iras LIMITED
Independent Radiation Assessment Services

RADIATION SURVEY OF COUPLAND 1 BUILDING UPON COMPLETION OF SOFT STRIPPING

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Technical Report

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1 Executive Summary

In order that Coupland 1 may be refurbished and re-occupied without radiological restrictions, work is underway to identify and remove contamination in the building.

As part of this work, the building has been subjected to a systematic and extensive survey of the floors, walls and ceilings in those areas where the stripping of fixtures and fittings has been completed.

This survey has shown that low levels of radioactive contamination are present in discrete areas in the majority of the rooms within the building, with over 50 areas of contamination being identified. One room (2.62) is more extensively contaminated, whilst two areas of significantly higher contamination have been identified, these being in rooms 2.52/2.53 and The Bee Keepers.

Of the 20 areas of contamination which are one or more orders of magnitude above background, 16 have been positively identified as being contaminated with radium-226, and one identified as being lead-210. These are both naturally occurring radionuclides commonly associated with work in the Rutherford era. The remaining three were not assessed as they were in close proximity to contamination where the radionuclide had been identified.

These areas of contamination must be removed as part of the decontamination work, however, consideration must now be given to those areas where contamination may be present and be undetected in order to determine the extent of any further stripping work which may be required in order to allow monitoring to take place with a suitable sensitivity.

Firstly, attention is drawn to the Lecture Theatre, and the Corridor and Lift Shaft on each floor. These areas must be stripped in order that a survey may be undertaken with a high level of confidence that significant contamination will be detected.

Secondly, previous work and indications from some preliminary investigations of conditions beneath floorboards show that radioactive contamination is likely to be present and be undetected under the floorboards. That this has been shown to be the case in rooms where contamination has not been detected above the floorboards prevents the limitation of the floorboard removal to any specific areas.

In summary, low level radioactive contamination has been shown to be present in the majority of rooms and must be removed. In order that the project objective can be met, extensive removal of floor boards is required in order to facilitate the monitoring of the area beneath. In addition, the stripping of the lecture theatre and the completion of the stripping work in the corridor and lift shaft on each floor is required.

2 Introduction

This report describes the radiation survey of Coupland I building that took place during September / October 2004. The survey excluded those areas where stripping was incomplete, these being the Cohen Lecture Theatre (Figure 1) and the Main Access corridor (Figure 2) and lift shaft on each floor. The stripping of the Lecture Theatre had been deferred to "hard stripping" stage of the project to reflect the extensive demolition work required, whilst the completion of the stripping of the Main Access corridor and lift shaft on each floor has been delayed pending identification of important data and fire system cabling.

Figure 1. The Cohen Lecture Theatre at the time of the survey

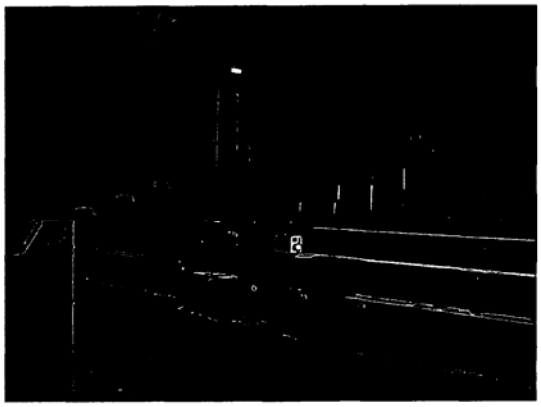
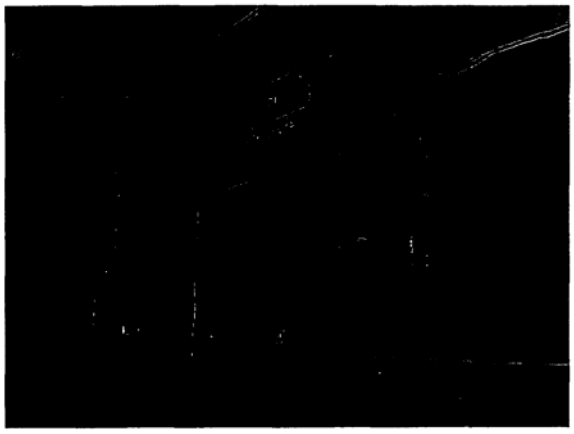


Figure 2. One of the corridors with electrical installations evident on the wall.



The objective of the survey was to determine the nature and distribution of radioactive contamination throughout the building, being that present on the floors, walls and ceilings. A further objective was to identify areas where the survey was unlikely to detect contamination if present, that would require further stripping before monitoring could take place. An example of such an area, identified in previous operations in the building as being likely to contain undetected contamination, is the space beneath the floorboards.

The report describes the survey method and reports and discusses the monitoring results.

3 Method

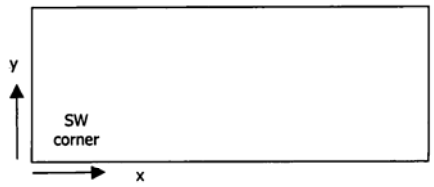
3.1 Location Referencing

The contamination survey was to give full coverage of the available surfaces, which were divided into 1 metre squares for position referencing purposes. Whilst areas of contamination may be detected that are small and discrete, for referencing purposes they are assigned to the metre square in which they lie.

In order that the location of contamination can be referenced to the original survey sheets, it is necessary to go into the detail of the referencing system. As a starting point, the front of Coupland 1 building, i.e. that which opens onto Coupland Street, was nominally assigned as "north".

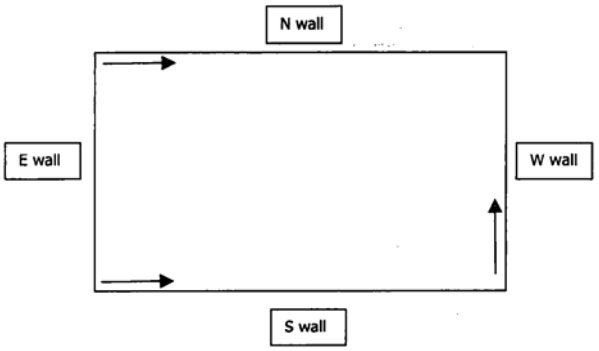
In the case of floor surveys (Figure 3), the origin was set in the nominally assigned South West corner of the room with metre squares marked from the this origin. The co-ordinates of a square are given in (x,y) format where x is the distance to the east of the origin (easting), and y is the distance to the north of the origin (the northing). Positions are referenced to the bottom left hand corner of each metre square.

Figure 3 Position referencing on floors



For the walls, the y co-ordinate was used to give the height above floor level, whilst the x co-ordinate was used to give the distance along the wall from the origins shown in Figure 4. This system has the consequence that on the plans for the South and East walls, x increases right to left.

Figure 4 Plan view of wall referencing system which notes the x-direction



The co-ordinate system used for the ceilings is based on a projection of the floor co-ordinates on to the ceiling.

3.2 Contamination monitoring

Contamination monitoring was undertaken in each metre square using a Mini Instruments 900 monitor with an EP15 probe for the floors and walls up to a height of 3 m, and a Thermo Selectra with a dual phosphor DP6 probe for the walls above 3 m and the ceilings. Both instruments are sensitive to alpha and beta radiation.

Whilst these monitoring techniques were applied in a systematic and thorough manner, the limitations on these techniques must be acknowledged.

Firstly, whilst not relevant to the radioactive contaminants used in Rutherford's work, there is the potential that more recent work with radioactive materials in Coupland 1 for biomedical purposes may have involved the use of tritium. These monitoring techniques are largely insensitive to tritium contamination.

Secondly, the level of dust present during the monitoring and also that many of the original surfaces had at some time been painted, means that the detection of alpha radiation will be unreliable. It should be noted that the majority of those alpha emitting radionuclides associated with the Rutherford era will be accompanied by emission of beta and gamma radiation either directly or via an immediate decay product. The presence of dust or paint is unlikely to prevent the detection of the radionuclides previously identified as being the most likely contaminants, i.e. radium-226 or lead-210 / polonium-210.

The likelihood that any "pure" alpha emitting radionuclides would have been used at any time in this building is low, but the possibility cannot be ruled out.

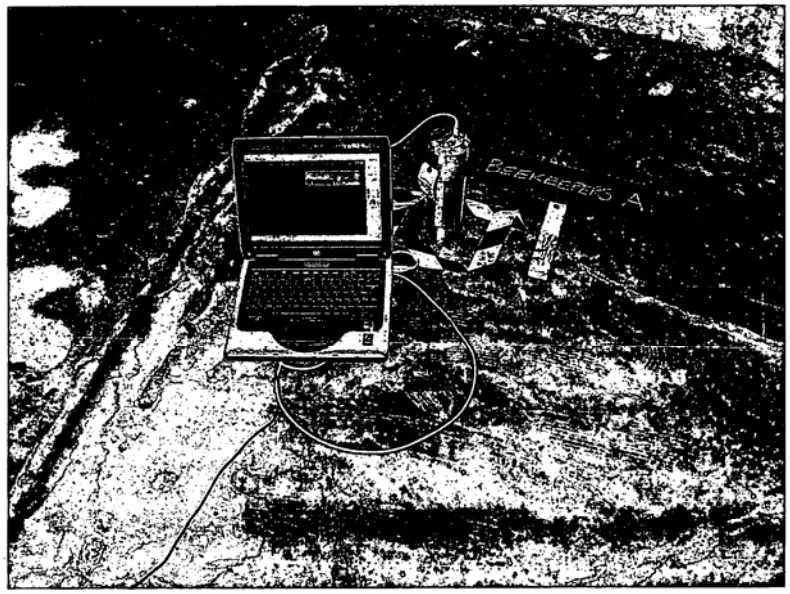
In addition to those factors which reduce the sensitivity of the measurement techniques to alpha radiation, where contamination is covered by a layer of plaster or is present beneath floor boards, attenuation of beta and gamma radiation may also occur to a degree which presents detection in this survey. These areas were to be noted during this survey and be subjected to "hard stripping" in the next stage of operation, in order to permit monitoring of those covered areas.

When detected, an area of contamination was surrounded by high visibility tape and was marked with a trefoil and the word "radioactive". A simple assessment of the radiation emitted was made by using instruments preferentially sensitive to alpha, beta and gamma radiation. These were a Giltech Contamination Meter with a Mullard Alpha Probe Type L313 for alpha, a Mini Instruments 900 Type EP15 for beta, and a Mini Instruments 900 Type 42A NaI(Tl) scintillation detector for gamma radiation.

3.3 Radionuclide identification

A portable low-resolution gamma spectrometry (LRGS) system (Figure 5) was used to identify gamma emitting contaminants, which in the main were anticipated as being radium-226 together with it's decay products, and lead-210 / polonium-210.

Figure 5 LRGS being used to identify gamma emitting radionuclides



Radium-226 is relatively straightforward to identify using LRGS. Identification of lead-210 / polonium-210 by LRGS is more difficult on account of the low energy and low emission probability of the gamma radiation emitted by lead-210 (46.5 keV at 4% emission probability). This results in a poor limit of detection, which prevents identification of lead-210 / polonium-210 at lower levels of contamination.

In each case, identification was undertaken by direct comparison in situ with test sources containing radium-226 and lead-210.

4 Results

4.1 Building Survey

The systematic survey of the building identified over 50 areas of contamination. These are listed in Table 1, with photographic records being appended in Appendix A.

Table 1 Areas of contamination identified by the Soft Strip Survey.

Room	Coordinate	Identifier	Alpha cps	Beta cps	Gamma cps
G57 (B7)	F (5,2)	A	1	7	5 (=bgd)
	F (6,2)	B	0.5	8	5 (=bgd)
	F (5,3)	C	0	6	5 (=bgd)
	F (6,3)	D	0	10	5 (=bgd)
G52	EW (7,2)	A		20	
G53	F (8,3)	A	0	15	7
	F (7,2)	B	0	5	(4-5 =bgd)
	F(7,0)	C	0	10	(4-5 =bgd)
	F (7,6)	D	0	8	(4-5 =bgd)
	F (1,2)	E	0	15	10
1.51	C	Not assessed - same location as above room.			
1.52	F (0,1)	A	0	700	200
1.53	SW (1,0)	A	0 (painted)	60	40
	WW (0,0)	B	0 (Painted)	10	(4-5 =bgd)
1.54/1.55	F (8,0)	A	0.5	20	9
	F (8,1)	B	0	10	9
	F (7,2)	C	0	250	80
	F (4,4)	D	0	10	7
	F (4,4)	E	0	20	10
	F (4,5)	F	0	100	20
1.56	F (2,0)	A	0.5	120	50
	F (0,0)	B	0.5	15	(4-5 =bgd)
	WW (1,0)	C	0	30	20
	F (3,3)	D		4	(4-5 =bgd)
	F (1,5)	E	0	50	100
1.57	WW (0,0)	A	0	70	30
	F (1,4) *	B	0	20	20
	F (1,4) *	C	0	30	40
	F (1,4) *	D	0	5	9
2.52/2.53	F (2,5)	A	0	60	40
	F (2,6)	B	5	30	15
	F (4,3)	C	0	50	50
	F (2,4)	D	300	2000	250
	F (0,0)	E	0	50	10
	F (3,0)	F	0	5	5
2.54/2.55/2.56	F (1,3)	A (BENEATH FLOOR)	0	150	15
	F (1,3)	b Floorboard	0	20	15
	F (4,1)	C	0	10	4

Room	Coordinate	Identifier	Alpha cps	Beta cps	Gamma cps
	C (1,4)	D (CEILING)		3	8
Mezzanine	F (9,3)	A	0.5	30	8
	F (5,1)	B	0.5	8	7
	F (3,4)	C	40	100	20
	F (3,5)	D	1.5	100	30
2.60/.61	F (8,0)	A	0	15	10
	F (8,2)	B	0	200	70
	F (4,5)	C	0	30	10
2.62		Many areas	0-50	05-1O	
	WW (3,0)	West wall	40	100	20
2.63	WW (0,0)	A	0	400	150
	SW (1,0)	B	0	50	20
	F (3,3)	C	0.5	20	9
	F (1,3)	D	0	20	20
	F (3,5)	E	0	20	20
Tank room	F (0,3)	A	0.5	40	10
Beekeepers	F (4,2)	A	1	2000	600
	F (2,0)	B	0.5	100	20
	F (2,1)	C	0	7	4-5 (=bgd)

4.2 Radionuclide identification

Radionuclide identification using LRGS was successful in identifying radium-226 in 21 areas and lead-210 in one area. In this way radionuclide identification was undertaken of 17 of the 20 most contaminated areas (those above 50 cps, beta), with the remaining 3 locations not being assessed on account of them being in close proximity to identified contamination.

Figure 6 gives an example of a spectrum where radium-226 is identified, whilst Table 2 lists those areas where the contaminant was identified.

Figure 6 The gamma spectrum of the contamination in Room 1.52 (blue) compared with a radium-226 spectrum (yellow)

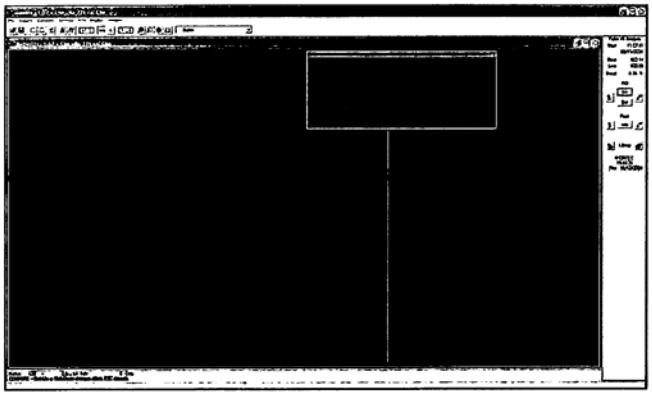


Table 2 Locations where contaminants have been positively identified.

Room	Coordinate	Identifier	Alpha cps	Beta cps	Gamma cps	Radionuclide
1.52	F (0,1)	A	0	700	200	Ra-226
1.53	SW (1,0)	A	0 (painted)	60	40	Ra-226
1.54/1.55	F (8,0)	A	0.5	20	9	Ra-226
	F (7,2)	C	0	250	80	Ra-226
	F (4,5)	F	0	100	20	Ra-226
1.56	F (2,0)	A	0.5	120	50	Ra-226
	WW (1,0)	C	0	30	20	Ra-226
	F (1,5)	E	0	50	100	Ra-226
1.57	WW (0,0)	A	0	70	30	Ra-226
	F (1,4) *	C	0	30	40	Ra-226
2.52/2.53	F (2,5)	A	0	60	40	Ra-226
	F (4,3)	C	0	50	50	Ra-226
	F (2,4)	D	300	2000	250	Ra-226
2.54/2.55/2.56	F (1,3)	A (BENEATH FLOOR)	0	150	15	Ra-226
	C (1,4)	D (CEILING)		3	8	Ra-226
Mezzanine	F (3,4)	C	40	100	20	Ra-226
Mezzanine	F (3,5)	D	1.5	100	30	Ra-226
2.60/.61	F (8,2)	B	0	200	70	Ra-226
2.62	WW (3,0)	West wall	40	100	20	Ra-226
2.63	WW (0,0)	A	0	400	150	Pb/Po-210
Tank room	F (0,3)	A	0.5	40	10	Ra-226
Beekeepers	F (4,2)	A	1	2000	600	Ra-226

Radionuclide identification is useful in order to prepare prior risk assessments for the hard stripping and removal work, and also to identify which Authorised Very Low Level Waste (VLLW) limits apply to the waste.

It should be noted that, at this stage, estimating activity associated with these individual areas of contamination is of limited use, as in many cases, such as where the removal of a contaminated floor board reveals that the edges and underside of the floorboard are contaminated, the decontamination operation will uncover more activity. The activity assessment will be left until all waste items have been removed.

5 Conclusion

5.1 Distribution of contamination

Low levels of discrete contamination have been identified in the majority of rooms in Coupland 1 with only 2 rooms apparently free from contamination.

Exceptions to this were the more extensively contaminated areas in Room 2.62, and two areas where the level of contamination was significantly higher than that typical for the building. These areas were in Room 2.52/2.53 Floor (2,4) Area D and The Beekeepers Floor (4,2) Area A.

The majority of contaminated locations were associated with the floor, with only 8 locations being identified on the walls and 2 on the ceilings.

The contamination of the ceiling in Room 1.51 is clearly related to the contamination of the floor above, and is likely to have resulted from the spillage of material in the room above. This suggests that greater levels of contamination may be present in the space between.

5.2 Radionuclide identification

Low-resolution gamma spectrometry (LRGS) successfully identified radium-226 in 21 areas, and lead-210 in one area. Radionuclide identification was successful in 17 of the 20 most significantly contaminated areas, with the remainder being unassessed because of their close proximity to areas of identified contamination.

This result is consistent with previous information on the main contaminants of the building and is also consistent with those radionuclides used in the Rutherford era.

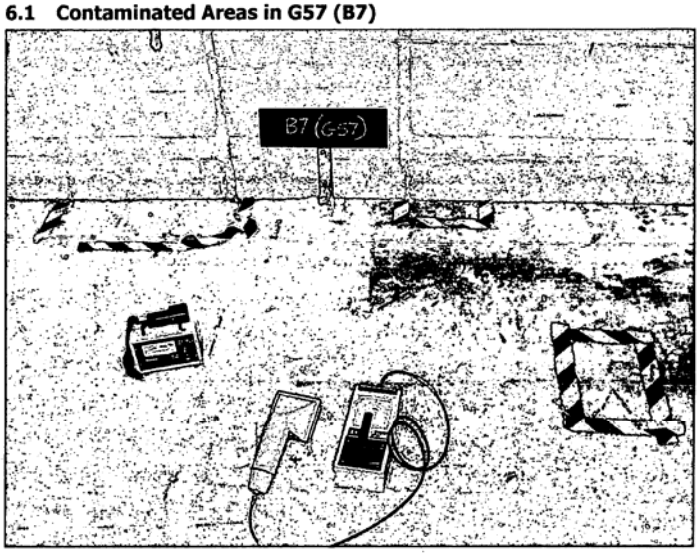
5.3 Proposed extent of hard stripping

Further stripping work is required in the Cohen Lecture Theatre and the Main Corridor and Lift Shaft areas on each floor, in order that monitoring may be undertaken with a high level of confidence of detecting contamination.

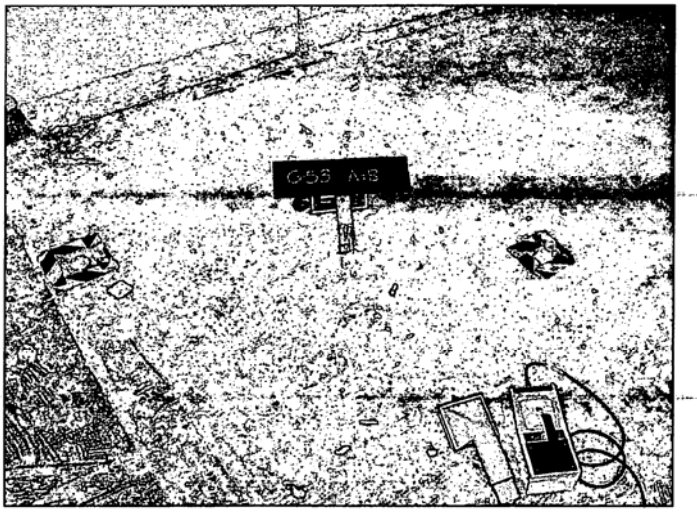
The hard stripping work must also include the removal of the floorboards, as both previous work and preliminary investigations undertaken as part of the current project have shown that radioactive contamination is likely to present beneath the floor boards. In particular, that contamination has been identified beneath floorboards in rooms which are otherwise free from contamination prevents the limitation of the floorboard removal work to any specific areas.

6 Appendix A – Photographic Records of Contaminated Areas

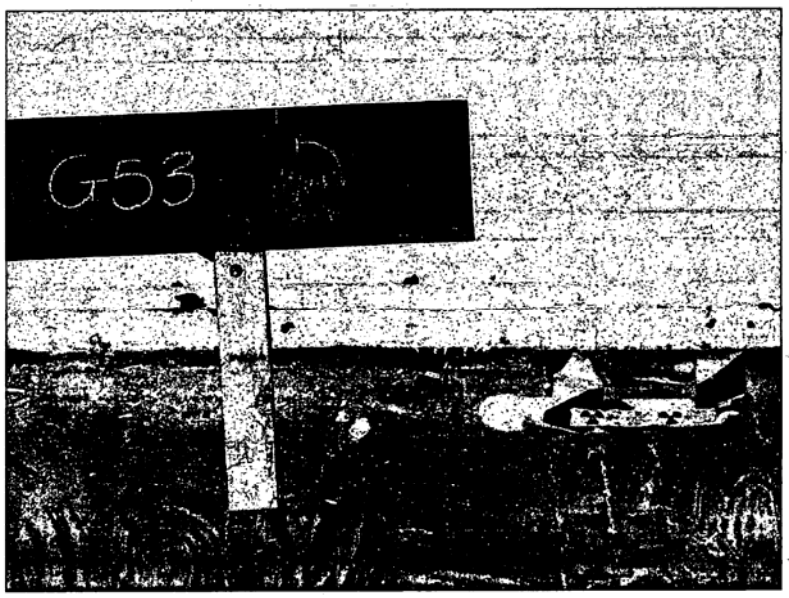
6.1 Contaminated Areas in G57 (B7)

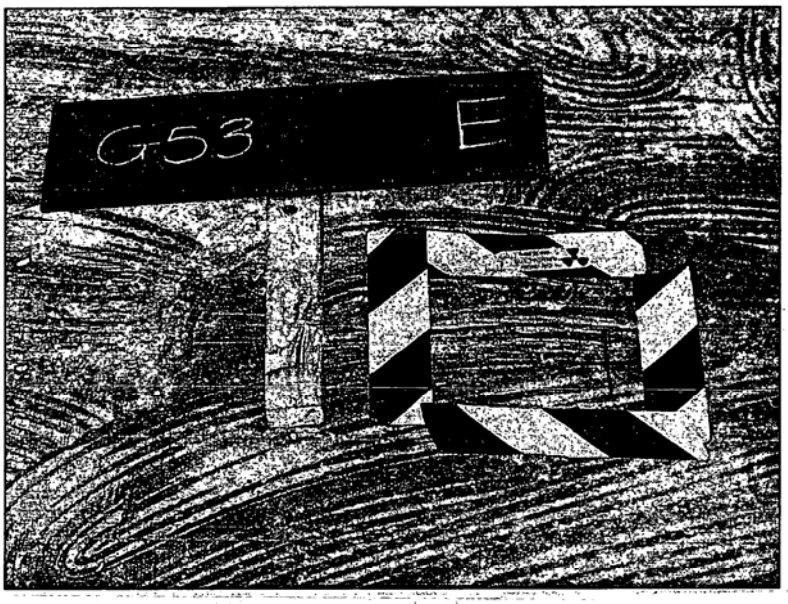


6.2 Contaminated Areas in G53




G53


G53

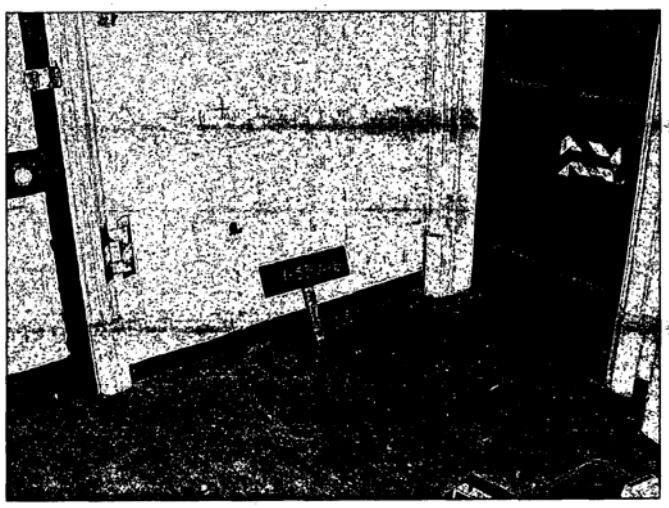


6.3 Contaminated Areas in 1.51

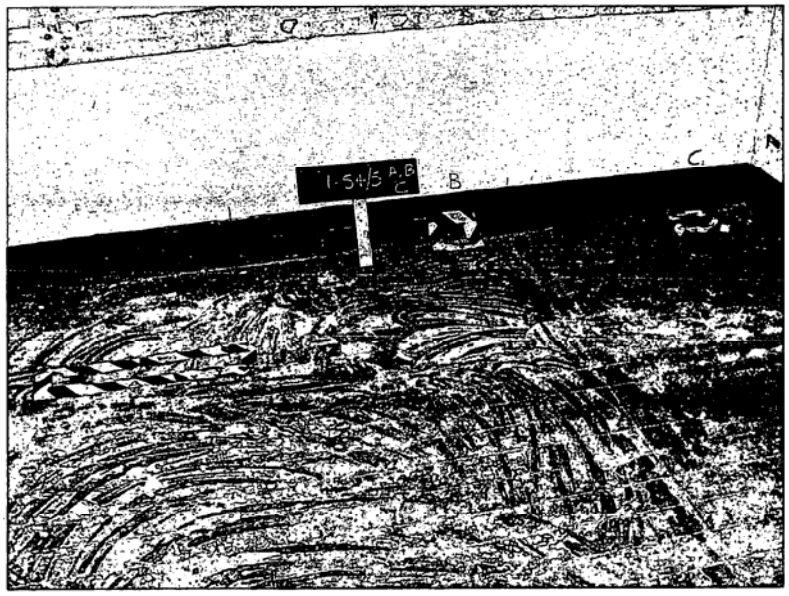
Not assessed or photographed.

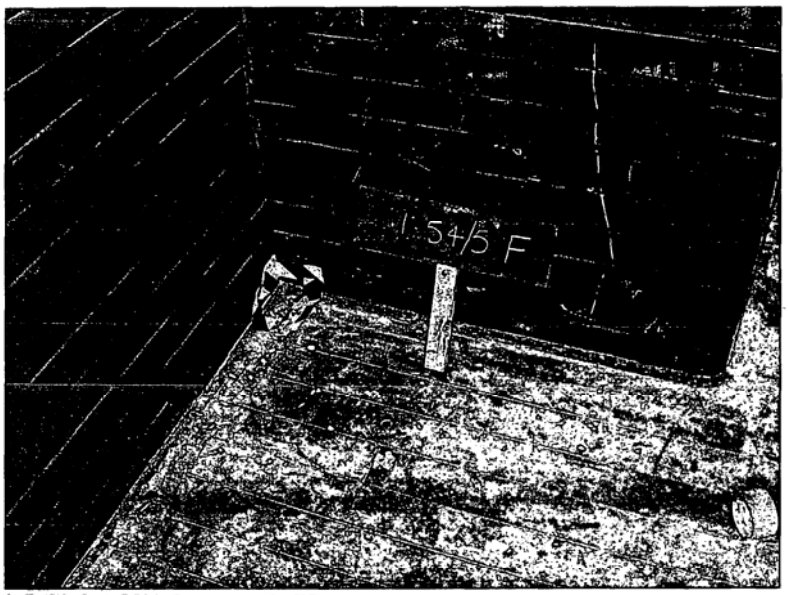
6.4 Contaminated Areas in 1.52

6.5 Contaminated Areas in 1.53

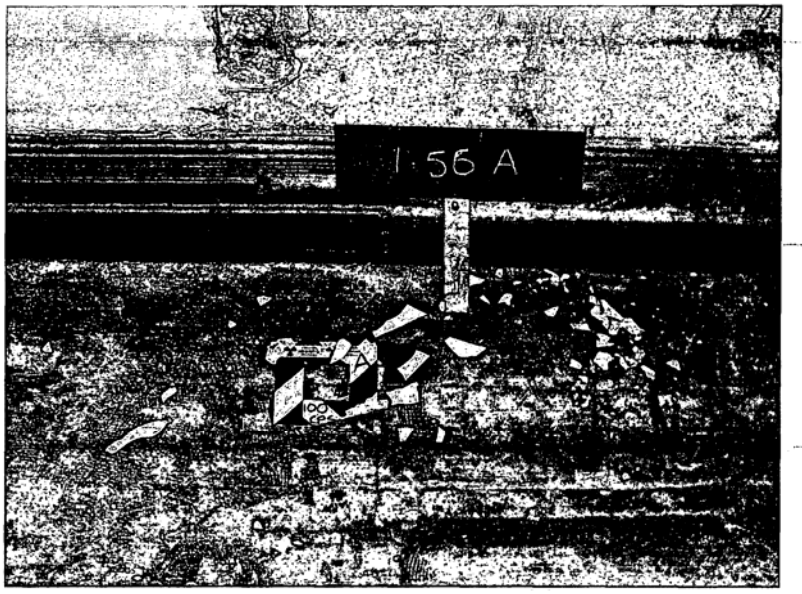


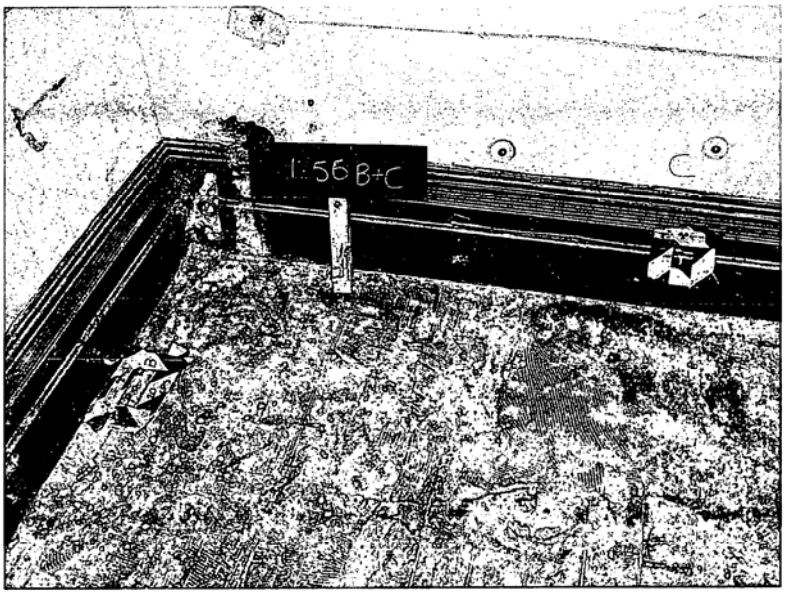
6.6 Contaminated Areas in 1.54/1.55

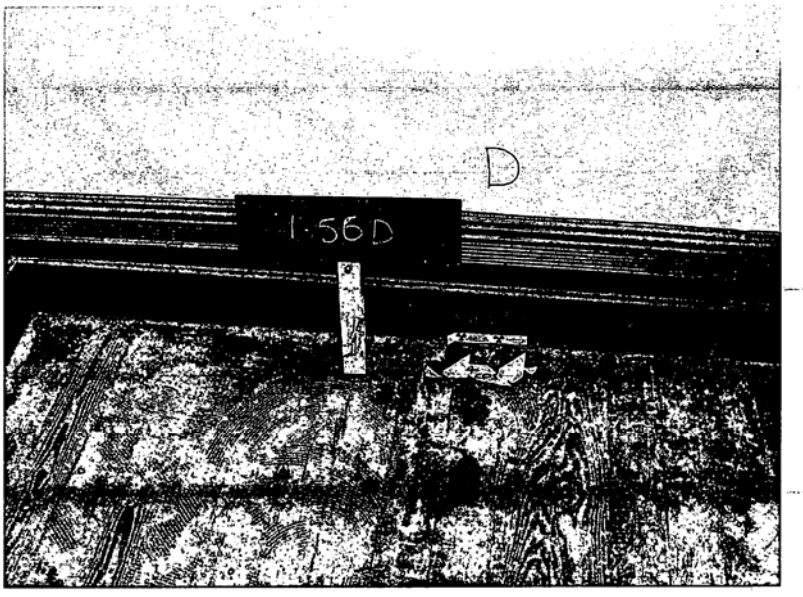


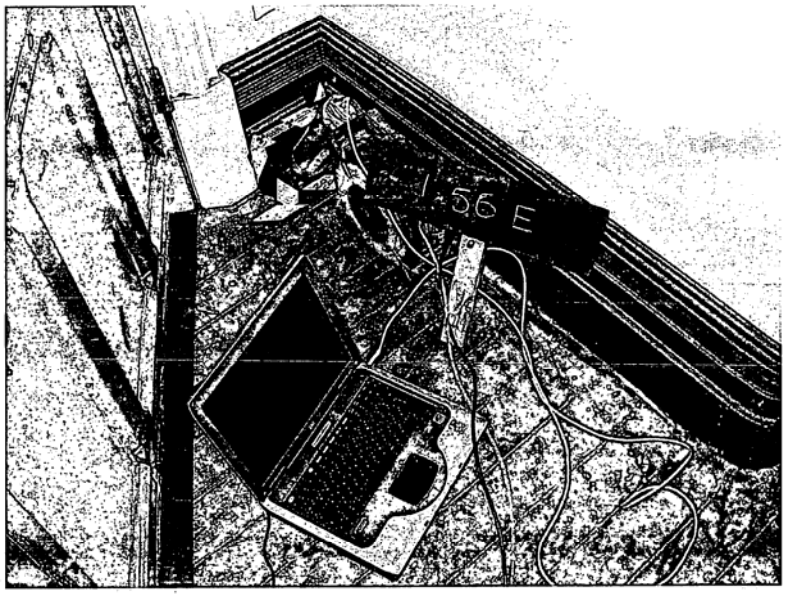


6.7 Contaminated Areas in 1.56



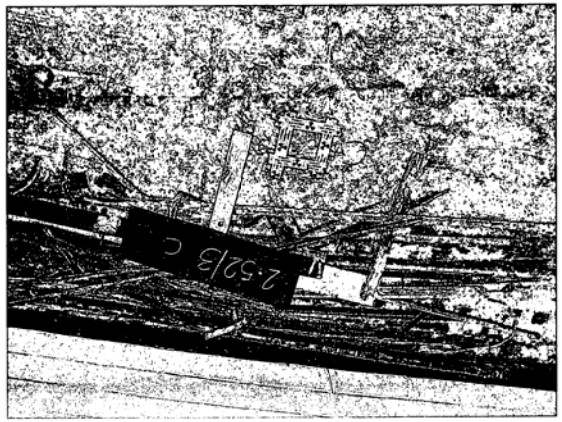

1.56 B+C
C


D
1.56 D

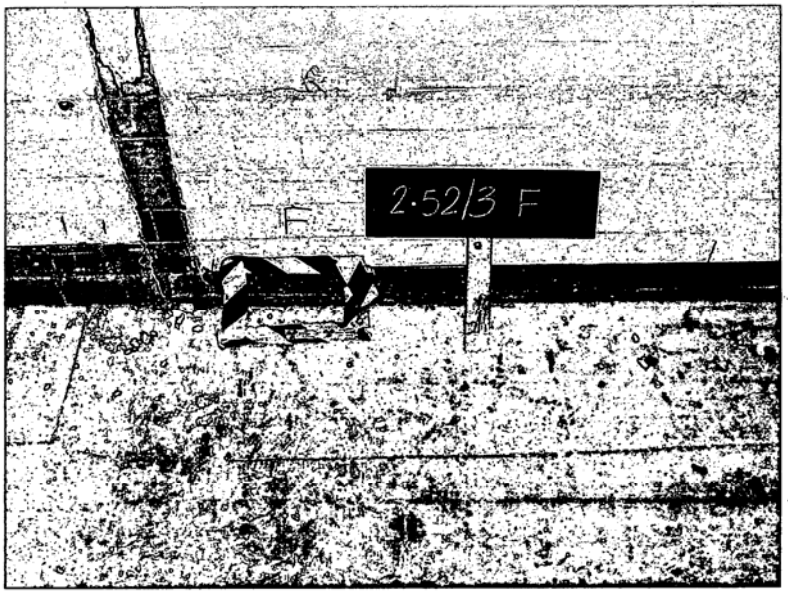


6.8 Contaminated Areas in 1.57

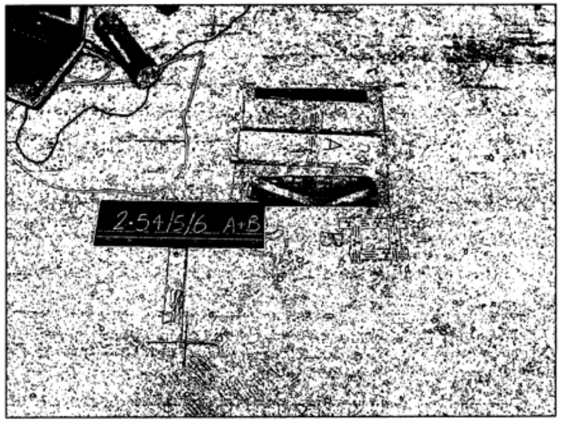
6.9 Contaminated Areas 2.52 / 2.53

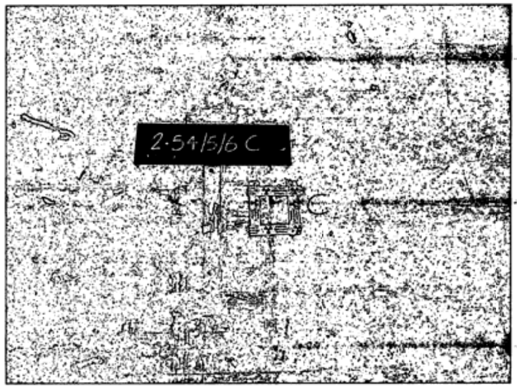


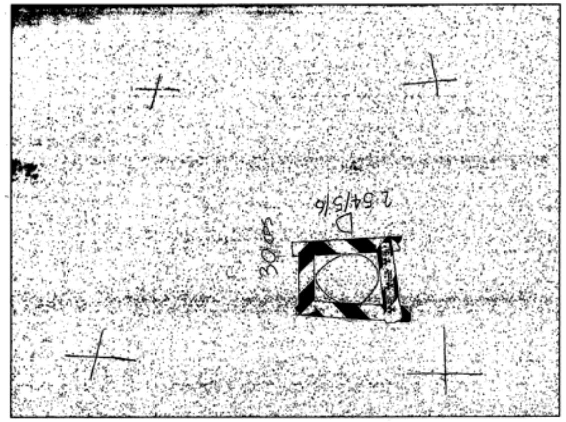

2·52/3 E
E


F
2·52/3 F

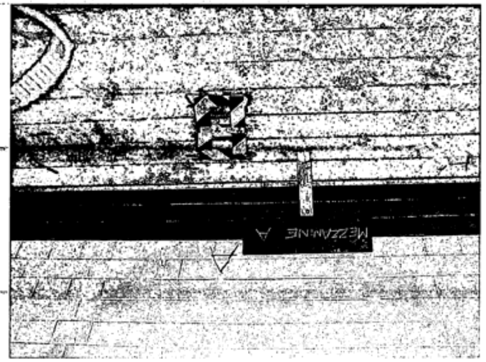
6.10 Contaminated Areas in 2.54 / 2.55 / 2.56

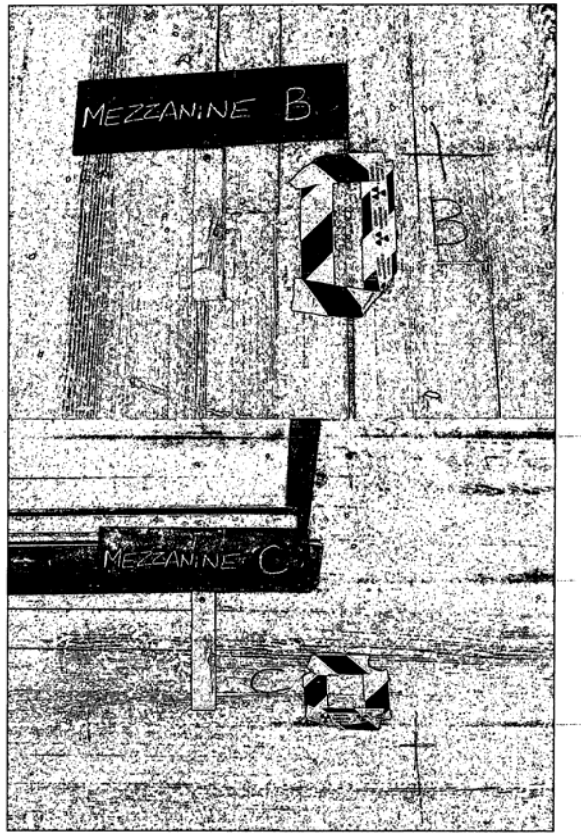


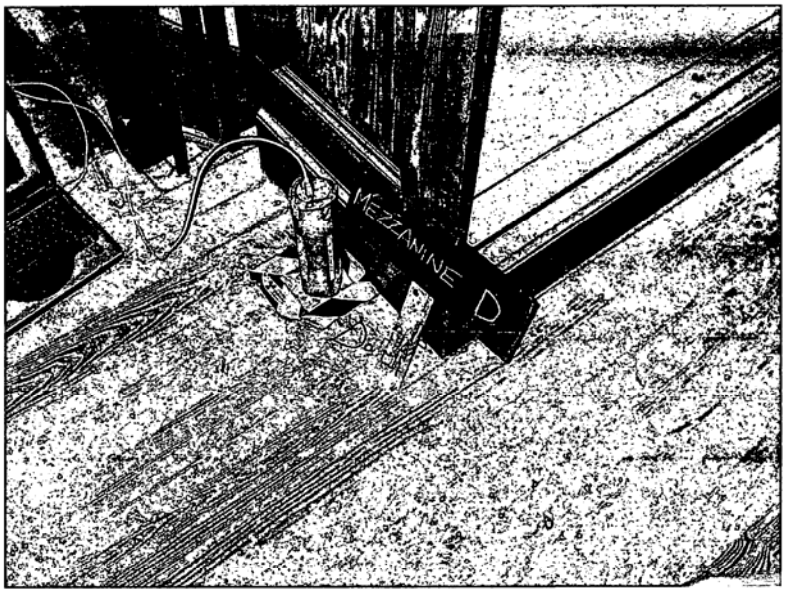




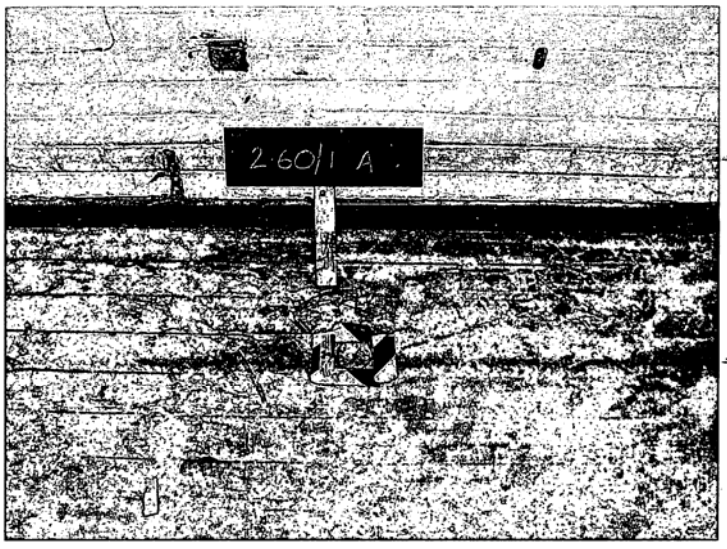
6.11 Contaminated Areas in Mezzanine Area

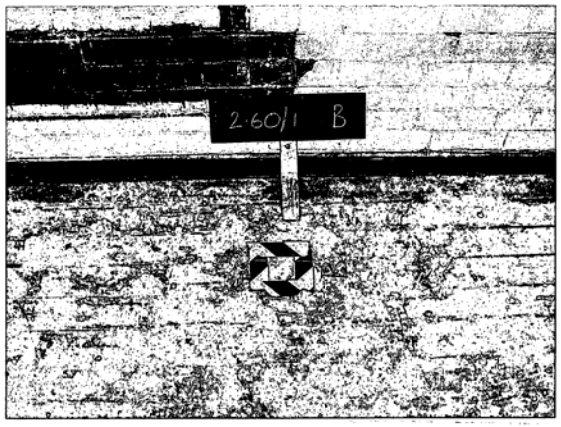



MEZZANINE B
B
MEZZANINE C
C

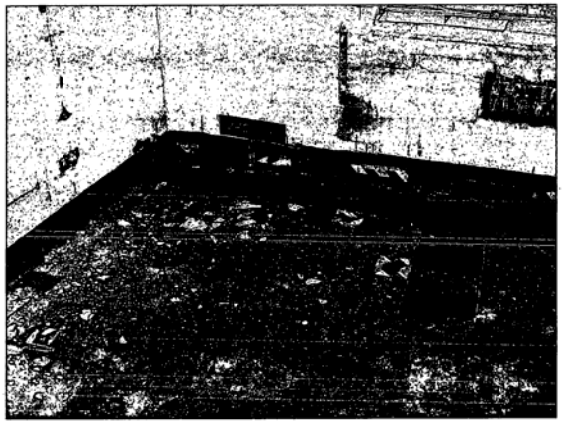


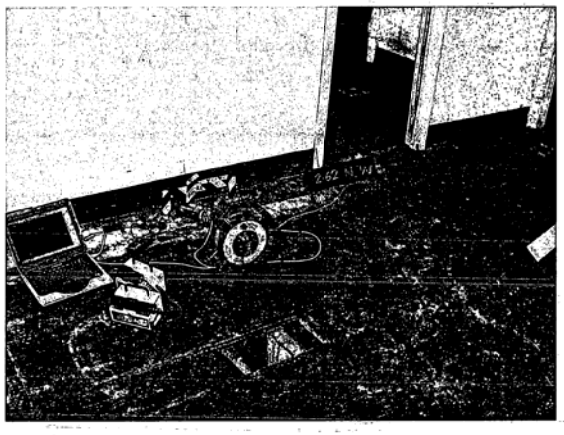
6.12 Contaminated Areas in 2.60/2.61

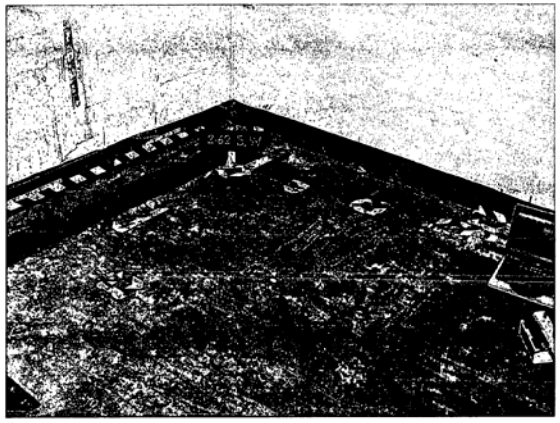




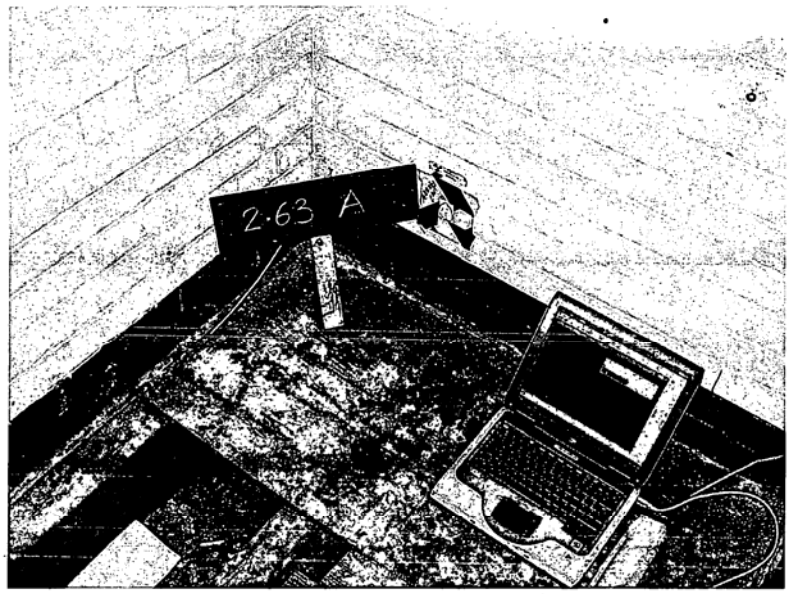
6.13 Contaminated Areas in 2.62

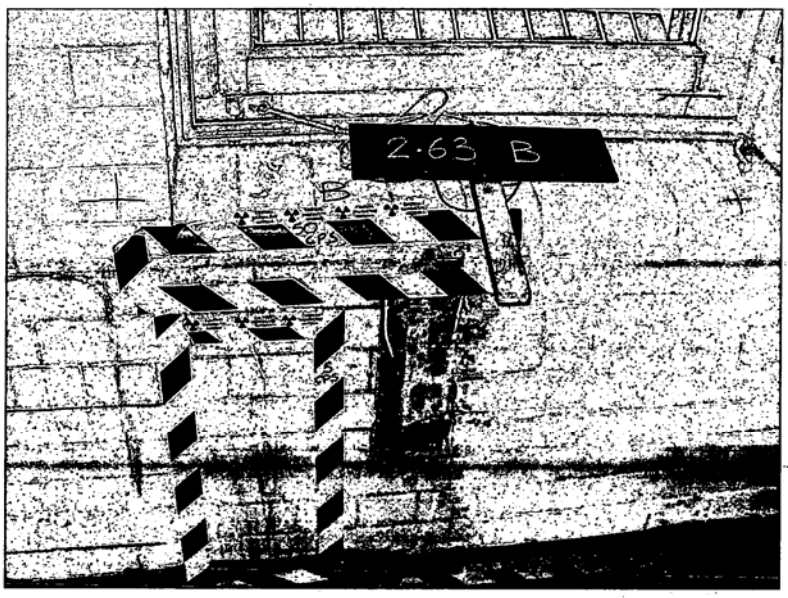


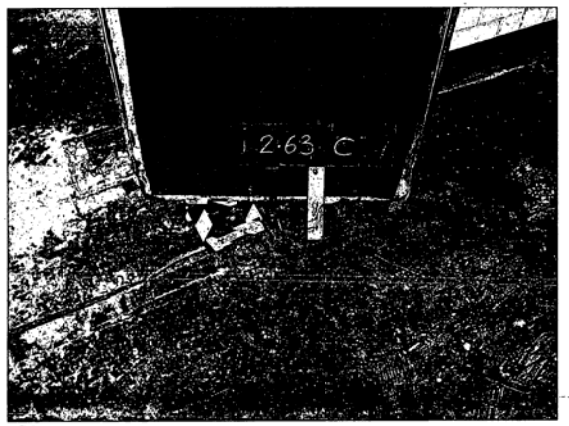


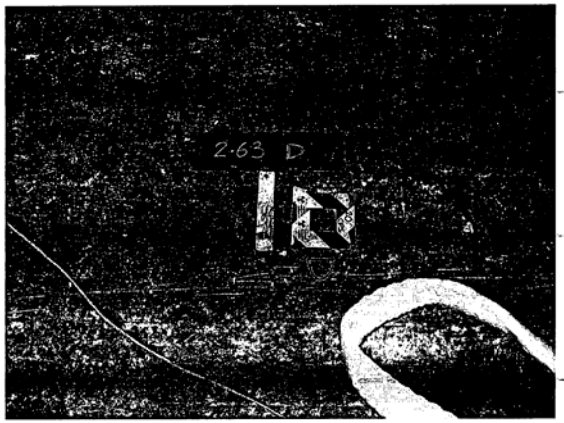


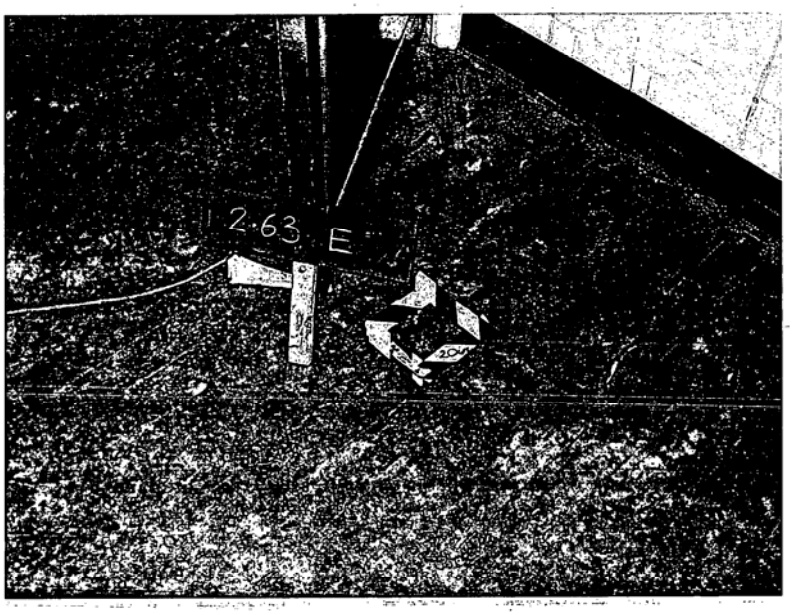
6.14 Contaminated Areas in 2.63





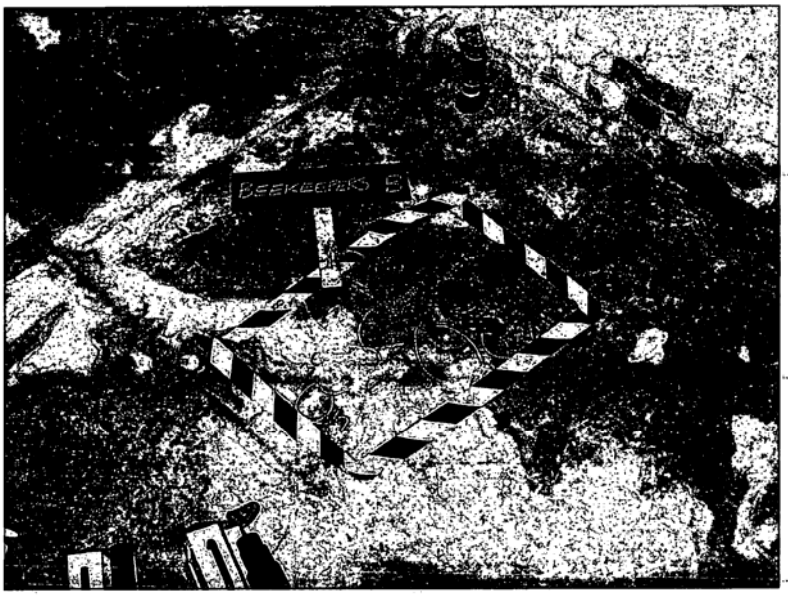

12-63 C

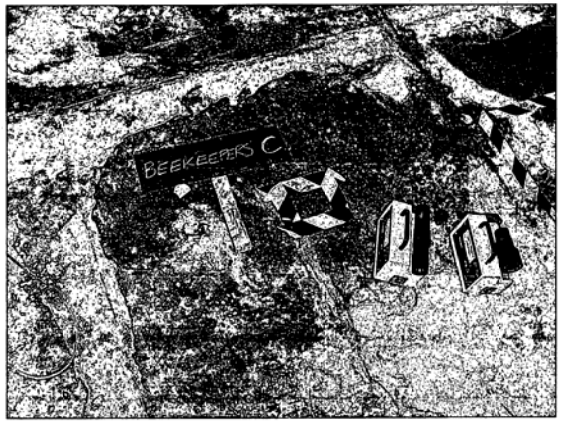

2-63 D



6.15 Contaminated Areas in the Tank Room

6.16 Contaminated Areas in the Beekeepers




BEEKEEPERS C