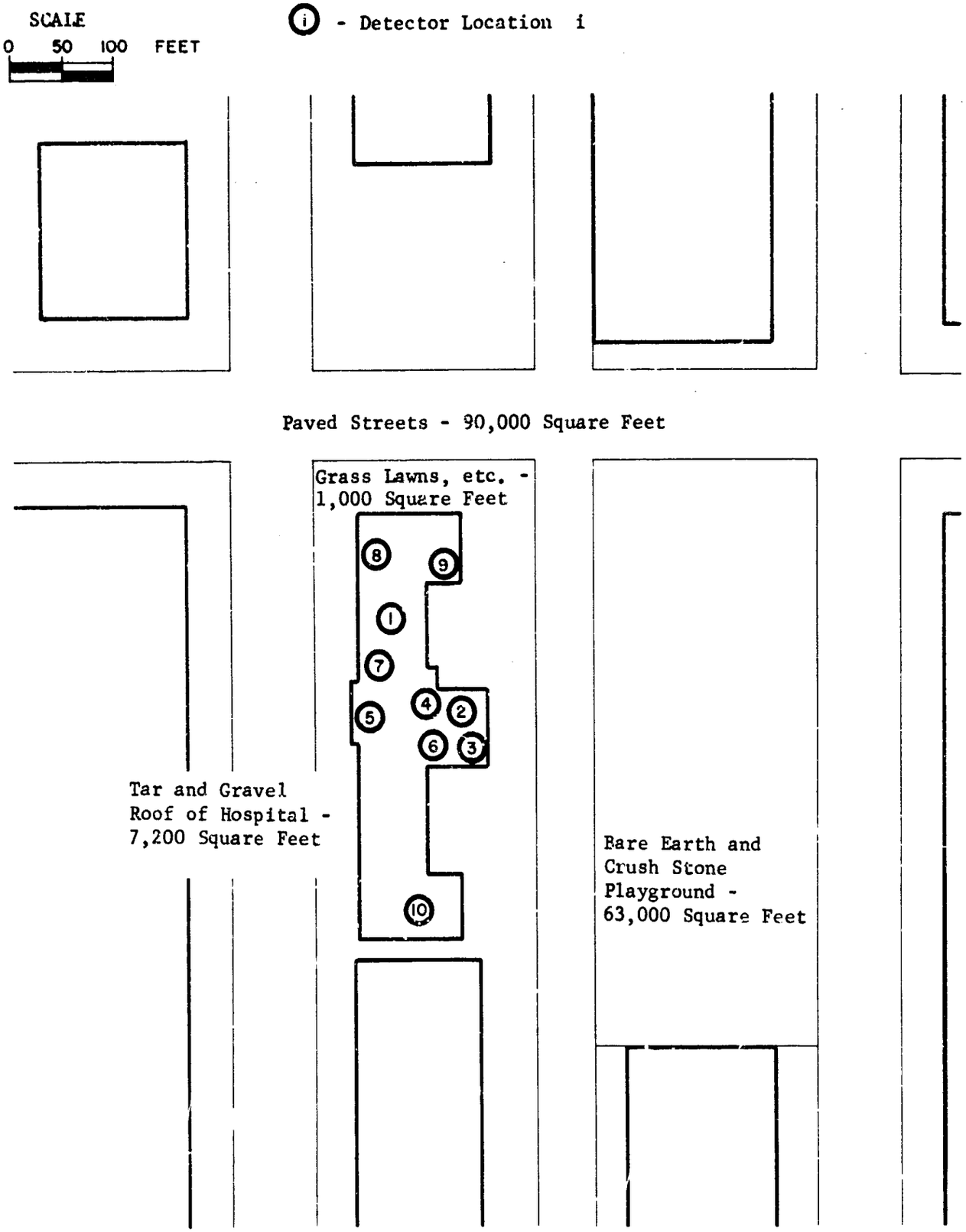


Figure 2

A Map of the Area Around Mercy Hospital Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 3

View 1 - Mercy Hospital -
A View of the Front of the Building
Showing the Large Glass Windows in
the Center Lobby

Figure 4

View 2 - Mercy Hospital -
A View of the Street and Lawn in Front
of the Building

Figure 5

View 3 - Mercy Hospital -
A View of the Hospital Showing a
Nearby Fireplug

Figure 6

View 4 - Mercy Hospital -
A View of the Side Street Next to
the Hospital

Figure 7

View 5 - Mercy Hospital -
A View of the Alley and Parking Lot
Behind the Hospital

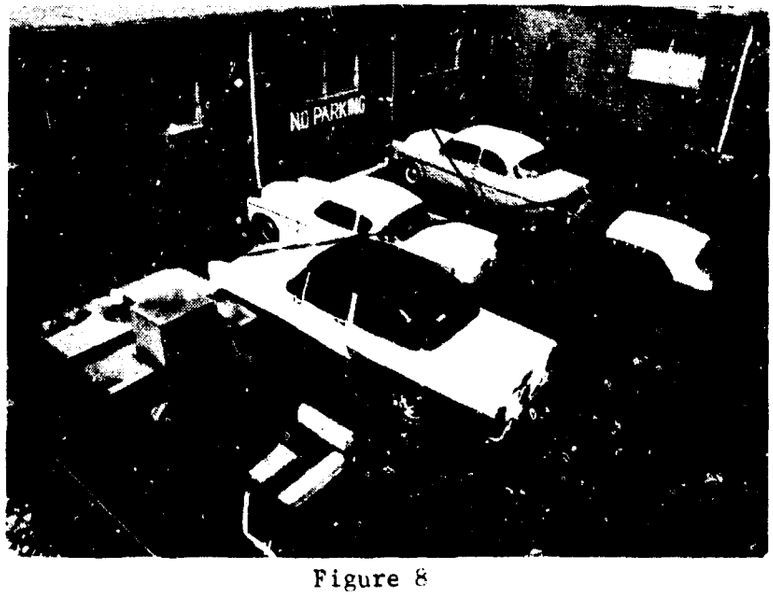


Figure 8

View 6 - Mercy Hospital -
A View of the Parking Lot Behind the Hospital
and the Cinder Block Rear Wall of the Building

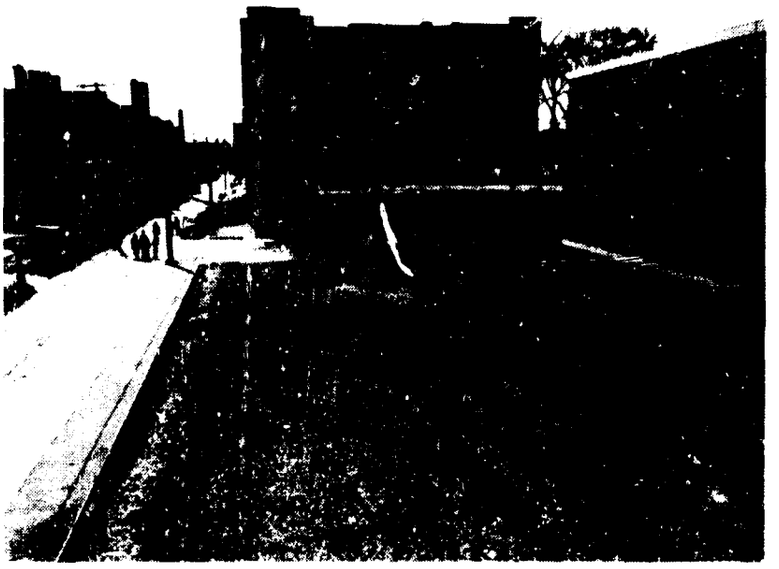


Figure 9

View 7 - Mercy Hospital -
A View of the Tar and Gravel Roof
of the Hospital

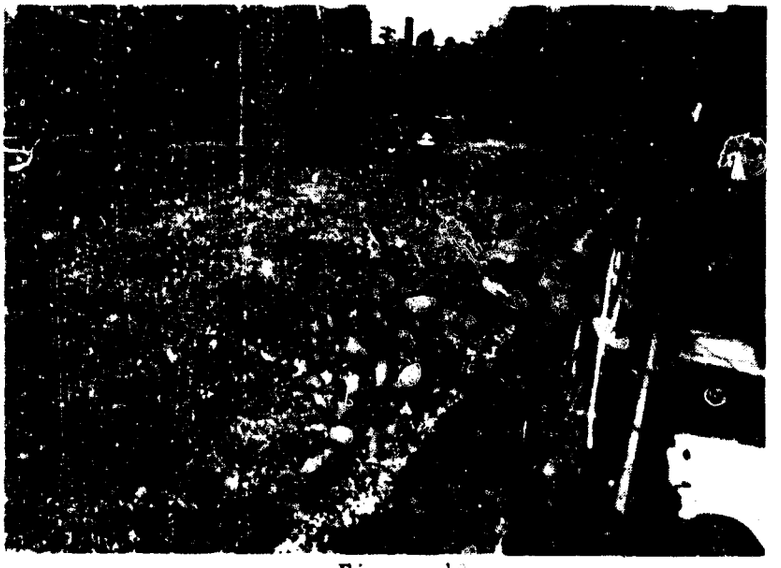


Figure 10

View 8 - Mercy Hospital -
A View of the Roof of the Hospital
Showing the Portion of the Building
Which is Two Storied

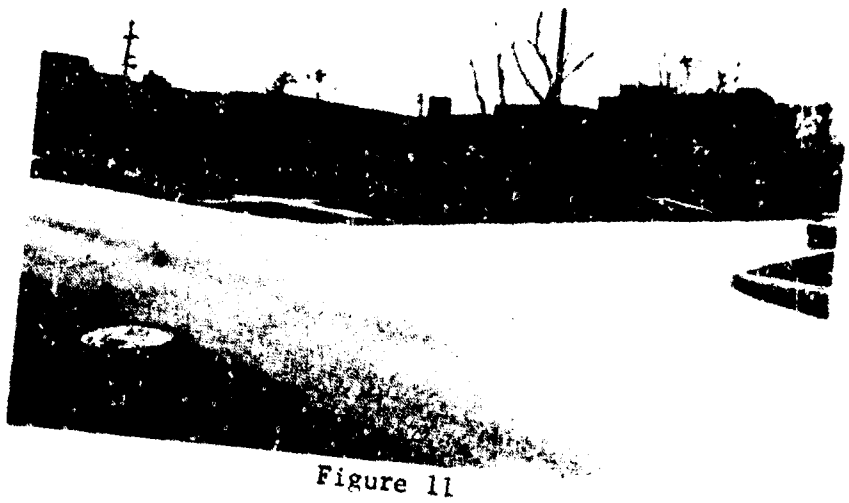


Figure 11

View 9 - Mercy Hospital -
A View of the Hospital Taken From Across the Corner Intersection

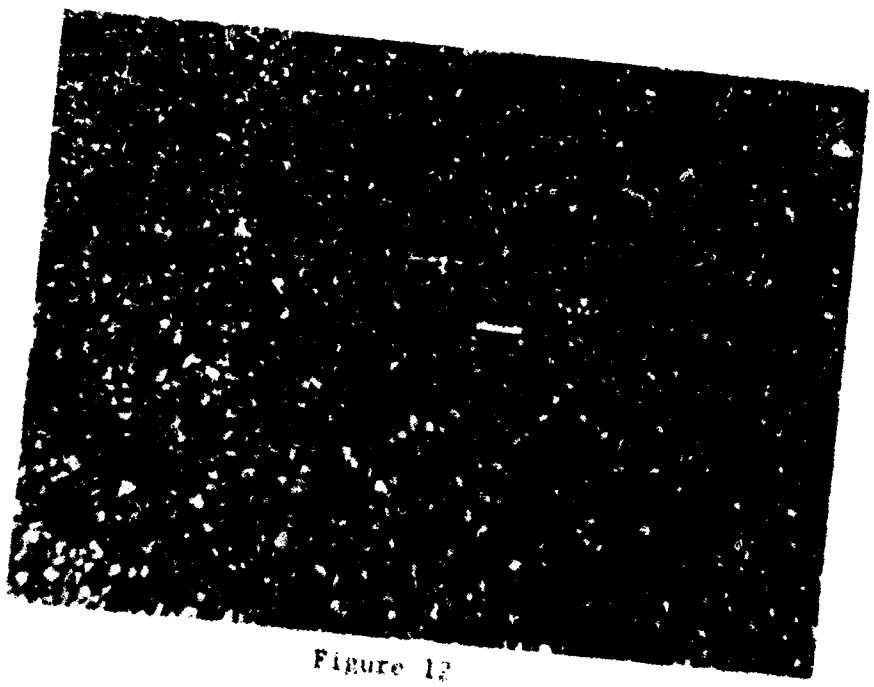


Figure 12

View 10 - Mercy Hospital -
A Close-up View of the Tar and Gravel Surface of the Roof

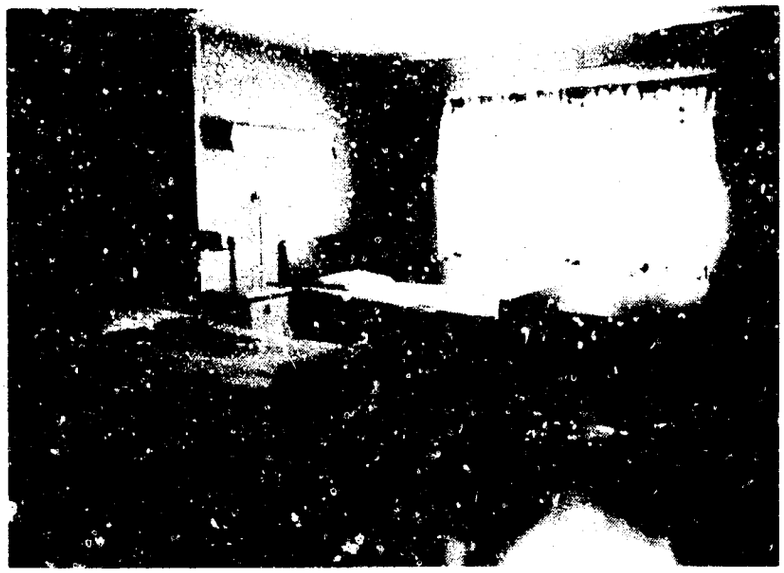


Figure 13

View 11 - Mercy Hospital -
A View of a Patient's Room in the Hospital

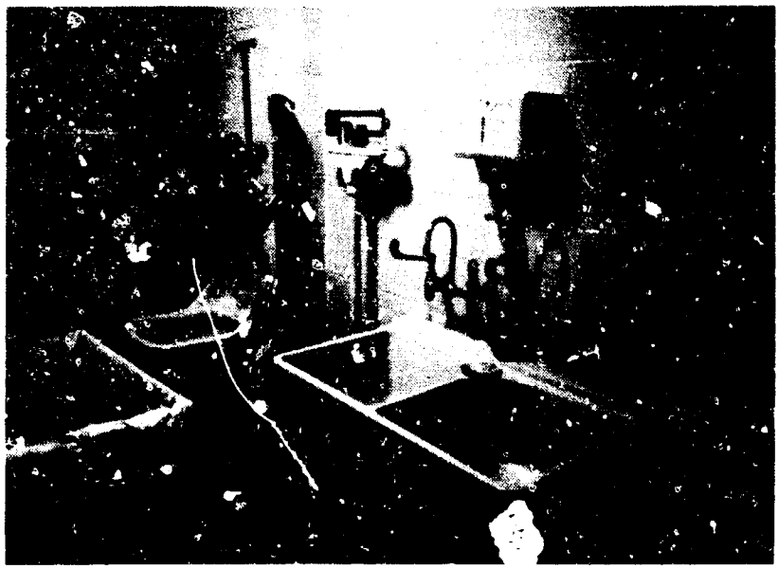


Figure 14

View 12 - Mercy Hospital -
A View of the Wash Room (Note that the Interior Walls are also Constructed of Cinder Block)

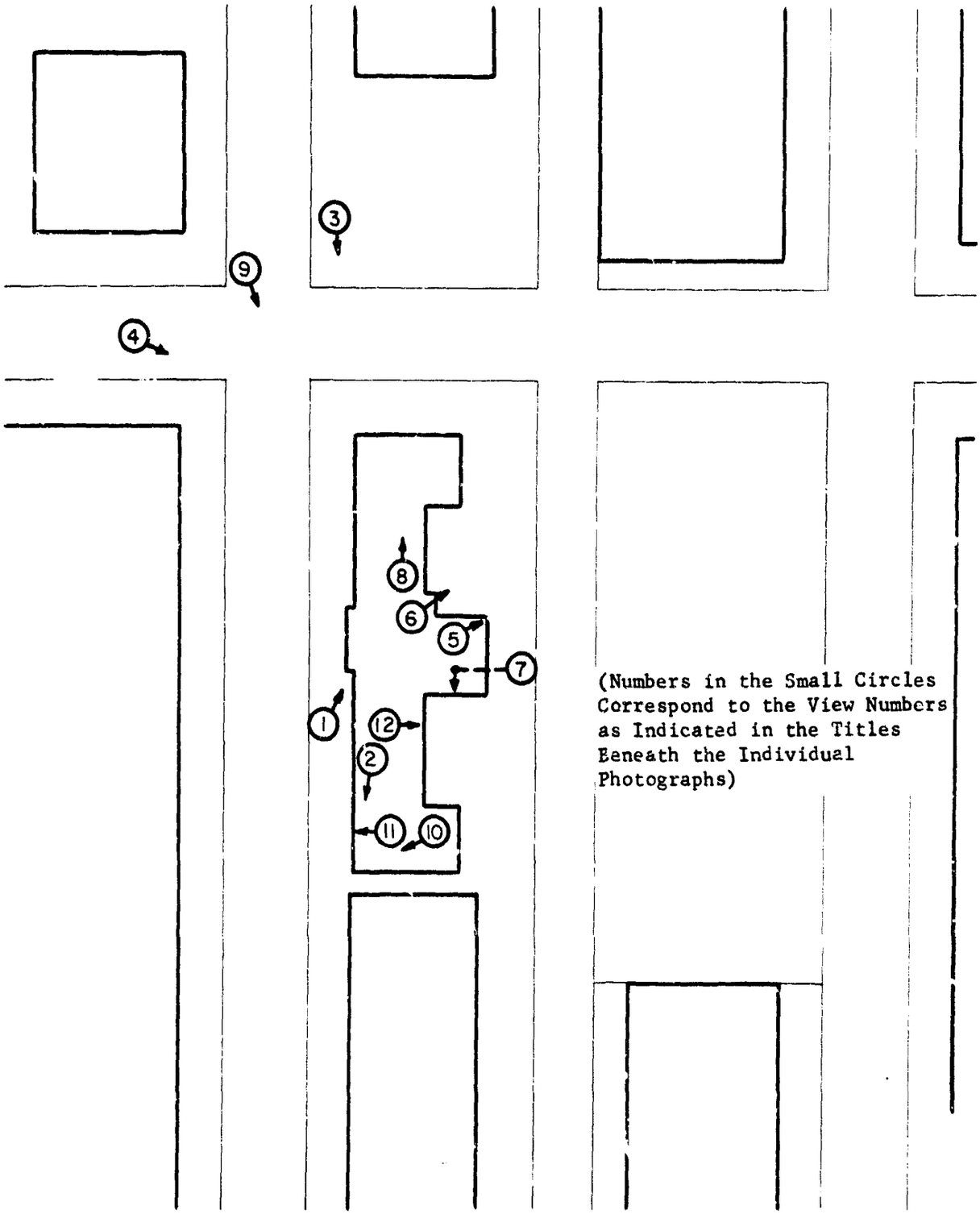


Figure 15

A Map of the Area Around Mercy Hospital Showing the Locations and Directions of the Photographs Shown in Figures 3 through 14

B. Definition of Activities

Six different activity patterns are considered in this analysis. Ten detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Location	Description
1	Center corridor on the first floor
2	Corridor of the surgical wing on the first floor
3	Operating room
4	Emergency room
5	Lobby
6	X-ray room
7	Office
8	Patient's room off the main corridor
9	Patient's room off the side corridor
10	Basement shelter area

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table I defines the six activity patterns.

Table I

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j IN MERCY HOSPITAL

Activity Pattern A_i	Detector Location j									
	1 Center Corridor (1st Floor)	2 Corridor Surgical Wing	3 Operating Room	4 Emergency Room	5 Lobby	6 X-ray Room	7 Office	8 Patient's Room on Main Corridor	9 Patient's Room on Side Corridor	10 Basement Shelter Area
A_1	.05	.00	.00	.20	.00	.00	.00	.25	.10	.40
A_2	.10	.00	.00	.00	.00	.25	.15	.10	.00	.40
A_3	.00	.05	.50	.05	.00	.05	.05	.00	.00	.30
A_4	.00	.00	.00	.00	.05	.00	.50	.00	.00	.45
A_5	.00	.00	.00	.00	.20	.00	.00	.00	.00	.80
A_6	.00	.10	.20	.20	.00	.05	.00	.05	.05	.35

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 2)

Detector Location		Original PF
1	Center corridor on first floor	9.8
2	Center corridor of the surgical wing on the first floor	5.1
3	Operating room	5.9
4	Emergency room	5.9
5	Lobby	4.3
6	X-ray room	6.3
7	Office	4.6
8	Patient's room off main corridor	5.1
9	Patient's room off side corridor	4.8
10	Basement shelter area	44

2. Equivalent Protection Factors for Activity Patterns

Activity (See Table I)	Equivalent PF
A_1	8.5
A_2	9.0
A_3	7.8
A_4	7.7
A_5	15
A_6	8.1

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Hospital Roof	7,200	Tar and Gravel
2	Parking Lots	2,800	Asphalt
3	Streets	90,000	Asphalt
4	Playground	63,000	Bare Earth and Crushed Stone
5	Lawns, Bare Earth, etc.	1,000	Grass and Ground

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the building which were required to calculate the contribution to intensity values:

a. Exterior walls - 12" lightweight cinder block (61 lb/ft^2).

b. Interior walls - 12" lightweight cinder block (61 lb/ft^2).

c. Floors - 3" reinforced concrete (37 lb/ft^2).

d. Roof - 3" reinforced concrete with tar and gravel (39 lb/ft^2).

Table II lists the contribution to intensity factors of the various planes to the selected detector locations.

Table II

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES)
FOR MERCY HOSPITAL

Contaminated Plane	Detector Location j									
	1 Center Corridor (1st Floor	2 Corridor Surgical Wing	3 Operating Room	4 Emergency Room	5 Lobby	6 X-ray Room	7 Office	8 Patient's Room on Main Corridor	9 Patient's Room on Side Corridor	10 Basement Shelter Area
1 Hospital Roof	.0848	.1880	.0812	.0814	.0837	.0837	.0821	.1170	.1168	.0064
2 Parking Lots	.0069	.0043	0481	.0488	.0024	.0395	.0026	.0660	.0730	.0088
3 Streets	.0027	.0021	.0221	.0235	.1128	.0025	.1100	.0034	.0123	.0039
4 Playgrounds	.0018	.0008	.0084	.0081	.0006	.0290	.0006	.0016	.0016	.0013
5 Lawns, Bare Earth, etc.	.0062	.0012	.0101	.0090	.0309	.0054	.0216	.0079	.0063	.0023

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions (fraction of total intensity) are given in Table III below.

Table III

RELATIVE INTENSITY CONTRIBUTION (CF_{ij} VALUES)
FOR MERCY HOSPITAL

Contaminated Plane	Detector Location j									
	1 Center Corridor (1st Floor	2 Corridor Surgical Wing	3 Operating Room	4 Emergency Room	5 Lobby	6 X-ray Room	7 Office	8 Patient's Room on Main Corridor	9 Patient's Room on Side Corridor	10 Basement Shelter Area
1 Hospital Roof	.83	.96	.48	.48	.36	.52	.38	.60	.56	.28
2 Parking Lots	.07	.02	.28	.29	.01	.25	.01	.34	.35	.39
3 Streets	.03	.01	.13	.14	.49	.02	.51	.02	.06	.17
4 Playgrounds	.02	.00	.05	.05	.00	.18	.00	.01	.01	.06
5 Lawns, Bare Earth, etc.	.06	.01	.06	.05	.13	.03	.10	.04	.03	.10

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in the following table.

Table IV

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR MERCY HOSPITAL

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Hospital Roof (1)	.07	0.5	7
Firehose	B	Hospital Roof (1)	.01	1.0	7
Firehose	C	Parking Lots (2)	.02	0.1	5
Firehose	D	Streets (3)	.02	1.8	5
Grader	E	Playground (4)	.10	15.1	1
Bulldozer	F	Lawns, Bare Earth, etc (5)	.10	0.2	1
Flusher	G	Streets (3)	.02	0.9	1
Street Sweeper	H	Streets (3)	.15	0.9	1

H. RN_j Values

The fractions of intensity remaining (RN_j Values) for selected strategies of decontamination are given in Table V below.

Table V

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR DECONTAMINATING AROUND MERCY HOSPITAL

Combined Strategy of Decontamination	Detector Location j									
	1 Center Corridor (1st Floor	2 Corridor Surgical Wing	3 Operating Room	4 Emergency Room	5 Lobby	6 X-ray Room	7 Office	8 Patient's Room on Main Corridor	9 Patient's Room on Side Corridor	10 Basement Shelter Area
A	.23	.11	.56	.56	.66	.51	.65	.44	.48	.74
B	.18	.05	.53	.53	.64	.48	.63	.41	.45	.72
C	.93	.98	.72	.72	.99	.76	.99	.67	.66	.62
D	.97	.99	.87	.87	.52	.98	.50	.98	.94	.83
E	.98	1.00	.96	.96	1.00	.84	1.00	.99	.99	.95
F	.95	.99	.95	.95	.88	.97	.91	.96	.97	.91
A+C	.16	.09	.28	.28	.65	.27	.64	.11	.14	.36
A+G	.20	.10	.43	.42	.18	.50	.15	.43	.43	.57
A+C+G	.14	.08	.15	.14	.17	.26	.14	.10	.08	.19
A+F+H	.15	.10	.39	.39	.13	.47	.13	.39	.41	.50
A+C+D+E+F	.07	.07	.05	.05	.05	.06	.05	.05	.05	.05
B+C+D+E+F	.02	.01	.02	.02	.03	.03	.02	.02	.02	.03

I. RN_A Values

The activity reduction factors for related strategies and all activity patterns are given in Table VI below.

Table VI

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES OF DECONTAMINATION AND ALL ACTIVITY PATTERNS FOR MERCY HOSPITAL

Selected Strategies of Decontamination	Activity Pattern					
	A_1	A_2	A_3	A_4	A_5	A_6
A	.50	.53	.54	.66	.68	.48
B	.46	.50	.51	.63	.66	.45
C	.69	.81	.76	.96	.89	.75
D	.93	.83	.85	.53	.61	.91
E	.98	.93	.95	.99	.98	.96
F	.96	.94	.95	.91	.89	.96
A+C	.19	.35	.30	.62	.57	.23
A+G	.43	.36	.39	.19	.29	.39
A+C+G	.12	.18	.15	.15	.18	.14
A+F+H	.39	.33	.36	.16	.23	.36
A+C+D+E+F	.05	.06	.05	.05	.05	.06
B+C+D+E+F	.02	.03	.02	.03	.03	.02

J. Conclusions

Effective roof decontamination appears to be the best "single-plane" strategy of decontamination. Its cost effectiveness is most easily seen by noting that approximately a one hour effort by a seven-man firehosing crew could reduce the mass loading to one percent of its original level. Such an effort would reduce the intensity by as much as 95% at one of the detector locations considered in this analysis (corridor-surgical wing) and by at least about 50% almost everywhere else in the hospital outside of the front lobby and office section. Combined with a few minutes effort firehosing the parking lots and paved areas close to the building, the roof decontamination strategy (Strategy B) would reduce the intensity at most

detector locations to about one third of the pre-decontamination intensity.

If all of the potentially contributing planes of contamination were effectively decontaminated, the intensity would be reduced by about 97%. Such a combined strategy (Strategy B+C+D+E+F), however, would cost over thirty man-hours of effort.

III. DECONTAMINATION ANALYSIS OF E. J. KORVETTE DEPARTMENT STORE

A. Discussion

The E. J. Korvette store on Telegraph Road is a very large two story building surrounded by large paved surfaces (parking lots and streets). Figure 16 is a map of the area showing the locations of the detectors and indicating the sizes and surface materials of the contributing planes of contamination. Figures 17 through 24 are photographs taken around the area, showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 25 is a map showing the locations and directions of the photographs.

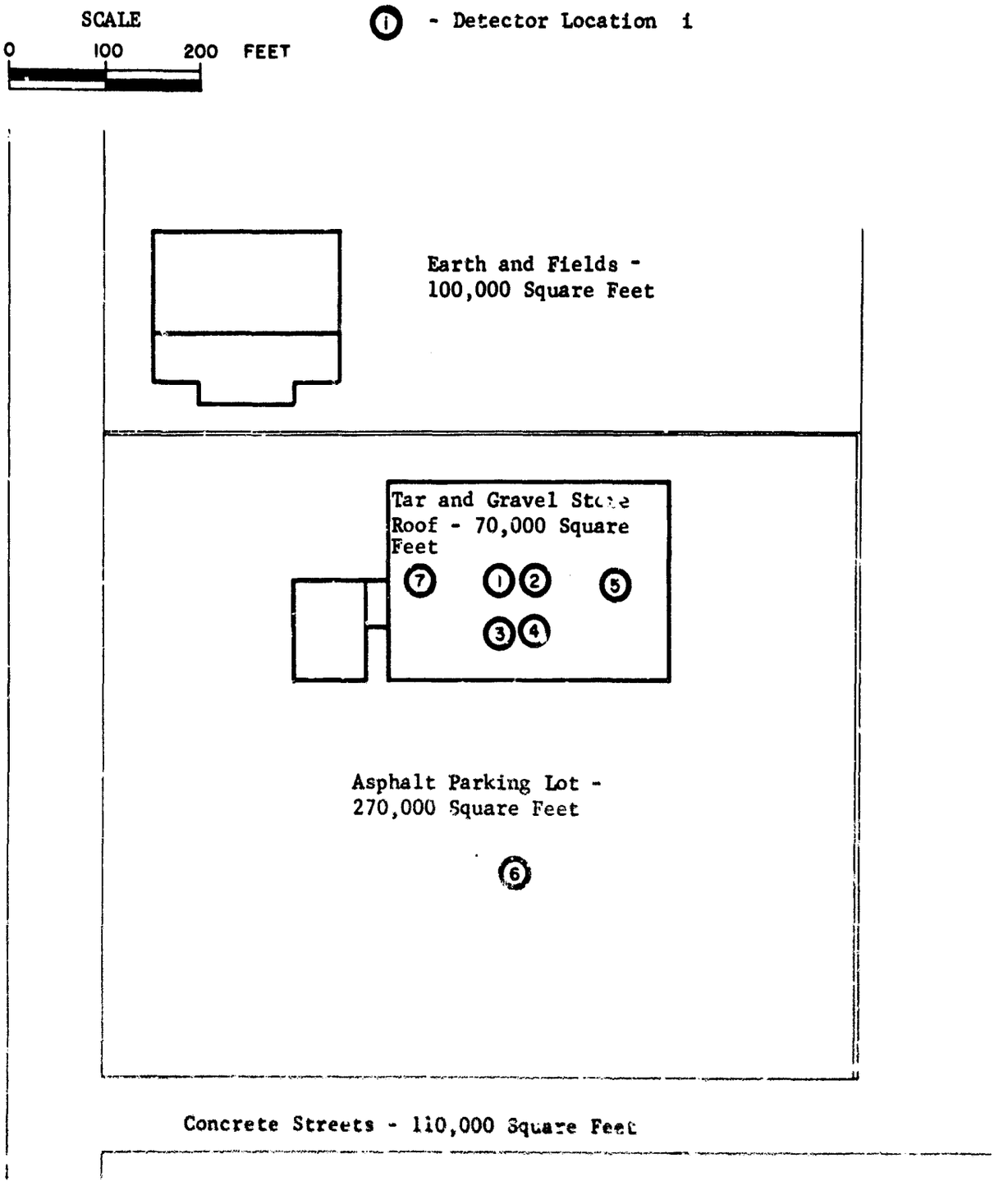


Figure 16

A Map of the Area Around the E. J. Korvette Department Store
Showing the Locations of Detectors and Indicating the Sizes,
and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 17

View 1 - E. J. Korvette Department Store -
A View of the Parking Lot on the
Left Side of the Building

Figure 18

View 2 - E. J. Korvette Department Store -
A View of the Front Parking Lot

Figure 19

View 3 - E. J. Korvette Department Store - A View of the Large Tar and Gravel Roof Surface

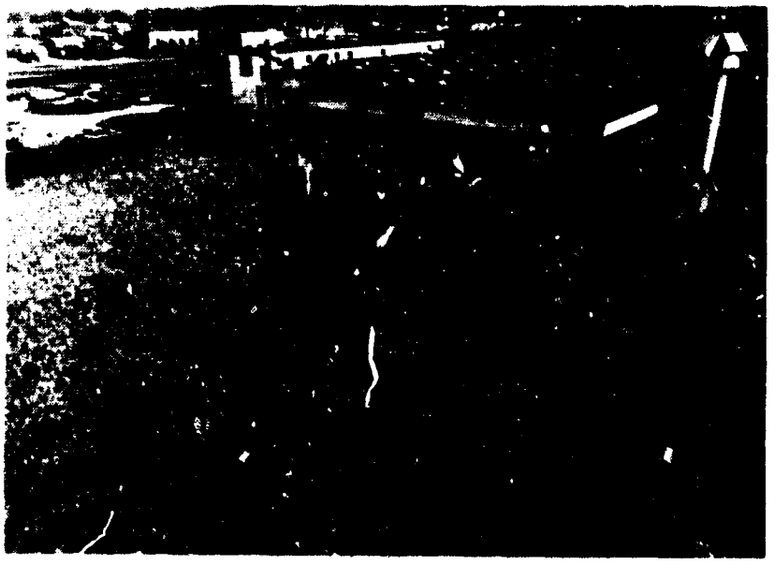


Figure 20

View 4 - E. J. Korvette Department Store - A View of the Southeast Corner of the Roof Showing the Relative Size of one of the Drains

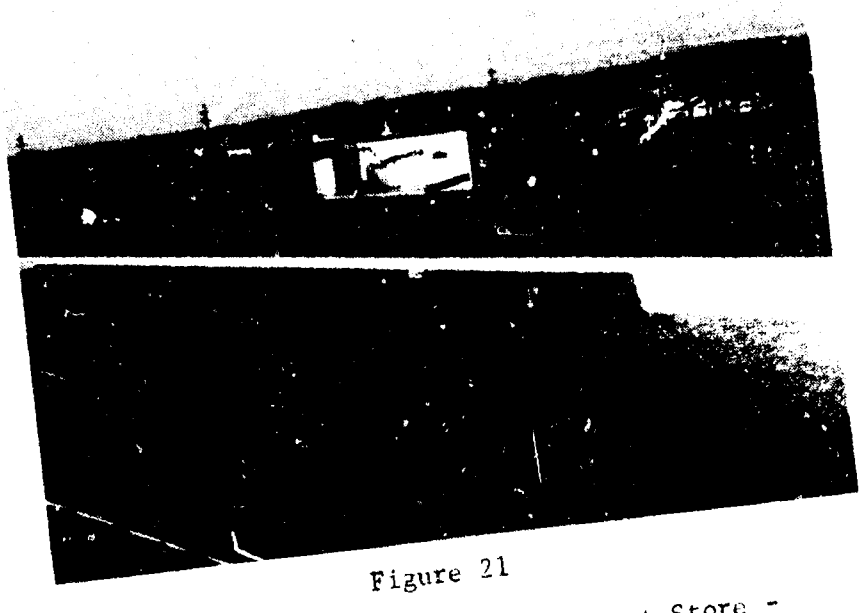


Figure 21

View 5 - E. J. Korvette Department Store - A View of the Roof of the Adjoining Part of the Main Building

Figure 23

View 7 - E. J. Korvette Department Store - A View of the Alley and Parking Area South of the Building

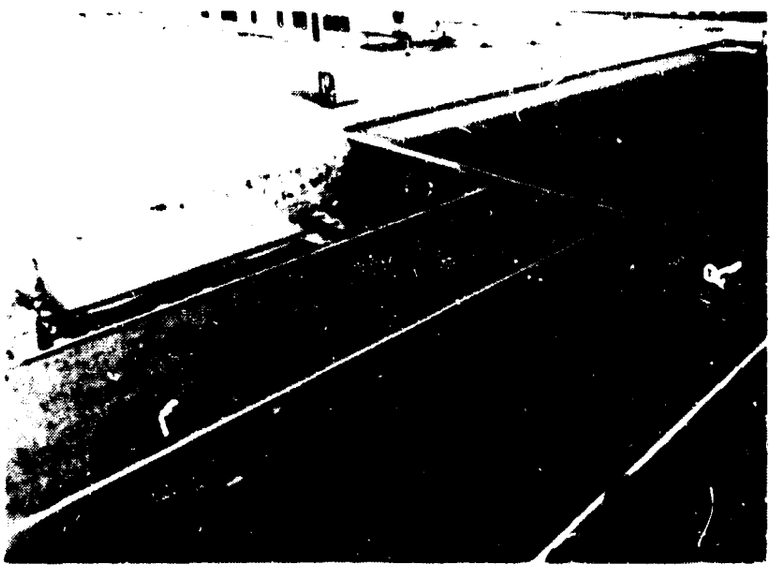


Figure 24

View 8 - E. J. Korvette Department Store - A View of the Patio Store on the North Side of the Building

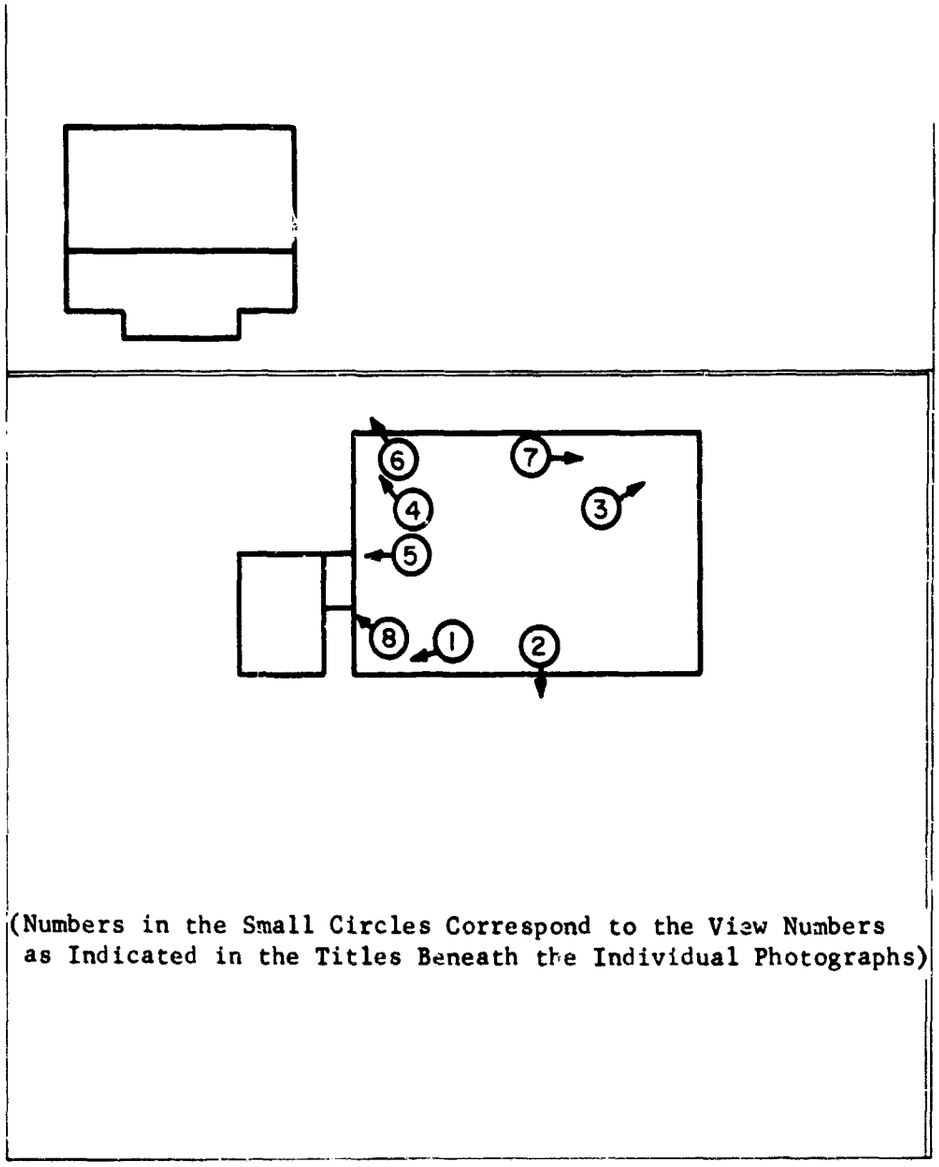


Figure 25

A Map of the Area Around the E. J. Korvette Store Showing the Locations and Directions of the Photographs Shown in Figures 17 through 24

B. Definition of Activities

Three activity patterns are considered in this analysis. Seven detector locations are used to characterize these activities. These detector locations are:

Detector Location	Description
1	Center of First Floor
2	Center of Second Floor
3	Off-center Location on First Floor
4	Off-center Location on Second Floor
5	Office on Second Floor
6	Center of Parking Lot
7	Shelter Area in Partial Basement

The activities are described entirely according to the amount of time that the activity pattern requires a person to spend at each detector location. Thus, Table VII defines the activity.

Table VII

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j AT THE E. J. KORVETTE DEPARTMENT STORE

Activity Pattern A_i	Detector Location j						
	1 Center of 1st Floor	2 Center of 2nd Floor	3 Off Center Location on 1st Floor	4 Off Center Location on 2nd Floor	5 Office on 2nd Floor	6 Center of Parking Lot	7 Shelter Area in Partial Basement
A_1	.30	.00	.30	.00	.00	.00	.40
A_2	.00	.05	.05	.00	.50	.00	.40
A_3	.00	.00	.00	.20	.00	.40	.40

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 16)

	Detector Location	Original PF
1	Center of First Floor	52
2	Center of Second Floor	13
3	Off Center Location on 1st Floor	14
4	Off Center Location on 2nd Floor	13
5	Office on 2nd Floor	13
6	Center of Parking Lot	1.4
7	Shelter Area in Partial Basement	28

2. Equivalent Protection Factors for Activity Patterns

Activity Pattern (See Table VII)	Equivalent PF
A_1	25
A_2	17
A_3	3.1

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Store Roof	70,000	Tar and Gravel
2	Parking Lot	370,000	Asphalt
3	Streets	110,000	Concrete
4	Earth and Fields	100,000	Bare Earth Grass, etc.

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the building which were required to calculate the contribution to intensity values.

1. Exterior Walls - 12" cinder block with brick facing except on store front which was 80% glass with asbestos backdrops on 1st floor; 10% apertures on 2nd floor. (108 lb/ft^2).
2. Large 2 feet by 2 feet posts throughout store; no interior partitions except in 2nd floor office area.
3. Roof - 4" reinforced concrete with tar and gravel cover (55 lb/ft^2).
4. Floors - 6" reinforced concrete with ½" vinyl tile (80 lb/ft^2).

Table VIII lists the contribution to intensity factors of the various planes to the selected detector locations.

Table VIII

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES)
FOR E. J. KORVETTE DEPARTMENT STORE

Contaminated Plane i	Detector Location j						
	1 Center of 1st Floor	2 Center of 2nd Floor	3 Off Center Location on 1st Floor	4 Off Center Location on 2nd Floor	5 Office on 2nd Floor	6 Center of Parking Lot	7 Shelter Area in Partial Basement
1 Store Roof	.0084	.0702	.0081	.0692	.0698	.0001	.0311
2 Parking Lot	.0100	.0034	.0604	.0073	.0057	.6918	.0021
3 Streets	.0000	.0000	.0001	.0000	.0000	.0304	.0000
4 Earth and Field	.0010	.0008	.0009	.0005	.0013	.0112	.0019

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table IX below.

Table IX

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES)
FOR E. J. KORVETTE DEPARTMENT STORE

Contaminated Plane i	Detector Location j						
	1 Center of 1st Floor	2 Center of 2nd Floor	3 Off Center Location on 1st Floor	4 Off Center Location on 2nd Floor	5 Office on 2nd Floor	6 Center of Park-Lot	7 Shelter Area in Partial Basement
1 Store Roof	.43	.94	.12	.90	.91	.00	.89
2 Parking Lot	.52	.05	.87	.09	.07	.94	.06
3 Streets	.00	.00	.00	.00	.00	.04	.00
4 Earth and Field	.05	.01	.01	.01	.02	.02	.05

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in the following table.

Table X

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING
SURFACES FOR E. J. KORVETTE DEPARTMENT STORE

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Store Roof (1)	.01	9.8	7
Firehose	B	Store Roof (1)	.12	3.0	7
Firehose	C	Parking Lot (2)	.02	7.4	5
Street Sweeper	D	Parking Lot (2)	.04	14.8	1
Flusher	E	Parking Lot (2)	.02	3.7	1
Firehose	F	Streets (3)	.02	2.2	5
Flusher	G	Streets (3)	.02	1.1	1
Grader	H	Earth and Fields (4)	.10	24.0	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table XI.

Table XI

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR E. J. KORVETTE DEPARTMENT STORE

Combined Strategy	Detector Location j						
	1 Center of 1st Floor	2 Center of 2nd Floor	3 Off Center Location on 1st Floor	4 Off Center Location on 2nd Floor	5 Office on 2nd Floor	6 Center of Parking Lot	7 Shelter Area in Partial Basement
A	.57	.07	.88	.11	.10	1.00	.12
B	.62	.17	.90	.21	.20	1.00	.22
C	.49	.96	.15	.91	.93	.08	.94
D	.51	.96	.17	.91	.93	.09	.94
F	1.00	1.00	1.00	1.00	1.00	.96	1.00
H	.95	.99	.99	.99	.98	.99	.95
A+C or A+E	.07	.02	.03	.02	.03	.08	.06
B+C or B+E	.11	.12	.05	.12	.13	.08	.16
A+C+F	.07	.02	.03	.02	.03	.03	.06
A+E+G+H	.02	.01	.02	.01	.01	.02	.02

I. RN_A Values

The activity reduction factors for selected strategies and the activity patternsare given in Table XII.

Table XII

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR THE E.J. KORVETTE DEPARTMENT STORE

Combined Strategy	Activity Pattern		
	A_1	A_2	A_3
A	.58	.15	.92
B	.62	.24	.93
C	.47	.89	.15
D	.48	.89	.17
F	1.00	1.00	.96
H	.97	.98	.99
A+C or A+E	.05	.04	.07
B+C or B+E	.10	.13	.08
A+C+F	.05	.04	.04
A+E+G+H	.02	.01	.02

J. Conclusions

Almost all of the intensity at all of the detector locations considered would come from either the roof or a paved surface. Therefore, the protection could be increased by a factor of from ten to twenty at most places inside the store (or outside on the parking lot) with only a modest decontamination effort. For example, combined strategy B+E (firehosing the roof and flushing the parking lot) would cost approximately 25 man-hours of effort and reduce the intensity at most detector locations by factors ranging from seven to fifteen.

IV. DECONTAMINATION ANALYSIS OF SPRINGWELLS WATER PUMPING STATION

A. Discussion

The Springwells Station is a water pumping plant located in about the center of a 53 acre tract of land. The plant is capable of pumping 540 million gallons per day. Several buildings comprise the plant. Some of these are a pumping plant building, a turbine building, an office building (with chemistry laboratories), 2 filtration buildings, and a control house. Most of the land around the buildings is covered with grass or brick tile.

Figure 26 is a map of the area around the plant, showing the sizes and surface materials of the contributing planes of contamination as well as the locations of the detector positions selected for this analysis. Figures 27 through 52 are photographs taken around the area showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 53 is a map showing the locations and directions of the photographs.

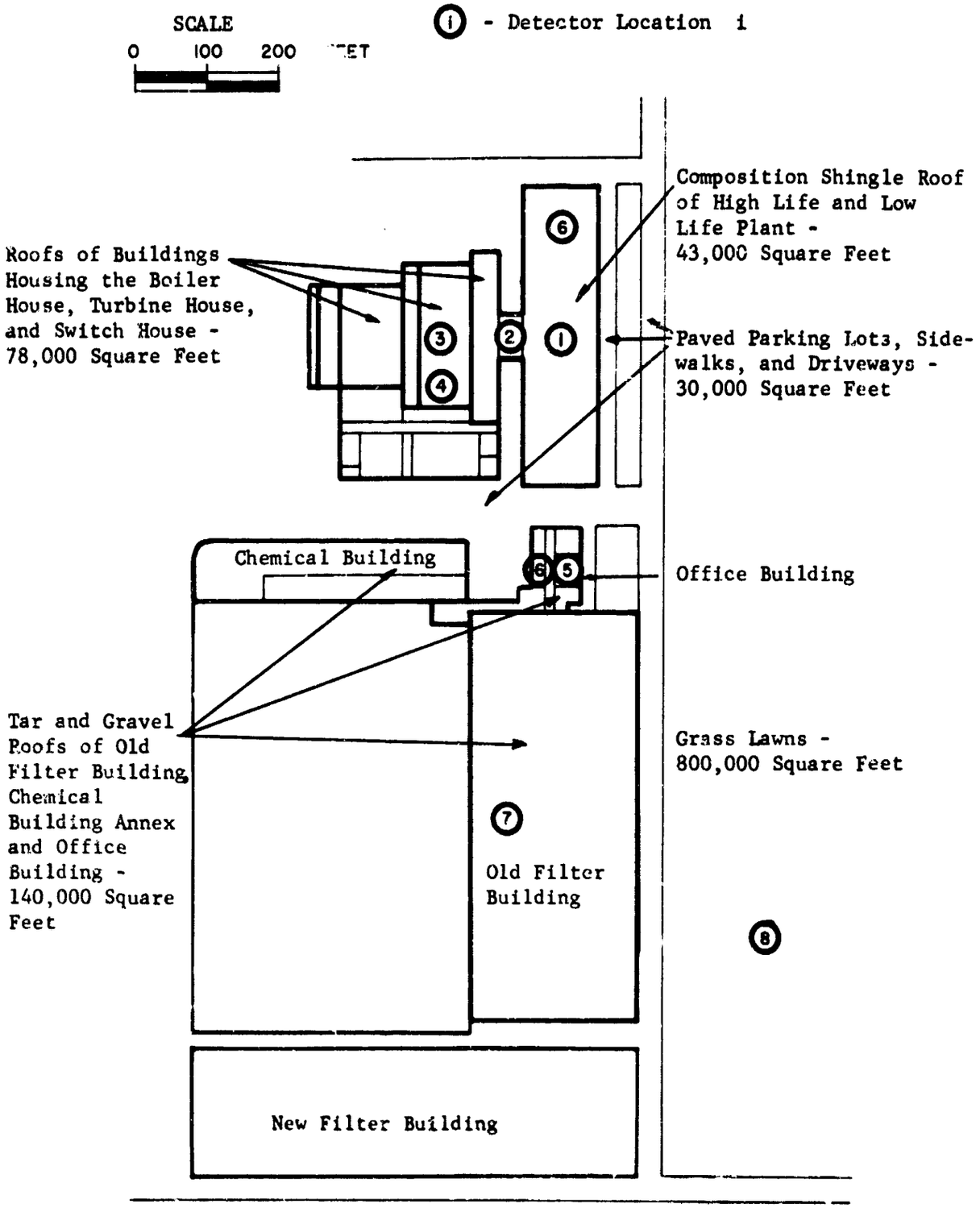


Figure 26

A Map of the Area Around Springwells Station Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 27

View 1 - Springwells Station -
A View of the Interior of the Pumping Plant Showing the Heavy Wall Construction and Large Windows

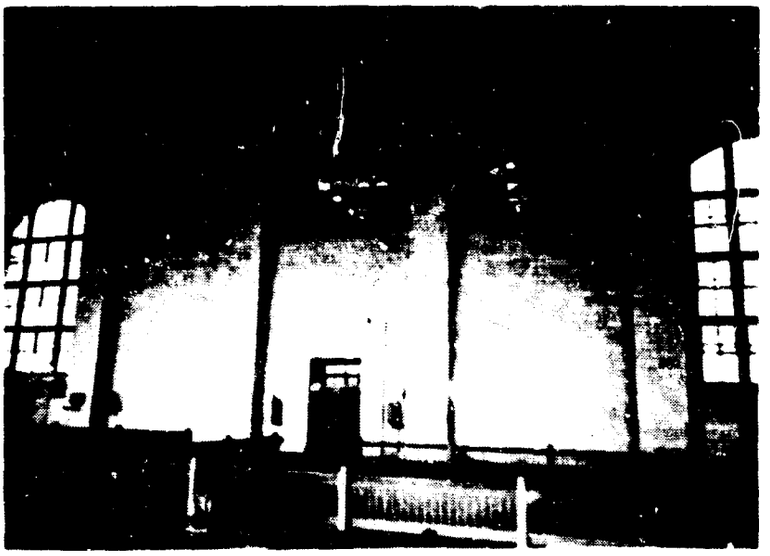


Figure 28

View 2 - Springwells Station -
A View of the Interior of the Pumping Plant Showing the Door and Windows to the Control House

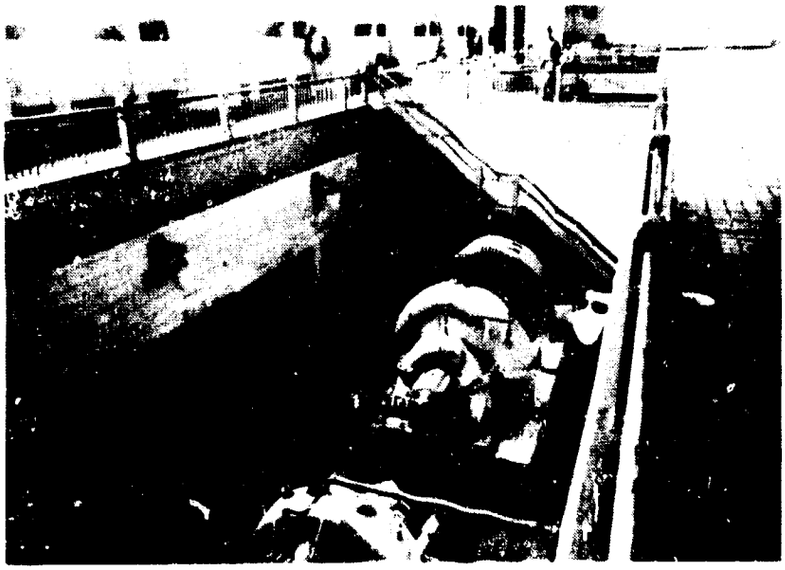


Figure 29

View 3 - Springwells Station -
A View of One of the High Lift Pumps
and Well Areas in the Pumping Plant

Figure 30

View 4 - Springwells Station -
A View of the Interior of the High Lift
Pump Section of the Pumping Plant

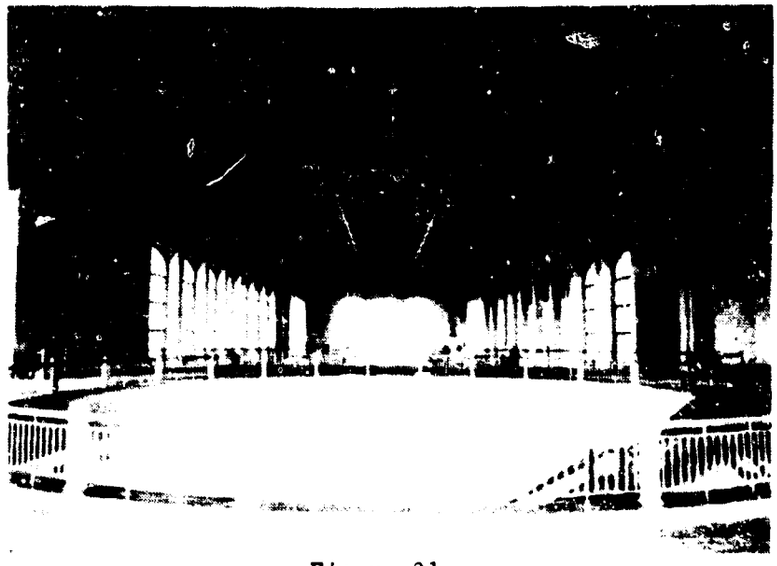


Figure 31

View 5 - Springwells Station -
A View of the Low Lift Pump Section
in the Pumping Plant

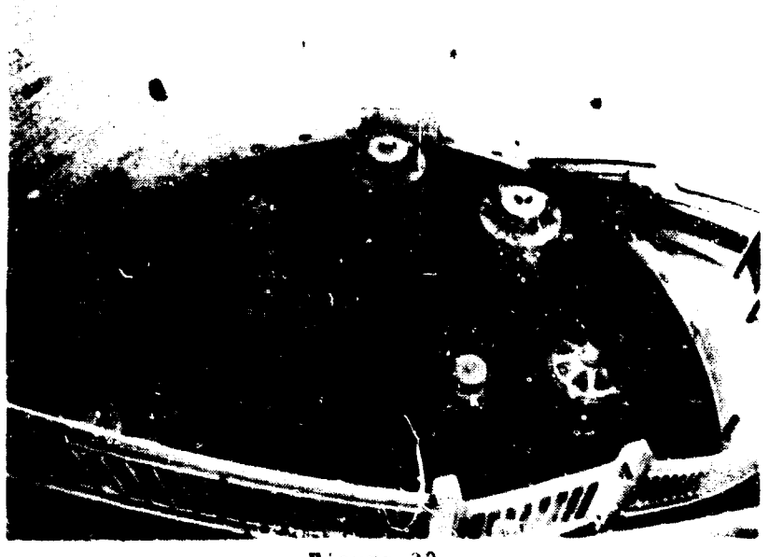


Figure 32

View 6 - Springwells Station -
A View of the Well Area of the Low Lift
Pump in the Pumping Plant

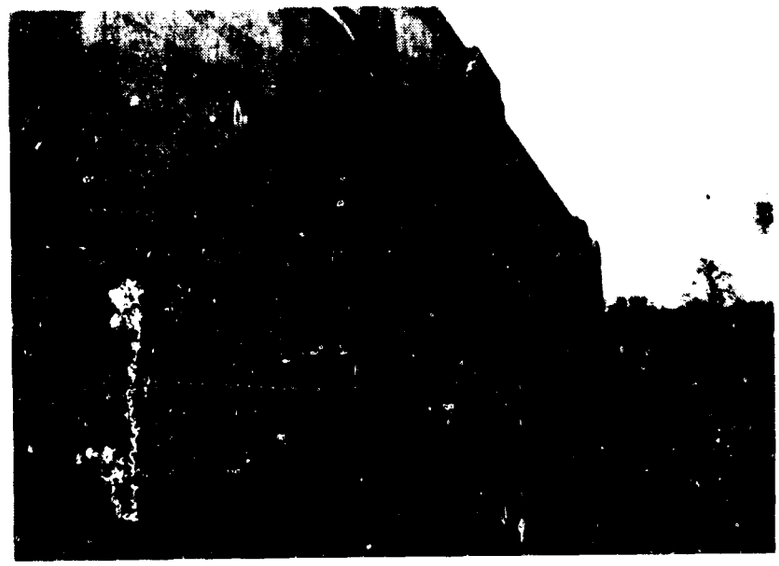


Figure 33

View 7 - Springwells Station -
A View of the Pumping Plant Showing the 25 Feet Wide Brick Walk Around the Building

Figure 34

View 8 - Springwells Station -
A View of the Parking Area and Driveway Between the Pumping Plant and the Old Filter Building

Figure 35

View 9 - Springwells Station -
A View of the Large Grass Lawn Over the Filtration Reservoirs in Front of the Old Filter Building

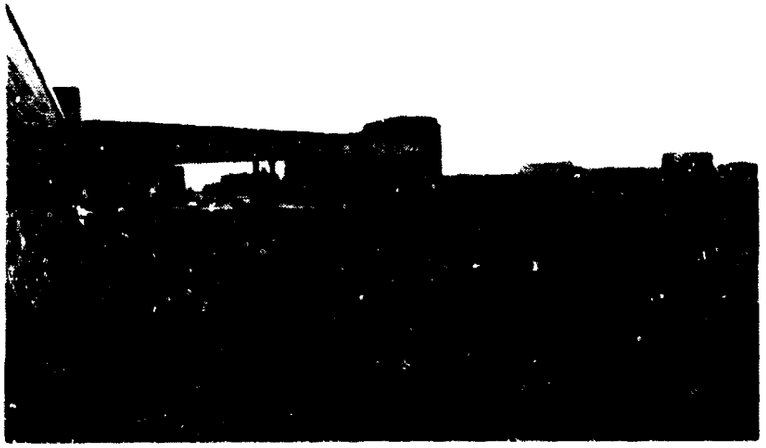


Figure 36

View 10 - Springwells Station -
A View of the Grass Lawn Behind the Turbine Building

Figure 37

View 11 - Springwells Station -
A View of the Interior of the Chemistry Laboratory on the Second Floor of the Office Building

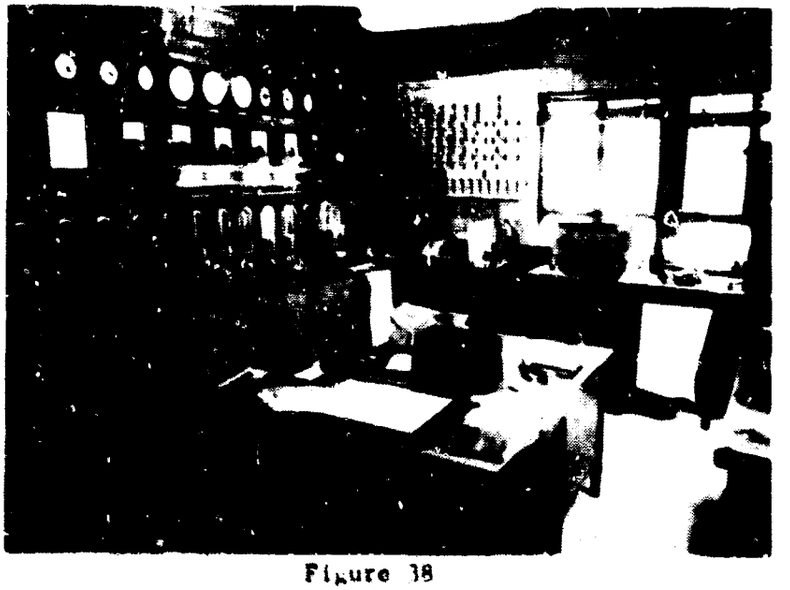


Figure 38

View 12 - Springwells Station -
Another View of the Interior of the Chemistry Laboratory on the Second Floor of the Office Building

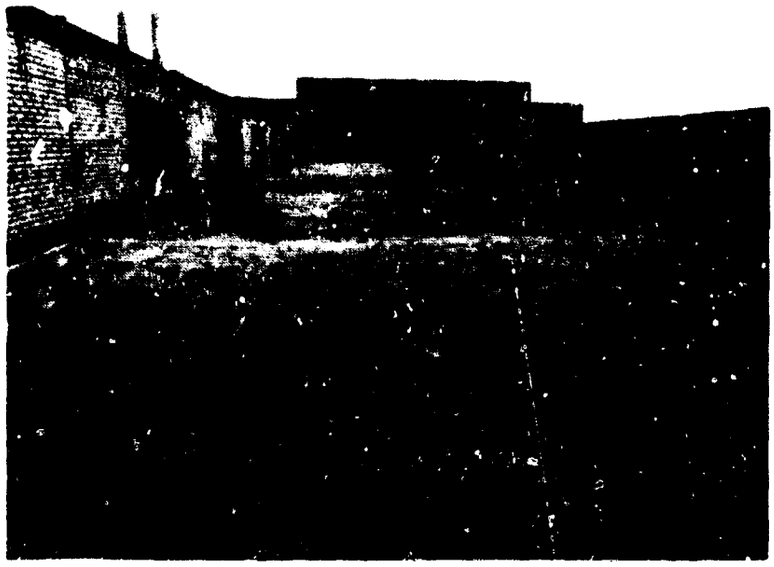


Figure 39

View 13 - Springwells Station -
A View of the Lower Roof of the
Old Filter Building

Figure 40

View 14 - Springwells Station -
A View of the Tar and Gravel Roof of the
New Filter Building

Figure 41

View 15 - Springwells Station -
An Interior View of the Old Filter Building Showing the Aisles, Filter Beds, and Skylights

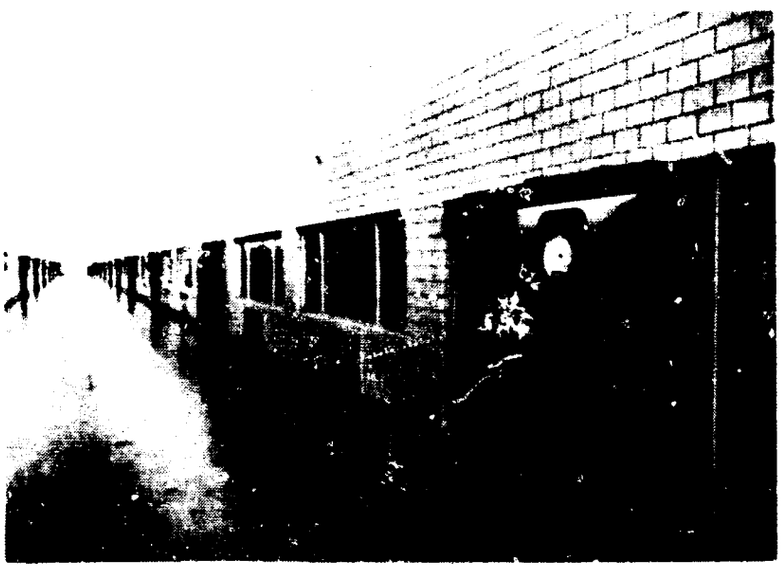


Figure 42

View 16 - Springwells Station -
An Interior View of the New Filter Building Showing the Aisles, Windows to the Filter Beds, and Skylights

Figure 43

View 17 - Springwells Station -
An Exterior View of One of the Driveways
Between the Buildings Showing a Typical Drain

Figure 44

View 18 - Springwells Station -
A View of the Parking Area Showing the
Sidewalk on the Ledge Attached to the
Turbine House

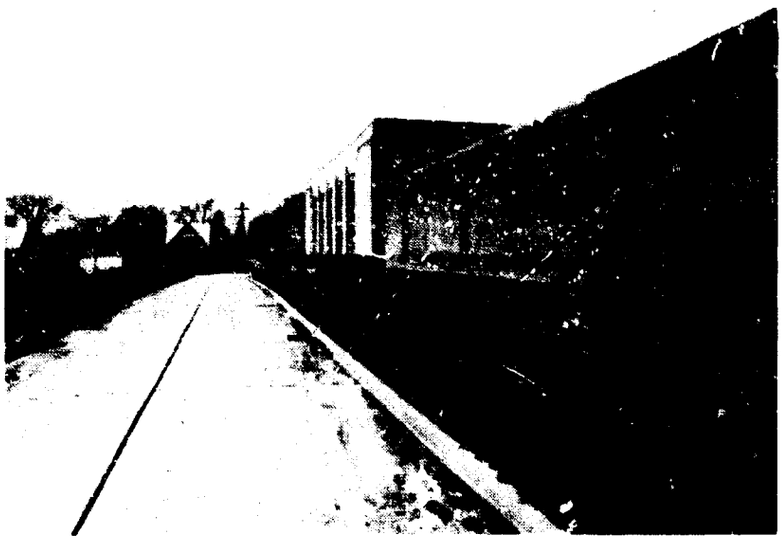


Figure 45

View 19 - Springwells Station -
A View of the Road Which Runs in
Front of the Old and New Filter
Buildings

Figure 46

View 20 - Springwells Station -
An Interior View of the Mixing
Chamber Attached to the Old
Filter Building

Figure 47

View 21 - Springwells Station -
A View of the Roof of the Office
Building

Figure 48

View 22 - Springwells Station -
A Close-up View of the Drain
on the Roof of the Office Building

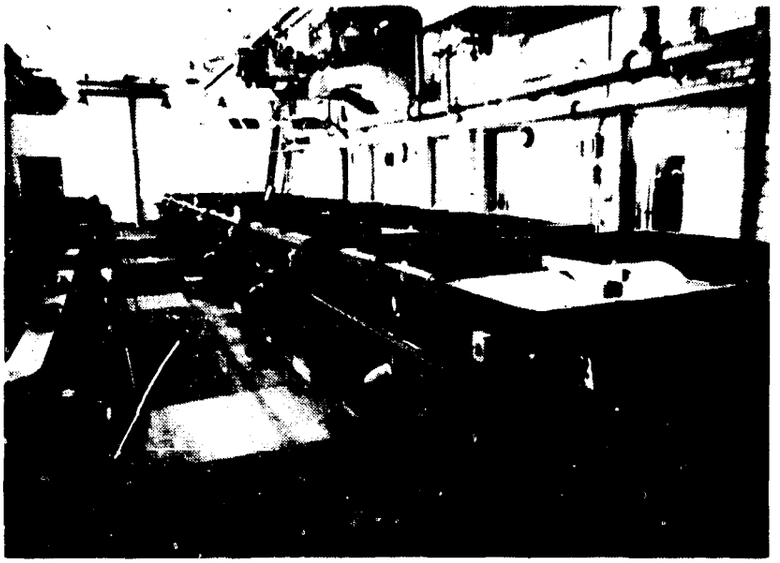


Figure 49

View 23 - Springwells Station -
A View of the Interior of the
Chemical Mixing Room

Figure 50

View 24 - Springwells Station -
A View of the Paved Area Behind the
Mixing Chamber Building

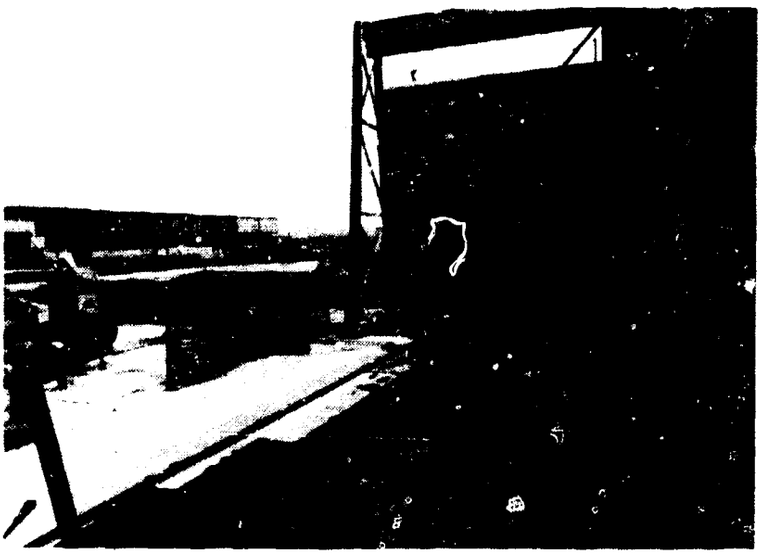


Figure 51

View 25 - Springwells Station -
A View of the Paved Area in Front
of the Garage and Service Area

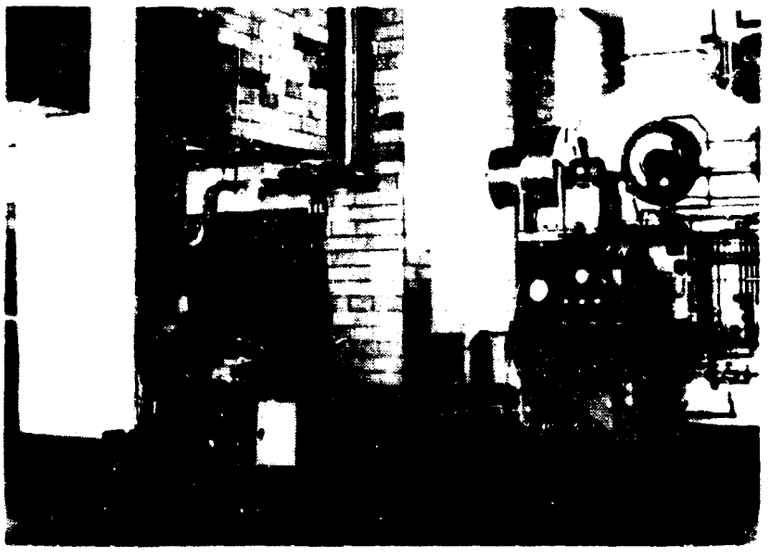
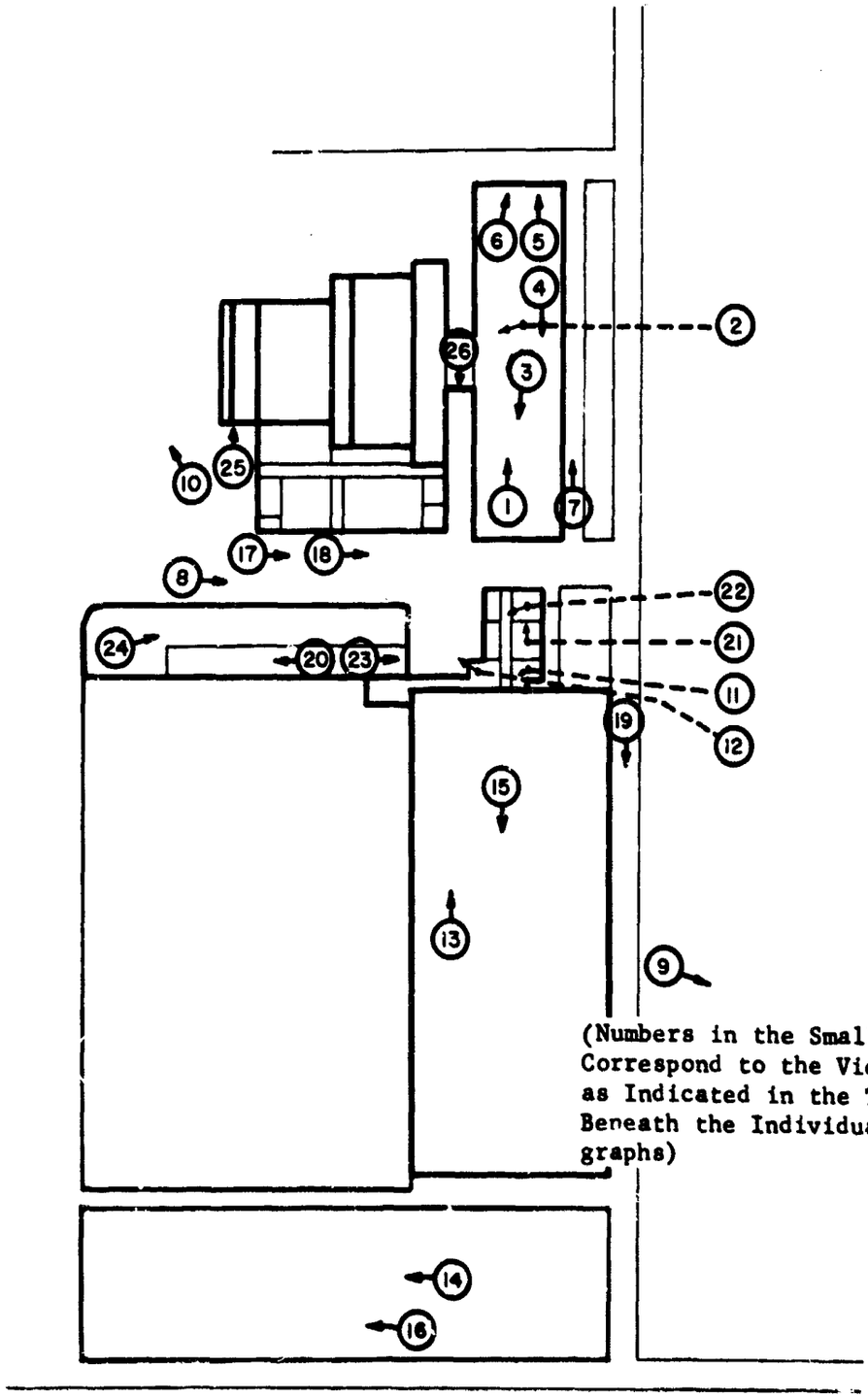


Figure 52

View 26 - Springwells Station -
A View of the Interior of the Control
House Showing the Protective Shielding
Near the Work Desk



(Numbers in the Small Circles Correspond to the View Numbers as Indicated in the Titles Beneath the Individual Photographs)

Figure 53

A Map of the Area Around Springwells Station Showing the Locations and Directions of the Photographs Shown in Figures 27 through 52

B. Definition of Activities

Seven activity patterns are considered in this analysis. Nine detector locations are used to characterize these activities. These detector locations are:

Detector Location	Description
1	Center of First Floor in High Lift Plant
2	Control House
3	Center Location in Turbine House
4	Off-center Location in Turbine House
5	Chemistry Laboratory in Office Building
6	Office in Office Building
7	Aisle in Old Filter Building
8	At Meter Control in Center of Grass Lawn over Filtered Water Reservoir
9	Shelter Area in Basement Area near Low Lift Plant

The activity patterns are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table XIII defines the seven activity patterns.

Table XIII

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j AT SPRINGWELLS STATION

Activity Pattern A_i	Detector Location j								
	1 Center of First Floor in High Left Plant	2 Control House	3 Center Location in Turbine House	4 Off-center Location in Turbine House	5 Chemistry Laboratory in Office Building	6 Office in Office Building	7 Aisle in Old Filter Building	8 At Meter Control in Center of Grass Lawn over Filtered Water Reservoir	9 Shelter Area in Basement Area near Low Left Plant
A_1	.30	.05	.00	.00	.00	.35	.00	.00	.30
A_2	.00	.60	.00	.00	.00	.00	.00	.00	.40
A_3	.00	.00	.00	.00	.00	.00	.45	.05	.50
A_4	.00	.00	.20	.30	.00	.00	.00	.00	.50
A_5	.00	.00	.00	.00	.50	.00	.00	.00	.50
A_6	.00	.30	.00	.00	.00	.20	.00	.00	.50
A_7	.40	.20	.00	.00	.00	.00	.00	.00	.40

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 26)

	Detector Location	Original PF
1	Center of First Floor in High Life Plant	14
2	Control House	58
3	Center Location in Turbine House	15
4	Off-center Location in Turbine House	18
5	Chemistry Laboratory in Office Building	12
6	Office in Office Building	14
7	Aisle in Old Filter Building	5.8
8	At Meter Control in Center of Grass Lawn over Filtered Water Reservoir	1.8
9	Shelter Area in Basement Area near Low Lift Plant	68

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table XIII)	Equivalent PF
A_1	20
A_2	61
A_3	8.8
A_4	26
A_5	20
A_6	38
A_7	26

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roofs of Old Filter Building, Chemical Building Annex, and Office Building	140,000	Tar and Gravel
2	Roof of High Lift and Low Lift Plant	43,000	Composition Shingle
3	Roofs of Buildings housing the Boiler House, Turbine House, and Switch House	78,000	Tar and Gravel
4	Paved Parking Lots, Side Walks, and Driveways	30,000	Asphalt and Brick Tile
5	Lawns	800,000	Grass

E. Contributions to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the building which were required to calculate the contribution to intensity values:

a. Exterior wall of high and low lift pumping plant - 12" concrete, 1" terra-cotta, 4" common brick, 1" baked tile, 6" air space, 50% apertures with sill heights at 2 feet. (wall weight 150 lbs/ft^2).

b. Roof of Pumping Plant - 4" concrete, 16 oz. copper, 1½" cork (51 lbs/ft^2).

c. First floor of Pumping Plant - 18" concrete with asphalt tile (200 lbs/ft^2).

d. Exterior Walls of Office Building - 4" brick veneer, 1" plaster, 20% apertures (40 lbs/ft^2).

e. Floors of Office Building - 6" reinforced concrete with 3/4" wood flooring (77 lbs/ft^2).

f. Roof of Office Building - 6" reinforced concrete covered with tar and gravel (77 lbs/ft^2).

g. Interior Partitions of Office Building - dry wall plaster (5 lbs/ft^2).

h. Exterior Walls of Turbine House - 12" concrete, 1" terra-cotta, 4" common brick, 1" baked tile, 8" air space, 40% apertures with 2 feet still height (150 lbs/ft^2).

i. Roof of Turbine House - 4" concrete, 16 oz copper, 1½" cork (51 lbs/ft^2).

j. Exterior Wall of Old Filter Building - 4" brick veneer, 1" asbestos, 1" tile (44 lbs/ft^2).

k. Roof of Old Filter Building - 3" concrete over aisles, 3" concrete with 1" tar and gravel over filter beds, skylights over each aisle (43 lbs/ft^2).

l. The walls and roof of the Control House are the same as those for the Pumping Plant except the apertures constituted only 15% of the Exterior Walls.

Table XIV lists the contribution to intensity factors of the various planes to the selected detector locations.

F. Relative Intensity Contributions (CFij Values)

The relative intensity contributions are given in Table XV.

Table XIV

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR SPRINGWELLS WATER PUMPING STATION

Contaminated Plane i	Detector Location j								
	1 Center of First Floor in High Lift Plant	2 Control House	3 Center Location in Turbine House	4 Off-center Location in Turbine House	5 Chemistry Laboratory in Office Building	6 Office in Office Building	7 Aisle in Old Filter Building	8 At Meter Control in Center of Grass Lawn over Filtered Water Reservoir	9 Shelter Area in Basement Area near Low Lift Plant
1 Roofs of Old Filter Building, Chemical Building Annex, and Office Building	.0000	.0000	.0000	.0000	.0414	.0039	.1504	.0000	.0000
2 Roof of High Lift and Low Lift Plant	.0718	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0148
3 Roof of Buildings housing the Boiler House, Turbine House, and Switch House	.0008	.0153	.0663	.0554	.0000	.0000	.0000	.0000	.0000
4 Paved Parking Lots, Side Walks, and Driveways	.0000	.0019	.0011	.0007	.0173	.0591	.0018	.0283	.0000
5 Lawn	.0000	.0001	.0003	.0001	.0254	.0061	.0204	.5412	.0000

Table XV

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR SPRINGWELLS WATER PUMPING STATION

Contaminated Plane i	Detector Location j								
	1 Center of First Floor in High Lift Plant	2 Control House	3 Center Location in Turbine House	4 Off-center Location in Turbine House	5 Chemistry Laboratory in Office Building	6 Office in Office Building	7 Aisle in Old Filter Building	8 At Meter Control in Center of Grass Lawn over Filtered Water Reservoir	9 Shelter Area in Basement Area near Low Lift Plant
1 Roofs of Old Filter Building, Chemical Building Annex, and Office Building	.00	.00	.00	.00	.49	.06	.87	.00	.00
2 Roof of High Lift and Low Lift Plant	.99	.00	.00	.00	.00	.00	.00	.00	1.00
3 Roof of Buildings housing the Boiler House, Turbine House, and Switch House	.01	.88	.93	.99	.00	.00	.00	.00	.00
4 Paved Parking Lots, Side Walks, and Driveways	.00	.11	.02	.01	.21	.86	.01	.05	.00
5 Lawn	.00	.01	.00	.00	.30	.09	.12	.95	.00

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in the following table.

Table XVI

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR SPRINGWELLS WATER PUMPING STATION

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Roof of Old Filter Building, Chemical Building Annex, and Office Building (1)	.01	19.6	7
Firehose	B	Roof of Old Filter Building (1)	.07	9.0	7
Firehose	C	Roof of Old Filter Building (1)	.12	6.0	7
Firehose	D	Roof of Lift Plant (2)	.03	3.4	6
Firehose	E	Roof of Lift Plant (2)	.08	1.1	6
Firehose	F	Other Roofs (3)	.01	10.9	7
Firehose	G	Other Roofs (3)	.12	3.4	7
Firehose	H	Paved Parking Lots and Side Walks (4)	.02	0.6	5
Vacuumized Sweeper	I	Paved Parking Lots and Side Walks (4)	.02	1.2	1
Flusher	J	Paved Parking Lots and Side Walks (4)	.02	0.3	1
Grader	K	Lawns (5)	.10	192.0	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table XVII.

Table XVII

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR SPRINGWELLS WATER PUMPING STATION

Combined Strategy	Detector Location j								
	1 Center of First Floor in High Lift Plant	2 Control House	3 Center Location in Turbine House	4 Off-Center Location in Turbine House	5 Chemistry Laboratory in Office Building	6 Office in Office Building	7 Aisle in Old Filter Building	8 At Meter Control in Center of Grass Lawn over Filtered Water Reservoir	9 Shelter Area in Basement Area near Low Lift Plant
A	1.00	1.00	1.00	1.00	.51	.94	.14	1.00	1.00
B	1.00	1.00	1.00	1.00	.54	.95	.19	1.00	1.00
D	.04	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.03
F	.99	.12	.03	.02	1.00	1.00	1.00	1.00	1.00
I	1.00	.89	.98	.99	.80	.16	.99	.95	1.00
J	1.00	.89	.98	.99	.80	.16	.99	.95	1.00
K	1.00	.99	1.00	1.00	.73	.92	.89	.14	1.00
A+G	.99	.22	.14	.13	.51	.94	.14	1.00	1.00
C+F	.99	.12	.03	.02	.57	.95	.23	1.00	1.00
A+D+F	.03	.12	.03	.02	.51	.94	.14	1.00	.03
C+E+G+J+K	.08	.11	.12	.12	.09	.03	.12	.10	.08
A+D+F+H+K	.03	.01	.01	.01	.04	.03	.02	.10	.03

I. RN_A Values

The activity reduction factors for selected strategies and the activity patterns are given in Table XVIII.

Table XVIII

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR THE SPRINGWELLS WATER PUMPING STATION

Combined Strategy	Activity Patterns						
	A_1	A_2	A_3	A_4	A_5	A_6	A_7
A	.97	1.00	.41	1.00	.59	.97	1.00
B	.98	1.00	.45	1.00	.61	.97	1.00
D	.51	.65	.94	.81	.85	.73	.13
F	.98	.44	1.00	.22	1.00	.83	.91
I	.60	.93	.98	.99	.83	.54	.99
J	.60	.93	.98	.99	.83	.54	.99
K	.96	1.00	.71	1.00	.77	.96	1.00
A+G	.96	.50	.41	.30	.59	.82	.92
C+F	.96	.44	.48	.22	.63	.80	.91
A+D+F	.46	.09	.35	.03	.44	.53	.04
C+E+G+J+K	.06	.10	.11	.11	.09	.06	.08
A+D+F+H+K	.03	.02	.04	.01	.04	.02	.03

J. Conclusions

Since the detector locations are spread over a large area and the contributions to intensity are from several different planes of contamination, substantial reductions in intensity at several different detectors would incur high costs in terms of man-hours of decontamination effort. Except for the detectors in the office building and the detector at the outdoor meter, the lawn contribution is not high. A substantial effort, however, would be required to decontaminate the lawns and earth surfaces (approximately 200 man-hours). Thus, decontaminating

the unpaved ground surfaces does not seem to be a good strategy. Most of the buildings are surrounded by paved areas from ten to twenty feet wide so that firehosing the roofs and paved areas would substantially reduce the intensity at most detectors.

Just decontaminating all of the roofs, say strategy A+D+F would reduce the intensity at most indoor detector locations, except for those in the office building, by at least a factor of ten. Such an effort would cost about 300 man-hours, or about 35 team-hours, of effort. Four or five firehose crews could do the job in about 7 or 8 hours.

If a high reference intensity occurs, such decontamination could not begin before two or three weeks without exposing the decontamination teams to high doses of gamma radiation.

V. DECONTAMINATION ANALYSIS OF MISTERSKY POWER PLANT

A. Discussion

Mistersky Power Plant at 5425 West Jefferson Avenue is an electric steam generating plant located on the Detroit River. It is in a heavily developed industrial area and is surrounded by small factories and warehouses.

Figure 54 is an aerial photograph of the plant showing all of the buildings in the complex as well as the large coal yard between the buildings and the Detroit River. Figure 55 is a map of the plant area showing the locations of the detectors and indicating the sizes and surface materials of some of the contributing planes of contamination to the activity area. Figures 56 through 89 are a number of photographs taken around the plant, showing some of the contaminated planes and other features of the buildings and the area that would influence decontamination. Figure 90 is a map showing the locations and directions of the photographs.

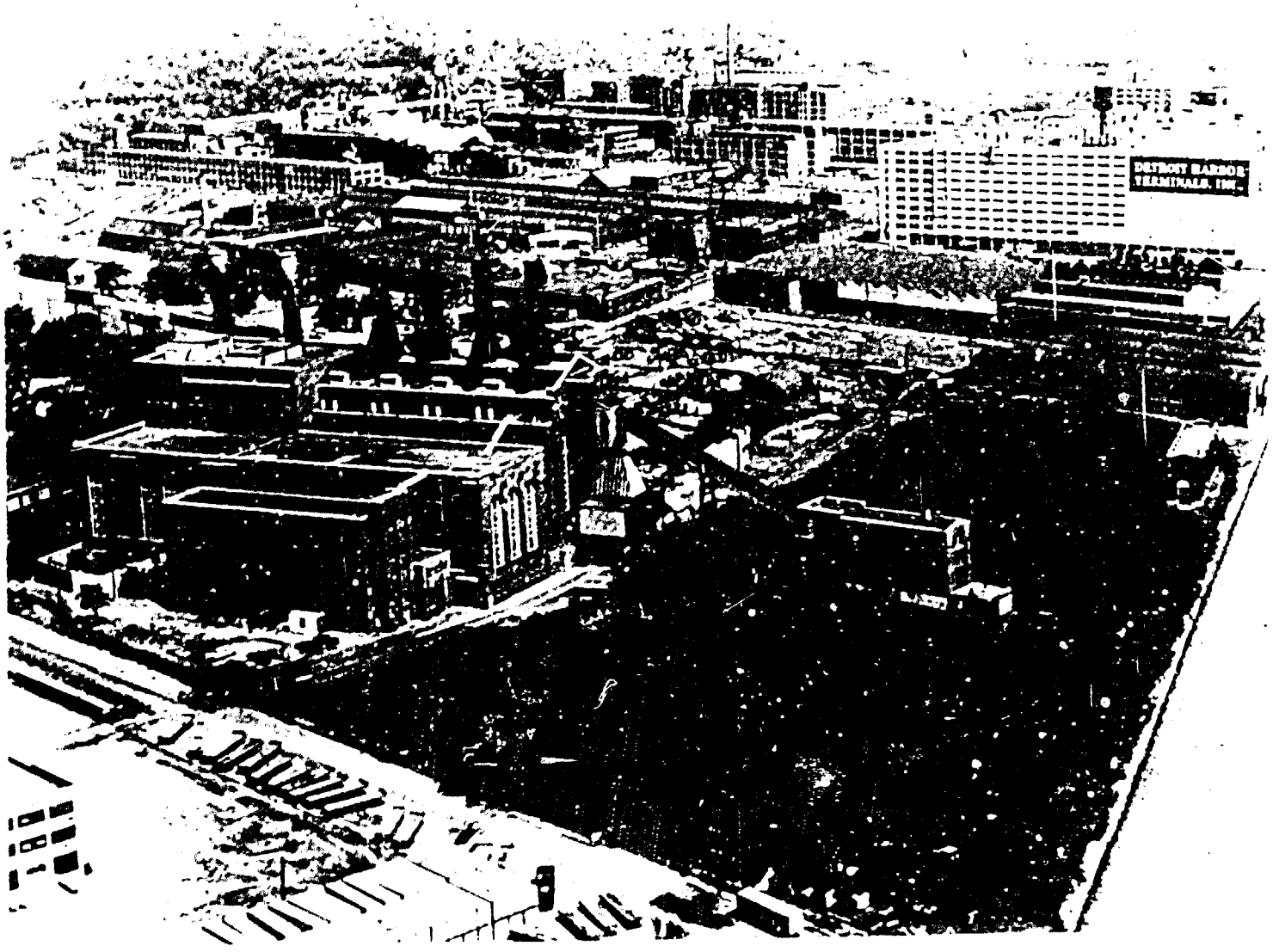


Figure 54

An Aerial View of the Mistersky Power Plant

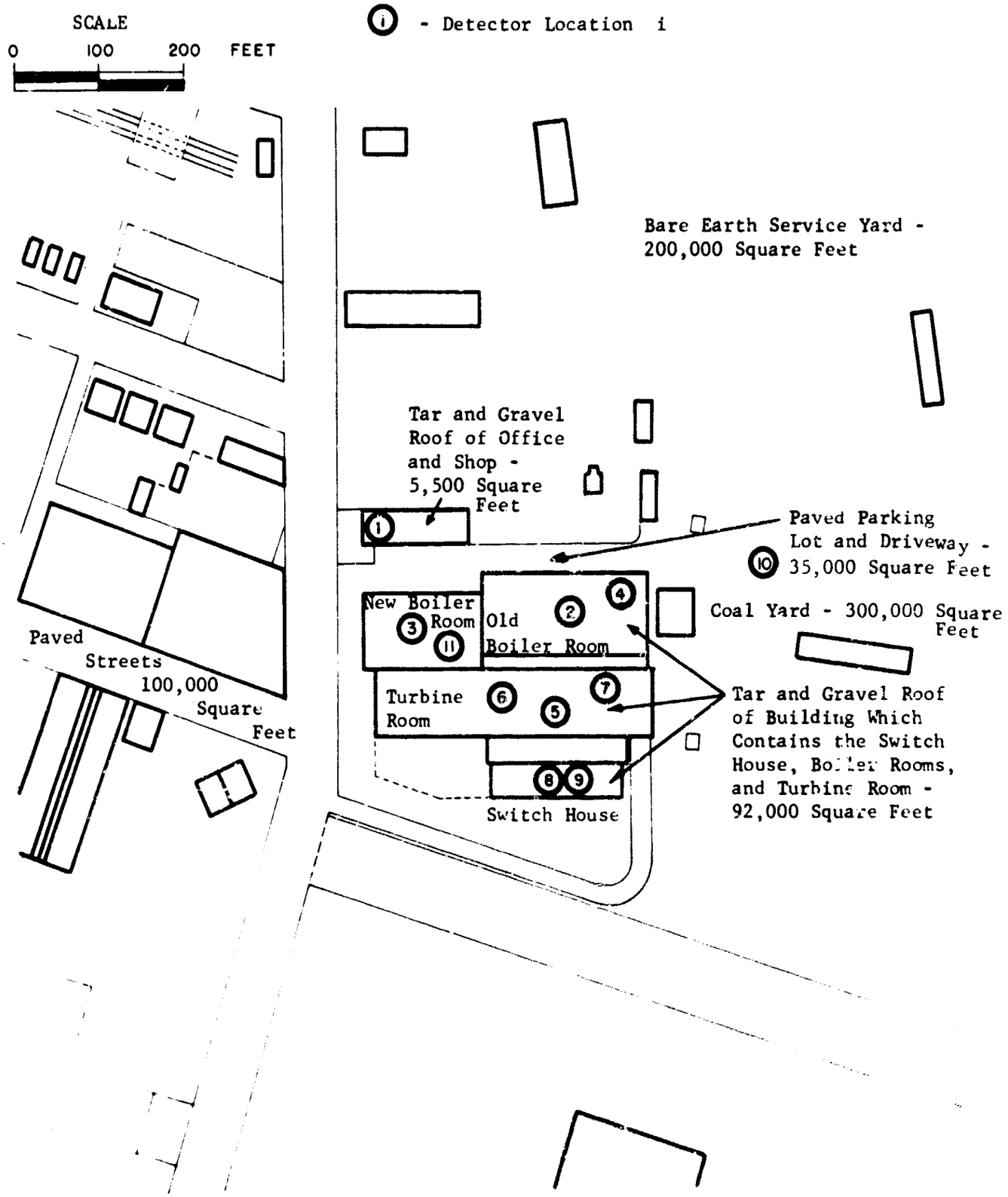


Figure 55

A Map of the Area Around Mistersky Power Plant Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 56

View 1 - Mistersky Power Plant -
A View of the Interior of the Turbine Room

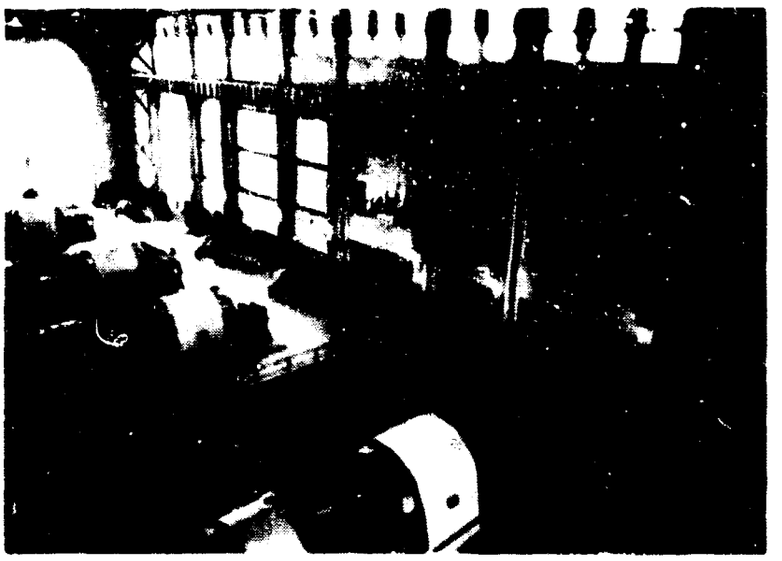


Figure 57

View 2 - Mistersky Power Plant -
A View of the Interior of the Turbine Room Showing the Control Room Where Persons Must Be Stationed to Operate the Plant

Figure 58

View 3 - Mistersky Power Plant -
A View of the Interior of the Turbine Room Showing the Relative Size of the Large Windows

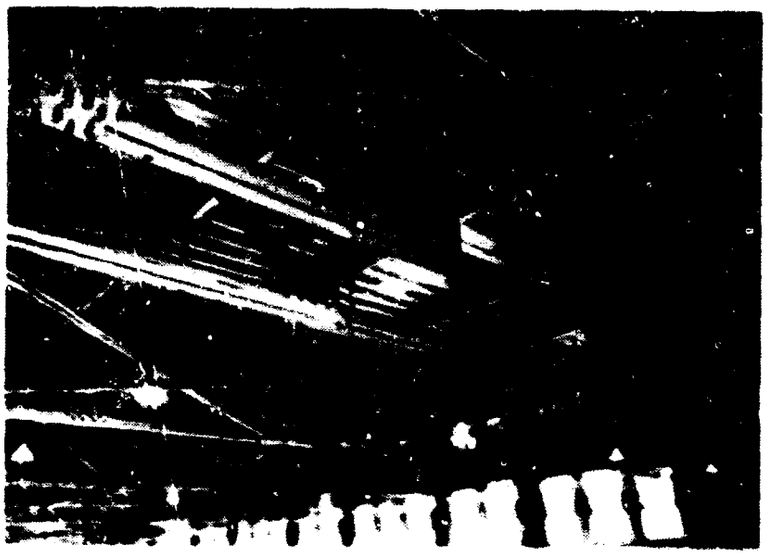


Figure 59

View 4 - Mistersky Power Plant -
A Close-up View of the Steel Trusses and Corrugated Interior of the Roof of the Turbine Room

Figure 60

View 5 - Mistersky Power Plant -
A View of the Service and Storage
Yard Next to the Power Plant

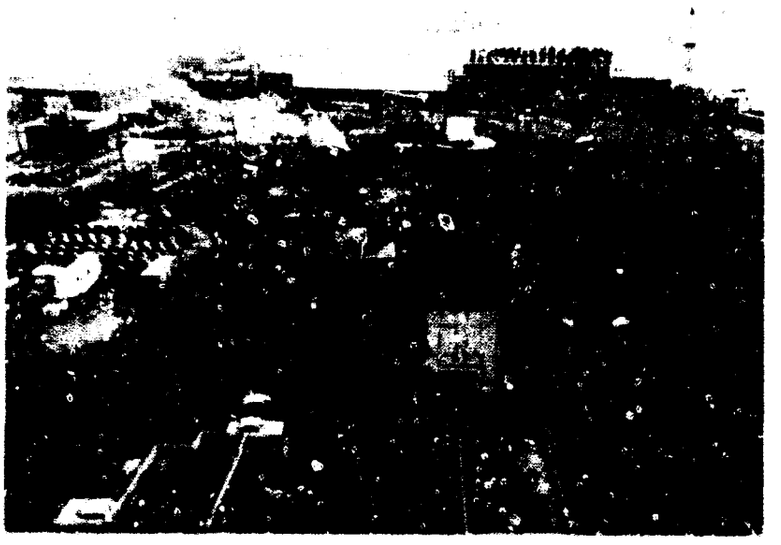


Figure 61

View 6 - Mistersky Power Plant -
A View the Rear of the Service
Yard Showing the Ash Silo

Figure 62

View 7 - Mistersky Power Plant -
A View of the Driveway and Parking Lot
Between the Plant Building and the Office
Building

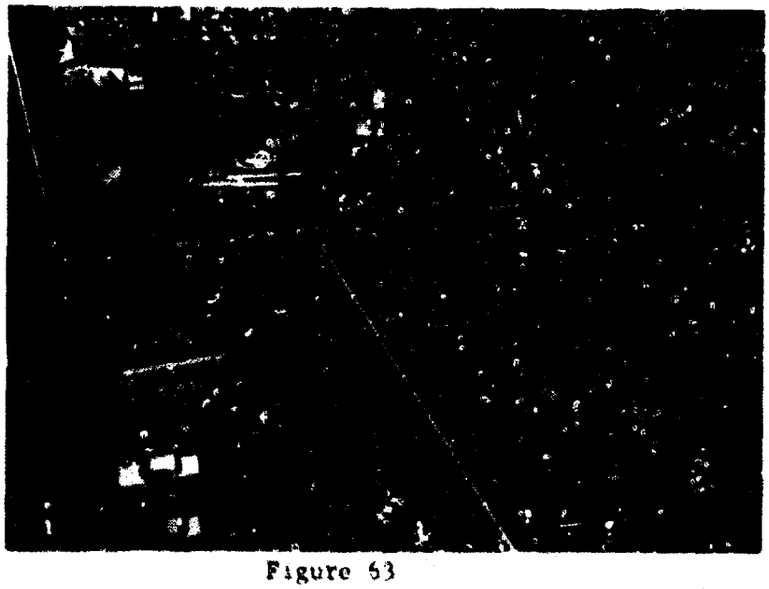


Figure 63

View 8 - Mistersky Power Plant -
A View of the Roof of the Office Building

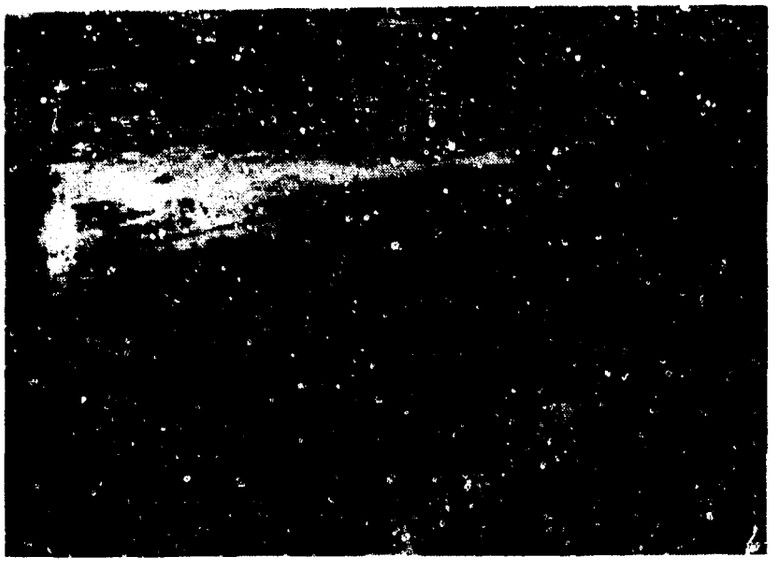


Figure 64

View 9 - Mistersky Power Plant -
A View of the Large Bare Earth Yard
and Parking Lot Southwest of the Power
Plant

Figure 65

View 10 - Mistersky Power Plant -
A View of the Northeast Wall of the
Plant Building

Figure 66

View 11 - Miscersky Power Plant -
A View of Some of the Semi-Residential
and Commercial Area Around the Plant

Figure 67

View 12 - Mistersky Power Plant -
Another View of the Area in the
Vicinity of the Plant

Figure 68

View 13 - Mistersky Power Plant -
A View of the Screen House (Operated by Remote TV Control) and the Coal Yard

Figure 69

View 14 - Mistersky Power Plant -
A View of the Breaker House and Conveyor Belt Adjacent to the Coal Yard

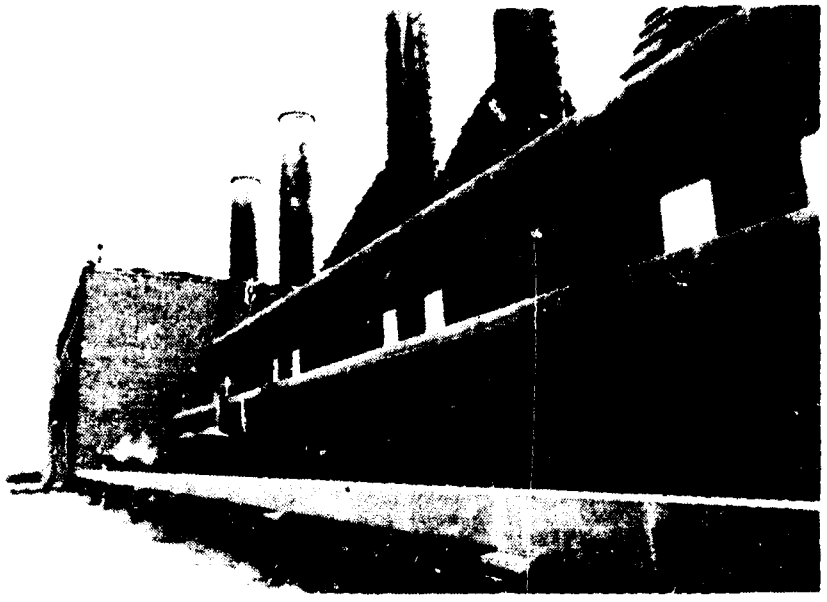


Figure 70

View 15 - Mistersky Power Plant -
A View of the Several Levels of Roofs
on the Plant Building

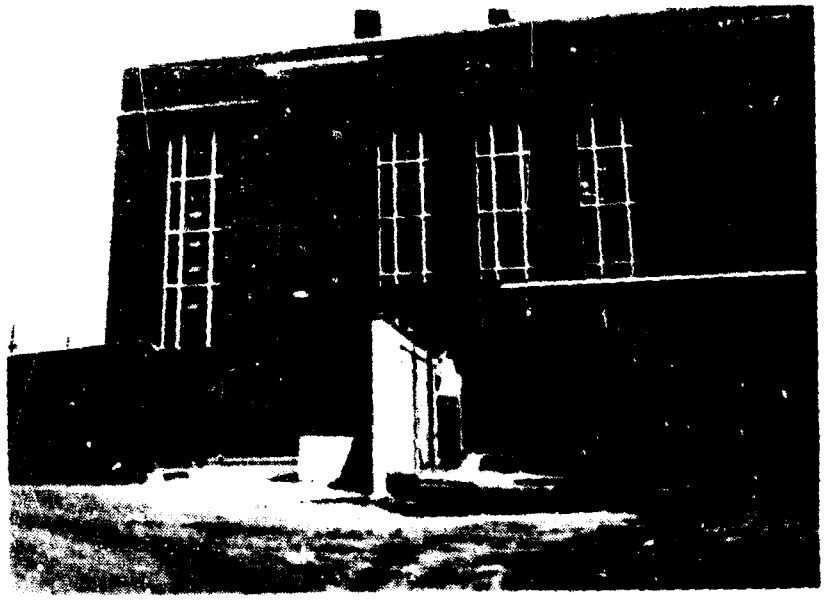


Figure 71

View 16 - Mistersky Power Plant -
A View of the Southwest Wall of the
Power Plant

Figure 72

View 17 - Mistersky Power Plant -
A View of the Tar and Gravel Roof
of the Turbine Room

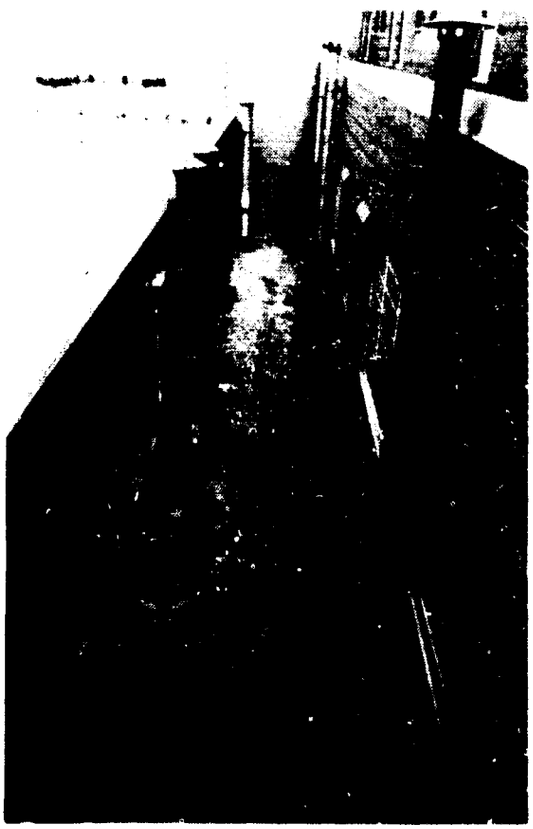


Figure 73

View 18 - Mistersky Power Plant -
A View of one of the Lower Roofs Between
Sections of the Plant Building

Figure 74

View 19 - Mistersky Power Plant -
A View of Another Lower Section of Roof
Between Sections of the Plant Building

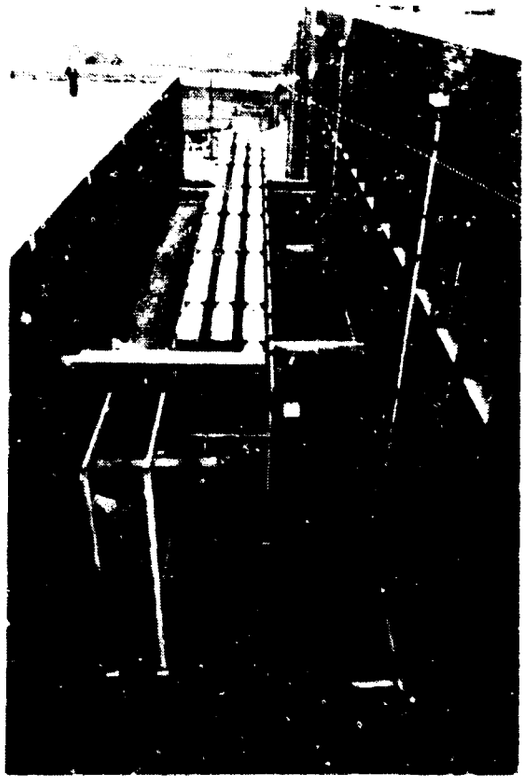


Figure 75

View 20 - Mistersky Power Plant -
A View of Another Lower Section of Roof With Many
Obstructions Which Would Influence Decontamination

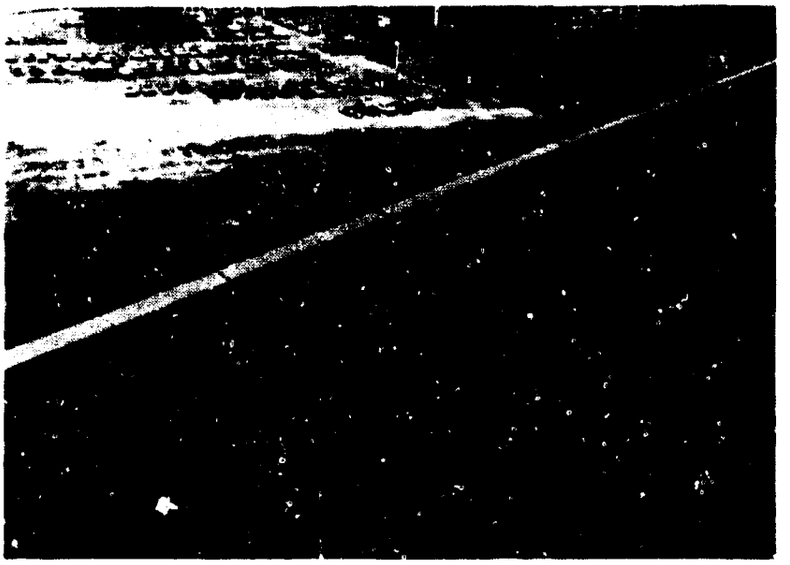


Figure 76

View 21 - Mistersky Power Plant -
A View of the Roof of the Switch
Room Showing a Large Drain

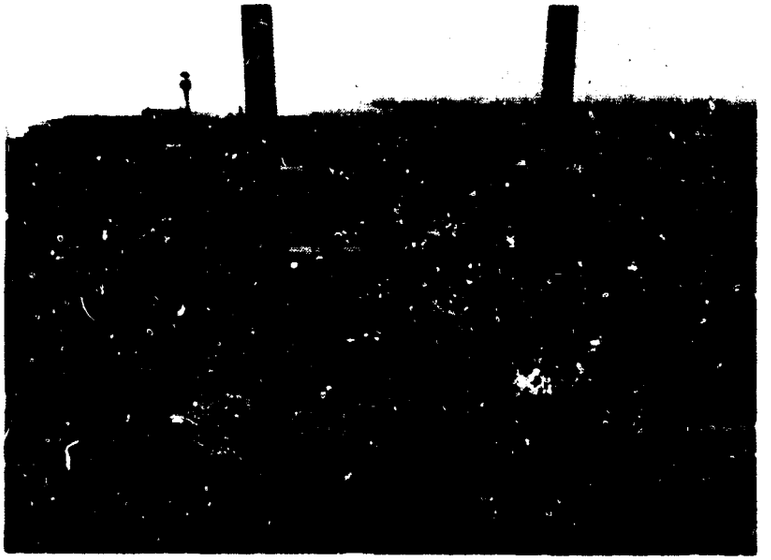


Figure 77

View 22 - Mistersky Power Plant -
A View of the Roof of the Turbine Room
Showing the Large Wall Along the Edge
of the Roof

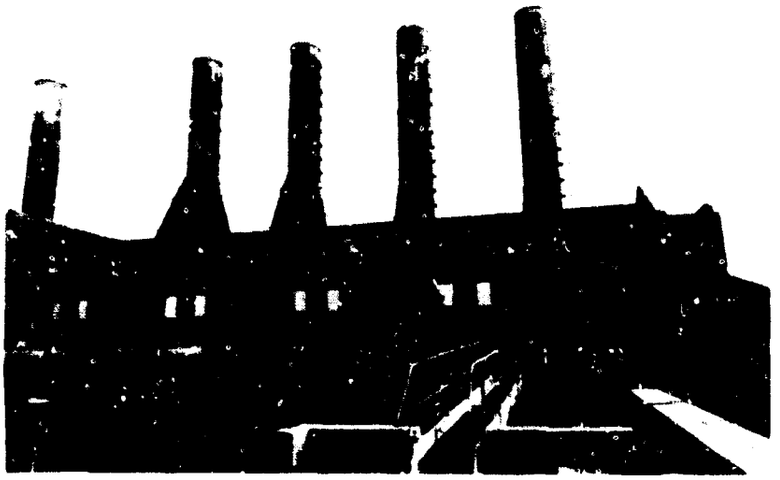


Figure 78

View 23 - Mistersky Power Plant -
A View of the Upper Roofs Over the
Boiler Rooms Showing the Large
Obstructions to Decontamination

Figure 79

View 24 - Mistersky Power Plant -
A View of the Upper Roof of the Boiler
Room Showing Water Outlets Which Could
Be Used for Decontamination

Figure 80

View 25 - Mistersky Power Plant -
A View of the Control Switch Panel on
Fourth Floor of the Boiler Building

Figure 81

View 26 - Mistersky Power Plant -
A View of the Remote TV Control
to the Screen House

Figure 82

View 27 - Mistersky Power Plant -
A View of the Chemical Control Panel on
the Fourth Floor in the Boiler Building

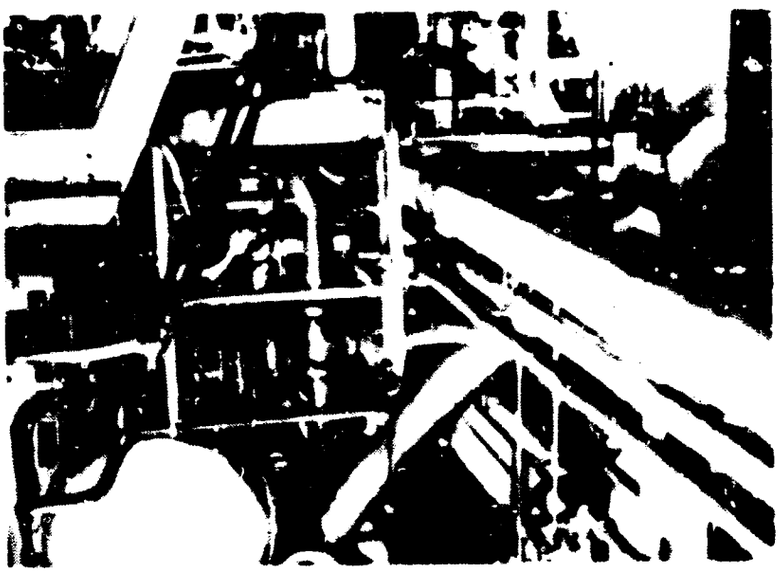


Figure 83

View 28 - Mistersky Power Plant -
A View Taken From an Operator's Station Toward
the Nearest Exterior Wall Showing Some of the
Shielding Afforded by Pipes and Machinery

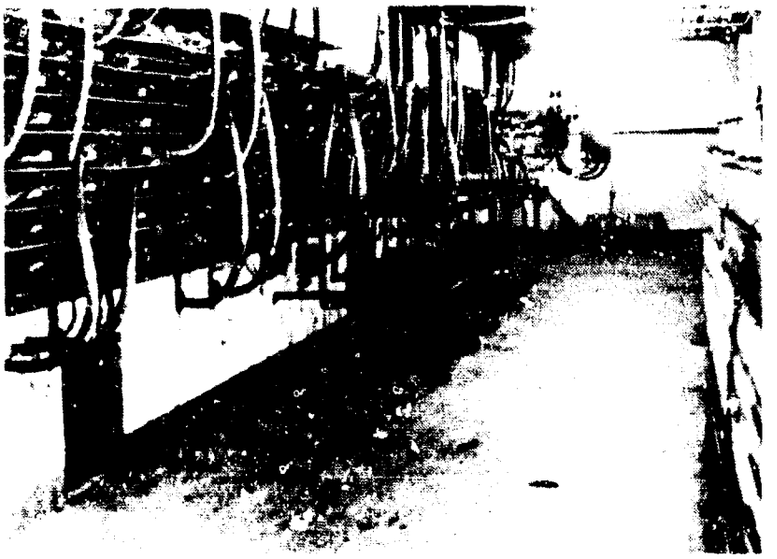


Figure 84

View 29 - Mistersky Power Plant -
A View of the Circuit Panel on the
Second Floor of the Switch House

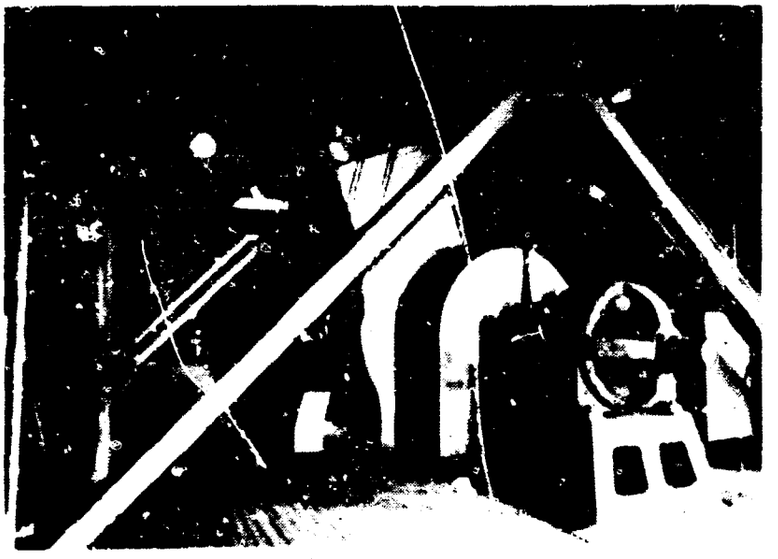


Figure 85

View 30 - Mistersky Power Plant -
A View of Some of the Machinery on the
Second Floor in the Boiler Building

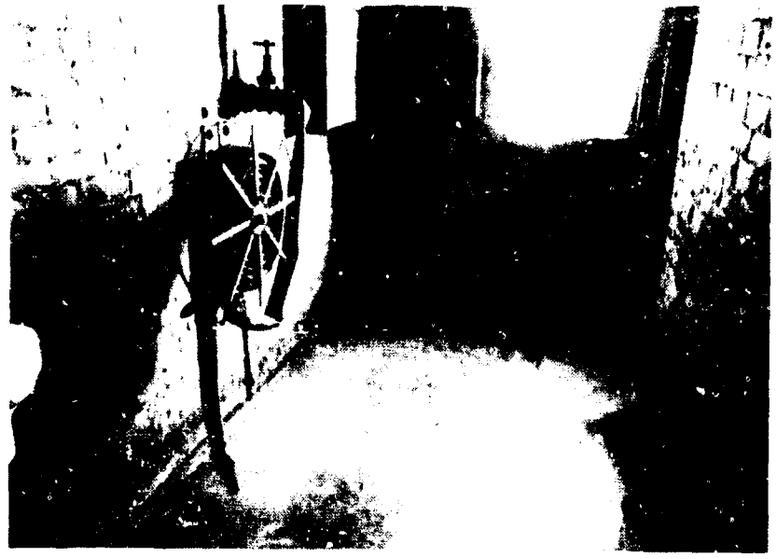


Figure 86

View 31 - Mistersky Power Plant -
A View of the Fire Hose at the Exit
to the Roof of the Turbine Building

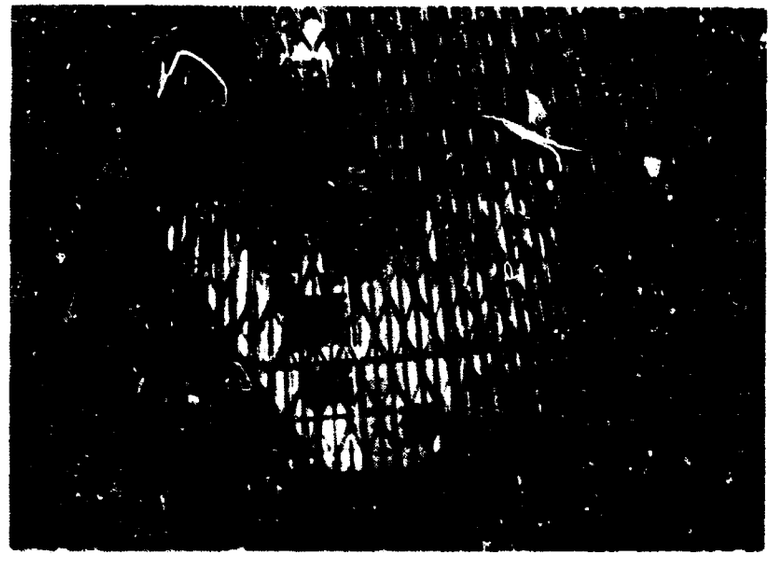


Figure 87

View 32 - Mistersky Power Plant -
A View of the Grating on the Third
Floor of the Boiler Building

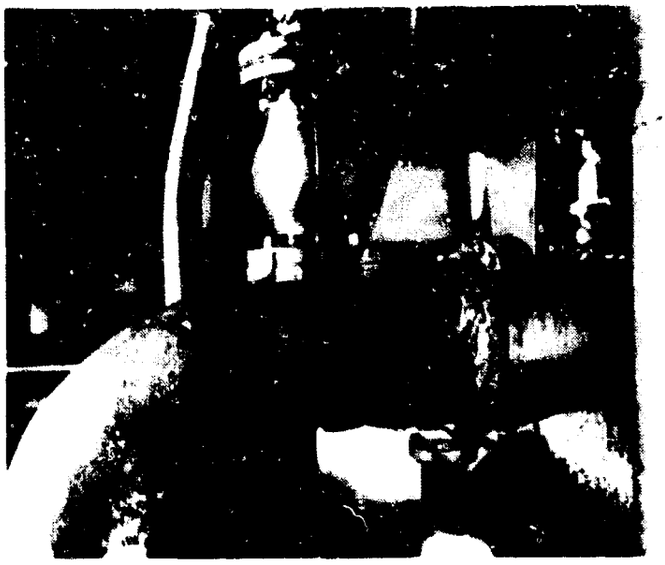


Figure 88

View 33 - Mistersky Power Plant -
A Close-up View of One of the Pipes Which Shows that Much of the Exterior Diameter of the Pipes Is a Low Density Asbestos Insulation

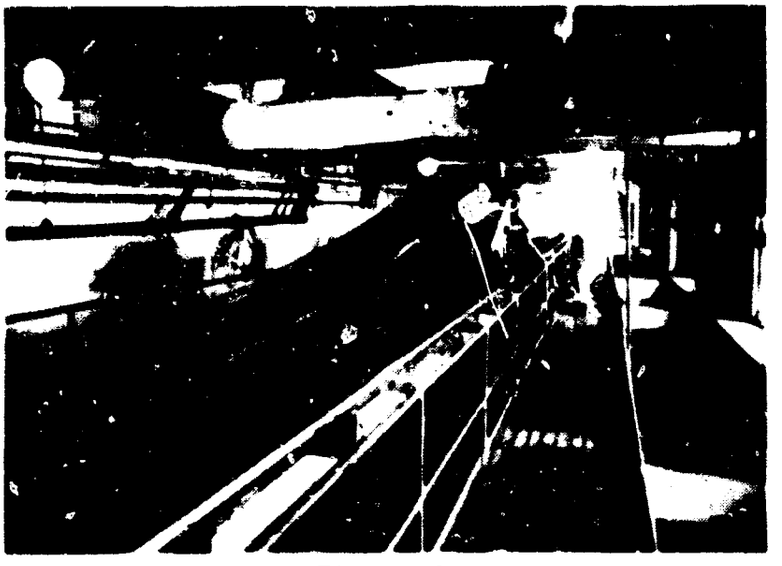


Figure 89

View 34 - Mistersky Power Plant -
An Interior View of the Conveyor Room Which Feeds Crushed Coal to the Boilers

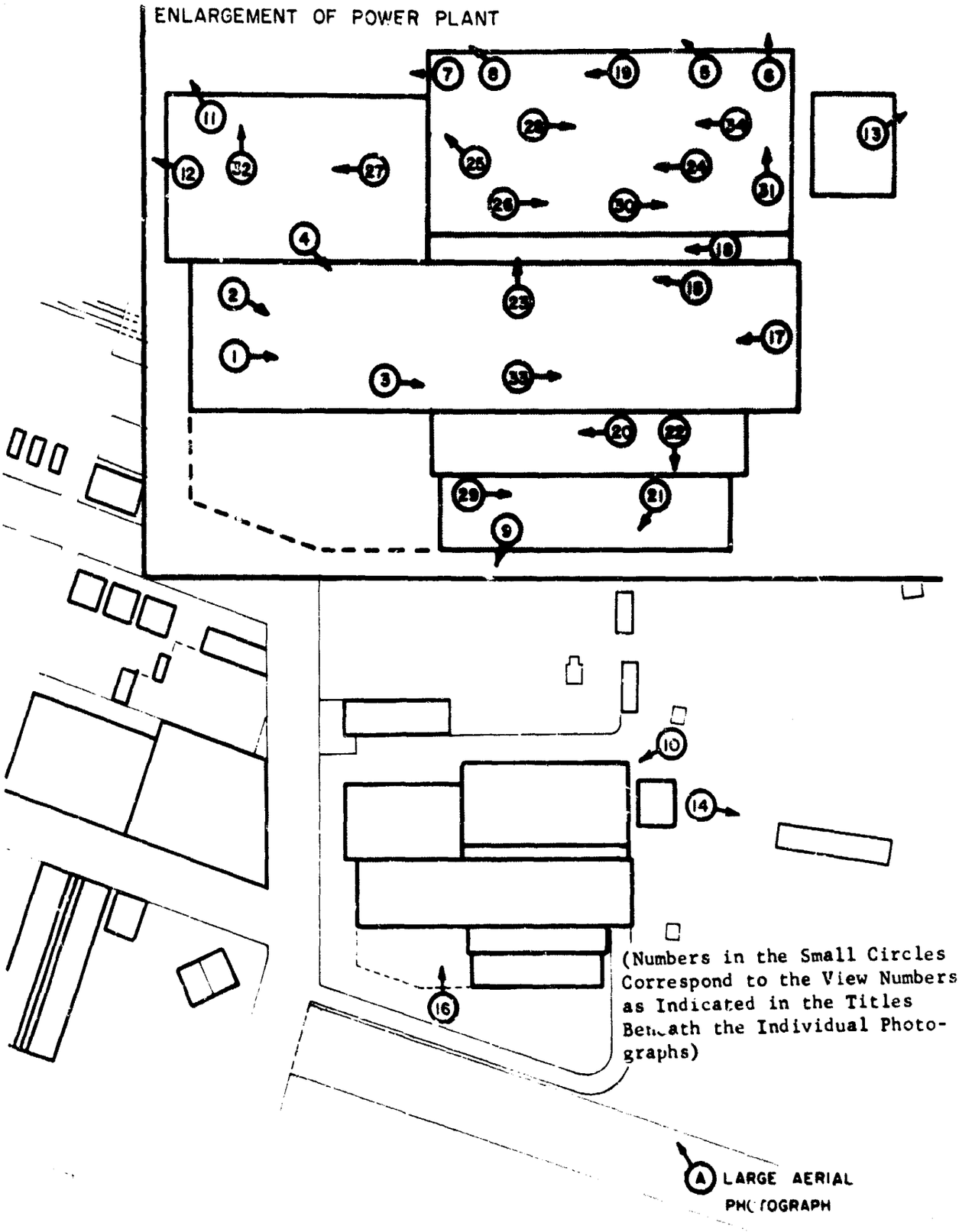


Figure 90
A Map of the Area Around the Mistersky Power Plant Showing the Locations and Directions of the Photographs Shown in Figure 54 and Figures 56 through 89

B. Definition of Activities

Fifteen different activity patterns are considered in this analysis. Eleven detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Location	Description
1	Center Location in Plant Office
2	Center Location in Old Boiler Room
3	Center Location in New Boiler Room
4	Off-center Location in Old Boiler Room
5	Control House
6	Center Location in Turbine Room
7	Off-center Location in Turbine Room
8	Center Location on Third Floor of Switch House
9	Center Location on First Floor of Switch House
10	In Coal Yard on Bulldozer
11	Shelter Area below New Boiler Room

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table XIX defines the fifteen activity patterns.

Table XIX

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j AT MISTERSKY POWER PLANT

Activity Pattern A_i	Detector Location j										
	1 Center Location in Plant Office	2 Center Location in Old Boiler Room	3 Center Location in New Boiler Room	4 Off-Center Location in Old Boiler Room	5 Control House	6 Center Location in Turbine Room	7 Off-Center Location in Turbine Room	8 Center Location on Third Floor of Switch House	9 Center Location on First Floor of Switch House	10 In Coal Yard on Bull-dozer	11 Shelter Area below New Boiler Room
A_1	.00	.35	.35	.00	.00	.00	.00	.00	.00	.00	.30
A_2	.00	.00	.30	.30	.00	.00	.00	.00	.00	.00	.40
A_3	.00	.20	.00	.40	.00	.00	.00	.00	.00	.00	.40
A_4	.00	.00	.00	.00	.70	.00	.00	.00	.00	.00	.30
A_5	.50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.50
A_6	.00	.00	.00	.00	.00	.00	.00	.35	.35	.00	.30
A_7	.00	.00	.00	.00	.00	.00	.00	.00	.60	.00	.40
A_8	.60	.00	.00	.00	.00	.05	.05	.00	.00	.00	.30
A_9	.00	.00	.00	.00	.00	.50	.00	.00	.00	.00	.50
A_{10}	.00	.00	.00	.00	.00	.20	.50	.00	.00	.00	.30
A_{11}	.00	.00	.00	.00	.00	.00	.00	.50	.00	.00	.50
A_{12}	.00	.00	.00	.00	.50	.00	.00	.00	.00	.00	.50
A_{13}	.10	.00	.10	.00	.10	.00	.10	.10	.00	.00	.50
A_{14}	.00	.00	.00	.50	.00	.00	.00	.00	.00	.00	.50
A_{15}	.00	.00	.00	.30	.00	.00	.00	.00	.00	.10	.60

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 55)

	Detector Location	Original PF
1	Center Location in Plant Office	14
2	Center Location in Old Boiler Room	30
3	Center Location in New Boiler Room	28
4	Off-center Location in Old Boiler Room	52
5	Control House	69
6	Center Location in Turbine Room	625
7	Off-center Location in Turbine Room	769
8	Center Location on Third Floor of Switch House	130
9	Center Location on First Floor of Switch House	45
10	In Coal Yard on Buildozer	1.4
11	Shelter Area below New Boiler Room	385

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table XIX)	Equivalent PF
A_1	40
A_2	57
A_3	65
A_4	91
A_5	27
A_6	89
A_7	70
A_8	23
A_9	476
A_{10}	571
A_{11}	194
A_{12}	117
A_{13}	70
A_{14}	91
A_{15}	12

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roof of Building which contains the Switch House, Boiler Rooms, and Turbine Room	92,000	Tar and Gravel
2	Roof of Office and Shop	5,500	Tar and Gravel
3	Parking Lots and Driveway	35,000	Asphalt and Concrete
4	Coal Yard	300,000	Coal Piles
5	Service Yard	200,000	Bare Earth (oil drums and other materials stacked throughout area)
6	Streets	100,000	Asphalt

E. Contributions to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the building which were required to calculate the contribution to intensity values:

a. Floors in Old Boiler House - 6" to 12" reinforced concrete. (Their thickness varied considerably) (100 lbs/ft^2).

b. Floors in New Boiler House - metal floor grating (40 lbs/ft^2).

c. Floors in Switch House - 12" reinforced concrete except fourth floor which is 36" reinforced concrete (150 lbs/ft^2 except fourth floor which is 400 lbs/ft^2).

d. Exterior Walls of Plant Building - 13" reinforced concrete, 12 3/4" brick, 30% apertures (300 lbs/ft^2).

e. Exterior Wall of Office Building - 6" concrete, 8" brick, 20% apertures (135 lbs/ft^2).

f. Floors of Office Building - 1" wood with concrete and steel support beams (30 lbs/ft^2).

Table XX lists the contribution to intensity factors of the various planes to the selected detector locations.

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table XXI.

Table XX

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR MISTERSKY POWER PLANT

Contaminated Plane i	Detector Location j										
	1 Center Location in Plant Office	2 Center Location in Old Boiler Room	3 Center Location in New Boiler Room	4 Off-Center Location in Old Boiler Room	5 Control House	6 Center Location in Turbine Room	7 Off-Center Location in Turbine Room	8 Center Location on Third Floor of Switch House	9 Center Location on First Floor of Switch House	10 In Coal Yard on Bull-dozer	11 Shelter Area below New Boiler Room
1 Roof of Building which contains the Switch House, Boiler Rooms, and Turbine Room	.0000	.0004	.0182	.0003	.0000	.0015	.0012	.0000	.0000	.0000	.0000
2 Roof of Office and Shop	.0017	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3 Parking Lots and Driveway	.0188	.0088	.0028	.0071	.0000	.0000	.0000	.0000	.0000	.0024	.0001
4 Coal Yard	.0095	.0014	.0006	.0008	.0000	.0001	.0001	.0030	.0020	.7180	.0009
5 Service Yard	.0292	.0121	.0068	.0056	.0104	.0000	.0000	.0038	.0148	.0203	.0012
6 Streets	.0110	.0105	.0076	.0055	.0041	.0000	.0000	.0009	.0052	.0018	.0004

Table XXI

RELATIVE INTENSITY CONTRIBUTIONS (CR_{ij} VALUES) FOR MISTERSKY POWER PLANT

Contaminated Plane i	Detector Location j										
	1 Center Location in Plant Office	2 Center Location in Old Boiler Room	3 Center Location in New Boiler Room	4 Off-Center Location in Old Boiler Room	5 Control House	6 Center Location in Turbine Room	7 Off-Center Location in Turbine Room	8 Center Location on Third Floor of Switch House	9 Center Location on First Floor of Switch House	10 In Coal Yard on Bull-dozer	11 Shelter Area below New Boiler Room
1 Roof of Building which contains the Switch House, Boiler Rooms, and Turbine Room	.00	.01	.51	.02	.00	.94	.92	.00	.00	.00	.00
2 Roof of Office and Shop	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3 Parking Lots and Driveway	.27	.27	.08	.37	.00	.00	.00	.00	.00	.00	.04
4 Coal Yard	.14	.04	.02	.04	.00	.06	.08	.39	.09	.97	.35
5 Service Yard	.42	.36	.19	.29	.72	.00	.00	.49	.67	.03	.46
6 Streets	.16	.32	.21	.28	.28	.00	.00	.12	.24	.00	.15

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table XXII.

Table XXII

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR MISTERSKY POWER PLANT

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Roof of Main Plant (1)	.01	12.9	7
Firehose	B	Roof of Main Plant (1)	.07	5.9	7
Firehose	C	Roof of Main Plant (1)	.12	4.0	7
Firehose	D	Roof of Office and Shop (2)	.01	0.8	7
Firehose	E	Parking Lots and Driveway (3)	.02	0.7	5
Vacuumized Sweeper	F	Parking Lots and Driveway (3)	.09	1.4	1
Flusher	G	Parking Lots and Driveway (3)	.02	0.4	1
Bulldozer	H	Coal Yard (4)	.10	72.0	1
Bulldozer	I	Service Yard (5)	.10	48.0	1
Flusher	J	Streets (6)	.02	1.0	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table XXIII.

I. RN_A Values

The activity reduction factors for selected strategies and the activity patterns are given in Table XXIV.

Table XXIII

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR MISTERSKY POWER PLANT

Combined Strategy	Detector Location j										
	1 Center Location in Plant Office	2 Center Location in Old Boiler Room	3 Center Location in New Boiler Room	4 Off-center Location in Old Boiler Room	5 Control House	6 Center Location in Turbine Room	7 Off-center Location in Turbine Room	8 Center Location on Third Floor of Switch House	9 Center Location on First Floor of Switch House	10 In Coal Yard on Bull-dozer	11 Shelter Area below New Boiler Room
A	1.00	.99	.50	.98	1.00	.07	.09	1.00	1.00	1.00	1.00
B	1.00	.99	.53	.99	1.00	.13	.14	1.00	1.00	1.00	1.00
C	1.00	.99	.56	.99	1.00	.17	.19	1.00	1.00	1.00	1.00
D	.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	.74	.74	.92	.64	1.00	1.00	1.00	1.00	1.00	1.00	.96
H	.88	.96	.98	.96	1.00	.94	.93	.65	.92	.13	.69
I	.63	.67	.83	.74	.35	1.00	1.00	.56	.39	.98	.58
J	.85	.69	.79	.72	.72	1.00	1.00	.89	.77	1.00	.85
A+D	.98	.99	.50	.98	1.00	.07	.09	1.00	1.00	1.00	1.00
A+F	.76	.75	.43	.65	1.00	.07	.09	1.00	1.00	1.00	.96
C+G	.74	.73	.48	.63	1.00	.17	.19	1.00	1.00	1.00	.96
A+D+E+J	.56	.42	.22	.34	.72	.07	.09	.89	.77	.99	.81
A+D+E+H+I+J	.06	.05	.03	.05	.08	.02	.02	.09	.08	.10	.08

Table XXIV

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR MISTERSKY POWER PLANT

Combined Strategy	Activity Patterns														
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}
A	.74	.69	.99	1.00	1.00	1.00	1.00	1.00	.69	.49	1.00	1.00	.87	.99	1.00
B	.76	.71	.99	1.00	1.00	1.00	1.00	1.00	.67	.52	1.00	1.00	.87	.99	1.00
C	.77	.72	.99	1.00	1.00	1.00	1.00	1.00	.69	.55	1.00	1.00	.88	.99	1.00
D	1.00	1.00	1.00	1.00	.98	1.00	1.00	.98	1.00	1.00	1.00	1.00	.99	1.00	1.00
E	.84	.83	.70	1.00	.75	1.00	1.00	.74	.98	.98	.99	.99	.85	.68	.97
H	.97	.96	.94	.98	.87	.84	.90	.87	.79	.83	.66	.95	.89	.93	.20
I	.75	.79	.70	.37	.62	.45	.41	.63	.74	.81	.56	.39	.65	.72	.95
J	.75	.77	.72	.73	.85	.80	.77	.85	.91	.93	.88	.74	.82	.74	.98
A+D	.74	.69	.99	1.00	.98	1.00	1.00	.97	.65	.49	1.00	1.00	.85	.99	1.00
A+F	.59	.53	.71	1.00	.76	1.00	1.00	.76	.62	.48	.99	.99	.72	.69	.97
C+G	.61	.56	.69	1.00	.75	1.00	1.00	.74	.66	.53	.99	.99	.73	.67	.97
A+D+E+J	.33	.29	.41	.73	.57	.80	.77	.56	.53	.41	.87	.74	.53	.40	.94
A+D+E+H+I+J	.04	.04	.05	.08	.06	.08	.08	.06	.06	.05	.09	.08	.06	.05	.10

J. Conclusions

Many locations inside the turbine house and boiler house at Mistersky Power Plant have extremely high PF's before decontamination. Moderate decontamination of the roof of the plant building would increase the protection even more by factors ranging from slightly more than one to more than ten. Many detector locations outside of the plant building or on the lower floors of the boiler house are virtually unaffected by roof decontamination, however.

The intensity at all of the detector locations considered would be reduced by factors ranging from ten to fifty by applying the combined strategy A+D+E+H+I+J (firehosing all roofs and paved areas in the plant grounds, bulldozing the coal pile and service yard, and flushing the streets). This strategy would require approximately 200 man-hours of effort. The bulldozing alone would require 120 man-hours of effort. Many of the PF's computed for the specified detector locations are conservative inasmuch as not all of the interior contents of the buildings were considered during their computation. Thus, the plant operations might begin quite soon after an attack without decontamination and without over exposing the plant personnel.

VI. DECONTAMINATION ANALYSIS OF COBO CONVENTION HALL

A. Discussion

Cobo Convention Hall at 1 Washington Boulevard is a three level, rectangular structure with a circular annex, the convention arena, connected to its southeast corner. The hall and arena cover 17 acres of the Civic Center in downtown Detroit and provide 2,220,490 square feet of usable floor space.

Because it is located on the slope of the north bank of the Detroit River, the hall has two ground level floors. The main or middle level contains the entrance from Washington Boulevard, the main exhibit area, the ballroom and other major meeting rooms, and the main truck access. Located on the river, or lower level, are entrances from Civil Center Drive and Larned Street, another exhibit area, the coffee shop, the service and storage area, a truck access, and two underground parking garages. The upper level contains meeting rooms, dressing rooms, the cafeteria, and the administrative offices. The rooftop is a 1200-car parking deck.

The electric power system in the buildi g can provide 22,500 k.v.a. (10,000 k.v.a. in each of the exhibit halls). The gas line system can provide 200,000 b.t.u. from regular outlets and 1,000,000 b.t.u. through auxiliary piping in strategic locations. The water system maintains a constant 70 p.s.i. pressure at all one-inch outlets. The buildings are completely equipped with television lines, a telephone system with 3,000 external connections to the Bell system, and is completely air conditioned.

Figure 91 is an aerial view of the hall showing both the rectangular convention building and the circular arena annex. Figure 92 is a map of the area around Cobo Hall, showing the locations of detectors and indicating the sizes and surface materials of the contributing planes of contamination to the activity areas. Figures 93 through 116 are a number of photographs taken in and around Cobo Hall, showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 117 is a map indicating the locations and directions of photographs.

Figure 91

An Aerial View of Cobo Convention Hall

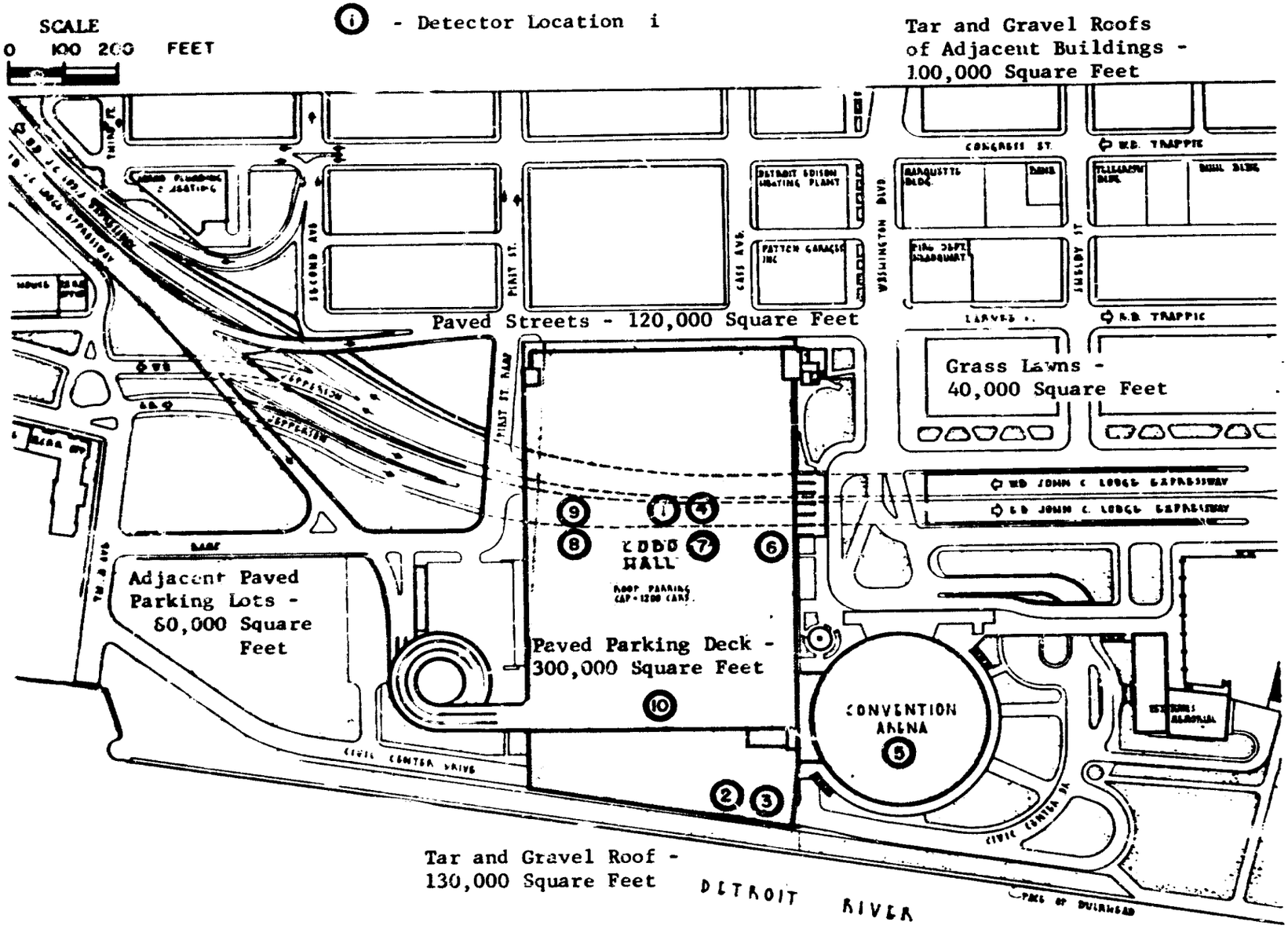


Figure 92

A Map of the Area Around Cobo Hall Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 93

View 1 - Cobo Hall -
A View of the Main Corridor at the South Side
of the Main Exhibition Building

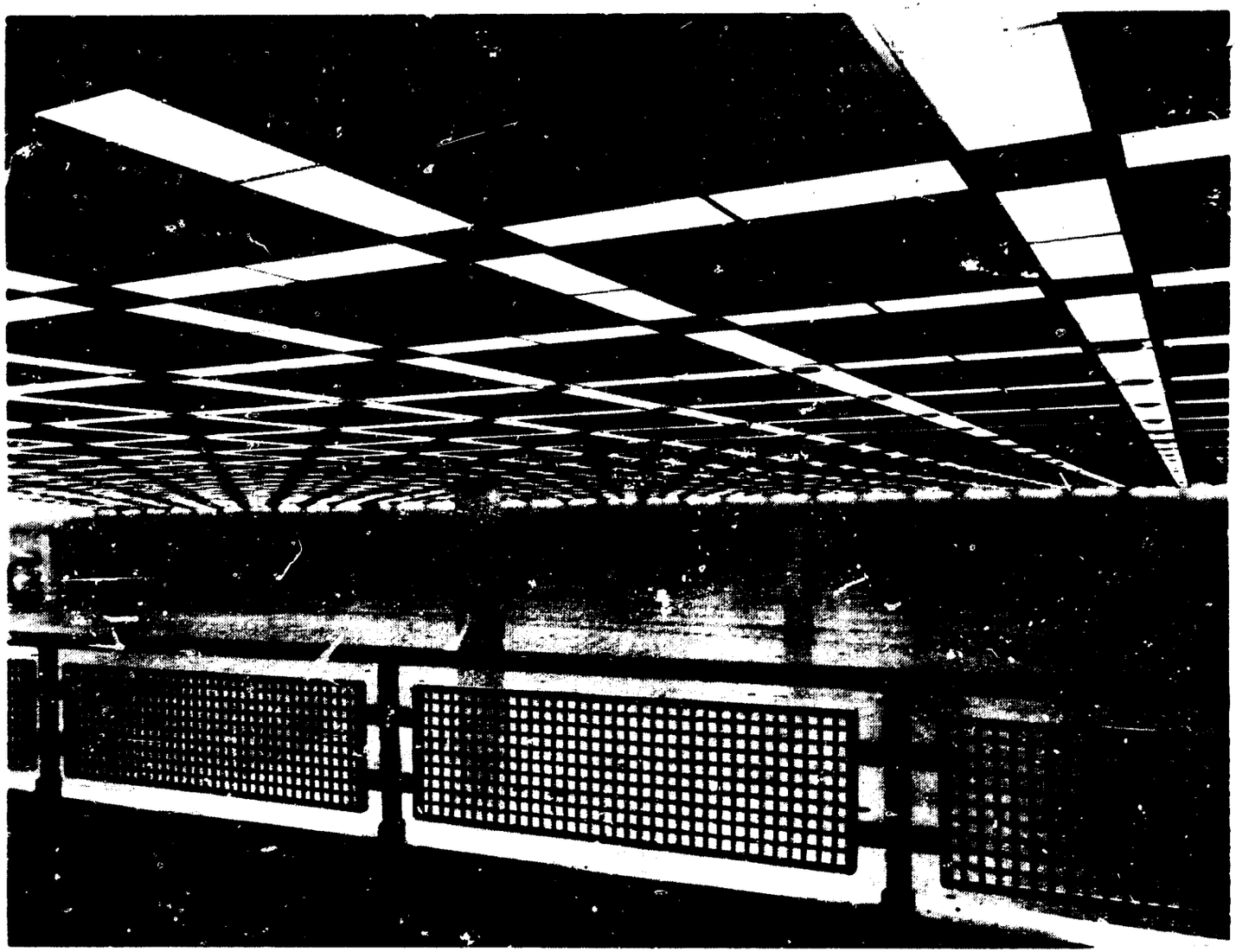


Figure 94

View 2 - Cobo Hall -
A View of the Main Exhibition Hall in the
Exhibition Building

Figure 95

View 3 - Cobo Hall -
A View of the Southwest Corner of Cobo Hall Showing a Large Grass Area and the Spiral Parking Ramp

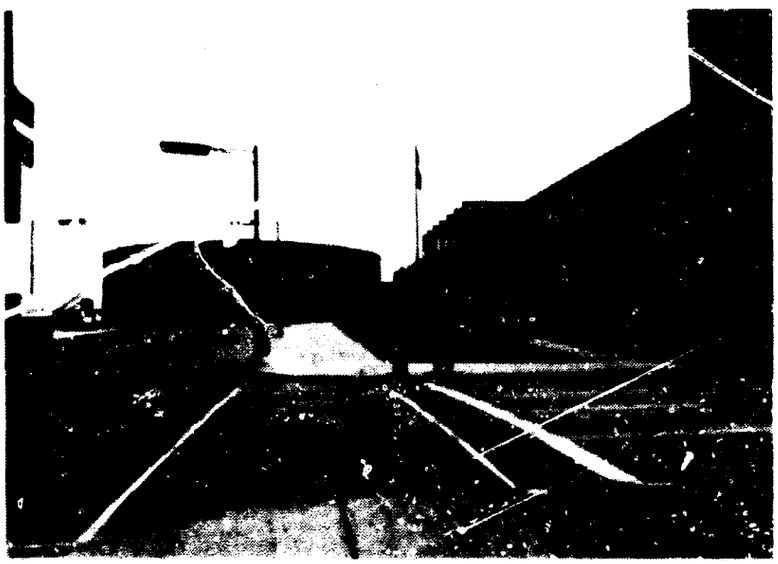


Figure 96

View 4 - Cobo Hall -
A View of the East Side of Cobo Hall Showing he Administration Offices and Convention Arena

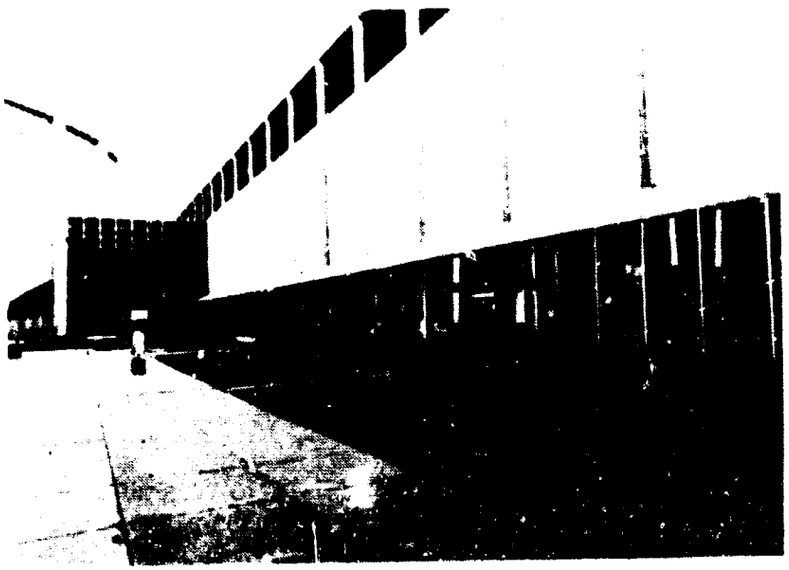


Figure 97

View 5 - Cobo Hall -
A View of the East Side of the Exhibition Hall Showing the Wide Sidewalks and Grass Areas

Figure 98

View 6 - Cobo Hall -
A View of the Northeast Corner of the Exhibition Hall Showing a Garden Area and Pool Which Are Adjacent to the Entrance

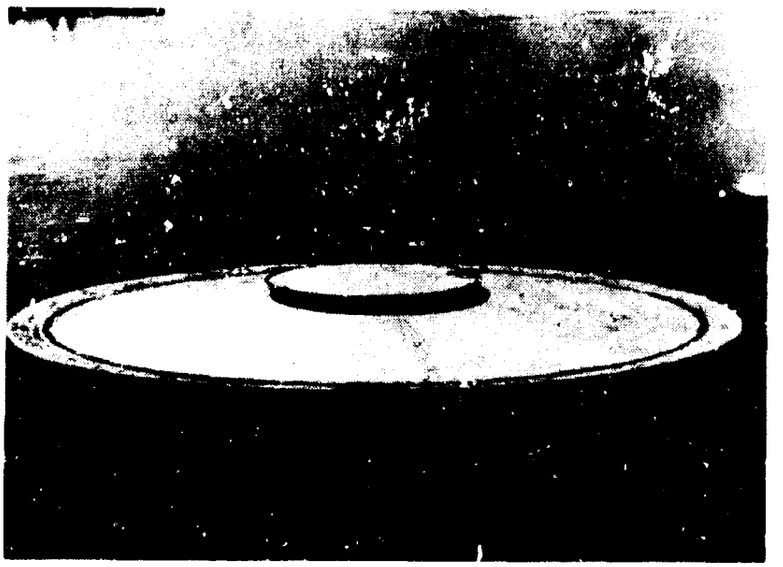


Figure 99

View 7 - Cobo Hall -
A Close-up View of the Convention Arena Roof

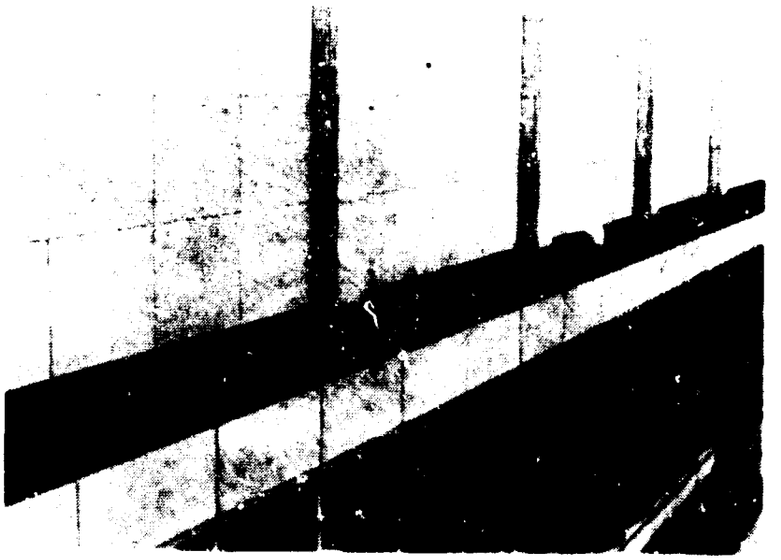


Figure 100

View 8 - Cobo Hall -
A View of the Ledge Which Extends Around Two Sides of the Exhibition Hall

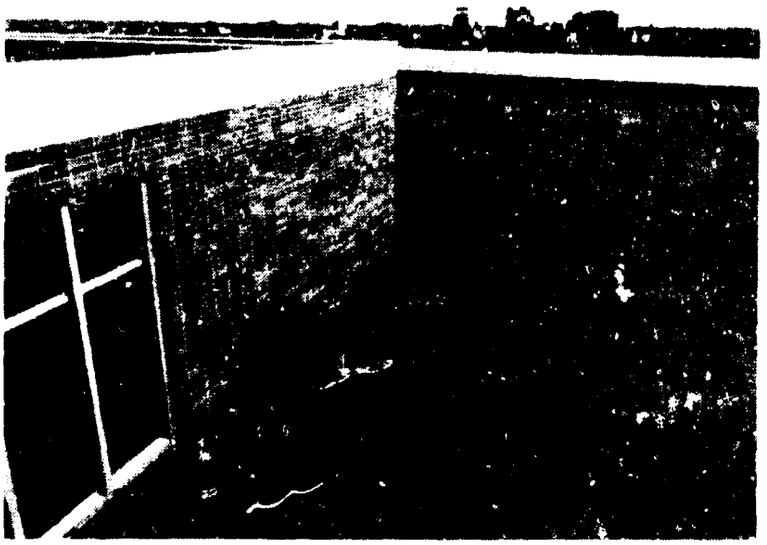


Figure 101

View 9 - Cobo Hall
A View of the South Portion of the Roof
of the Exhibition Building

Figure 102

View 10 - Cobo Hall -
A View of the Parking Deck on the Rooftop
of the Exhibition Building

Figure 103

View 11 - Cobo Hall -
A Close-up View of One of the Drains on the Parking Deck

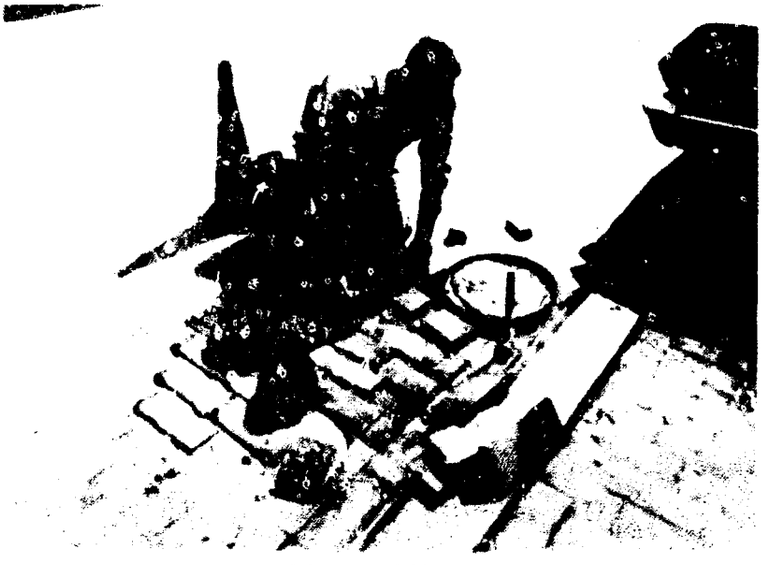


Figure 104

View 12 - Cobo Hall -
A Close-up View Which Shows Clearly the Exterior Surface Material of the Parking Deck

Figure 105

View 13 - Cobo Hall -
A View of the South Patio Ledge and
Sidewalk on the Convention Arena

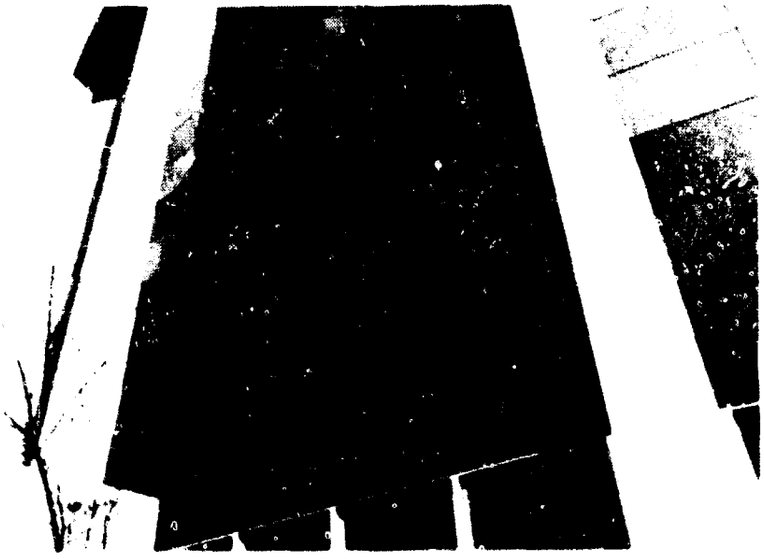


Figure 106

View 14 - Cobo Hall -
A Close-up View of the Marble and Granite
Exterior Wall of the Convention Arena

Figure 107

View 15 - Cobo Hall -
A View of the Interior of the Upper Level Hall in the Exhibition Building

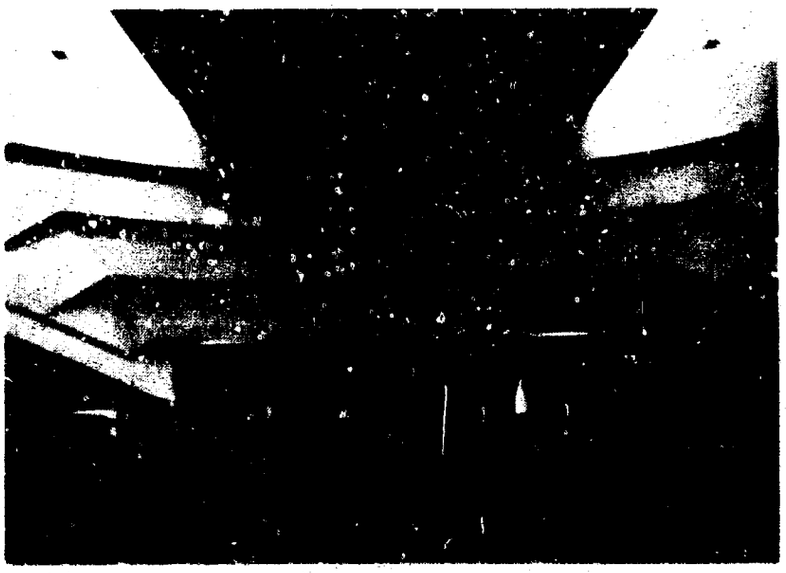


Figure 108

View 16 - Cobo Hall -
A View of the Interior of the Convention Arena

Figure 109

View 17 - Cobo Hall -
A View of the West Hall of the Lower Level
of the Exhibition Building

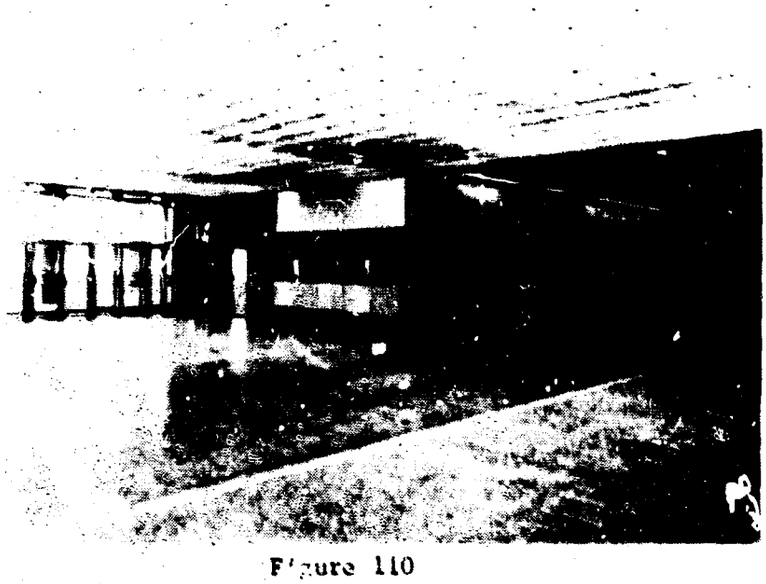


Figure 110

View 18 - Cobo Hall -
A View of the Interior of the South Entrance
Into the Exhibition Building

Figure 111

View 19 - Cobo Hall -
A View in the Interior of the Power Generating Plant in the Exhibition Building

Figure 112

View 20 - Cobo Hall -
A View of the Interior of the Lighting Control Room in the Exhibition Building

Figure 113

View 21 - Cobo Hall -
A View of the Northeast Corner of the Exhibition Building

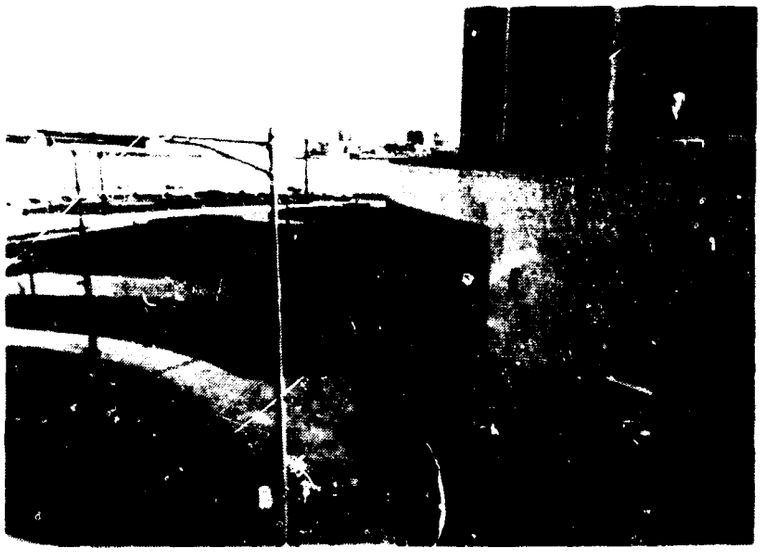


Figure 114

View 22 - Cobo Hall -
A View of the Entrance to a Tunnel Beneath the Convention Arena

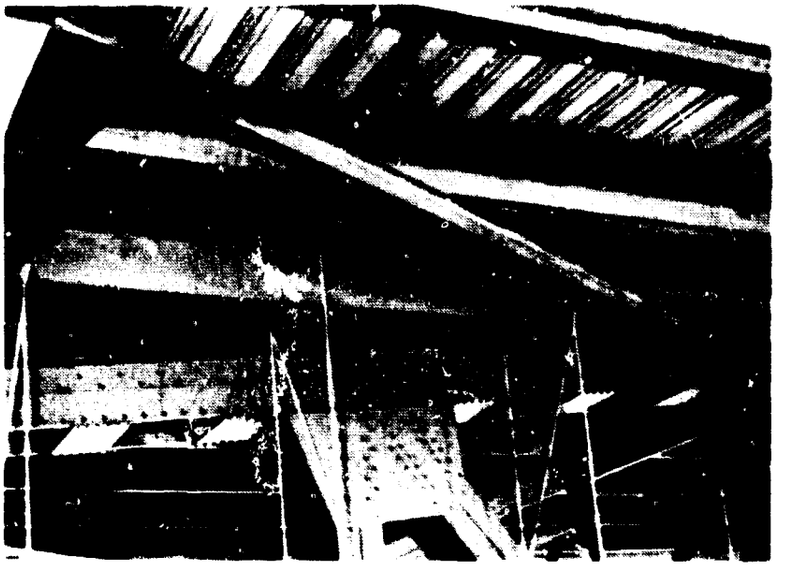
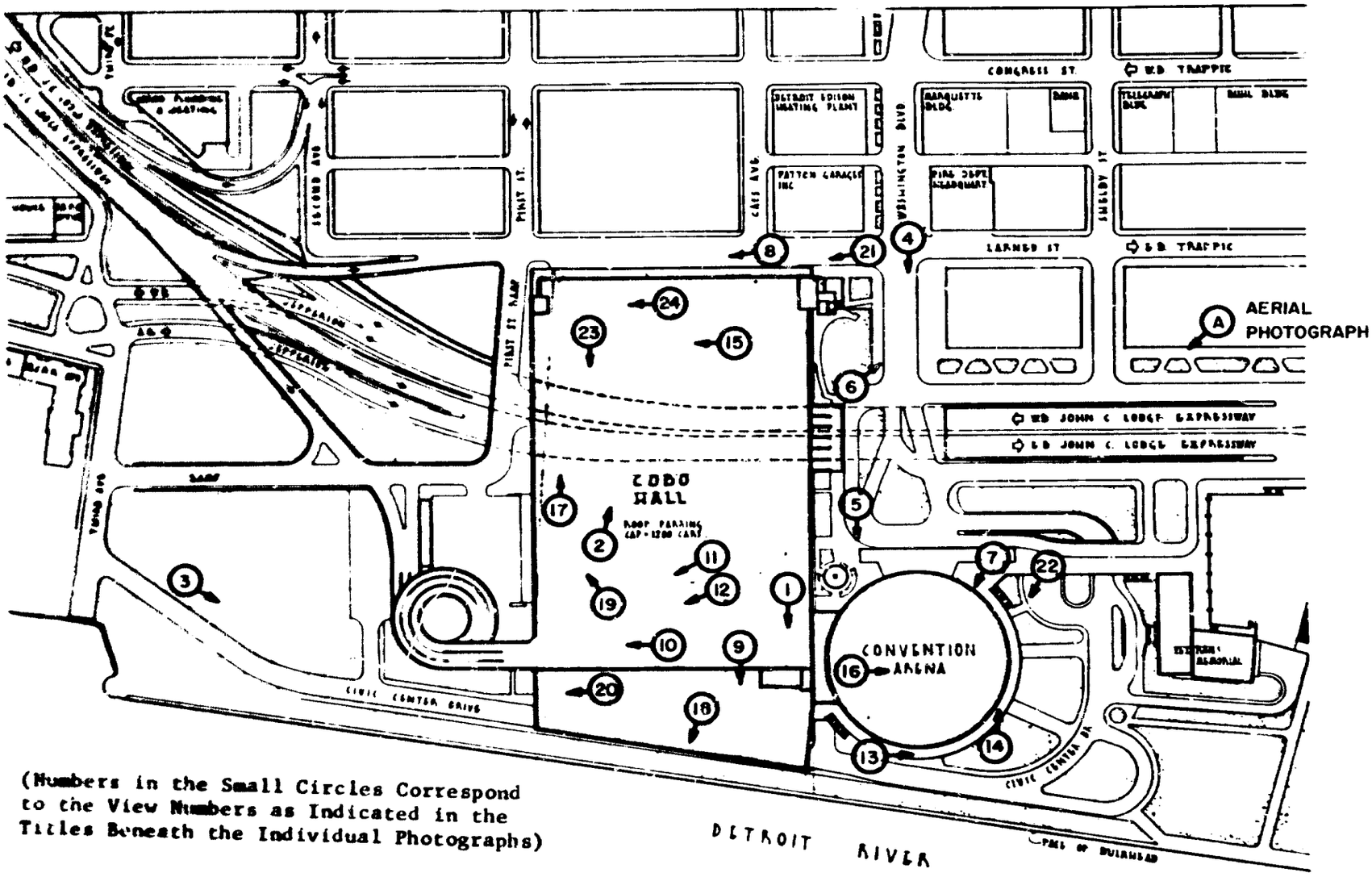


Figure 115

View 23 - Cobo Hall -
An Interior View of the Steel Supporting Structures of the Roof of the Exhibition Building

Figure 116

View 24 - Cobo Hall -
A View of the Interior of the 30 Feet High Space Between the Exhibition Building Roof and the Ceiling of the Uppermost Exhibition Hall



(Numbers in the Small Circles Correspond to the View Numbers as Indicated in the Titles Beneath the Individual Photographs)

Figure 117

A Map of the Area Around Cobo Hall Showing the Locations and Directions of the Photographs Shown in Figure 91 and Figures 93 through 116

B. Definition of Activities

Eight different activity patterns are considered in this analysis. Ten detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Location	Description
1	Center Location in Center Hall on Main Level
2	Off-center Location in South Hall on River Level
3	Cafeteria in Upper Level
4	Center Location in Garage on River Level
5	Center Location in Convention Arena
6	Northmost Office in Administrative Office Section of Upper Level
7	Center of Parking Deck on Roof Top
8	Lighting Control Room - Rectangular Hall
9	Power Plant (Electric) on River Level
10	Shelter Area in Storage Area on River Level

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table XXV defines the eight activity patterns.

Table XXV

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j IN COBO CONVENTION HALL

Activity Pattern A_i	Detector Location j									
	1 Center Location in Center Hall on Main Level	2 Off-center Location in South Hall on River Level	3 Cafe-teria in Upper Level	4 Center Location in Garrage on River Level	5 Center Location in Con-vention Arena	6 Northmost Office in Ad-ministrative Office Section of Upper Level	7 Center of Park-ing Deck on Roof-top	8 Lighting Control Room--Rec-tangular Hall	9 Power Plant (Electric) on River Level	10 Shelter Area in Storage Area on River Level
A_1	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
A_2	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00
A_3	.00	.00	.50	.00	.00	.00	.00	.00	.00	.50
A_4	.00	.00	.00	.00	.40	.25	.00	.00	.00	.35
A_5	.00	.00	.00	.40	.10	.00	.10	.00	.00	.40
A_6	.00	.00	.00	.00	.00	.00	1.00	.00	.00	.00
A_7	.00	.00	.00	.00	.00	.00	.00	.50	.00	.50
A_8	.00	.00	.00	.00	.00	.00	.00	.00	.50	.50

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 92)

	Detector Location	Original PF
1	Center Location in Center Hall on Main Level	208
2	Off-center Location in South Hall on River Level	52
3	Cafeteria in Upper Level	278
4	Center Location in Garage on River Level	769
5	Center Location in Convention Arena	45
6	Northmost Office in Administrative Office Section of Upper Level	303
7	Center of Parking Deck on Roof Top	1.4
8	Lighting Control Room--Rectangular Hall	1,111
9	Power Plant (Electric) on River Level	909
10	Shelter Area in Storage Area on River Level	1,667

2. Equivalent Protection Factors for the Activity Pattern

Activity Pattern (See Table XXV)	Equivalent PF
A_1	208
A_2	52
A_3	476
A_4	100
A_5	14
A_6	1.4
A_7	1,333
A_8	1,176

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Parking Deck on Rooftop of Rectangular Convention Hall	300,000	Loose Coldpack Tar and Gravel
2	Streets	120,000	Asphalt
3	Grass Lawns	40,000	Grass, Shrubs
4	Adjacent Parking Lots	80,000	Asphalt
5	Roof of Convention Arena	130,000	Fibreglass and Asphalt
6	Roofs of Adjacent Buildings	100,000	Tar and Gravel

E. Contributions to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the building which were used to calculate the contribution to intensity values:

a. Parking Deck on Rooftop of Main (Rectangular) Building - 1½" asphalt, 3" loose cold-pack tar (10 lbs/ft^2).

b. Roof Portion of Building (not including surfacing for parking deck) - 12" reinforced concrete (150 lbs/ft^2).

c. Floors of Exhibition Hall - 12" reinforced concrete (150 lbs/ft^2).

d. Interior Walls in Exhibition Hall (not including partition curtains) - 16" cinder block (144 lbs/ft^2).

e. Removable Partitions in Exhibition Hall - steel (85 lbs/ft^2).

f. Exterior Walls of Exhibition Hall - North and East Walls - 15" brick and cinder block reinforced with steel (135 lbs/ft^2), South and West Walls - 12" marble and cinder block (127 lbs/ft^2).

g. Exterior Wall of Convention Arena - 3" granite over cinder block and glass panels; marble pilasters (115 lbs/ft^2).

h. Roof of Convention Arena - ¼ steel pan, thin fibreglass layer, 2" asphalt - (50 lbs/ft^2).

Table XXVI lists the contribution to intensity factors of the various planes to the selected detector locations.

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table XXVII.

Table XXVI

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR COBO CONVENTION HALL

Contaminated Plane i	Detector Location j									
	1 Center Location in Center Hall on Main Level	2 Off-center Location in South Hall on River Level	3 Cafeteria in Upper Level	4 Center Location in Garage on River Level	5 Center Location in Convention Arena	6 Northmost Office in Administrative Office Section of Upper Level	7 Center of Parking Deck on Rooftop	8 Lighting Control Room--Rectangular Hall	9 Power Plant (Electric) on River Level	10 Shelter Area in Storage Area on River Level
1 Parking Deck on Rooftop of Rectangular Convention Hall	.0004	.0000	.0022	.0000	.0000	.0023	.6118	.0004	.0000	.0000
2 Streets	.0041	.0058	.0002	.0000	.0065	.0006	.0001	.0003	.0000	.0000
3 Grass Lawn	.0001	.0135	.0002	.0013	.0147	.0004	.0000	.0000	.0011	.0006
4 Adjacent Parking Lots	.0002	.0000	.0000	.0000	.0000	.0000	.0002	.0002	.0000	.0000
5 Roof of Convention Arena	.0000	.0000	.0000	.0000	.0012	.0000	.0911	.0000	.0000	.0000
6 Roofs of Adjacent Buildings	.0000	.0000	.0010	.0000	.0000	.0000	.0003	.0000	.0000	.0000

Table XXVII

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR COBO CONVENTION HALL

Contaminated Plane i	Detector Location j									
	1 Center Location in Center Hall on Main Level	2 Off-center Location in South Hall on River Level	3 Cafeteria in Upper Level	4 Center Location in Garage on River Level	5 Center Location in Convention Arena	6 Northmost Office in Administrative Office Section of Upper Level	7 Center of Parking Deck on Rooftop	8 Lighting Control Room--Rectangular Hall	9 Power Plant (Electric) on River Level	10 Shelter Area in Storage Area on River Level
1 Parking Deck on Rooftop of Rectangular Convention Hall	.08	.00	.61	.00	.00	.70	.87	.44	.00	.00
2 Streets	.85	.30	.06	.00	.29	.18	.00	.33	.00	.00
3 Grass Lawn	.02	.70	.06	1.00	.66	.12	.00	.00	1.00	1.00
4 Adjacent Parking Lots	.04	.00	.00	.00	.00	.00	.00	.22	.00	.00
5 Roof of Convention Arena	.00	.00	.00	.00	.05	.00	.13	.00	.00	.00
6 Roofs of Adjacent Bldgs.	.00	.00	.28	.00	.00	.00	.00	.00	.00	.00

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table XXVIII.

Table XXVIII

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR CCBO CONVENTION HALL

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Parking Deck on Convention Hall (1)	.02	6.0	5
Flusher	B	Parking Deck on Convention Hall (1)	.02	3.0	1
Vacuumized Sweeper	C	Parking Deck on Convention Hall (1)	.02	12.0	1
Vacuumized Sweeper	D	Parking Deck on Convention Hall (1)	.09	6.0	1
Firehose	E	Streets (2)	.02	2.4	5
Flusher	F	Streets (2)	.02	1.2	1
Steeet Sweeper	G	Streets (2)	.04	4.8	1
Bulldozer	H	Lawns (3)	.10	9.6	1
Firehose	I	Adjacent Parking Lots (4)	.02	1.6	5
Flusher	J	Adjacent Parking Lots (4)	.02	0.8	1
Firehose	K	Roof of Convention Arena (5)	.03	10.4	6
Firehose	L	Roofs of Adjacent Buildings (6)	.01	14.0	7
Firehose	M	Roofs of Adjacent Buildings (6)	.07	6.4	7
Firehose	N	Roofs of Adjacent Buildings (6)	.12	4.3	7

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table XXIX.

I. RN_A Values

The activity reduction factors for selected strategies and the activity patterns are given in Table XXV.

Table XXIX

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR COBO CONVENTION HALL

Combined Strategy	Detector Location j									
	1 Center Location in Center Hall on Main Level	2 Off-center Location in South Hall on River Level	3 Cafeteria in Upper Level	4 Center Location in Garage on River Level	5 Center Location in Convention Arena	6 Northmost Office in Administrative Office Section of Upper Level	7 Center of Parking Deck on Rooftop	8 Lighting Control Room--Rectangular Hall	9 Power Plant (Electric) on River Level	10 Shelter Area in Storage Area on River Level
A	.92	1.00	.40	1.00	1.00	.32	.15	.56	1.00	1.00
E	.16	.71	.95	1.00	.72	.82	1.00	.67	1.00	1.00
H	.98	.37	.95	.10	.41	.89	1.00	1.00	.10	.10
I	.96	1.00	1.00	1.00	1.00	1.00	1.00	.78	1.00	1.00
K	1.00	1.00	1.00	1.00	.95	1.00	.87	1.00	1.00	1.00
L	1.00	1.00	.73	1.00	1.00	1.00	1.00	1.00	1.00	1.00
A+E	.08	.71	.35	1.00	.72	.14	.15	.24	1.00	1.00
B+F+J+M	.04	.71	.09	1.00	.72	.14	.15	.02	1.00	1.00
D+G+M	.10	.71	.15	1.00	.72	.19	.21	.28	1.00	1.00
C+E+H+I+K+L	.02	.08	.02	.10	.07	.03	.02	.02	.10	.10

Table XXX

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR COBO CONVENTION HALL

Combined Strategy	Activity Pattern							
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8
A	.92	1.00	.49	.94	.18	.15	.74	1.00
E	.16	.71	.95	.73	.99	1.00	.80	1.00
I	.98	.37	.83	.44	.97	1.00	.64	.10
H	.96	1.00	1.00	1.00	1.00	1.00	.87	1.00
K	1.00	1.00	1.00	.95	.88	.87	1.00	1.00
L	1.00	1.00	.76	1.00	1.00	1.00	1.00	1.00
A+E	.08	..71	.44	.67	.17	.15	.54	1.00
B+F+J+M	.04	.71	.22	.67	.17	.15	.41	1.00
D+G+N	.10	.71	.27	.68	.23	.21	.51	1.00
C+E+H+I+K+L	.02	.08	.03	.07	.02	.02	.05	.10

J. Conclusions

Inasmuch as most of the area around Cobo Hall is paved, the area could be decontaminated relatively quickly. Only the river level detectors are affected very much by contamination on the grass lawns. These detectors, however, are in relatively high PF locations (PF's equal to 769,23, 909.09, and 1,666.67) before decontamination.

Therefore, it seems as though the best strategy would be to hose down or flush the parking deck on the Exhibition Building, and flush the adjacent parking lots and streets. Such an effort would require between 25 and 40 man-hours of effort and increase the protection at most detectors above the river level by at least a factor of ten.

VII. DECONTAMINATION ANALYSIS OF THE CITY-COUNTY BUILDING

A. Discussion

The City-County Building on Jefferson Avenue is the central location of the governmental agencies of Wayne County and the City of Detroit. Its two towers, 14 stories and 20 stories tall, are faced on three sides with white Vermont marble, aluminum, and glass. Its fourth side is bricked in contemplation of expansion. A legislative amphitheater is on the thirteenth floor and has a large window 25 feet high and 98 feet long.

Figure 118 is a map of the area surrounding the City-County Building, showing the locations of detectors and indicating the sizes, and surface materials of some of the contributing planes of contamination to the activity area. The map also indicates the portion of the building that is 14 stories and the portion that is 20 stories. Figures 119 through 137 are a number of photographs taken in and around the building, showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 138 is a map showing the locations and directions of the photographs.

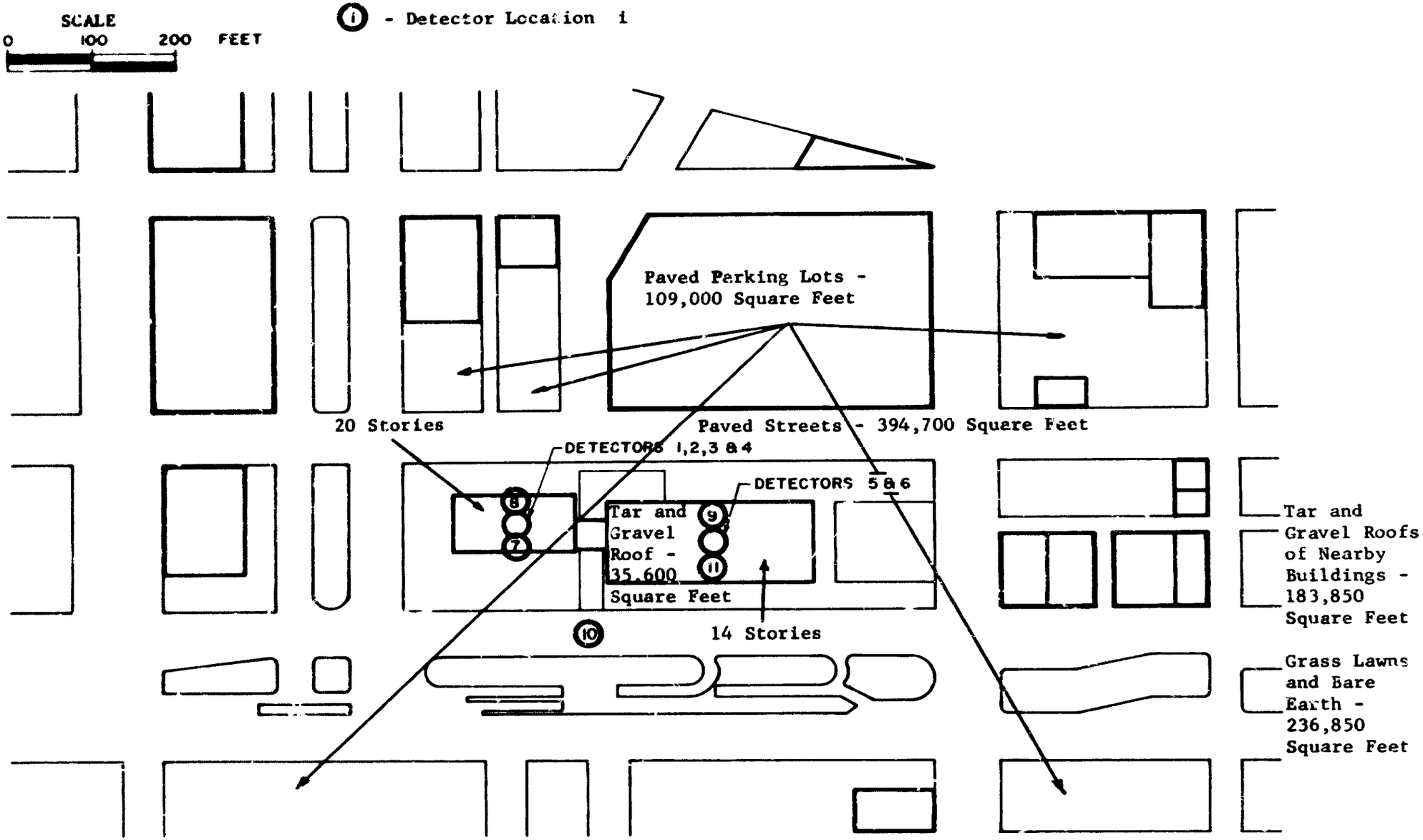


Figure 118

A Map of the Area Around the City-County Building Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 119

View 1 - The City-County Building
A View of the South Side of the Building Showing
the General Landscape in the Area

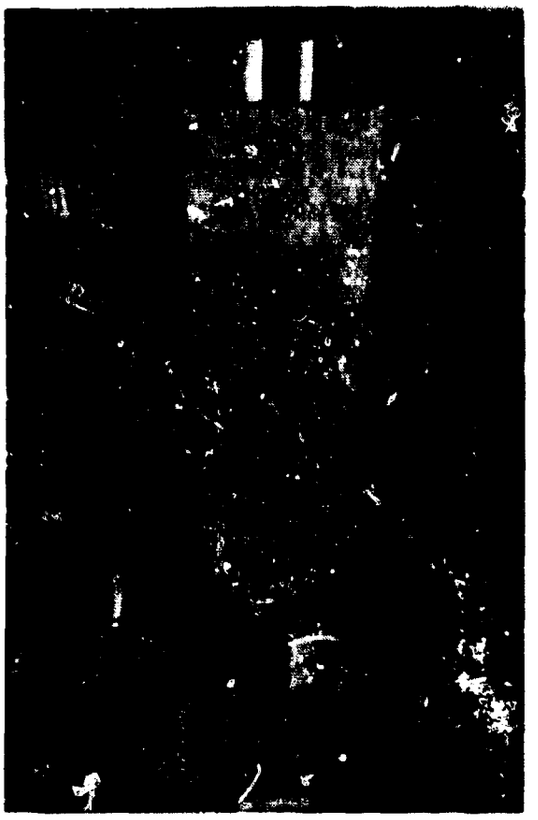


Figure 120

View 2 - The City-County Building -
A View of the Marble (West) Wall of
the City-County Building

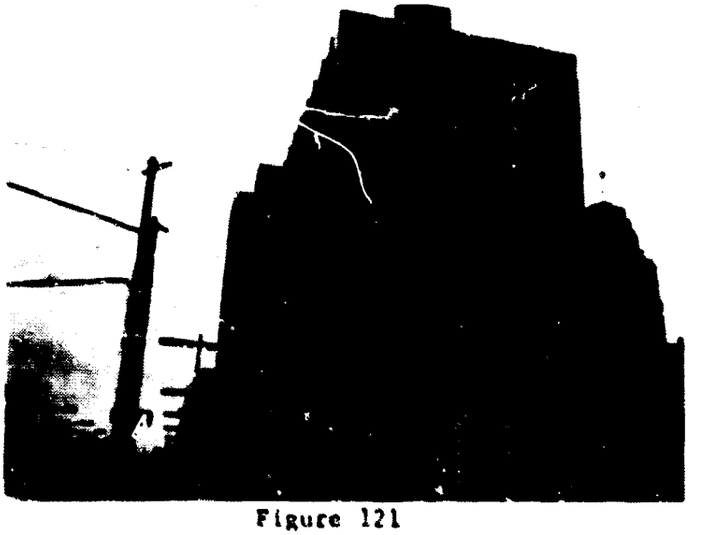


Figure 121

View 3 - The City-County Building -
A View of the Brick (East) Wall of the
City-County Building

Figure 122

View 4 - The City-County Building -
A View of the Surrounding Area Looking
Northeast from the 20 Story Tower

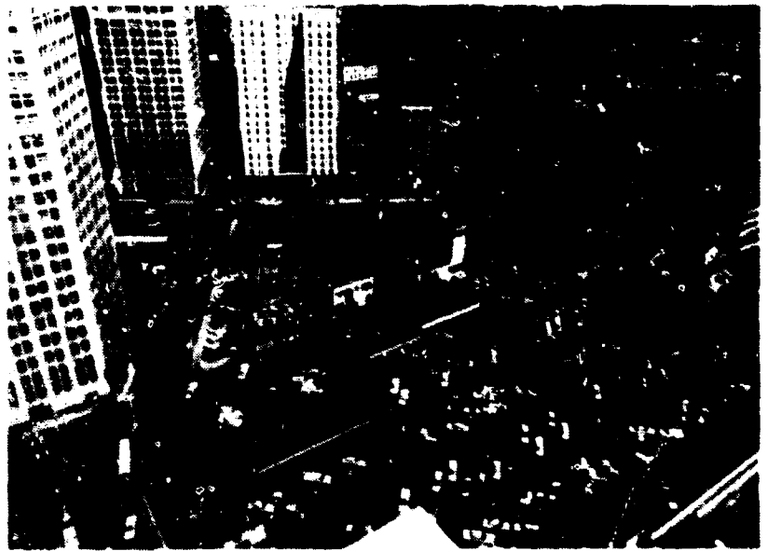


Figure 123

View 5 - The City-County Building -
A View of the Large Parking Lots
Northeast of the Building

Figure 124

View 6 - The City-County Building -
A View Looking East From the Building
Showing the Surrounding Area

Figure 125

View 7 - The City-County Building -
A View Looking South (Toward the Detroit
River) From the Building

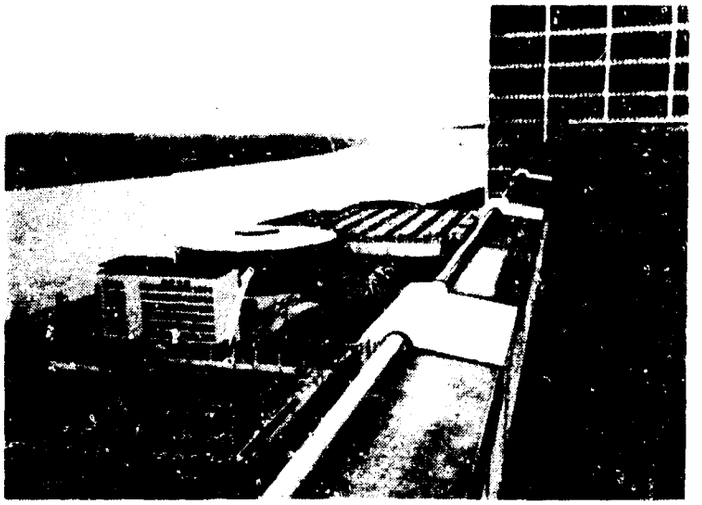


Figure 126

View 8 - The City-County Building -
A View Looking Southwest from the
Building Showing Some of the Surrounding
Area

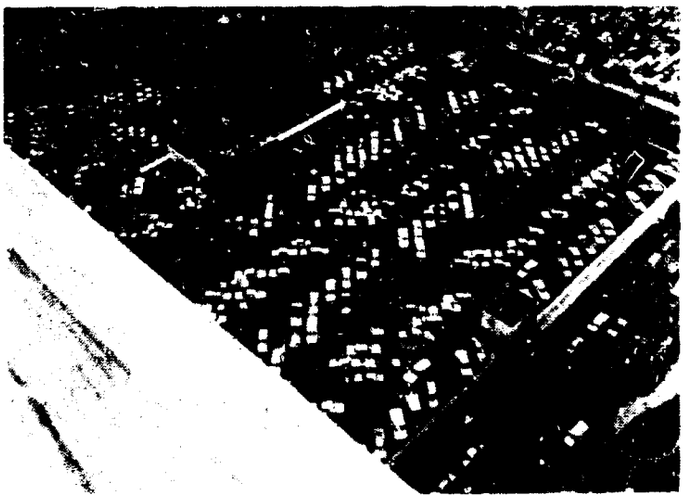


Figure 127

View 9 - The City-County Building -
A View Looking Northwest from the Building
Showing Some of the Surrounding Area

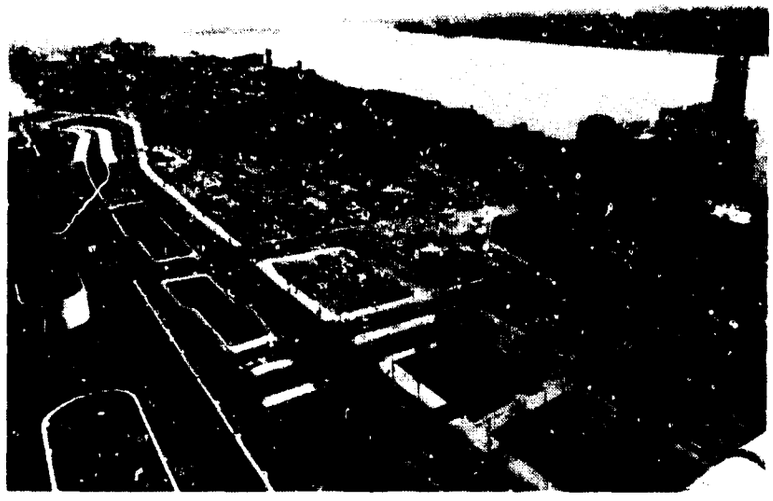


Figure 128

View 10 - The City-County Building -
A View Looking Southeast Showing the Large
Flat Area Towards the Detroit River

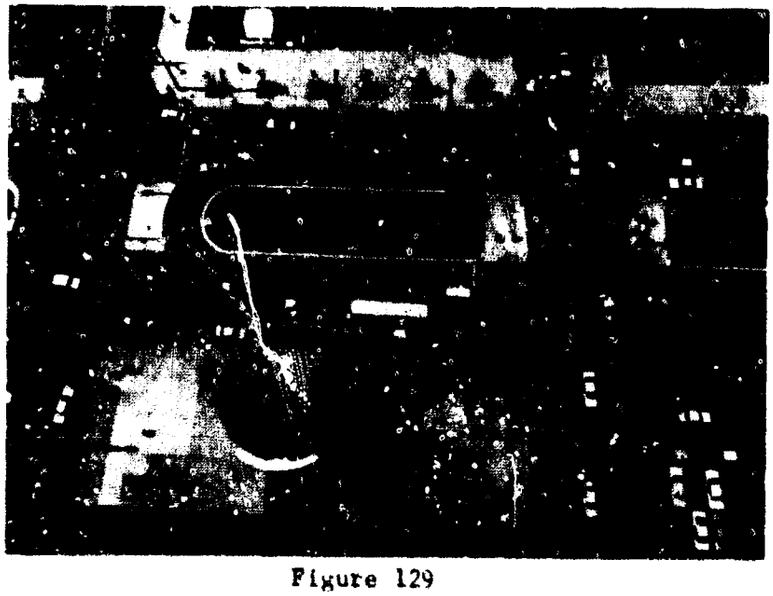


Figure 129

View 11 - The City-County Building -
A View Straight Down on the West Side of
the Building Showing a Large Paved Area

Figure 130

View 12 - The City-County Building -
An Interior View of the Corridor on the
Fifth Floor of the 20 Story Tower

Figure 131

View 13 - The City-County Building -
An Interior View of an Office Section in
the Fourteen Story Tower Showing the Con-
struction of Some of the Interior Partitions

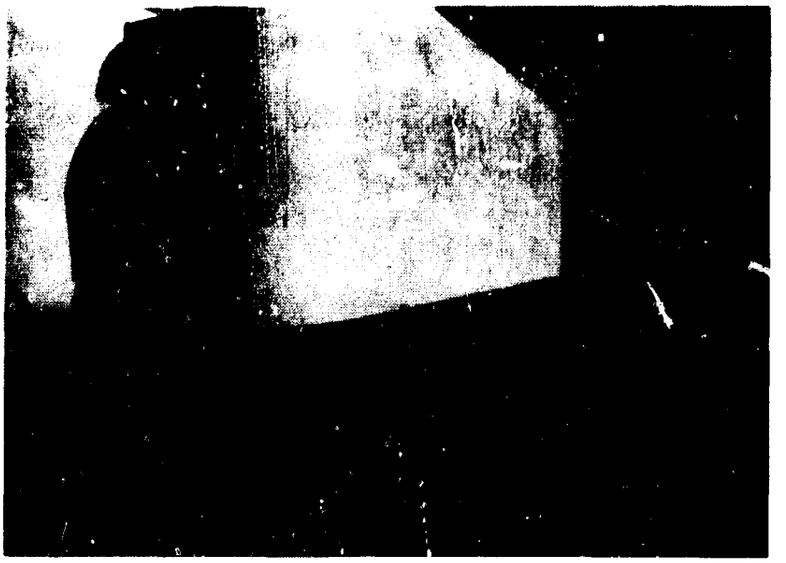


Figure 132

View 14 - The City-County Building -
A View of the Roof of the Fourteen
Story Tower Showing the Height of the
Ventilating Fans

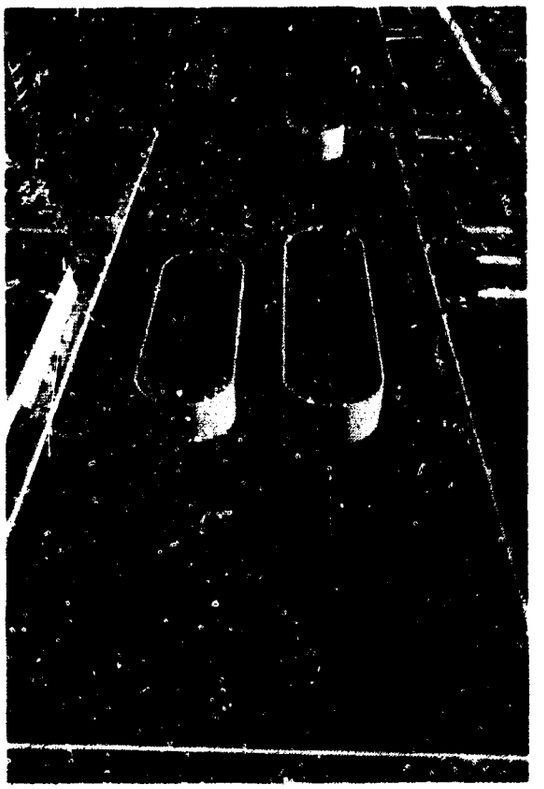


Figure 133

View 15 - The City-County Building -
A View of the Fourteen Story Tower Roof
Taken from the Roof of the Twenty Story
Tower

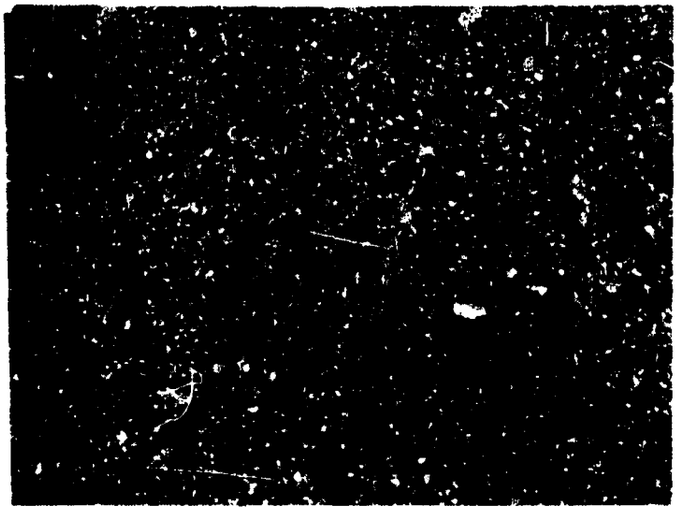


Figure 134

View 16 - The City-County Building -
A Close-up View of the Tar and Gravel
Roof of the Twenty Story Tower

Figure 135

View 17 - The City-County Building -
A Close-up View Which Shows the Depth of
the Gravel on the Roof of the Twenty Story
Tower

Figure 136

View 18 - The City-County Building -
A Close-up View of One of the Drains
on the Twenty Story Tower Roof

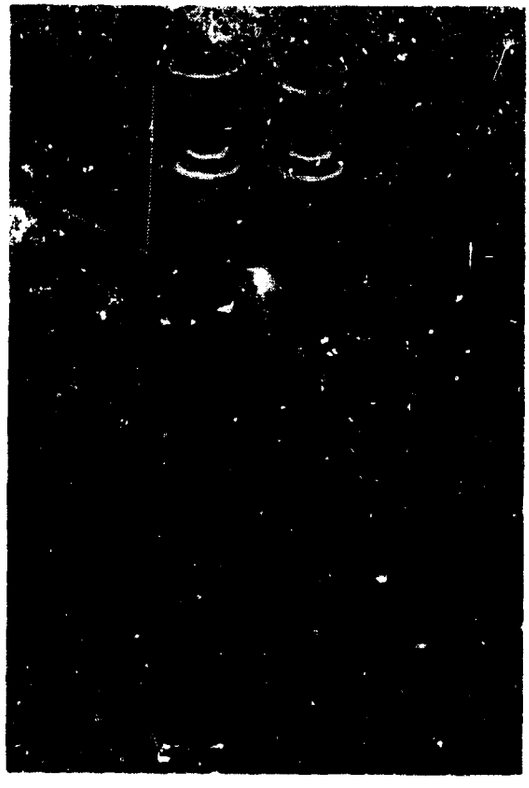


Figure 137

View 19 - The City-County Building -
A Water Outlet on the Twenty Story
Roof

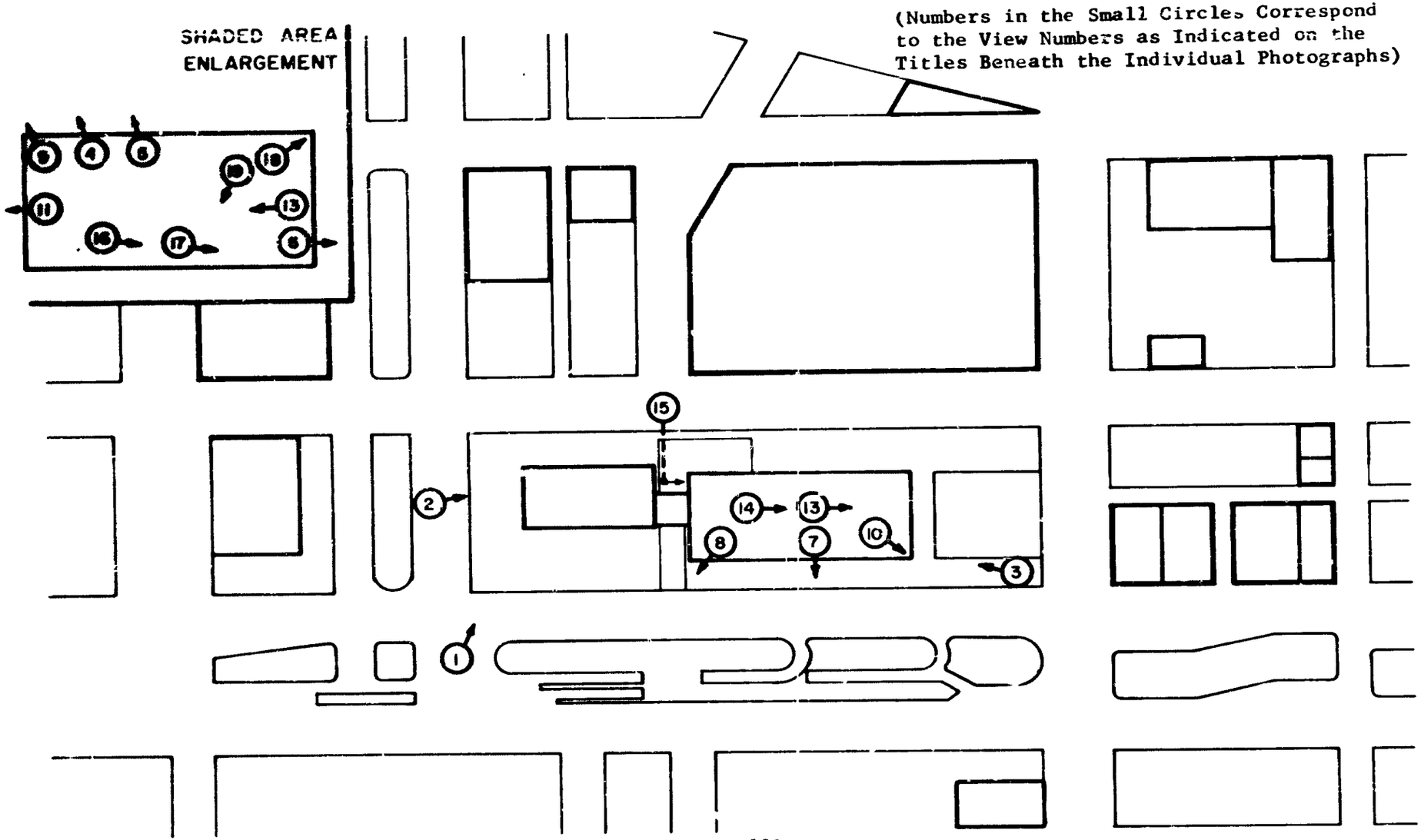


Figure 138

A Map of the Area Around the City-County Building Showing the Locations and Directions of the Photographs Shown in Figures 119 through 137

B. Definition of Activities

Ten different activity patterns are considered in this analysis. Eleven detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Location	Description
1	Center Location in Corridor on First Floor in 20 Story Tower
2	Center Location in Corridor on Fifth Floor in 20 Story Tower
3	Center Location in Corridor on Thirteenth Floor in 20 Story Tower
4	Center Location in Corridor in 20th Story in 20 Story Tower
5	Center Location in Main Lobby on First Floor in 14 Story Tower
6	Center Location in Corridor on 14th Floor in 14 Story Tower
7	Office on Fifth Floor in 20 Story Tower
8	Legislative Amphitheater on Thirteenth Floor in 20 Story Tower
9	Office on Twelfth Floor in 14 Story Tower
10	Center of Jefferson Avenue
11	Basement Shelter Area

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table XXXI defines the ten activity patterns.

Table XXXI

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j IN CITY-COUNTY BUILDING

Activity Pattern A_i	Detector Location j										
	1 Center Location in Corridor on 1st Floor in 20 Story Tower	2 Center Location in Corridor on 5th Floor in 20 Story Tower	3 Center Location in Corridor on 13th Floor in 20 Story Tower	4 Center Location in Corridor on 20th Floor in 20 Story Tower	5 Center Location in Main Lobby on 1st Floor in 14 Story Tower	6 Center Location in Corridor on 14th Floor in 14 Story Tower	7 Office on 5th Floor in 20 Story Tower	8 Legislative Amphitheater on 13th Floor in 20 Story Tower	9 Office on 12th Floor in 1' Story Tower	10 Center of Jefferson Avenue	11 Basement Shelter Area
A_1	.10	.00	.00	.00	.40	.00	.00	.00	.00	.00	.50
A_2	.00	.05	.00	.00	.00	.00	.55	.00	.00	.00	.40
A_3	.00	.00	.50	.00	.00	.00	.00	.00	.00	.00	.50
A_4	.00	.00	.00	.70	.00	.00	.00	.00	.00	.00	.30
A_5	.00	.00	.00	.00	.00	.00	.00	.70	.00	.00	.30
A_6	.00	.00	.00	.00	.00	.50	.00	.00	.00	.00	.50
A_7	.00	.00	.00	.20	.00	.00	.30	.00	.00	.00	.50
A_8	.00	.00	.00	.00	.55	.00	.00	.00	.00	.05	.40
A_9	.00	.00	.00	.00	.00	.00	.00	.60	.00	.40	.00
A_{10}	.20	.20	.20	.00	.00	.00	.00	.00	.00	.00	.40

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 118)

	Detector Location	Original PF
1	Center Location in Corridor on First Floor in 20 Story Tower	11
2	Center Location in Corridor on Fifth Floor in 20 Story Tower	213
3	Center Location in Corridor on 13th Floor in 20 Story Tower	769
4	Center Location in Corridor on 20th Story in 20 Story Tower	11
5	Center Location in Main Lobby on First Floor in 14 Story Tower	111
6	Center Location in Corridor on 14th Floor in 14 Story Tower	11
7	Office on Fifth Floor in 20 Story Tower	172
8	Legislative Amphitheater on 13th Floor in 20 Story Tower	270
9	Office on 12th Floor in 14 Story Tower	101
10	Center of Jefferson Avenue	1.5
11	Basement Shelter Area	263

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table XXXI)	Equivalent PF
A_1	67
A_2	202
A_3	392
A_4	16
A_5	268
A_6	21
A_7	47
A_8	26
A_9	3.8
A_{10}	46

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roof of Building	35,600	Tar and Gravel
2	Roofs around the Building	183,850	Tar and Gravel
3	Parking Lots	109,000	Asphalt
4	Streets	394,700	Asphalt
5	Lawns and Bare Earth	236,850	Grass and Earth

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the City-County Building which were required to calculate the contribution to intensity values:

1. Exterior Walls
   a. 12" marble faced walls - (150 lbs/ft^2).
   b. 12" brick wall - (120 lbs/ft^2).
2. Interior Partitions - ½" asbestos board, wood frame, glass (4 lbs/ft^2).
3. Floors - 6" reinforced concrete (72 lbs/ft^2).
4. Roof - 6" reinforced concrete plus 2" tar and gravel - (80 lbs/ft^2).

Table XXXII lists the contribution to intensity factors of the various planes to the selected detector locations.

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table XXXIII.

Table XXXII

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR CITY-COUNTY BUILDING

Contaminated Plane i	Detector Location j										
	1 Center Location in Corridor on 1st Floor in 20 Story Tower	2 Center Location in Corridor on 5th Floor in 20 Story Tower	3 Center Location in Corridor on 13th Floor in 20 Story Tower	4 Center Location in Corridor on 20th Floor in 20 Story Tower	5 Center Location in Main Lobby on 1st Floor in 14 Story Tower	6 Center Location in Corridor on 14th Floor in 14 Story Tower	7 Office on 5th Floor in 20 Story Tower	8 Legislative Amphitheater on 13th Floor in 20 Story Tower	9 Office on 12th Floor in 14 Story Tower	10 Center of Jefferson Avenue	11 Basement Shelter Area
1 Roof of Building	.0000	.0000	.0009	.0873	.0000	.0914	.0000	.0008	.0071	.0000	.0000
2 Roofs around the Building	.0000	.0000	.0004	.0001	.0000	.0000	.0000	.0007	0001	.0000	.0000
3 Parking Lots	.0000	.0021	.0000	.0000	.0023	.0000	.0000	.0012	.0011	.0804	.0012
4 Streets	.0429	.0024	.0000	.0000	.0034	.0000	.0029	.0008	.0016	.5318	.0020
5 Lawns and Bare Earth	.0521	.0002	.0000	.0000	.0033	.0000	.0029	.0002	.0000	.0401	.0006

Table XXXIII

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR THE CITY-COUNTY BUILDING

Contaminated Plane i	Detector Location j										
	1 Center Location in Corridor on 1st Floor in 20 Story Tower	2 Center Location in Corridor on 5th Floor in 20 Story Tower	3 Center Location in Corridor on 13th Floor in 20 Story Tower	4 Center Location in Corridor on 20th Floor in 20 Story Tower	5 Center Location in Main Lobby on 1st Floor in 14 Story Tower	6 Center Location in Corridor on 14th Floor in 14 Story Tower	7 Office on 5th Floor in 20 Story Tower	8 Legislative Amphitheater on 13th Floor in 20 Story Tower	9 Office on 12th Floor in 14 Story Tower	10 Center of Jefferson Avenue	11 Basement Shelter Area
1 Roof of Building	.00	.00	.69	1.00	.00	1.00	.00	.22	.72	.00	.00
2 Roofs around the Building	.00	.00	.31	.00	.00	.00	.00	.19	.01	.00	.00
3 Parking Lots	.00	.45	.00	.00	.26	.00	.00	.32	.11	.12	.32
4 Streets	.45	.51	.00	.00	.38	.00	.50	.22	.16	.82	.53
5 Lawns and Bare Earth	.55	.04	.00	.00	.37	.00	.50	.05	.00	.06	.16

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table XXXIV.

Table XXXIV

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR CITY-COUNTY BUILDING

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Roof of Building (1)	.01	5.0	7
Firehose	B	Roof of Building (1)	.07	2.3	7
Firehose	C	Roof of Building (1)	.12	1.5	7
Firehose	D	Adjacent Roofs (2)	.01	25.7	7
Firehose	E	Adjacent Roofs (2)	.07	11.8	7
Firehose	F	Adjacent Roofs (2)	.12	7.9	7
Firehose	G	Parking Lots (3)	.02	2.2	5
Street Sweeper	H	Parking Lots (3)	.15	1.1	1
Flusher	I	Parking Lots (3)	.02	1.1	1
Firehose	J	Streets (4)	.02	7.9	5
Street Sweeper	K	Streets (4)	.15	4.0	1
Flusher	L	Streets (4)	.02	4.0	1
Grader	M	Lawns and Earth (5)	.10	56.8	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table XXXV.

I. RN_A Values

The activity reduction factors for selected strategies and the activity patterns are given in Table XXXVI.

Table XXXV

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR THE CITY-COUNTY BUILDING

Combined Strategy	Detector Location j										
	1 Center Location in Corridor on 1st Floor in 20 Story Tower	2 Center Location in Corridor on 5th Floor in 20 Story Tower	3 Center Location in Corridor on 13th Floor in 20 Story Tower	4 Center Location in Corridor on 20th Floor in 20 Story Tower	5 Center Location in Main Lobby on 1st Floor in 14 Story Tower	6 Center Location in Corridor on 14th Floor in 14 Story Tower	7 Office on 5th Floor in 20 Story Tower	8 Legislative Amphitheater on 13th Floor in 20 Story Tower	9 Office on 12th Floor in 14 Story Tower	10 Center of Jefferson Avenue	11 Basement Shelter Area
A	1.00	1.00	.31	.01	1.00	.01	1.00	.79	.29	1.00	1.00
B	1.00	1.00	.36	.07	1.00	.07	1.00	.80	.33	1.00	1.00
D	1.00	1.00	.70	1.00	1.00	1.00	1.00	.81	.99	1.00	1.00
E	1.00	1.00	.71	1.00	1.00	1.00	1.00	.82	.99	1.00	1.00
G	1.00	.56	1.00	1.00	.75	1.00	1.00	.68	.89	.88	.69
I	1.00	.56	1.00	1.00	.75	1.00	1.00	.68	.89	.88	.69
J	.56	.50	1.00	1.00	.63	1.00	.51	.79	.84	.20	.48
L	.56	.50	1.00	1.00	.63	1.00	.51	.79	.84	.20	.48
M	.51	.96	1.00	1.00	.67	1.00	.55	.95	1.00	.94	.86
A+D	1.00	1.00	.01	.01	1.00	.01	1.00	.60	.28	1.00	1.00
C+F	1.00	1.00	.12	.12	1.00	.12	1.00	.64	.36	1.00	1.00
H+M	.51	.58	1.00	1.00	.45	1.00	.55	.68	.91	.84	.59
A+D+G	1.00	.56	.01	.01	.75	.01	1.00	.28	.17	.88	.69
A+D+G+J	.56	.06	.01	.01	.38	.01	.51	.07	.01	.08	.17
A+D+G+J+M	.06	.02	.01	.01	.05	.01	.06	.02	.01	.02	.03

Table XXXVI

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR THE CITY-COUNTY BUILDING

Combined Strategy	Activity Pattern									
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}
A	1.00	1.00	.83	.03	.85	.05	.18	1.00	1.00	.99
B	1.00	1.00	.84	.09	.86	.11	.23	1.00	1.00	.99
D	1.00	1.00	.92	1.00	.87	1.00	1.00	1.00	1.00	1.00
E	1.00	1.00	.93	1.00	.88	1.00	1.00	1.00	1.00	1.00
G	.90	.88	.77	.99	.68	.99	.97	.86	.88	.96
I	.90	.88	.77	.99	.68	.99	.97	.86	.88	.96
J	.57	.50	.62	.99	.70	.98	.91	.27	.21	.56
L	.57	.50	.62	.99	.70	.98	.91	.27	.21	.56
M	.59	.66	.89	1.00	.92	.99	.95	.91	.94	.56
A+D	1.00	1.00	.75	.03	.72	.05	.18	1.00	1.00	.99
C+F	1.00	1.00	.78	.14	.75	.16	.27	1.00	1.00	.99
H+M	.50	.56	.69	.99	.65	.98	.93	.78	.84	.52
A+D+G	.90	.88	.52	.02	.41	.04	.15	.86	.87	.95
A+D+G+J	.47	.39	.13	.01	.10	.02	.07	.12	.08	.50
A+D+G+J+M	.06	.05	.03	.01	.02	.01	.02	.03	.02	.06

J. Conclusions

The City-County Building is typical of tall downtown office buildings. The middle floors have very high PF's and the top and bottom floors have moderate to low PF's (as low as 10). Thus, as would be expected, roof decontamination could substantially increase the protection on the uppermost floors and ground decontamination could substantially increase the protection on the lower floors. From a cost-effectiveness standpoint, more shelter space would be added to the building's available shelter space per man-hour of effort by decontaminating the roof. Any of the strategies involving roof decontamination increase the protection of the uppermost floors by factors of from 15 to 100. This is equivalent, in the case of the City-County Building, to attaining PF's ranging from 150 to 1000 on the uppermost floors.

The lower floors receive their radiation intensity from a variety of contaminated planes (streets, lawns, sidewalks, parking lots, etc.) so that fairly extensive decontamination would be required to attain substantial intensity reduction.

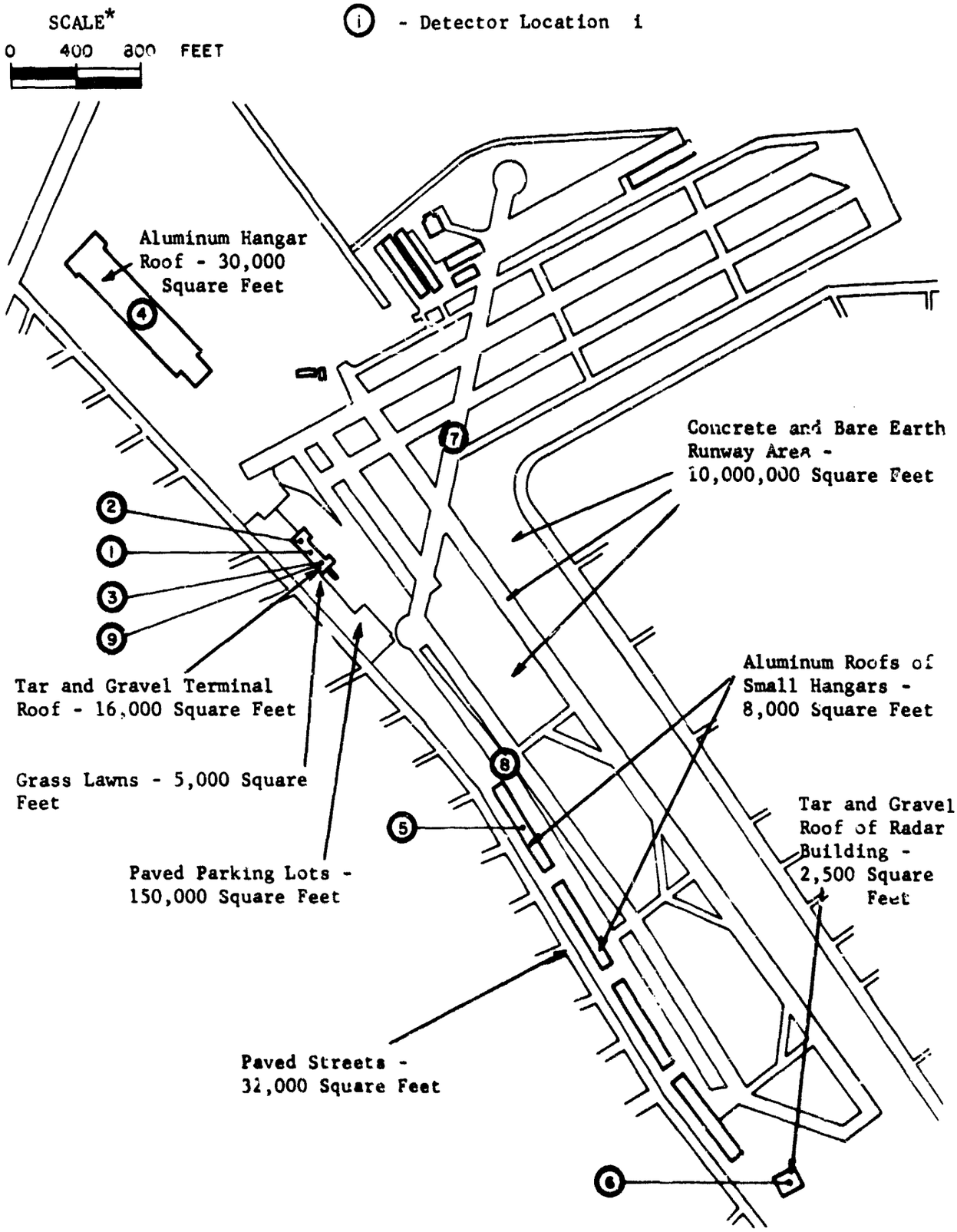
Of course, outside detectors would be affected very much by decontaminating the planes of contamination immediately under the detector. Flushing the streets and parking lots, for instance, would reduce the intensity in the center of Jefferson Avenue by a factor of 25.

VIII. DECONTAMINATION ANALYSIS OF THE DETROIT CITY AIRPORT

A. Discussion

The Detroit City Airport is a local municipal airport in a semi-residential area in Northeast Detroit. It occupies about 250 acres, and has a large hangar, a main terminal building, several small hangars, and a radar building. The airport is the busiest in the State of Michigan, and handles about 200,000 movements each year.

Figure 139 is a map of the area showing the locations of the detectors and indicating the sizes and surface materials of some of the planes of contamination. Figures 140 through 151 are a number of photographs taken in the airport area, showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 152 is a map indicating the locations and directions of the photographs.



*Buildings are enlarged so that they can be distinguished.

Figure 139

A Map of the Area Around the Detroit City Airport Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

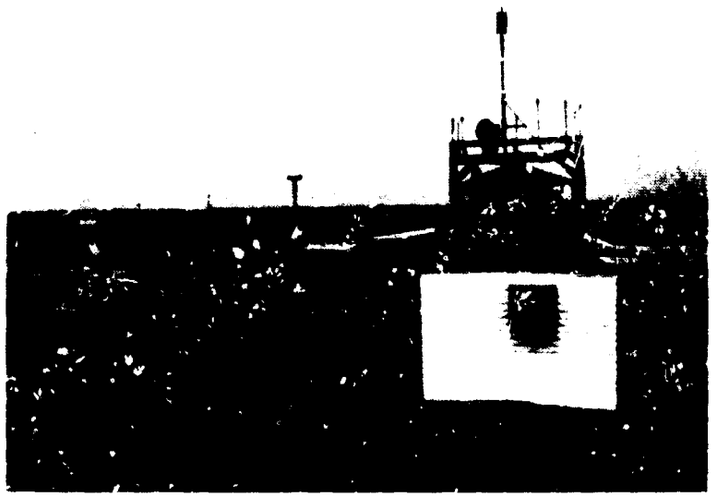


Figure 140

View 1 - Detroit City Airport -
A View of the Control Tower on the
Terminal Building

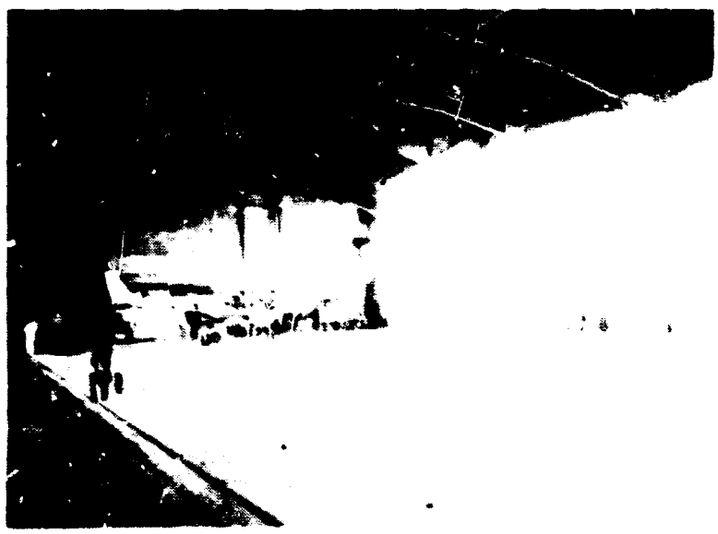


Figure 141

View 2 - Detroit City Airport -
An Interior View of the Large Hangar

Figure 142

View 3 - Detroit City Airport -
A View of the Corridor to the Airfield
from the Main Lobby in the Terminal
Building

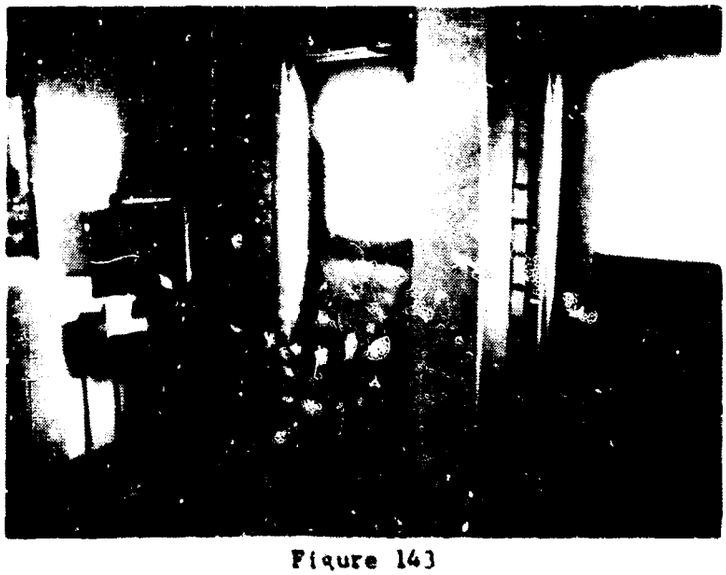


Figure 143

View 4 - Detroit City Airport -
A View of the Interior of the Storage Room
on the Second Floor of the Terminal Building
Showing a Firehose Connection

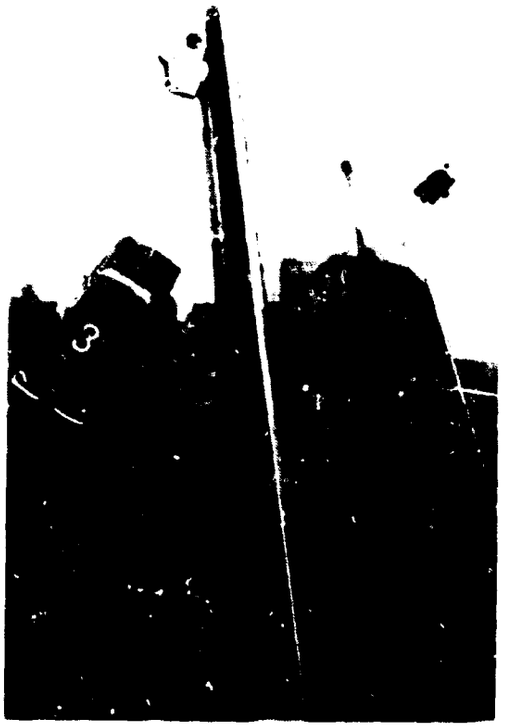


Figure 144

View 5 - Detroit City Airport -
A View of the Roof of the Waiting Deck
Attached to the Terminal Building

Figure 145

View 6 - Detroit City Airport -
A View of the Roof of the Terminal and
Some of the Surrounding Area North of the
Airport

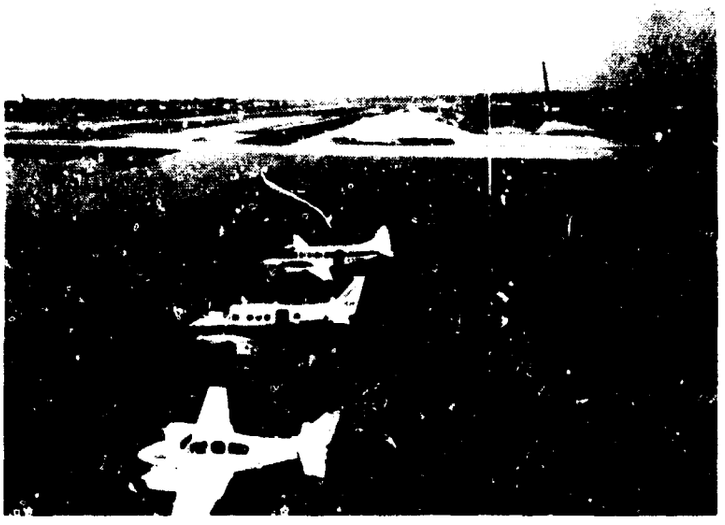


Figure 146

View 7 - Detroit City Airport -
A Northwest View of the Runway Area

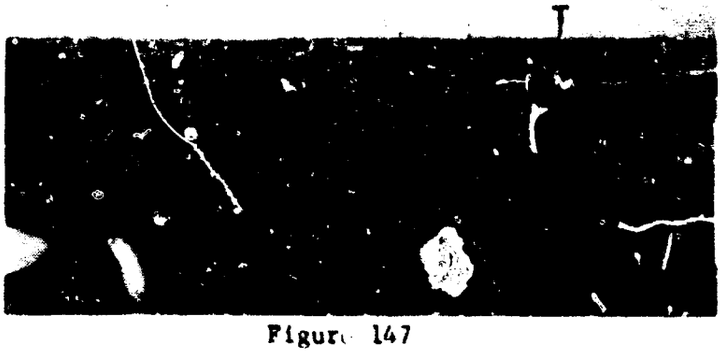


Figure 147

View 8 - Detroit City Airport -
A View of the Roof of the Terminal
Building Showing Some of the Sur-
rounding Area South of the Airport

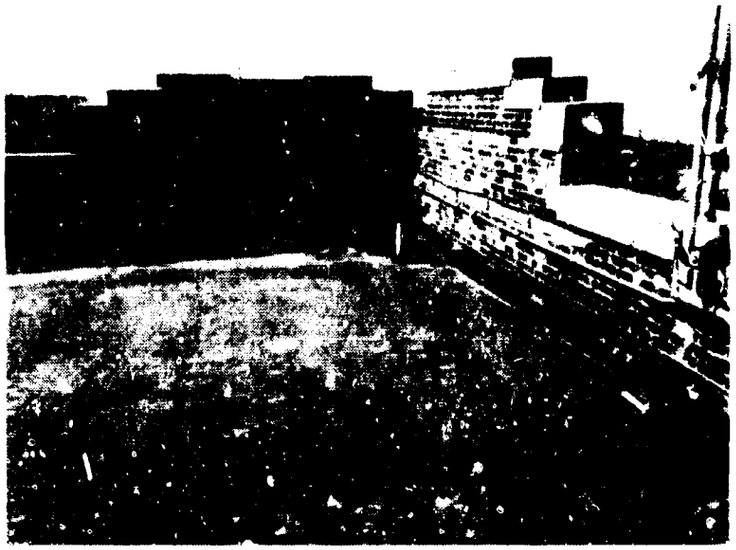


Figure 148

View 9 - Detroit City Airport -
A View of a Corner of the Roof of the Terminal Building Showing the Large Bricked Wall on the Edge and a Corner Drain

Figure 149

View 10 - Detroit City Airport -
A View of the Roof of the Terminal Building

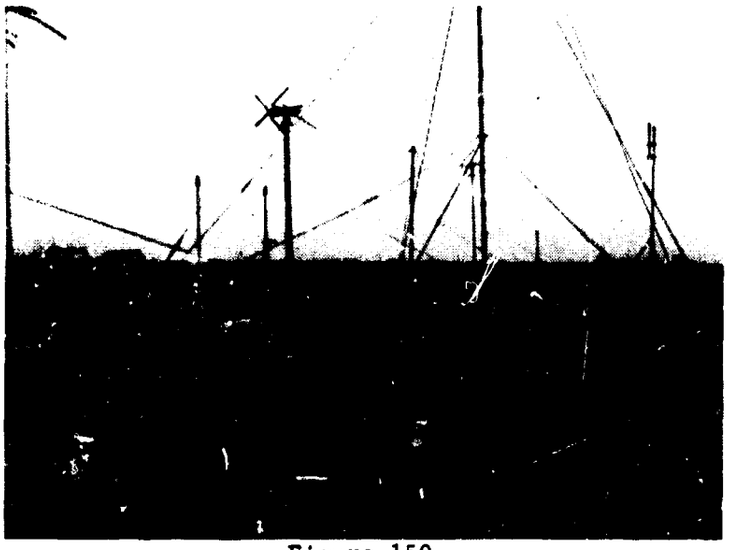


Figure 150

View 11 - Detroit City Airport -
A View of the Roof of the Terminal Building Showing Several Antennae and Other Obstructions to Decontamination

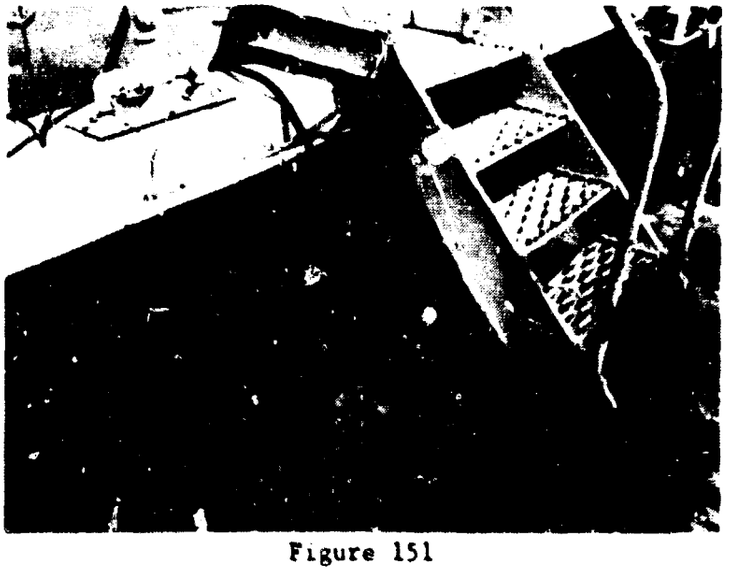


Figure 151

View 12 - Detroit City Airport -
A Close-up View of One of the Drains on the Roof of the Terminal Building

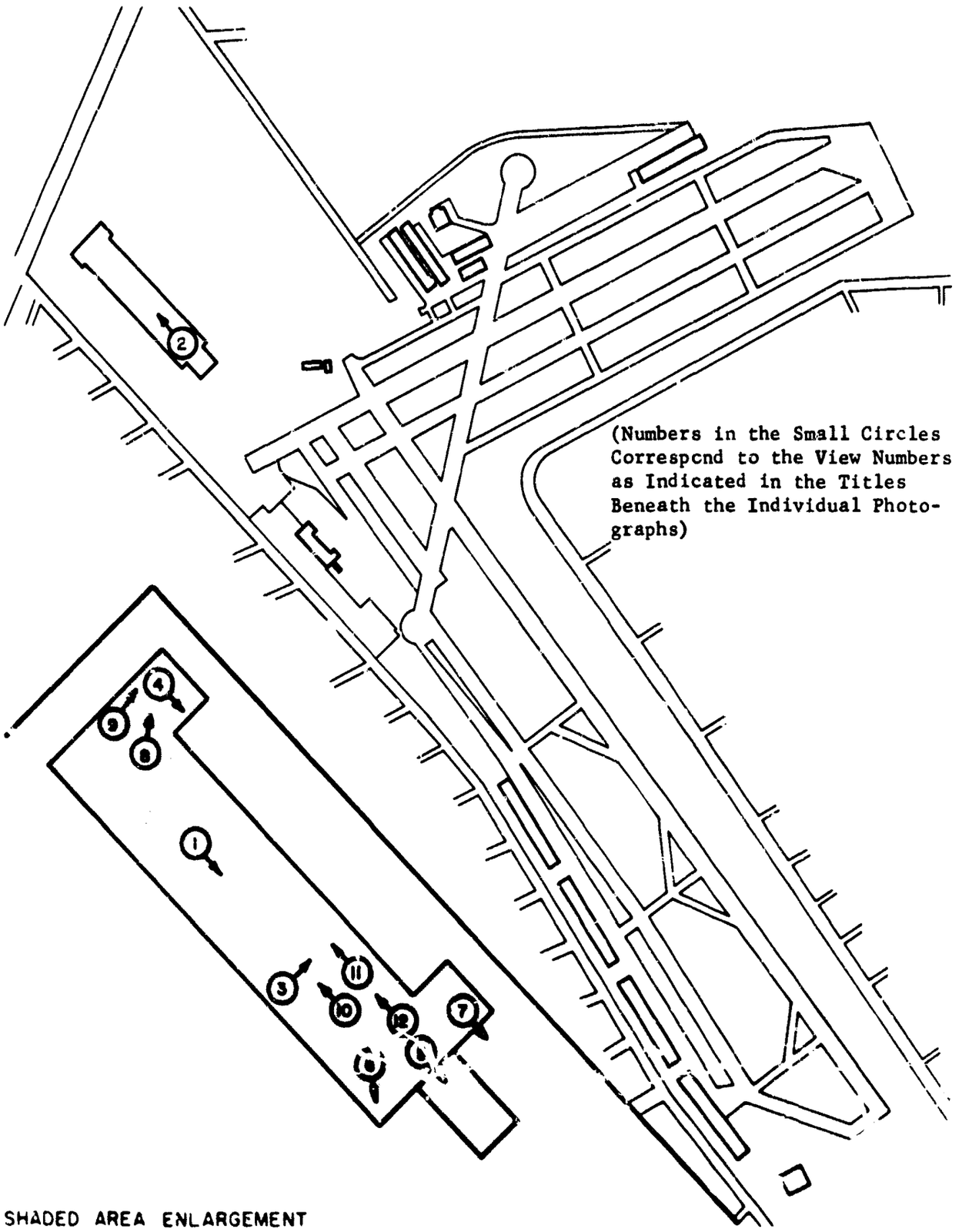


Figure 152

A Map of the Area Around the Detroit City Airport Showing the Locations and Directions of the Photographs Shown in Figures 140 through 151

B. Definition of Activities

Nine different activity patterns are considered in this analysis. Nine detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Locations	Description
1	Lobby of Main Terminal Building
2	Office in Main Terminal Building
3	Control Tower on Main Terminal Building
4	Center Location in Large Hangar Building
5	Center Location in one of the Small Hangars
6	In Radar Building
7	In a Plane on the Runway
8	Unprotected on the Runway
9	Basement Shelter in Partial Basement beneath Terminal Building

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table XXXVII defines the nine activity patterns.

Table XXXVII

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j AT THE DETROIT CITY AIRPORT

Activity Pattern A_i	Detector Location j								
	1 Lobby of Main Terminal Building	2 Office in Main Terminal Building	3 Control Tower on Main Terminal Building	4 Center Location in Large Hangar Building	5 Center Location in One of the Small Hangars	6 In Radar Building	7 In a Plane on the Runway	8 Unprotected on the Runway	9 Basement Shelter in Partial Basement beneath Terminal Building
A_1	.50	.00	.00	.00	.00	.00	.00	.00	.50
A_2	.00	.50	.00	.00	.00	.00	.00	.00	.50
A_3	.10	.00	.60	.00	.00	.00	.00	.00	.30
A_4	.00	.00	.00	.60	.00	.00	.00	.00	.40
A_5	.00	.00	.00	.00	.50	.00	.00	.00	.50
A_6	.00	.10	.00	.00	.10	.00	.05	.05	.70
A_7	.00	.00	.00	.00	.00	.50	.00	.00	.50
A_8	.00	.00	.00	.00	.00	.00	.00	.50	.50
A_9	.00	.00	.00	.00	.00	.65	.00	.05	.30

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 139)

	Detector Location	Original PF
1	Lobby of Main Terminal Building	10
2	Office in Main Terminal Building	9.1
3	Control Tower on Main Terminal Building	1.4
4	Center Location in Large Hangar Building	14
5	Center Location in one of the Small Hangars	3.1
6	In Radar Building	4.8
7	In a Plane on the Runway	1.6
8	Unprotected on the Runway	1.2
9	Basement Shelter in Partial Basement beneath Terminal Building	27.9

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table XXXVII)	Equivalent PF
A_1	15
A_2	14
A_3	2.2
A_4	18
A_5	5.6
A_6	7.1
A_7	8.2
A_8	2.4
A_9	5.4

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Runway Area	10,000,000	Concrete and Bare Earth
2	Terminal Roof	16,000	Tar and Gravel
3	Main Hangar Roof	30,000	Aluminum and Glass
4	Streets	32,000	Asphalt
5	Lawns and Gardens	5,000	Grass, Shrubs, etc.
6	Parking Lots	150,000	Concrete
7	Small Hangar Roofs	8,000	Aluminum
8	Roof of Radar Building	2,500	Tar and Gravel

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the buildings that were required to calculate the contribution to intensity values:

a. Roof of Terminal Building - 8" pre-cast concrete, 1½" built-up felt and celatex, 1" tar and gravel, supported by steel trusses (150 lbs/ft^2) (15% apertures).

b. Floors in Terminal Building - 6" slab concrete with wood floor (65 lbs/ft^2).

c. Exterior Walls of Terminal Building - 14" brick and hollow tile supported by 12" steel H-beams (90 lbs/ft^2).

d. Roof and Walls of all Hangars - aluminum (20 lbs/ft^2).

e. Walls of Control Tower - 6" wood and plaster (60% apertures) (20 lbs/ft^2).

f. Roof of Radar Building - 3" pre-cast concrete with 1" tar and gravel (35 lbs/ft^2).

g. Exterior Walls of Radar Building - 6" brick and plaster (62 lbs/ft^2) (50% apertures on two sides, 20% apertures on other two sides).

Table XXXVIII lists the contribution to intensity factors of the various planes to the selected detector locations.

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table XXXIX.

Table XXXVIII

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR THE DETROIT CITY AIRPORT

Contaminated Plane i	Detector Location j								
	1 Lobby of Main Terminal Building	2 Office in Main Terminal Building	3 Control Tower on Main Terminal Building	4 Center Location in Large Hangar Building	5 Center Location in one of the Small Hangars	6 In Radar Building	7 In a Plane on the Runway	8 Unprotected on the Runway	9 Basement Shelter in Partial Basement beneath Terminal Building
1 Runway Area	.0191	.0203	.0841	.0112	.1691	.1008	.6312	.8110	.0031
2 Terminal Roof	.0302	.0311	.6213	.0038	.0000	.0000	.0001	.0001	.0210
3 Main Hangar Roof	.0031	.0080	.0038	.0418	.0000	.0000	.0001	.0001	.0081
4 Streets	.0279	.0261	.0004	.0081	.0601	.0031	.0002	.0002	.0028
5 Lawns and Gardens	.0080	.0064	.0000	.0019	.0000	.0000	.0000	.0000	.0004
6 Parking Lots	.0108	.0181	.0004	.0024	.0028	.0031	.0008	.0009	.0005
7 Small Hangar Roof	.0000	.0000	.0000	.0060	.0686	.0000	.0000	.0000	.0000
8 Roof of Radar Building	.0000	.0000	.0000	.0000	.0000	.1014	.0000	.0000	.0000

Table XXXIX

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR THE DETROIT CITY AIRPORT

Contaminated Plane i	Detector Location j								
	1 Lobby of Main Terminal Building	2 Office in Main Terminal Building	3 Control Tower on Main Terminal Building	4 Center Location in Large Hangar Building	5 Center Location in One of the Small Hangars	6 In Radar Building	7 In a Plane on the Runway	8 Unprotected on the Runway	9 Basement Shelter in Partial Basement beneath Terminal Building
1 Runway Area	.19	.18	.12	.16	.53	.48	1.00	1.00	.09
2 Terminal Roof	.30	.28	.88	.05	.00	.00	.00	.00	.58
3 Main Hangar Roof	.03	.07	.01	.60	.00	.00	.00	.00	.23
4 Steeets	.28	.24	.00	.12	.19	.01	.00	.00	.08
5 Lawns and Gardens	.08	.06	.00	.03	.00	.00	.00	.00	.01
6 Parking Lots	.11	.16	.00	.03	.01	.01	.00	.00	.01
7 Small Hangar Roof	.00	.00	.00	.00	.28	.00	.00	.00	.00
8 Roof of Radar Building	.00	.00	.00	.00	.00	.49	.00	.00	.00

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table XL.

Table XL

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR THE DETROIT CITY AIRPORT

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Runway Area (1)	.02	200.0	5
Flusher	B	Runway Area (1)	.02	100.0	1
Vacuumized Sweeper	C	Runway Area (1)	.09	200.0	1
Firehose	D	Terminal Roof (2)	.01	2.2	7
Firehose	E	Terminal Roof (2)	.07	1.0	7
Firehose	F	Terminal Roof (2)	.12	0.7	7
Firehose	G	Main Hangar Roof (3)	.03	2.4	6
Firehose	H	Main Hangar Roof (3)	.08	0.5	6
Firehose	I	Streets (4)	.02	0.6	5
Flusher	J	Streets (4)	.02	0.3	1
Street Sweeper	K	Streets (4)	.15	0.3	1
Bulldozer	L	Lawns and Gardens (5)	.10	1.2	1
Firehose	M	Parking Lots (6)	.02	3.0	5
Flusher	N	Parking Lots (6)	.02	1.5	1
Firehose	O	Small Hangar Roofs (7)	.03	0.6	6
Firehose	P	Roof of Radar Building (8)	.01	0.4	7
Firehose	Q	Roof of Radar Building (8)	.07	0.2	7

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table XLI.

I. RN_A Values

The activity reduction factors for selected strategies and the activity patterns are given in Table XLII.

Table XLI

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR THE DETROIT CITY AIRPORT

Combined Strategy	Detector Location j								
	1 Lobby of Main Terminal Building	2 Office in Main Terminal Building	3 Control Tower on Main Terminal Building	4 Center Location in Large Hangar Building	5 Center Location in one of the Small Hangars	6 In Radar Building	7 In a Plane on the Runway	8 Unprotected on the Runway	9 Basement Shelter in Partial Basement beneath Terminal Building
A	.81	.82	.88	.84	.48	.53	.02	.02	.92
C	.82	.83	.89	.85	.52	.56	.09	.09	.92
D	.70	.72	.13	.95	1.00	1.00	1.00	1.00	.42
E	.72	.74	.19	.95	1.00	1.00	1.00	1.00	.46
F	.73	.75	.23	.95	1.00	1.00	1.00	1.00	.49
G	.97	.93	.99	.41	1.00	1.00	1.00	1.00	.78
J	.72	.77	1.00	.89	.82	.99	1.00	1.00	.92
K	.76	.80	1.00	.90	.84	.99	1.00	1.00	.93
L	.93	.95	1.00	.98	1.00	1.00	1.00	1.00	.99
M	.89	.84	1.00	.97	.99	.99	1.00	1.00	.99
O	1.00	1.00	1.00	1.00	.73	1.00	1.00	1.00	1.00
P	1.00	1.00	1.00	1.00	1.00	.52	1.00	1.00	1.00
A+D	.51	.54	.02	.79	.48	.53	.02	.02	.34
D+G	.78	.85	.88	.26	.48	.53	.02	.02	.70
H+I+N+Q	.59	.54	.99	.30	.81	.52	1.00	1.00	.70
A+D+G+I+L+M+O+P	.02	.02	.01	.03	.02	.02	.02	.02	.02

Table XLII

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR THE DETROIT CITY AIRPORT

Combined Strategy	Activity Patterns								
	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9
A	.84	.84	.88	.86	.53	.35	.58	.06	.44
C	.85	.85	.89	.87	.56	.40	.61	.13	.48
D	.62	.65	.15	.81	.94	.87	.91	.98	.97
E	.65	.67	.20	.82	.95	.88	.92	.98	.97
F	.67	.69	.25	.83	.95	.89	.92	.98	.97
G	.92	.89	.99	.51	.98	.96	.97	.99	.99
J	.78	.81	.99	.90	.83	.93	.98	1.00	.98
K	.81	.93	.99	.91	.85	.94	.98	1.00	.99
L	.94	.96	1.00	.98	1.00	.99	1.00	1.00	1.00
M	.92	.88	1.00	.97	.99	.98	.99	1.00	.99
O	1.00	1.00	1.00	1.00	.76	.94	1.00	1.00	1.00
P	1.00	1.00	1.00	1.00	1.00	1.00	.59	1.00	.65
A+D	.46	.49	.04	.67	.47	.22	.50	.03	.41
B+G	.76	.74	.87	.37	.50	.30	.55	.05	.43
H+I+N+Q	.62	.58	.98	.40	.30	.87	.55	.99	.63
A+D+G+I+L+N+O+P	.02	.02	.01	.03	.02	.02	.02	.02	.02

J. Conclusions

Except for detectors on the runway itself, the fallout material on most of the runway area does not contribute very much to detectors inside the various buildings on the runway. Although the fallout on the runway area contributes 48% of the intensity inside the radar building and 53% inside one of the small hangars, most of this contribution to intensity is from the part of the runway area close to these buildings. Thus, decontaminating the roofs and 25 to 50 feet of ground area from each of the buildings would substantially reduce the intensity at all inside detectors. As Table XLI shows, if all other planes of contamination were decontaminated (other than the runways), then the intensity at most inside detectors in the main terminal and large hangar would be reduced by about a factor of five.

This analysis did not consider methods of decontaminating the runway areas using prop wash or other such novel methods.

IX. DECONTAMINATION ANALYSIS OF THE DETROIT OFFICE OF CIVIL DEFENSE BUILDING

A. Discussion

The headquarters for the Office of Civil Defense for the City of Detroit is located at 900 Merrill Plaisance in a semi-residential area in north Detroit. The building itself is surrounded on three sides by grass lawn and parkgrounds. A parking lot and service garage are behind the building. The building features a relatively high PF basement emergency headquarters which can be used to coordinate all of the city departments during a post-attack period.

Figure 153 is a map of the area showing the locations of detectors and indicating the sizes, and surface materials of some of the contributing planes of contamination. Figures 154 through 159 are a number of photographs taken around the building showing some of the planes of contamination and other features of the area that would influence decontamination. Figure 160 is a map showing the locations and directions of the photographs.

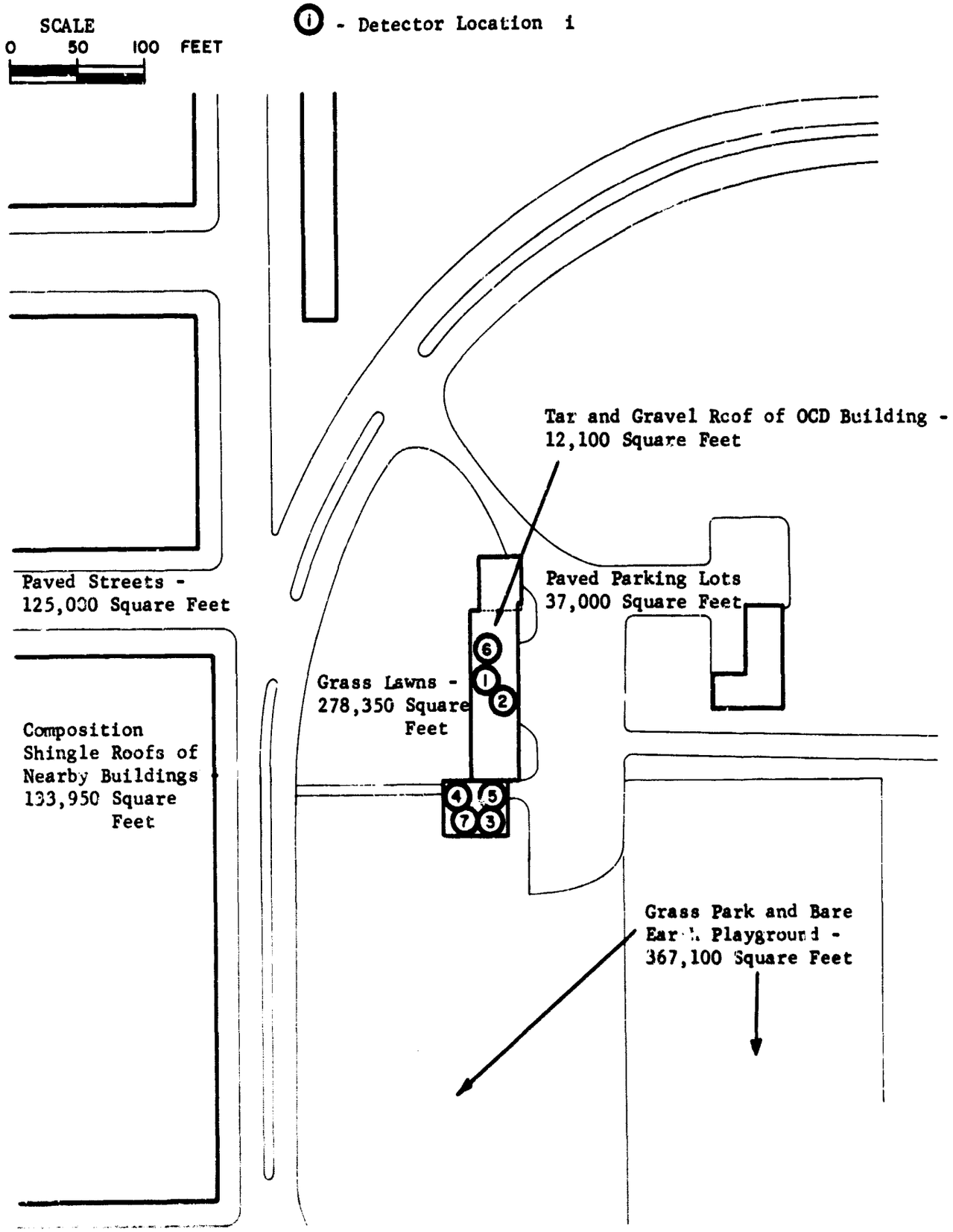


Figure 153

A Map of the Area Around the Detroit OCD Building Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 154

View 1 - Detroit OCD Building -
A View of the Front of the Building Showing the Large Grass Lawn, a Sewage Drain, and the Large Windows in Front of the Building

Figure 155

View 2 - Detroit OCD Building -
A View of the Street and Apartment Buildings in Front of the OCD Building

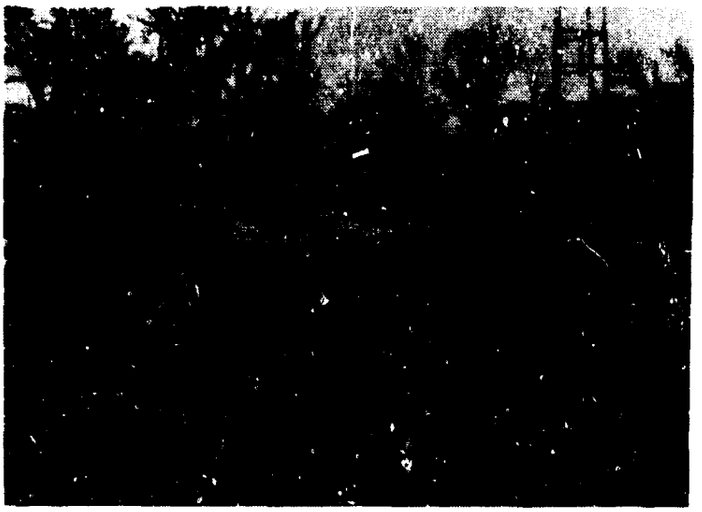


Figure 156

View 3 - Detroit OCD Building -
A View of the Parking Lot in Back of the Building Showing One of the Drains

Figure 157

View 4 - Detroit OCD Building -
A View of the Rear of the Parking Lot

Figure 158

View 5 - Detroit OCD Building -
A View of the Grass Lawn and Trees
to the Side of the Building

Figure 159

View 6 - Detroit OCD Building -
A View of the Rear of the Parking Lot
Showing the Service Garage behind the
Building

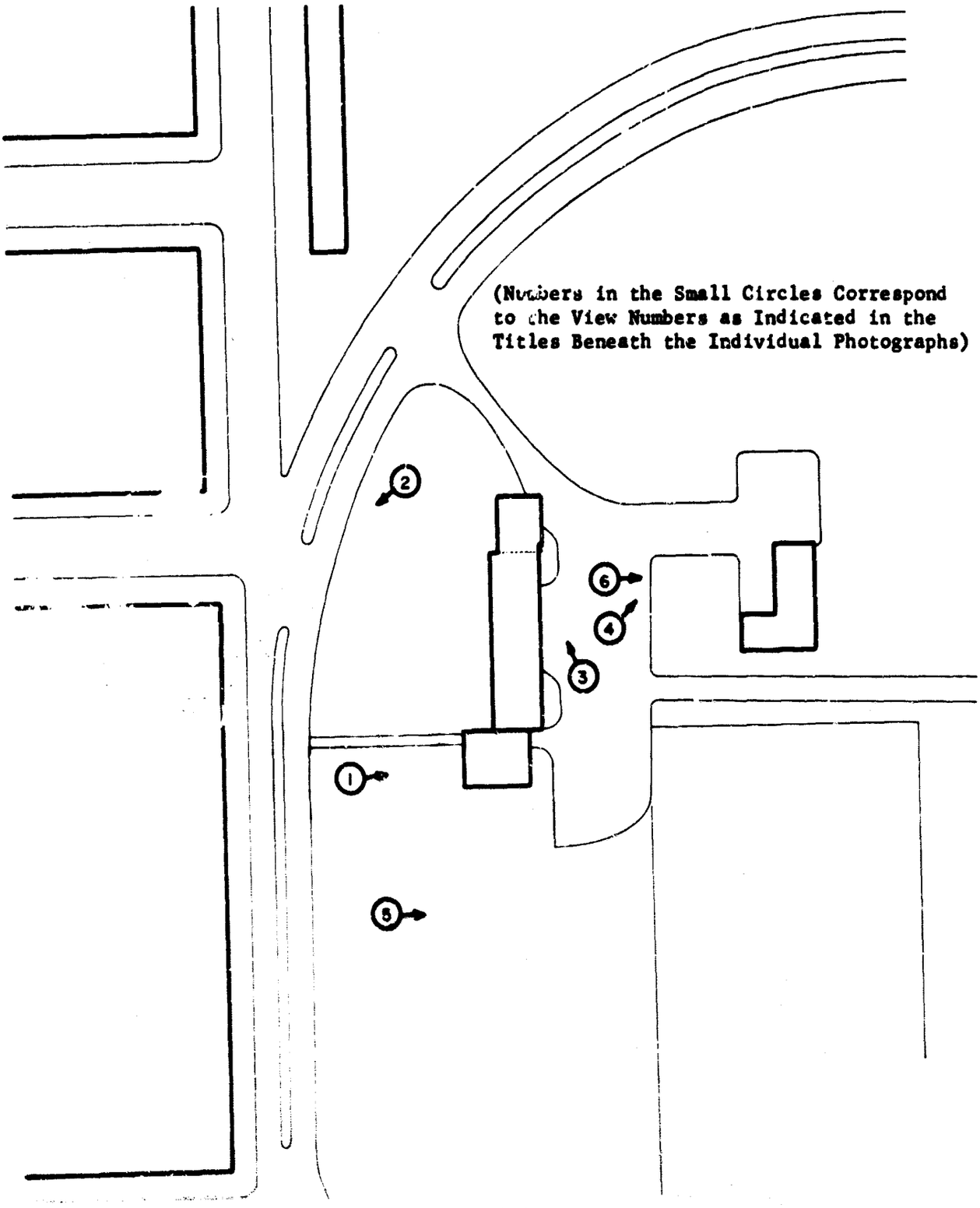


Figure 160

A Map of the Area Around the Detroit OCD Building Showing the Locations and Directions of the Photographs Shown in Figures 154 through 159

B. Definition of Activities

Six different activity patterns are considered in this analysis. Seven detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Location	Description
1	Center Hall 1st Floor
2	Message Center in Basement
3	Supply Room in Basement
4	Director's Office in Basement
5	Medical Room in Basement
6	Men's Rest Room in Basement
7	Emergency Dormitory on Main Floor

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table XLIII defines the six activity patterns.

Table XLIII

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j IN THE DETROIT OFFICE OF CIVIL DEFENSE BUILDING

Activity Pattern A_i	Detector Location j						
	1 Center Hall on 1st Floor	2 Message Center in Basement	3 Supply Room in Basement	4 Director's Office in Basement	5 Medical Room in Basement	6 Men's Rest Room in Basement	7 Emergency Dormitory on Main Floor
A_1	.10	.40	.45	.00	.00	.05	.00
A_2	.00	.70	.30	.00	.00	.00	.00
A_3	.00	.00	.30	.70	.00	.00	.00
A_4	.00	.00	.30	.00	.60	.00	.10
A_5	.40	.00	.60	.00	.00	.00	.00
A_6	.00	.00	.00	.98	.00	.02	.00

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 153)

	Detector Location	Original PF
1	Center Hall on 1st Floor	4.5
2	Message Center in Basement	70
3	Supply Room in Basement	79
4	Director's Office in Basement	78
5	Medical Room in Basement	78
6	Men's Rest Room in Basement	70
7	Emergency Dormitory on Main Floor	4.2

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table XLIII)	Equivalent PF
A_1	29
A_2	73
A_3	78
A_4	28
A_5	10
A_6	77

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roof of Building	12,100	Tar and Gravel
2	Roofs of Nearby Buildings	133,950	Shingles
3	Parking Lots	37,000	Asphalt
4	Streets	125,500	Asphalt
5	Park and Playground	367,100	Grass
6	Lawns, Bare Earth, etc.	278,350	Grass and Earth

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the Office of Civil Defense Building which were required to calculate the contribution to intensity values:

1. Exterior Walls
   a. Basement - 12" brick (108 lb/ft^2).
   b. First Story - 8" brick (72 lb/ft^2).
2. Interior Partitions - 3/4" plywood (2 lb/ft^2).
3. Floor - 6" reinforced concrete and asphalt tile floor (80 lb/ft^2).
4. Roof - built up roofing on metal base (20 lb/ft^2).

Table XLIV lists the contribution to intensity factors of the various planes to the selected detector location.

Table XLIV

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR THE OFFICE OF CIVIL DEFENSE BUILDING

Contaminated Plane i	Detector Location j						
	1 Center Hall on 1st Floor	2 Message Center in Base-ment	3 Supply Room in Basement	4 Director's Office in Basement	5 Medical Room in Base-ment	6 Men's Rest Room in Basement	7 Emergency Dormitory on Main Floor
1 Roof of Building	.1808	.0143	.0126	.0128	.0128	.0143	.1115
2 Roofs of Nearby Buildings	.0000	.0000	.0000	.0000	.0000	.0000	.0004
3 Parking Lots	.0174	.0000	.0000	.0000	.0000	.0000	.0276
4 Streets	.0008	.0000	.0000	.0000	.0000	.0000	.0166
5 Park and Play-ground	.0033	.0000	.0000	.0000	.0000	.0000	.0215
6 Lawns, Bare Earth, etc.	.0182	.0000	.0000	.0001	.0000	.0000	.0608

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table XLV.

Table XLV

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR THE OFFICE OF CIVIL DEFENSE BUILDING

Contaminated Plane i	Detector Location j						
	1 Center Hall on 1st Floor	2 Message Center in Basement	3 Supply Room in Basement	4 Director's Office in Basement	5 Medical Room in Basement	6 Men's Rest Room in Basement	7 Emergency Dormitory on Main Floor
1 Roof of Building	.82	1.00	1.00	.99	1.00	1.00	.47
2 Roofs of Nearby Buildings	.00	.00	.00	.00	.00	.00	.00
3 Parking Lots	.08	.00	.00	.00	.00	.00	.12
4 Streets	.00	.00	.00	.00	.00	.00	.07
5 Park and Playground	.01	..00	.00	.00	.00	.00	.09
6 Lawns, Bare Earth, etc.	.08	.00	.00	.01	.00	.00	.26

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table XLVI.

Table XLVI

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR THE OFFICE OF CIVIL DEFENSE BUILDING

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Roof of Building (1)	.01	1.7	7
Firehose	B	Roof of Building (1)	.07	0.8	7
Firehose	C	Roof of Building (1)	.12	0.5	7
Firehose	D	Roofs of Nearby Buildings (2)	.03	10.7	6
Firehose	E	Roofs of Nearby Buildings (2)	.08	3.4	6
Firehose	F	Parking Lots (3)	.02	0.7	5
Flusher	G	Parking Lots (3)	.02	0.4	1
Street Sweeper	H	Parking Lots (3)	.15	0.4	1
Firehose	I	Streets (4)	.02	2.5	5
Flusher	J	Streets (4)	.02	1.3	1
Flusher	K	Streets (4)	.04	0.4	1
Vacuumized Sweeper	L	Streets (4)	.02	5.0	1
Street Sweeper	M	Streets (4)	.04	5.0	1
Grader	N	Park and Playground (5)	.10	88.1	1
Grader	O	Lawns, Bare Earth, etc. (6)	.10	66.8	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table XLVII.

Table XLVII

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR THE OFFICE OF CIVIL DEFENSE BUILDING

Combined Strategy	Detector Location j						
	1 Center Hall on 1st Floor	2 Message Center in Basement	3 Supply Room in Basement	4 Director's Office in Basement	5 Medical Room in Basement	6 Men's Rest Room in Basement	7 Emergency Dormitory on Main Floor
A	.19	.01	.01	.02	.01	.01	.54
B	.24	.07	.07	.08	.07	.07	.57
C	.28	.12	.12	.13	.12	.12	.59
D	1.00	1.00	1.00	1.00	1.00	1.00	1.00
F	.92	1.00	1.00	1.00	1.00	1.00	.89
H	.93	1.00	1.00	1.00	1.00	1.00	.90
I	1.00	1.00	1.00	1.00	1.00	1.00	.93
N	.99	1.00	1.00	1.00	1.00	1.00	.92
O	.93	1.00	1.00	.99	1.00	1.00	.77
A+E	.19	.01	.01	.02	.01	.01	.54
A+J	.18	.01	.01	.02	.01	.01	.47
B+K	.23	.07	.07	.08	.07	.07	.50
C+L	.27	.12	.12	.13	.12	.12	.52
D+M	1.00	1.00	1.00	1.00	1.00	1.00	.93
A+D+G+I+N+O	.02	.01	.01	.01	.01	.01	.04

I. RN_A Values

The activity reduction factors for selected strategies and the activity patterns are given in Table XLVIII.

TABLE XLVIII

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR THE OFFICE OF CIVIL DEFENSE BUILDING

Combined Strategy	Activity Patterns					
	A_1	A_2	A_3	A_4	A_5	A_6
A	.13	.01	.02	.37	.17	.02
B	.18	.07	.08	.40	.22	.08
C	.22	.12	.12	.44	.27	.13
D	1.00	1.00	1.00	1.00	1.00	1.00
F	.95	1.00	1.00	.92	.93	1.00
H	.96	1.00	1.00	.93	.94	1.00
I	1.00	1.00	1.00	.95	1.00	1.00
N	.99	1.00	1.00	1.00	.99	1.00
O	.95	1.00	1.00	.84	.93	.99
A+E	.13	.01	.02	.36	.17	.02
A+J	.12	.01	.02	.32	.17	.02
B+K	.18	.07	.08	.36	.22	.08
C+L	.22	.12	.12	.39	.26	.13
D+M	1.00	1.00	1.00	.95	1.00	1.00
A+D+G+I+N+O	.02	.01	.01	.03	.02	.01

J. Conclusions

Virtually all of the intensity contribution at basement detectors is from the fallout on the roof of the building. Thus, if first floor activities are not considered essential, roof decontamination would be the only beneficial strategy. From four to ten man-hours of effort firehosing the roof would increase the protection at most basement locations by factors ranging from 20 to 100.

Since the original PF's at most detectors in the basement are about 75, roof decontamination would provide extremely high radiation protection (equivalent to PF's ranging from 1,500 to 7,500) at these detectors.

For first floor detectors, the roof contributes between 50 and 80 percent of the radiation intensity. In the emergency dormitory on the right side of the building, the grass and bare earth contribution is about 35 percent. Thus, effective decontamination with respect to that detector must include grading or bulldozing the lawn outside. This is a costly (in terms of man-hours of effort) operation and would have little effect on most other detector locations.

X. DECONTAMINATION ANALYSIS OF SAINT MARY'S HIGH SCHOOL AND ELEMENTARY SCHOOL

A. Discussion

Saint Mary's High School and Elementary School at 14601 Mansfield Avenue consists of two buildings, a new one (the high school) and the old high school (now an elementary school). Just south of the schools is a large church. To the north of the schools is a large playground. There are two parking lots next to each of the two schools. The neighborhood is mostly residential.

Figure 161 is a map of the area around the schools showing the locations of detectors and indicating the sizes, and surface materials of some of the contributing planes of contamination. Figures 162 through 173 are a number of photographs taken in and around the schools, showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 174 is a map showing the locations and directions of the photographs.

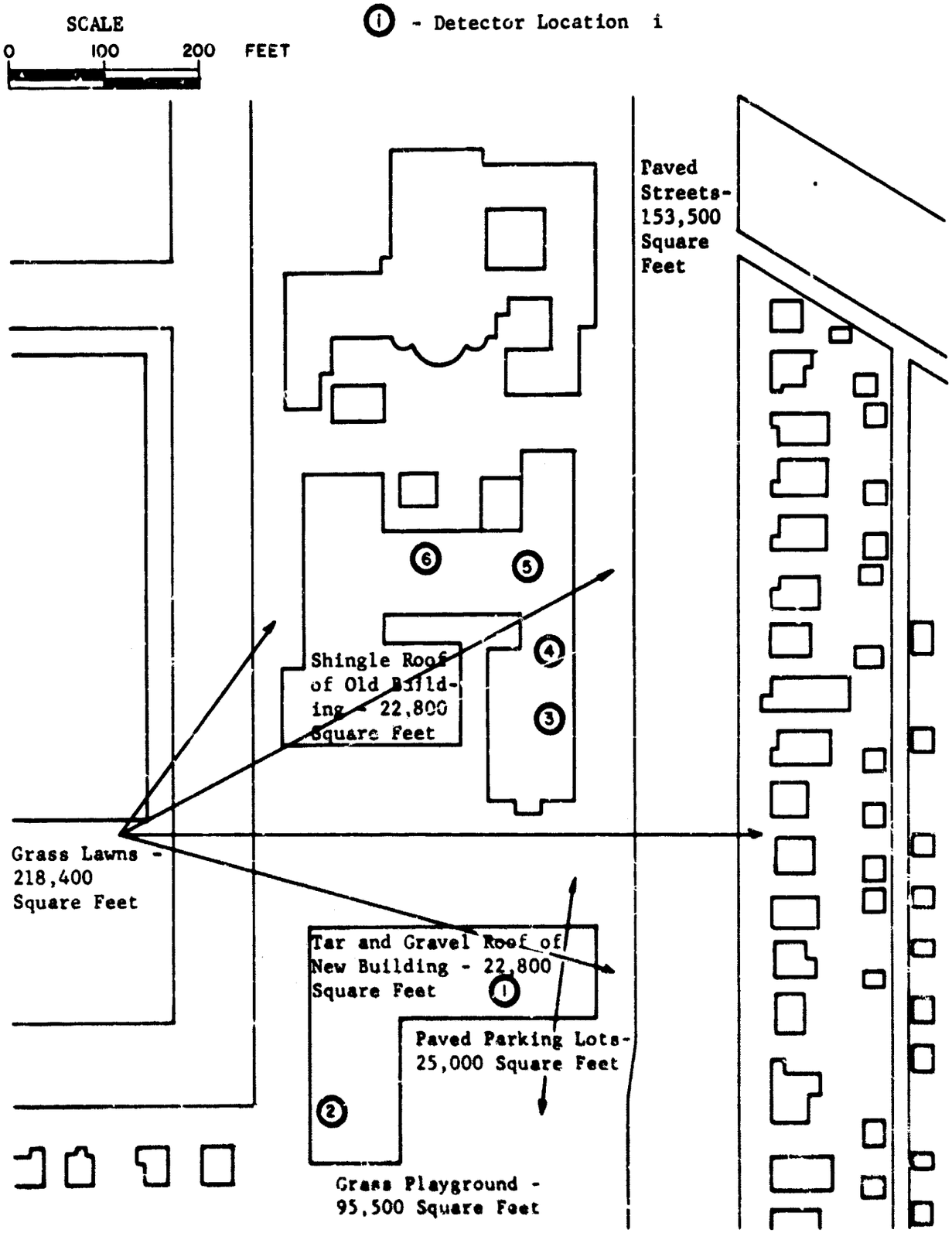


Figure 161

A Map of the Area Around Saint Mary's High School and Elementary School Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 162

View 1 - Saint Mary's School -
A View of the Front of the Old
Building (The Elementary School)

Figure 163

View 2 - Saint Mary's School -
A View of the Church Just South of
the Old Building -

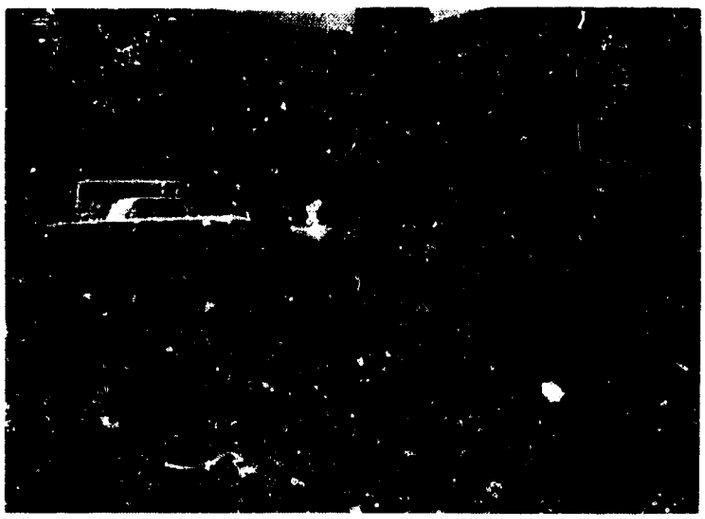


Figure 164

View 3 - Saint Mary's School -
A View of the South Side of the
Old Building Showing a Parking Lot

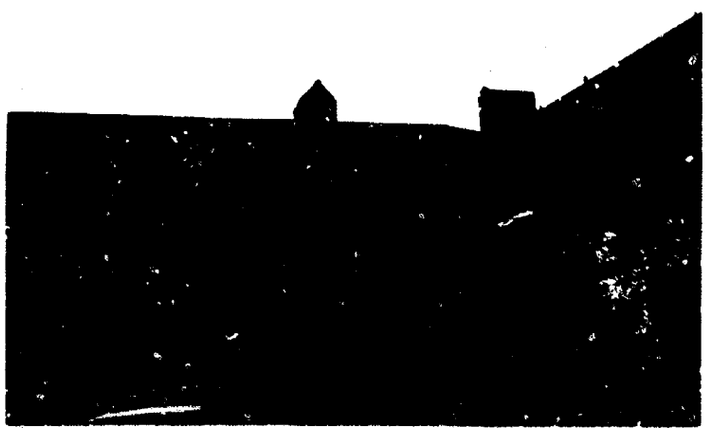


Figure 165

View 4 - Saint Mary's School -
A View of the South Side of the Old
Building Showing the Tile Roof and the
Relative Size of the Windows

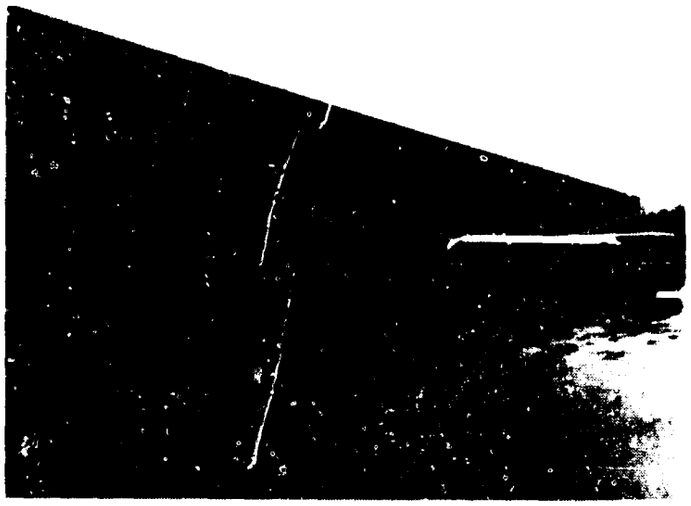


Figure 166

View 5 - Saint Mary's School -
A View of the South Side of the New Building (The High School)

Figure 167

View 6 - Saint Mary's School -
A View of the Northeast Portion of the New Building

Figure 168

View 7 - Saint Mary's School -
A View of the Playground and Field
North of the New Building

Figure 169

View 8 - Saint Mary's School -
An Interior View in the New Building
Showing the Cinder Block Construction
of the Exterior Wall

Figure 170

View 9 - Saint Mary's School -
A View of the First Floor Corridor in
the New Building

Figure 171

View 10 - Saint Mary's School -
A View of a Typical Classroom in
the New Building

Figure 172

View 11 - Saint Mary's School -
A View of the Roof of the New Building
Showing the Ledge and Some Water Puddles
from a Recent Rain

Figure 173

View 12 - Saint Mary's School -
A View of the Tar and Gravel R of of
the New Building Showing a Drain

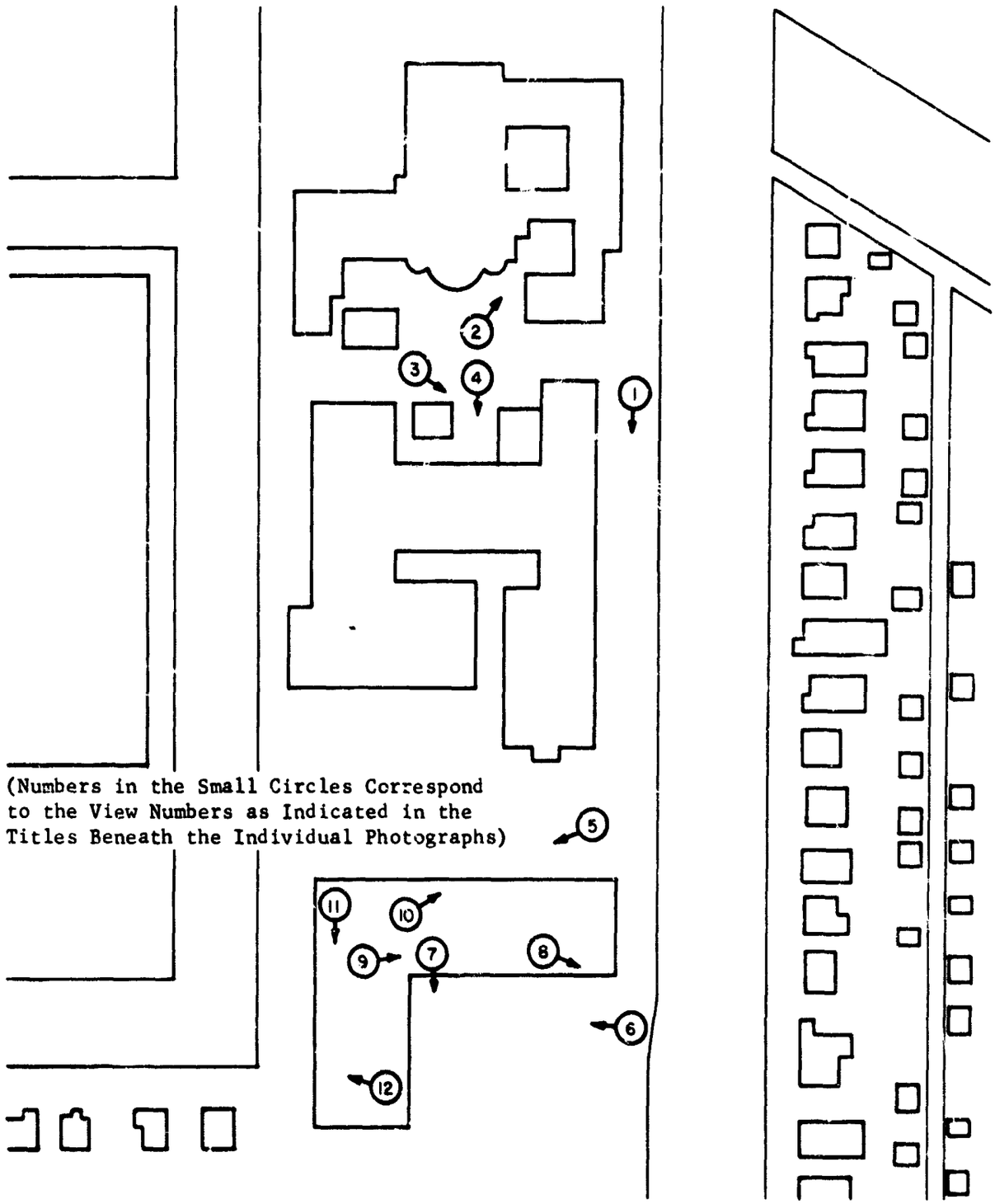


Figure 174

A Map of the Area Around Saint Mary's High School and Elementary School Showing the Locations and Directions of the Photographs Shown in Figures 162 through 173

B. Definition of Activities

Six different activity patterns are considered in this analysis. Six detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Location	Description
1	Schoolroom in New Building on First Floor
2	Schoolroom in New Building on Second Floor
3	Schoolroom in Old Building on First Floor
4	Schoolroom in Old Building on Second Floor
5	First Floor Corridor in New Building
6	Shelter Area in Basement of Old Building

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table XLIX defines the six activity patterns.

Table XLIX

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j IN SAINT MARY'S SCHOOL

Activity Pattern A_i	Detector Location j					
	1 Schoolroom in New Building or First Floor	2 Schoolroom in New Building on Second Floor	3 Schoolroom in Old Building on First Floor	4 Schoolroom in Old Building on Second Floor	5 First Floor Corridor in New Building	6 Shelter Area in Basement of Old Building
A_1	.20	.20	.00	.10	.10	.40
A_2	.00	.60	.00	.00	.00	.40
A3	.00	.00	.50	.00	.00	.50
A_4	.00	.00	.40	.10	.00	.50
A_5	.00	.00	.00	.00	.70	.30
A_6	.00	.00	.00	.50	.00	.50

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 161)

	Detector Location	Original PF
1	Schoolroom in New Building on First Floor	2.9
2	Schoolroom in New Building on Second Floor	3.6
3	Schoolroom in Old Building on First Floor	8.4
4	Schoolroom in Old Building on Second Floor	7.6
5	First Floor Corridor in New Building	6.7
6	Shelter Area in Basement of Old Building	244

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table XLIX)	Equivalent PF
A_1	6.4
A_2	5.9
A_3	16
A_4	16
A_5	9.4
A_6	15

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roof of New Building	22,800	Tar and Gravel
2	Roof of Old Building	38,800	Shingles
3	Parking Lots	25,000	Asphalt
4	Streets	153,500	Asphalt
5	Playground	95,500	Grass
6	Lawns, Bare Earth, etc.	218,400	Grass and Earth

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the school buildings (two distinctly separate structures) which were required to calculate the contribution to intensity values:

1. Exterior Walls of
   a. New Building - 10" cinder block including 4" brick facing (90 lb/ft^2).
2. Exterior Walls of Old Building - 13" brick (118 lb/ft^2).
3. Interior Partitions in New Building - 1" plaster applied on metal lath (10 lb/ft^2).
4. Interior Walls in Old Building - 4" hollow cinder block with openings (20 lb/ft^2).
5. Floors in New Building - 4" reinforced concrete (50 lb/ft^2).
6. Floors in Old Building - 6" reinforced concrete (75 lb/ft^2).
7. Roof of New Building - 4" concrete covered with tar and gravel (60 lb/ft^2).
8. Roof of Old Building - Venetian tile on 1" wood (18 lb/ft^2).

Table L lists the contribution to intensity factors of the various planes to the selected detector locations.

Table L

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR SAINT MARY'S HIGH SCHOOL AND ELEMENTARY SCHOOL

Contaminated Plane i	Detector Location j					
	1 Schoolroom in New Building on First Floor	2 Schoolroom in New Building on Second Floor	3 Schoolroom in Old Building on First Floor	4 Schoolroom in Old Building on Second Floor	5 First Floor Corridor in New Building	6 Shelter Area in Basement of Old Building
1 Roof of New Building	.0311	.0718	.0000	.0000	.0408	.0000
2 Roof of Old Building	.0000	.0000	.0207	.0617	.0000	.0021
3 Parking Lots	.1141	.0902	.0481	.0372	.0411	.0010
4 Streets	.0328	.0200	.0191	.0116	.0188	.0003
5 Playground	.0992	.0691	.0021	.0018	.0349	.0001
6 Lawns, Bare Earth, etc.	.0681	.0308	.0288	.0196	.0148	.0006

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table LI.

Table LI

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR SAINT MARY'S HIGH SCHOOL AND ELEMENTARY SCHOOL

Contaminated Plane i	Detector Location j					
	1 Schoolroom in New Building on First Floor	2 Schoolroom in New Building on Second Floor	3 Schoolroom in Old Building on First Floor	4 Schoolroom in Old Building on Second Floor	5 First Floor Corridor in New Building	6 Shelter Area in Basement of Old Building
1 Roof of New Building	.09	.25	.00	.00	.27	.00
2 Roof of Old Building	.00	.00	.17	.47	.00	.51
3 Parking Lots	.33	.32	.40	.28	.27	.24
4 Streets	.09	.07	.16	.09	.12	.07
5 Playground	.29	.25	.02	.01	.23	.02
6 Lawns, Bare Earth, etc.	.20	.11	.24	.15	.10	.15

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table LII.

Table LII

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR SAINT MARY'S HIGH SCHOOL AND ELEMENTARY SCHOOL

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Roof of New Building (1)	.01	3.2	7
Firehose	B	Roof of New Building (1)	.07	1.5	7
Firehose	C	Roof of New Building (1)	.12	1.0	7
Firehose	D	Roof of Old Building (2)	.03	3.1	6
Firehose	E	Roof of Old Building (2)	.08	1.0	6
Firehose	F	Parking Lots (3)	.02	0.5	5
Flusher	G	Parking Lots (3)	.02	0.3	1
Street Sweeper	H	Parking Lots (3)	.15	0.3	1
Firehose	I	Streets (4)	.02	3.1	5
Flusher	J	Streets (4)	.02	1.5	1
Street Sweeper	K	Streets (4)	.15	1.5	1
Grader	L	Playground (5)	.10	22.9	1
Grader	M	Lawns, Bare Earth, etc. (6)	.10	52.4	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table LIII.

Table LIII

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR SAINT MARY'S HIGH SCHOOL AND ELEMENTARY SCHOOL

Combined Strategy	Detector Location j					
	1 Schoolroom in New Building on First Floor	2 Schoolroom in New Building on Second Floor	3 Schoolroom in Old Building on First Floor	4 Schoolroom in Old Building on Second Floor	5 First Floor Corridor in New Building	6 Shelter Area in Basement of Old Building
A	.91	.75	1.00	1.00	.73	1.00
B	.92	.76	1.00	1.00	.75	1.00
C	.92	.78	1.00	1.00	.76	1.00
D	1.00	1.00	.83	.55	1.00	.50
E	1.00	1.00	.84	.57	1.00	.53
F	.66	.69	.60	.72	.73	.76
G	.72	.73	.66	.76	.77	.79
I	.91	.93	.84	.91	.88	.93
K	.76	.79	.98	.99	.80	.98
L	.74	.73	.98	.99	.79	.98
M	.82	.90	.78	.87	.91	.87
A+G	.59	.43	.60	.72	.46	.76
A+J	.82	.68	.84	.91	.61	.93
B+G	.59	.45	.60	.72	.48	.76
A+D+F	.59	.43	.43	.27	.46	.26
A+D+F+I+L+M	.06	.05	.04	.04	.04	.04

I. RNA Values

The activity reduction factors for selected strategies and the activity patterns are given in Table LIV.

Table LIV

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR SAINT MARY'S HIGH SCHOOL AND ELEMENTARY SCHOOL

Combined Strategy	Activity Patterns					
	A_1	A_2	A3	A_4	A_5	A6
A	.84	.75	1.00	1.00	.73	1.00
B	.85	.77	1.00	1.00	.75	1.00
C	.86	.78	1.00	1.00	.76	1.00
D	.96	1.00	.82	.76	.99	.54
E	.96	1.00	.83	.77	.99	.57
F	.69	.69	.61	.63	.73	.72
H	.73	.73	.66	.68	.77	.76
I	.91	.93	.85	.86	.88	.91
K	.80	.79	.98	.99	.80	.99
L	.78	.78	.98	.98	.79	.99
M	.86	.90	.78	.80	.91	.87
A+G	.53	.44	.61	.63	.47	.72
A+J	.76	.68	.85	.86	.61	.91
B+G	.54	.45	.61	.63	.48	.72
A+D+F	.49	.43	.43	.39	.46	.27
A+D+F+I+L+M	.05	.05	.04	.04	.04	.04

J. Conclusions

In order to appreciably reduce the radiation intensity at any of the detector locations considered in this analysis, a combined strategy involving the decontamination of several contaminated planes is required. This is because large percentages of intensity at each detector are from two or more planes of contamination. If more than 130 man-hours of effort were expended decontaminating all of the contributing planes of contamination (e.g., combined strategy A+D+F+I+L+M), then the intensity could be reduced by a factor of fifteen or higher at all of the detector locations considered.

XI. DECONTAMINATION ANALYSIS OF ISAAC CRARY ELEMENTARY SCHOOL

A. Discussion

Isaac Crary School is an elementary school in a residential section of northwest Detroit. It consists of an "L" shaped section twenty-five years old and a new section to complete the "U" shaped building which is about thirteen years old. The power plant for the building is in a separate small building just north of the main school building. The building itself features a very high PF subbasement which is stocked with food and water.

Figure 175 is a map of the area surrounding the school, showing the location of detectors and indicating the sizes and surface materials of some of the contributing planes of contamination. Figures 176 through 195 are a number of photographs taken in and around the school, showing some of the planes of contamination and other features of the area that would influence decontamination. Figure 196 is a map showing the locations and directions of the photographs.

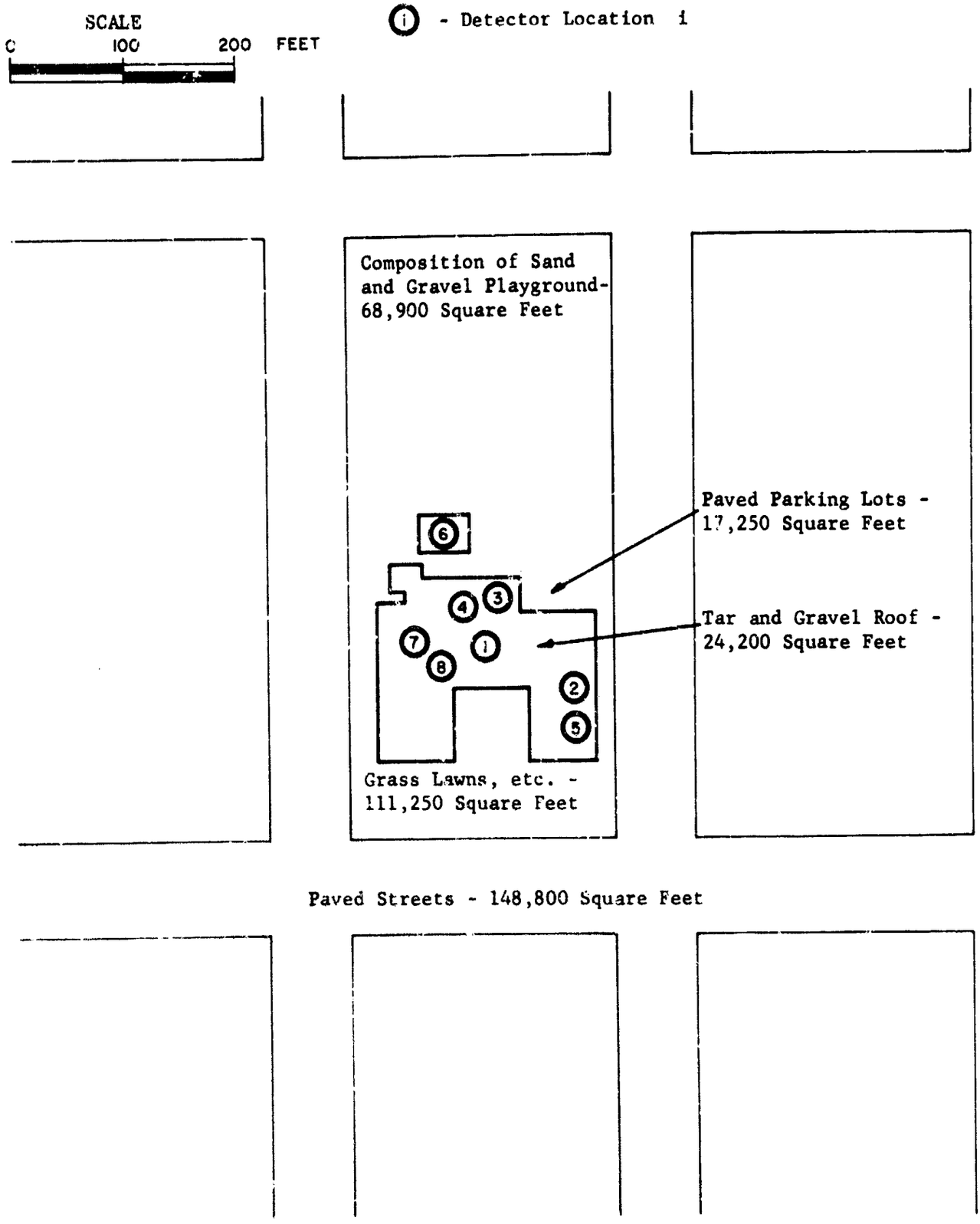


Figure 175

A Map of the Area Around Isaac Crary School Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

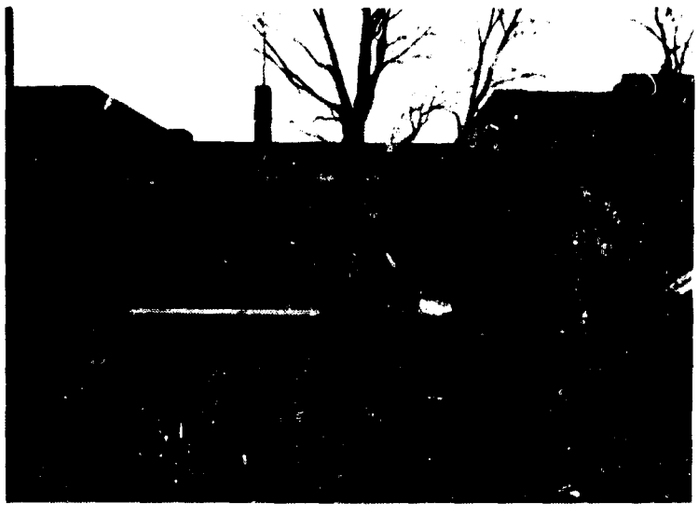


Figure 176

View 1 - Isaac Crary School -
A View of the South Side of the
School Building

Figure 177

View 2 - Isaac Crary School -
A View of the West Side of the
School Building

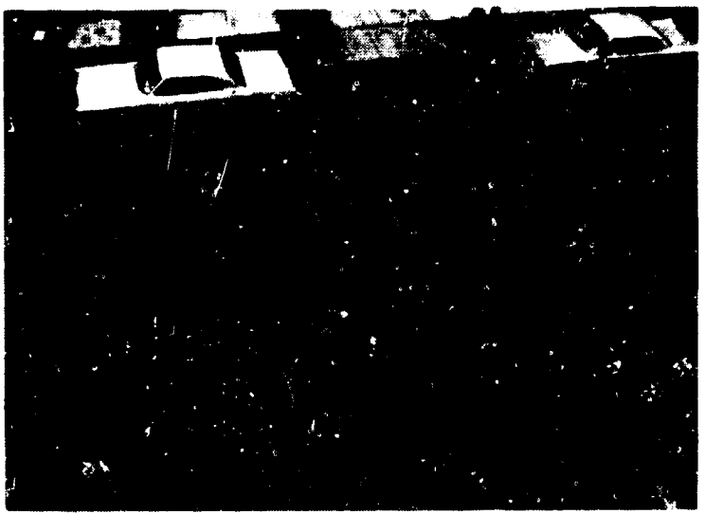


Figure 178

View 3 - Isaac Crary School -
A View of the Sidewalk and Street
on the West Side of the Building

Figure 179

View 4 - Isaac Crary School -
A View of the Trees and Street
Northwest of the Building

Figure 180

View 5 - Isaac Crary School -
A View of the Lawns Across the Street
on the West Side of the Building

Figure 181

View 6 - Isaac Crary School -
A View of a Typical Classroom on the
First Floor of the Building

Figure 182

View 7 - Isaac Crary School -
A View of the Gymnasium

Figure 183

View 8 - Isaac Crary School -
A View of the Auditorium

Figure 184

View 9 - Isaac Crary School -
A View of the Power Plant North of
the Main Building

Figure 185

View 10 - Isaac Crary School -
An Interior View of the Power
Plant

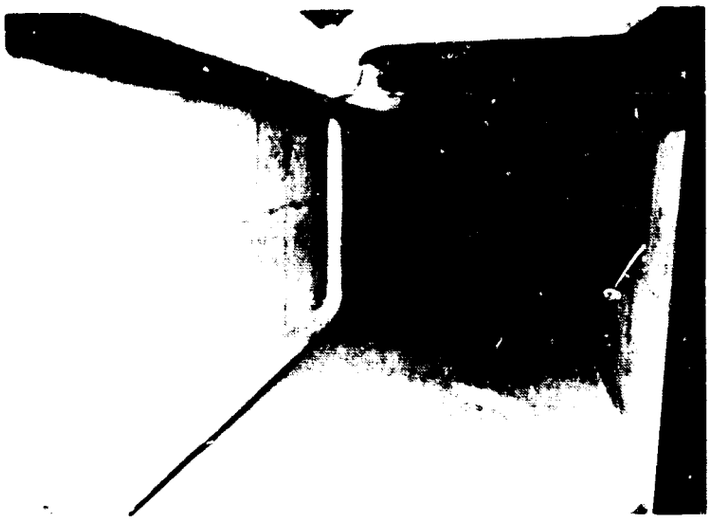


Figure 186

View 11 - Isaac Crary School -
A View of the Shelter Area in the Sub-basement

Figure 187

View 12 - Isaac Crary School -
A View of the Corridor on the Second Floor

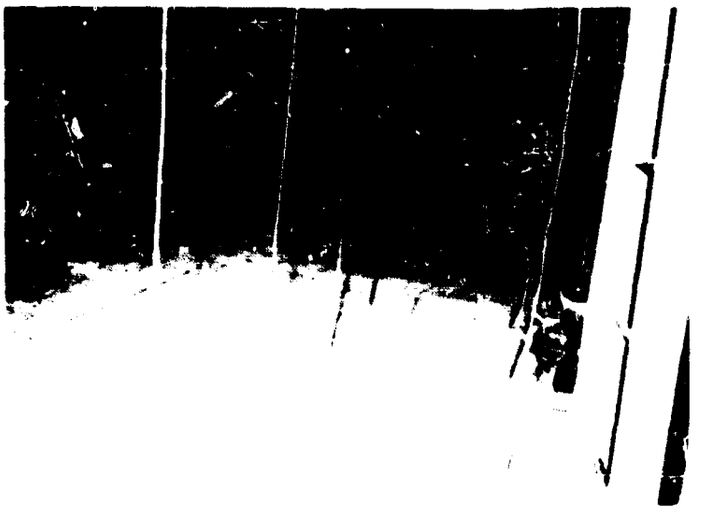


Figure 188

View 13 - Isaac Crary School -
A View of the Space Between the
Roof and the Ceiling of the Gymnasium

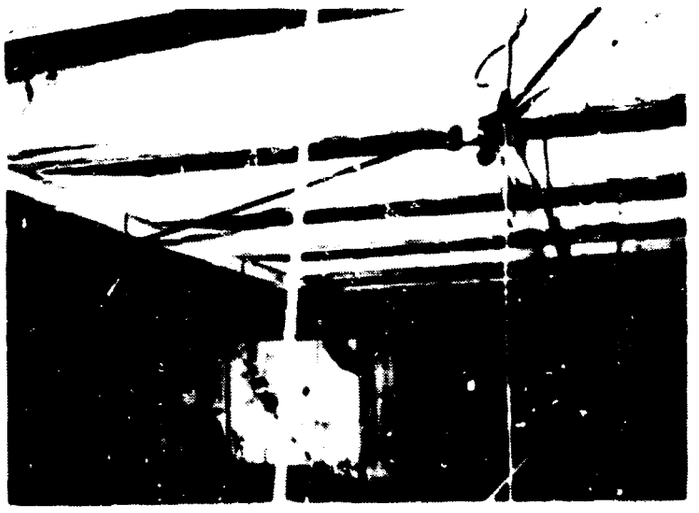


Figure 189

View 14 - Isaac Crary School -
An Interior View of the Building
Roof Showing Some of the Construction
Details

Figure 190

View 15 - Isaac Crary School -
A View of the Tar and Gravel Roof
of the School

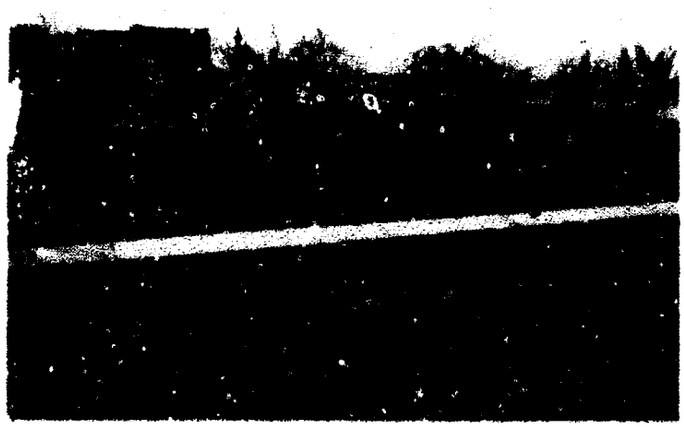


Figure 191

View 16 - Isaac Crary School -
A View of the Roof Showing the
Several Levels of the Roof Which
Would Influence Decontamination

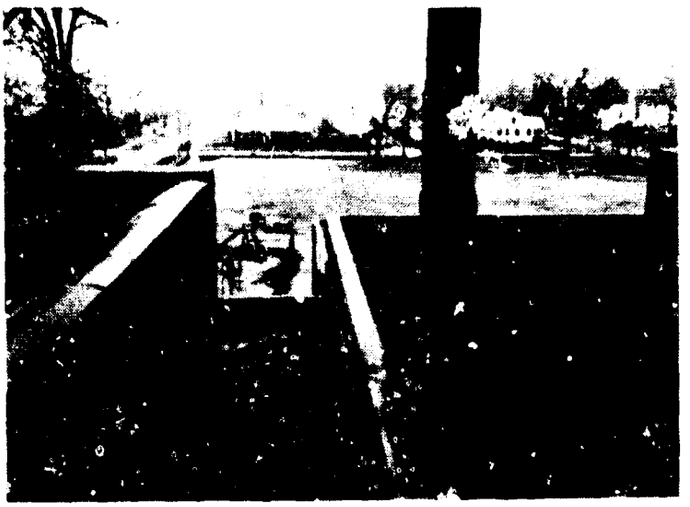


Figure 192

View 17 - Isaac Crary School -
A View of Two Sections of the Roof
and the Playground North of the School

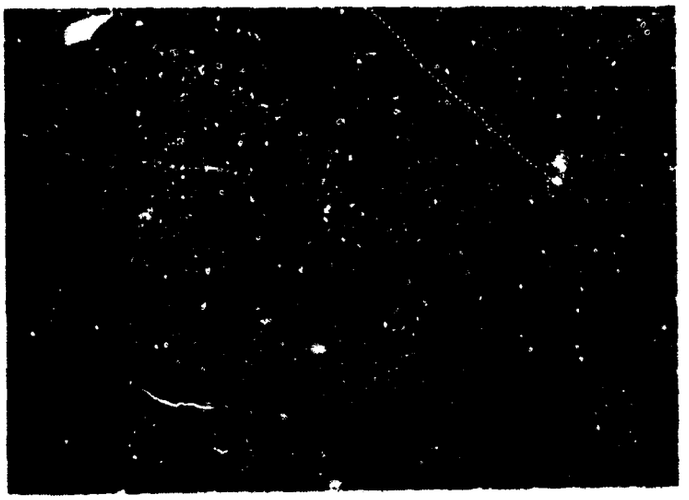


Figure 193

View 18 - Isaac Crary School -
A Close-up View of the Tar and Gravel
Surface of the Roof

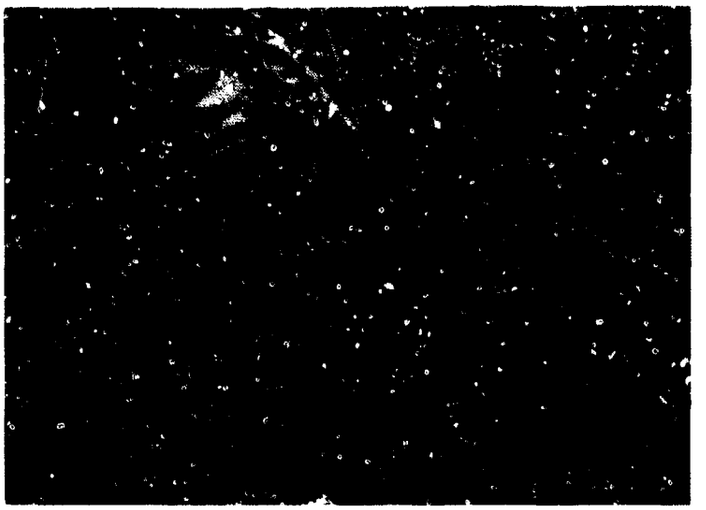


Figure 194

View 19 - Isaac Crary School -
A Close-up View of the Surface
Material of the Playground

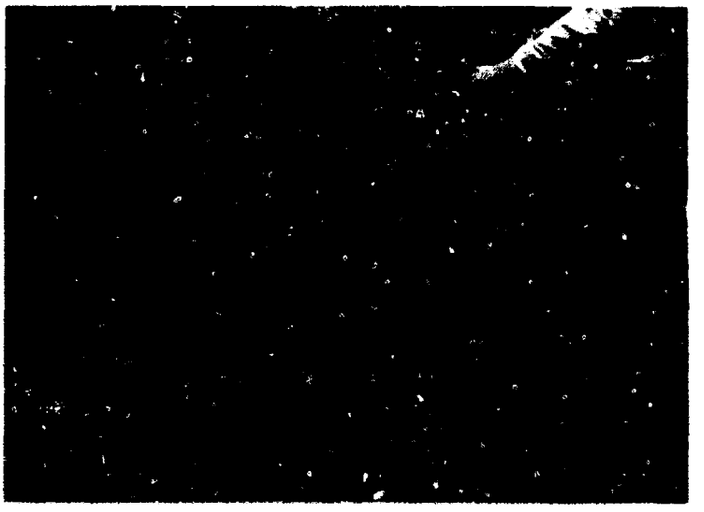


Figure 195

View 20 - Isaac Crary School -
A View of One of the Drains on the
Playground

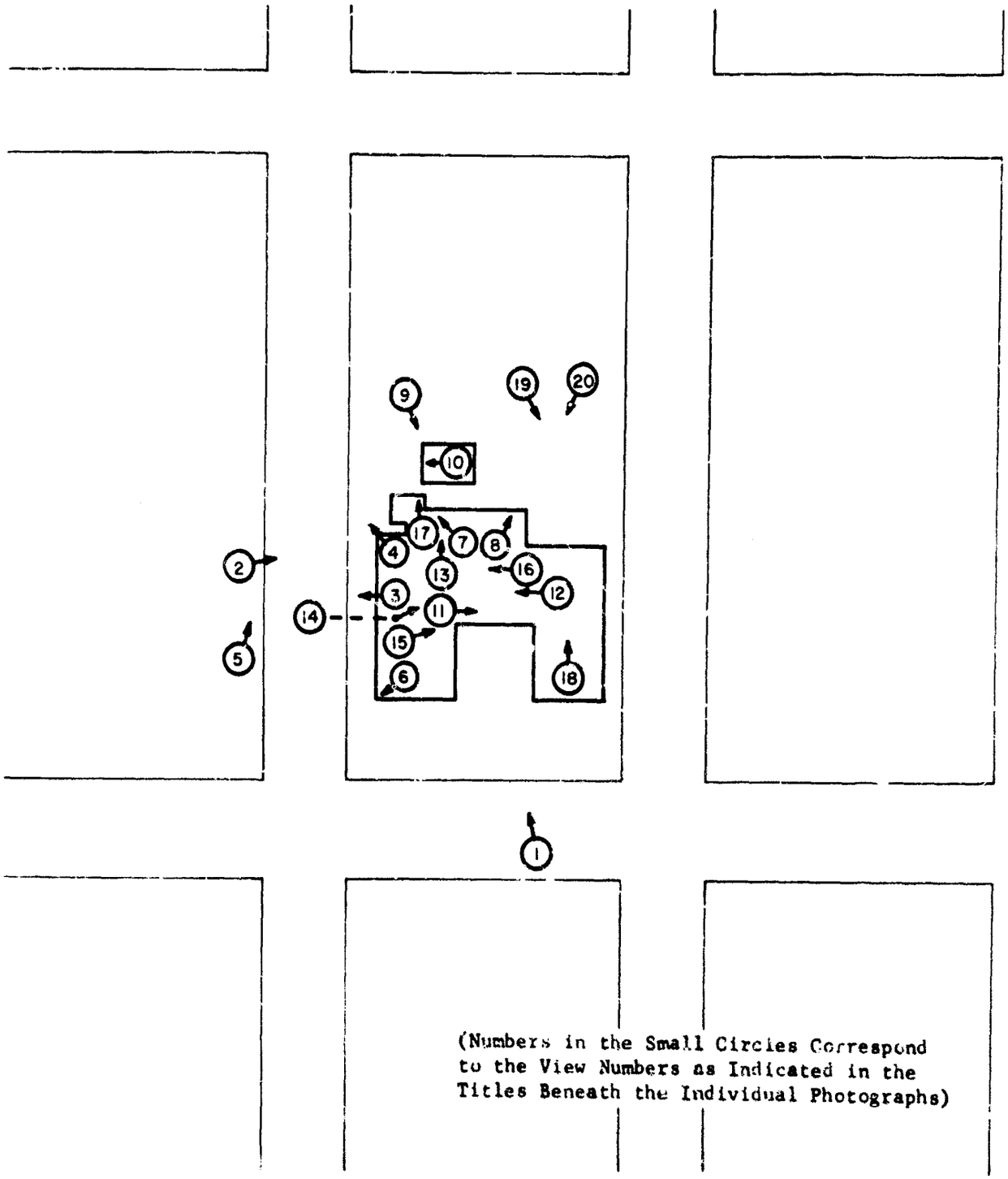


Figure 196

A Map of the Area Around Isaac Crary School Showing the Locations and Directions of the Photographs Shown in Figures 176 through 195

B. Definition of Activities

Six different activity patterns are considered in this analysis. Eight detector locations are used to characterize these activity patterns. These detector locations are as follows:

Detector Location	Description
1	Center Corridor, First Floor
2	Classroom, First Floor
3	Auditorium
4	Gymnasium
5	Classroom, Second Floor
6	Power Plant
7	Basement Location
8	Shelter Location in Sub-basement

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each of the detector locations. Thus, Table LV defines the six activity patterns.

Table LV

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j IN ISAAC CRARY ELEMENTARY SCHOOL

Activity Pattern A_i	Detector Location j							
	1 Center Corridor, First Floor	2 Classroom, First Floor	3 Auditorium	4 Gymnasium	5 Classroom, Second Floor	6 Power Plant	7 Basement Location	8 Shelter Location in Sub-basement
A_1	.00	.50	.00	.00	.00	.00	.50	.00
A_2	.00	.00	.00	.50	.00	.00	.50	.00
A_3	.20	.20	.20	.00	.00	.00	.00	.40
A_4	.00	.00	.50	.00	.00	.00	.00	.50
A_5	.10	.00	.00	.00	.50	.00	.00	.40
A_6	.00	.00	.00	.00	.00	.70	.00	.30

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 175)

	Detector Location	Original PF
1	Center Corridor, First Floor	39
2	Classroom, First Floor	28
3	Auditorium	18
4	Gymnasium	20
5	Classroom, Second Floor	23
6	Power Plant	4.1
7	Basement Location	125
8	Shelter Location in Sub-basement	667

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table LV)	Equivalent PF
A_1	45
A_2	34
A_3	41
A_4	35
A_5	40
A_6	5.8

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roof of Building	24,200	Tar and Gravel
2	Parking Lots	17,250	Asphalt
3	Streets	148,800	Asphalt
4	Playground	68,900	Composition of Sand and Gravel
5	Lawns, Bare Earth, etc.	111,250	Grass and Earth

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the school building which were required to calculate the contribution to intensity values:

1. Exterior Walls - 6" brick (53 lb/ft^2).
2. Interior Partitions - brick with openings (10 lb/ft^2).
3. Floors - 9" reinforced concrete covered with tile (120 lb/ft^2).
4. Roof - 9" reinforced concrete tar and gravel with insulation (122 lb/ft^2).

Table LVI lists the contribution to intensity factors of the various planes to the selected detector locations.

Table LVI

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR ISAAC CRARY ELEMENTARY SCHOOL

Contaminated Plane i	Detector Location j							
	1 Center Corridor, First Floor	2 Class-room, First Floor	3 Audi-torium	4 Gymna-sium	5 Class-room, Second Floor	6 Power Plant	7 Base-ment Loca-tion	8 Shelter Location in Sub-basement
1 Roof of Building	.0053	.0053	.0082	.0084	.0199	.0030	.0019	.0009
2 Parking Lots	.0104	.0093	.0191	.0180	.0081	.0908	.0006	.0001
3 Streets	.0044	.0031	.0080	.0009	.0023	.0218	.0001	.0000
4 Playground	.0024	.0024	.0143	.0179	.0009	.0882	.0012	.0003
5 Lawns, Bare Earth, etc.	.0031	.0162	.0064	.0052	.0121	.0406	.0042	.0002

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table LVII.

Table LVII

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR ISAAC CRARY ELEMENTARY SCHOOL

Contaminated Plane i	Detector Location j							
	1 Center Corridor, First Floor	2 Class-room, First Floor	3 Audi-torium	4 Gymna-sium	5 Class-room, Second Floor	6 Power Plant	7 Base-ment Loca-tion	8 Shelter Location in Sub-basement
1 Roof of Building	.21	.15	.15	.17	.46	.01	.24	.60
2 Parking Lots	.41	.26	.34	.36	.19	.37	.07	.07
3 Streets	.17	.09	.14	.02	.05	.09	.01	.00
4 Playground	.09	.07	.26	.36	.02	.36	.15	.20
5 Lawns, Bare Earth, etc.	.12	.45	.11	.10	.28	.17	.52	.13

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table LVIII.

Table LVIII

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR ISAAC CRARY ELEMENTARY SCHOOL

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Roof of Building (1)	.01	3.4	7
Firehose	B	Roof of Building (1)	.07	1.6	7
Firehose	C	Roof of Building (1)	.12	1.0	7
Firehose	D	Parking Lots (2)	.02	0.4	5
Flusher	E	Parking Lots (2)	.02	0.2	1
Street Sweeper	F	Parking Lots (2)	.15	0.2	1
Firehose	G	Streets (3)	.02	3.0	5
Flusher	H	Streets (3)	.02	1.5	1
Street Sweeper	I	Streets (3)	.15	1.5	1
Grader	J	Playground (4)	.10	16.5	1
Grader	K	Lawns, Bare Earth, etc. (5)	.10	26.7	1

H. $\overline{RN}_j$ Values

The fraction of intensity remaining for selected strategies is given in Table LIX.

Table LIX

FRACTION OF INTENSITY REMAINING (RN VALUES) FOR SELECTED STRATEGIES FOR ISAAC CRARY ELEMENTARY SCHOOL

Combined Strategy	Detector Location j							
	1 Center Corridor, First Floor	2 Class-room, First Floor	3 Audi-torium	4 Gymna-sium	5 Class-room, Second Floor	6 Power Plant	7 Base-ment Loca-tion	8 Shelter Location in Sub-basement
A	.80	.86	.86	.83	.55	.99	.76	.41
B	.81	.86	.86	.84	.57	.99	.78	.44
C	.82	.87	.87	.85	.60	.99	.79	.48
D	.60	.75	.67	.65	.82	.64	.93	.93
G	.83	.92	.86	.98	.95	.91	.99	1.00
J	.92	.94	.77	.68	.98	.66	.86	.82
K	.89	.60	.90	.91	.75	.85	.53	.88
A+E	.40	.60	.52	.49	.36	.62	.69	.34
A+F	.45	.64	.57	.53	.39	.67	.70	.35
B+H	.64	.78	.72	.83	.52	.90	.77	.44
B+I	.66	.79	.74	.83	.53	.91	.77	.44
A+D+G+J+K	.04	.06	.05	.05	.04	.06	.07	.04

I. RNA Values

The activity reduction factors for selected strategies and the activity patternsare given in Table LX.

Table LX

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR ISAAC CRARY ELEMENTARY SCHOOL

Combined Strategy	Activity Patterns					
	A_1	A_2	A_3	A_4	A_5	A_6
A	.84	.83	.83	.84	.57	.99
B	.85	.84	.84	.85	.59	.99
C	.86	.84	.85	.86	.62	.99
D	.78	.69	.68	.67	.60	.64
G	.93	.98	.87	.86	.94	.91
J	.93	.71	.85	.77	.97	.68
K	.59	.86	.81	.90	.77	.85
A+E	.62	.51	.52	.52	.36	.62
A+F	.65	.55	.56	.56	.39	.67
B+H	.78	.82	.72	.72	.53	.90
B+I	.79	.82	.73	.73	.54	.91
A+D+G+J+K	.06	.06	.05	.05	.04	.06

J. Conclusions

As in the previous analysis, appreciable intensity reductions at any of the detectors can only be achieved by performing a combined strategy involving the decontamination of several contaminated planes. About 85 man-hours of effort (Strategy A+D+G+J+K) would be required to reduce the intensity at all of the detector locations considered in this analysis by factors of fifteen or more.

XII. DECONTAMINATION ANALYSIS OF THE CADILLAC MOTOR CAR DIVISION OF GENERAL MOTORS CORPORATION

A. Discussion

The Cadillac Motor Car Division of General Motors Corporation is a large complex of buildings and outdoor service and storage areas in central Detroit. This analysis concerns itself only with activities and detector locations in three of the buildings in the complex: the engineering building, the main manufacturing and assembly plant, and the general offices and administration building. The general area around the plant is largely industrial since major railroad trunk lines converge in the area. These railroad tracks define two of the boundaries of the Cadillac complex.

Figure 197 is a map of the area showing the locations of detector positions and the sizes and surface materials of contributing planes of contamination. Figures 198 through 213 are several photographs taken around the area, showing some of the contaminated planes and other features of the area that would influence decontamination. Figure 214 is a map showing the locations and directions of the photographs.

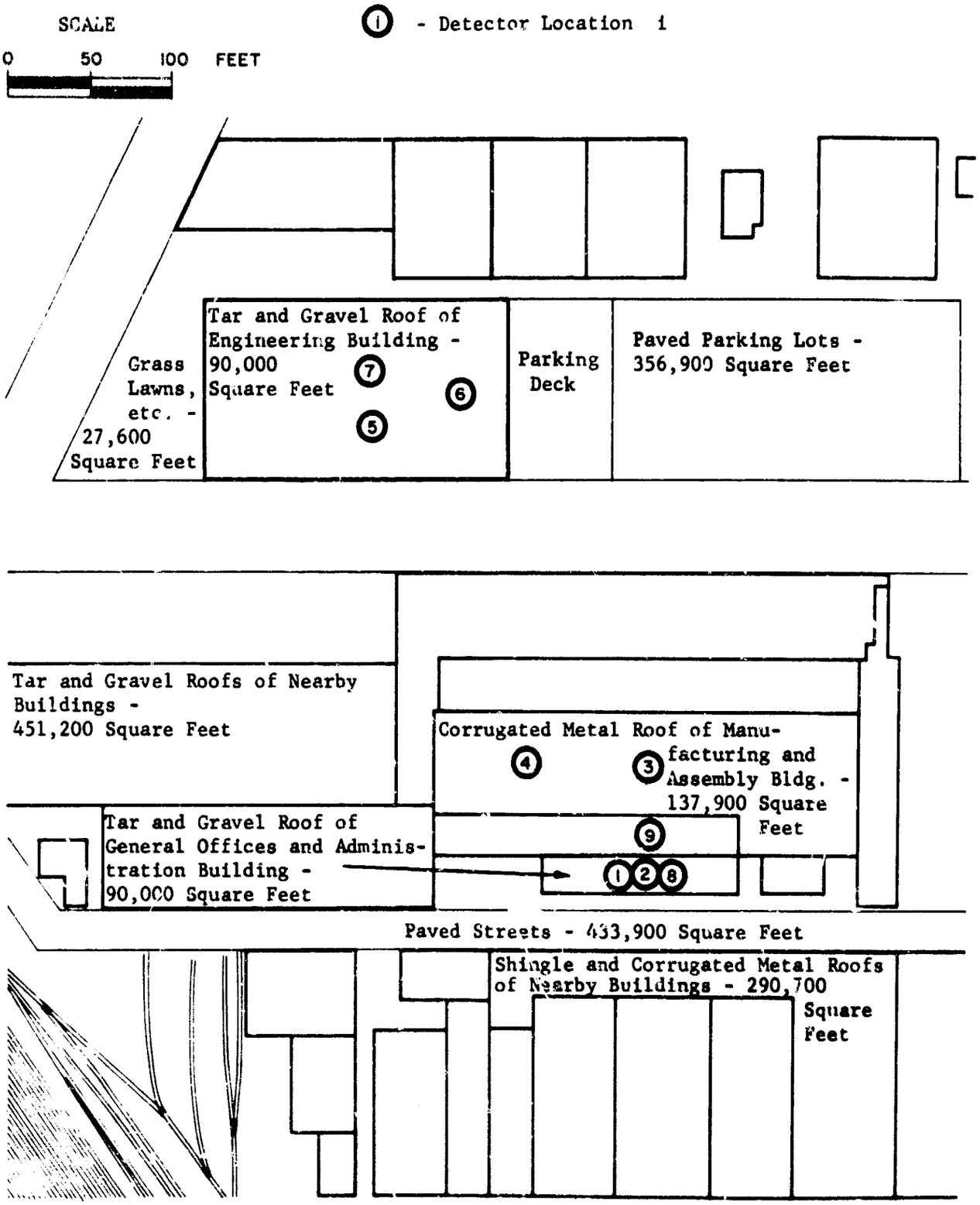


Figure 197

A Map of the Area Around the Cadillac Motor Car Division Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

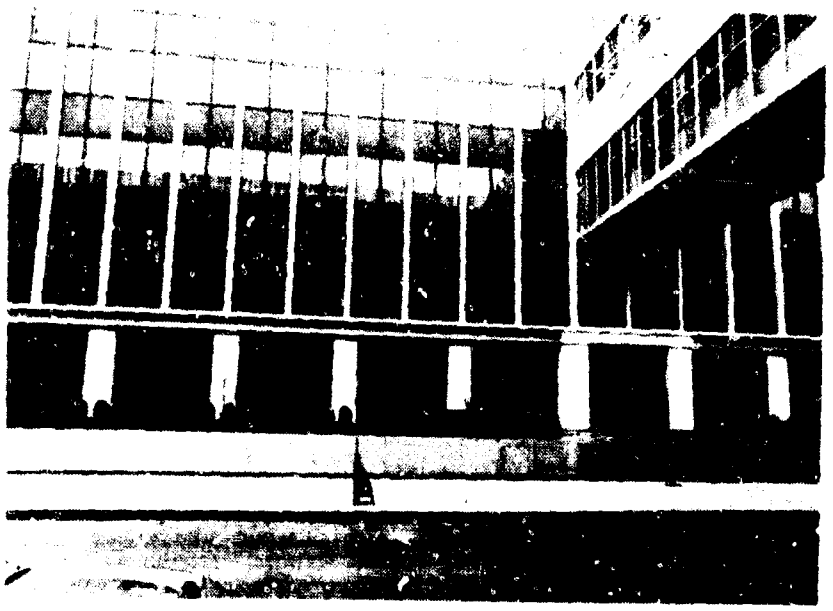


Figure 198

View 1 - Cadillac Motor Car Division -
A View of the Front Wall of the
General Offices and Administration
Building

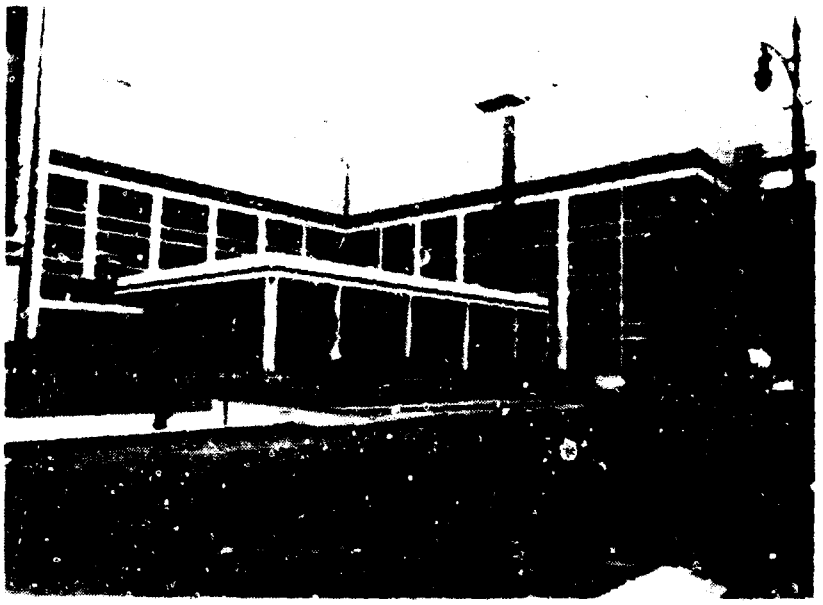


Figure 199

View 2 - Cadillac Motor Car Division -
A View of the Front Entrance and Lobby in
the General Offices and Administration
Building

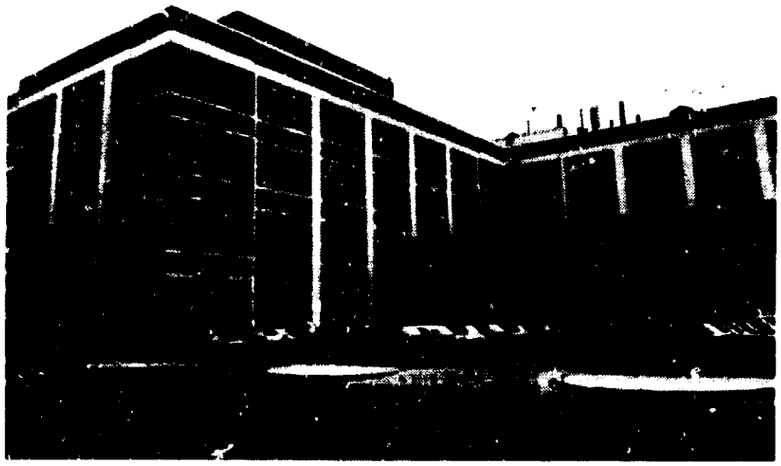


Figure 200

View 3 - Cadillac Motor Car Division -
A View of the Parking Lot Between the General Offices and Administration Building and a Section of the Manufacturing Building

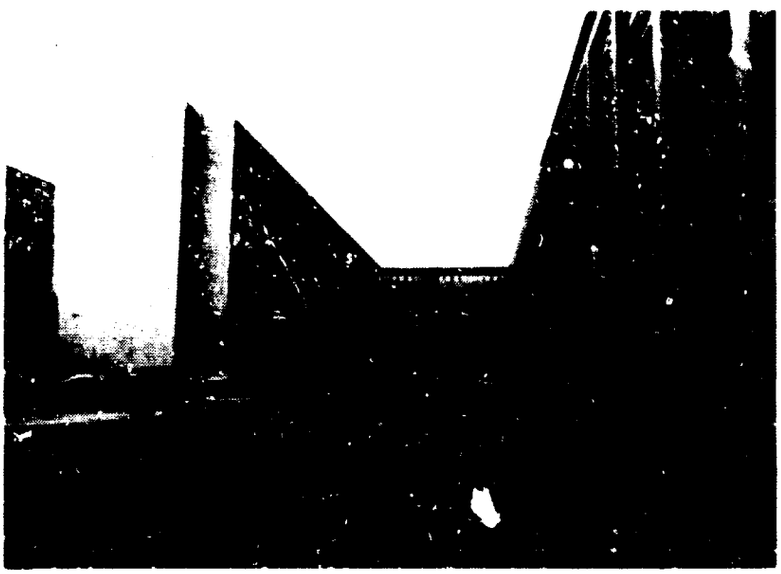


Figure 201

View 4 - Cadillac Motor Car Division -
A View of the Street in Front of the General Offices and Administration Building

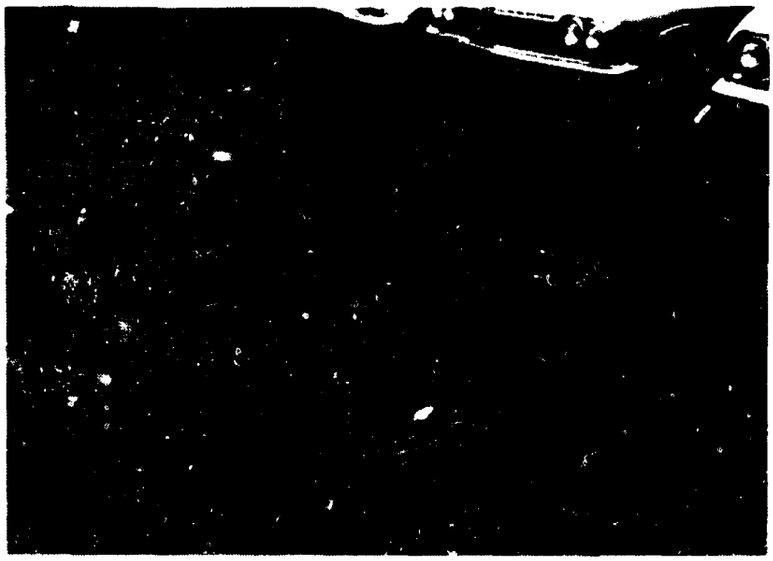


Figure 202

View 5 - Cadillac Motor Car Division -
A Close-up View of One of the Drains in
the Parking Lot Next to the General Offices
and Administration Building

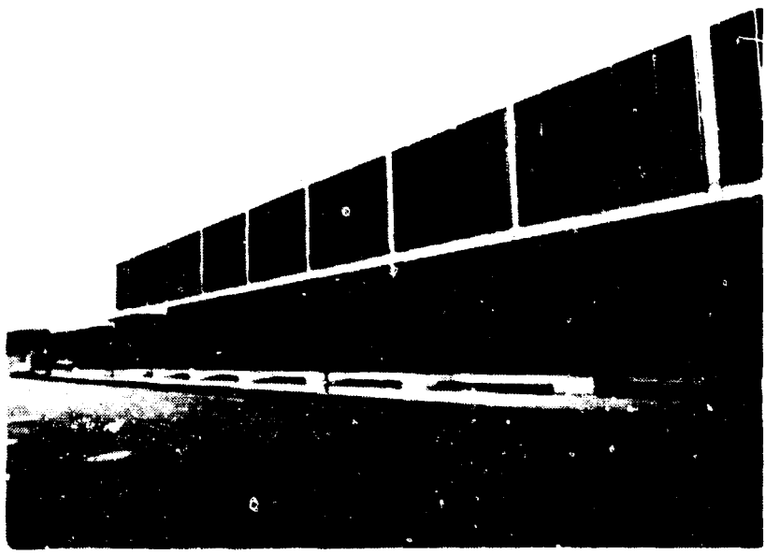


Figure 203

View 6 - Cadillac Motor Car Division -
A View of the Front of the Engineering
Building

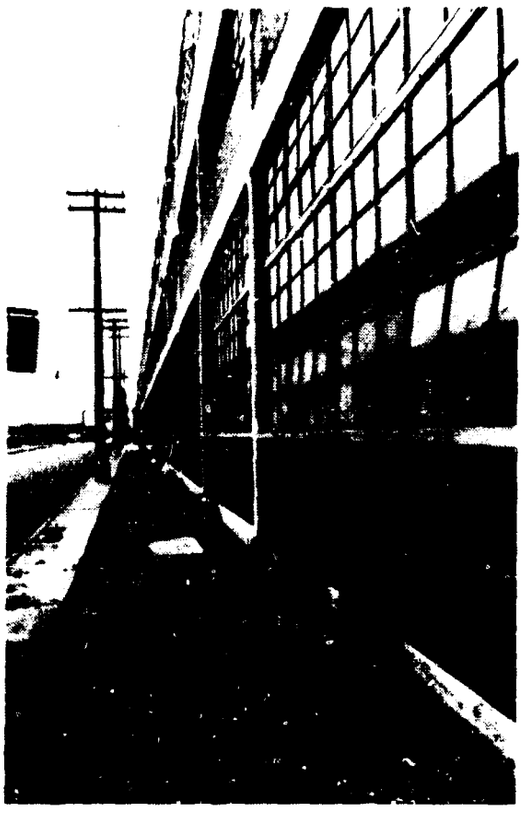


Figure 204

View 7 - Cadillac Motor Car Division - A View of One Side of the Manufacturing Building

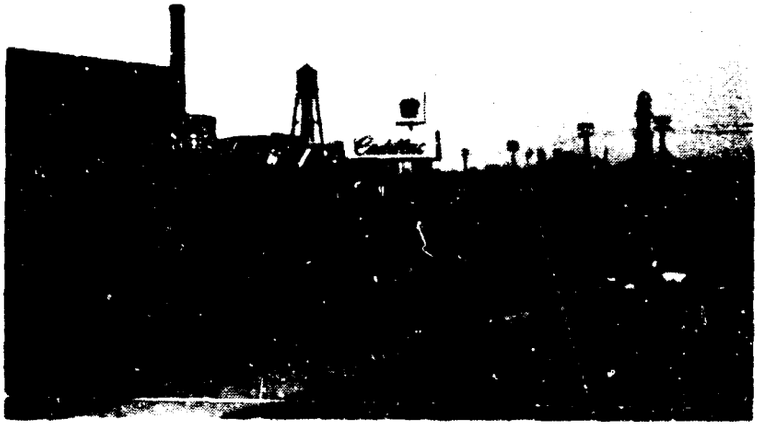


Figure 205

View 8 - Cadillac Motor Car Division - A View of Two of the Major Streets Which Border the Cadillac Complex

Figure 206

View 9 - Cadillac Motor Car Division -
A View of the Cadillac Complex Taken From
a Short Distance West of the Engineering
Building

Figure 207

View 10 - Cadillac Motor Car Division -
A View of One of the Shipping and
Receiving Yards in the Cadillac Complex

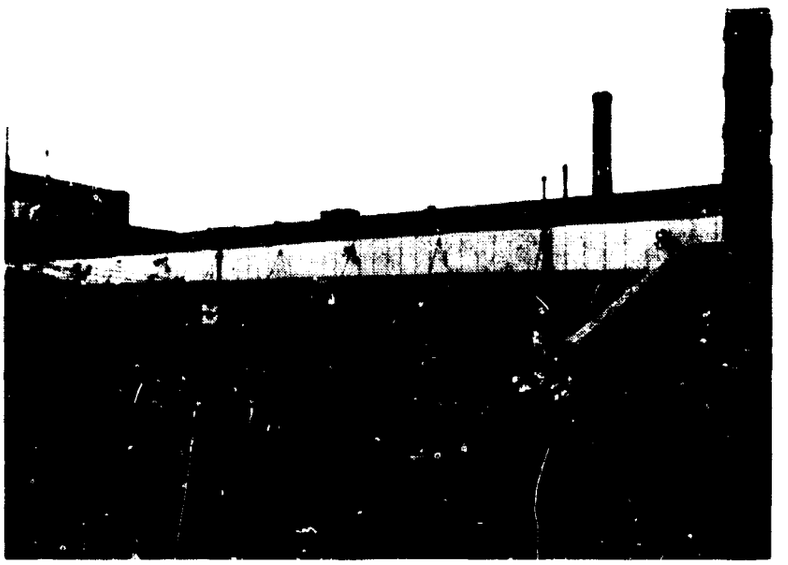


Figure 208

View 11 - Cadillac Motor Car Division -
A View of One of the Shipping Docks
in Back of the Manufacturing Building

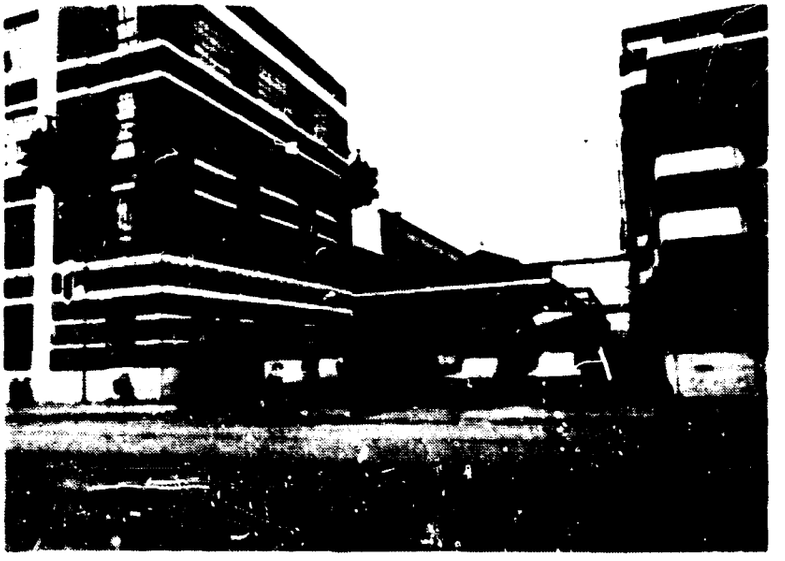


Figure 209

View 12 - Cadillac Motor Car Division -
A View of an Entrance to One of the
Parking Lots in the Cadillac Complex

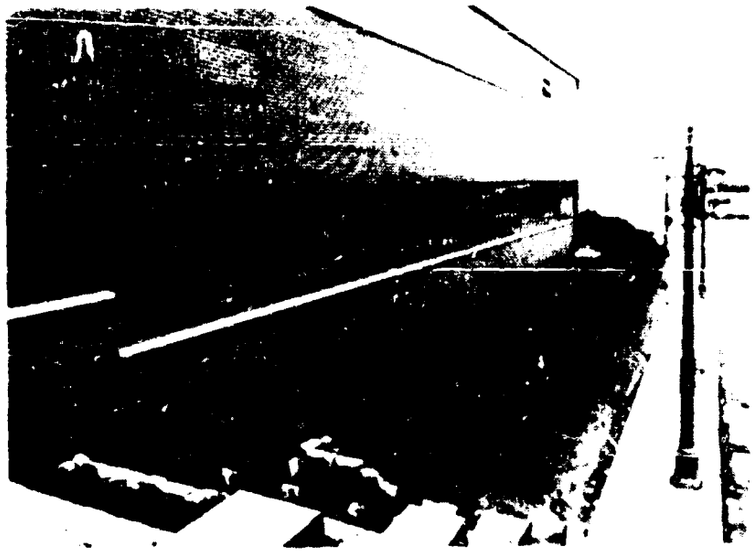


Figure 210

View 13 - Cadillac Motor Car Division -
A View of the West Wall of the
Manufacturing Building

Figure 211

View 14 - Cadillac Motor Car Division -
A View of One of the Unpaved Parking
Lots in the Cadillac Complex

Figure 212

View 15 - Cadillac Motor Car Division -
A View of One of the Paved Parking
Lots in the Cadillac Complex

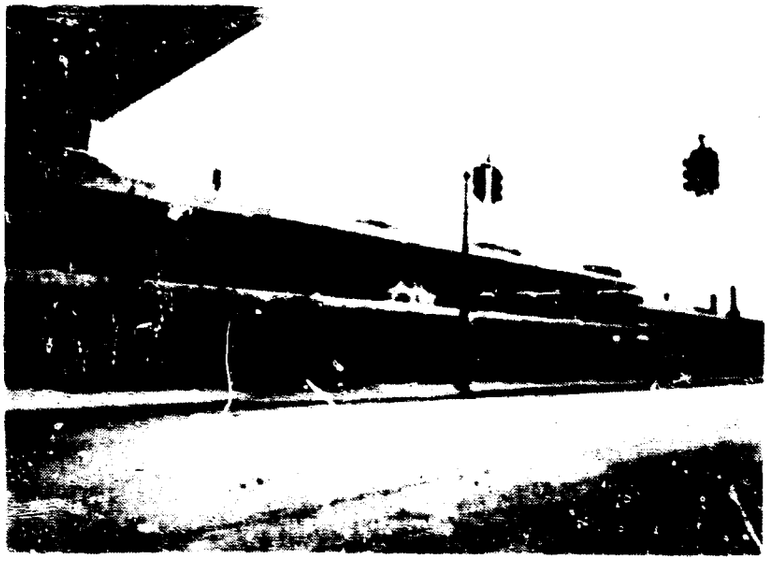


Figure 213

View 16 - Cadillac Motor Car Division -
A View of the Parking Decks Adjacent
to the Engineering Building

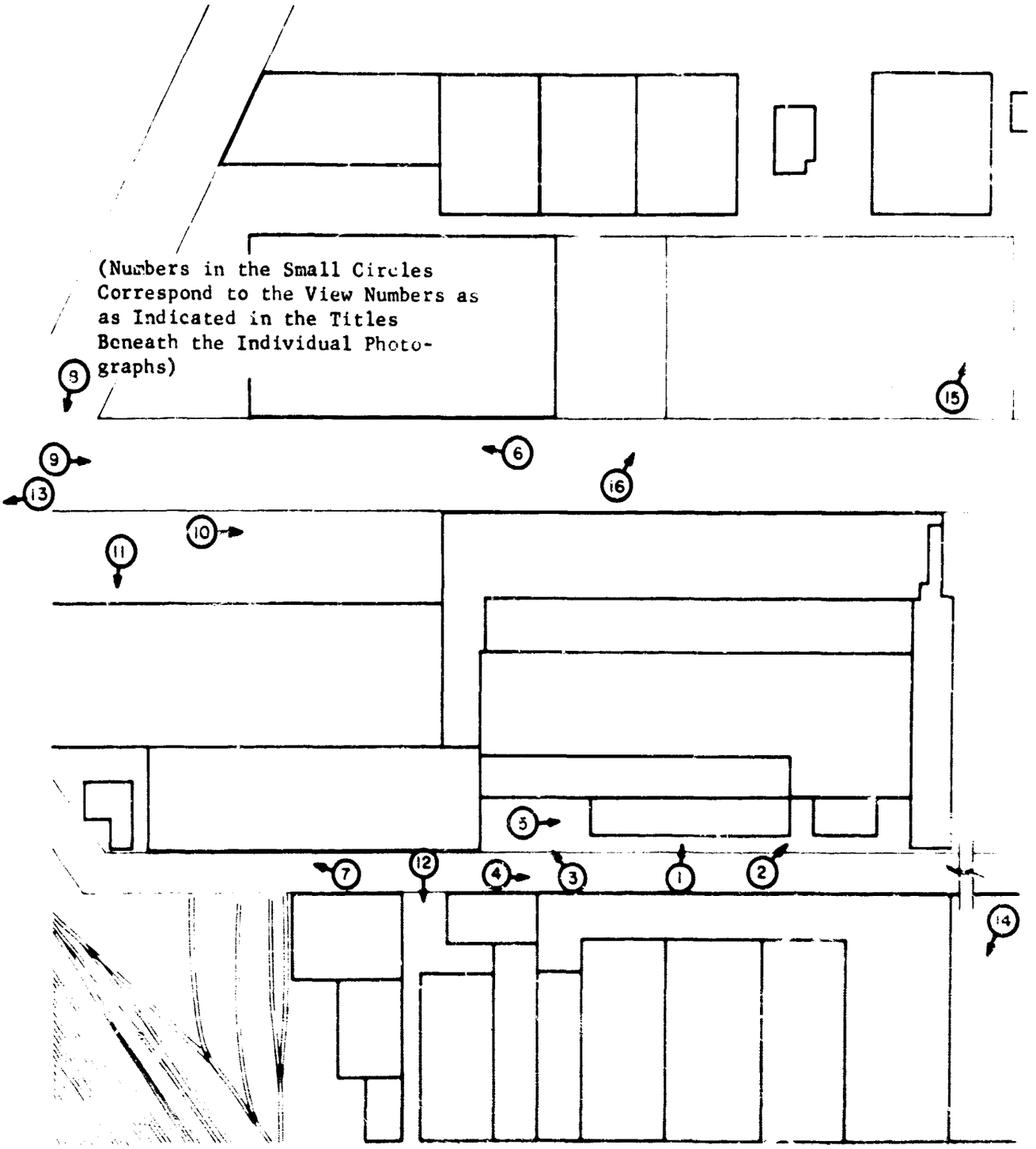


Figure 214

A Map of the Area Around the Cadillac Motor Car Division Showing the Locations and Directions of the Photographs Shown in Figures 198 through 211

B. Definition of Activities

Six activity patterns are considered in this analysis. Nine detector locations are used to characterize these activities. These detector locations are:

Detector Location	Description
1	Main Lobby in Administration Building
2	Office on Second Floor of Administration Building
3	Central Location in Manufacturing Plant
4	Off-center Location in Manufacturing Plant
5	Office in Engineering Building
6	Blueprint Room in Engineering Building
7	Drafting Room in Engineering Building
8	Shelter Location in the Basement of Administration Building
9	Shelter Location in Tunnel between Administration Building and Manufacturing Building

The activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each detector location. Thus, Table LXI defines the activities.

Table LXI

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j AT CADILLAC MOTOR CAR DIVISION

Activity Pattern A_i	Detector Location j								
	1 Main Lobby in Administration Building	2 Office on Second Floor of Administration Building	3 Central Location in Manufacturing Plant	4 Off-Center Location in Manufacturing Plant	5 Second Floor Office in Engineering Building	6 Second Floor Blueprint Room in Engineering Building	7 Second Floor Drafting Room in Engineering Building	8 Shelter Location in Basement of Administration Building	9 Shelter Location in Tunnel between Administration Building and Manufacturing Building
A_1	.05	.75	.00	.00	.00	.00	.00	.00	.20
A_2	.00	.00	.50	.00	.00	.00	.00	.00	.50
A_3	.00	.00	.00	.50	.00	.00	.00	.50	.00
A_4	.00	.00	.00	.00	.50	.00	.00	.00	.50
A_5	.00	.00	.00	.00	.00	.10	.40	.00	.50
A_6	.00	.00	.00	.00	.00	.00	.40	.30	.30

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 197)

	Detector Location	Original PF
1	Main Lobby in Administration Building	6.5
2	Office on Second Floor of Administration Building	27
3	Central Location in Manufacturing Plant	7.3
4	Off-center Location in Manufacturing Plant	5.0
5	Office in Engineering Building	79
6	Blueprint Room in Engineering Building	20
7	Drafting Room in Engineering Building	21
8	Shelter Location in Basement of Administration Building	476
9	Shelter Location in Tunnel between Administration Building and Manufacturing Building	2000

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table LXI)	Equivalent PF
A_1	29
A_2	14
A_3	9.9
A_4	153
A_5	41
A_6	50

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roof of Manufacturing and Assembly Building	137,900	Corrugated Metal Sheets (pitched)
2	Roof of Engineering Building	90,000	Tar and Gravel
3	Roof of General Offices and Administration Building	90,000	Tar and Gravel
4	Roofs of Nearby Buildings	451,200	Tar and Gravel
5	Roofs of Nearby Buildings	290,700	Shingles and Corrugated Metal
6	Streets	433,900	Asphalt
7	Paved Parking	356,900	Asphalt
8	Grass, etc.	27,600	Grass and Bare Earth

E. Contribution to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the buildings which were used to calculate the contribution to intensity values:

a. General Offices and Administration Building

Exterior Walls

Wall facing street - 4" brick (80% apertures) (25 lbs/ft^2).

Side exterior walls - 8" brick with marble facing (65 lbs/ft^2).

Wall on the back of building - 8" brick (55 lbs/ft^2).

Interior Partitions - plaster on metal lath (8 lbs/ft^2).

Floors - 6" reinforced concrete (75 lbs/ft^2).

Roof - 6" reinforced concrete (75 lbs/ft^2).

b. Engineering Building

Exterior Walls - 12" brick (100 lbs/ ft^2).

Interior Partitions - 8" brick (60 lbs/ft^2).

Floors - 6" reinforced concrete (75 lbs/ft^2).

Roof - 6" reinforced concrete (75 lbs/ft^2).

c. Manufacturing and Assembly Building

Exterior Walls - 12" brick (100 lbs/ft^2).

Interior Partitions - 8" brick (60 lbs/ft^2).

Floors - 6" reinforced concrete (75 lbs/ft^2).

Roof - 6" reinforced concrete (75 lbs/ft^2).

Table LXII lists the contribution to intensity factors of the various planes to the selected detector locations.

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table LXIII.

Table LXII

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR CADILLAC MOTOR CAR DIVISION OF GENERAL MOTORS CORPORATION

Contaminated Plane i	Detector Location j								
	1 Main Lobby in Administration Building	2 Office on Second Floor of Administration Building	3 Central Location in Manufacturing Plant	4 Off-center Location in Manufacturing Plant	5 Second Floor Office in Engineering Building	6 Second Floor Blueprint Room in Engineering Building	7 Second Floor Drafting Room in Engineering Building	8 Shelter Location in Basement of Administration Building	9 Shelter Location in Tunnel between Administration Bldg. and Manufacturing Bldg.
1 Roof of Manufacturing and Assembly Building	.0004	.0074	.1280	.1204	.0000	.0000	.0000	.0000	.0000
2 Roof of Engineering Building	.0000	.0000	.0000	.0000	.0036	.0455	.0457	.0000	.0000
3 Roof of General Offices and Administration Building	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0006	.0003
4 Roofs of Nearby Buildings	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5 Roofs of Nearby Buildings	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000
6 Streets	.0341	.0059	.0019	.0081	.0075	.0006	.0006	.0003	.0000
7 Paved Parking	.0006	.0084	.0064	.0648	.0015	.0048	.0016	.0008	.0001
8 Grass, etc.	.1180	.0142	.0012	.0071	.0000	.0000	.0000	.0004	.0001

Table LXIII

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR CADILLAC MOTOR CAR DIVISION OF GENERAL MOTORS CORPORATION

Contaminated Plane i	Detector Location j								
	1 Main Lobby in Administration Building	2 Office on Second Floor of Administration Building	3 Central Location in Manufacturing Plant	4 Off-center Location in Manufacturing Plant	5 Second Floor Office in Engineering Building	6 Second Floor Blueprint Room in Engineering Building	7 Second Floor Drafting Room in Engineering Building	8 Shelter Location in Basement of Administration Building	9 Shelter Location in Tunnel between Administration Bldg. and Manufacturing Bldg.
1 Roof of Manufacturing and Assembly Building	.00	.20	.93	.60	.00	.00	.00	.00	.00
2 Roof of Engineering Building	.00	.00	.00	.00	.29	.89	.95	.00	.00
3 Roof of General Offices and Administration Building	.00	.00	.00	.00	.00	.00	.00	.29	.60
4 Roofs of Nearby Buildings	.00	.01	.00	.00	.00	.00	.00	.00	.00
5 Roofs of Nearby Buildings	.00	.00	.00	.00	.00	.00	.00	.00	.00
6 Streets	.22	.16	.01	.04	.60	.01	.01	.14	.00
7 Paved Parking	.00	.23	.05	.32	.12	.09	.03	.38	.20
8 Grass, etc.	.77	.39	.01	.04	.00	.00	.00	.19	.20

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in Table LXIV.

Table LXIV

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR CADILLAC MOTOR CAR DIVISION OF GENERAL MOTORS CORPORATION

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction Fallout material remaining after decontamination)	Team Hours of Effort	No. in Team
Firehose	A	Roof of Manufacturing Building (1)	.01	19.3	7
Firehose	B	Roof of Manufacturing Building (1)	.07	8.8	7
Firehose	C	Roof of Manufacturing Building (1)	.12	5.9	7
Firehose	D	Roof of Engineering Building (2)	.01	12.6	7
Firehose	E	Roof of Engineering Building (2)	.07	5.8	7
Firehose	F	Roof of Engineering Building (2)	.12	3.9	7
Firehose	G	Roof of Administration Building (3)	.01	12.6	7
Firehose	H	Roof of Administration Building (3)	.07	5.8	7
Firehose	I	Roof of Administration Building (3)	.12	3.9	7
Firehose	J	Roofs of Nearby Buildings (4)	.01	63.2	7
Firehose	K	Roofs of Nearby Buildings (4)	.07	28.9	7
Firehose	L	Roofs of Nearby Buildings (5)	.03	23.3	6
Firehose	M	Roofs of Nearby Buildings (5)	.08	7.3	6
Firehose	N	Streets (6)	.02	8.7	5
Street Sweeper	O	Streets (6)	.15	4.3	1
Firehose	P	Paved Parking (7)	.02	7.1	5
Grader	Q	Grass, etc. (o)	.10	6.6	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table LXV.

I. RN_A Values

The activity reduction factors for selected strategies and the activity patterns are given in Table LXVI.

J. Conclusions

The potentially contributing planes of contamination in the Cadillac complex add up to about two million square feet of area including roof surfaces. To decontaminate the entire area would require about one thousand man-hours of decontamination effort. Therefore, if only a few critical locations could be identified as requiring intensity reductions, the cost of the decontamination effort could be reduced appreciably. No single combined strategy outside of decontaminating the entire complex reduced all detector locations to any substantial degree.

Table LXV

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR CADILLAC MOTOR CAR DIVISION OF GENERAL MOTORS CORPORATION

Combined Strategy	Detector Location j								
	1 Main Lobby in Administration Building	2 Office on Second Floor of Administration Building	3 Central Location in Manufacturing Plant	4 Off-center Location in Manufacturing Plant	5 Second Floor Office in Engineering Building	6 Second Floor Blueprint Room in Engineering Building	7 Second Floor Drafting Room in Engineering Building	8 Shelter Location in Basement of Administration Building	9 Shelter Location in Tunnel between Administration Building and Manufacturing Building
A	1.00	.80	.08	.41	1.00	1.00	1.00	1.00	1.00
B	1.00	.81	.13	.44	1.00	1.00	1.00	1.00	1.00
C	1.00	.82	.18	.47	1.00	1.00	1.00	1.00	1.00
D	1.00	1.00	1.00	1.00	.72	..12	.06	1.00	1.00
E	1.00	1.00	1.00	1.00	.73	.17	.11	1.00	1.00
F	1.00	1.00	1.00	1.00	.75	.21	.16	1.00	1.00
G	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.72	.41
H	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.73	.44
I	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.75	.47
J	1.00	.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
M	.78	.84	.99	.96	.42	.99	.99	.86	1.00
P	1.00	.77	.95	.68	.88	.91	.97	.63	.80
Q	.31	.65	.99	.97	1.00	1.00	1.00	.83	.82
A+K+M+O	.91	.65	.07	.37	.49	.99	.99	.88	1.00
A+K+M+O+P	.80	.42	.02	.05	.38	.90	.96	.51	.80
A+D+G+J+L+N+P+Q	.03	.05	.02	.02	.02	.01	.01	.03	.03

Table LXVI

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR THE CADILLAC MOTOR CAR DIVISION OF GENERAL MOTORS CORPORATION

Combined Strategy	Activity Pattern					
	A_1	A_2	A_3	A_4	A_5	A_6
A	.84	.08	.41	1.00	1.00	1.00
B	.85	.14	.45	1.00	1.00	1.00
C	.86	.18	.48	1.00	1.00	1.00
D	1.00	1.00	1.00	.73	.08	.09
E	1.00	1.00	1.00	.74	.13	.15
F	1.00	1.00	1.00	.76	.18	.19
G	1.00	1.00	1.00	.98	.99	.99
H	1.00	1.00	1.00	.98	.99	.99
I	1.00	1.00	1.00	.98	.99	.99
J	.99	1.00	1.00	1.00	1.00	1.00
L	1.00	1.00	1.00	1.00	1.00	1.00
N	.83	.99	.96	.44	.99	.98
P	.82	.95	.68	.78	.95	.96
Q	.57	.99	.97	.99	1.00	.99
A+K+M+O	.69	.07	.38	.51	.99	.99
A+K+M+O+P	.51	.02	.06	.39	.94	.94
A+D+G+J+L+N+P+Q	.06	.01	.02	.02	.01	.01

XIII. DECONTAMINATION ANALYSIS OF A PURE OIL GASOLINE AND SERVICE STATION

A. Discussion

The gas station selected for this analysis is the Pure Oil Station on the corner of McNichols Road and Prevost Avenue in northwest Detroit. It is in a semi-residential neighborhood with small stores beside it and across the street from it.

Figure 215 is a map of the area, showing the detector locations and the sizes and surface materials of the contributing planes of contamination. Figures 216 and 217 are two photographs of the gas station showing some of the planes of contamination and other features of the area that would influence decontamination. Figure 218 is a map showing the locations and directions of the photographs.

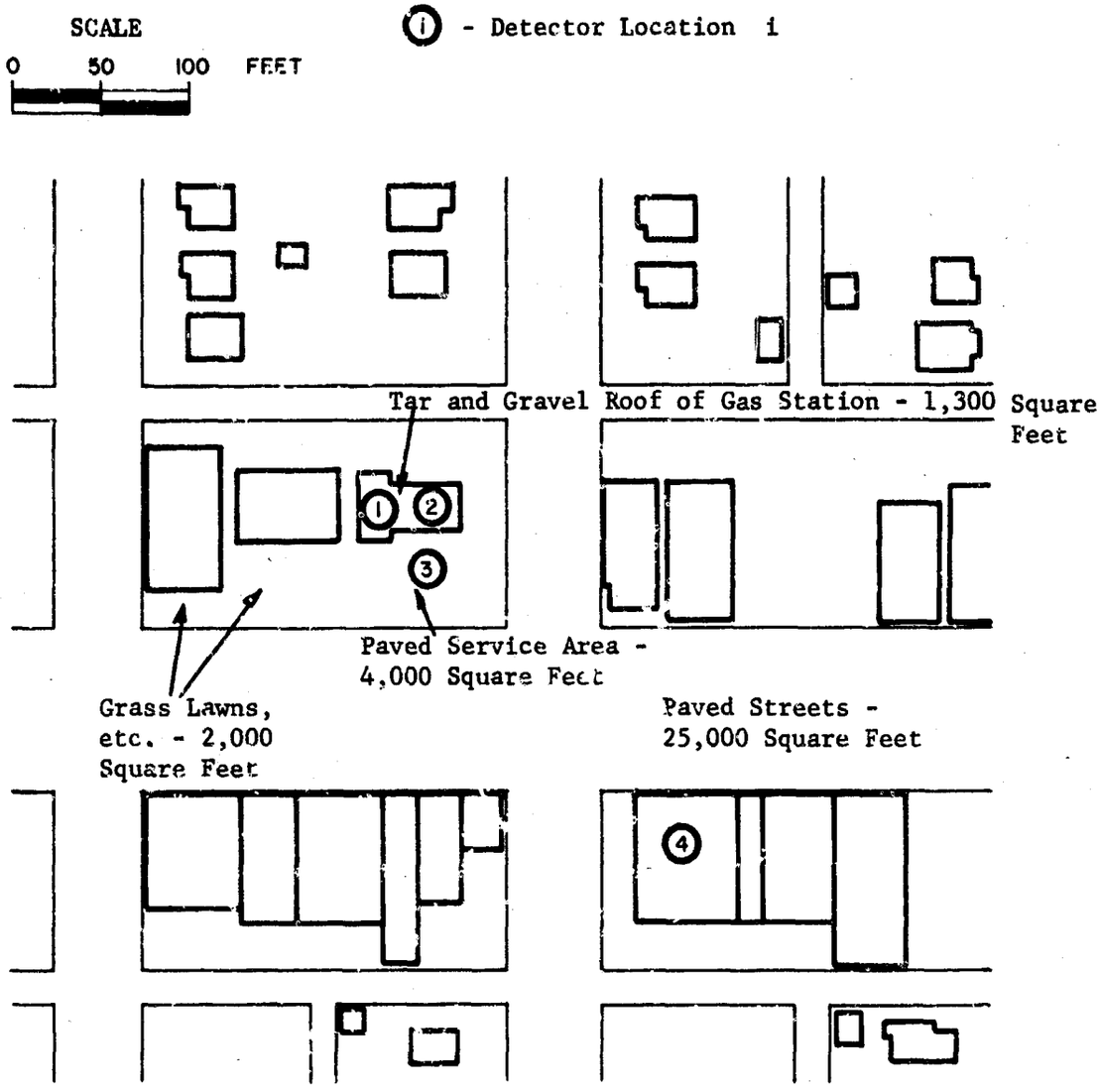


Figure 215

A Map of the Area Around the Pure Oil Gas Station Showing the Locations of Detectors and Indicating the Sizes, and Surface Materials of the Potentially Contributing Contaminated Planes

Figure 216

View 1 - Pure Oil Gas Station -
A View of the Gas Station Showing the Intersection of Prevost Avenue and McNichols Road

Figure 217

View 2 - Pure Oil Gas Station -
A View of McNichols Road Showing the Stores and Buildings Across the Street From the Gas Station

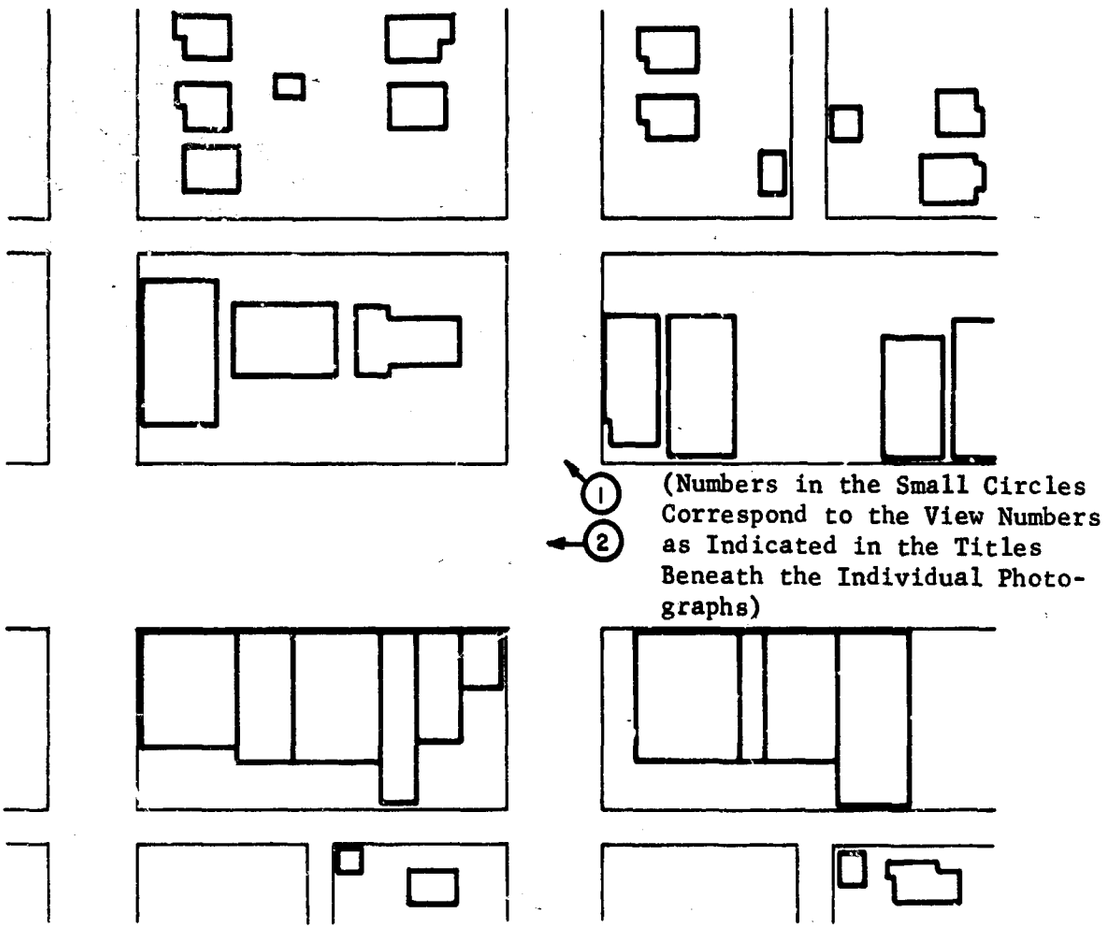


Figure 218

A Map of the Area Around the Pure Oil Gas Station Showing the Locations and Directions of the Photographs Shown in Figures 216 through 217

B. Definition of Activities

Two activity patterns are considered in this analysis. Four detector locations are used to characterize these activities. These detector locations are:

Detector Location	Description
1	Service Station Office
2	Indoor Service Area
3	Outdoor Service Area
4	Nearby Shelter Area

The two activities are described entirely according to the amount of time that an activity pattern requires a person to spend at each detector location. Thus, Table LXVII defines the activities.

Table LXVII

FRACTION OF TIME AS REQUIRED BY ACTIVITY A_i TO BE SPENT AT DETECTOR LOCATION j AT THE PURE OIL GAS STATION

Activity Pattern A_i	Detector Location j			
	1 Service Station Office	2 Indoor Service Area	3 Outdoor Service Area	4 Nearby Shelter Area
A_1	.10	.00	.40	.50
A_2	.10	.40	.20	.30

C. Protection Factors

1. Original PF's at Detector Locations (See Figure 215)

	Detector Location	Original PF
1	Service Station Office	1.9
2	Indoor Service Area	2.5
3	Outdoor Service Area	1.8
4	Nearby Shelter Area	32

2. Equivalent Protection Factors for the Activity Patterns

Activity Pattern (See Table LXVII)	Equivalent PF
A_1	3.4
A_2	3.0

D. Contaminated Planes

Identification Number	Description	Area Size (in ft^2)	Surface Material
1	Roof of Gas Station	1,300	Tar and Gravel with Shingle on Overhang in Front
2	Paved Service Area in Gas Station	4,000	Asphalt
3	Streets	25,000	Asphalt
4	Lawns and Bare Earth	2,000	Grass and Earth

E. Contributions to Intensity Factors (C_{ij} Values)

The following gives the structural characteristics of the building which were used to calculate the contributions to intensity values:

a. Roof of Gas Station - 3" pre-cast concrete with 1" tar and gravel (35 lbs/ft^2).

b. Exterior Walls of Gas Station - 8" cinder block with 4" brick veneer in front (80% apertures in front) (40 lbs/ft^2).

c. Interior Partition in Gas Station - 8" cinder block (30 lbs/ft^2).

Table LXVIII lists the contribution to intensity factors of the various planes to the selected detector locations.

Table LXVIII

CONTRIBUTION TO INTENSITY FACTORS (C_{ij} VALUES) FOR THE PURE OIL GAS STATION

Contaminated Plane i	Detector Location j			
	Service Station Office	Indoor Service Area	Outdoor Service Area	Nearby Shelter Area
1 Roof of Gas Station	.2088	.2183	.0014	.0000
2 Paved Service Area in Gas Station	.1444	.1144	.3418	.0000
3 Streets	.0939	.0604	.2119	.0111
4 Lawns and Bare Earth	.0687	.0142	.0067	.0201

F. Relative Intensity Contributions (CF_{ij} Values)

The relative intensity contributions are given in Table LXIX below.

Table LXIX

RELATIVE INTENSITY CONTRIBUTIONS (CF_{ij} VALUES) FOR THE PURE OIL GAS STATION

Contaminated Plane i	Detector Location j			
	1 Service Station Office	2 Indoor Service Area	3 Outdoor Service Area	4 Nearby Shelter Area
1 Roof of Gas Station	.40	.54	.00	.00
2 Paved Service Area in Gas Station	.28	.28	.61	.00
3 Streets	.18	.15	.38	.36
4 Lawns and Bare Earth	.13	.03	.01	.64

G. Cost and Effectiveness

The cost and effectiveness data for selected methods of decontaminating surfaces are given in the following table.

Table LXX

COST AND EFFECTIVENESS DATA FOR SELECTED METHODS OF DECONTAMINATING SURFACES FOR THE PURE OIL GAS STATION

Method	Identification Symbol	Surface (Surface Number)	Mass Reduction Factor (Fraction fallout material remaining after decontamination	Team Hours of Effort	No. in Team
Firehose	A	Roof of Gas Station (1)	.01	0.2	7
Firehose	B	Roof of Gas Station (1)	.07	0.1	7
Firehose	C	Roof of Gas Station (1)	.12	0.1	7
Firehose	D	Paved Service Area (2)	.02	0.1	5
Flusher	E	Paved Service Area (2)	.02	0.1	1
Street Sweeper	F	Paved Service Area (2)	.15	0.1	1
Firehose	G	Streets (3)	.02	0.5	5
Flusher	H	Streets (3)	.02	0.3	1
Street Sweeper	I	Streets (3)	.15	0.3	1
Grader	J	Lawns, Bare Earth, etc.	.10	0.5	1

H. RN_j Values

The fraction of intensity remaining for selected strategies is given in Table LXXI.

Table LXXI

FRACTION OF INTENSITY REMAINING (RN_j VALUES) FOR SELECTED STRATEGIES FOR THE PURE OIL GAS STATION

Combined Strategy	Detector Location j			
	Service Station Office	Indoor Service Area	Outdoor Service Area	Nearby Shelter Area
A	.60	.47	1.00	1.00
B	.62	.50	1.00	1.00
C	.64	.53	1.00	1.00
D	.73	.72	.40	1.00
G	.82	.85	.63	.65
J	.88	.97	.99	.42
A+E	.32	.19	.40	1.00
A+F	.36	.23	.48	1.00
B+H	.45	.36	.63	.65
B+I	.47	.38	.68	.70
A+D+G	.15	.05	.03	.65
A+D+G+J	.03	.02	.02	.07

I. RN_A Values

The activity reduction factors for selected strategies and the activity pattern are given in Table LXXII.

Table LXXII

ACTIVITY REDUCTION FACTORS (RN_A VALUES) FOR SELECTED STRATEGIES AND THE ACTIVITY PATTERNS FOR THE PURE OIL GAS STATION

Combined Strategy	Activity Pattern	
	A_1	A_2
A	.93	.68
B	.93	.70
C	.94	.72
D	.49	.63
G	.67	.77
J	.94	.95
A+E	.42	.31
A+F	.49	.36
B+H	.60	.47
B+I	.64	.50
A+D+G	.09	.07
A+D+G+J	.02	.02

J. Conclusions

Five man-hours of effort (combined strategy A+D+G) would reduce the radiation dose to persons operating the gas station by more than a factor of ten. If only the service station area (the roof and paved service area) were decontaminated, the intensity at the three detector locations at the gas station itself would be reduced by about a factor of three (see Table LXII - Strategy A+E).

XIV. SUMMARY AND CONCLUSIONS

For all of the sites and facilities considered in this report, properly planned decontamination can substantially reduce the intensity at almost all indoor detector locations by at least a factor of five. This assumes that the persons responsible for performing decontamination have investigated and properly accounted for the problems of resource acquisition, personnel assignment and the drainage or other types of control of the fallout material removed from the contaminated planes. In many cases decontamination can decrease the intensity at certain indoor detectors by factors as high as fifty.

The results of the analyses in this report show one strategy of decontamination as influencing the radiation intensity at indoor detector locations. That strategy is firehosing the roof directly above the detector. This is because the roof contribution is most often the principle contributor to the intensity at indoor detectors. Table LXXIII shows the fraction of the total intensity at various indoor detector locations (selected from the facilities analyzed in Sections II through XIII) which is contributed by the roof directly above the detector. Inasmuch as every structure studied in this report has a flat or very low pitch roof, the only method which could effectively remove the fallout is high velocity firehosing. Most of the structures studied have high pressure hose connectors close to or on the roof. Fireplugs are within 200 feet of the bases of each of the other buildings.

Table LXXIII

FRACTION OF TOTAL INTENSITY TO VARIOUS DETECTOR LOCATIONS CONTRIBUTED BY THE ROOF OF THE FACILITY

Facility	Detector Number and Description	Fraction of Intensity Contributed By the Roof
1. Mercy Hospital	1 Center Corridor (1st Floor)	.83
	2 Corridor-Surgical Wing	.96
	8 Patient's Room on Main Corridor	.60
2. E. J. Korvette Department Store	2 Center of 2nd Floor	.94
	4 Off-center Location on 2nd Floor	.90
	5 Office on 2nd Floor	.90
	7 Shelter Area in Partial Basement	.89
3. Springwells Station	1 Center of 1st Floor in High Lift Plant	.99
	2 Control House	.88
	3 Center Location in Turbine Room	.98
	4 Off-center Location in Turbine Room	.99
	7 Aisle in Old Filter Building	.87
	9 Shelter Area in Basement Area near Low Lift Plant	1.00
4. Mistersky Power Plant	6 Center Location in Turbine Room	.94
	7 Off-center Location in Turbine Room	.92
5. Cobo Hall	3 Cafeteria in Upper Level	.61
	6 Office in Upper Level	.70
6. City-County Building	3 Center Location on 13th Floor in 20 Story Tower	.69 *
	4 Center Location on 20th Floor in 20 Story Tower	1.00
	9 Office on 12th Floor of 14 Story Tower	.72
7. Detroit City Airport	4 Center Location in Large Hangar	.60
8. Detroit OCD Building	1 Center Hall on 1st Floor	.82
	2 Message Center in Basement	1.00
	3 Supply Room in Basement	1.00
	4 Director's Office in Basement	.99
	5 Medical Room in Basement	1.00
	6 Men's Rest Room in Basement	1.00
9. Saint Mary's School	4 Schoolroom on 2nd Floor (Old Building)	.47
	6 Shelter Area in Basement of Old Building	.51
10. Isaac Crary School	5 Classroom on 2nd Floor	.46
	6 Shelter Location in Sub-basement	.60
11. Cadillac Motor Car Division	3 Center Location in Manufacturing Plant	.93
	6 Blueprint Room in Engineering Building	.89
	7 Drafting Room in Engineering Building	.95
12. Pure Oil Gas Station	1 Service Station Office	.40
	2 Indoor Service Area	.54

* (Entirely from Roof of 14 Story Tower)

The team-hours of effort required to firehose the roofs directly above the detector locations are listed in Table LXXIV. These figures do not include set-up or travel time.

The intensity at outdoor detector locations can also be reduced appreciably by decontaminating the surfaces contributing most to the intensity at the detector. If the plane directly below the detector is decontaminated, the intensity is almost always reduced by at least a factor of ten. Unless the surface is paved, however, the cost in man-hours of effort is usually quite high. Since ground surface planes of contamination are usually quite large, it might be more practical to consider only decontaminating those outdoor planes where persons are required to be (e.g., major streets), or those which contribute heavily to an essential indoor detector.

Table LXIV

TEAM HOURS OF EFFORT REQUIRED TO FIREHOSE THE ROOFS OF THE FACILITIES CONSIDERED IN THIS ANALYSIS

Facility (and Buildings where applicable)	Mass Reduction Factor	Team Hours of Effort	No. in Team
1. Mercy Hospital	.01	1.01	7
	.07	.46	7
2. E. J. Korvette Department Store	.01	9.80	7
	.12	3.01	7
3. Springwells Station			
a. Old Filter Building, Annex, and Office Building	.01	19.63	7
	.12	6.02	7
b. Lift Plant	.03	3.44	6
	.08	1.08	6
4. Mistersky Power Plant			
a. Main Plant Building	.01	12.88	7
	.07	5.89	7
b. Office and Shop Building	.01	.77	7
5. Cobo Hall			
a. Exhibition Building (Parking Deck)	.02	6.00	5
b. Convention Arena	.03	10.40	6
6. City-County Building	.01	4.98	7
	.12	1.53	6
7. Detroit City Airport			
a. Terminal	.01	2.24	7
	.12	.69	7
b. Main Hangar	.03	2.40	6
	.08	.50	6
8. Detroit OCD Building	.01	1.69	7
	.07	.77	7
9. Saint Mary's School			
a. New Building	.01	3.19	7
	.12	.98	7
b. Old Building	.03	3.10	6
	.08	.97	6
10. Isaac Crary School	.01	3.39	7
	.07	1.55	7
	.12	1.04	7
11. Cadillac Motor Car Division			
a. Manufacturing Building	.01	19.30	7
	.12	5.93	7
b. Engineering Building	.01	12.60	7
	.07	5.76	7
c. Administration Building	.01	12.60	7
	.12	3.87	7
12. Pure Oil Station	.01	.18	7
	.07	.08	7

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13. ABSTRACT

This is Volume IV of four separately bound volumes that report the research completed under the general terms of the Office of Civil Defense Substask No. 3233B, "Radiological Recovery Requirements, Structures, and Operations Research". This volume contains the supporting data related to decontamination analyses of twelve sites and facilities from Detroit, Michigan. Volume I describes the general aspects of the investigations and presents the conclusions and recommendations.

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