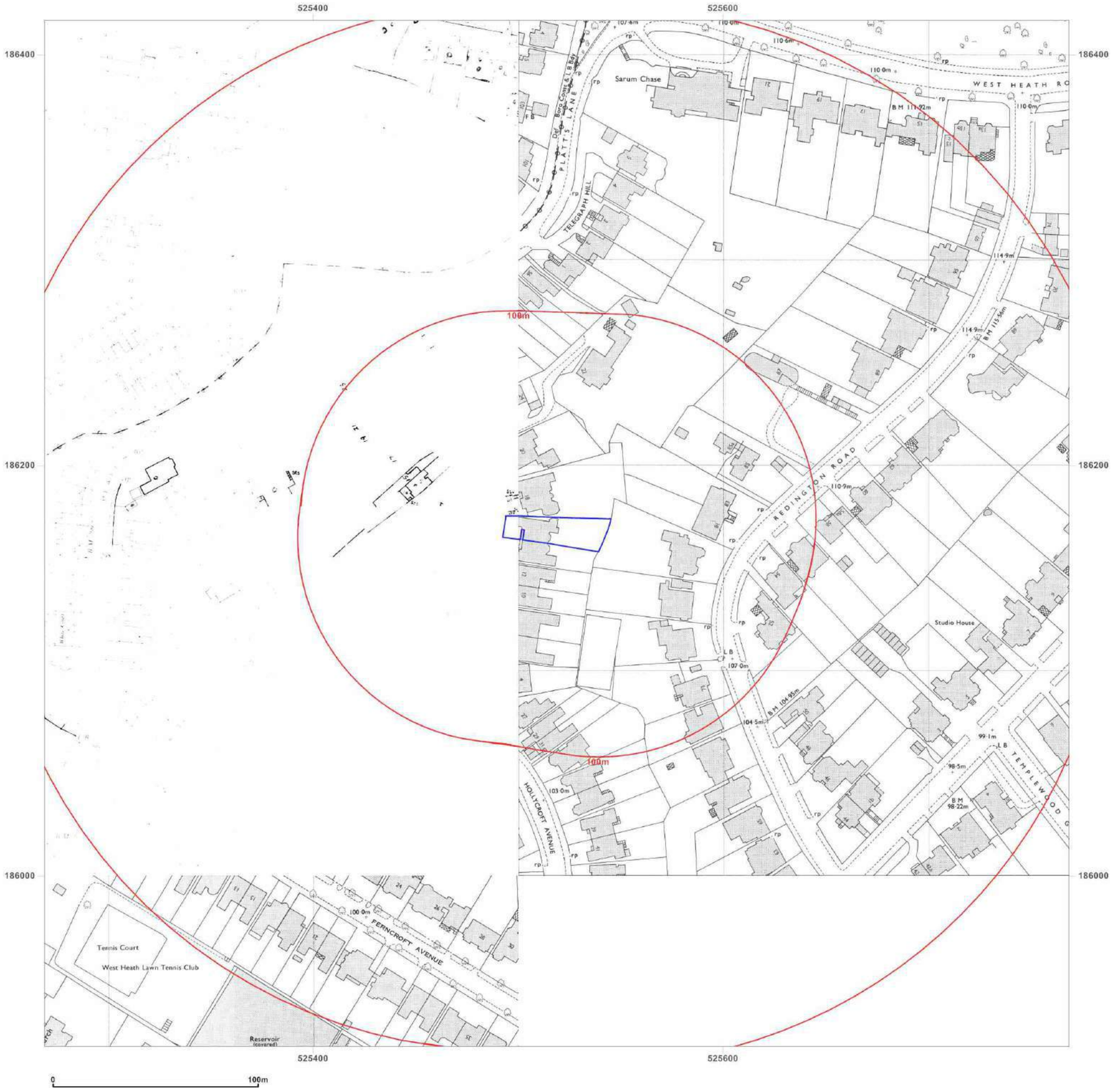


Groundsure INSIGHTS

**Site Details:**

16, ROSECROFT AVENUE,
LONDON, NW3 7QB

**Client Ref:** GWPR2630_16_Rosecroft_Avenue
**Report Ref:** HMD-445-5129163
**Grid Ref:** 525519, 186167

**Map Name:** National Grid

**Map date:** **1971-1974**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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|---|---|---|
| Surveyed N/A<br>Revised N/A<br>Edition N/A<br>Copyright 1974<br>Levelled N/A | | Surveyed 1972<br>Revised 1972<br>Edition N/A<br>Copyright N/A<br>Levelled N/A |
| Surveyed 1953<br>Revised 1970<br>Edition N/A<br>Copyright 1971<br>Levelled 1953 | | |

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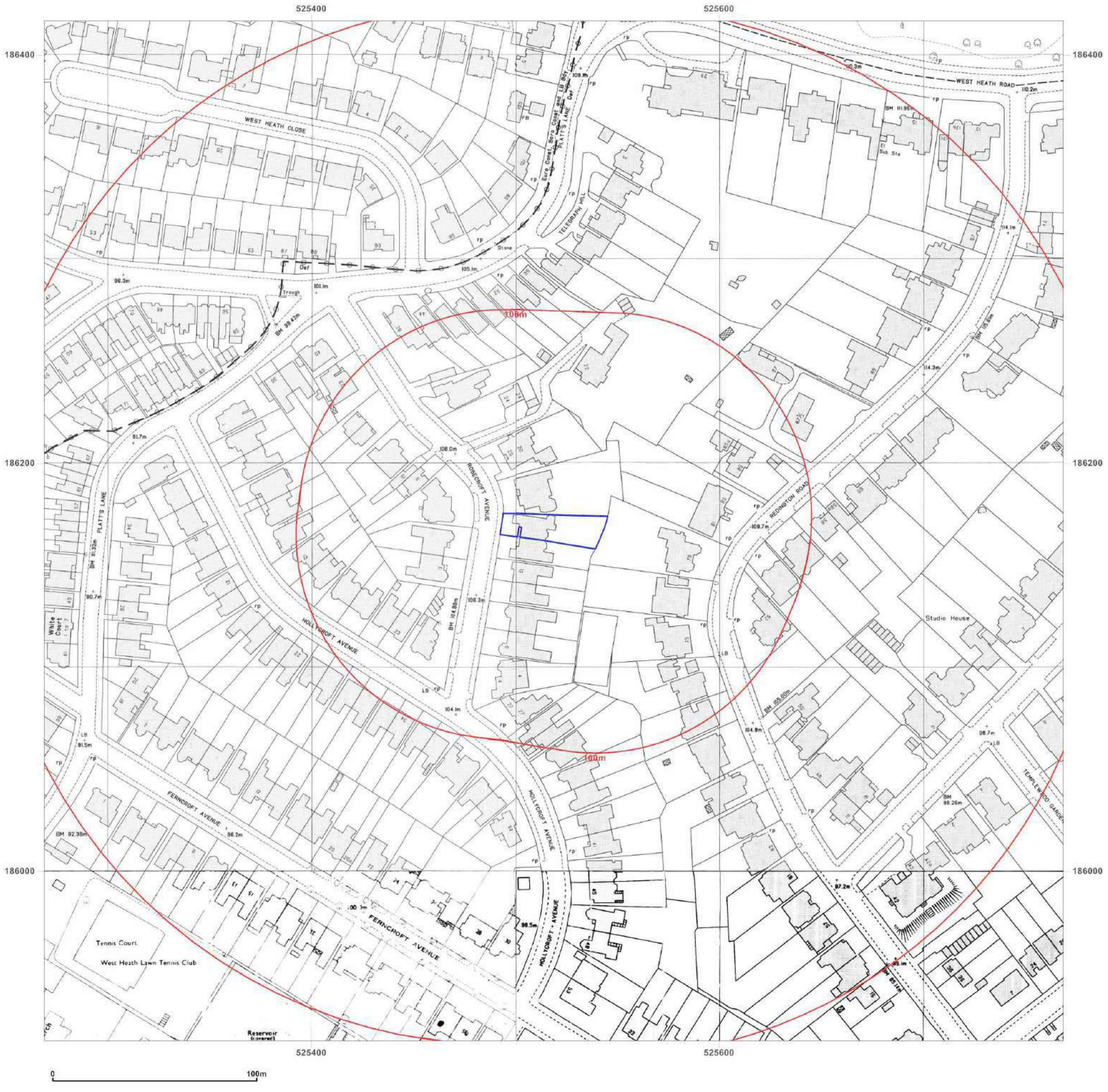


Groundsure INSIGHTS

**Site Details:**

16, ROSECROFT AVENUE,
LONDON, NW3 7QB

**Client Ref:** GWPR2630_16_Rosecroft_Avenue
**Report Ref:** HMD-445-5129163
**Grid Ref:** 525519, 186167

**Map Name:** National Grid

**Map date:** **1974-1979**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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|---|---|---|
| Surveyed 1979<br>Revised 1979<br>Edition N/A<br>Copyright N/A<br>Levelled N/A | | Surveyed 1979<br>Revised 1979<br>Edition N/A<br>Copyright N/A<br>Levelled N/A |
| Surveyed N/A<br>Revised N/A<br>Edition N/A<br>Copyright N/A<br>Levelled N/A | | Surveyed 1953<br>Revised 1978<br>Edition N/A<br>Copyright 1966<br>Levelled 1953 |

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Groundsure INSIGHTS

**Site Details:**

16, ROSECROFT AVENUE,
LONDON, NW3 7QB

**Client Ref:** GWPR2630_16_Rosecroft_Avenue
**Report Ref:** HMD-445-5129163
**Grid Ref:** 525519, 186167

**Map Name:** National Grid

**Map date:** **1979-1981**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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|---|---|---|
| Surveyed 1953<br>Revised 1979<br>Edition N/A<br>Copyright 1981<br>Levelled 1976 | | Surveyed N/A<br>Revised N/A<br>Edition N/A<br>Copyright N/A<br>Levelled N/A |
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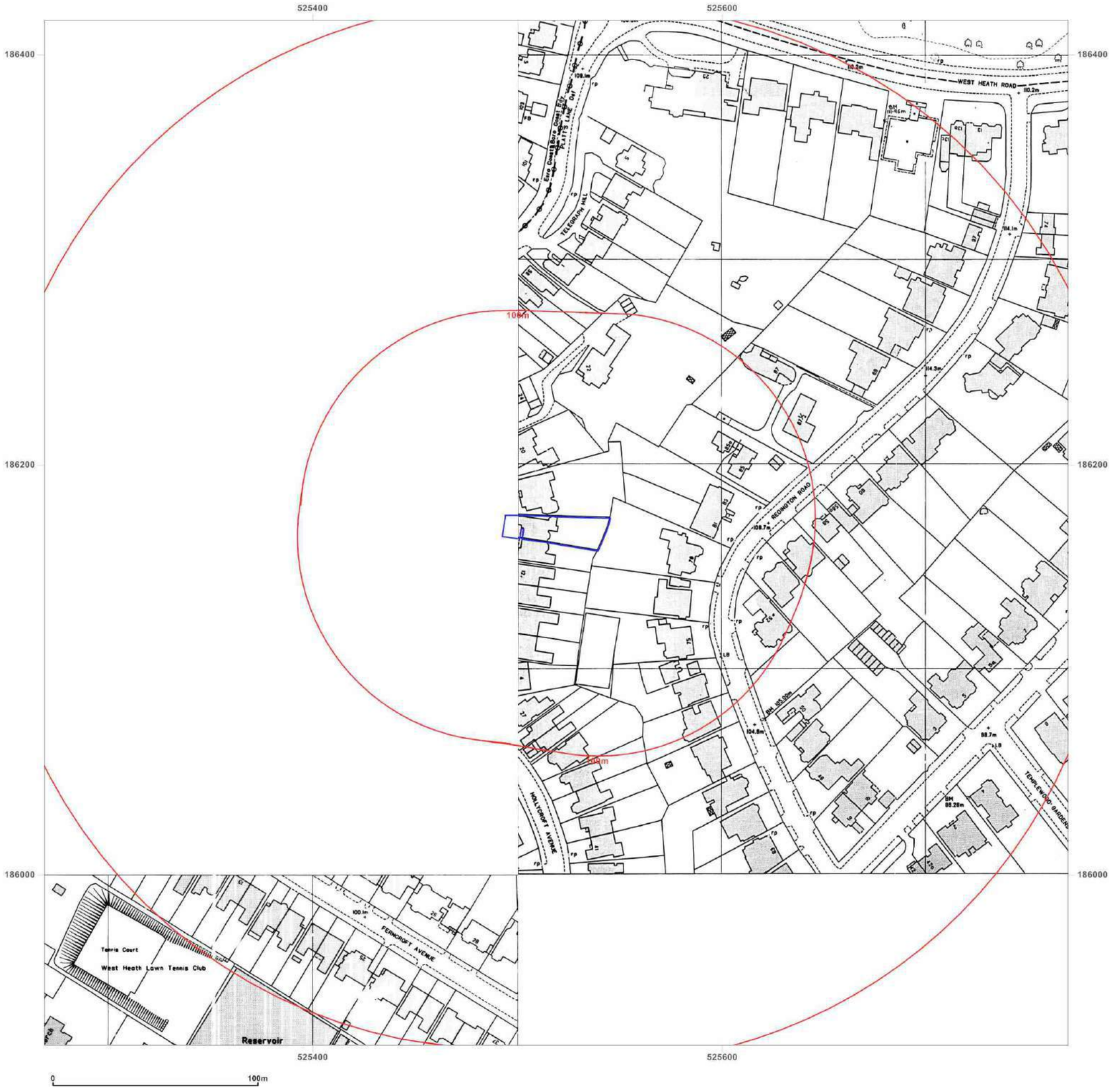


Groundsure INSIGHTS

**Site Details:**

16, ROSECROFT AVENUE,
LONDON, NW3 7QB

**Client Ref:** GWPR2630_16_Rosecroft_Avenue
**Report Ref:** HMD-445-5129163
**Grid Ref:** 525519, 186167

**Map Name:** National Grid

**Map date:** **1981-1986**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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Surveyed 1974
Revised 1986
Edition N/A
Copyright 1986
Levelled 1974

Surveyed N/A
Revised 1978
Edition N/A
Copyright 1981
Levelled N/A

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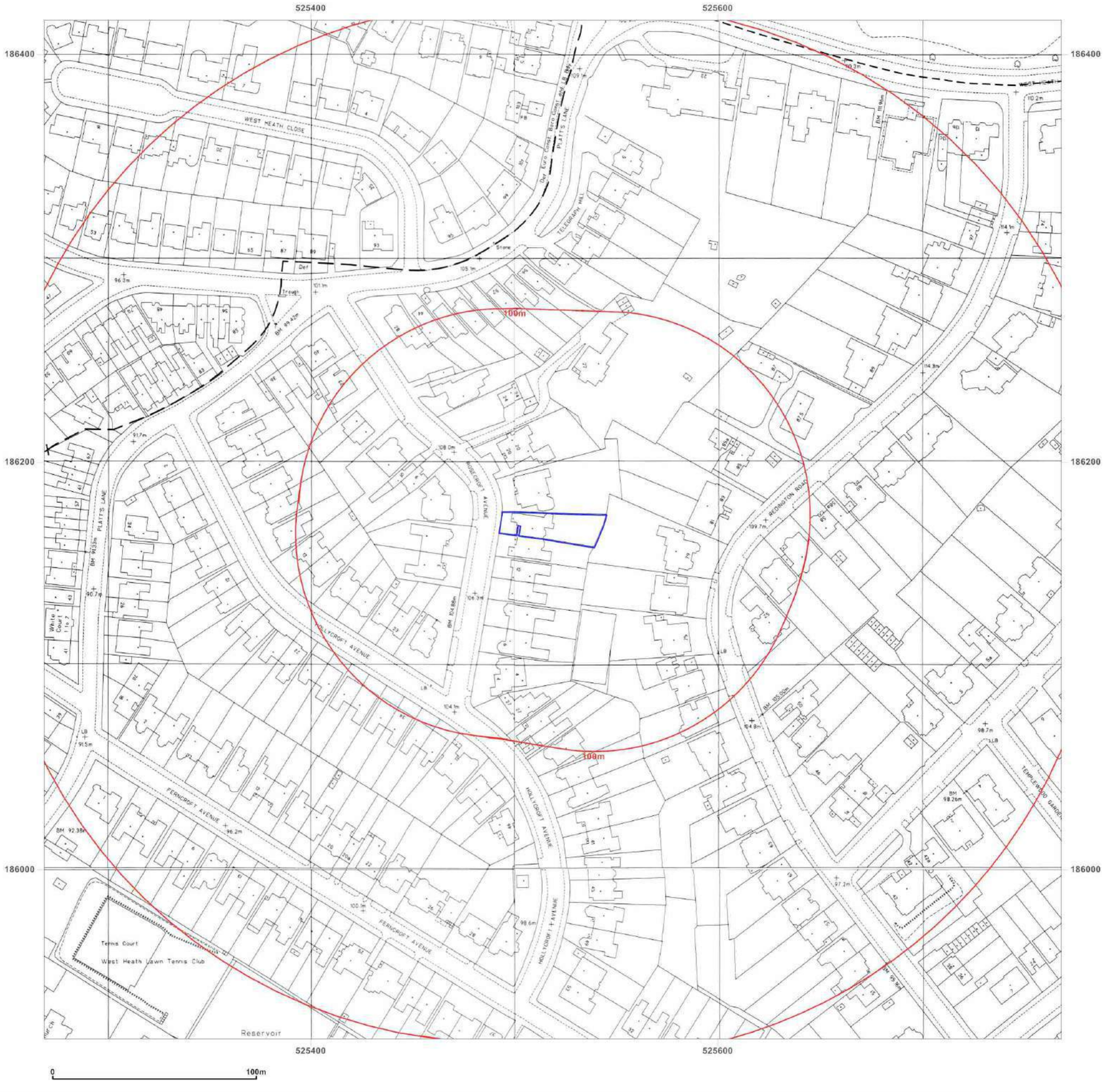


Groundsure INSIGHTS

**Site Details:**

16, ROSECROFT AVENUE,
LONDON, NW3 7QB

**Client Ref:** GWPR2630_16_Rosecroft_Avenue
**Report Ref:** HMD-445-5129163
**Grid Ref:** 525519, 186167

**Map Name:** National Grid

**Map date:** **1991**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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|---|---|
| Surveyed 1991<br>Revised 1991<br>Edition N/A<br>Copyright 1991<br>Levelled N/A | Surveyed 1991<br>Revised 1991<br>Edition N/A<br>Copyright 1991<br>Levelled N/A |
| Surveyed 1991<br>Revised 1991<br>Edition N/A<br>Copyright 1991<br>Levelled N/A | Surveyed 1991<br>Revised 1991<br>Edition N/A<br>Copyright 1991<br>Levelled N/A |

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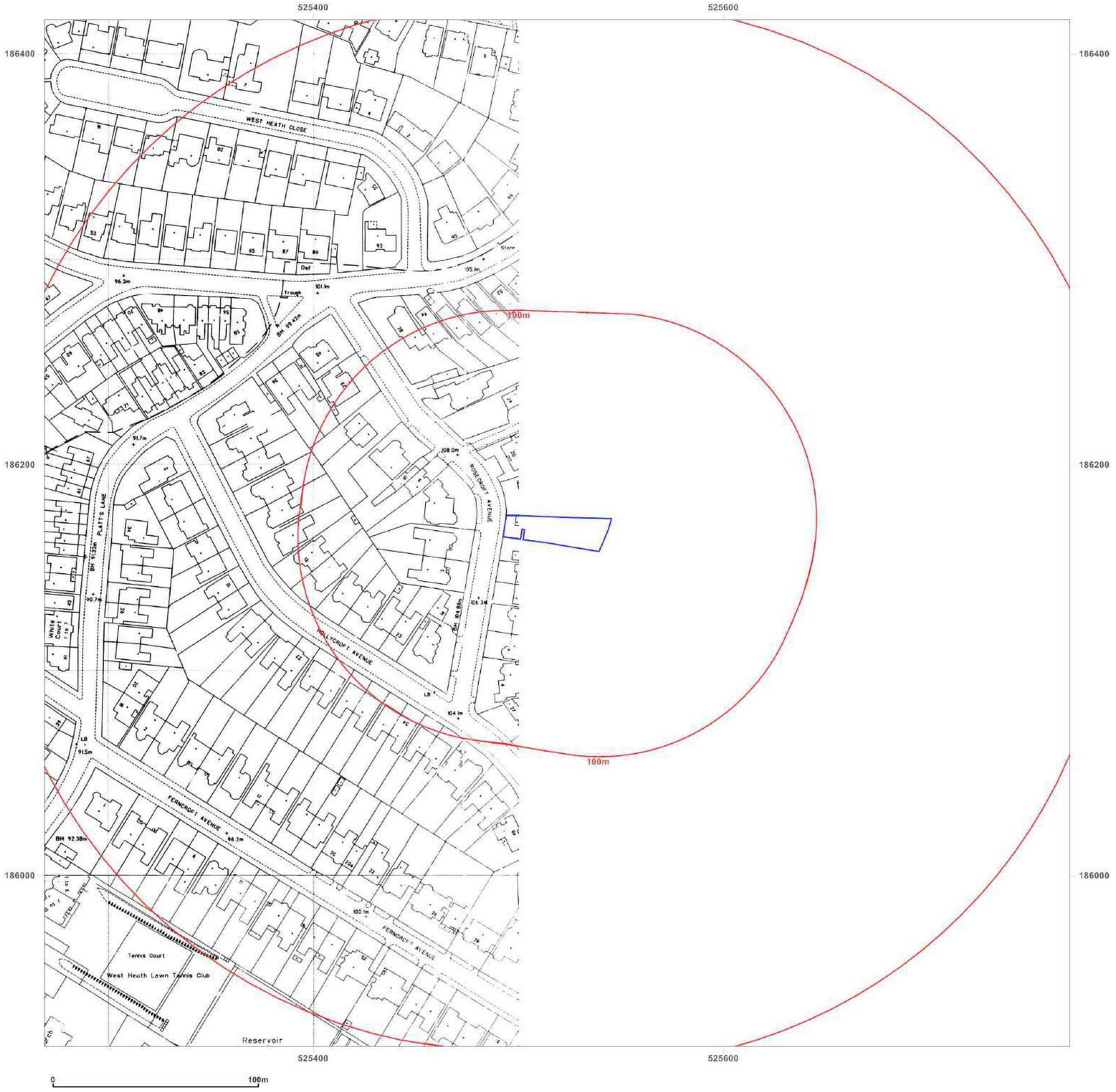


# Groundsure INSIGHTS

**Site Details:**

16, ROSECROFT AVENUE,
LONDON, NW3 7QB

**Client Ref:** GWPR2630_16_Rosecroft_Avenue
**Report Ref:** HMD-445-5129163
**Grid Ref:** 525519, 186167

**Map Name:** National Grid

**Map date:** **1993-1994**

**Scale:** 1:1,250

**Printed at:** 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1994
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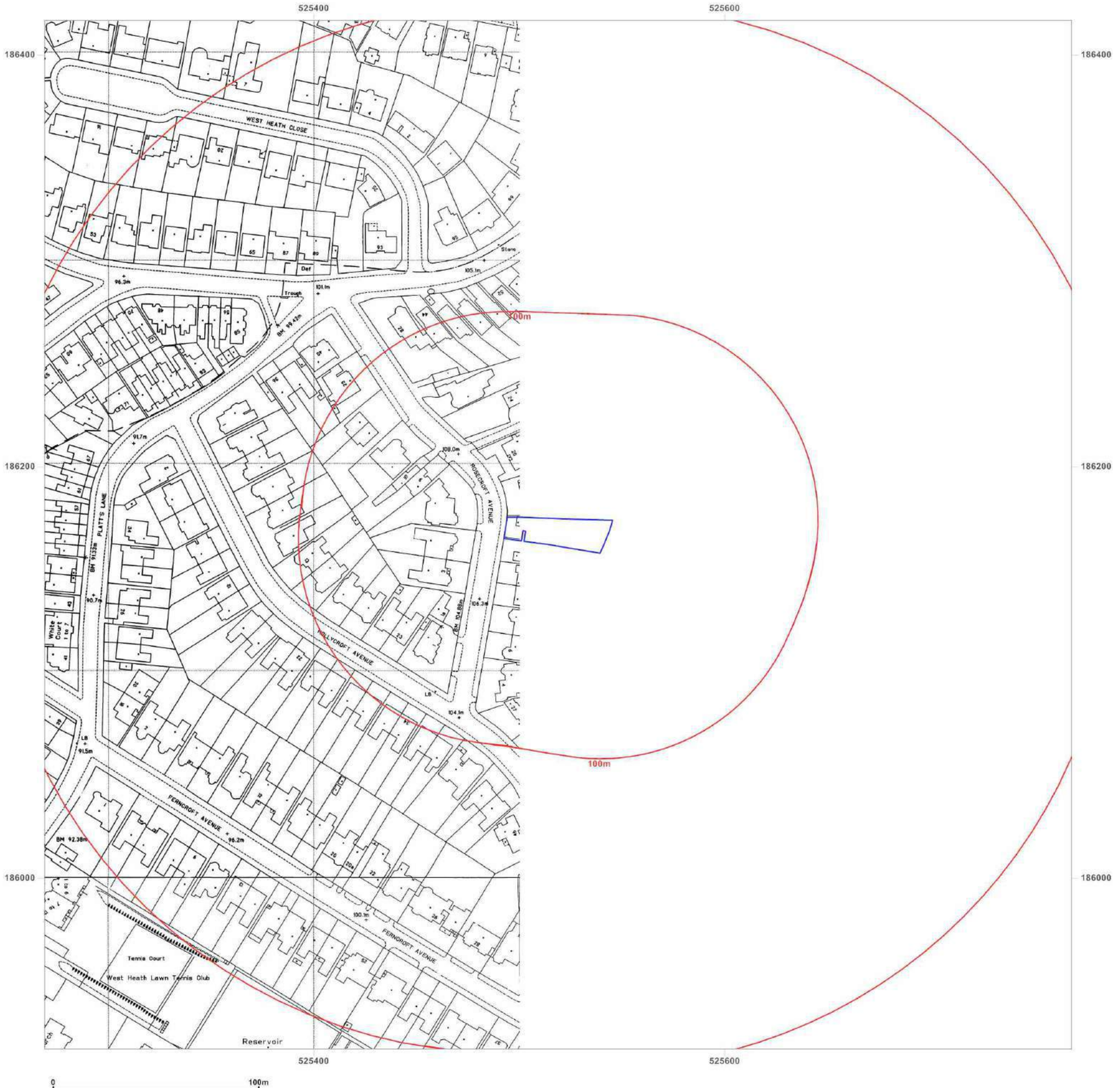
Production date: 13 June 2018

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf




Groundsure INSIGHTS

**Site Details:**

16, ROSECROFT AVENUE,
LONDON, NW3 7QB

**Client Ref:** GWPR2630_16_Rosecroft_Avenue
**Report Ref:** HMD-445-5129163
**Grid Ref:** 525519, 186167

**Map Name:** National Grid
**Map date:** **1993-1994**
**Scale:** 1:1,250
**Printed at:** 1:2,000

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Edition N/A
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Surveyed N/A
Revised N/A
Edition N/A
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Production date: 13 June 2018

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf

**APPENDIX C**
**Fieldwork Logs**

Ground and Water Ltd

Borehole No
**BH1**
Sheet 1 of 1

| Project Name | Project No. | Co-ords: - | Hole Type |
|---|---|---|---|
| 16 Rosecroft Avenue | GWPR2630 | | WLS |
| Location: Hampstead, London NW3 7QB | | Level: - | Scale 1:50 |
| Client: Mr Heard c/o Vincent & Rymill | | Dates: 25/05/2018 | Logged By HB |

| Well | Water Strikes | Samples & In Situ Testing Depth (m) | Type | Results | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | | | | 0.15 | | | Lean concrete. |
| | | 0.30 | D | | | | | BAGSHOT FORMATION: Brown-orange clayey silty SAND. Sand is fine to medium grained. Becomes more clayey with depth. |
| | | 0.50 | D | | | | | |
| | | 0.80 | D | | | | | |
| | | 1.00 | SPT | N=12 | | | | |
| | | 1.00 | D | (2,2/ 3,3,3,3) | 1.10 | | | BAGSHOT FORMATION: Brown-orange silty sandy CLAY. Sand is fine to medium grained. |
| | | 1.50 | D | | | | | |
| | | 2.00 | SPT | N=15 | | | | |
| | | 2.00 | D | (3,3/ 4,3,4,4) | 2.20 | | | CLAYGATE MEMBER OF THE LONDON CLAY FORMATION: Brown clayey silty SAND. Sand is fine to medium grained. |
| | | 2.50 | D | | | | | |
| | | 3.00 | SPT | N=11 | | | | |
| | | 3.00 | D | (2,3/ 2,3,3,3) | 3.30 | | | CLAYGATE MEMBER OF THE LONDON CLAY FORMATION: Brown silty very sandy CLAY. Sand is fine to medium grained |
| | ▽ | 3.50 | D | | | | | |
| | | 4.00 | SPT | N=8 | 4.00 | | | CLAYGATE MEMBER OF THE LONDON CLAY FORMATION: Brown silty very clayey SAND. Sand is fine to medium grained. Pockets of sand observed. |
| | | 4.00 | D | (2,2/ 2,2,2,2) | | | | |
| | | 4.50 | D | | | | | |
| | | 5.00 | SPT | N=10 | 4.80 | | | CLAYGATE MEMBER OF THE LONDON CLAY FORMATION: Brown silty very sandy CLAY. Sand is fine to medium grained. |
| | | 5.00 | D | (2,2/ 3,2,2,3) | | | | |
| | | 5.50 | D | | | | | |
| | | 6.00 | SPT | N=13 | | | | |
| | | 6.00 | D | (2,3/ 3,3,4,3) | | | | |
| | | 6.50 | D | | | | | |
| | | 7.00 | D | | 7.00 | | | End of Borehole at 7.00 m |
| | | | Type | Results | | | | |

Remarks: Groundwater strike at 3.80m bgl.
Roots noted to 1.50m bgl.

AGS

Ground and Water Ltd

Borehole No
**WS2**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name<br>16 Rosecroft Avenue | Project No.<br>GWPR2630 | Co-ords: - | Hole Type<br>WS |
| Location: Hampstead, London NW3 7QB | | Level: - | Scale<br>1:50 |
| Client: Mr Heard c/o Vincent & Rymill | | Dates: 23/05/2018 | Logged By<br>HB |

| Well | Water Strikes | Samples & In Situ Testing Depth (m) | Type | Results | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | | | | 0.08 | | | Concrete slab. |
| | | 0.30 | D | | | | | BAGSHOT FORMATION: Brown sandy silty CLAY. Sand is fine grained. Pockets of sand observed. |
| | | 0.50 | D | | | | | |
| | | 0.80 | D | | | | | |
| | | 1.00 | D | | 1.00 | | | BAGSHOT FORMATION: Brown silty very clayey SAND. Sand is fine to medium grained. |
| | | 1.50 | D | | | | | |
| | | 2.00 | D | | 2.00 | | | BAGSHOT FORMATION: Brown-orange mottled silty sandy CLAY. Sand is fine to medium grained. Pockets of sand observed. |
| | | 2.50 | D | | | | | |
| | | 3.00 | D | | | | | |
| | ▽ | | | | | | | |
| | | 4.00 | D | | | | | |
| | | 4.50 | D | | | | | |
| | | | | | 4.80 | | | End of Borehole at 4.80 m |
| | | | Type | Results | | | | |

1 2 3 4 5 6 7 8 9

Remarks: Groundwater strike at 3.70m bgl.
Roots noted to 1.50m bgl.

AGS

Ground and Water Ltd

Borehole No
**WS3**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name<br>16 Rosecroft Avenue | Project No.<br>GWPR2630 | Co-ords: - | Hole Type<br>WS |
| Location: Hampstead, London NW3 7QB | | Level: - | Scale<br>1:50 |
| Client: Mr Heard c/o Vincent & Rymill | | Dates: 23/05/2018 | Logged By<br>HB |

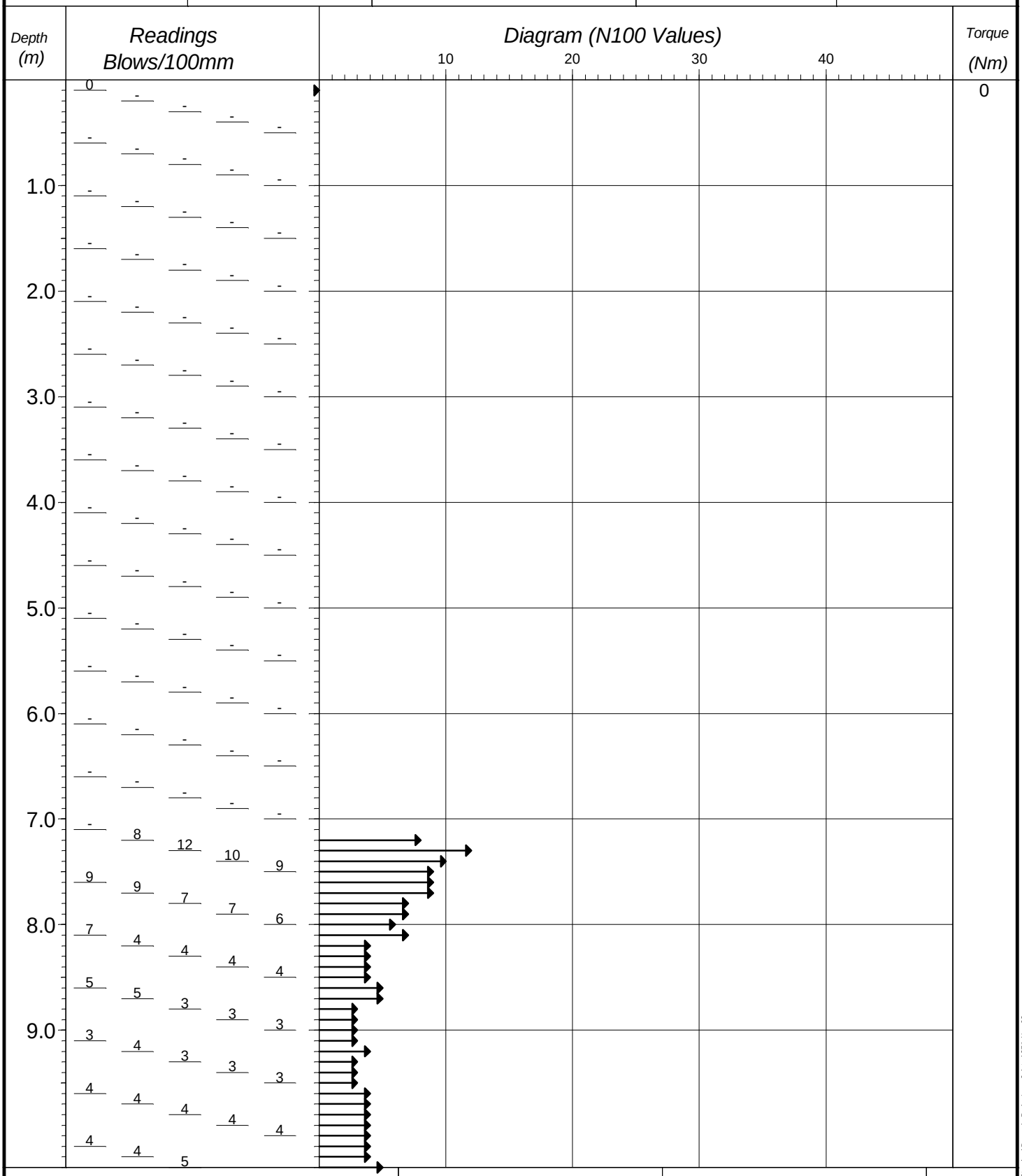
| Well | Water Strikes | Samples & In Situ Testing Depth (m) | Type | Results | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | 0.30 | D | | | | | MADE GROUND: Orange-brown gravelly sandy silty clay. Sand is fine to medium grained. Gravel is rare, fine, sub-angular to sub-rounded brick and ash. Pockets of sand noted. Becomes more sandy with depth. |
| | | 0.50 | D | | | | | |
| | | | | | 0.70 | | | |
| | | 0.80 | D | | | | | MADE GROUND: Brown gravelly silty clayey sand. Sand is fine to coarse grained. Gravel is occasional, fine, sub-angular to sub-rounded brick. |
| | | 1.00 | D | | 1.00 | | | |
| | | 1.50 | D | | | | | BAGSHOT FORMATION: Brown sandy silty CLAY. Sand is fine grained. Becomes more sandy with depth. |
| | | 2.00 | D | | | | | |
| | | 2.50 | D | | | | | |
| | | 3.00 | D | | | | | |
| | | | | | 3.30 | | | End of Borehole at 3.30 m |
| | | | Type | Results | | | | |

Remarks: No groundwater encountered.
Roots noted to 1.80m bgl.

AGS

# DYNAMIC PROBING

| | |
|---|---|
| *Probe No* **DP1** | |
| *Client* **Mr Heard c/o Vincent & Rymill** | Sheet 1 of 2 |
| *Site* **16 Rosecroft Avenue** | *Project No* **GWPR2630** |
| *E* - *N* - *Level* - | *Date* **25/05/2018** *Logged by* **KDS** |



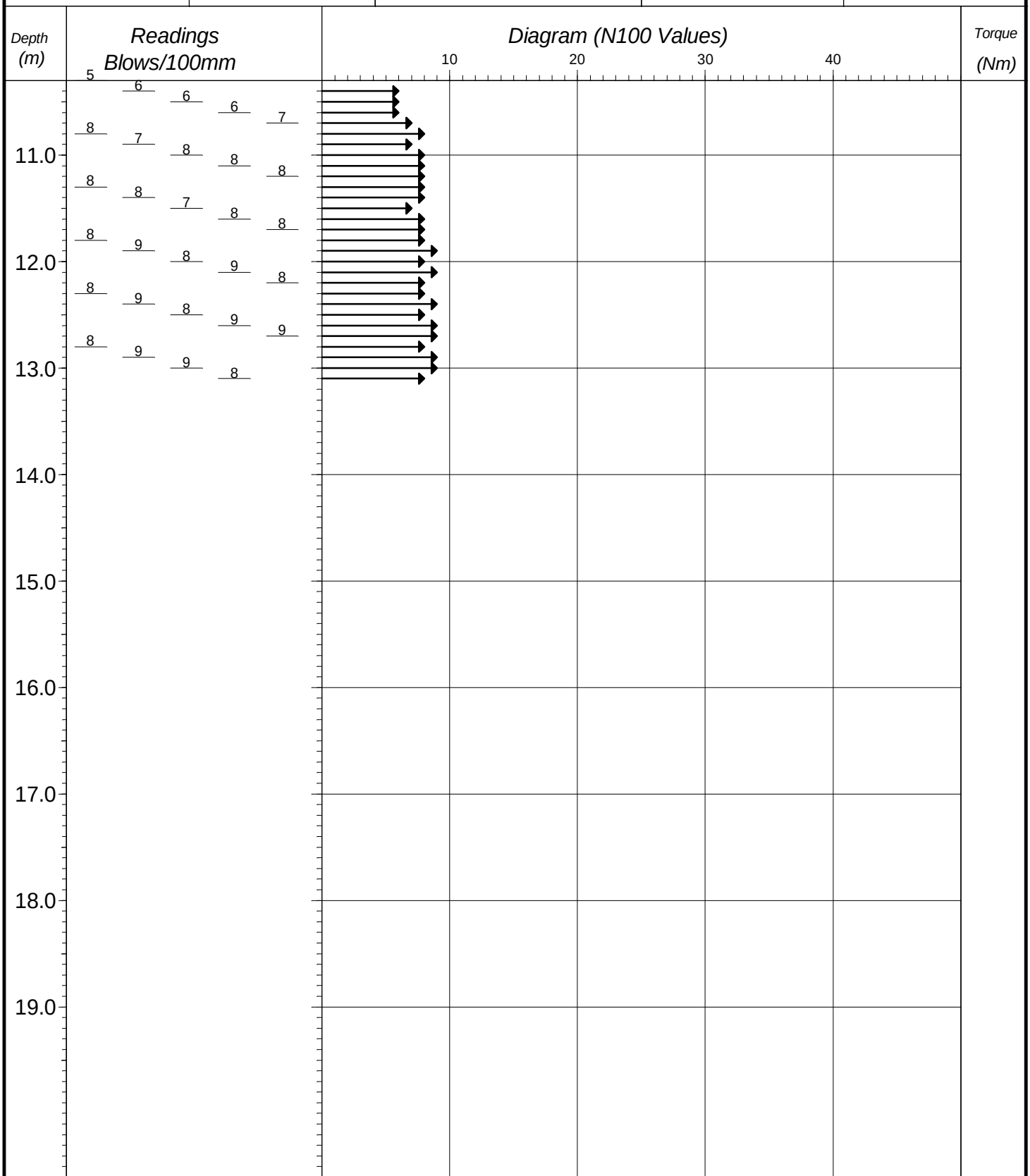

Ground and Water Ltd

| | | | |
|---|---|---|---|
| *Fall Height* | **500** | *Cone Base Diameter* | **43** |
| *Hammer Wt* | **50.00** | *Final Depth* | **13.00** |
| *Probe Type* | **DPSH** | *Log Scale* | 1:50 |

AGS

# DYNAMIC PROBING

| | |
|---|---|
| *Probe No* **DP1** | |
| *Client* **Mr Heard c/o Vincent & Rymill** | Sheet 2 of 2 |
| *Site* **16 Rosecroft Avenue** | *Project No* **GWPR2630** |
| *E* - *N* - *Level* - | *Date* **25/05/2018** *Logged by* **KDS** |




Ground and Water Ltd

| | | | |
|---|---|---|---|
| *Fall Height* | **500** | *Cone Base Diameter* | **43** |
| *Hammer Wt* | **50.00** | *Final Depth* | **13.00** |
| *Probe Type* | **DPSH** | *Log Scale* | 1:50 |

AGS

Ground and Water Ltd

Trialpit No
**TP2**
Sheet 1 of 1

| Project Name | Project No. | Co-ords: - | Date |
|---|---|---|---|
| 16 Rosecroft Avenue | GWPR2630 | Level: - | 23/05/2018 |
| Location: Hampstead, London NW3 7QB | | Dimensions: - | Scale 1:25 |
| | | Depth 0.80m | |
| Client: Mr Heard c/o Vincent & Rymill | | | Logged By HB |

| Samples & In Situ Testing | | | Depth (m) | Level (m AOD) | Legend | Stratum Description |
|---|---|---|---|---|---|---|
| Depth (m) | Type | Results | | | | |
| | | | 0.12 | | | MADE GROUND: Slab / sand. |
| 0.20 | D | | 0.20 | | | MADE GROUND: Brown stone sub-base. |
| | | | | | | MADE GROUND: Brown gravelly sandy silty clay. Sand is fine to medium grained. Gravel is rare, sub-angular to sub-rounded brick and ash. |
| 0.50 | D | | 0.48 | | | BAGSHOT FORMATION: Orange-brown sandy silty CLAY. Sand is fine to medium grained. Pockets of sand observed. |
| 0.80 | D | | 0.80 | | | Trialpit Complete at 0.80 m |

1
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3
4

Remarks: Roots noted to 0.80m bgl.

Groundwater: No groundwater encountered.

AGS

**APPPENDIX D**
**Geotechnical Laboratory Test Results**

# Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

| Job No. | Project Name | Programme | |
|---|---|---|---|
| 24628 | 16 Rosecroft Avenue, London, NW3 7QB | Samples received | 1/069/2018 |
| | | Schedule received | 31/05/2018 |
| Project No. | Client | Project started | 01/06/2018 |
| GWPR2630 | Ground & Water Ltd | Testing Started | 12/06/2018 |

| Hole No. | Sample | | | | Soil Description | NMC | Passing 425µm | LL | PL | PI | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top m | Base m | Type | | % | % | % | % | % | |
| BH1 | - | 3.50 | | D | Orangish brown slightly mottled grey silty sandy CLAY | 30 | 100 | 44 | 16 | 28 | |
| BH1 | - | 6.50 | | D | Orangish brown slightly mottled grey silty sandy CLAY | 34 | 100 | 40 | 16 | 24 | |
| WS2 | - | 2.50 | | D | Light orangish brown slightly mottled grey silty sandy CLAY | 23 | 100 | 37 | 14 | 23 | |
| WS3 | - | 1.50 | | D | Orangish brown slightly mottled grey silty sandy CLAY | 20 | 100 | 37 | 15 | 22 | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Test Methods: BS1377: Part 2: 1990:**
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

**Test Report by K4 SOILS LABORATORY**
**Unit 8 Olds Close Olds Approach**
**Watford Herts WD18 9RU**

**Tel: 01923 711 288**
**Email: James@k4soils.com**

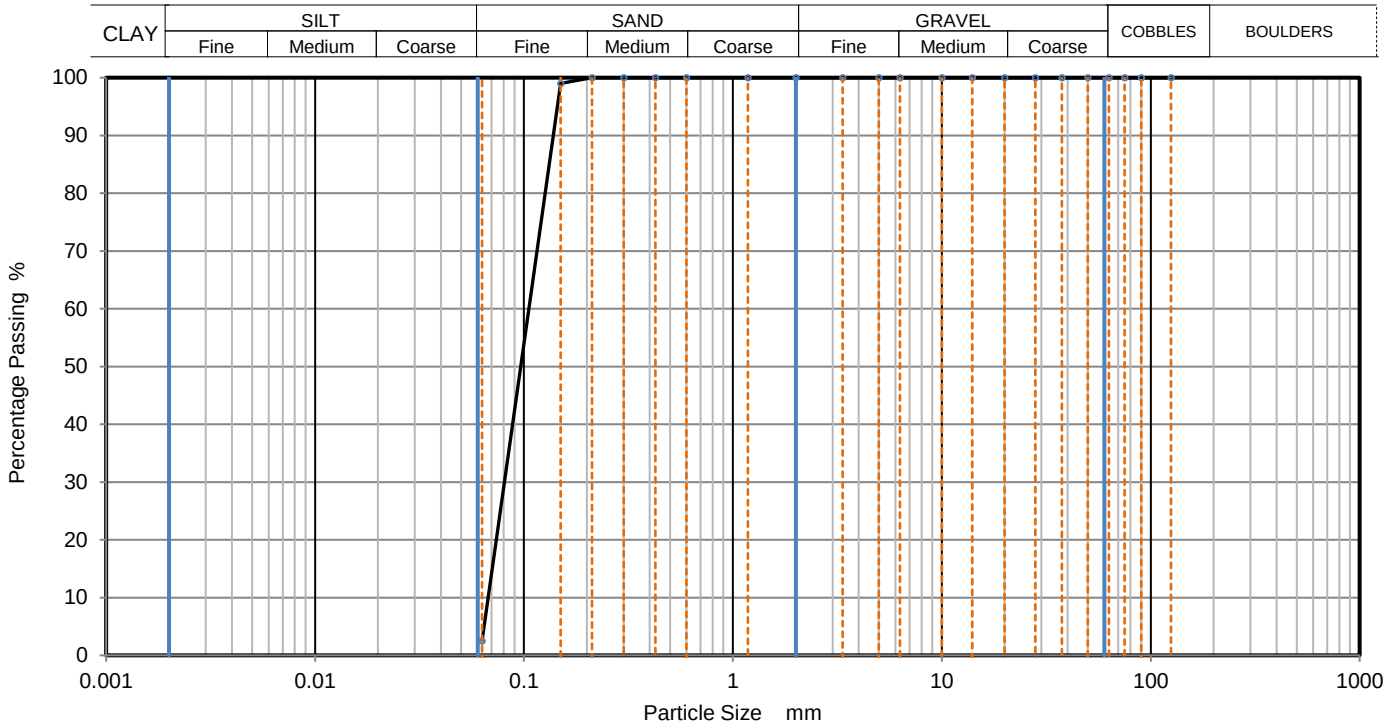
**Checked and Approved**
**Initials** kp
**Date:** 14/06/2018

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

# PARTICLE SIZE DISTRIBUTION

| | | | | | |
|---|---|---|---|---|---|
| | | | | Job Ref | 24628 |
| | | | | Borehole/Pit No. | BH1 |
| Site Name | 16 Rosecroft Avenue, London, NW3 7QB | | | Sample No. | - |
| Project No. | GWPR2630 | Client | Ground & Water Ltd | Depth Top | 4.50 m |
| Soil Description | Orangish brown slightly silty SAND | | | Depth Base | - m |
| | | | | Sample Type | D |
| | | | | Samples received | 01/06/2018 |
| | | | | Schedules received | 31/05/2018 |
| Test Method | BS1377:Part 2: 1990, clause 9.0 | | | Project started | 01/06/2016 |
| | | | | Date tested | 13/06/2018 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 100 | | |
| 20 | 100 | | |
| 14 | 100 | | |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 100 | | |
| 1.18 | 100 | | |
| 0.6 | 100 | | |
| 0.425 | 100 | | |
| 0.3 | 100 | | |
| 0.212 | 100 | | |
| 0.15 | 99 | | |
| 0.063 | 3 | | |

| Dry Mass of sample, g | 375 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0.0 |
| Gravel | 0.0 |
| Sand | 97.5 |
| | |
| Fines <0.063mm | 2.5 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.106 |
| D30 | mm | 0.0807 |
| D10 | mm | 0.0674 |
| Uniformity Coefficient | | 1.6 |
| Curvature Coefficient | | 0.91 |

Remarks

Preparation and testing in accordance with BS1377 unless noted below


**K4 Soils Laboratory**

**Unit 8, Olds Close, Watford, Herts, WD18 9RU**

**Email: james@k4soils.com**

**Tel: 01923 711288**


**Checked and Approved**

**Initials:** **kp**

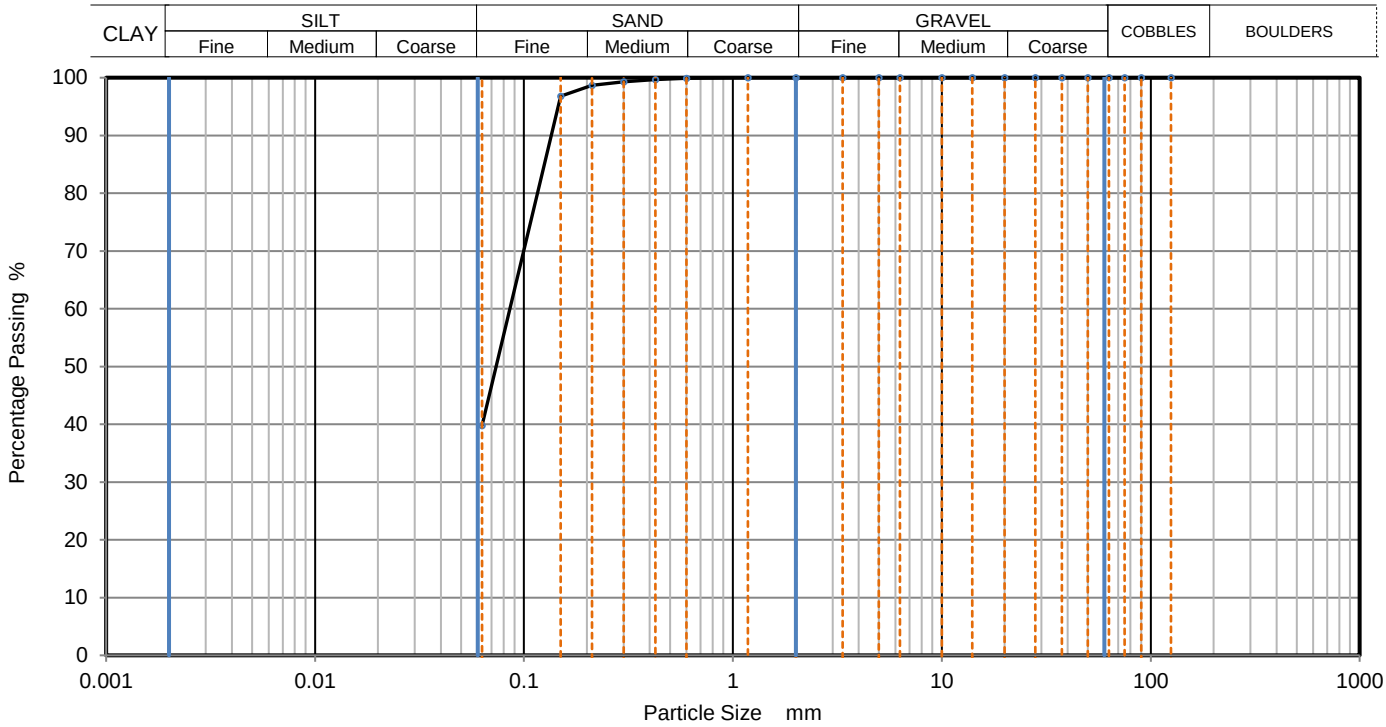
**Date:** 14/06/2018

UKAS TESTING 2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

# PARTICLE SIZE DISTRIBUTION

| | | | | | |
|---|---|---|---|---|---|
| | | | | Job Ref | 24628 |
| | | | | Borehole/Pit No. | WS2 |
| Site Name | 16 Rosecroft Avenue, London, NW3 7QB | | | Sample No. | - |
| Project No. | GWPR2630 | Client | Ground & Water Ltd | Depth Top | 1.00 m |
| Soil Description | Orangish brown mottled grey silty sandy CLAY | | | Depth Base | - m |
| | | | | Sample Type | D |
| | | | | Samples received | 01/06/2018 |
| | | | | Schedules received | 31/05/2018 |
| Test Method | BS1377:Part 2: 1990, clause 9.0 | | | Project started | 01/06/2018 |
| | | | | Date tested | 13/06/2018 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 100 | | |
| 20 | 100 | | |
| 14 | 100 | | |
| 10 | 100 | | |
| 6.3 | 100 | | |
| 5 | 100 | | |
| 3.35 | 100 | | |
| 2 | 100 | | |
| 1.18 | 100 | | |
| 0.6 | 100 | | |
| 0.425 | 100 | | |
| 0.3 | 99 | | |
| 0.212 | 99 | | |
| 0.15 | 97 | | |
| 0.063 | 40 | | |

| Dry Mass of sample, g | 211 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0.0 |
| Gravel | 0.0 |
| Sand | 60.2 |
| | |
| Fines <0.063mm | 39.8 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 0.0856 |
| D30 | mm | |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

Preparation and testing in accordance with BS1377 unless noted below


**K4 Soils Laboratory**

**Unit 8, Olds Close, Watford, Herts, WD18 9RU**

**Email: james@k4soils.com**

**Tel: 01923 711288**


**Checked and Approved**

**Initials:** **kp**

**Date:** 14/06/2018

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

## Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results

**Tested in accordance with BS1377 : Part 3 : 1990, clause 5.3 and clause 9**

| Job No. | Project Name | Programme | |
|---|---|---|---|
| 24628 | 16 Rosecroft Avenue, London, NW3 7QB | Samples received | 01/06/2018 |
| | | Schedule received | 31/05/2018 |
| Project No. | Client | Project started | 01/06/2018 |
| GWPR2630 | Ground & Water Ltd | Testing Started | 12/06/2018 |

| Hole No. | Sample | | | | Soil description | Dry Mass passing 2mm | SO3 Content | SO4 Content | pH | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top m | Base m | Type | | % | g/l | g/l | | |
| BH1 | - | 3.50 | | D | Orangish brown slightly mottled grey silty sandy CLAY | 100 | 0.12 | 0.15 | 7.70 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
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**Test Report by K4 SOILS LABORATORY**
**Unit 8 Olds Close Olds Approach**
**Watford Herts WD18 9RU**
**Tel: 01923 711 288**
**Email: James@k4soils.com**


**Checked and Approved**

**Initials** **kp**

**Date:** **14/06/2018**

**APPPENDIX E**
**Chemical Laboratory Test Results**

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2 The Long Barn
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GU34 3NB

**DETS Ltd**
Unit 1
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Lenham Heath
Kent
ME17 2JN
**t:** 01622 850410
russell.jarvis@qtsenvironmental.com

4480

# DETS Report No: 18-76084

| | |
|---|---|
| **Site Reference:** | 16 Rosecroft Avenue, London, NW3 7QB |
| **Project / Job Ref:** | GWPR2630 |
| **Order No:** | None Supplied |
| **Sample Receipt Date:** | 01/06/2018 |
| **Sample Scheduled Date:** | 01/06/2018 |
| **Report Issue Number:** | 2 |
| **Reporting Date:** | 13/06/2018 |

**Authorised by:**

Russell Jarvis
Associate Director of Client Services

**Authorised by:**

Dave Ashworth
Deputy Quality Manager

DETS Ltd
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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

| Soil Analysis Certificate | | | | | | |
|---|---|---|---|---|---|---|
| **DETS Report No: 18-76084** | **Date Sampled** | 25/05/18 | 23/05/18 | 23/05/18 | | |
| **Ground & Water Ltd** | **Time Sampled** | None Supplied | None Supplied | None Supplied | | |
| **Site Reference: 16 Rosecroft Avenue, London, NW3 7QB** | **TP / BH No** | WS3 | None Supplied | None Supplied | | |
| **Project / Job Ref: GWPR2630** | **Additional Refs** | None Supplied | None Supplied | None Supplied | | |
| **Order No: None Supplied** | **Depth (m)** | 0.25 | 0.80 | 7.00 | | |
| **Reporting Date: 13/06/2018** | **QTSE Sample No** | 337553 | 337555 | 337556 | | |

| Determinand | Unit | RL | Accreditation | | | | | |
|---|---|---|---|---|---|---|---|---|
| Asbestos Screen (S) | N/a | N/a | ISO17025 | Not Detected | | | | |
| pH | pH Units | N/a | MCERTS | 5.8 | 4.8 | 6.3 | | |
| Total Cyanide | mg/kg | < 2 | NONE | < 2 | | | | |
| Total Sulphate as $SO_4$ | mg/kg | < 200 | NONE | | 246 | < 200 | | |
| Total Sulphate as $SO_4$ | % | < 0.02 | NONE | | 0.02 | < 0.02 | | |
| W/S Sulphate as $SO_4$ (2:1) | mg/l | < 10 | MCERTS | 16 | 76 | 88 | | |
| W/S Sulphate as $SO_4$ (2:1) | g/l | < 0.01 | MCERTS | 0.02 | 0.08 | 0.09 | | |
| Total Sulphur | % | < 0.02 | NONE | | < 0.02 | < 0.02 | | |
| Organic Matter | % | < 0.1 | MCERTS | 1.4 | | | | |
| Total Organic Carbon (TOC) | % | < 0.1 | MCERTS | 0.8 | | | | |
| Ammonium as $NH_4$ | mg/kg | < 0.5 | NONE | | 1.1 | 2 | | |
| Ammonium as $NH_4$ | mg/l | < 0.05 | NONE | | 0.11 | 0.20 | | |
| W/S Chloride (2:1) | mg/kg | < 1 | MCERTS | | 45 | 55 | | |
| W/S Chloride (2:1) | mg/l | < 0.5 | MCERTS | | 22.5 | 27.4 | | |
| Water Soluble Nitrate (2:1) as $NO_3$ | mg/kg | < 3 | MCERTS | | 4 | 14 | | |
| Water Soluble Nitrate (2:1) as $NO_3$ | mg/l | < 1.5 | MCERTS | | 2 | 6.9 | | |
| Arsenic (As) | mg/kg | < 2 | MCERTS | 8 | | | | |
| W/S Boron | mg/kg | < 1 | NONE | < 1 | | | | |
| Cadmium (Cd) | mg/kg | < 0.2 | MCERTS | < 0.2 | | | | |
| Chromium (Cr) | mg/kg | < 2 | MCERTS | 16 | | | | |
| Chromium (hexavalent) | mg/kg | < 2 | NONE | < 2 | | | | |
| Copper (Cu) | mg/kg | < 4 | MCERTS | 20 | | | | |
| Lead (Pb) | mg/kg | < 3 | MCERTS | 80 | | | | |
| W/S Magnesium | mg/l | < 0.1 | NONE | | 1.9 | 3.1 | | |
| Mercury (Hg) | mg/kg | < 1 | NONE | < 1 | | | | |
| Nickel (Ni) | mg/kg | < 3 | MCERTS | 5 | | | | |
| Selenium (Se) | mg/kg | < 3 | NONE | < 3 | | | | |
| Vanadium (V) | mg/kg | < 2 | NONE | 30 | | | | |
| Zinc (Zn) | mg/kg | < 3 | MCERTS | 48 | | | | |
| Total Phenols (monohydric) | mg/kg | < 2 | NONE | < 2 | | | | |

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30$^{O}$C
Subcontracted analysis (S)

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

| Soil Analysis Certificate - Speciated PAHs | | | | | | | |
|---|---|---|---|---|---|---|---|
| DETS Report No: 18-76084 | Date Sampled | 25/05/18 | | | | | |
| Ground & Water Ltd | Time Sampled | None Supplied | | | | | |
| Site Reference: 16 Rosecroft Avenue, London, NW3 7QB | TP / BH No | WS3 | | | | | |
| Project / Job Ref: GWPR2630 | Additional Refs | None Supplied | | | | | |
| Order No: None Supplied | Depth (m) | 0.25 | | | | | |
| Reporting Date: 13/06/2018 | QTSE Sample No | 337553 | | | | | |

| Determinand | Unit | RL | Accreditation | | | | | |
|---|---|---|---|---|---|---|---|---|
| Naphthalene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Acenaphthylene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Acenaphthene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Fluorene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Phenanthrene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Anthracene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Fluoranthene | mg/kg | < 0.1 | MCERTS | 0.21 | | | | |
| Pyrene | mg/kg | < 0.1 | MCERTS | 0.19 | | | | |
| Benzo(a)anthracene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Chrysene | mg/kg | < 0.1 | MCERTS | 0.13 | | | | |
| Benzo(b)fluoranthene | mg/kg | < 0.1 | MCERTS | 0.18 | | | | |
| Benzo(k)fluoranthene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Benzo(a)pyrene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Indeno(1,2,3-cd)pyrene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Dibenz(a,h)anthracene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Benzo(ghi)perylene | mg/kg | < 0.1 | MCERTS | < 0.1 | | | | |
| Total EPA-16 PAHs | mg/kg | < 1.6 | MCERTS | < 1.6 | | | | |

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30$^{O}$C

**DETS Ltd**
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**Rose Lane**
**Lenham Heath**
**Maidstone**
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4480

| Soil Analysis Certificate - TPH CWG Banded | | | | | | | |
|---|---|---|---|---|---|---|---|
| **DETS Report No: 18-76084** | **Date Sampled** | 25/05/18 | | | | | |
| **Ground & Water Ltd** | **Time Sampled** | None Supplied | | | | | |
| **Site Reference: 16 Rosecroft Avenue, London, NW3 7QB** | **TP / BH No** | WS3 | | | | | |
| **Project / Job Ref: GWPR2630** | **Additional Refs** | None Supplied | | | | | |
| **Order No: None Supplied** | **Depth (m)** | 0.25 | | | | | |
| **Reporting Date: 13/06/2018** | **QTSE Sample No** | 337553 | | | | | |

| **Determinand** | **Unit** | **RL** | **Accreditation** | | | | | |
|---|---|---|---|---|---|---|---|---|
| Aliphatic >C5 - C6 | mg/kg | < 0.01 | NONE | < 0.01 | | | | |
| Aliphatic >C6 - C8 | mg/kg | < 0.05 | NONE | < 0.05 | | | | |
| Aliphatic >C8 - C10 | mg/kg | < 2 | **MCERTS** | < 2 | | | | |
| Aliphatic >C10 - C12 | mg/kg | < 2 | **MCERTS** | < 2 | | | | |
| Aliphatic >C12 - C16 | mg/kg | < 3 | **MCERTS** | < 3 | | | | |
| Aliphatic >C16 - C21 | mg/kg | < 3 | **MCERTS** | < 3 | | | | |
| Aliphatic >C21 - C34 | mg/kg | < 10 | **MCERTS** | < 10 | | | | |
| Aliphatic (C5 - C34) | mg/kg | < 21 | NONE | < 21 | | | | |
| Aromatic >C5 - C7 | mg/kg | < 0.01 | NONE | < 0.01 | | | | |
| Aromatic >C7 - C8 | mg/kg | < 0.05 | NONE | < 0.05 | | | | |
| Aromatic >C8 - C10 | mg/kg | < 2 | **MCERTS** | < 2 | | | | |
| Aromatic >C10 - C12 | mg/kg | < 2 | **MCERTS** | < 2 | | | | |
| Aromatic >C12 - C16 | mg/kg | < 2 | **MCERTS** | < 2 | | | | |
| Aromatic >C16 - C21 | mg/kg | < 3 | **MCERTS** | < 3 | | | | |
| Aromatic >C21 - C35 | mg/kg | < 10 | **MCERTS** | < 10 | | | | |
| Aromatic (C5 - C35) | mg/kg | < 21 | NONE | < 21 | | | | |
| Total >C5 - C35 | mg/kg | < 42 | NONE | < 42 | | | | |

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30$^{O}$C

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Tel : 01622 850410

| Soil Analysis Certificate - BTEX / MTBE | | | | | | | |
|---|---|---|---|---|---|---|---|
| DETS Report No: 18-76084 | Date Sampled | 25/05/18 | | | | | |
| Ground & Water Ltd | Time Sampled | None Supplied | | | | | |
| Site Reference: 16 Rosecroft Avenue, London, NW3 7QB | TP / BH No | WS3 | | | | | |
| Project / Job Ref: GWPR2630 | Additional Refs | None Supplied | | | | | |
| Order No: None Supplied | Depth (m) | 0.25 | | | | | |
| Reporting Date: 13/06/2018 | QTSE Sample No | 337553 | | | | | |

| Determinand | Unit | RL | Accreditation | | | | | |
|---|---|---|---|---|---|---|---|---|
| Benzene | ug/kg | < 2 | MCERTS | < 2 | | | | |
| Toluene | ug/kg | < 5 | MCERTS | < 5 | | | | |
| Ethylbenzene | ug/kg | < 2 | MCERTS | < 2 | | | | |
| p & m-xylene | ug/kg | < 2 | MCERTS | < 2 | | | | |
| o-xylene | ug/kg | < 2 | MCERTS | < 2 | | | | |
| MTBE | ug/kg | < 5 | MCERTS | < 5 | | | | |

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30$^{O}$C

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**Maidstone**
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**Tel : 01622 850410**

MCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME
UKAS TESTING 4480

## Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **DETS Report No: 18-76084** | | **Date Sampled** | 25/05/18 | | | | **Landfill Waste Acceptance Criteria Limits** | | |
| **Ground & Water Ltd** | | **Time Sampled** | None Supplied | | | | **Inert Waste Landfill** | **Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill** | **Hazardous Waste Landfill** |
| **Site Reference: 16 Rosecroft Avenue, London, NW3 7QB** | | **TP / BH No** | WS3 | | | | | | |
| **Project / Job Ref: GWPR2630** | | **Additional Refs** | None Supplied | | | | | | |
| **Order No: None Supplied** | | **Depth (m)** | 0.50 | | | | | | |
| **Reporting Date: 13/06/2018** | | **QTSE Sample No** | 337554 | | | | | | |
| **Determinand** | **Unit** | **MDL** | | | | | | | |
| TOC[MU] | % | < 0.1 | 0.6 | | | | 3% | 5% | 6% |
| Loss on Ignition | % | <0.01 | | | | | -- | -- | 10% |
| BTEX[MU] | mg/kg | < 0.05 | < 0.05 | | | | 6 | -- | -- |
| Sum of PCBs | mg/kg | < 0.1 | < 0.1 | | | | 1 | -- | -- |
| Mineral Oil[MU] | mg/kg | < 10 | < 10 | | | | 500 | -- | -- |
| Total PAH[MU] | mg/kg | < 1.7 | < 1.7 | | | | 100 | -- | -- |
| pH[MU] | pH Units | + / - 0.1 | | | | | -- | >6 | -- |
| Acid Neutralisation Capacity | mol/kg (+/-) | N/a | | | | | -- | To be evaluated | To be evaluated |
| **Eluate Analysis** | | | **10:1 mg/l** | | | **Cumulative 10:1 mg/kg** | **Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)** | | |
| Arsenic[U] | | | < 0.01 | | | < 0.1 | 0.5 | 2 | 25 |
| Barium[U] | | | < 0.02 | | | < 0.2 | 20 | 100 | 300 |
| Cadmium[U] | | | < 0.0005 | | | < 0.005 | 0.04 | 1 | 5 |
| Chromium[U] | | | < 0.005 | | | < 0.05 | 0.5 | 10 | 70 |
| Copper[U] | | | < 0.01 | | | < 0.1 | 2 | 50 | 100 |
| Mercury[U] | | | < 0.0005 | | | < 0.01 | 0.01 | 0.2 | 2 |
| Molybdenum[U] | | | < 0.001 | | | < 0.01 | 0.5 | 10 | 30 |
| Nickel[U] | | | < 0.007 | | | < 0.07 | 0.4 | 10 | 40 |
| Lead[U] | | | < 0.005 | | | < 0.05 | 0.5 | 10 | 50 |
| Antimony[U] | | | < 0.005 | | | < 0.05 | 0.06 | 0.7 | 5 |
| Selenium[U] | | | < 0.005 | | | < 0.05 | 0.1 | 0.5 | 7 |
| Zinc[U] | | | 0.019 | | | 0.19 | 4 | 50 | 200 |
| Chloride[U] | | | 1 | | | < 10 | 800 | 15000 | 25000 |
| Fluoride[U] | | | < 0.5 | | | < 5 | 10 | 150 | 500 |
| Sulphate[U] | | | 2 | | | 19 | 1000 | 20000 | 50000 |
| TDS | | | 13 | | | 130 | 4000 | 60000 | 100000 |
| Phenol Index | | | < 0.01 | | | < 0.1 | 1 | - | - |
| DOC | | | 5.7 | | | 56.8 | 500 | 800 | 1000 |
| **Leach Test Information** | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Sample Mass (kg) | | | 0.11 | | | | | | |
| Dry Matter (%) | | | 83.7 | | | | | | |
| Moisture (%) | | | 19.4 | | | | | | |
| **Stage 1** | | | | | | | | | |
| Volume Eluate L10 (litres) | | | 0.88 | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

**DETS Ltd**
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**Rose Lane**
**Lenham Heath**
**Maidstone**
**Kent ME17 2JN**
**Tel : 01622 850410**

| Soil Analysis Certificate - Sample Descriptions | |
|---|---|
| DETS Report No: 18-76084 | |
| Ground & Water Ltd | |
| Site Reference: 16 Rosecroft Avenue, London, NW3 7QB | |
| Project / Job Ref: GWPR2630 | |
| Order No: None Supplied | |
| Reporting Date: 13/06/2018 | |

| QTSE Sample No | TP / BH No | Additional Refs | Depth (m) | Moisture Content (%) | Sample Matrix Description |
|---|---|---|---|---|---|
| 337553 | WS3 | None Supplied | 0.25 | 14.6 | Brown sandy clay with stones |
| 337554 | WS3 | None Supplied | 0.50 | 16.3 | Brown sandy clay with stones |
| 337555 | None Supplied | None Supplied | 0.80 | 18.8 | Brown sandy clay |
| 337556 | None Supplied | None Supplied | 7.00 | 17 | Brown sandy clay |

*Moisture content is part of procedure E003 & is not an accredited test*

Insufficient Sample I/S

Unsuitable Sample U/S

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mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING 4480

| Soil Analysis Certificate - Methodology & Miscellaneous Information |
|---|
| DETS Report No: 18-76084 |
| Ground & Water Ltd |
| Site Reference: 16 Rosecroft Avenue, London, NW3 7QB |
| Project / Job Ref: GWPR2630 |
| Order No: None Supplied |
| Reporting Date: 13/06/2018 |

| Matrix | Analysed On | Determinand | Brief Method Description | Method No |
|---|---|---|---|---|
| Soil | D | Boron - Water Soluble | Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES | E012 |
| Soil | AR | BTEX | Determination of BTEX by headspace GC-MS | E001 |
| Soil | D | Cations | Determination of cations in soil by aqua-regia digestion followed by ICP-OES | E002 |
| Soil | D | Chloride - Water Soluble (2:1) | Determination of chloride by extraction with water & analysed by ion chromatography | E009 |
| Soil | AR | Chromium - Hexavalent | Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry | E016 |
| Soil | AR | Cyanide - Complex | Determination of complex cyanide by distillation followed by colorimetry | E015 |
| Soil | AR | Cyanide - Free | Determination of free cyanide by distillation followed by colorimetry | E015 |
| Soil | AR | Cyanide - Total | Determination of total cyanide by distillation followed by colorimetry | E015 |
| Soil | D | Cyclohexane Extractable Matter (CEM) | Gravimetrically determined through extraction with cyclohexane | E011 |
| Soil | AR | Diesel Range Organics (C10 - C24) | Determination of hexane/acetone extractable hydrocarbons by GC-FID | E004 |
| Soil | AR | Electrical Conductivity | Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement | E022 |
| Soil | AR | Electrical Conductivity | Determination of electrical conductivity by addition of water followed by electrometric measurement | E023 |
| Soil | D | Elemental Sulphur | Determination of elemental sulphur by solvent extraction followed by GC-MS | E020 |
| Soil | AR | EPH (C10 – C40) | Determination of acetone/hexane extractable hydrocarbons by GC-FID | E004 |
| Soil | AR | EPH Product ID | Determination of acetone/hexane extractable hydrocarbons by GC-FID | E004 |
| Soil | AR | EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40) | Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS | E004 |
| Soil | D | Fluoride - Water Soluble | Determination of Fluoride by extraction with water & analysed by ion chromatography | E009 |
| Soil | D | FOC (Fraction Organic Carbon) | Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate | E010 |
| Soil | D | Loss on Ignition @ 450oC | Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace | E019 |
| Soil | D | Magnesium - Water Soluble | Determination of water soluble magnesium by extraction with water followed by ICP-OES | E025 |
| Soil | D | Metals | Determination of metals by aqua-regia digestion followed by ICP-OES | E002 |
| Soil | AR | Mineral Oil (C10 - C40) | Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge | E004 |
| Soil | AR | Moisture Content | Moisture content; determined gravimetrically | E003 |
| Soil | D | Nitrate - Water Soluble (2:1) | Determination of nitrate by extraction with water & analysed by ion chromatography | E009 |
| Soil | D | Organic Matter | Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate | E010 |
| Soil | AR | PAH - Speciated (EPA 16) | Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards | E005 |
| Soil | AR | PCB - 7 Congeners | Determination of PCB by extraction with acetone and hexane followed by GC-MS | E008 |
| Soil | D | Petroleum Ether Extract (PEE) | Gravimetrically determined through extraction with petroleum ether | E011 |
| Soil | AR | pH | Determination of pH by addition of water followed by electrometric measurement | E007 |
| Soil | AR | Phenols - Total (monohydric) | Determination of phenols by distillation followed by colorimetry | E021 |
| Soil | D | Phosphate - Water Soluble (2:1) | Determination of phosphate by extraction with water & analysed by ion chromatography | E009 |
| Soil | D | Sulphate (as SO4) - Total | Determination of total sulphate by extraction with 10% HCl followed by ICP-OES | E013 |
| Soil | D | Sulphate (as SO4) - Water Soluble (2:1) | Determination of sulphate by extraction with water & analysed by ion chromatography | E009 |
| Soil | D | Sulphate (as SO4) - Water Soluble (2:1) | Determination of water soluble sulphate by extraction with water followed by ICP-OES | E014 |
| Soil | AR | Sulphide | Determination of sulphide by distillation followed by colorimetry | E018 |
| Soil | D | Sulphur - Total | Determination of total sulphur by extraction with aqua-regia followed by ICP-OES | E024 |
| Soil | AR | SVOC | Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS | E006 |
| Soil | AR | Thiocyanate (as SCN) | Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry | E017 |
| Soil | D | Toluene Extractable Matter (TEM) | Gravimetrically determined through extraction with toluene | E011 |
| Soil | D | Total Organic Carbon (TOC) | Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate | E010 |
| Soil | AR | TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35) | Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS | E004 |
| Soil | AR | TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44) | Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS | E004 |
| Soil | AR | VOCs | Determination of volatile organic compounds by headspace GC-MS | E001 |
| Soil | AR | VPH (C6-C8 & C8-C10) | Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID | E001 |

**D Dried**
**AR As Received**

**APPPENDIX F**
**Soil Assessment Criteria**

**Appendix F**
**Soil Guideline Values and Genera Assessment Criteria**

## F1 Assessment Criteria

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'.

### F1.1 Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment Model (CLEA).

The CLEA Guidance comprises the following documents:

1) EA Science Report SC050021/SR2: *Human health toxicological assessment of contaminants in soil.*
2) EA Science Report SC050021/SR3: *Updated technical background to the CLEA model.*
3) EA CLEA Bulletin (2009).
4) CLEA software version 1.06 (2009)
5) Toxicological reports and SGV technical notes.

The CLEA guidance and tools:

- *do not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures.*
- *do not cover risks to the environment, such as groundwater, ecosystems or buildings.*
- *do not provide a definitive test for telling when human health risks are significant.*
- *are not a legal requirement in assessing land contamination risks. They are not part of the legal regime for Part 2A of the Environmental Protection Act 1990.*

The CLEA guidance derives soil concentrations of contaminants above which (in the opinion of the EA) there may be a concern that warrants further investigation. It does not provide a definitive test for establishing that the risk is significant.

### F1.2 Land-use Scenarios

The CLEA model uses a range of standard land-use scenarios to develop conceptual exposure models as follows:

***1 Residential (with home grown produce) (RwHP)***

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil and indoor dust ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours.
- Building type is a two-storey small terraced house.

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur. (Residential without homegrown produce (RwoHP)).

***2) Allotments***

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours.
- There is no building.

***3) Commercial/Industrial***

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

- Critical receptor is a working female adult (aged 16 to 65 years old).
- Exposure duration is a working lifetime of 49 years.
- Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours.
- Building type is a three-storey office (pre 1970).

**F1.4 LQM/CIEH SUITABLE 4 USE LEVELS (S4UL)**

For derivation of these S4UL reference must be made to:

Nathanial, P., McCaffrey, C., Gillet, A., Ogden, R., Nathanial, J.,. *The LQM/CIEH S4UL's for Human Health Risk Assessment*. **Land Quality Press**. 2015

The LQM/CIEH S4UL for a given land use is the concentration of the contaminant in soil at which the predicted daily exposure, as calculated by the CLEA software, equals the Health Criteria Value.

The final output for each contaminant represents a synthesis of new toxicological (and fate and transport) reviews published since the preparation of the 2nd edition LQM/CIEH GAC's (Nathanial et al., 2009).

In the derivation of LQM/CIEH S4UL's the principles of 'minimal' or 'tolerable' risk enshrined in SR2, which has not been withdrawn, has been maintained.

S4UL's have been derived for the basic CLEA land-uses, as described above, and for two new land uses:

- Public Open Spaces near Residential Housing (POSresi)
- Public Park (POSpark).

**Public Open Spaces near Residential Housing (POSresi)**
Includes the predominantly grassed areas adjacent to high density housing, the central green area on many 1930's – 1970's housing estates, and smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soils with planting. It is assumed that the close proximity to the place of residence will allow tracking back of soil to occur.

**Public Park (POSpark)**
An area of open space, usually owned and maintained by the local authority, provided for recreational uses including family visists and picnics, children's play area, informal sporting activities (not a dedicated sports pitch), and dog walking. It is assumed that tracking back of soils into places of residence will be negligible.

The following LQM/CIEH S4Uls (Copyright Land Quality Management Limited) have been reproduced with permission, to the publication number S4UL3072

**F1.5 Category** 4 **Screening Levels (C4SLs)**
In the case of Lead, no SGV or GAC has been published to date. This is likely to be due to the toxicity review that is currently being undertaken by the Environment Agency. In the absence of updated toxicity information the SGV derived using CLEA 1.06 methodology and related toxicity will be used.

The overall objective of the C4SLs research project was to assist the provision of technical guidance in support of Defra's revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A) (Defra, 2012a). Specifically, the project aimed to deliver:

• A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
• A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised SG presented a new four category system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high. More specific guidance on what type of land should be considered as Category 4 (Human Health) is provided in Paragraphs 4.21 and 4.22 of the revised SG, as follows:

*"4.21 The local authority should consider that the following types of land should be placed into Category 4: Human Health:*
*(a) Land where no relevant contaminant linkage has been established.*
*(b) Land where there are only normal levels of contaminants in soil, as explained in Section 3 of this Guidance.*
*(c) Land that has been excluded from the need for further inspection and assessment because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of this Guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of this Guidance.*
*(d) Land where estimated levels of exposure to contaminants in soil are likely to form only a small proportion of what a receptor might be exposed to anyway through other sources of environmental exposure (e.g. in relation to average estimated national levels of exposure to substances commonly found in the environment, to which receptors are likely to be exposed in the normal course of their lives).*

*4.22 The local authority may consider that land other than the types described in paragraph 4.21 should be placed into Category 4: Human Health if following a detailed quantitative risk assessment it is satisfied that the level of risk posed is sufficiently low."*

The C4SLs are intended as "relevant technical tools" (in relation to Paragraph 4.21(c)) to help local authorities and others when deciding to stop further assessment of a site, on the grounds that it falls within Category 4 (Human Health).

The Impact Assessment (IA), which accompanied the revised SG (Defra, 2012b) provides further information on the nature and potential role of the C4SLs. Paragraph 47(h) of the IA states that:

*"The new statutory guidance will bring about a situation where the current SGVs/GACs are replaced with more pragmatic (but still strongly precautionary) Category 4 screening levels (C4SLs) which will provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land."*

A key distinction between the Soil Guideline Values (SGVs) and the C4SLs is the level of risk that they describe. As described by the Environment Agency (2009a):
*"SGVs are guidelines on the level of long-term human exposure to individual chemicals in soil that, unless stated otherwise, are tolerable or pose a minimal risk to human health."*

The implication of Paragraph 47(h) of the IA is that minimal risk is well within Category 4 and that the C4SLs should describe a higher level of risk which, whilst not minimal, can still be considered low enough to allow a judgement to be made that land containing substances at, or below, the C4SLs would typically fall within Category 4. This reflects Paragraph 4.20 of the revised SG, which states:

*"4.20 The local authority should not assume that land poses a significant possibility of significant harm if it considers that there is no risk or that the level of risk posed is low. For the purposes of this Guidance, such land is referred to as a "Category 4: Human Health" case. The authority may decide that the land is a Category 4: Human Health case as soon as it considers it has evidence to this effect, and this may happen at any stage during risk assessment including the early stages."*

C4SLs, therefore, should not be viewed as "SPOSH levels" and they should not be used as a legal trigger for the determination of land under Part 2A.

The generic screening values referred to before usually take the form of risk-based Soil Guideline Values (SGVs) or other Generic Assessment Criteria (GACs) that are most typically derived using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) model, as described in the Environment Agency's SR2, SR3 and SR7 reports (EA, 2009b & c; EA, 2008). It is anticipated that C4SLs will be used in a similar manner; as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the SGVs.

The suggested approach to the development of C4SLs consists of the retention and use of the CLEA framework, modified according to considerations of the underlying science within the context of Defra's policy objectives relating to the revised SG. Within this context, it is suggested that the development of C4SLs may be achieved in one of three ways, namely:

- By modifying the toxicological parameters used within CLEA (while maintaining current exposure parameters);
- By modifying the exposure parameters embedded within CLEA (while maintaining current toxicological "minimal risk" interpretations); and
- By modifying both toxicological and exposure parameters.

There is also a suggested check on "other considerations" (e.g., background levels, epidemiological data, sources of uncertainty) within the approach, applicable to all three options.

It is suggested that a new term is defined for the toxicological guidance values associated with the derivation of C4SLs – a Low Level of Toxicological Concern (LLTC). A LLTC should represent an intake of low concern that remains suitably protective of health, and definitely does not approach an intake level that could be defined as SPOSH.

**F1.6 CL:AIRE Generic Assessment Criteria (GAC)**

For derivation of the CL:AIRE Generic Assessment Criteria (GAC) reference should be made to the following report:

CL:AIRE, *The Soil Generic Assessment Criteria for Human Health Risk Assessment.* **Contaminated Land: Applications in the Real Environment**. 2009.

Within this report CL:AIRE provided Generic Assessment Criteria (GAC's) in accordance with the CLEA software and the principles outlined above for a further 35 contaminants sometime encountered on land affected by contamination.

**E1.7 Detailed Quantitative Risk Assessments (DQRA)**
Where the adoption of an S4UL/GAC/C4SL is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses then a DQRA may be undertaking to develop site specific values for relevant soil contaminants.

⇒ Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.

⇒ Developing more accurate parameters using site data.

**F1.8 Phytotoxicity**
CLEA guidance only addresses human health toxicity; assessment of plant toxicity (phytotoxicity) is based on threshold trigger values obtained from the following source:

- ICRCL 70/90: *Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing*.

**F1.8 Statistical Tests**
DEFRA R&D Publication CLR 7 (DOE 1994) addressed the statistical treatment of test results and their comparison to Soil Guideline Values.

Consideration must be given to the appropriate area of land to be considered termed the critical averaging area.

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot.

It may be appropriate to compare the upper 95$^{th}$ percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

The DEFRA discussion paper Assessing risks from land contamination – a proportionate approach ('the way forward') (CLAN06/2006) aimed to increase understanding of the role that statistics can play in quantifying the uncertainty attached to the estimates of the mean concentration of contaminants in soil. In direct response CLAIRE/CIEH published a joint report, *Guidance in comparing soil contamination data with a critical concentration* (CLAIRE/CIEH 2008). A software implementation of the statistical techniques given in the report was published by ESI International (2008).

**Treatment of Hot-Spots**

⇒ A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.

⇒ Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.

**F2 Ground and Water Limited Soil Assessment Criteria**

The Soil Assessment Criteria used in the preparation of this report are tabulated in the following pages:

## C4SL Low Level of Toxicological Concern

| C4SL Low Level of Toxicological Concern | | | | | | |
|---|---|---|---|---|---|---|
| **Contaminant** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| | | | | | | |
| **Lead** | <210 | <330 | <84 | <6000 | <760 | <1400 |
| | | | | | | |

## Phytotoxicity Recommendations

**ICRCL 70/90** ***Restoration of metalliferous mining areas***

| Phytotoxicity (Harmful to Plants) Threshold Trigger Values | |
|---|---|
| **Copper** | 250mg/kg |
| **Zinc** | 1000mg/kg |
| Notes:<br>Many cultivars and specifically grasses have a high tolerance and there will be no ill-effect at the threshold trigger values given for neutral or near neutral pH. Site observation of plant vitality may give additional guidance. | |

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## LQM CIEH Suitable 4 Use Levels (S4UL's)

| LQM/CIEH Suitable 4 Use Levels – Metals and Semi-metals | | | | | | |
|---|---|---|---|---|---|---|
| **Contaminant** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| ***Metals:*** | | | | | | |
| **Arsenic** | 37 | 40 | 43 | 640 | 79 | 170 |
| **Beryllium** | 1.7 | 1.7 | 35 | 12 | 2.2 | 63 |
| **Boron** | 290 | 11000 | 45 | 240000 | 21000 | 46000 |
| **Cadmium** | 11 | 85 | 1.9 | 190 | 120 | 532 |
| **Chromium (III)** | 910 | 910 | 18000 | 8600 | 1500 | 33000 |
| **Chromium (VI)** | 6 | 6 | 1.8 | 33 | 7.7 | 20 |
| **Copper** | 2400 | 7100 | 520 | 68000 | 12000 | 44000 |
| **Elemental Mercury** | 1.2 | 1.2 | 21 | 58 | 16 | 30 |
| **Inorganic Mercury** | 40 | 56 | 19 | 1100 | 120 | 240 |
| **Methylmercury** | 11 | 15 | 6 | 320 | 40 | 68 |
| **Nickel** | 180 | 180 | 230 | 980 | 230 | 3400 |
| **Selenium** | 250 | 430 | 88 | 12000 | 1100 | 1800 |
| **Vanadium** | 410 | 1200 | 91 | 9000 | 2000 | 5000 |
| **Zinc** | 3700 | 40000 | 620 | 730000 | 81000 | 170000 |

| LQM/CIEH Suitable 4 Use Levels – BTEX Compounds | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Contaminant** | **Soil Organic Matter** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| | | | | | | | |
| **Benzene** | **1.0% SOM** | 0.087 | 0.38 | 0.017 | 27 | 72 | 90 |
| | **2.5% SOM** | 0.170 | 0.70 | 0.034 | 47 | 72 | 100 |
| | **6.0% SOM** | 0.370 | 1.40 | 0.075 | 90 | 73 | 110 |
| | | | | | | | |
| **Toluene** | **1.0% SOM** | 130 | 880 | 22 | 56000 | 56000 | 87000 |
| | **2.5% SOM** | 290 | 1900 | 51 | 110000 | 56000 | 95000 |
| | **6.0% SOM** | 660 | 3900 | 120 | 180000 | 56000 | 100000 |
| | | | | | | | |
| **Ethylbenzene** | **1.0% SOM** | 47 | 83 | 16 | 5700 | 24000 | 17000 |
| | **2.5% SOM** | 110 | 190 | 39 | 13000 | 24000 | 22000 |
| | **6.0% SOM** | 260 | 440 | 91 | 27000 | 25000 | 27000 |
| | | | | | | | |
| **o-Xylene** | **1.0% SOM** | 60 | 88 | **28** | 6600 | **41000** | **17000** |
| | **2.5% SOM** | 140 | 210 | **67** | 15000 | **42000** | 24000 |
| | **6.0% SOM** | 330 | 480 | **160** | 33000 | **43000** | 33000 |
| | | | | | | | |
| **m-Xylene** | **1.0% SOM** | 59 | 82 | 31 | 6200 | **41000** | 17000 |
| | **2.5% SOM** | 140 | 190 | 74 | **14000** | **42000** | 24000 |
| | **6.0% SOM** | 320 | 450 | 170 | 31000 | **43000** | 33000 |
| | | | | | | | |
| **p-Xylene** | **1.0% SOM** | **56** | **79** | 29 | **5900** | **41000** | **17000** |
| | **2.5% SOM** | **130** | **180** | 69 | **14000** | **42000** | **23000** |
| | **6.0% SOM** | **310** | **430** | **160** | **30000** | **43000** | **31000** |
| **The most health protective value in each scenario for Xylene is highlighted in bold.** | | | | | | | |

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## LQM/CIEH Suitable 4 Use Levels For TPH

| Aliphatic | | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
|---|---|---|---|---|---|---|---|
| EC 5-6 | 1.0% SOM | 42 | 42 | 730 | 3,200 (304) sol | 570,000 (304) sol | 95,000 (304) sol |
| | 2.5% SOM | 78 | 78 | 1,700 | 5,900 (558) sol | 590,000 | 130,000 (558) sol |
| | 6.0% SOM | 160 | 160 | 3,900 | 12,000 (1150) sol | 600,000l | 180,000 (1150) sol |
| | | | | | | | |
| EC >6-8 | 1.0% SOM | 100 | 100 | 2,300 | 7,800 (144) sol | 600,000 | 150,000 (144) sol |
| | 2.5% SOM | 230 | 230 | 5,600 | 17,000 (322) sol | 610,000 | 220,000 (322) sol |
| | 6.0% SOM | 530 | 530 | 13,000 | 40,000 (736) sol | 620,000 | 320,000 (736) sol |
| | | | | | | | |
| EC >8-10 | 1.0% SOM | 27 | 27 | 320 | 2,000 (78) sol | 13,000 | 14,000 (78) sol |
| | 2.5% SOM | 65 | 65 | 770 | 4,800 (118) vap | 13,000 | 18,000 (118) vap |
| | 6.0% SOM | 150 | 150 | 1,700 | 11,000 (451) vap | 13,000 | 21,000 (451) vap |
| | | | | | | | |
| EC >10-12 | 1.0% SOM | 130 (48) vap | 130 (48) vap | 2,200 | 9,700 (48) sol | 13,000 | 21,000 (48) sol |
| | 2.5% SOM | 330 (118) vap | 330 (118) vap | 4,400 | 23,000 (118) vap | 13,000 | 23,000 (118) vap |
| | 6.0% SOM | 760 (283) vap | 770 (283) vap | 7,300 | 47,000 (283) vap | 13,000 | 24,000 (283) vap |
| | | | | | | | |
| EC >12-16 | 1.0% SOM | 1,100 (24) sol | 1,100 (24) sol | 11,000 | 59,000 (24) sol | 13,000 | 25,000 (24) sol |
| | 2.5% SOM | 2,400 (59) sol | 2,400 (59) sol | 13,000 | 82,000 (59) sol | 13,000 | 25,000 (59) sol |
| | 6.0% SOM | 4,300 (142) sol | 4,400 (142) sol | 13,000 | 90,000 (142) sol | 13,000 | 26,000 (142) sol |
| | | | | | | | |
| EC >16-35 | 1.0% SOM | 65,000 (8.48) sol | 65,000 (8.48) sol | 260,000 | 1,600,000 | 250,000 | 450,000 |
| | 2.5% SOM | 92,000 (21) sol | 92,000 (21) sol | 270,000 | 1,700,000 | 250,000 | 480,000 |
| | 6.0% SOM | 110,000 | 110,000 | 270,000 | 1,800,000 | 250,000 | 490,000 |
| | | | | | | | |
| EC >35-44 | 1.0% SOM | 65,000 (8.48) sol | 65,000 (8.48) sol | 260,000 | 1,600,000 | 250,000 | 450,000 |
| | 2.5% SOM | 92,000 (21) sol | 92,000 (21) sol | 270,000 | 1,700,000 | 250,000 | 480,000 |
| | 6.0% SOM | 110,000 | 110,000 | 270,000 | 1,800,000 | 250,000 | 490,000 |

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## LQM/CIEH Suitable 4 Use Levels For TPH

| Aromatic | | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
|---|---|---|---|---|---|---|---|
| EC 5-7 (Benzene) | 1.0% SOM | 70 | 370 | 13 | 26,000 (1220) [sol] | 56,000 | 76,000 (1220 [sol] |
| | 2.5% SOM | 140 | 690 | 27 | 46,000 (2260) [sol] | 56,000 | 84,000 (2260) [sol] |
| | 6.0% SOM | 300 | 1,400 | 57 | 86,000 (4710) [sol] | 56,000 | 92,000 (4710) [sol] |
| | | | | | | | |
| EC >7-8 (Toluene) | 1.0% SOM | 130 | 860 | 22 | 56,000 (869) [vap] | 56,000 | 87,000 (869) [sol] |
| | 2.5% SOM | 290 | 1,800 | 51 | 110,000 (1920) [sol] | 56,000 | 95,000 (1920) [sol] |
| | 6.0% SOM | 660 | 3,900 | 120 | 180,000 (4360) [vap] | 56,000 | 100,000 (4360) [vap] |
| | | | | | | | |
| EC >8-10 | 1.0% SOM | 34 | 47 | 8.6 | 3,500 (613) [vap] | 5,000 | 7,200 (613) [vap] |
| | 2.5% SOM | 83 | 110 | 21 | 8,100 (1500) [vap] | 5,000 | 8,500 (1500) [vap] |
| | 6.0% SOM | 190 | 270 | 51 | 17,000 (3850) [vap] | 5,000 | 9,300 (3580) [vap] |
| | | | | | | | |
| EC >10-12 | 1.0% SOM | 74 | 250 | 13 | 16,000 (364) [sol] | 5,000 | 9,200 (364) [sol] |
| | 2.5% SOM | 180 | 590 | 31 | 28,000 (899) [sol] | 5,000 | 9,700 (889) [sol] |
| | 6.0% SOM | 380 | 1,200 | 74 | 34,000 (2150) [sol] | 5,000 | 10,000 |
| | | | | | | | |
| EC >12-16 | 1.0% SOM | 140 | 1,800 | 23 | 36,000 (169) [sol] | 5,100 | 10,000 |
| | 2.5% SOM | 330 | 2,300 (419) [sol] | 57 | 37,000 | 5,100 | 10,000 |
| | 6.0% SOM | 660 | 2,500 | 130 | 38,000 | 5,000 | 10,000 |
| | | | | | | | |
| EC >16-21 | 1.0% SOM | 260 | 1,900 | 46 | 28,000 | 3,800 | 7,600 |
| | 2.5% SOM | 540 | 1,900 | 110 | 28,000 | 3,800 | 7,700 |
| | 6.0% SOM | 930 | 1,900 | 260 | 28,000 | 3,800 | 7,800 |
| | | | | | | | |
| EC >21-35 | 1.0% SOM | 1,100 | 1,900 | 370 | 28,000 | 3,800 | 7,800 |
| | 2.5% SOM | 1,500 | 1,900 | 820 | 28,000 | 3,800 | 7,800 |
| | 6.0% SOM | 1,700 | 1,900 | 1,600 | 28,000 | 3,800 | 7,900 |
| | | | | | | | |
| EC >35-44 | 1.0% SOM | 1,100 | 1,900 | 370 | 28,000 | 3,800 | 7,800 |
| | 2.5% SOM | 1,500 | 1,900 | 820 | 28,000 | 3,800 | 7,800 |
| | 6.0% SOM | 1,700 | 1,900 | 1,600 | 28,000 | 3,800 | 7,900 |
| | | | | | | | |
| EC >44-70 | 1.0% SOM | 1,600 | 1,900 | 1,200 | 28,000 | 3,800 | 7,800 |
| | 2.5% SOM | 1,800 | 1,900 | 2,100 | 28,000 | 3,800 | 7,800 |
| | 6.0% SOM | 1,900 | 1,900 | 3,000 | 28,000 | 3,800 | 7,900 |

*SOM = Soil Organic Matter Content (%)*

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## LQM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAH's)

| Determinants | | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
|---|---|---|---|---|---|---|---|
| **Acenapthene** | 1.0% SOM | 210 | 3,000 (57.0) [sol] | 34 | 84,000(57.0) [sol] | 15,000 | 29,000 |
| | 2.5% SOM | 510 | 4,700(141) [sol] | 85 | 97,000(141) [sol] | 15,000 | 30,000 |
| | 6.0% SOM | 1100 | 6,000(336) [sol] | 200 | 100,000 | 15,000 | 30,000 |
| **Acenapthylene** | 1.0% SOM | 170 | 2,900(86.1) [sol] | 28 | 83,000(86.1) [sol] | 15,000 | 29,000 |
| | 2.5% SOM | 420 | 4,600(212) [sol] | 69 | 97,000(212) [sol] | 15,000 | 30,000 |
| | 6.0% SOM | 920 | 6,000(506) [sol] | 160 | 100,000 | 15,000 | 30,000 |
| **Anthracene** | 1.0% SOM | 2,400 | 31,000(1.17) [vap] | 380 | 520,000 | 74,000 | 150,000 |
| | 2.5% SOM | 5,400 | 35,000 | 950 | 540,000 | 74,000 | 150,000 |
| | 6.0% SOM | 11,000 | 37,000 | 2,200 | 540,000 | 74,000 | 150,000 |
| **Benzo(a)anthracene** | 1.0% SOM | 7.20 | 11 | 2.90 | 170 | 29 | 49 |
| | 2.5% SOM | 11 | 14 | 6.50 | 170 | 29 | 56 |
| | 6.0% SOM | 13 | 15 | 13 | 180 | 29 | 62 |
| **Benzo(a)pyrene** | 1.0% SOM | 2.20 | 3.20 | 0.97 | 35 | 5.70 | 11 |
| | 2.5% SOM | 2.70 | 3.20 | 2.00 | 35 | 5.70 | 12 |
| | 6.0% SOM | 3.00 | 3.20 | 3.50 | 36 | 5.70 | 13 |
| **Benzo(b)flouranthene** | 1.0% SOM | 2.60 | 3.90 | 0.99 | 44 | 7.10 | 13 |
| | 2.5% SOM | 3.30 | 4.00 | 2.10 | 44 | 7.20 | 15 |
| | 6.0% SOM | 3.70 | 4.00 | 3.90 | 45 | 7.20 | 16 |
| **Benzo(ghi)perylene** | 1.0% SOM | 320 | 360 | 290 | 3,900 | 640 | 1,400 |
| | 2.5% SOM | 340 | 360 | 470 | 4,000 | 640 | 1,500 |
| | 6.0% SOM | 350 | 360 | 640 | 4,000 | 640 | 1,600 |
| **Benzo(k)flouranthene** | 1.0% SOM | 77 | 110 | 37 | 1,200 | 190 | 370 |
| | 2.5% SOM | 93 | 110 | 75 | 1,200 | 190 | 410 |
| | 6.0% SOM | 100 | 110 | 130 | 1,200 | 190 | 440 |
| **Chrysene** | 1.0% SOM | 15 | 30 | 4.10 | 350 | 57 | 93 |
| | 2.5% SOM | 22 | 31 | 9.40 | 350 | 57 | 110 |
| | 6.0% SOM | 27 | 32 | 19 | 350 | 57 | 120 |
| **Dibenzo(ah)anthracene** | 1.0% SOM | 0.24 | 0.31 | 0.14 | 3.50 | 0.57 | 1.10 |
| | 2.5% SOM | 0.28 | 0.32 | 0.27 | 3.60 | 0.57 | 1.30 |
| | 6.0% SOM | 0.30 | 0.32 | 0.43 | 3.60 | 0.58 | 1.40 |

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## LQM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAH's)

| Determinants | | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
|---|---|---|---|---|---|---|---|
| Flouranthene | 1.0% SOM | 280 | 1,500 | 52 | 2,3000 | 3,100 | 6,300 |
| | 2.5% SOM | 560 | 1,600 | 130 | 2,3000 | 3,100 | 6,300 |
| | 6.0% SOM | 890 | 1,600 | 290 | 2,3000 | 3,100 | 6,300 |
| Flourene | 1.0% SOM | 170 | 2,800 (30.9) [sol] | 27 | 63,000(30.9) [sol] | 9,900 | 20,000 |
| | 2.5% SOM | 400 | 3,800(76.5) [sol] | 67 | 68,000 | 9,900 | 20,000 |
| | 6.0% SOM | 860 | 4,500(183) [sol] | 160 | 71,000 | 9,900 | 20,000 |
| Indeno(123-cd)pyrene | 1.0% SOM | 27 | 45 | 9.50 | 500 | 82 | 150 |
| | 2.5% SOM | 36 | 46 | 21 | 510 | 82 | 170 |
| | 6.0% SOM | 41 | 46 | 39 | 510 | 82 | 180 |
| Napthalene | 1.0% SOM | 2.30 | 2.6 | 4.10 | 190 [f] (76.4) [sol] | 4,900[f] | 1,200[f](76.4) [sol] |
| | 2.5% SOM | 5.60 | 5.6 | 10 | 460 [f](183) [sol] | 4,900[f] | 1,900[f](183) [sol] |
| | 6.0% SOM | 13 | 13 | 24 | 1,100[f](432) [sol] | 4,900[f] | 3,000 |
| Phenanthrene | 1.0% SOM | 95 | 1,300(183) [sol] | 18 | 22,000 | 3,100 | 6,200 |
| | 2.5% SOM | 220 | 1,500 | 38 | 22,000 | 3,100 | 6,200 |
| | 6.0% SOM | 440 | 1,500 | 90 | 23,000 | 3,100 | 6,300 |
| Pyrene | 1.0% SOM | 620 | 3,700 | 110 | 54,000 | 7,400 | 15,000 |
| | 2.5% SOM | 1200 | 3,800 | 270 | 54,000 | 7,400 | 15,000 |
| | 6.0% SOM | 2000 | 3,800 | 620 | 54,000 | 7,400 | 15,000 |
| Coal Tar (Benzo(a)pyrene used as marker compound | 1.0% SOM | 0.79 | 1.2 | 0.32 | 15 | 2.20 | 4.40 |
| | 2.5% SOM | 0.98 | 1.2 | 0.67 | 15 | 2.20 | 4.70 |
| | 6.0% SOM | 1.10 | 1.2 | 1.20 | 15 | 2.20 | 4.80 |

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.
[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

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## LQM/CIEH Suitable 4 Use Levels (cont.)

### LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

| Contaminant | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
|---|---|---|---|---|---|---|
| ***Chloroalkanes & alkenes*** | | | | | | |
| | | | | | | |
| **1,2 Dichloroethane** | | | | | | |
| 1.0% SOM | 0.0071 | 0.0092 | 0.0046 | 0.67 | 29 | 21 |
| 2.5% SOM | 0.011 | 0.013 | 0.0083 | 0.97 | 29 | 24 |
| 6.0% SOM | 0.019 | 0.023 | 0.016 | 1.70 | 29 | 28 |
| | | | | | | |
| **1,1,2,2 Tetrachloroethane** | | | | | | |
| 1.0% SOM | 1.60 | 3.90 | 0.41 | 270 | 1,400 | 1,800 |
| 2.5% SOM | 3.40 | 8.00 | 0.89 | 550 | 1,400 | 2,100 |
| 6.0% SOM | 7.50 | 17 | 2.00 | 1,100 | 1,400 | 2,300 |
| | | | | | | |
| **1,1,1,2 Tetrachloroethane** | | | | | | |
| 1.0% SOM | 1.20 | 1.50 | 0.79 | 110 | 1,400 | 1,500 |
| 2.5% SOM | 2.80 | 3.50 | 1.90 | 250 | 1,400 | 1,800 |
| 6.0% SOM | 6.40 | 8.20 | 4.40 | 560 | 1,400 | 2,100 |
| | | | | | | |
| **Tetrachloroethene** | | | | | | |
| 1.0% SOM | 0.18 | 0.18 | 0.65 | 19 | 1,400 | 810 $^{sol}$(424) |
| 2.5% SOM | 0.39 | 0.40 | 1.50 | 42 | 1,400 | 1,100 $^{sol}$(951) |
| 6.0% SOM | 0.90 | 0.92 | 3.60 | 95 | 1,400 | 1,500 |
| | | | | | | |
| **1,1,1 Trichloroethane** | | | | | | |
| 1.0% SOM | 8.80 | 9.00 | 48 | 660 | 140,000 | 57,000 $^{vap}$(1425) |
| 2.5% SOM | 18 | 18 | 110 | 1,300 | 140,000 | 76,000 $^{vap}$(2915) |
| 6.0% SOM | 39 | 40 | 240 | 3,000 | 140,000 | 100,000 $^{vap}$(6392) |
| | | | | | | |
| **Tetrachloromethene** | | | | | | |
| 1.0% SOM | 0.026 | 0.026 | 0.45 | 2.90 | 890 | 190 |
| 2.5% SOM | 0.056 | 0.056 | 1.00 | 6.30 | 920 | 270 |
| 6.0% SOM | 0.130 | 0.130 | 2.40 | 14 | 950 | 400 |
| | | | | | | |
| **Trichloroethene** | | | | | | |
| 1.0% SOM | 0.016 | 0.017 | 0.041 | 1.20 | 120 | 70 |
| 2.5% SOM | 0.034 | 0.036 | 0.091 | 2.60 | 120 | 91 |
| 6.0% SOM | 0.075 | 0.080 | 0.210 | 5.70 | 120 | 120 |
| | | | | | | |
| **Trichloromethane** | | | | | | |
| 1.0% SOM | 0.91 | 1.20 | 0.42 | 99 | 2,500 | 2,600 |
| 2.5% SOM | 1.70 | 2.10 | 0.83 | 170 | 2,500 | 2,800 |
| 6.0% SOM | 3.40 | 4.20 | 1.70 | 350 | 2,500 | 3,100 |
| | | | | | | |
| **Vinyl Chloride** | | | | | | |
| 1.0% SOM | 0.00064 | 0.00077 | 0.00055 | 0.059 | 3.50 | 4.80 |
| 2.5% SOM | 0.00087 | 0.00100 | 0.00100 | 0.077 | 3.50 | 5.00 |
| 6.0% SOM | 0.00014 | 0.00150 | 0.00180 | 0.120 | 3.50 | 5.40 |

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## LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

| Contaminant | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
|---|---|---|---|---|---|---|
| ***Explosives*** | | | | | | |
| | | | | | | |
| **2,4,6 Trinitrotoluene** | | | | | | |
| 1.0% SOM | 1.60 | 65 | 0.24 | 1,000 | 130 | 260 |
| 2.5% SOM | 3.70 | 66 | 0.58 | 1,000 | 130 | 270 |
| 6.0% SOM | 8.10 | 66 | 1.40 | 1,000 | 130 | 270 |
| | | | | | | |
| **RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)** | | | | | | |
| 1.0% SOM | 120 | 13,000 | 17 | 210,000 | 26,000 | 49,000(18.7)$^{sol}$ |
| 2.5% SOM | 250 | 13,000 | 38 | 210,000 | 26,000 | 51,000 |
| 6.0% SOM | 540 | 13,000 | 85 | 210,000 | 27,000 | 53,000 |
| | | | | | | |
| **HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)** | | | | | | |
| 1.0% SOM | 5.70 | 67,00 | 0.86 | 110,000 | 13,000 | 23,000(0.35)$^{vap}$ |
| 2.5% SOM | 13 | 67,00 | 1.90 | 110,000 | 13,000 | 23,000(0.39)$^{vap}$ |
| 6.0% SOM | 26 | 67,00 | 3.90 | 110,000 | 13,000 | 24,000(0.48)$^{vap}$ |
| | | | | | | |
| **Atrazine** | | | | | | |
| 1.0% SOM | 3.30 | 610 | 0.50 | 9,300 | 1,200 | 2,300 |
| 2.5% SOM | 7.60 | 620 | 1.20 | 9,400 | 1,200 | 2,400 |
| 6.0% SOM | 17.40 | 620 | 2.70 | 9,400 | 1,200 | 2,400 |
| | | | | | | |
| ***Pesticides*** | | | | | | |
| | | | | | | |
| **Aldrin** | | | | | | |
| 1.0% SOM | 5.70 | 7.30 | 3.20 | 170 | 18 | 30 |
| 2.5% SOM | 6.60 | 7.40 | 6.10 | 170 | 18 | 31 |
| 6.0% SOM | 7.10 | 7.50 | 9.60 | 170 | 18 | 31 |
| | | | | | | |
| **Dieldrin** | | | | | | |
| 1.0% SOM | 0.97 | 7.00 | 0.17 | 170 | 18 | 30 |
| 2.5% SOM | 2.00 | 7.30 | 0.41 | 170 | 18 | 30 |
| 6.0% SOM | 3.50 | 7.40 | 0.96 | 170 | 18 | 31 |
| | | | | | | |
| **Dichlorvos** | | | | | | |
| 1.0% SOM | 0.032 | 6.40 | 0.0049 | 140 | 16 | 26 |
| 2.5% SOM | 0.066 | 6.50 | 0.0100 | 140 | 16 | 26 |
| 6.0% SOM | 0.140 | 6.60 | 0.0220 | 140 | 16 | 27 |
| | | | | | | |
| **Alpha - Endosulfan** | | | | | | |
| 1.0% SOM | 7.40 | 160(0.003)$^{vap}$ | 1.20 | 5,600(0.003)$^{vap}$ | 1,200 | 2,400 |
| 2.5% SOM | 18 | 280(0.007)$^{vap}$ | 2.90 | 7,400(0.007)$^{vap}$ | 1,200 | 2,400 |
| 6.0% SOM | 41 | 410(0.016)$^{vap}$ | 6.80 | 8,400(0.016)$^{vap}$ | 1,200 | 2,400 |
| | | | | | | |

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## LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds

| Contaminant | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
|---|---|---|---|---|---|---|
| ***Pesticides*** | | | | | | |
| **Beta - Endosulfan** | | | | | | |
| 1.0% SOM | 7.00 | 190(0.00007)[vap] | 1.10 | 6,300(0.00007)[vap] | 1,200 | 2,400 |
| 2.5% SOM | 17 | 320(0.0002)[vap] | 2.70 | 7,800(0.0002)[vap] | 1,200 | 2,400 |
| 6.0% SOM | 39 | 440(0.0004)[vap] | 6.40 | 8700 | 1,200 | 2,500 |
| | | | | | | |
| **Alpha - Hexachlorocyclohexanes** | | | | | | |
| 1.0% SOM | 0.23 | 6.90 | 0.035 | 170 | 24 | 47 |
| 2.5% SOM | 0.55 | 9.20 | 0.087 | 180 | 24 | 48 |
| 6.0% SOM | 1.20 | 11 | 0.210 | 180 | 24 | 48 |
| | | | | | | |
| **Beta - Hexachlorocyclohexanes** | | | | | | |
| 1.0% SOM | 0.085 | 3.70 | 0.013 | 65 | 8.10 | 15 |
| 2.5% SOM | 0.200 | 3.80 | 0.032 | 65 | 8.10 | 15 |
| 6.0% SOM | 0.460 | 3.80 | 0.077 | 65 | 8.10 | 16 |
| | | | | | | |
| **Gamma - Hexachlorocyclohexanes** | | | | | | |
| 1.0% SOM | 0.06 | 2.90 | 0.0092 | 67 | 8.2 | 14 |
| 2.5% SOM | 0.14 | 3.30 | 0.0230 | 69 | 8.2 | 15 |
| 6.0% SOM | 0.33 | 3.50 | 0.0540 | 70 | 8.2 | 15 |
| | | | | | | |
| ***Chlorobenzenes*** | | | | | | |
| **Chlorobenzene** | | | | | | |
| 1.0% SOM | 0.46 | 0.46 | 5.90 | 56 | 11,000 | 1,300(675)[sol] |
| 2.5% SOM | 1.00 | 1.00 | 14 | 130 | 13,000 | 2,000(1520)[sol] |
| 6.0% SOM | 2.40 | 2.40 | 32 | 290 | 14,000 | 2,900 |
| | | | | | | |
| **1,2-Dichlorobenzene** | | | | | | |
| 1.0% SOM | 23 | 24 | 94 | 2,000 (571) [sol] | 90,000 | 24,000(571)[sol] |
| 2.5% SOM | 55 | 57 | 230 | 4,800 (1370) [sol] | 95,000 | 36,000(1370)[sol] |
| 6.0% SOM | 130 | 130 | 540 | 11,000 (3240) [sol] | 98,000 | 51,000(3240)[sol] |
| | | | | | | |
| **1,3-Dichlorobenzene** | | | | | | |
| 1.0% SOM | 0.40 | 0.44 | 0.25 | 30 | 300 | 390 |
| 2.5% SOM | 1.00 | 1.10 | 0.60 | 73 | 300 | 440 |
| 6.0% SOM | 2.30 | 2.50 | 1.50 | 170 | 300 | 470 |
| | | | | | | |
| **1,4-Dichlorobenzene** | | | | | | |
| 1.0% SOM | 61 | 61 | 15 | 4,400 (224)[vap] | 17,000[g] | 36,000 (224)[vap] |
| 2.5% SOM | 150 | 150 | 37 | 10,000 (540)[vap] | 17,000[g] | 36,000 (540)[vap] |
| 6.0% SOM | 350 | 350 | 88[g] | 25,000 (1280)[vap] | 17,000[g] | 36,000 (1280)[vap] |
| | | | | | | |
| **1,2,3,-Trichlorobenzene** | | | | | | |
| 1.0% SOM | 1.50 | 1.50 | 4.70 | 102 | 1,800 | 770(134)[vap] |
| 2.5% SOM | 3.60 | 3.70 | 12 | 250 | 1,800 | 1,100(330)[vap] |
| 6.0% SOM | 8.60 | 8.80 | 28 | 590 | 1,800 | 1,600(789)[vap] |

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| LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | | | |
|---|---|---|---|---|---|---|
| **Contaminant** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| ***Chlorobenzenes*** | | | | | | |
| | | | | | | |
| **1,2,3,- Trichlorobenzene** | | | | | | |
| 1.0% SOM | 1.50 | 1.50 | 4.70 | 102 | 1,800 | 770(134)$^{vap}$ |
| 2.5% SOM | 3.60 | 3.70 | 12 | 250 | 1,800 | 1,100(330)$^{vap}$ |
| 6.0% SOM | 8.60 | 8.80 | 28 | 590 | 1,800 | 1,600(789)$^{vap}$ |
| | | | | | | |
| **1,2,4,- Trichlorobenzene** | | | | | | |
| 1.0% SOM | 2.60 | 2.60 | 55 | 220 | 15,000 | 1,700(318)$^{vap}$ |
| 2.5% SOM | 6.40 | 6.40 | 140 | 530 | 17,000 | 2,600(786)$^{vap}$ |
| 6.0% SOM | 15 | 15 | 320 | 1,300 | 19,000 | 4,000(1880)$^{vap}$ |
| | | | | | | |
| **1,3,5,- Trichlorobenzene** | | | | | | |
| 1.0% SOM | 0.33 | 0.33 | 4.70 | 23 | 1,700 | 380(36.7)$^{vap}$ |
| 2.5% SOM | 0.81 | 0.81 | 12 | 55 | 1,700 | 590(90.8)$^{vap}$ |
| 6.0% SOM | 1.90 | 1.90 | 140 | 130 | 1,800 | 860(217)$^{vap}$ |
| | | | | | | |
| **1,2,3,4,- Tetrachlorobenzene** | | | | | | |
| 1.0% SOM | 15 | 24 | 4.40 | 1,700(122)$^{vap}$ | 830 | 1,500(122)$^{vap}$ |
| 2.5% SOM | 36 | 56 | 11 | 3,080(304)$^{vap}$ | 830 | 1,600 |
| 6.0% SOM | 78 | 120 | 26 | 4,400(728)$^{vap}$ | 830 | 1,600 |
| | | | | | | |
| **1,2,3,5,- Tetrachlobenzene** | | | | | | |
| 1.0% SOM | 0.66 | 0.75 | 0.38 | 49(39.4)$^{vap}$ | 78 | 110(39)$^{vap}$ |
| 2.5% SOM | 1.60 | 1.90 | 0.90 | 120(98.1)$^{vap}$ | 79 | 120 |
| 6.0% SOM | 3.70 | 4.30 | 2.20 | 240(235)$^{vap}$ | 79 | 130 |
| | | | | | | |
| **1,2,4, 5,- Tetrachlobenzene** | | | | | | |
| 1.0% SOM | 0.33 | 0.73 | 0.06 | 42(19.7)$^{sol}$ | 13 | 25 |
| 2.5% SOM | 0.77 | 1.70 | 0.16 | 72(49.1)$^{sol}$ | 13 | 26 |
| 6.0% SOM | 1.60 | 3.50 | 0.37 | 96 | 13 | 26 |
| | | | | | | |
| **Pentachlrobenzene** | | | | | | |
| 1.0% SOM | 5.80 | 19 | 1.20 | 640(43.0)$^{sol}$ | 100 | 190 |
| 2.5% SOM | 12 | 30 | 3.10 | 770(107)$^{sol}$ | 100 | 190 |
| 6.0% SOM | 22 | 38 | 7.00 | 830 | 100 | 190 |
| | | | | | | |
| **Hexachlorobenzene** | | | | | | |
| 1.0% SOM | 1.80(0.20)$^{vap}$ | 4.10 (0.20)$^{vap}$ | 0.47 | 110(0.20)$^{vap}$ | 16 | 30 |
| 2.5% SOM | 3.30(0.50)$^{vap}$ | 5.70 (0.50)$^{vap}$ | 1.10 | 120 | 16 | 30 |
| 6.0% SOM | 4.90 | 6.70 (1.2)$^{vap}$ | 2.50 | 120 | 16 | 30 |
| | | | | | | |

**Cont'd Overleaf:**

| LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | | | |
|---|---|---|---|---|---|---|
| **Contaminant** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| ***Phenols & Chlorophenols*** | | | | | | |
| | | | | | | |
| ***Phenols*** | | | | | | |
| 1.0% SOM | 280 | 750 | 66 | 760$^{dir}$(31,000) | 760$^{dir}$(11,000) | 760$^{dir}$(8,600) |
| 2.5% SOM | 550 | 1,300 | 140 | 1,500$^{dir}$(35,000) | 1,500$^{dir}$(11,000) | 1,500$^{dir}$(9,700) |
| 6.0% SOM | 1100 | 2,300 | 280 | 3,200$^{dir}$(37,000) | 3,200$^{dir}$(11,000) | 3,200$^{dir}$(11,000) |
| | | | | | | |
| **Chlorophenols (4 Congeners)** | | | | | | |
| 1.0% SOM | 0.87 | 94 | 0.13 | 3,500 | 620 | 1,100 |
| 2.5% SOM | 2.00 | 150 | 0.30 | 4,000 | 620 | 1,100 |
| 6.0% SOM | 4.50 | 210 | 0.70 | 4,300 | 620 | 1,100 |
| | | | | | | |
| **Pentachlorophenols** | | | | | | |
| 1.0% SOM | 0.22 | 27(16.4)$^{vap}$ | 0.03 | 400 | 60 | 110 |
| 2.5% SOM | 0.52 | 29 | 0.08 | 400 | 60 | 120 |
| 6.0% SOM | 1.20 | 31 | 0.19 | 400 | 60 | 120 |
| | | | | | | |
| ***Others*** | | | | | | |
| | | | | | | |
| **Carbon Disulphide** | | | | | | |
| 1.0% SOM | 0.14 | 0.14 | 4.80 | 11 | 11,000 | 1,300 |
| 2.5% SOM | 0.29 | 0.29 | 10 | 22 | 11,000 | 1,900 |
| 6.0% SOM | 0.62 | 0.62 | 23 | 47 | 12,000 | 2,700 |
| | | | | | | |
| **Hexachloro-1,3-Butadiene** | | | | | | |
| 1.0% SOM | 0.29 | 0.32 | 0.25 | 31 | 25 | 48 |
| 2.5% SOM | 0.70 | 0.78 | 0.61 | 68 | 25 | 50 |
| 6.0% SOM | 1.60 | 1.80 | 1.40 | 120 | 25 | 51 |
| | | | | | | |

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| CL:AIRE Soil Generic Assessment Criteria | | | | |
|---|---|---|---|---|
| **Contaminant** | **Residential (mg/kg)** | **Residential without plant uptake (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| ***Metals:*** | | | | |
| | | | | |
| **Antimony** | ND | 550 | ND | 7500 |
| **Barium** | ND | 1300 | ND | 22000 |
| **Molybdenum** | ND | 670 | ND | 17000 |
| | | | | |

ND – Not Derived.
NA – Not Applicable

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| CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | |
|---|---|---|---|---|
| **Contaminant** | **Residential (mg/kg)** | **Residential without plant uptake (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| | | | | |
| **1,1,2 Trichloroethane** | | | | |
| 1.0% SOM | 0.60 | 0.88 | 0.28 | 94 |
| 2.5% SOM | 1.20 | 1.8 | 0.61 | 190 |
| 6.0% SOM | 2.70 | 3.9 | 1.40 | 400 |
| | | | | |
| **1,1-Dichloroethane** | | | | |
| 1.0% SOM | 2.40 | 2.50 | 9.20 | 280 |
| 2.5% SOM | 3.90 | 4.10 | 17 | 450 |
| 6.0% SOM | 7.40 | 7.70 | 35 | 850 |
| | | | | |
| **1,1-Dichloroethene** | | | | |
| 1.0% SOM | 0.23 | 0.23 | 2.80 | 26 |
| 2.5% SOM | 0.40 | 0.41 | 5.60 | 46 |
| 6.0% SOM | 0.82 | 0.82 | 12 | 92 |
| | | | | |
| **1,2,4-Trimethylbenzene** | | | | |
| 1.0% SOM | 0.35 | 0.41 | 0.38 | 42 |
| 2.5% SOM | 0.85 | 0.99 | 0.93 | 99 |
| 6.0% SOM | 2.00 | 2.30 | 2.20 | 220 |
| | | | | |
| **1,2-Dichloropropane** | | | | |
| 1.0% SOM | 0.024 | 0.024 | 0.62 | 3.3 |
| 2.5% SOM | 0.042 | 0.042 | 1.20 | 5.9 |
| 6.0% SOM | 0.084 | 0.085 | 2.60 | 12 |
| | | | | |
| **2,4-Dimethylphenol** | | | | |
| 1.0% SOM | 19 | 210 | 3.10 | 16000* |
| 2.5% SOM | 43 | 410 | 7.20 | 24000* |
| 6.0% SOM | 97 | 730 | 17 | 30000* |
| | | | | |
| **2,4-Dinitrotoluene** | | | | |
| 1.0% SOM | 1.50 | 170* | 0.22 | 3700* |
| 2.5% SOM | 3.20 | 170 | 0.49 | 3700* |
| 6.0% SOM | 7.20 | 170 | 1.10 | 3800* |
| | | | | |
| **2,6-Dinitrotoluene** | | | | |
| 1.0% SOM | 0.78 | 78 | 0.12 | 1900* |
| 2.5% SOM | 1.70 | 84 | 0.27 | 1900* |
| 6.0% SOM | 3.90 | 87 | 0.61 | 1900* |
| | | | | |
| **2-Chloronapthalene** | | | | |
| 1.0% SOM | 3.70 | 3.80 | 40 | 390* |
| 2.5% SOM | 9.20 | 9.30 | 98 | 960* |
| 6.0% SOM | 22 | 22 | 230 | 2200* |

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| CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | |
|---|---|---|---|---|
| **Contaminant** | **Residential (mg/kg)** | **Residential without plant uptake (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| | | | | |
| **Biphenyl** | | | | |
| 1.0% SOM | 66* | 220* | 14 | 18000* |
| 2.5% SOM | 160 | 500* | 35 | 33000* |
| 6.0% SOM | 360 | 980* | 83 | 48000* |
| | | | | |
| **Bis (2-ethylhexyl) phthalate** | | | | |
| 1.0% SOM | 280* | 2700* | 47* | 85000* |
| 2.5% SOM | 610* | 2800* | 120* | 86000* |
| 6.0% SOM | 1100* | 2800* | 280* | 86000* |
| | | | | |
| **Bromobenzene** | | | | |
| 1.0% SOM | 0.87 | 0.91 | 3.2 | 97 |
| 2.5% SOM | 2.0 | 2.1 | 7.6 | 220 |
| 6.0% SOM | 4.7 | 4.9 | 18 | 520 |
| | | | | |
| **Bromodichloromethane** | | | | |
| 1.0% SOM | 0.016 | 0.019 | 0.016 | 2.1 |
| 2.5% SOM | 0.030 | 0.034 | 0.032 | 3.7 |
| 6.0% SOM | 0.061 | 0.070 | 0.068 | 7.6 |
| | | | | |
| **Bromoform** | | | | |
| 1.0% SOM | 2.8 | 5.2 | 0.95 | 760 |
| 2.5% SOM | 5.9 | 11 | 2.1 | 1500 |
| 6.0% SOM | 13 | 23 | 4.6 | 3100 |
| | | | | |
| **Butyl benzyl phthalate** | | | | |
| 1.0% SOM | 1400* | 42000* | 220* | 940000* |
| 2.5% SOM | 3300* | 44000* | 550* | 940000* |
| 6.0% SOM | 7200* | 44000* | 1300* | 950000* |
| | | | | |
| **Chloroethane** | | | | |
| 1.0% SOM | 8.3 | 8.4 | 110 | 960 |
| 2.5% SOM | 11 | 11 | 200 | 1300 |
| 6.0% SOM | 18 | 18 | 380 | 2100 |
| | | | | |
| **Chloromethane** | | | | |
| 1.0% SOM | 0.0083 | 0.0085 | 0.066 | 1.0 |
| 2.5% SOM | 0.0098 | 0.0099 | 0.13 | 1.2 |
| 6.0% SOM | 0.013 | 0.013 | 0.23 | 1.6 |
| | | | | |
| ***Cis* 1,2 Dichloroethene** | | | | |
| 1.0% SOM | 0.11 | 0.12 | 0.26 | 14 |
| 2.5% SOM | 0.19 | 0.20 | 0.50 | 24 |
| 6.0% SOM | 0.37 | 0.39 | 1.0 | 47 |

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| CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | |
|---|---|---|---|---|
| **Contaminant** | **Residential (mg/kg)** | **Residential without plant uptake (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| | | | | |
| **Dichloromethane** | | | | |
| 1.0% SOM | 0.58 | 2.10 | 0.10 | 270 |
| 2.5% SOM | 0.98 | 2.80 | 0.19 | 360 |
| 6.0% SOM | 1.70 | 4.50 | 0.34 | 560 |
| | | | | |
| **Diethyl Phthalate** | | | | |
| 1.0% SOM | 120* | 1800* | 19* | 150000* |
| 2.5% SOM | 260* | 3500* | 41* | 220000* |
| 6.0% SOM | 570* | 6300* | 94* | 290000* |
| | | | | |
| **Di-*n*-butyl phthalate** | | | | |
| 1.0% SOM | 13* | 450* | 2.00 | 15000* |
| 2.5% SOM | 31* | 450* | 5.00 | 15000* |
| 6.0% SOM | 67* | 450* | 12 | 15000* |
| | | | | |
| **Di-*n*-octyl phthalate** | | | | |
| 1.0% SOM | 2300* | 3400* | 940* | 89000* |
| 2.5% SOM | 2800* | 3400* | 2100* | 89000* |
| 6.0% SOM | 3100* | 3400* | 3900* | 89000* |
| | | | | |
| **Hexachloroethane** | | | | |
| 1.0% SOM | 0.20 | 0.22 | 0.27 | 22* |
| 2.5% SOM | 0.48 | 0.54 | 0.67 | 53* |
| 6.0% SOM | 1.10 | 1.30 | 1.60 | 120* |
| | | | | |
| **Isopropylbenzene** | | | | |
| 1.0% SOM | 11 | 12 | 32 | 1400* |
| 2.5% SOM | 27 | 28 | 79 | 3300* |
| 6.0% SOM | 64 | 67 | 190 | 7700* |
| | | | | |
| **Methyl *tert*-butyl ether** | | | | |
| 1.0% SOM | 49 | 73 | 23 | 7900 |
| 2.5% SOM | 84 | 120 | 44 | 13000 |
| 6.0% SOM | 160 | 220 | 90 | 24000 |
| | | | | |
| **Propylbenzene** | | | | |
| 1.0% SOM | 34 | 40 | 34 | 4100* |
| 2.5% SOM | 82 | 97 | 83 | 9700* |
| 6.0% SOM | 190 | 230 | 200 | 21000* |
| | | | | |
| **Styrene** | | | | |
| 1.0% SOM | 8.10 | 35 | 1.60 | 3300* |
| 2.5% SOM | 19 | 78 | 3.70 | 6500* |
| 6.0% SOM | 43 | 170 | 8.70 | 11000* |

**Cont'd Overleaf:**

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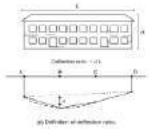
| CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | |
|---|---|---|---|---|
| **Contaminant** | **Residential (mg/kg)** | **Residential without plant uptake (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| | | | | |
| **Total Cresols (2-, 3-, and 4-methylphenol)** | | | | |
| 1.0% SOM | 80 | 3700 | 12 | 160000 |
| 2.5% SOM | 180 | 5400 | 27 | 180000* |
| 6.0% SOM | 400 | 6900 | 63 | 180000* |
| | | | | |
| ***Trans* 1,2 Dichloroethene** | | | | |
| 1.0% SOM | 0.19 | 0.19 | 0.93 | 22 |
| 2.5% SOM | 0.34 | 0.35 | 1.90 | 40 |
| 6.0% SOM | 0.70 | 0.71 | 0.24 | 81 |
| | | | | |
| **Tributyl tin oxide** | | | | |
| 1.0% SOM | 0.25 | 1.40 | 0.042 | 130* |
| 2.5% SOM | 0.59 | 3.10 | 0.100 | 180* |
| 6.0% SOM | 1.30 | 5.70 | 0.240 | 200* |
| | | | | |

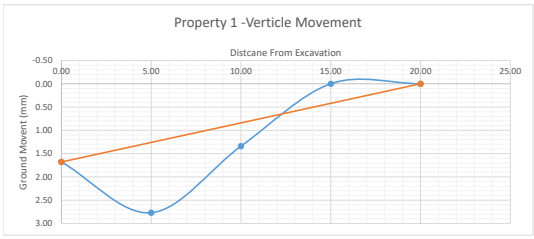
Notes: *Soil concentration above soil saturation limit

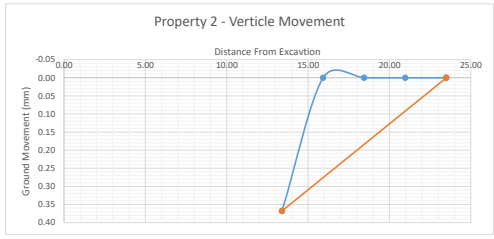
**APPENDIX G**
**Ground Movement Assessment Calculations**

***Potential Damage to Building***

**Excavation Depth: 3.00m bgl**






**Neighbouring Property 1** No. 18 Rosecroft Avenue

| | m | mm |
|---|---|---|
| **L** | 16.80 | 16800 |
| **H** | 12.00 | 12000 |
| **L/H** | 1.40 | |

| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 1.5 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.008929 | % | |
| Horizontal Movement (δh) | 6.30 | mm | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Ɛh) = δh/L | 0.03750 | % | |

**Neighbouring Property 2** No. 12 Rosecroft Avenue

| | m | mm |
|---|---|---|
| **L** | 10.10 | 10100 |
| **H** | 12.00 | 12000 |
| **L/H** | 0.84 | |

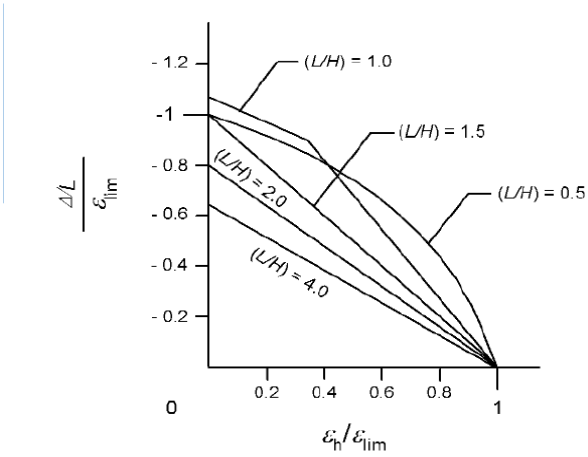
| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 2.75 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.027228 | % | |
| Horizontal Movement (δh) | 1.28 | | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Ɛh) = δh/L | 0.01262 | % | |

**CATEGORY OF DAMAGE** Damage category limits are given in Table 2.5 (below) you will also need Fig 2.18 (also shown below).

| | | |
|---|---|---|
| **L/H** | 1.40 | |
| **Negligible damage limit (Ɛlim)** | **0.05** | |
| (Δ/L)/(Ɛlim) | 0.178571429 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Ɛh)/(Ɛlim) | 0.75 | |
| **Very Slight damage limit (Ɛlim)** | **0.075** | |
| (Δ/L)/(Ɛlim) | 0.119047619 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Ɛh)/(Ɛlim) | 0.5 | |
| **Slight damage limit (Ɛlim)** | **0.15** | |
| (Δ/L)/(Ɛlim) | 0.05952381 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Ɛh)/(Ɛlim) | 0.25 | |
| **Moderate damage limit (Ɛlim)** | **0.3** | |
| (Δ/L)/(Ɛlim) | 0.029761905 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Ɛh)/(Ɛlim) | 0.125 | |
| **Calculated Category of Damage** | Negligible | |

| | | |
|---|---|---|
| **L/H** | 0.84 | |
| **Negligible damage limit (Ɛlim)** | **0.05** | |
| (Δ/L)/(Ɛlim) | 0.544554455 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Ɛh)/(Ɛlim) | 0.252475248 | |
| **Very Slight damage limit (Ɛlim)** | **0.075** | |
| (Δ/L)/(Ɛlim) | 0.363036304 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Ɛh)/(Ɛlim) | 0.168316832 | |
| **Slight damage limit (Ɛlim)** | **0.15** | |
| (Δ/L)/(Ɛlim) | 0.181518152 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Ɛh)/(Ɛlim) | 0.084158416 | |
| **Moderate damage limit (Ɛlim)** | **0.3** | |
| (Δ/L)/(Ɛlim) | 0.090759076 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Ɛh)/(Ɛlim) | 0.042079208 | |
| **Calculated Category of Damage** | Negligible | |

**Fig 2.18 (b)**



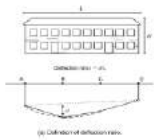

(b) Influence of horizontal strain on $\Delta/L$ / $\varepsilon_{lim}$ (after Burland, 2001)

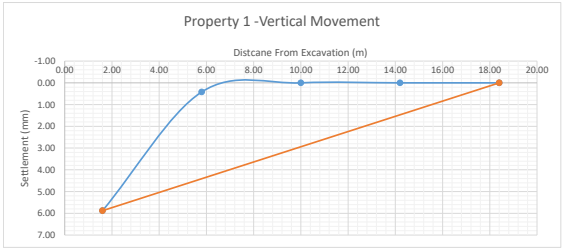
**Table 2.5**

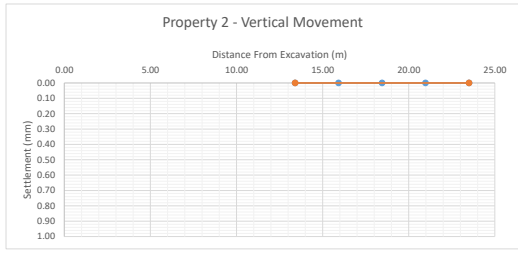
Table 2.5 *Classification of visible damage to walls (after Burland et al., 1977, Boscardin and Cording, 1989, and Burland, 2001)*

| Category of damage | Description of typical damage (ease of repair is underlined) | Approximate crack width (mm) | Limiting tensile strain $\varepsilon_{lim}$ (per cent) |
|---|---|---|---|
| 0 Negligible | Hairline cracks of less than about 0.1 mm are classed as negligible. | < 0.1 | 0.0–0.05 |
| 1 Very slight | Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection. | < 1 | 0.05–0.075 |
| 2 Slight | Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly. | < 5 | 0.075–0.15 |
| 3 Moderate | The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired. | 5–15 or a number of cracks > 3 | 0.15–0.3 |
| 4 Severe | Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor slopes noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted. | 15–25 but also depends on number of cracks | > 0.3 |
| 5 Very severe | This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability. | usually > 25 but depends on number of cracks. | |

***Potential Damage to Building***






**Neighbouring Property 1** No. 18 Rosecroft Avenue

| | m | mm |
|---|---|---|
| **L** | 16.80 | 16800 |
| **H** | 12.00 | 12000 |
| **L/H** | 1.40 | |

Vertical Deflection (Δ) 3.1 mm — from graph (max difference between blue and orange line)

Defelction Ratio (Δ/L) 0.018452 %

**Neighbouring Property 2** No. 12 Rosecroft Avenue

| | m | mm |
|---|---|---|
| **L** | 10.10 | 10100 |
| **H** | 12.00 | 12000 |
| **L/H** | 0.84 | |

Vertical Deflection (Δ) 0 mm — from graph (max difference between blue and orange line)

Defelction Ratio (Δ/L) 0.000000 %

**CATEGORY OF DAMAGE** Damage category limits are given in Table 2.5 (below).

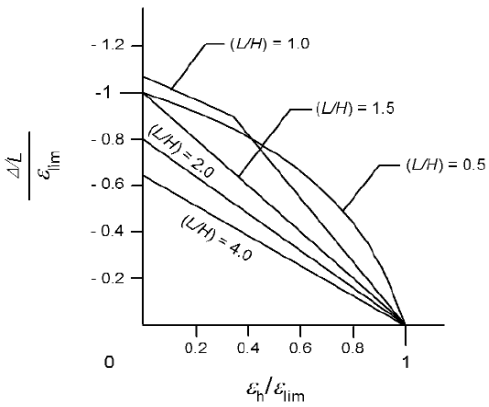
**Method 1 - Prefferred method**
- Open up 'Damage Category Relationship Plots GMA' spreadsheet
- Find relevant L/H graph (different graph on each each tab along the bottom of the spreadsheet)
- Input calculated values for deflection ratio and horizontal strain
- Point will plot on graph and show category of dameg

**Method 2 - can be used to confirm category or is useful if L/H for property is between the given L/H graphs**
- Plot points calculated below on figure 2.18 for each damage category
- Appropriate damage category will plot below L/H for property

| | | |
|---|---|---|
| **L/H** | 1.40 | |
| **Negligible damage limit (Elim)** | **0.05** | |
| (Δ/L)/(Elim) | 0.369047619 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | #REF! | |
| **Very Slight damage limit (Elim)** | **0.075** | |
| (Δ/L)/(Elim) | 0.246031746 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | #REF! | |
| **Slight damage limit (Elim)** | **0.15** | |
| (Δ/L)/(Elim) | 0.123015873 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | #REF! | |
| **Moderate damage limit (Elim)** | **0.3** | |
| (Δ/L)/(Elim) | 0.061507937 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | #REF! | |
| **Calculated Category of Damage** | Negligible | |

| | | |
|---|---|---|
| **L/H** | 0.84 | |
| **Negligible damage limit (Elim)** | **0.05** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | #REF! | |
| **Very Slight damage limit (Elim)** | **0.075** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | #REF! | |
| **Slight damage limit (Elim)** | **0.15** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | #REF! | |
| **Moderate damage limit (Elim)** | **0.3** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | #REF! | |
| **Calculated Category of Damage** | Negligible | |

**Fig 2.18 (b)**




(b) Influence of horizontal strain on $\Delta/L$ / $\varepsilon_{lim}$ (after Burland, 2001)

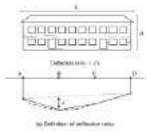
**Table 2.5**

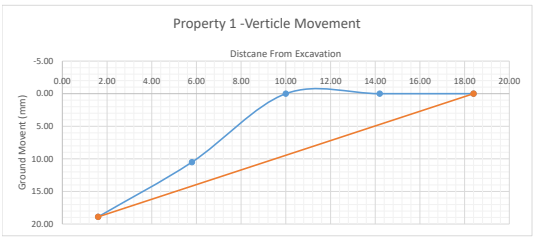
Table 2.5 *Classification of visible damage to walls (after Burland et al. 1977, Boscardin and Cording, 1989, and Burland, 2001)*

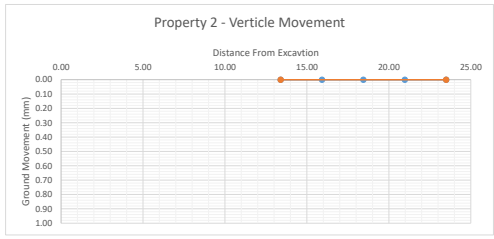
| Category of damage | Description of typical damage (ease of repair is underlined) | Approximate crack width (mm) | Limiting tensile strain $\varepsilon_{lim}$ (per cent) |
|---|---|---|---|
| 0 Negligible | Hairline cracks of less than about 0.1 mm are classed as negligible | < 0.1 | 0.0–0.05 |
| 1 Very slight | Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection. | < 1 | 0.05–0.075 |
| 2 Slight | Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly. | < 5 | 0.075–0.15 |
| 3 Moderate | The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired. | 5–15 or a number of cracks > 3 | 0.15–0.3 |
| 4 Severe | Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted. | 15–25 but also depends on number of cracks | > 0.3 |
| 5 Very severe | This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability | usually > 25 but depends on number of cracks. | |

***Potential Damage to Building***

**Soft to firm clays - Conservative**






**Neighbouring Property 1** No. 18

| | m | mm |
|---|---|---|
| **L** | 16.80 | 16800 |
| **H** | 12.00 | 12000 |
| **L/H** | 1.40 | |

| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 9 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.053571 | % | |
| Horizontal Movement (δh) | 6.30 | mm | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Єh) = δh/L | 0.03750 | % | |

**Neighbouring Property 2** No. 12

| | m | mm |
|---|---|---|
| **L** | 10.10 | 10100 |
| **H** | 12.00 | 12000 |
| **L/H** | 0.84 | |

| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 0 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.000000 | % | |
| Horizontal Movement (δh) | 3.79 | | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Єh) = δh/L | 0.03750 | % | |

**CATEGORY OF DAMAGE** Damage category limits are given in Table 2.5 (below) you will also need Fig 2.18 (also shown below).

**L/H** 1.40

**Negligible damage limit (Elim)** **0.05**

| | | |
|---|---|---|
| (Δ/L)/(Elim) | 1.071428571 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | 0.75 | |

**Very Slight damage limit (Elim)** **0.075**

| | | |
|---|---|---|
| (Δ/L)/(Elim) | 0.714285714 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.5 | |

**Slight damage limit (Elim)** **0.15**

| | | |
|---|---|---|
| (Δ/L)/(Elim) | 0.357142857 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.25 | |

**Moderate damage limit (Elim)** **0.3**

| | | |
|---|---|---|
| (Δ/L)/(Elim) | 0.178571429 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | 0.125 | |

**Calculated Category of Damage** Slight

**L/H** 0.84

**Negligible damage limit (Elim)** **0.05**

| | | |
|---|---|---|
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | 0.75 | |

**Very Slight damage limit (Elim)** **0.075**

| | | |
|---|---|---|
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.5 | |

**Slight damage limit (Elim)** **0.15**

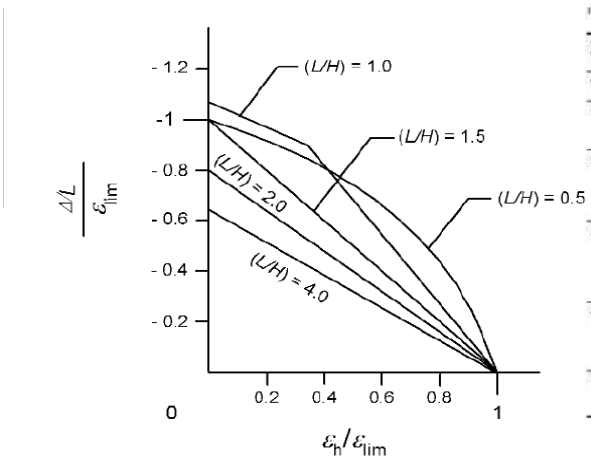
| | | |
|---|---|---|
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.25 | |

**Moderate damage limit (Elim)** **0.3**

| | | |
|---|---|---|
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | 0.125 | |

**Calculated Category of Damage** Negligible

**Fig 2.18 (b)**




(b) Influence of horizontal strain on $\Delta/L$ / $\varepsilon_{lim}$ (after Burland, 2001)

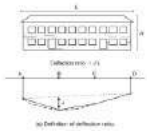
**Table 2.5**

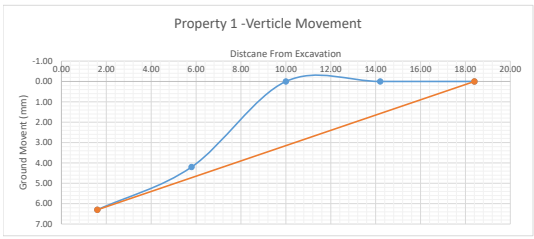
Table 2.5 Classification of visible damage to walls (after Burland et al., 1977, Boscardin and Cording, 1989, and Burland, 2001)

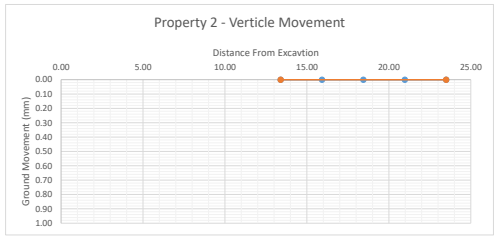
| Category of damage | Description of typical damage (ease of repair is underlined) | Approximate crack width (mm) | Limiting tensile strain $\varepsilon_{lim}$ (per cent) |
|---|---|---|---|
| 0 Negligible | Hairline cracks of less than about 0.1 mm are classed as negligible. | < 0.1 | 0.0–0.05 |
| 1 Very slight | Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection. | < 1 | 0.05–0.075 |
| 2 Slight | Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly. | < 5 | 0.075–0.15 |
| 3 Moderate | The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired. | 5–15 or a number of cracks > 3 | 0.15–0.3 |
| 4 Severe | Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor slopes noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted. | 15–25 but also depends on number of cracks | > 0.3 |
| 5 Very severe | This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability. | usually > 25 but depends on number of cracks | |

***Potential Damage to Building***

**Soft to firm clays - Conservative**






**Neighbouring Property 1** No. 18

| | m | mm |
|---|---|---|
| **L** | 16.80 | 16800 |
| **H** | 12.00 | 12000 |
| **L/H** | 1.40 | |

| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 3.2 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.019048 | % | |
| Horizontal Movement (δh) | 6.30 | mm | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Єh) = δh/L | 0.03750 | % | |

**Neighbouring Property 2** No. 12

| | m | mm |
|---|---|---|
| **L** | 10.10 | 10100 |
| **H** | 12.00 | 12000 |
| **L/H** | 0.84 | |

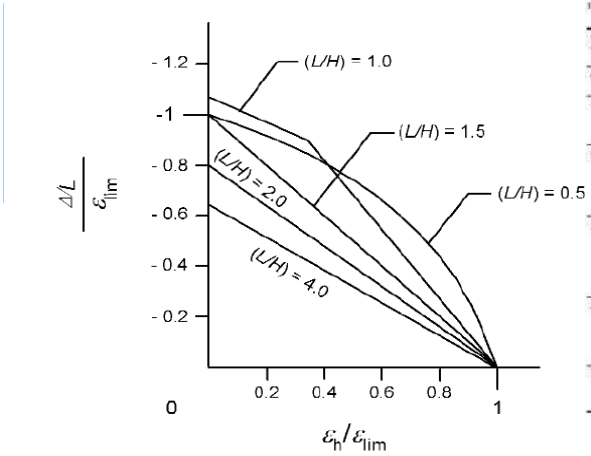
| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 0 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.000000 | % | |
| Horizontal Movement (δh) | 0.00 | | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Єh) = δh/L | 0.00000 | % | |

**CATEGORY OF DAMAGE** Damage category limits are given in Table 2.5 (below) you will also need Fig 2.18 (also shown below).

| | | |
|---|---|---|
| **L/H** | 1.40 | |
| **Negligible damage limit (Elim)** | **0.05** | |
| (Δ/L)/(Elim) | 0.380952381 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | 0.75 | |
| **Very Slight damage limit (Elim)** | **0.075** | |
| (Δ/L)/(Elim) | 0.253968254 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.5 | |
| **Slight damage limit (Elim)** | **0.15** | |
| (Δ/L)/(Elim) | 0.126984127 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.25 | |
| **Moderate damage limit (Elim)** | **0.3** | |
| (Δ/L)/(Elim) | 0.063492063 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | 0.125 | |
| **Calculated Category of Damage** | Negligible | |

| | | |
|---|---|---|
| **L/H** | 0.84 | |
| **Negligible damage limit (Elim)** | **0.05** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | 0 | |
| **Very Slight damage limit (Elim)** | **0.075** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | 0 | |
| **Slight damage limit (Elim)** | **0.15** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | 0 | |
| **Moderate damage limit (Elim)** | **0.3** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | 0 | |
| **Calculated Category of Damage** | Negligible | |

**Fig 2.18 (b)**




(b) Influence of horizontal strain on $\Delta/L$ / $\varepsilon_{lim}$ (after Burland, 2001)

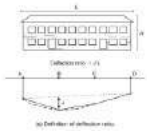
**Table 2.5**

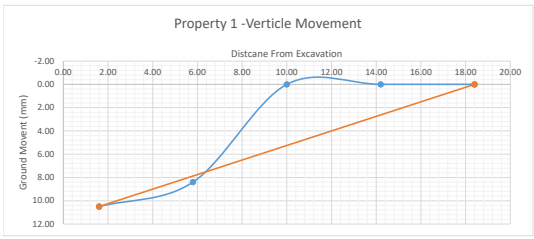
Table 2.5 Classification of visible damage to walls (after Burland et al., 1977, Boscardin and Cording, 1989, and Burland, 2001)

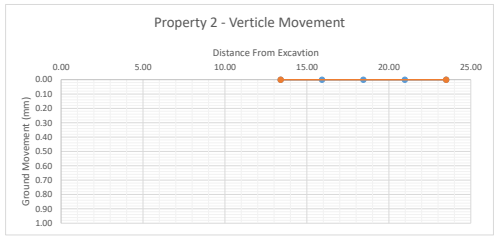
| Category of damage | Description of typical damage (ease of repair is underlined) | Approximate crack width (mm) | Limiting tensile strain $\varepsilon_{lim}$ (per cent) |
|---|---|---|---|
| 0 Negligible | Hairline cracks of less than about 0.1 mm are classed as negligible. | < 0.1 | 0.0–0.05 |
| 1 Very slight | Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection. | < 1 | 0.05–0.075 |
| 2 Slight | Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly. | < 5 | 0.075–0.15 |
| 3 Moderate | The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired. | 5–15 or a number of cracks > 3 | 0.15–0.3 |
| 4 Severe | Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor slopes noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted. | 15–25 but also depends on number of cracks | > 0.3 |
| 5 Very severe | This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability. | usually > 25 but depends on number of cracks | |

***Potential Damage to Building***

**Soft to firm clays - Conservative**






**Neighbouring Property 1** No. 18

| | m | mm |
|---|---|---|
| **L** | 16.80 | 16800 |
| **H** | 12.00 | 12000 |
| **L/H** | 1.40 | |

| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 5.2 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.030952 | % | |
| Horizontal Movement (δh) | 6.30 | mm | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Ɛh) = δh/L | 0.03750 | % | |

**Neighbouring Property 2** No. 12

| | m | mm |
|---|---|---|
| **L** | 10.10 | 10100 |
| **H** | 12.00 | 12000 |
| **L/H** | 0.84 | |

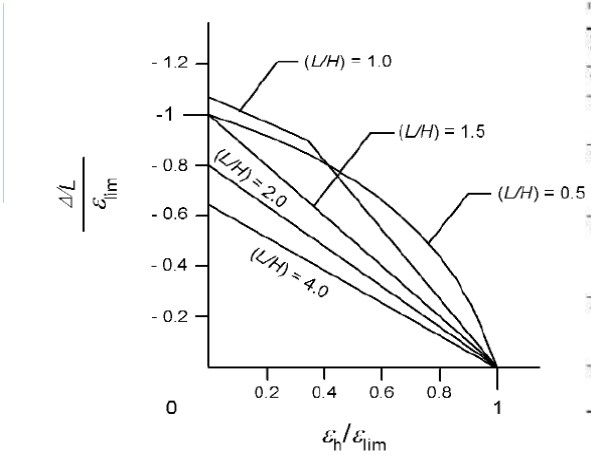
| | | | |
|---|---|---|---|
| Verticle Deflection (Δ) | 0 | mm | from graph (max difference between blue and orange line) |
| Defelction Ratio (Δ/L) | 0.000000 | % | |
| Horizontal Movement (δh) | 2.00<br>2.81 | | difference between horizontal movement at nearest and farthest walls |
| Horzontal Strain (Ɛh) = δh/L | 0.01980 | % | |

**CATEGORY OF DAMAGE** Damage category limits are given in Table 2.5 (below) you will also need Fig 2.18 (also shown below).

| | | |
|---|---|---|
| **L/H** | 1.40 | |
| **Negligible damage limit (Elim)** | **0.05** | |
| (Δ/L)/(Elim) | 0.619047619 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | 0.75 | |
| **Very Slight damage limit (Elim)** | **0.075** | |
| (Δ/L)/(Elim) | 0.412698413 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.5 | |
| **Slight damage limit (Elim)** | **0.15** | |
| (Δ/L)/(Elim) | 0.206349206 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.25 | |
| **Moderate damage limit (Elim)** | **0.3** | |
| (Δ/L)/(Elim) | 0.103174603 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | 0.125 | |
| **Calculated Category of Damage** | Very Slight | |

| | | |
|---|---|---|
| **L/H** | 0.84 | |
| **Negligible damage limit (Elim)** | **0.05** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'negligible' category - no need to plot points below |
| (Eh)/(Elim) | 0.396039604 | |
| **Very Slight damage limit (Elim)** | **0.075** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'very slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.264026403 | |
| **Slight damage limit (Elim)** | **0.15** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'slight' category - no need to plot points below |
| (Eh)/(Elim) | 0.132013201 | |
| **Moderate damage limit (Elim)** | **0.3** | |
| (Δ/L)/(Elim) | 0 | Plot this point on fig2.18 (b) if the plotted point is below the appropriate L/H line then damage falls into 'moderate' category - if the point is not below, damage is 'severe' |
| (Eh)/(Elim) | 0.066006601 | |
| **Calculated Category of Damage** | Negligible | |

**Fig 2.18 (b)**




(b) Influence of horizontal strain on $\Delta/L$ / $\varepsilon_{lim}$ (after Burland, 2001)

**Table 2.5**

Table 2.5 Classification of visible damage to walls (after Burland et al., 1977, Boscardin and Cording, 1989, and Burland, 2001)

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| 4 Severe | Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor slopes noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted. | 15–25 but also depends on number of cracks | > 0.3 |
| 5 Very severe | This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability. | usually > 25 but depends on number of cracks | |