HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 7/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 12

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
FILL (Grey slightly clayey silty sand containing frequent brick rubble. Very tarry in parts).		D1/J1	0.5-1.0	
	1.4			
Red-brown silty SAND. (Possibly FILL?).		D2/J2	1.5-2.0	
	1.8			
Firm brown very sandy silty CLAY. (Possibly FILL?).		D3/J3	2.5-3.0	
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 7/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 13

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
Vegetation over TOPSOIL (Grey silty clay with frequent roots).	0.2			
Soft becoming firm brown very sandy silty CLAY containing occasional roots. (Possibly FILL?).		D1/J1	0.5-1.0	
		D2/J2	1.5-2.0	
	2.6	D3/J3	2.5-3.0	
Firm brown becoming grey silty CLAY. (Possibly FILL?).				
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 6/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 14

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
Vegetation over TOPSOIL (Brown silty clay containing frequent roots).	0.3			
Brown slightly clayey silty SAND. (Possibly FILL?).		D1/J1	0.5-1.0	
		D2/J2	1.5-2.0	
	1.8			
Firm orange-brown silty CLAY. (Possibly FILL?).				
	2.6	D3/J3	2.5-3.0	
Firm green-brown very clayey silty SAND. (Possibly FILL?).				
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 6/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 15

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
Vegetation over TOPSOIL (Brown silty clay containing frequent roots).	0.15			
Firm brown slightly sandy silty CLAY. (Possibly FILL?).		D1/J1	0.5-1.0	
		D2/J2	1.5-2.0	
	1.7			
Firm orange-brown silty CLAY. (Possibly FILL?).		D3/J3	2.5-3.0	
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 7/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 16

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
TARMAC.	0.05			
FILL (Grey silty clay with frequent gravel).	0.5			
Brown silty fine to coarse SAND. (Possibly FILL?).		D1/J1	0.5-1.0	
		D2/J2	1.5-2.0	
	2.2			
Firm orange-brown very sandy silty CLAY. (Possibly FILL?).		D3/J3	2.5-3.0	
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 7/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 17

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
TARMAC.	0.05			
FILL (Grey silty sand with frequent gravel).	0.3			
FILL (Grey-black silty ashy clay containing occasional timber fragments).		D1/J1	0.5-1.0	
	0.7			
Firm brown becoming orange-brown very sandy silty CLAY. (Possibly FILL?).		D2/J2	1.5-2.0	
		D3/J3	2.5-3.0	
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 6/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 18

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
Gravel over FILL (Grey silty clay and gravel with occaisonal roots).	0.2			
FILL (Grey to brown slightly sandy silty clay containing frequent brick, coke and ash fragments).		D1/J1	0.5-1.0	
	1.0			
		D2/J2	1.5-2.0	
Firm brown very fine sandy silty CLAY. (Possibly FILL?).				
		D3/J3	2.5-3.0	
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 6/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 19

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour. Smell)
	0.0			
Vegetation over TOPSOIL (Grey slightly sandy silty clay containing frequent gravel and roots).	0.2			
Firm black-grey silty CLAY. (Possibly FILL?).	0.5	D1/J1	0.5-1.0	
Firm brown silty CLAY. (Possibly FILL?).	1.2	D2/J2	1.5-2.0	
Orange-brown silty fine SAND. (Possibly FILL?).		D3/J3	2.5-3.0	
Trial Pit Complete at 3.0m.	3.0			

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

Trial Pit Record

Location : Otford Road, Sevenoaks, Kent.

Client : British Gas (South Eastern).

Date : 6/8/92

Job No. : C1935/22

Plant : J.C.B. Excavator

Diameter : 0.70m x 1.50m

Trial Pit No. : 20

Soil Description	Depth below Ground Level (m)	Sample Type	Sample Depth (m)	Notes (e.g. Colour, Smell)
	0.0			
Vegetation over TOPSOIL (Grey slightly sandy silty clay containing frequent roots).	0.3			
Firm brown silty CLAY. (Possibly FILL?).		D1/J1	0.5-1.0	
	1.5	D2/J2	1.5-2.0	
Orange-brown silty fine SAND. (Possibly FILL?).		D3/J3	2.5-3.0	
	3.0			
Trial Pit Complete at 3.0m.				

Remarks :

Groundwater was not encountered.

Trial pit relatively stable on completion.

Key :

D : Disturbed Sample

J : Jar Sample

W : Water Sample

HARRISON & COMPANY

SITE : SEVENOAKS

Results relate to air dried whole soil and are expressed in mg/kg, unless otherwise stated

		pH	Stone Content %	Loss on Ignition %	Soil Moisture Content %	PAH	Phenols	Copper	Nickel	Chromium	Zinc	Cadmium	Lead	Iron	Arsenic	Mercury	Total Cyanide	Elemental Sulphur %	Water Soluble Sulphate	Water Soluble Chloride
Trial Pit/Borehole No.	1																			
Depth	D1	5.70	0.40	1.02	5.1	<5	<0.5	<10	32.0	12.7	31.9	1.11	23.7	19718	4.07	0.02	9.4	<0.01	33.96	11.81
	D2	6.20	0.00	0.62	9.8	<5	<0.5	<10	54.7	26.2	31.4	1.06	21.7	21029	2.26	0.10	1.1	<0.01	25.13	6.80
	D3	5.70	1.32	0.56	5.0	<5	<0.5	<10	56.6	39.7	31.1	0.60	<20	24545	1.58	0.02	<1	<0.01	28.72	10.23
Trial Pit/Borehole No.	2																			
Depth	D1	6.65	0.81	0.80	6.0	<5	<0.5	17.4	20.5	12.6	32.3	0.50	23.6	23413	6.3	0.02	6.4	<0.01	99.19	16.37
	D2	5.95	0.00	0.75	10.0	<5	<0.5	<10	13.2	<10	23.3	0.88	27.5	11714	12.25	0.04	10.0	<0.01	34.54	10.46
	D3	6.15	0.53	0.76	9.4	<5	<0.5	<10	63.9	23.2	28.0	0.40	23.7	24236	9.19	0.40	17.6	<0.01	29.89	9.58
Trial Pit/Borehole No.	3																			
Depth	D1	5.40	0.00	1.01	12.2	<5	<0.5	<10	39.8	21.6	38.1	0.62	29.2	34963	6.28	0.02	<1	<0.01	61.61	9.77
	D2	5.70	0.00	0.51	11.8	<5	<0.5	<10	37.1	19.3	38.7	0.62	34.1	32559	3.72	<0.02	13.4	<0.01	33.83	8.57
	D3	5.55	0.00	0.75	10.3	<5	<0.5	<10	36.7	14.8	30.5	0.61	28.6	24873	9.8	0.10	<1	<0.01	33.25	9.04
Trial Pit/Borehole No.	4																			
Depth	D1	3.30	0.00	0.78	15.1	<5	<0.5	<10	29.0	12.3	32.0	1.08	32.4	21684	2.5	0.02	4.7	<0.01	468.00	13.06
	D2	4.00	0.00	0.98	15.9	<5	<0.5	<10	67.2	32.1	40.6	1.23	57.8	40506	17.91	0.08	5.9	<0.01	850.22	14.64
	D3	3.90	0.26	0.34	8.3	<5	<0.5	<10	42.1	12.9	30.6	1.24	24.3	27123	18.69	<0.02	4.9	7.81	337.11	6.53
Trial Pit/Borehole No.	5																			
Depth	D1	4.70	0.00	1.18	14.4	<5	<0.5	<10	55.1	19.1	39.8	1.22	23.8	35025	4.7	0.05	0.9	<0.01	100.42	11.85
	D2	5.00	0.00	1.19	12.0	<5	<0.5	<10	63.0	18.7	37.5	0.90	<20	37324	4.6	0.02	11.9	<0.01	67.35	8.26
	D3	5.50	0.00	4.48	9.2	<5	<0.5	<10	48.2	16.9	30.1	0.91	<20	30203	2.36	0.02	21.6	<0.01	32.88	5.70
Trial Pit/Borehole No.	6																			
Depth	D1	3.50	11.99	3.80	20.5	<5	<0.5	53.8	41.6	20.1	119.6	1.58	<20	30877	1.93	1.01	906.5	<0.01	1944.41	13.25
	D2	3.90	2.36	23.43	25.4	5210	1252.1	29.4	60.1	44.8	334.2	3.68	<20	40111	2.51	2.52	10224.0	0.07	2328.03	15.11
	D3																			
Trial Pit/Borehole No.	7																			
Depth	D1	6.05	0.00	18.44	27.8	1923	<0.5	<18	20.7	12.7	339.3	1.73	486.4	40609	23.25	14.25	1268.1	3.06	2918.13	14.87
	D2	2.85	0.25	3.57	18.0	31	21.1	30.2	33.3	10.3	73.0	0.69	175.5	29494	24.94	0.30	217.2	<0.01	3170.66	10.43
	D3	5.15	0.48	1.73	12.9	<5	<0.5	11.5	27.1	20.9	61.1	0.90	79.9	31509	2.26	0.24	138.5	0.02	4156.88	10.03

HARRISON & COMPANY

SITE : SEVENOAKS

Results relate to air dried whole soil and are expressed in mg/kg, unless otherwise stated

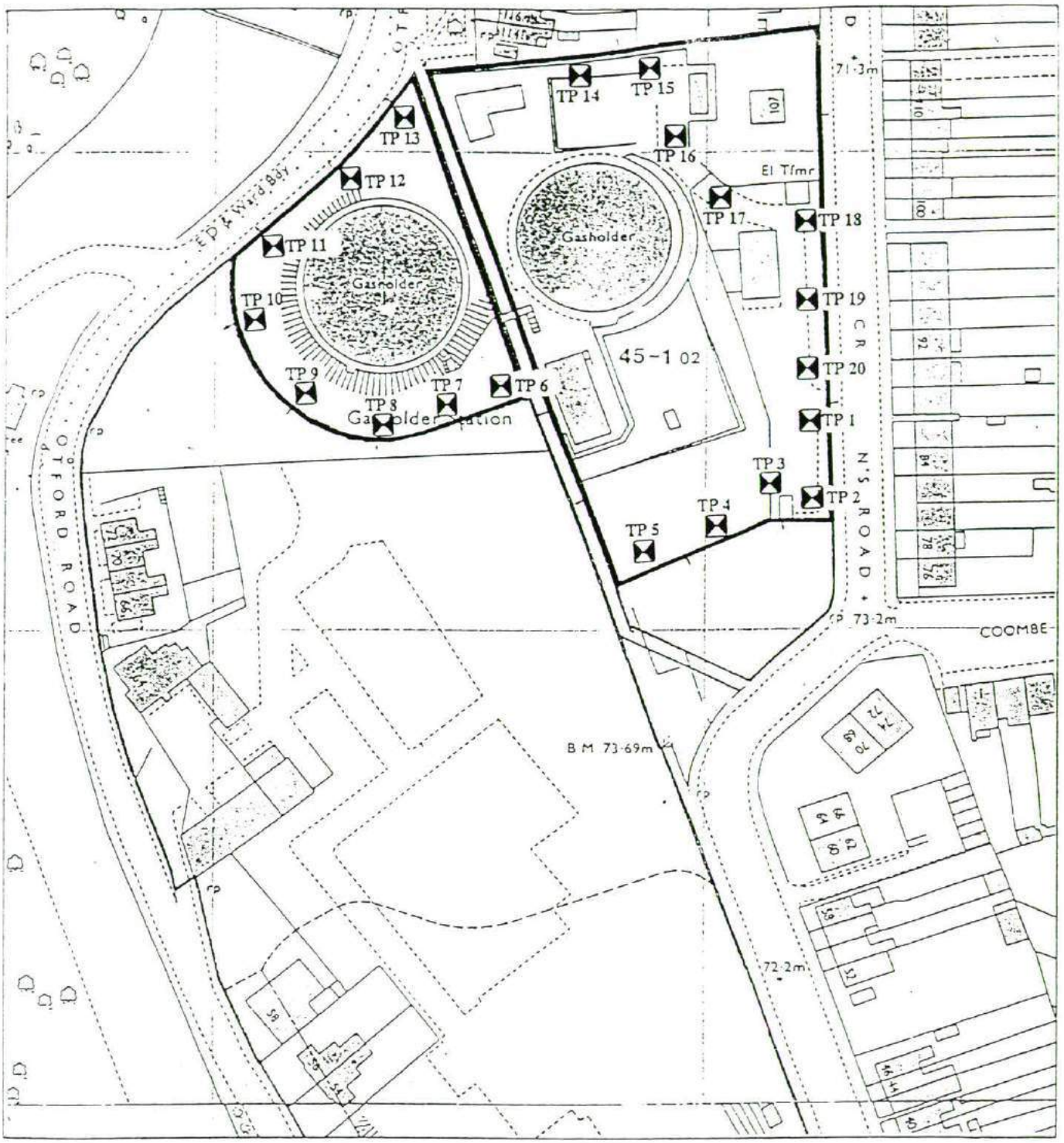
		pH	Stone Content %	Loss on Ignition %	Soil Moisture Content %	PAH	Phenols	Copper	Nickel	Chromium	Zinc	Cadmium	Lead	Iron	Arsenic	Mercury	Total Cyanide	Elemental Sulphur %	Water Soluble Sulphate	Water Soluble Chloride
Trial Pit/Borehole No.	8																			
Depth	D1	6.50	0.00	9.45	26.1	344.6	<0.5	189.2	113.6	18.5	374.1	3.06	856.5	47555	9.95	1.50	304.4	0.45	2261.64	13.98
	D2	3.25	0.00	2.92	17.7	110.8	<0.5	19.7	18.6	12.8	58.8	0.62	187.9	22817	9.8	0.19	162.9	0.71	3375.02	8.07
	D3	3.90	0.00	1.42	11.5	<5	<0.5	28.1	42.6	14.5	39.0	0.73	83.6	35323	2.44	0.24	149.2	0.03	1904.62	60.22
Trial Pit/Borehole No.	9																			
Depth	D1	3.70	0.00	1.01	14.8	<5	<0.5	<10	27.5	19.1	49.4	1.32	47.7	30456	8.62	0.08	7.8	<0.01	136.04	5.44
	D2	6.70	0.00	1.34	13.9	<5	<0.5	13.4	42.8	24.9	77.0	0.50	42.1	28366	7.21	0.29	4.6	<0.01	99.52	9.05
	D3	4.90	0.48	1.87	15.7	<5	<0.5	90.1	32.3	12.8	35.1	0.51	47.9	21175	4.8	0.05	<1	<0.01	575.07	11.85
Trial Pit/Borehole No.	10																			
Depth	D1	7.10	5.67	2.69	12.5	<5	<0.5	28.1	64.1	18.4	252.0	1.27	344.3	30049	1.89	0.25	67.4	0.11	284.68	12.05
	D2	7.20	13.82	1.65	18.5	<5	<0.5	47.0	55.4	16.4	73.9	1.14	180.8	25.53	1.78	0.13	8.7	<0.01	276.65	13.14
	D3	7.25	3.83	3.62	12.6	2690	<0.5	27.3	66.4	31.6	142.1	2.28	587.7	21802	1.81	0.18	2.8	<0.01	475.67	25.39
Trial Pit/Borehole No.	11																			
Depth	D1	6.30	0.00	16.80	22.1	3826	1313.1	179.1	25.5	10.7	161.6	1.13	794.8	28200	2.68	0.08	696.1	0.64	1217.73	17.78
	D2	6.70	0.12	2.77	11.0	<5	214.2	17.5	48.2	12.7	159.8	0.71	76.2	20280	6.19	0.06	9.3	<0.01	26.11	22.04
	D3	4.20	0.00	1.11	9.5	<5	226.8	<10	28.7	10.2	32.2	<0.1	32.1	17571	4.27	0.03	3.8	<0.01	275.78	14.49
Trial Pit/Borehole No.	12																			
Depth	D1	6.30	1.15	13.59	19.0	3314	236.2	219.0	40.0	16.4	422.8	1.97	554.6	33696	33.03	<0.02	564.6	10.69	1752.52	24.87
	D2	5.85	0.89	4.74	9.8	16.6	71.6	93.6	52.9	19.1	148.5	1.41	276.9	34557	21.52	1.55	1114.3	<0.01	1989.22	19.32
	D3	3.00	0.00	1.11	19.4	<5	<0.5	35.1	32.1	14.8	46.5	0.61	28.6	19543	5.00	0.22	14.9	<0.01	483.79	15.39
Trial Pit/Borehole No.	13																			
Depth	D1	4.40	0.00	1.35	8.6	<5	<0.5	<10	39.7	12.2	36.4	0.29	22.9	22452	0.63	0.10	3.3	<0.01	26.76	12.842
	D2	3.90	0.02	1.15	12.2	<5	<0.5	<10	27.3	10.5	36.0	1.41	<20	18090	1.14	0.05	1.1	<0.01	42.47	11.066
	D3	4.70	0.00	0.86	15.1	<5	<0.5	<10	25.0	12.6	27.4	0.91	<20	9549	0.61	0.04	<1	<0.01	53.37	9.098
Trial Pit/Borehole No.	14																			
Depth	D1	5.45	0.47	1.19	10.6	<5	<0.5	<10	32.0	12.6	42.5	0.91	23.7	21218	1.87	0.06	<1	<0.01	56.88	5.306
	D2	5.65	1.91	0.86	13.6	<5	<0.5	<10	50.8	18.3	32.6	0.78	<20	29045	1.8	0.13	1.2	<0.01	79.65	10.635
	D3	6.00	0.00	1.19	13.6	<5	<0.5	<10	48.2	33.9	50.4	0.41	<20	47461	3.13	0.04	2.3	0.10	36.12	10.91

HARRISON & COMPANY

SITE : SEVENOAKS

Results relate to air dried whole soil and are expressed in mg/kg, unless otherwise stated

		pH	Stone Content %	Loss on Ignition %	Soil Moisture Content %	PAH	Phenols	Copper	Nickel	Chromium	Zinc	Cadmium	Lead	Iron	Arsenic	Mercury	Total Cyanide	Elemental Sulphur %	Water Soluble Sulphate	Water Soluble Chloride
Trial Pit/Borehole No.	15																			
Depth	D1	5.90	0.00	1.31	11.2	<5	<0.5	<10	13.6	10.5	36.5	1.11	<20	18847	0.67	0.02	5.6	<0.01	51.13	11.136
	D2	3.85	0.24	0.56	8.0	<5	<0.5	<10	48.6	19.2	33.2	0.51	24.0	31968	1.56	0.04	2.2	<0.01	306.65	16.298
	D3	4.00	0.00	43.22	14.6	<5	<0.5	<10	78.7	36.3	48.0	1.16	27.3	61880	2.17	0.03	2.3	<0.01	13.76	11.166
Trial Pit/Borehole No.	16																			
Depth	D1	6.95	2.71	1.13	10.5	<5	<0.5	<10	36.5	12.6	33.2	1.11	37.9	21164	3.23	0.07	6.5	<0.01	12.13	5.697
	D2	5.90	0.00	1.13	13.9	<5	<0.5	<10	30.6	14.1	28.6	0.87	36.3	24413	4.08	0.03	2.9	<0.01	36.07	6.992
	D3	5.20	0.00	1.19	18.0	<5	<0.5	<10	47.3	18.7	29.9	0.80	28.1	18662	24.26	0.03	<1	<0.01	53.53	9.165
Trial Pit/Borehole No.	17																			
Depth	D1	5.45	1.01	5.523	15.9	<5	<0.5	30.8	<10	12.2	55.9	1.46	274.96	25122	2.88	0.29	107.84	0.54	2056.353	22.53
	D2	6.75	0	0.57	9.4	<5	<0.5	<10	34.4	10.6	27.1	0.51	<20	13451	0.6	0.04	<1	<0.01	210.734	9.28
	D3	6.00	0	0.83	14.3	<5	<0.5	15.6	40.9	25.2	39.8	1.01	<20	40458	2.27	0.06	<1	<0.01	192.55	15.048
Trial Pit/Borehole No.	18																			
Depth	D1	4.40	0.55	11.52	11.2	33.9	<0.5	79.4	41.1	14.7	83.9	1.21	678.2	40132	18.99	2.93	1035.0	0.50	349.75	21.228
	D2	5.60	0.00	1.03	12.3	<5	<0.5	<10	74.2	34.2	39.2	0.62	24.1	21535	6.83	0.02	7.6	<0.01	14.00	6.464
	D3	6.20	0.00	0.96	10.3	<5	<0.5	<10	67.8	24.4	52.7	0.49	50.4	42463	14.82	0.04	2.2	<0.01	22.14	9.426
Trial Pit/Borehole No.	19																			
Depth	D1	4.90	1.67	0.99	4.6	<5	<0.5	<10	84.6	42.1	33.5	0.67	49.6	25195	1.73	0.07	16.5	<0.01	149.99	77.483
	D2	5.55	0.00	1.07	5.0	<5	<0.5	<10	52.8	16.9	39.8	0.51	38.2	34771	7.29	0.09	1.1	<0.01	534.73	59.935
	D3	6.10	0.00	0.41	5.5	<5	<0.5	<10	30.5	13.0	24.7	1.14	24.3	26157	1.01	0.05	9.5	<0.01	282.70	37.348
Trial Pit/Borehole No.	20																			
Depth	D1	6.10	0.00	1.16	4.3	<5	<0.5	<10	34.8	12.8	37.2	0.72	48.2	21535	1.85	0.04	2.8	<0.01	30.34	10.686
	D2	5.50	0.00	0.64	4.5	<5	<0.5	<10	39.4	19.3	29.9	0.62	24.1	27688	0.62	0.29	<1	<0.01	16.76	22.044
	D3	5.50	0.00	0.35	2.1	<5	<0.5	15.6	45.9	12.7	13.4	1.22	28.6	17005	1.9	0.06	<1	<0.01	29.16	29.558



Otford Road, Sevenoaks, Kent.

Drawing No. C1935/22/7

Trial Pit Location Plan

Scale : Not to Scale

November 1992

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SS REPORT

1. Introduction

Over recent years public awareness and concern about the risks of building on contaminated land has increased. As a result, local district councils are requiring that the levels of contaminants are measured before planning permission is granted. This step is to protect the public at large.

A number of gaswork sites are now being offered for sale by South Eastern Gas and the Region are having full soil analyses of the sites carried out.

This note describes the results of the analyses of samples of soil taken from Sevenoaks Holder Station.

The report outlines the nature of the site, the samples taken, the analysis carried out, the results of the analyses and a discussion of the implications of the results.

The work was completed following guidelines set out by the Department of Environment, Greater London Council and British Gas.

2. The Site

2.1 Geographical Location

The Sevenoaks Holder Station is located about a mile north of Seveoaks. The site is on the north face of the Ragstone Ridge. Fig. 1 shows the location of the site with reference to Southern England.

2.2 Geological Description

The Ragstone Ridge is made up of sedimentry rock and much of the area surrounding the Holder Station is sandstone and exposed chalk scarps.

The site itself is on a slight platform of clay and fairly loose soil.

2.3 Site Description

The site plan is shown in Fig.2 and the photographs show various aspects of the site.

The site is fairly flat, having an estimated slope, from end to end, of about 6 feet.

Two major physical features exist on the site and these are shown in the photographs. The main part of the site is a concrete cover. This cover is where old plant and buildings used to exist.

Around the edge of the concrete is scrub grass and trees. The whole of the site that was soil had a covering of plant growth.

There was no apparent tendancy for the site to hold water or become water logged, nor was there any apparent flow of water across the site.

2.4 Site History

The acquisition of the site began in 1880 by the Sevenoaks Gas Company. By 1903 the major part of the site had been acquired and gas manufacture would have been underway by this point.

The records indicate that the site was only used for manufacture although agreements with respect to tramways and railway sidings were made in the 1930's. Presumably railway sidings and tramways existed on the site.

In 1933 the site was sold to the South Suburban Gas Company (later to become part of the Gas Corporation). At about this time there were also agreements between the gas company and South Eastern Tar Distillers. It is thought that the distillers bought the waste tar products from the gas company.

Cessation of gas production is estimated to have been around the late 1930's although an agreement to dump waste is known to have existed between the sewerage company and the Gas Council in 1961.

The site was demolished in

3. Sampling

3.1 Sample Locations

It is customary to sample a site at a number of locations. This ensures that a realistic picture of the distribution of contaminants is obtained.

Two constraints affect the number of sample locations that are chosen. These are : too few sampling locations will lead to a lack of information about the distribution of contaminants and too many locations will increase the cost of carrying out the analysis to a prohibitive degree.

Fig. 3 shows the sampling locations chosen for the site. The locations are based on a 25 metre grid. Chosing such a system as a grid ensures that there is no bias as to where the samples are taken.

The grid size and location was agreed with the Local Council. Also, it can be seen in Fig. 3 that a number of extra sample points were chosen. These represent possible contaminantion "hot spots" which would be likely due to past practices on the site in those areas.

Two samples from the surrounding area were taken to act as controls for the analysis of heavy metals.

3.2 Sample Depths

Land and soil exhibits stratification which is dependent upon the soil structure, density, permeability etc. As a result, stratification of contaminants is very likely and consequently samples of soil were taken at different depths. This would also show up contaminanets that were being gradually leached through the soil, or levels of contaminants in the water table.

Samples were taken at 0, 2, 4 and 6 foot depths.

3.3 Sampling Methods

The samples were taken using a three inch rotating drill mounted on the back of a Land Rover. The equipment was loaned by London Research Station.

The samples were taken by drilling to just above the required depth and sampling the undisturbed soil with a sampling auger.

Care was taken to ensure that the sample was not contaminated with soil from other depths.

4. Analyses

The assessment of the site may be separated into three major areas:-

4.1 The visual inspection of the site.

4.2 Visual inspection of the soil samples.

4.3 Physical and Chemical analysis of samples.

4.1 Visual Inspection of the Site

As stated previously, the general condition of the site was quite good. Concrete cover and vegetation accounted for over 90% of the site.

There were a few isolated areas of what appeared to be oxide waste although these constituted a very low proportion of the site.

The other contaminant visible was a two inch thick covering of tar in an area of some 200 square yards. This tar had obviously been allowed to run onto the site so it would solidify. This contamination would present no problem in terms of disposal.

4.2 Visual Inspection of the Samples

Each sample was visually examined at the laboratory. The texture, make-up and odour of the samples was described in the examination.

The results of this examination are included in Appendix A.

4.3 Chemical Analysis

Table 1 shows an outline of the experimental procedure adopted for the purpose of the tests. This section includes a brief description of each method of the analysis.

Full description of the analyses are detailed in Appendix B.

Table 1 - Outline of Test Method

Test	Method	Reference
pH	Air dried soil agitated with water	
Moisture	Oven dry at 110°C overnight ~~(or air dry at 30°C?)~~	
Chloride Determination	Mohr's method	BGAM 3.1.5
Ammoniacal Nitrogen	Release of Ammonia and Titration	
Phenol Determination	Water extract and Folin & Ciocalteus reagent method	
Organic Solvent Extraction	Cyclohexane Weigh extractables Toluene " "	
Total Soluble Cyanide	Lead Acetate/Cuprous chloride. Absorb in NaOH	DOE Method p.21
Simple Cyanide	Lead & Zinc Acetate Absorb in NaOH	DOE Method p.22
Soluble Ferro-Ferricyanide	Trap remnants of Simple Cyanide using Cuprous Chloride	
Soluble Thiocyanate	Repeated extraction with boiling water	IGE/AM/12
Total Sulphur	Eschka's mixture & extract with water	BS.1016
Acid Soluble Sulphate	Acid extraction & nephelometric finish	BS.1377.9
Sulphide	Acid liberation of H_2S, Iodometric finish	ICE/AM/13
Elemental/Free Sulphur	Extract with CS_2	NTG Standard Method 17
Total Metals Determination	X-ray dispersive/Atomic Absorption	Zn Cu Ni Pb Hg As Cd

5. Results

The results have been grouped together with reference to the bore hole. The codes correspond to the grid markings on the plan of the site (Fig.3).

5.1 Physical Observations.

The physical descriptions of the samples are included in Appendix A

5.2 Chemical Analysis.

Sample Point	Depth (ft)	Moisture Content (%)	pH	Chloride ppm (dry soil)	Phenols ppm (as rec'd)	Ammoniacal Nitrogen ppm (dry soil)
A2	2	17.8	7.0	475	8.7	235
	4	18.4	7.2	187	45	213
A3	2	8.6	7.3	3750	12.5	22
	6	8.6	7.3	4310	12.5	112
B2	0	23.6	7.4	687	117.5	258
B3	2	20.6	9.3	425	18	44
	6	13.2	6.7	5000	12.5	12
B4	4	24.2	7.1	212	375	146
	2	12	7.1	1450	115	12
C2	2	19.8	6.3	50	145	56
	4	25.6	6.8	475	56.5	90
C3	2	18.6	7.6	50	87.5	616
	4	23.6	7.7	1500	145	56
	6	18.0	8.1	850	150	672
C4	2	13.8	7.1	5050	42.5	22
	6	16	6.9	425	5.0	86.2
D2	2	7.8	8.2	262	5	463
	6	11.4	8.7	375	5	582
D3	2	17.6	8.0	50	45	56
	6	10.6	7.2	50	100	907
D4	2	12.6	7.8	1875	25	280
	4	9.0	7.7	425	5	168
	6	7.8	7.7	2675	5	336
E2	2	15.8	9.9	100	1625	12
	4	12.0	8.1	2250	5	12
	6	12.2	7.9	850	5	12

(cont'd)

Sample Point	Depth (ft)	Moisture Content (%)	pH	Chloride ppm (dry soil)	Phenols ppm (as rec'd)	Ammoniacal Nitrogen ppm (dry soil)
E4	2	13.2	7.6	262	5	134
	6	12	9.4	1612	65	739
F2	2	8.2	6.6	3100	30	336
	4	6.8	5.6	3425	7.5	22
	6	6.8	5.1	100	5	739
F3	0	15.2	7.7	50	35	560
	2	11.0	8.0	100	30	728
	4	13.2	7.8	3700	17.5	280
	6	19.2	7.3	50	42.5	672
F4	2	24.2	7.3	212	30	336
	4	16.4	7.3	50	17.5	280
	6	14.2	7.2	100	35	560
G2	2	14.0	6.4	162	5	146
	6	5.2	4.1	100	17.5	616
G3	2	10.8	7.5	475	30	123
	4	10	7.5	262	17.5	246
	6	10.2	8.3	962	12.5	56
G4	0	40.0	7.3	425	340	101
	4	13.6	7.5	962	12.5	12
	6	10.0	7.9	1662	30	56
H2	2	15.4	7.8	162	12.5	493
	6	6.8	4.1	50	12.5	739
I2	2	13.4	7.1	100	62.5	123
	6	8.6	7.0	1875	5	862
WELL WATER			6.1	9.6	100	7.3
SP1	0*	15.0	6.2	425	280	134
	0	18.6	7.6	750	7.5	68
	2	17.8	7.4	1025	7.5	56
	4	16.0	7.2	162	52.5	67
SP2	2	16.0	7.5	187	65	112
	4	4	19.0	7.1	475	140
	6	13.4	7.1	187	52.5	22
SP3	2	14.4	10.2	850	35.0	12
SP4	2	12.4	7.7	50	12.5	90
	6	11.4	7.8	58.7	5	762
SP5	2	20.8	7.5	537	232.5	134
SP6	2	15.0	7.0	100	42.5	582
	4	10.6	7.1	687	62.5	750
SP7	2	13.0	7.4	537	5.0	627
	4	14.6	8.0	587	17.5	123

Sample Point	Depth	Cyanides (ppm) Total (as rec'd)	Simple (as rec'd)	Ferro/Ferric (as rec'd)	Thiocyanate (as rec'd)
A2	2	187	0.8	57.6	200
	4	115	0.8	140	260
A3	2	0.8	6.8	90	240
	6	0.4	25.	16	380
B2	0	42.6	0.4	0.4	300
B3	2	43.6	5.1	38.4	1780
	6	6.0	3.6	5.2	1260
B4	2	1.6	19.5	84	500
	3-4	.4	16	144	140
	4	10	3.2	66	360
C2	2	1.1	25.9	175	25
	4	2.0	20.7	42.2	260
C3	2	1.1	4.7	94	150
	4	3.2	22.7	223	230
	6	1.1	1.1	127.5	150
C4	2	107.5	33.6	132	300
	6	4	0.4	.4	200
D2	2	2	.8	.4	.4
	6	1.1	0.4	0.4	40
D3	2	0.8	3.6	6.8	100
	6	1.1	o.4	1.1	260
D4	2	1.1	2.2	2.0	100
	4	1.6	1.1	1.6	525
	6	1.6	4.7	1.1	300
E2	2	5.1	2.4	1.1	7.0
	4	2.4	0.8	1.6	150
	6	1.6	0.4	2.8	310
E4	2	5.5	1.6	4.8	260
	6	2.8	2.8	1.6	260
F2	2	0.4	1.1	1.6	225
	4	0.4	0.8	0.8	80
	6	0.8	0.4	0.8	40
F3	0	0.8	0.4	2.4	100
	2	1.1	0.8	2.8	50
	4	0.4	1.1	1.6	375
	6	1.1	8.4	95.5	25
F4	2	0.4	6.0	10.8	12.5
	4	1.1	2.0	2.4	12.5
	6	0.8	1.6	4.0	100

Sample Point	Depth	Cyanides (ppm) Total (as rec'd)	Simple (as rec'd)	Ferro/Ferric (as rec'd)	Thiocyanate (as rec'd)
G2	2	8.4	23.9	5.1	84.0
	6	0.8	0.4	0.8	40
G3	2	4.7	7.2	8.8	40
	4	8.4	5.1	7.2	200
	6	1.1	3.2	1.1	125
G4	0	42.2	6.4	6.8	260
	4	47.8	17.1	29.6	300
	6	0.8	10.3	25.9	250
H2	2	28.4	57.5	0.4	720
	6	1.1	0.4	0.4	40
I2	2	6.7	0.4	0.4	1060
	6	0.4	0.4	0.8	720
WELL WATER		40	0.04	0.04	
SP1	0*	270	5.6	6.4	520
	0	36.4	8.8	11.2	460
	2	117.5	24.3	239	80
	4	155	19.1	4.4	300
SP2	2	2.8	16.3	135	20
	4	1.1	2.0	6.3	100
	6	0.4	6.3	4.3	370
SP3	2	2.4	4.3	44.2	70
SP4	2	4.4	0.4	0.4	2360
	6	4.7	0.4	1.1	1120
SP5	2	270	2.0	0.4	260
SP6	2	291	21.9	0.4	800
	4	19.5	2.8	22.3	740
SP7	2	10	0.8	5.1	260
	4	8	2.4	6.8	140

Sample Point	Depth	Sulphur Species(ppm) Total (as rec'd)	Acid SO_4^{2-} (as rec'd)	Sulphide (as rec'd)	Organic Extractables(%) Cyclohexane (as rec'd)	Toluene (as rec'd)	CS_2 (Dried)
A2	2	6250	9700	107	16	18	0.6
	4	4667	23000	73	22	12	2.1
A3	2	958	2600	27	8	8	0.4
	6	1000	2800	27	12	14	0.3
B2	0	3333	2100	187	20	20	1.0
B3	2	8083	-	-	14	14	1.5
	6	583	1400	13	10	14	0.3
B4	2	1250	2300	67	6	10	3.4
	3-4	-	-	8	20	0/8	
	4	20000	9900	120	24	6	3.2
C2	2	2292	6300	87	14	20	2.5
	4	1542	2600	113	14	22	1.5
C3	2	1375	1800	67	20	10	0.3
	4	917	2000	27	16	24	1.6
	6	750	1500	20	20	10	0.4
C4	2	2500	3100	87	14	18	0.5
	6	11250	1400	7	16	16	NIL
D2	2	1208	2000	113	12	12	1.0
	6	26250	1400	13	12	14	NIL
D3	2	1750	1900	87	20	18	1.9
	6	583	1600	87	14	14	4.0
D4	2	667	1500	27	10	6	0.2
	4	667	1300	27	10	6	0.2
	6	29583	-	-	8	4	0.3
E2	2	3167	2600	87	16	14	1.8
	4	875	1300	20	10	14	0.7
	6	542	1300	20	10	14	0.4
E4	2	708	850	113	10	14	0.9
	6	583	1800	273	12	14	2.0
F2	2	625	1300	20	10	6	0.3
	4	583	1400	13	2	2	0.3
	6	583	1900	27	2	4	4.0

Sample Point	Depth	Sulphur Species(ppm) Total (as rec'd)	Acid SO_4^{2-} (as rec'd)	Sulphide (as rec'd)	Organic Extractables(%) Cyclohexane (as rec'd)	Toluene (as rec'd)	CS_2 (Dried)
F3	0	3125	1700	87	24	22	15.6
	2	1042	1700	27	12	4	0.7
	4	625	1300	20	14	12	0.4
	6	1000	2900	27	20	14	0.5
F4	2	14375	-	-	24	24	0.6
	4	15625	-	-	16	12	0.8
	6	2292	3000	87	14	8	0.7
G2	2	4125	18400	127	14	8	1.2
	6	29167	4800	147	6	6	2.0
G3	2	15833	2900	127	14	16	2.0
	4	15208	8500	113	6	8	2.0
	6	4792	9000	33	6	2	0.1
G4	0	7125	1900	153	36	38	4.0
	6	875	2000	20	2	2	0.4
H2	2	7125	2580	140	14	18	0.7
	6	708	7400	100	14	18	0.7
I2	2	22333	2100	133	12	14	0.7
	6	21250	1400	133	12	14	0.7
WELL WATER		30	45	18	-	-	-
SP1	0*	3500	9300	153	10	12	4.0
	0	17000	-	-	10	16	1.0
	2	6500	-	-	12	16	0.3
	4	5000	16400	147	12	0	1.5
SP2	2	10625	-	-	12	8	0.8
	4	19792	-	-	18	16	0.3
	6	1083	1900	27	12	12	0.3
SP3	2	2125	7900	107	6	16	0.6
SP4	2	833	1700	100	12	10	1.1
	6	583	1400	107	12	14	4
SP5	2	4667	2100	213	22	24	4.0
SP6	2	4333	10580	120	16	18	3.2
	4	1000	2600	140	12	10	1.3
SP7	2	6000	2580	347	12	12	1.4

Sample Point	Depth	Total Metals ppm (as dried soil) Zn	Cu	Cd	Pb	Ni	As	Hg
A2	2	330	200	40	300	650	100	3.0
	4	460	325	40	350	800	300	12.2
A3	2	150	225	400	400	500	100	1.5
	6	270	275	60	300	900	100	4.0
B2	0	670	375	40	450	650	100	2.7
B3	2	510	300	60	3250	860	100	2.5
	6	280	275	50	1650	440	100	2.5
B4	2	260	250	50	850	720	100	3.0
	3-4	880	350	70	1180	1340	350	5.5
	4	770	325	80	2500	700	400	6.0
STD1	1	340	-	40	600	600	300	3.25
STD2	1	340	-	40	450	500	100	4.0
C2	2	410	250	50	2900	1040	100	1.5
	4	280	175	50	400	600	200	1.0
C3	2	330	275	380	400	1120	100	3.5
	4	230	175	30	2000	260	100	1.0
	6	360	650	50	1000	2400	100	3.5
C4	2	200	150	60	1900	380	350	6.5
	6	450	275	40	250	800	500	4.0
D2	2	550	375	60	850	650	100	9.0
	6	460	450	40	450	650	100	1.5
D3	2	910	525	30	1200	580	100	1.0
	6	390	250	40	75	850	100	2.2
D4	2	520	525	60	3050	680	100	1.5
	4	580	300	60	450	1900	100	3.5
	6	230	200	50	3500	440	100	2.0
E2	2	480	350	60	800	1480	100	2.0
	4	330	525	50	700	1500	450	5.5
	6	450	375	50	2400	900	100	2.0
E4	2	300	100	50	300	650	100	3.2
	6	330	200	40	300	400	100	3.2
F2	2	290	600	50	4850	2340	100	1.5
	4	190	175	60	1500	600	100	1.5
	6	240	150	40	75	500	100	2.2

Sample Point	Depth	Total Metals ppm (as dried soil) Zn	Cu	Cd	Pb	Ni	As	Hg
F3	0	5840	350	50	1950	820	100	3.0
	2	820	850	50	300	3840	100	6.5
	4	320	300	50	4300	480	450	2.0
	6	330	175	50	31500	1000	100	2.5
F4	2	2580	750	50	1250	1960	100	3.0
	4	1000	375	90	600	680	100	3.5
	6	2180	750	170	2950	640	100	1.0
G2	2	490	375	40	750	800	800	6.0
	6	300	125	40	250	600	100	3.2
G3	2	590	250	40	950	800	400	4.7
	4	800	175	50	750	700	100	3.?
	6	620	375	70	5000	860	300	3.5
G4	0	930	350	40	1550	600	100	7.5
	4	480	300	60	400	500	100	3.5
	6	440	500	70	1050	1180	100	1.0
H2	2	330	250	40	550	650	100	5.7
	6	340	175	50	75	600	100	4.0
I2	2	390	175	170	250	700	100	5.7
	6	330	250	150	75	800	100	6.0
WELL WATER		.09	0.02	0.01	0.05	0.05	0.4	0.01
SP1	0*	500	350	30	550	850	300	11.2
	0	500	225	50	800	620	100	16.5
	2	430	275	60	400	900	100	3.0
	4	2260	325	50	400	850	400	7.0
SP2	2	560	175	50	400	600	100	2.0
	4	540	500	440	400	1820	100	11.5
	6	730	425	60	300	2420	100	0.5
SP3	2	820	425	.60	700	1480	100	1.5
SP4	2	300	200	50	1150	400	500	7.5
	6	330	375	50	75	950	100	2.5
SP5	2	550	275	50	950	500	500	4.0
SP6	2	330	200	70	1750	600	100	7.0
	4	560	325	50	250	950	100	11.2
SP7	2	460	200	40	300	650	100	14.1
	4	330	125	40	250	650	100	8.2

5.3 General

The results show the levels of contamination found in the samples removed from the Sevenoaks site.

The GLC and the Department of Environment are establishing schemes for defining the contamination in soils. These are shown in 2 and 3. ~~at the end of the~~ report.

From these tables there are two ways of ~~dealing with~~ information concerning contaminant levels.

In the first case, the soil is categorised according to the levels of contaminants. For instance, a soil might be described as 'highly contaminated' or 'uncontaminated' depending on its chemical composition.

The second system defines the limits of contamination which are permissible for the intended use of the land. For instance, industrial buildings may be built on more contaminated land than, say, houses and gardens.

It should be appreciated that both these approaches are used in ascertaining the fitness of land for a particular purposes.

5.4 Soil Categorisation

The first step is to establish the classification of contamination for each of the soil samples, according to the GLC recommendations.

The categories and corresponding levels of contaminants are shown in Table 2.

Tables show the categorisation of the Sevenoaks samples on a scale of 1 to 5 (5 is the worst case).

Do we need to give standards of soil contamination categorisation. If so should they not be specific to anticipated use.

Table 2 GLC Guidelines for Land Classification

Parameter	Typical Values for uncontaminated	Slight Contamination	Contaminated	Heavy Contaminated	Unusually Heavily Contamination
pH (acid)	6-7	5-6	4-5	2-4	2
pH (alkali)	7-6	8-9	9-10	10-12	12
Total Phenols	0-1	2-5	5-50	50-250	250
Cyanide (Total)	0-5	5-25	25-250	250-500	500
Cyanide (Free)	0-1	1-5	5-50	50-100	100
Ferricyanide	0-100	100-500	500-1000	1000-5000	5000
Thiocyanate	0-10	10-50	50-100	100-500	500
Equivalent Zinc	0-250	250-500	500-200	2000-1.0%	1.0%
Copper(available)	0-100	100-200	200-500	500-2500	2500
Total Cadmium	0-1	1-3	3-10	10-50	50
Total Lead	0-500	500-1000	1000-2000	2000-1.0%	1.0%
Nickel(available)	0-20	20-50	50-200	200-1000	1000
Total Arsenic	0-30	30-50	50-100	100-500	500
Total Mercury	0-1	1-3	3-10	10-50	50
Toluene Extract	0-5000	5000-1%	1-5%	5-25%	25%
Cyclohexane Extract	0-200	2000-5000	5000-2.0%	2-10%	10%
Coal Tar(CS_2extract)	0-500	500-1000	1000-2000	2000-1%	1%
Sulphur	1-100	100-500	500-1000	1000-5000	5000
Sulphate	0-2000	2000-5000	5000-1%	1-5%	5%
Sulphide	0-10	10-20	20-100	100-500	500%

Table Categories of Samples

Sample	Depth	pH	Categories of Contamination Phenols	Total Cyanide	Simple Cyanide	Ferricyanide	Thiocyanate
A2	2	1	3	3	1	1	4
	4	1	3	3	1	2	4
A3	2	1	3	1	3	1	4
	6	2	3	1	3	1	4
B2	0	1	4	3	1	1	4
B3	2	3	3	3	3	1	5
	6	1	3	2	2	1	5
B4	2	1	4	1	3	1	5
	3-4	1	5	1	3	2	4
	4	1	5	2	2	1	4
C2	2	1	4	1	3	2	2
	4	1	4	1	3	1	4
C3	2	1	4	1	2	1	4
	4	1	4	1	3	2	4
	6	2	4	1	2	2	4
C4	2	1	3	3	3	2	4
	6	1	3	1	1	1	4
D2	2	2	1	1	1	1	2
D3	2	2	3	1	2	1	3
	6	1	4	1	1	1	4
D4	2	1	3	1	2	1	3
	4	1	2	1	2	1	5
	6	1	2	1	2	1	5
E2	2	3	4	2	2	1	3
	4	2	2	1	1	1	4
	6	1	2	1	1	1	4
E4	2	1	2	2	2	1	4
	6	3	4	1	2	1	4
F2	2	1	3	1	2	1	4
	4	2	2	1	1	1	3
	6	2	2	1	1	1	2
F3	0	1	3	1	1	1	3
	2	2	3	1	1	1	2
	4	1	3	1	2	1	4
	6	1	3	1	3	1	2

Sample	Depth	pH	Categories of Contamination Phenols	Total Cyanide	Simple Cyanide	Ferricyanide	Thiocyanate
F4	2	1	3	1	3	1	2
	4	1	3	1	2	1	2
	6	1	3	1	2	1	3
G2	2	1	2	2	3	1	5
	6	3	3	1	1	1	2
G3	2	1	3	3	3	1	2
	4	1	3	2	3	1	4
	6	2	3	1	2	1	2
G4	0	1	5	3	3	1	4
	4	1	3	3	3	1	4
	6	1	3	1	3	1	4
H2	2	1	3	3	4	1	5
	6	3	3	1	1	1	2
I2	2	1	4	2	1	1	5
	6	1	2	1	1	1	5
WELL WATER		1	1	3	1	1	-
SP1	0*	1	5	4	3	1	5
	0	1	3	3	3	1	4
	2	1	3	3	3	2	3
SP2	2	1	4	1	3	2	2
	4	1	4	1	2	1	3
	6	1	4	1	3	1	4
SP3	2	4	3	1	2	1	3
SP4	2	1	3	1	1	1	5
	6	1	2	1	1	1	5
SP5	2	1	4	4	2	1	4
SP6	2	1	3	4	3	1	5
	4	1	4	2	2	1	5
SP7	2	1	2	2	1	1	4
	4	1	3	2	2	1	4

Table Categorisation of Soils

Sample	Depth	Total Sulphur	Sulphate	Sulphide	Cyclohexane extract	Toluene extract	Coal Tar (CS_2 Extract
A2	2	5	3	4	5	4	4
	4	4	4	3	5	4	5
A3	2	3	2	3	4	4	4
	6	3	2	3	5	4	3
B2	0	4	2	4	5	4	4
B3	2	5	-	-	5	4	5
	6	3	1	2	4	4	4
B4	2	4	2	3	4	4	5
	3-4	5	-	-	4	4	4
	4	5	3	4	5	4	5
C2	2	4	3	3	5	4	5
	4	4	2	4	5	4	5
C3	2	4	1	3	5	4	4
	4	3	1	2	5	4	5
	6	3	1	1	5	4	4
C4	2	4	2	3	5	4	5
	6	5	1	1	5	4	-
D2	2	4	1	4	5	4	4
	6	5	1	2	5	4	0
D3	2	4	1	3	5	4	5
	6	3	1	3	5	4	5
D4	2	3	1	3	4	4	3
	4	3	1	3	4	4	3
	6	5	-	-	4	3	4
E2	2	4	2	3	5	4	5
	4	3	1	2	4	4	4
	6	3	1	2	4	4	4
E4	2	3	1	4	4	4	4
	6	3	1	4	5	4	5
F2	2	3	1	2	4	4	4
	4	3	1	2	3	3	4
	6	3	1	3	3	3	5
F4	2	5	-	-	5	4	4
	4	5	-	-	5	4	4
	6	4	2	3	5	4	4
G2	2	4	4	4	5	4	5
	6	5	2	4	4	4	5

Sample	Depth	Total Sulphur	Sulphate	Sulphide	Cyclohexane extract	Toluene extract	Coal Tar (CS_2 Extrac
G3	2	5	2	4	5	4	5
	4	5	3	4	4	4	5
	6	4	3	3	4	3	2
G4	0	5	1	4	5	5	5
	4	5	-	-	5	4	4
	6	3	1	2	3	3	4
H2	2	5	2	4	5	4	4
	6	3	3	3	4	4	5
I2	2	5	2	4	5	4	4
	6	5	1	4	4	4	5
WELL WATER	1	1	1	-	-	-	
SP1	0*	4	3	4	4	4	5
	0	5	-	-	4	4	4
	2	5	-	-	5	4	4
	4	4	4	4	5	1	5
SP2	2	5	-	-	5	4	4
	4	5	-	-	5	4	4
	6	4	1	3	5	4	4
SP3	2	4	3	4	4	4	4
SP4	2	3	1	3	5	4	5
	6	3	1	4	5	4	5
SP5	2	4	2	4	5	4	5
SP6	2	4	4	4	5	4	5
	4	3	2	4	5	4	5
SP7	2	5	2	4	5	4	5
	4	5	2	4	5	4	5

Adjust for background levels

Table Categorisation of Soils

Sample	Depth	Metals Zn	Cu	Cd	Pb	Ni	As	Hg
A2	2	2	2	4	1	4	3	2
	4	2	3	4	1	4	4	4
A3	2	1	3	5	1	4	3	2
	6	2	3	5	1	4	3	3
B2	0	3	3	4	1	4	3	2
B3	2	3	3	5	4	4	3	2
	6	2	3	4	3	4	3	2
B4	2	2	3	4	2	4	3	2
	3-4	3	3	5	3	5	4	3
	4	3	3	5	4	4	4	3
C2	2	2	3	4	4	5	3	2
	4	2	2	4	1	4	4	2
C3	2	2	3	5	1	5	3	3
	4	1	2	4	3	4	3	2
	6	2	4	4	2	5	3	3
C4	2	1	1	5	3	4	4	3
	6	2	3	4	1	4	4	3
STD1		2	-	4	2	4	4	3
STD2		2	-	4	1	4	3	3
D2	2	3	3	5	2	4	3	3
	6	2	3	4	1	4	3	2
D3	2	3	4	4	3	4	3	1
	6	2	3	4	1	4	3	@
D4	2	3	4	5	4	4	3	2
	4	3	3	5	1	5	3	3
	6	1	2	4	4	4	3	2
E2	2	2	3	5	2	5	3	2
	4	2	4	4	2	5	4	3
	6	2	3	4	4	4	3	2
E4	2	2	1	4	1	4	3	3
	6	2	2	4	1	4	3	3
F2	2	2	4	4	4	5	3	2
	4	1	2	5	3	4	3	2
	6	1	2	4	1	4	3	2
F3	0	5	3	4	3	4	3	2
	2	3	4	4	1	5	3	3
	4	2	3	4	4	4	4	2
	6	2	2	4	5	4	3	2

Sample	Depth	Metals Zn	Cu	Cd	Pb	Ni	As	Hg
G2	2	2	3	4	2	4	5	3
	6	2	2	4	1	4	3	3
G3	2	3	3	4	2	4	4	3
	4	3	2	4	2	4	3	3
	6	3	3	5	4	4	4	3
G4	0	3	3	4	3	4	3	3
	4	2	3	5	1	4	3	3
	6	2	3	5	3	5	3	1
H2	2	2	3	4	2	4	3	3
	6	2	2	4	1	4	3	3
I2	2	2	2	5	1	4	3	3
	6	2	3	5	1	4	3	3
WELL WATER		1	1	1	1	1	1	1
SP1	0*	2	3	4	2	4	4	4
	0	2	3	4	2	4	3	4
	2	2	3	5	1	4	3	2
	4	4	3	4	1	4	4	3
SP2	2	3	2	4	1	4	3	2
	4	3	3	5	1	5	3	4
	6	3	3	5	1	5	3	1
SP3	2	3	3	5	2	5	3	2
SP4	2	2	3	4	3	4	4	3
	6	2	3	4	1	4	3	2
SP5	2	3	3	4	2	4	4	3
SP6	2	2	2	5	3	4	3	3
	4	3	3	4	1	4	3	4
SP7	2	2	2	4	1	4	3	4
	4	2	2	4	1	4	3	3

6. Discussion

This section discusses the results and some of the implications of the results.

The section is divided according to the particular analysis being described.

A general sub-section on sampling techniques and interpretation of 64 results is included at the end of the section.

6.1 Visual Inspection of the Site

The visual inspection of the site indicated that the site was "clean". There was little debris laying around on the site. This would suggest that the clearing of the site was undertaken by a competent contractor.

Any equipment or plant on the site appeared to have been put on to the site at some time since the demolition of the site.

As stated previously, most of the site consisted of concrete cover and scrub grass, bushes and trees.

The concrete appeared to be mostly roadways and in good condition, showing no major signs of breaking up.

The grass, bushes etc, were prolific, indicating that the soil was at least uncontaminated enough to support vegetation.

The minor areas which did show contamination of the surface were specific, small dumps of waste materials. Consequently these areas would not prove to be any problem in terms of disposal.

The first impressions of the site indicated that not very much remedial action would be required in order to make the site usable.

The photographs included endorse this view.

6.2 Visual Inspection of Soil Samples

Appendix A shows the descriptions of the soil samples when inspected at the laboratory.

The descriptions of the soil give an extremely good indication as to the presence or otherwise of contaminants. For gross contamination it could be argued to be the only test necessary.

The careful application of a visual assessment of the soils can give a very good picture of the state of the soil. Especially so is the detection of organic components such as tars, liquors etc.

The soil descriptions would suggest the following contamination.

A2 No contamination
A3 Surface contamination
B2 No contamination
B3 Surface/mid depth contamination
B4 Surface clear but buried contaminant (?)
C2 Heavily contaminated especially further down
C3 Heavily contaminated further down
C4 No contamination
D2 Contamination towards the surface
D3 Contamination near surface
D4 Contamination in all samples
E2 Some contamination
E4 No contamination
F2 Some localised signs of contamination
F3 Some contamination
F4 Contamination
G2 Heavily contaminated at greater depths
G3 No contamination
G4 Heavy contamination at lower depth
H2 Some contamination
I2 Some contamination
SP1 Some contamination
SP2 Some contamination
SP3 Strong tar smell
SP4 No contamination
SP5 Contaminated
SP6 Some contamination
SP7 No contamination
STD1 No contamination
STD2 No contamination.

6.3 Chemical Analyses

The chemical analysis is the most detailed aspect of the soil investigation.

By and large the tabulated result tables and classifications are self-explanatory. For instance, a Group 1 represents no contamination and Group 5 indicates heavy contamination, according to the GLC Guidelines.

In some cases, however, the experimental determination carried out is not directly analogous to the classification table: such cases as the determination of total and available metals, for instance, is typical of this problem.

The discussion has been sub-divided according to test. Any problems that might be associated with the interpretation of the results is discussed in this sub-section. The second part of each sub-section describes the level of contaminant actually found at the sample points.

Figs show schematically the concentration of contamination found according to the grid position and contaminants.

The level of contamination is represented by concentric quandrants, each quadrant representing a depth of analysis. The first clockwise from 12 o'clock representing 0 feet, the second - 2 feet, the third - 4 feet and the last 6 feet. The larger the quadrant diameter, the higher is the contamination.

The contamination levels for the 'special' boreholes are not included on the diagrams for clarity.

6.3.1 pH Determination

The method used for measuring the pH of a soil is simple and relatively straightforward. As a result of this, it would be expected that the pH reading should be reproducible and representative of the soil sample.

The pH is a quick and simple means of indicating the general state of the soil.

A pH close to 7 is representative of a non-contaminated soil. The greater the divergence of the pH from 7, either upwards or downwards, then the greater the likely level of contamination.

Most of the samples showed pH values characteristic of low levels of contamination.

Only the sample at SP3 gave indications of "heavy levels of contamination". Some five samples gave indications of "contamination" (B3, E2, E4, G2, H2), and even these only at single depths.

6.3.2 Phenols

Phenols are a likely type of contamination of gasworks sites.

The analyses showed most of the samples to come above the category of "contaminated" soils.

Generally, the area around the old works' buildings (i.e. NNW end of the site), appears to have higher concentration. It would appear that the western side of the site is more affected also.

Phenols, however, are a short lived chemical species which undergo breakdown to less noxious compounds. In this respect, it would be expected that the levels would decrease with time.

6.3.3 Total Cyanides

The cyanide levels for the site are variable for the site (see Fig.6), although they are lower than would be anticipated for this type of site.

Most of the analyses show the levels to be between "uncontaminated" and "contaminated". The readings at SP5 and SP6 showed "heavy contamination". These readings were not duplicated at surrounding boreholes so this would indicate that the contamination was localised in the case of SP5.

Borehole SP6 had relatively high readings at the surrounding boreholes which would suggest that the contamination is more widespread. The other "contaminated" readings appear to be isolated.

6.3.4 Simple (Free) Cyanide

The free cyanide analysis shows the amount of cyanide that is free to react and hence be harmful. Consequently the levels in the GLC table are lower. ?

The measurements made on the site show reasonable levels of contamination except H2 which would be categorised as "highly contaminated". This reading is isolated and this would indicate localised contamination only. This is endorsed by the lower levels of contamination in the surrounding boreholes. None of the special boreholes showed "high contamination" although SP1, SP2 and SP6 showed readings in the "contaminated" category.

6.3.5 Ferro-Ferricyanide

The cyanide species in Ferro-Ferricyanide are bound up chemically, that is to say, the compound is comparatively inert. As a result the GLC table levels are higher. ?

All the samples analysed showed low readings, mainly being in the "uncontaminated" category. Therefore there would not seem to be any ferro-ferricyanide contamination.

6.3.6 Thiocyanate

The thiocyanate species incorporates both sulphur and the cyanide species. As a result the high sulphur analyses carried out (section 6.3.7) would be expected to be reflected in a high thiocyanate. Most of the levels of thiocyanate on the site are high (as may be seen by the large quadrants in Fig. 9). Most of the categories suggest "heavy contamination" and in one or two, "unusually heavy contamination" is shown.

6.3.7 Total Suplhur

The level of the total sulphur, using the analytical method in this work, gives an indication of the total sulphur contained in the soil.

As a result the concentrations would be expected to be greater than the GLC table because the table refers to "free" sulphur.

The free sulphur figures probably refer to the elemental sulphur in the soil.

For the purposes of this report the results have been compared to the GLC table and the contamination categories will err on the high side.

The results for the analysis do show the levels of contamination by sulphur compounds to be high.

The relationship between Free and Total sulphur is unknown and so it is not known at present by how much the categories exceed the "true" value.

6.3.8 Sulphate

The experimental method used is the acid extractable sulphate and this is higher than other extraction methods. Consequently the results will err on the pessimistic side, often indicating high categories of contamination.

The sulphate levels are low for all the tests except around grid locations A2, SP1 and SP6. Considering previous practices at these locations these readings are to be expected.

6.3.9 Sulphide

The sulphide levels on the site are three or four over the whole site.

This is indicative of "contaminated", or "heavily contaminated" soil and shows the fairly widespread deposition of waste, or migration of sulphides, over the site.

The visual examination also gave similar results in describing soils as "smelly".

6.3.10 Cyclohexane Extract

The tests carried out in this analysis were carried out on the soil as received. The extractables quoted in the GLC table refers to extractable material from the air dried material.

This means that the results of this analysis will include the water in the sample as well as hydrocarbons.

The GLC test result would include the water not removed by only air drying as opposed to oven drying.

Experience has shown that, of the total moisture content, approximately 3/4 is released by air drying at 30°C. Therefore about 3/4 of the water content obtained in the over dry samples should be subtracted from the extraction result in order to make the results equivalent.

The reason for not air drying is so not to lose any aliphatic components in the soil through evaporation. Consequently, these test results, even when corrected for moisture content, will still err on the high side.

If the results are corrected for moisture the most of the results will drop a category of contamination.

Thus, except in one or two cases, the maximum level of contamination is "heavily contaminated".

6.3.11 Toluene Extract

The same comments relating to the cyclohexane extraction are applicable to the Toluene.

Nevertheless, the majority of the analyses fall into category 4 and, by applying the same argument as section 6.3.10, would reduce to category 3 or lower.

The distribution of the results is similar to the cyclohexane extract results over the site.

6.3.12 CS_2 Extract

The extraction of a soil with CS_2 removes coal tar and elemental sulphur from the soil.

The GLC table refers to the concentration of coal tar and this group has been used to categorise the CS_2 extraction results. The CS_2 extraction results will therefore be excessively large by comparison.

The plan of the results (Fig. 15) shows a similar distribution of results to the other organic extractions.

The whole site would appear to be fairly evenly affected by the "organic extractables" contamination.

6.3.13 Heavy Metals - General

The analysis of the heavy metals was completed on dried, crushed soil samples. The analytical technique of fusion also ensures that the total metal in the soil is analysed.

The tabulated categories for heavy metals often quote the available metal, which can be considerably less than the total metal content. The tables also quote air dried samples, and consequently the results of our analyses will err on the high side.

Because of these artefacts of the analytical procedure two "standard" samples were also analysed. These samples were taken from the locality of Sevenoaks site, about half a mile away.

The results of the analysis of these samples show the"baseline" that could be expected for heavy metal content and can be used to "normalise" the soil analysis results.

6.3.14 Zinc

The table values used to categorise the samples refers to the available zinc. This is somewhat lower than the equivalent total metal content.

Nonetheless, the results for the analysis are low except in one or two localised areas. These examples would be expected to be due to rubbish dumping on the site or some similar reason.

6.3.16 Cadmium

The cadmium results, at first sight, would appear to be quite high.

In most cases, however, the level of cadmium contamination is of the same order as the reference soils. Thus the majority of the high readings are due to natural cadmium levels, or the particular analytical technique being too severe.

In one or two locations, however, very high cadmium levels were recorded and these cannot be attibuted to natural background levels etc.

The high levels at A3, SP2 and C3 appear to be localised to a narrow band of depth.

High levels of cadmium at sample point I2 cannot easily be explained, unless the contamination was from the road or dumped rubbish. —— ?

6.3.17 Lead

All the levels of lead, except the area around F3, appear to be low. Most of these fall in the categories 1 to 3.

The high lead contents of the samples around F3 are quite difficult to explain unless the lead is associated with the tar spillage etc. which was found in this area. The fact that the greatest contaminatin was measured at 6 foot would suggest that the contamination source was buried.

6.3.18 Nickel

The levels of nickel for the table refer to the available nickel and consequently the categories of contamination will err on the high side.

The "baseline" levels of nickel, as measured in the standard samples area aslo high, and this would suggest that the real level of contamination of nickel is quite low.

The baseline levels are shown in Fig. 20 for comparison.

6.3.19 Arsenic

The levels of arsenic are low when the background levels of arsenic in the reference soils are considered. Even disregarding the high background levels, the majority of the analyses showed the land to be "contaminated". In fact one of the standard samples was also "highly contaminated"

6.3.20 Mercury

As can be seen from Fig. 22, all of the levels of mercury measured were relatively low, being little greater than the background level. In most cases the soil samples had a lower level of mercury than the reference soils.

6.4 General

The analysis of the site has shown that contamination of the site does exist but generally it is not as high as was first anticipated.

The tests that were carried out were all designed to be over stringent rather than relaxed. As a result many of the results appear to be worse than they actually are.

The well-water samples were all of low levels of contamination and this would indicate that the seepage of the contaminants is low or that they have a low availability.

7. Conclusions

The results detailed in this report show the levels of contaminants found at different locations on the Sevenoaks site. There was considerably less localisation of contamination than was anticipated.

The levels of contamination for the different chemical species was fairly even over the whole site.

The major source of contamination on the site was due to organic or sulphur species. The visual examination of the samples gave a very good indication of this sort of contamination prior to the experimental analyses.

The heavy metal contamination was acceptable except in a few places where localised high readings were taken.

8. Recommendations

This report details the results of the analysis of samples from Sevenoaks Gas Works site.

The chemical species examined are based on the recommended species for evaluation by the GLC, Department of Environment and British Gas.

At present, however, the field of soil analysis for contamination is in a state of flux. New limits of contamination and new or different species for examination are expected to be introduced in the near future.

At present the GLC Guidelines provide the main data on contamination levels in soils.

Therefore, few recommendations may be made on the basis of these tests because of the uncertainty that lies in the interpretation of soil contamination data.

At some future date it might be hoped that a definitive report will be issued by the Department of Environment.

One or two recommendations can be made, however, namely:

1) A structural survey in conjunction with the planned development. This would allow the size and location of the underground structures (i.e. tanks, buildings and the like) to be assessed with reference to the proposed development. ?

Tanks etc. do not need to be a problem, but it is important that people know what is on the site.

2) <u>Retain concrete cover</u>

The concrete has the effect of sealing the site and it would be recommended that this should be retained. ?

To disrupt this cover might create a large number of problems of contamination not revealed by this report ? !!

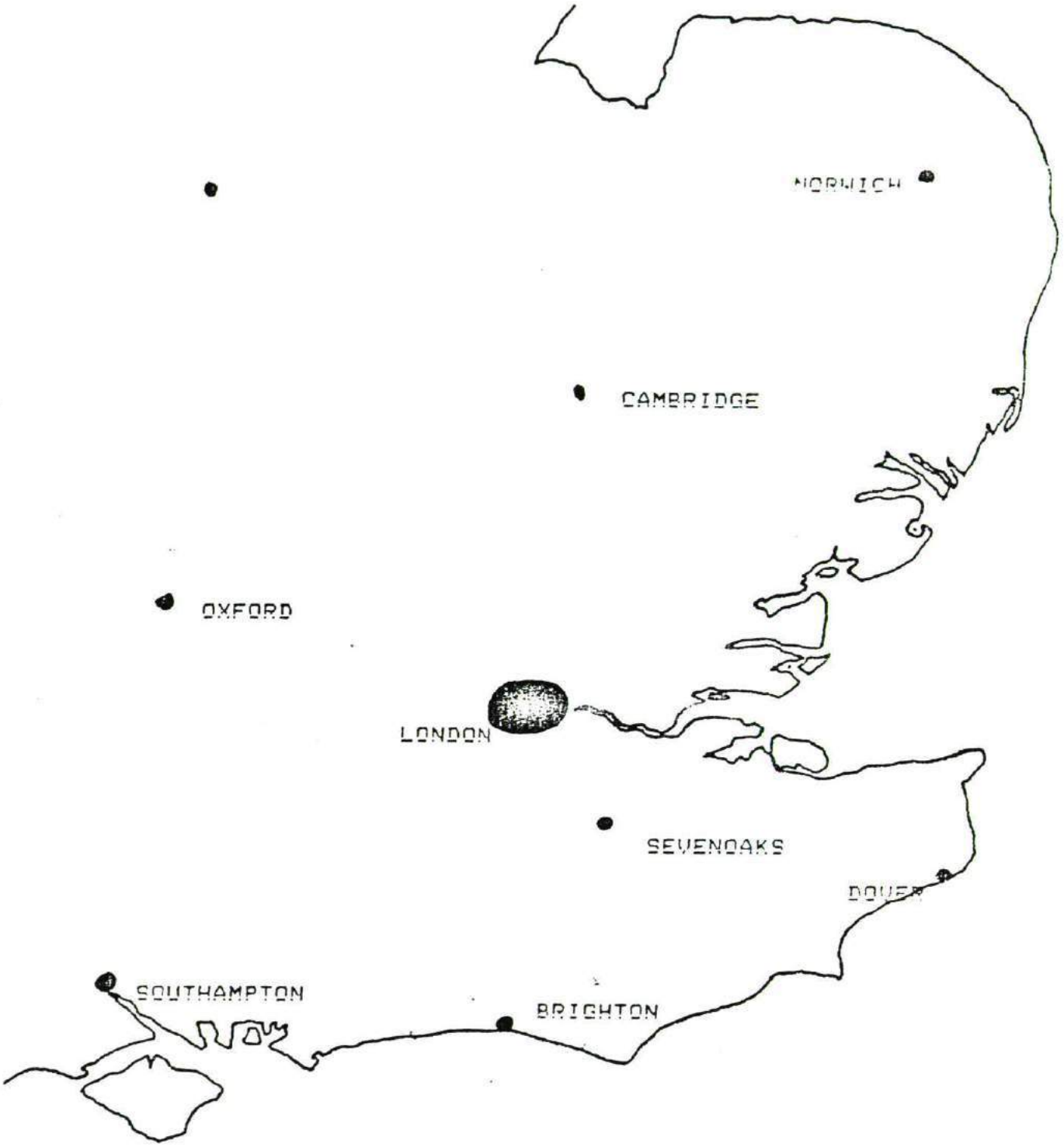

FIG.1. LOCATION OF SEVENOAKS

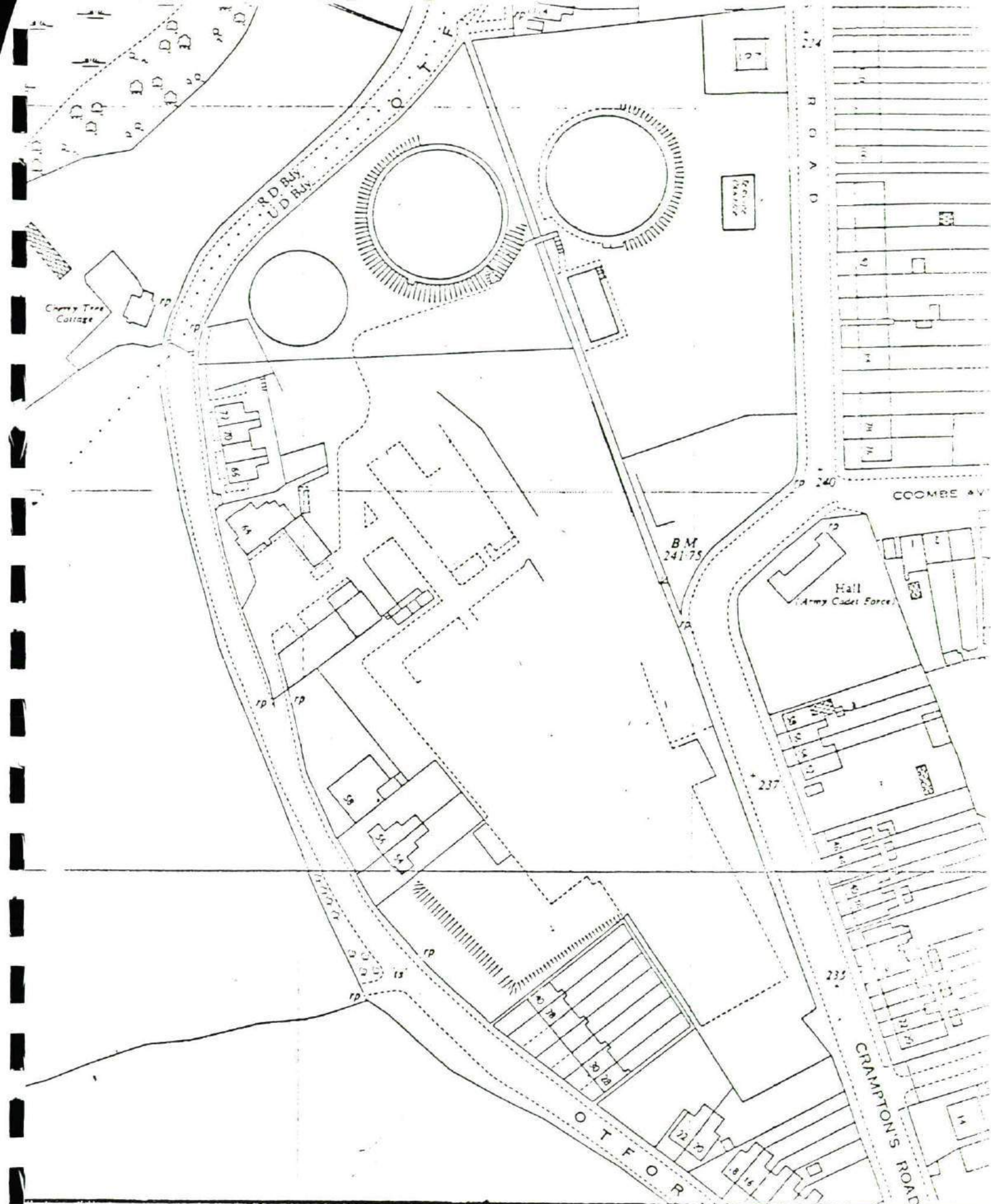

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FIG.2. SITE PLAN

Scale	1/1250
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Drawing No.	

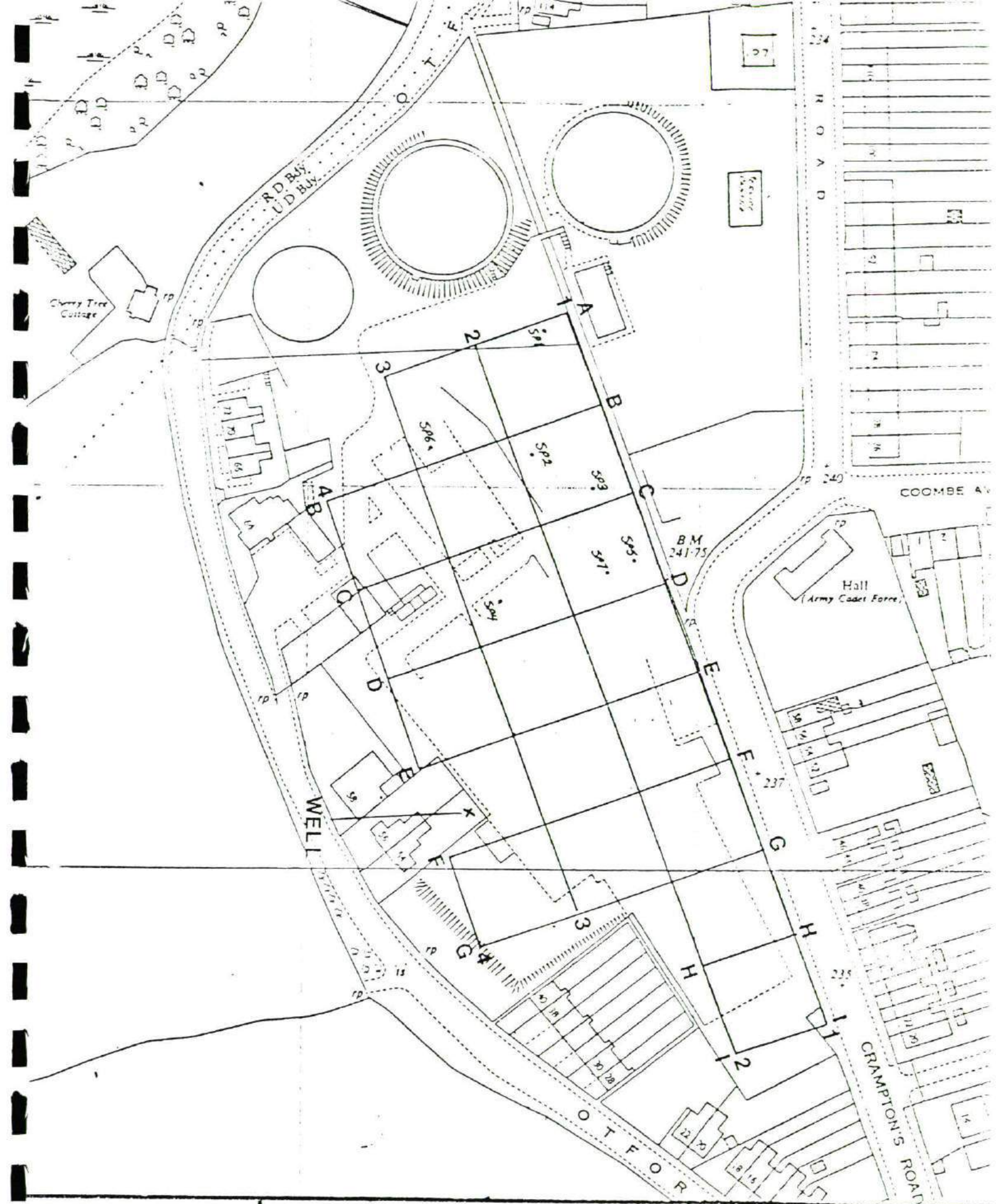

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FIG.3 SITE PLAN

SHOWING SAMPLING GRID

Scale	1/1250
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File Number	
Drawing No.	

Instruction on using "Quadrant Diagrams"

The analysis for each borehole and each contaminant has a possible four results, one for each depth.

The quadrant diagram has been devised in order to give a good visual representation of the level of contamination.

The quadrant diagram at each grid intersection refers to that location.

The diagram is made up of segments.

The four segments are aligned with the grid pattern such that the first segment is the first segment clockwise from the top position on the grid. The second becomes the second and so forth.

The first quadrant refers to 0 feet, the second to 2 feet, the third to 4 feet and the last quadrant to 6 feet.

The size of the quadrant is representative of the level of contamination found at that depth and location. These results are shown in tables .

For example an analysis of:

	depth	Category	Would appear as	
	0	2	6 feet	0 feet
	4	5		
	6	3	4 feet	2 feet
and	2	2	6 feet	0 feet
	4	2		
	6	1	4 feet	2 feet

Thus, the greater the quadrants then the greater is the contamination.

The diagram allows the amount, extent and distribution of contamination to be clearly seen.

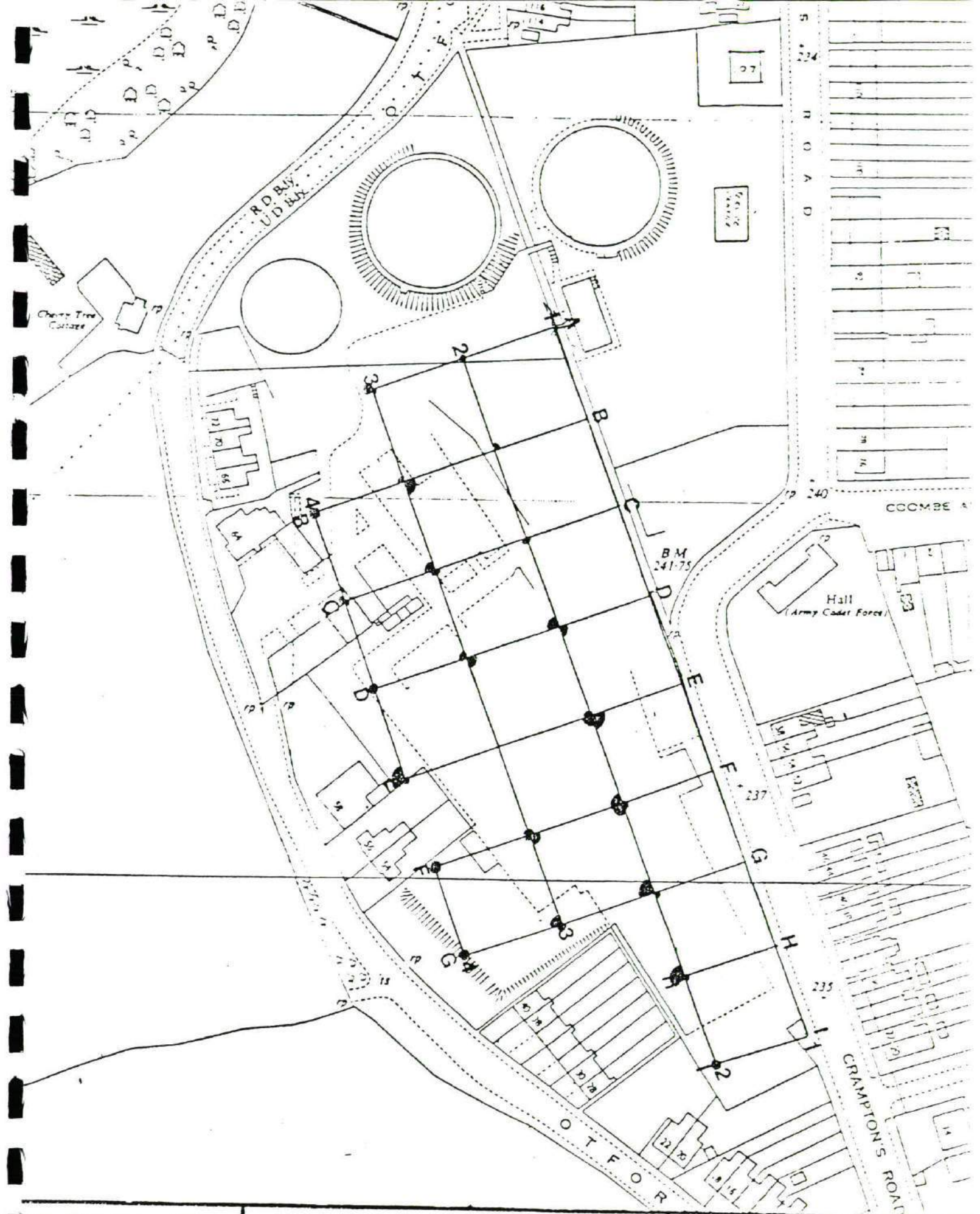

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FIG. 4
pH

Scale	1/1250
Date	
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File Number	

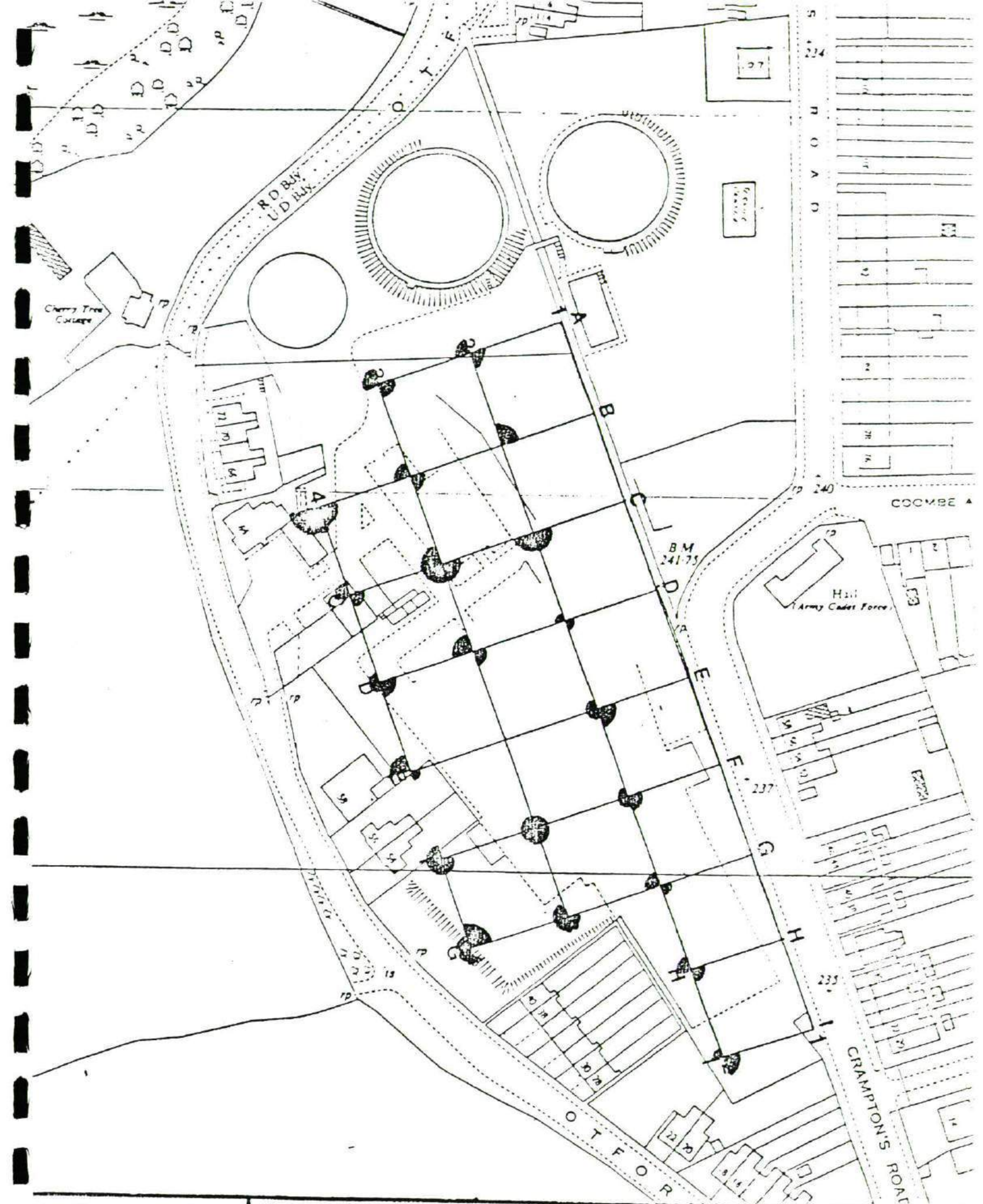

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FIG. 5

PHENOLS

Scale	1/1250
Date	
Copied From	
File Number	

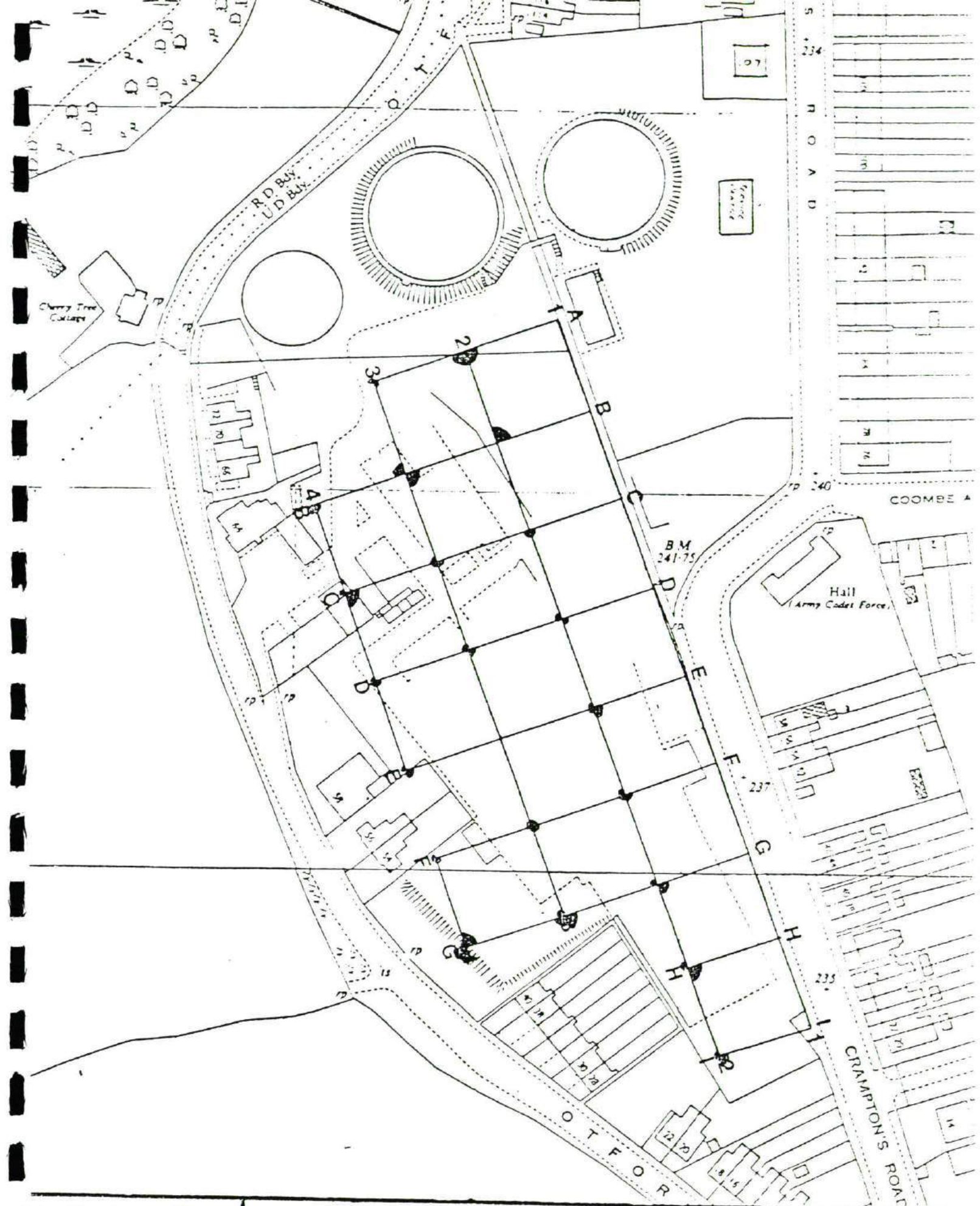

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FIG 6

TOTAL CYANIDES

Scale	1/1250
Date	
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File Number	

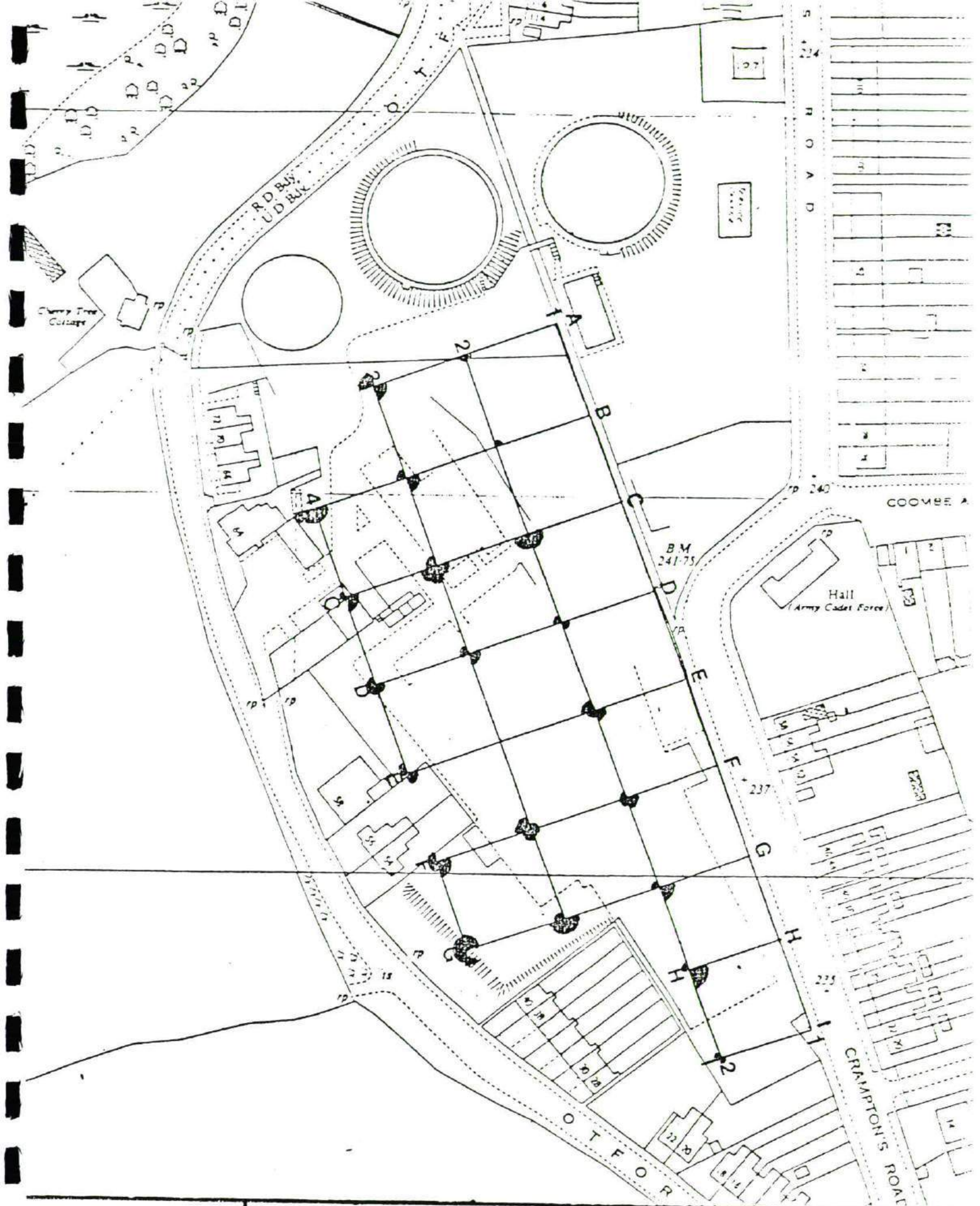

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FIG. 7

SIMPLE (FREE) CYANIDE

Scale	1/1250
Date	
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File Number	

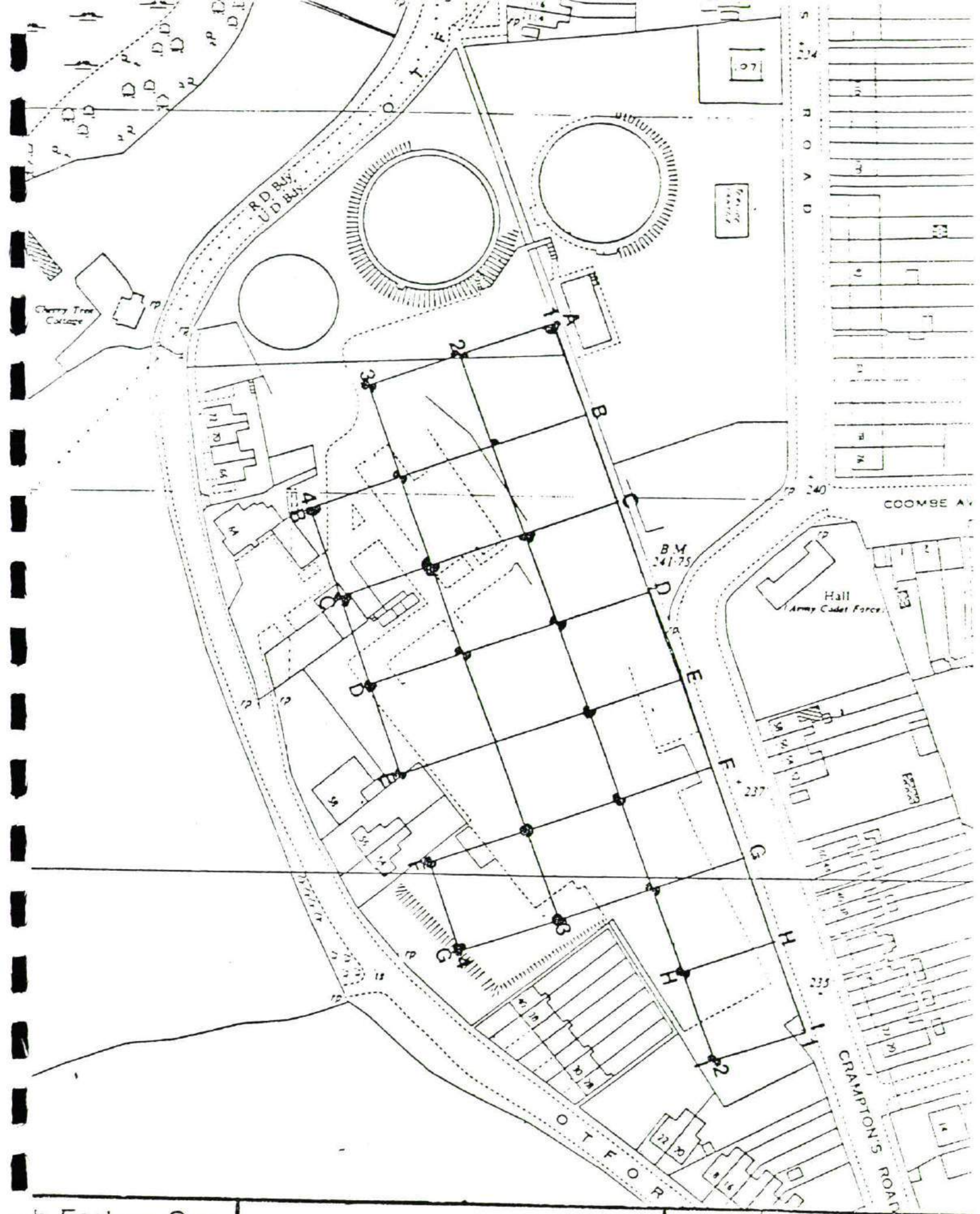

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FIG. 8

FERRO-FERRICYANIDE

Scale	1/1250
Date	
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File Number	

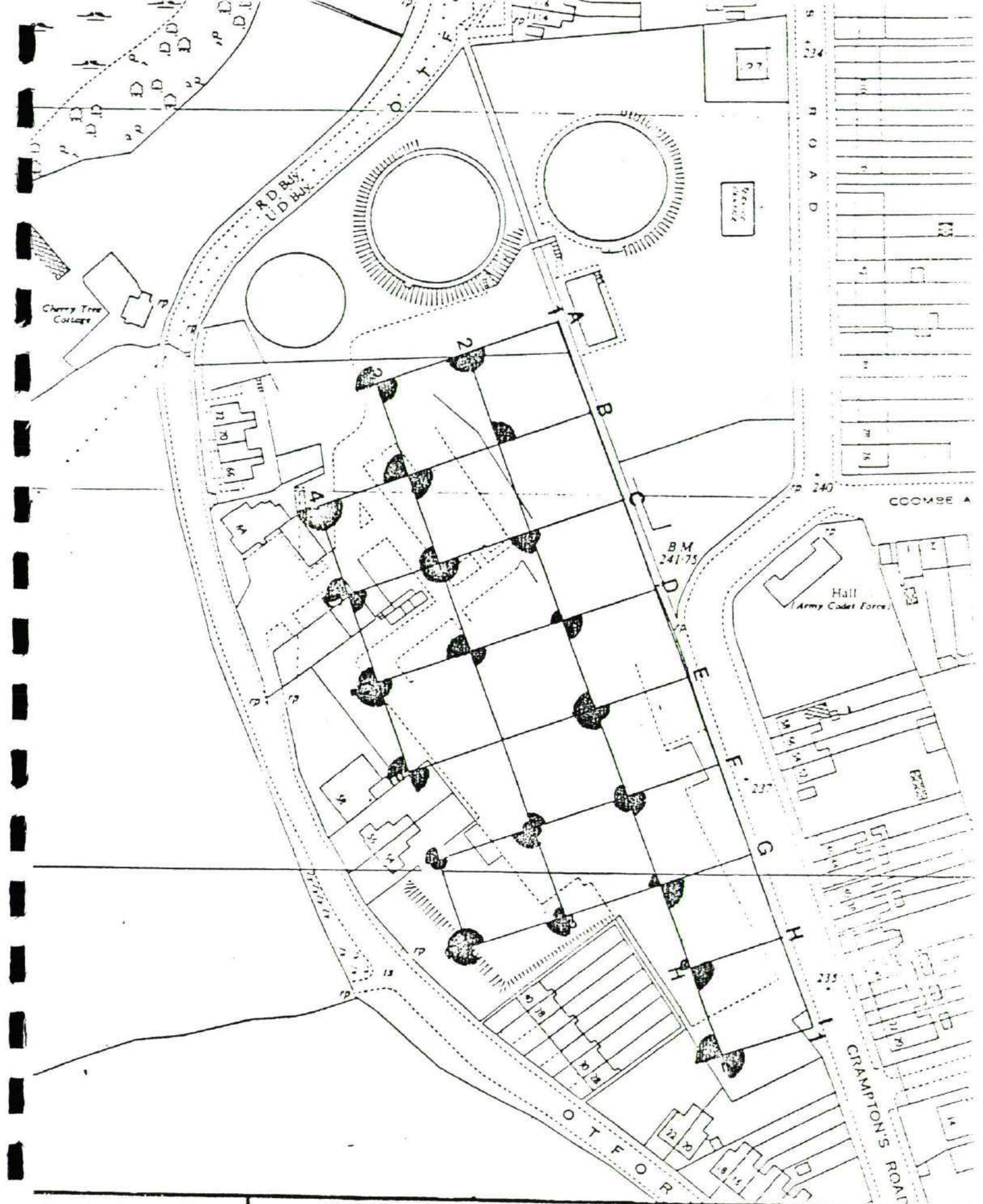

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FIG. 9

THIOCYANATE

Scale	1/1250
Date	
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File Number	

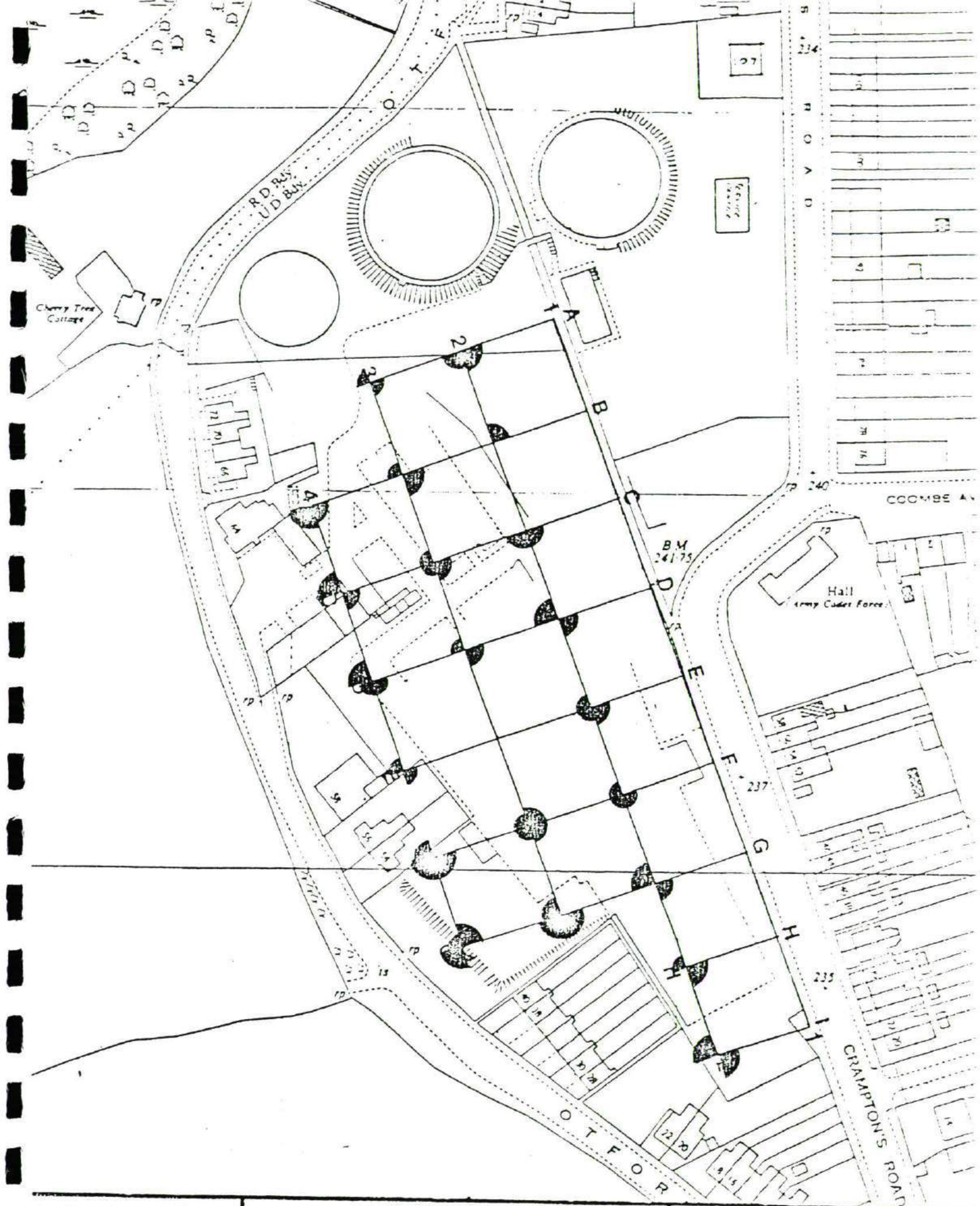

FIG. 10

TOTAL SULPHUR

Scale	1/1250
Date	
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File Number	

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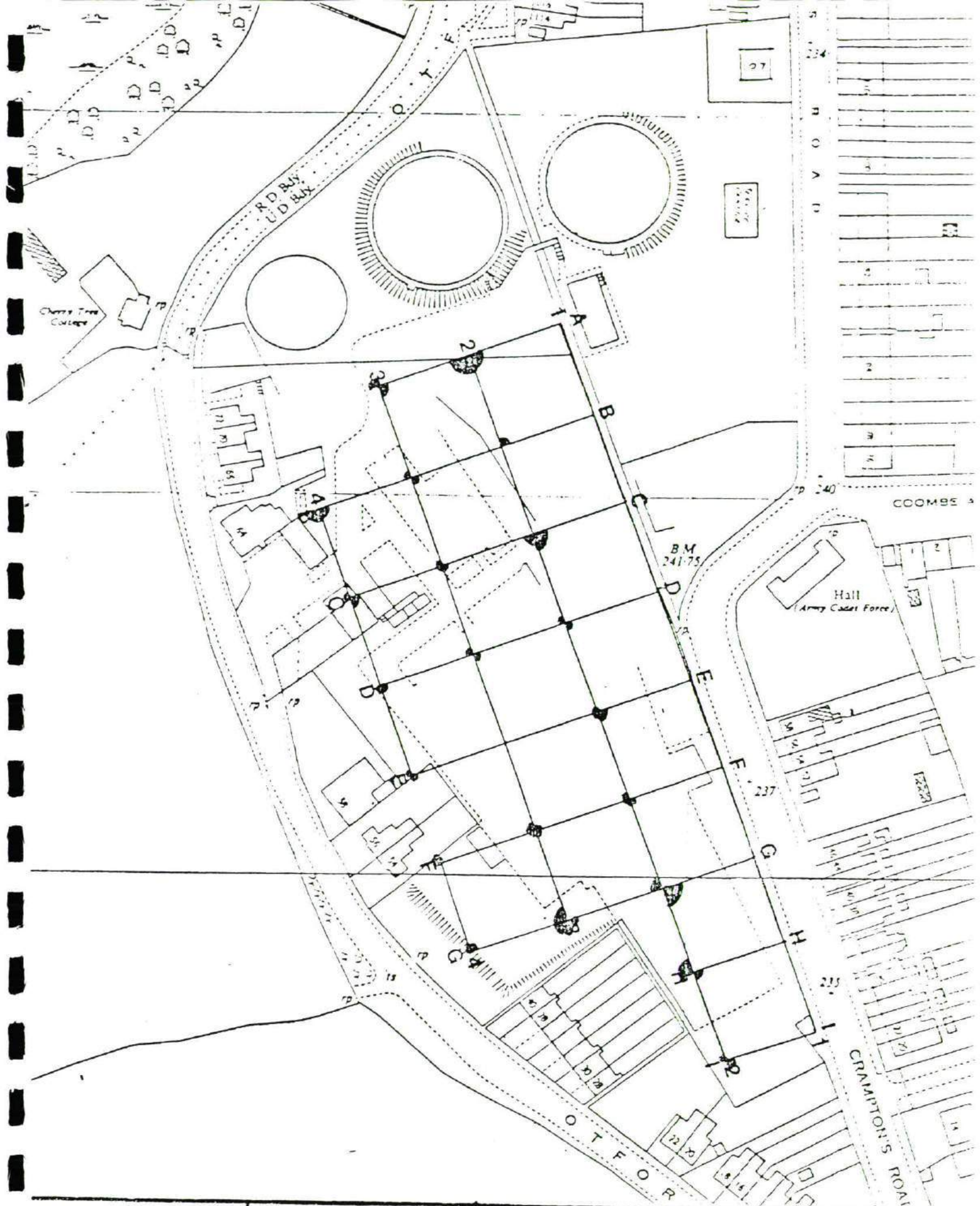

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FIG. 11

SULPHATE

Scale	1/1250
Date	
Copied From	TQ52575E
File Number	

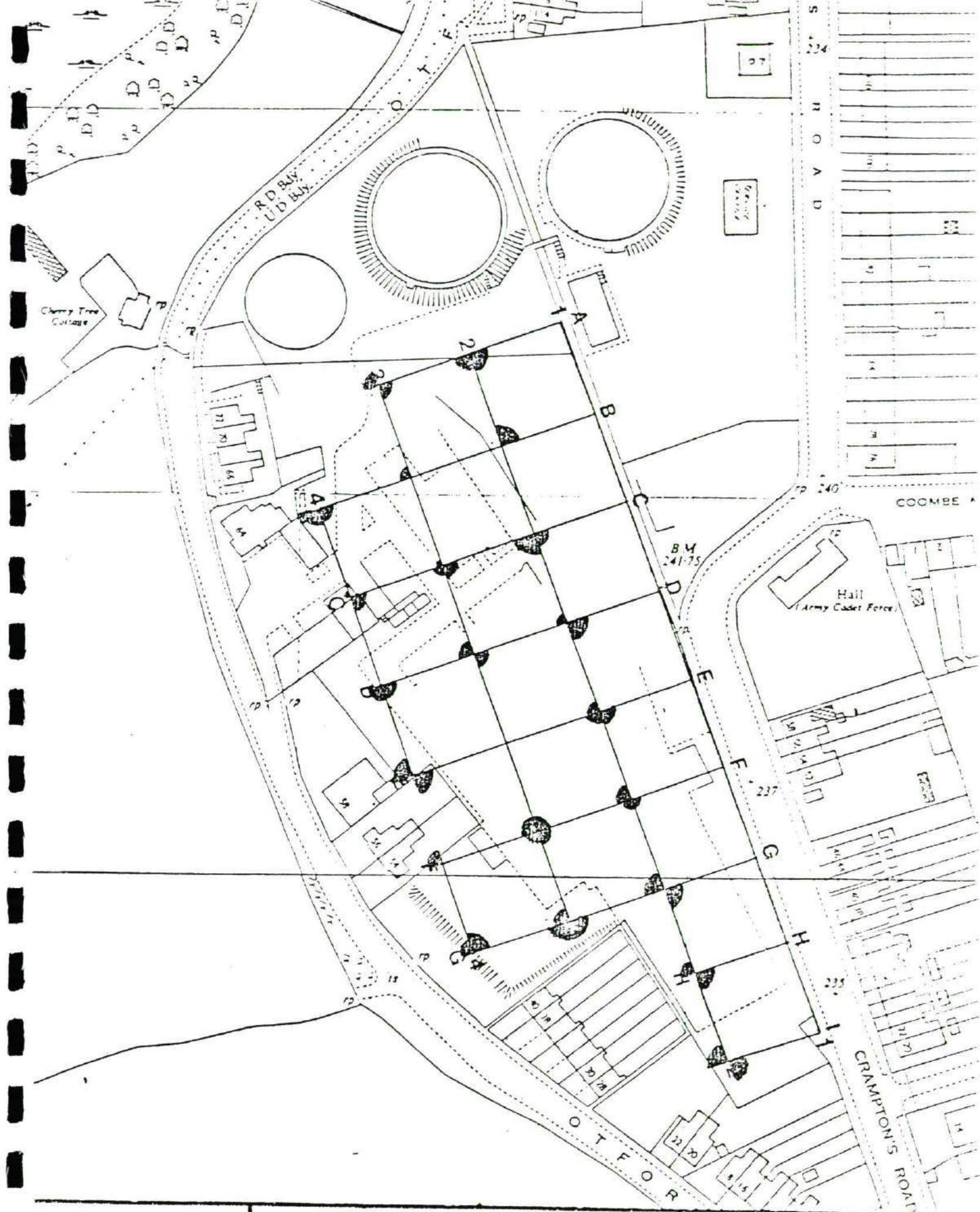

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FIG. 12

SULPHUR

Hide

Scale	1/1250
Date	
Copied From	TQ525788
File Number	

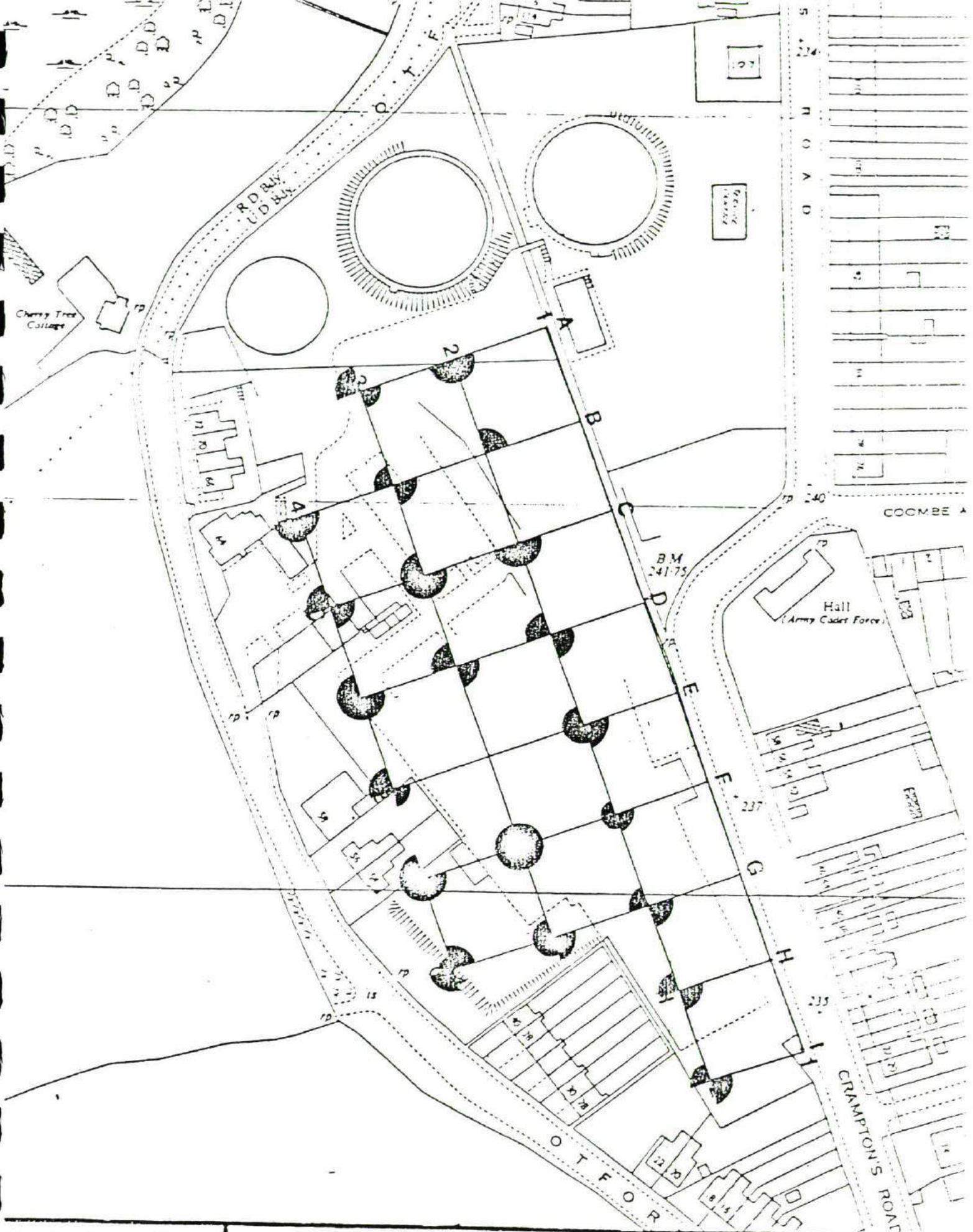

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FIG. 13

CYCLOHEXANE EXTRACTABLES

Scale	1/1250
Date	
Copied From	
File Number	

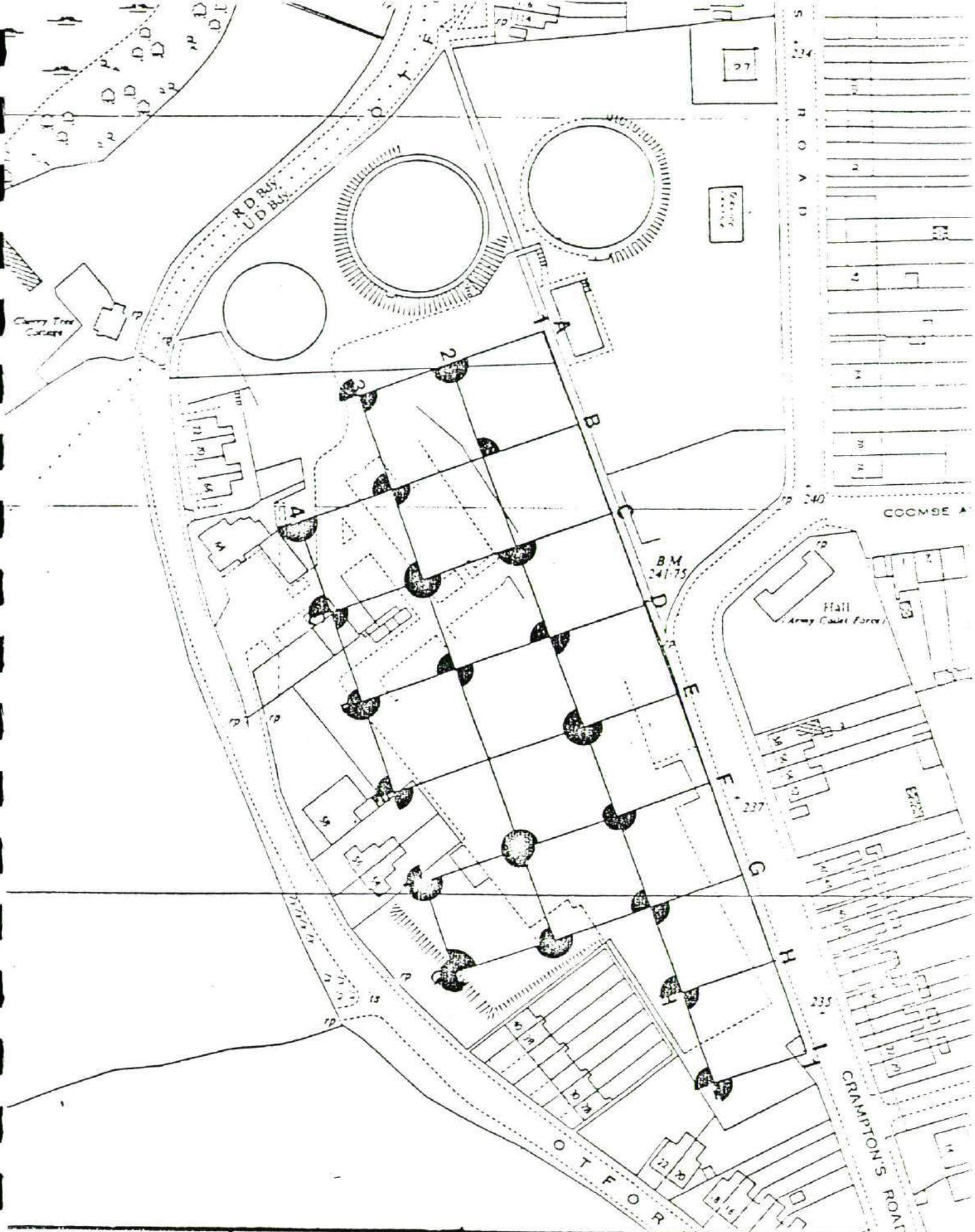

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FIG. 14

TOTAL EXTRACT

Scale	1/1250
Date	
Copied From	TQ5275SE
File Number	

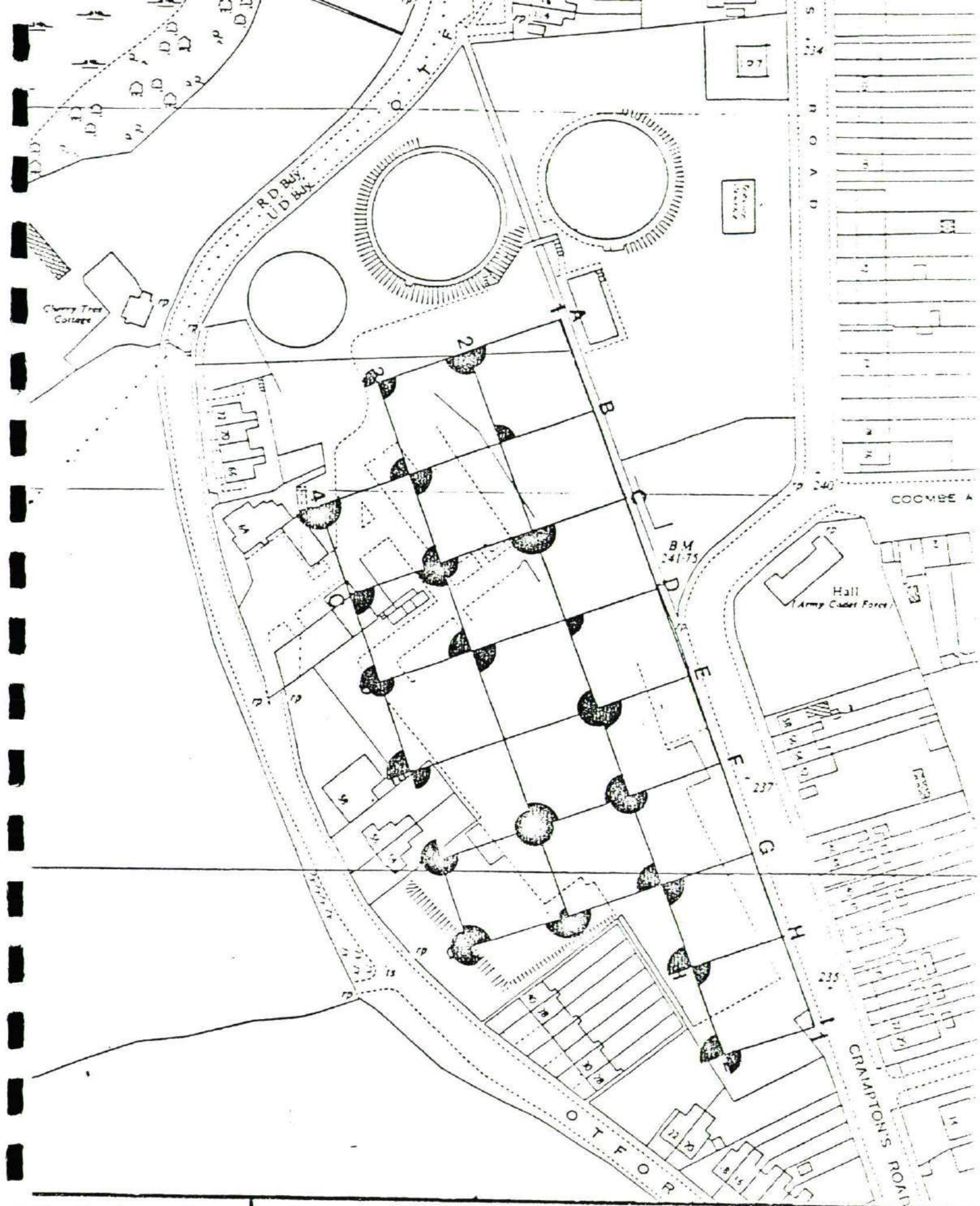

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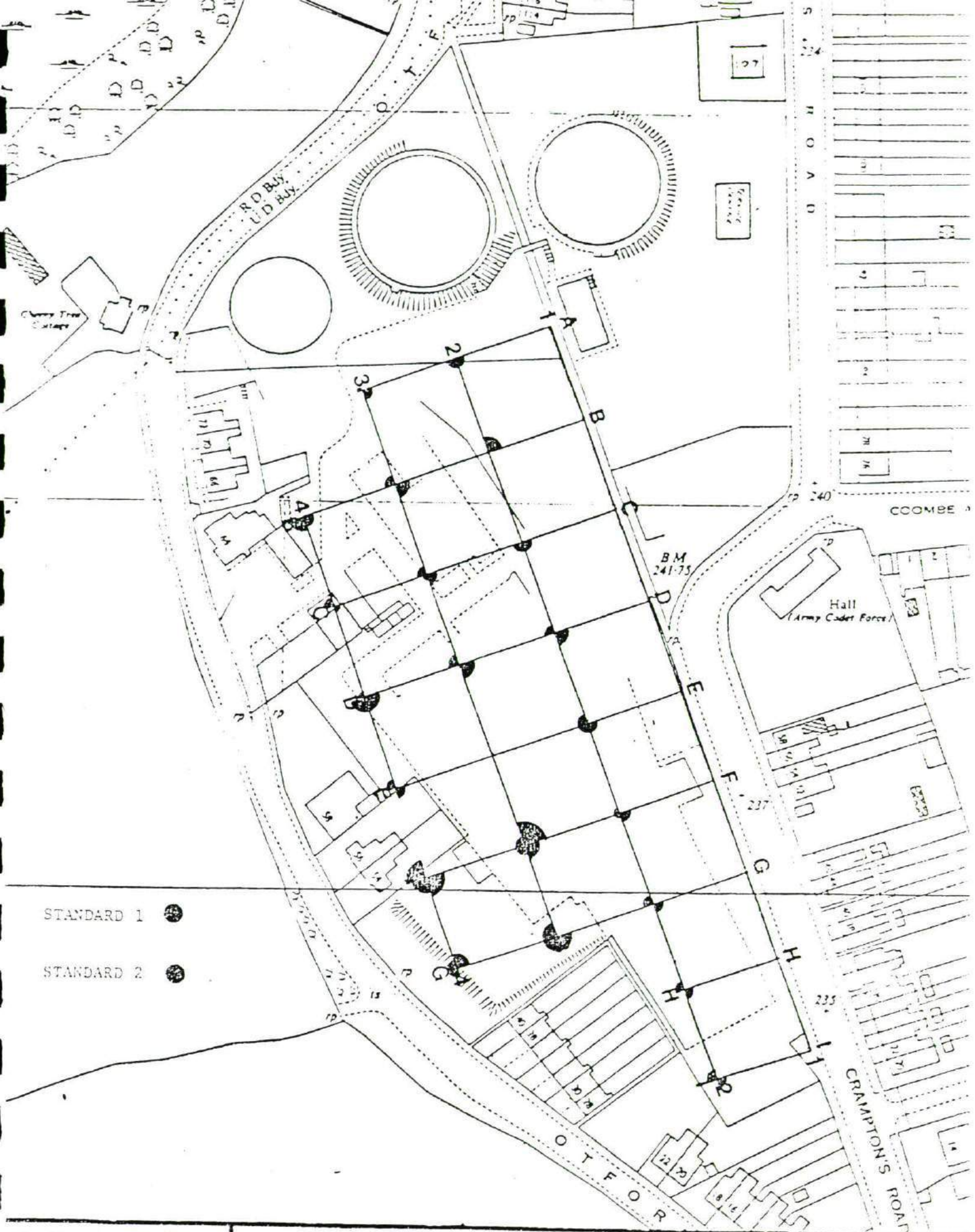
FIG. 15

CS_2 EXTRACT

Scale	1/1250
Date	
Copied From	TQ52SESE
File Number	



Scale	1/1250
Date	
Copied From	TQ5277SE
File Number	

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FIG. 16

ZINC

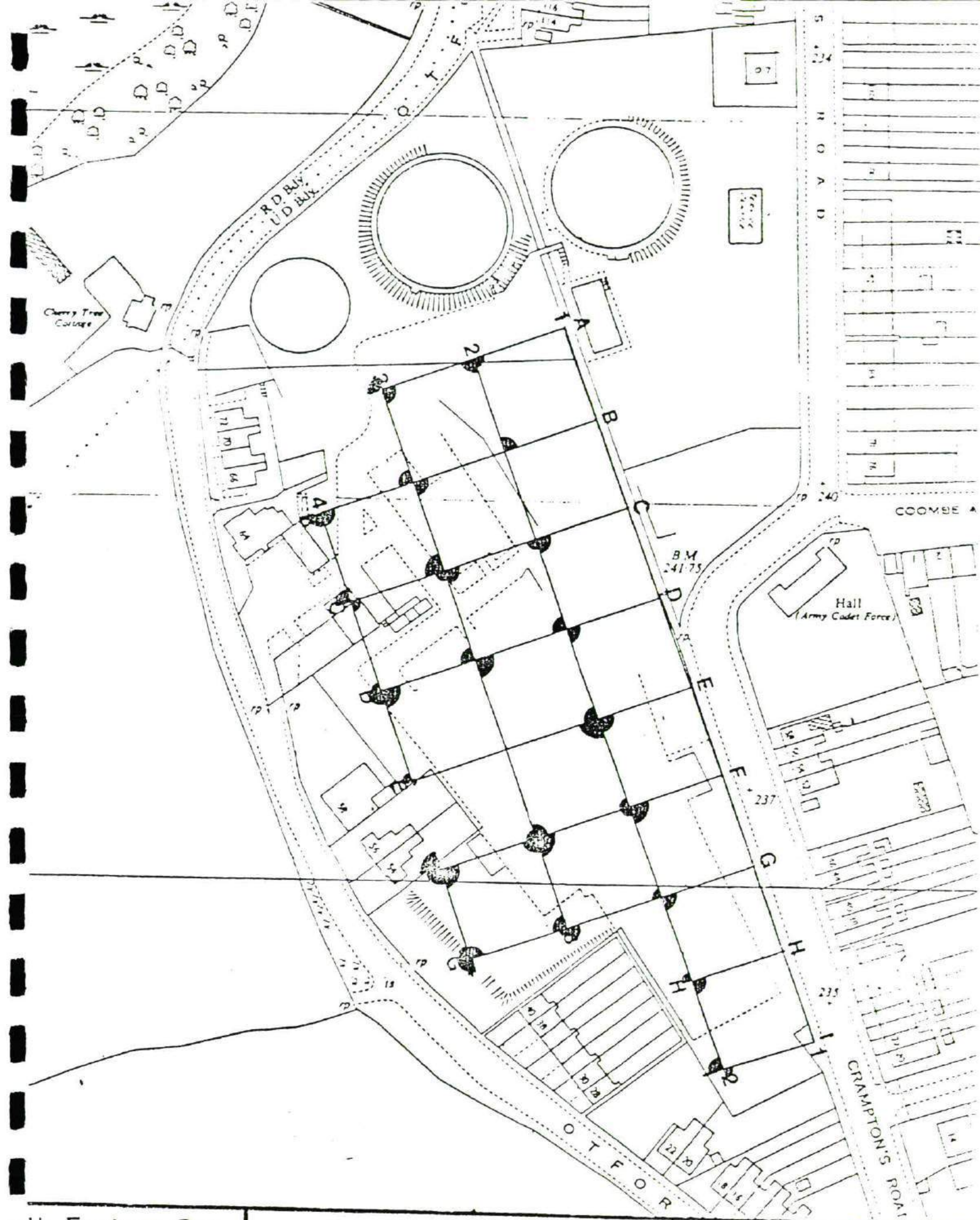

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FIG. 17

COPPER

Scale	1/1250
Date	
Copied From	TQ5237SE
File Number	

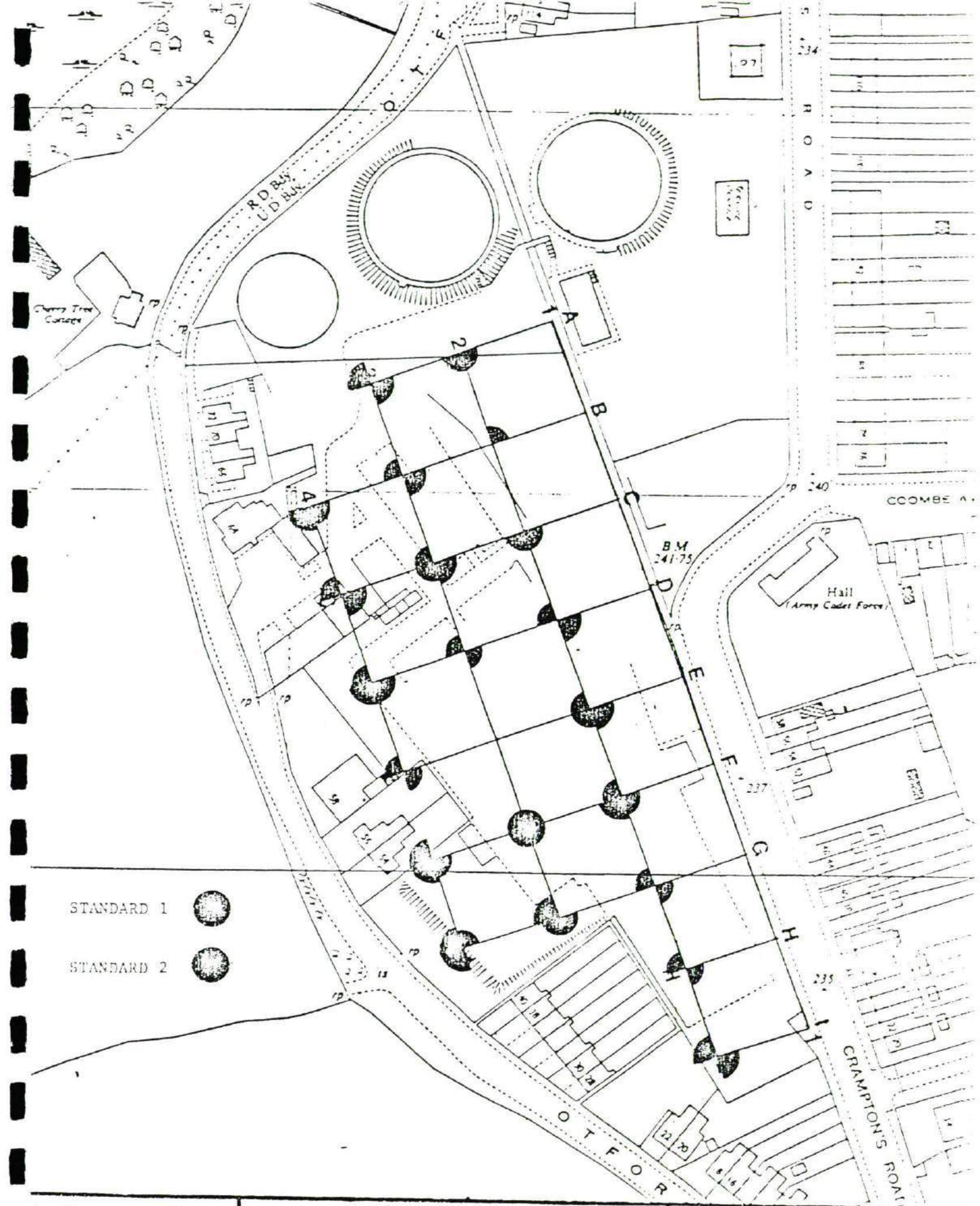

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FIG. 18

Cd

Scale	1/1250
Date	
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File Number	

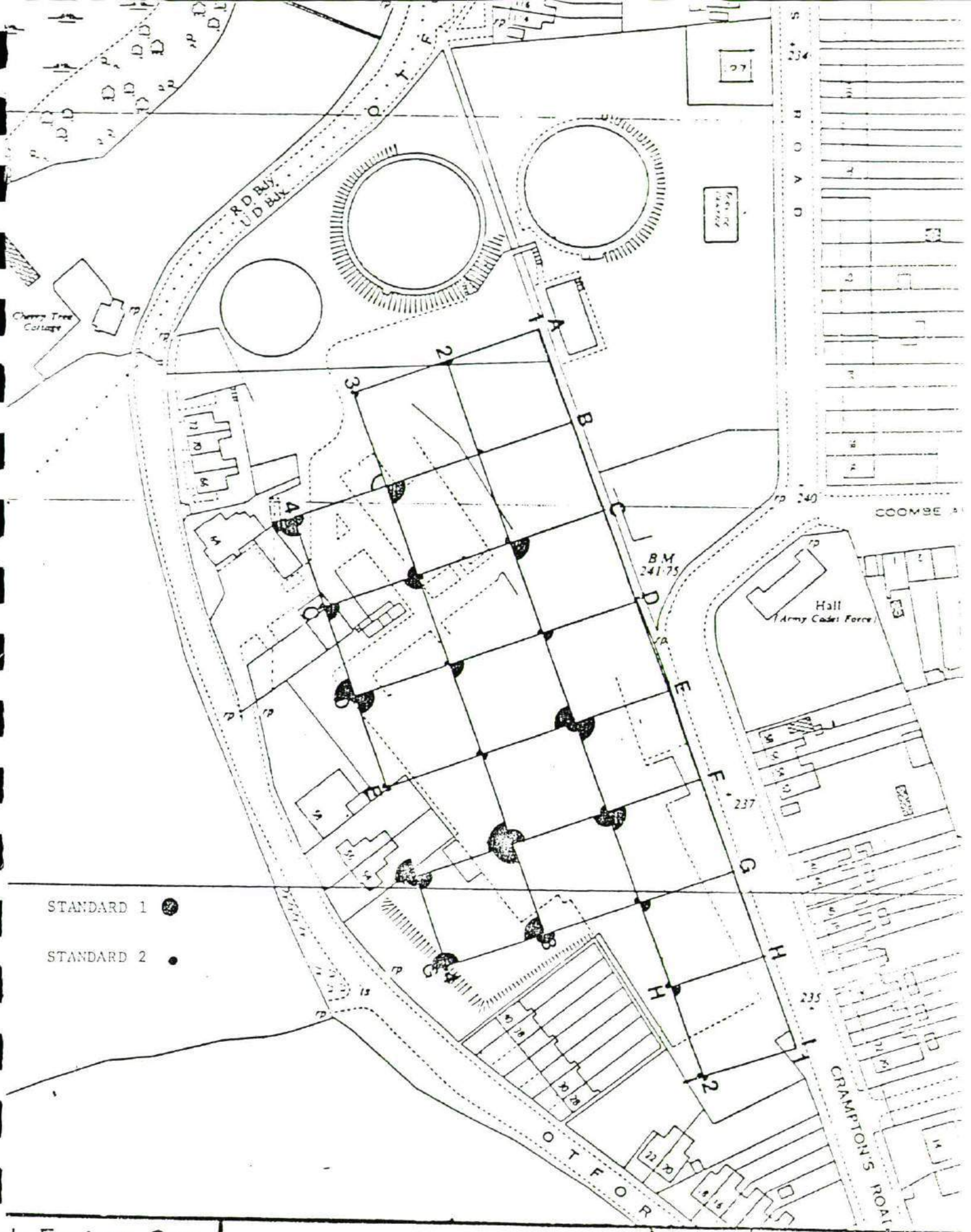

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FIG. 19

LEAD

Scale	1/1250
Date	
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File Number	

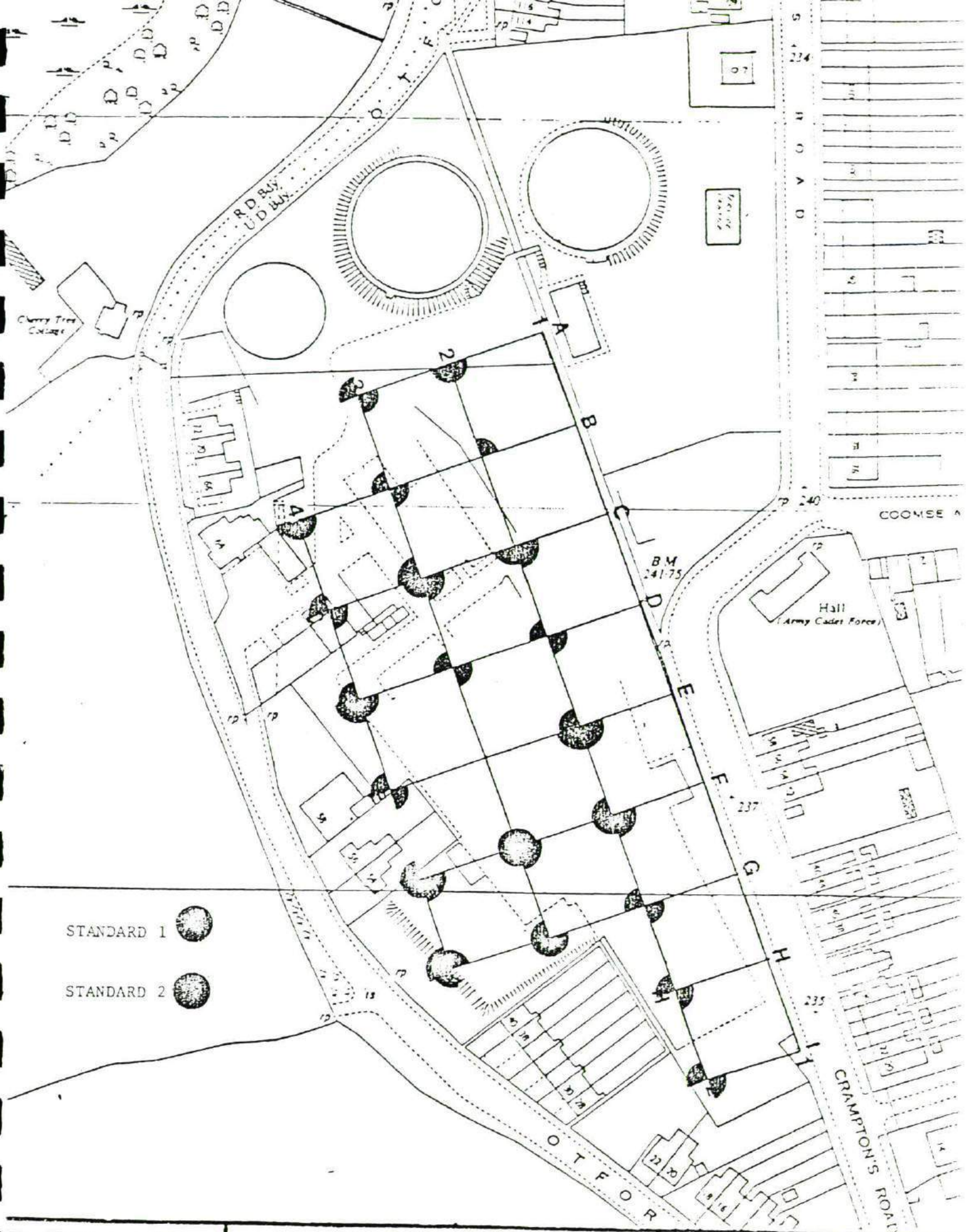

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FIG. 20

NICKEL

Scale	1/1250
Date	
Copied From	
File Number	

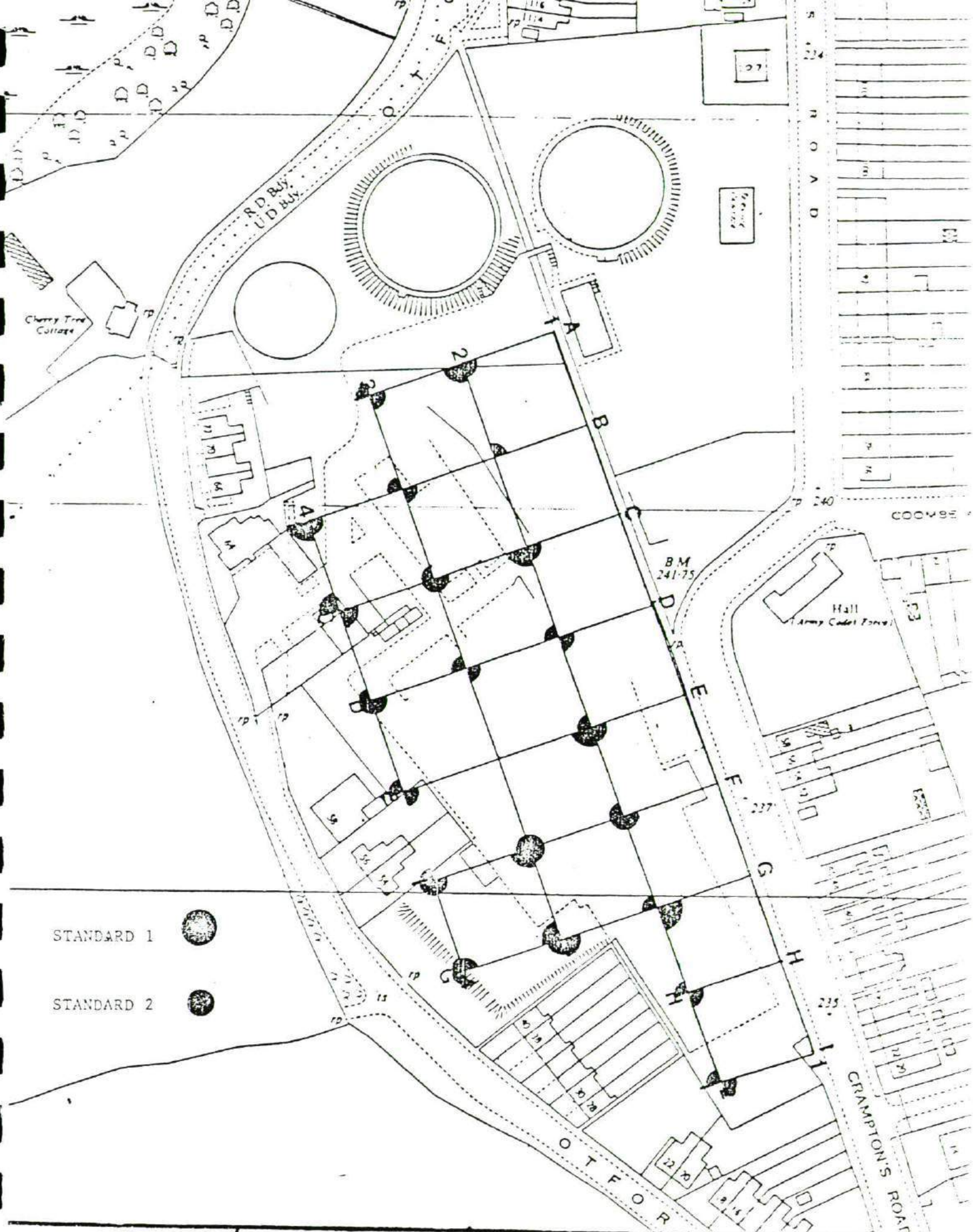

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FIG. 21

ARSENIC

Scale	1/1250
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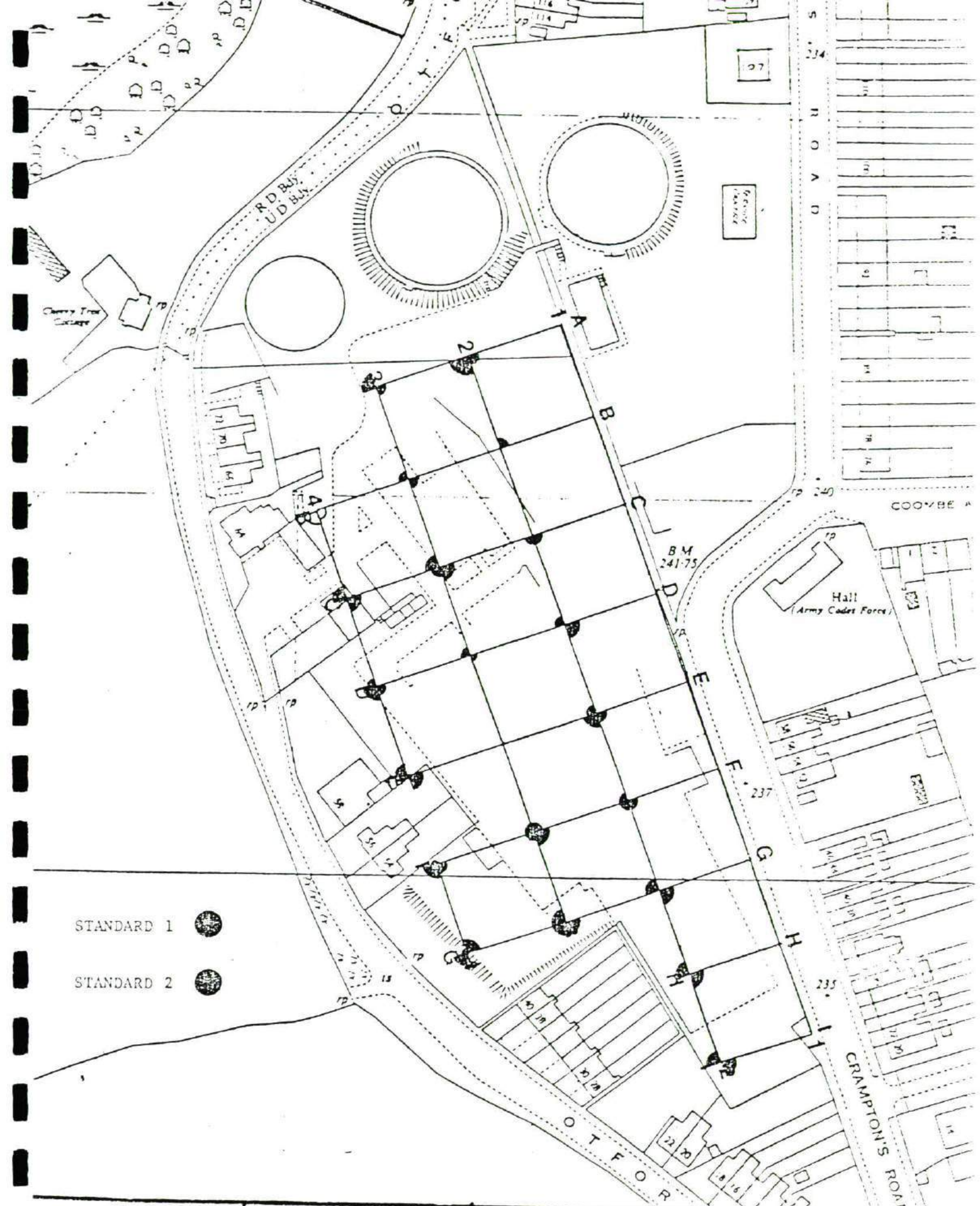

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FIG. 22

MERCURY

Scale	1/1250
Date	
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