

- Notes:**
1. ALL CONTOURS SHOWN ARE IN MM
 2. ANALYSIS HAS BEEN BASED ON THE SERVICE INFORMATION AVAILABLE AT THE TIME OF DESIGN
 3. MODELLING ONLY TAKES ACCOUNT OF THE IMPACT OF THE NORTHERN LINE EXTENSION AND ASSOCIATED INFRASTRUCTURE E.G. STATION BOXES.
 4. TUNNEL ALIGNMENT IS BASED ON DRAWING GRNLEB-HGL-00-XX-M2-PWY-00010-02-01.
 5. CROSS PASSAGE LOCATION IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-0002-03-01.
 6. SUBSTATION AT KENNINGTON PARK IS BASED ON DRAWING GRNLEB-BHD-ST-XX-DR-STR-13120-01-01. ADT BETWEEN SHAFT AND HEADHOUSE AT KENNINGTON GREEN IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-2300-03-01.
 7. SETTLEMENT DUE TO RUNNING TUNNELS IS BASED ON A 1.5% VOLUME LOSS. SEE SETTLEMENT REPORT FOR FULL DETAILS ON OTHER TUNNEL TYPES.
 8. SETTLEMENT DUE TO STATION EXCAVATIONS ARE BASED ON CURVES FROM CIRIA C580 FIGURE 2.9 (B) EXCEPT THE ADIT AT KENNINGTON GREEN WHICH IS BASED ON CIRIA C580 FIGURE 2.12. THE GROUND MOVEMENT CURVES ARE CONSIDERED TO REPRESENT 100% GROUND MOVEMENT PROFILE. HOWEVER THE STATION EXCAVATIONS WILL HAVE AN INCREASED STIFFNESS AT THE CORNERS, THEREFORE THE SETTLEMENT CONTOURS AROUND THE EXCAVATIONS ARE A CONSERVATIVE ESTIMATE.
 9. SETTLEMENT DUE TO EXCAVATIONS OF SHAFTS IS BASED ON THE LONDON UNDERGROUND MANUAL OF GOOD PRACTICE USING G-058 NEW AND BOWERS (1994). THE MAP IS BASED ON ORDNANCE SURVEY © ON BEHALF OF THE CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE, © CROWN COPYRIGHT 1988. ALL RIGHTS RESERVED. LICENSE NUMBER: AL 10005517. THE ORDNANCE SURVEY DATA USED WAS THAT AVAILABLE AT THE TIME OF 2012 REFERENCE DESIGN, AND THUS ANY RECENT CHANGES WILL NOT BE REFLECTED IN THE MAPS USED FOR ANALYSIS.
 10. ALL SHALLOW UTILITIES EXCEEDING 10MM OF SETTLEMENT OR EXCEEDING LIMITS OF STRAIN, JOINT PULL-OUT OR JOINT ROTATION REQUIRE FURTHER INVESTIGATION AND ANALYSIS. (SEE SETTLEMENT REPORT GRNLEB-BHD-00-XX-TNT-GEO-00048).

- SETTLEMENT CONTOUR 10mm
 - WATER UTILITIES NOT AFFECTED
 - WATER UTILITIES AFFECTED
 - WATER UTILITIES CRITICAL
- (18) CROSS REFERENCE TO THE SETTLEMENT REPORT GRNLEB-BHD-00-XX-TNT-GEO-00049

Rev	By	Chkd	Appvd	Date	Description
04-01	JMB	JD	SL	13/03/13	NOTES AMENDED
03-01	JMB	JD	SL	19/02/13	NOTES AMENDED
02-01	JMB	JD	SL	06/02/13	INCLUSION OF ADITS & SUBSTATION
01-01	JMB	JD	SL	18/01/13	FIRST DRAWN

Client

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TEL: 020 3479 8000
FAX: 020 3479 8001
www.halcrow.com

Project: **NORTHERN LINE EXTENSION TO BATTERSEA TWAO FOR TfL**

Drawing: **UTILITY DAMAGE ASSESSMENT WATER - SHEET 1 OF 5**

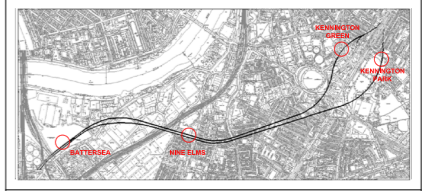
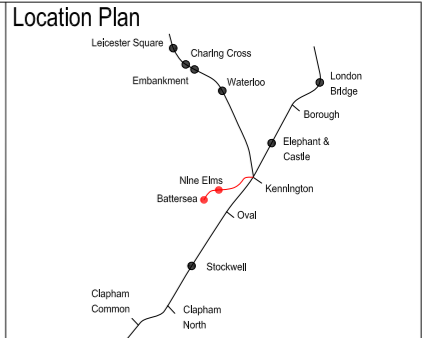
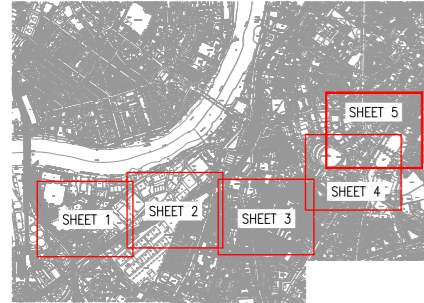
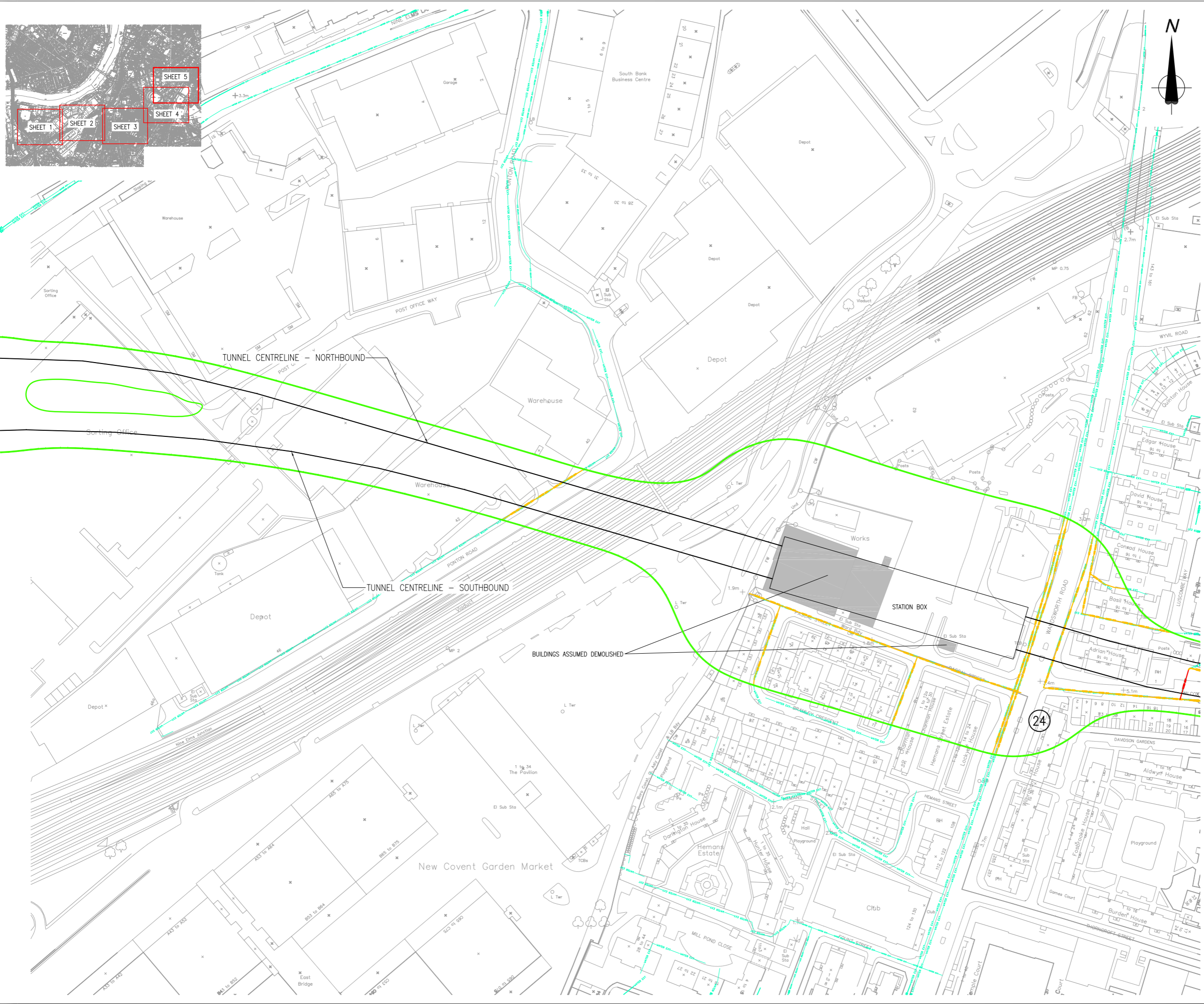
Suitability: **S4 - FORMAL ISSUE TO CLIENT**

Drawn by: JMB Date: 13/03/13
Checked by: JD Date: 13/03/13
Approved by: SL Date: 13/03/13
Drawing Scale: 1:1000

Drawing No.: **GRNLEB-BHD-00-XX-DR-GEO-14620** Revision: **04-01**

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Drawing file path & name: ... : pName: 13:32:03 - 03 pm
User and Plot Date



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 3. MODELLING ONLY TAKES ACCOUNT OF THE IMPACT OF THE NORTHERN LINE EXTENSION AND ASSOCIATED INFRASTRUCTURE E.G. STATION BOXES.
 4. TUNNEL ALIGNMENT IS BASED ON DRAWING GRNLEB-HGL-00-XX-M2-PWY-0001-02-01.
 5. CROSS PASSAGE LOCATION IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-0002-03-01.
 6. SUBSTATION AT KENNINGTON PARK IS BASED ON DRAWING GRNLEB-BHD-ST-XX-DR-STR-13120-01-01. ADIT BETWEEN SHAFT AND HEADHOUSE AT KENNINGTON GREEN IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-23000-03-01.
 7. SETTLEMENT DUE TO RUNNING TUNNELS IS BASED ON A 1.5% VOL. LOSS. SEE SETTLEMENT REPORT FOR FULL DETAILS ON OTHER TUNNEL TYPES.
 8. SETTLEMENT DUE TO STATION EXCAVATIONS ARE BASED ON CURVES FROM CIRIA CS80 FIGURE 2.9 (B), EXCEPT THE ADIT AT KENNINGTON GREEN WHICH IS BASED ON CIRIA CS80 FIGURE 2.12. THE GROUND MOVEMENT CURVES ARE CONSIDERED TO REPRESENT 100% GROUND MOVEMENT PROFILE. HOWEVER THE STATION EXCAVATIONS WILL HAVE AN INCREASED STIFFNESS AT THE CORNERS, THEREFORE THE SETTLEMENT CONTOURS AROUND THE EXCAVATIONS ARE A CONSERVATIVE ESTIMATE.
 9. SETTLEMENT DUE TO EXCAVATIONS OF SHAFTS IS BASED ON THE LONDON UNDERGROUND MANUAL OF GOOD PRACTICE USING G-058 NEW AND BOWERS (1994) MAP BY PERMISSION OF ORDNANCE SURVEY, REPRODUCED FROM LANDRANGER 1:50,000 MAP BY PERMISSION OF ORDNANCE SURVEY © ON BEHALF OF THE CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE © CROWN COPYRIGHT 1988. ALL RIGHTS RESERVED. LICENSE NUMBER: AL 10005917. THE ORDNANCE SURVEY DATA USED WAS THAT AVAILABLE AT THE TIME OF 2012 REFERENCE DESIGN, AND THUS ANY RECENT CHANGES WILL NOT BE REFLECTED IN THE MAPS USED FOR ANALYSIS.
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- SETTLEMENT CONTOUR 10mm
 - WATER UTILITIES NOT AFFECTED
 - WATER UTILITIES AFFECTED
 - WATER UTILITIES CRITICAL
- (18)** CROSS REFERENCE TO THE SETTLEMENT REPORT GRNLEB-BHD-00-XX-TNT-GEO-00049

Rev	By	Chkd	Appvd	Date	Description
04-01	JMB	JD	SL	13/03/13	NOTES AMENDED
03-01	JMB	JD	SL	19/02/13	NOTES AMENDED
02-01	JMB	JD	SL	06/02/13	INCLUSION OF ADITS & SUBSTATION
01-01	JMB	JD	SL	18/01/13	FIRST DRAWN

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www.halcrow.com

Halcrow

Project: **NORTHERN LINE EXTENSION TO BATTERSEA TWAO FOR TfL**

Drawing: **UTILITY DAMAGE ASSESSMENT WATER - SHEET 2 OF 5**

Subtitle: **S4 - FORMAL ISSUE TO CLIENT**

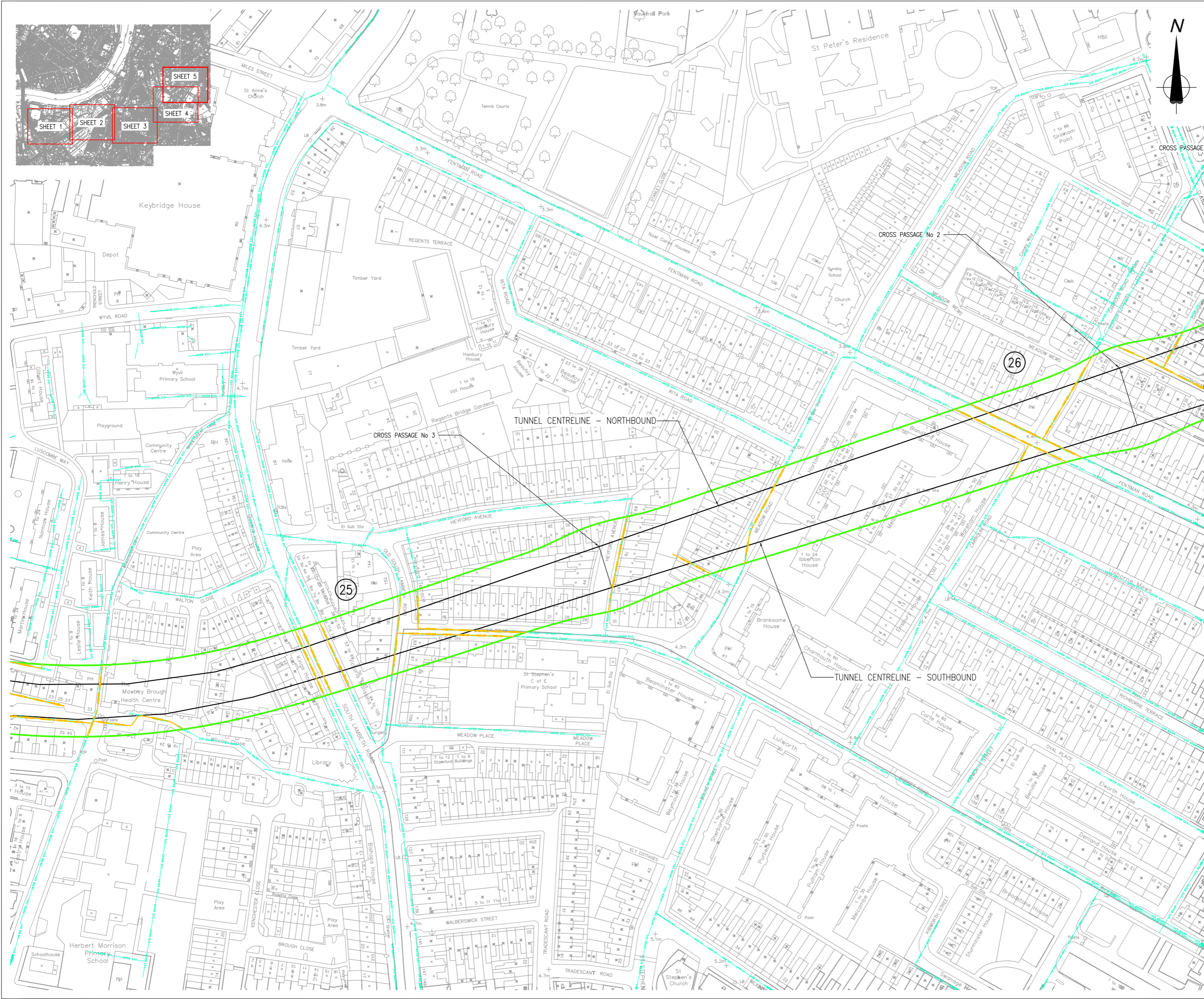
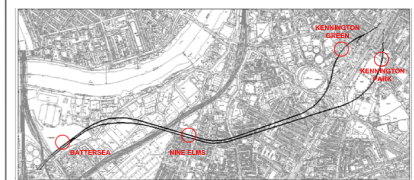
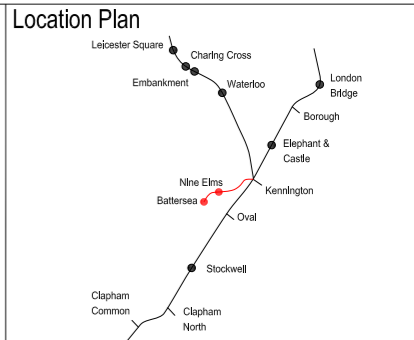
Drawn by: JMB Date: 13/03/13

Checked by: JD Date: 13/03/13

Approved by: SL Date: 13/03/13

Drawing Scale: 1:1000

Drawing No.: **GRNLEB-BHD-00-XX-DR-GEO-14621** Revision: **04-01**



Notes:

1. ALL CONTOURS SHOWN ARE IN MM
2. ANALYSIS HAS BEEN BASED ON THE SERVICE INFORMATION AVAILABLE AT THE TIME OF DESIGN
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4. TUNNEL ALIGNMENT IS BASED ON DRAWING GRNLEB-HGL-00-XX-M2-PWY-00010-02-01.
5. CROSS PASSAGE LOCATION IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-00020-01.
6. SUBSTATION AT KENNINGTON PARK IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-STR-13120-01-ADT BETWEEN SHAFT AND HEADHOUSE AT KENNINGTON GREEN IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-23000-03-01.
7. SETTLEMENT DUE TO TUNNELLING OF SHAFTS IS BASED ON A 1.5% VOLUME LOSS. SEE SETTLEMENT REPORT FOR FULL DETAILS ON OTHER TUNNEL TYPES.
8. SETTLEMENT DUE TO STATION EXCAVATIONS ARE BASED ON CURVES FROM CIRIA C580 FIGURE 2.9 (B) . EXCEPT THE ADIT AT KENNINGTON GREEN WHICH IS BASED ON CIRIA C580 FIGURE 2.12. THE GROUND MOVEMENT CURVES ARE CONSIDERED TO REPRESENT 100% GROUND MOVEMENT PROFILE. HOWEVER THE STATION EXCAVATIONS WILL HAVE AN INCREASED STIFFNESS AT THE CORNERS, THEREFORE THE SETTLEMENT CONTOURS AROUND THE EXCAVATIONS ARE A CONSERVATIVE ESTIMATE.
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- SETTLEMENT CONTOUR 10mm
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 - WATER UTILITIES AFFECTED
 - WATER UTILITIES CRITICAL
- (18) CROSS REFERENCE TO THE SETTLEMENT REPORT GRNLEB-HGL-00-XX-TNT-GEO-00049

Rev	By	Chkd	Appvd	Date	Description
04-01	JMB	JD	SL	13/03/13	NOTES AMENDED
03-01	JMB	JD	SL	19/02/13	NOTES AMENDED
02-01	JMB	JD	SL	06/02/13	INCLUSION OF ADITS & SUBSTATION
01-01	JMB	JD	SL	18/01/13	FIRST DRAWN

Client

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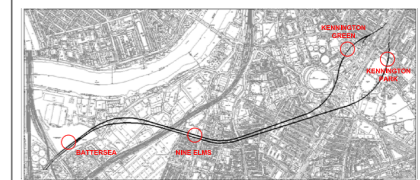
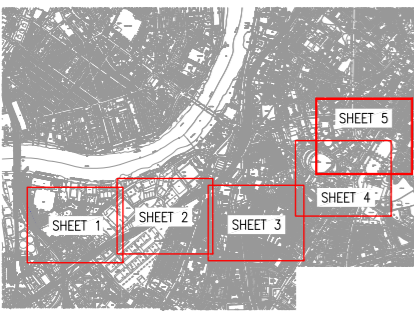
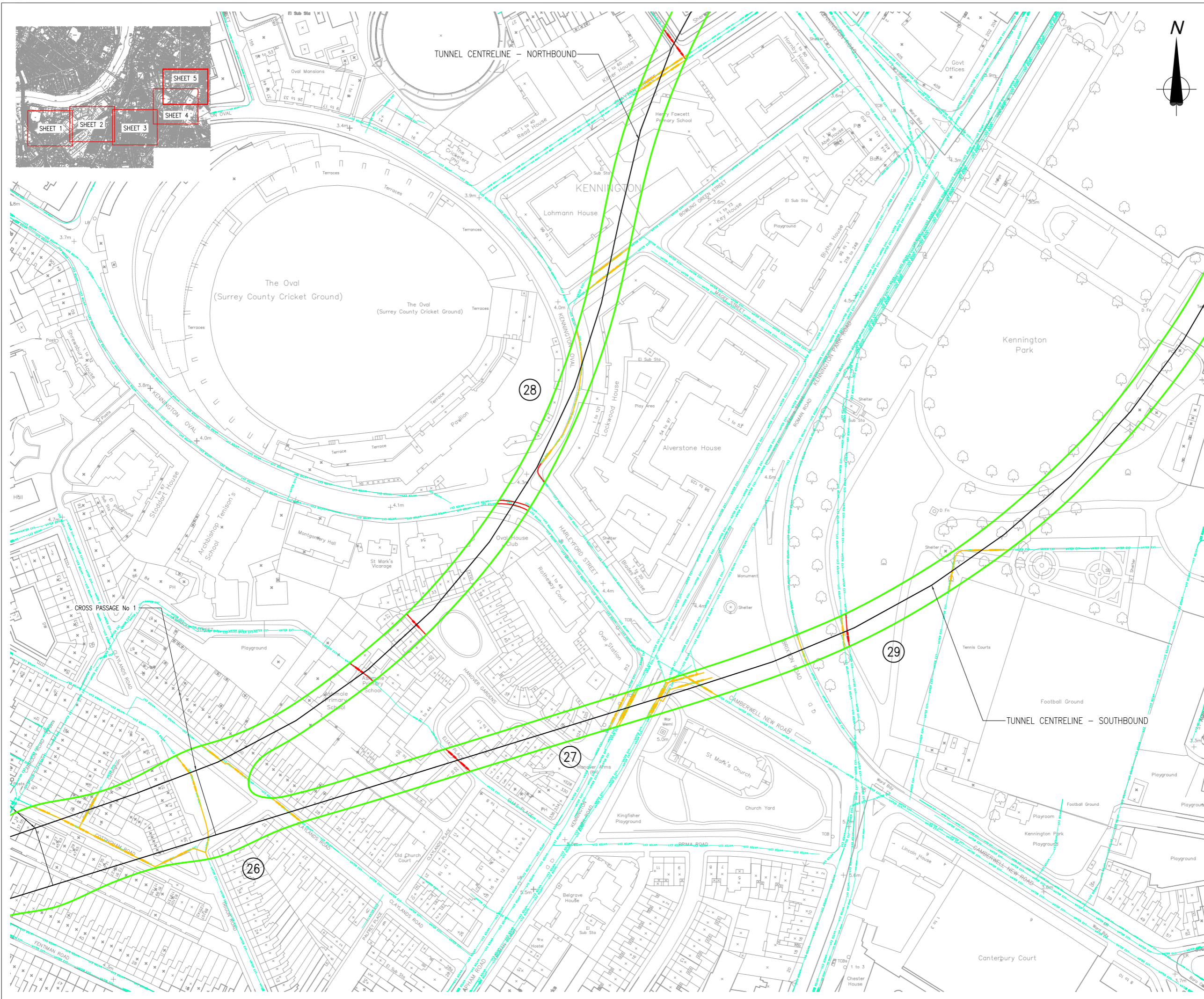
Project: **NORTHERN LINE EXTENSION TO BATTERSEA TWAO FOR TIL**

Drawing: **UTILITY DAMAGE ASSESSMENT WATER - SHEET 3 OF 5**

Suballity: **S4 - FORMAL ISSUE TO CLIENT**

Drawn by: JMB Date: 13/03/13
 Checked by: JD Date: 13/03/13
 Approved by: SL Date: 13/03/13
 Drawing Scale: 1:1000

Drawing No.: **GRNLEB-HGL-00-XX-DR-GEO-14622** Revision: **04-01**



- Notes:**
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 4. TUNNEL ALIGNMENT IS BASED ON DRAWING GRNLEB-HGL-00-XX-M2-PWY-00010-02-01.
 5. CROSS PASSAGE LOCATION IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-2042-03-01.
 6. SUBSTATION AT KENNINGTON GREEN IS BASED ON DRAWING GRNLEB-BHD-ST-XX-DR-STR-13120-01-01. ADT BETWEEN SHAFT AND HEADHOUSE AT KENNINGTON GREEN IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-2300-03-01.
 7. SETTLEMENT DUE TO RUNNING TUNNELS IS BASED ON A 1.5% VOLUME LOSS. SEE SETTLEMENT REPORT FOR FULL DETAILS ON OTHER TUNNEL TYPES.
 8. SETTLEMENT DUE TO STATION EXCAVATIONS ARE BASED ON CURVES FROM CRMA C580 FIGURE 2.9 (B) EXCEPT THE ADT AT KENNINGTON GREEN WHICH IS BASED ON CRMA C580 FIGURE 2.12. THE GROUND MOVEMENT CURVES ARE CONSIDERED TO REPRESENT 100% GROUND MOVEMENT PROFILE. HOWEVER THE STATION EXCAVATIONS WILL HAVE AN INCREASED STIFFNESS AT THE CORNERS. THEREFORE THE SETTLEMENT CONTOURS AROUND THE EXCAVATIONS ARE A CONSERVATIVE ESTIMATE.
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- SETTLEMENT CONTOUR 10mm
 - WATER UTILITIES NOT AFFECTED
 - WATER UTILITIES AFFECTED
 - WATER UTILITIES CRITICAL
- (18)** CROSS REFERENCE TO THE SETTLEMENT REPORT GRNLEB-BHD-00-XX-TNT-GEO-00049

Rev	By	Chkd	Appvd	Date	Description
04-01	JMB	JD	SL	13/03/13	NOTES AMENDED
03-01	JMB	JD	SL	19/02/13	NOTES AMENDED
02-01	JMB	JD	SL	06/02/13	INCLUSION OF ADITS & SUBSTATION
01-01	JMB	JD	SL	18/01/13	FIRST DRAWN

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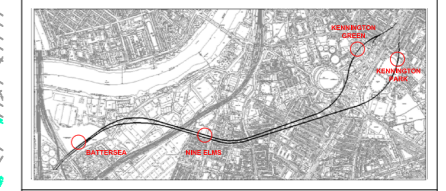
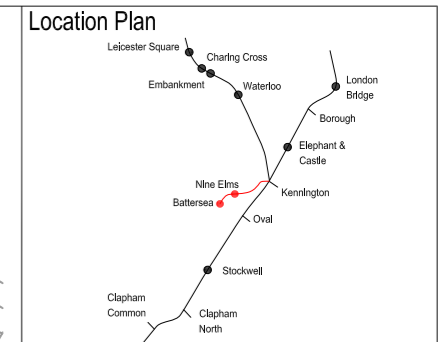
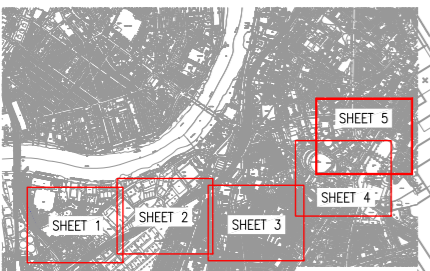
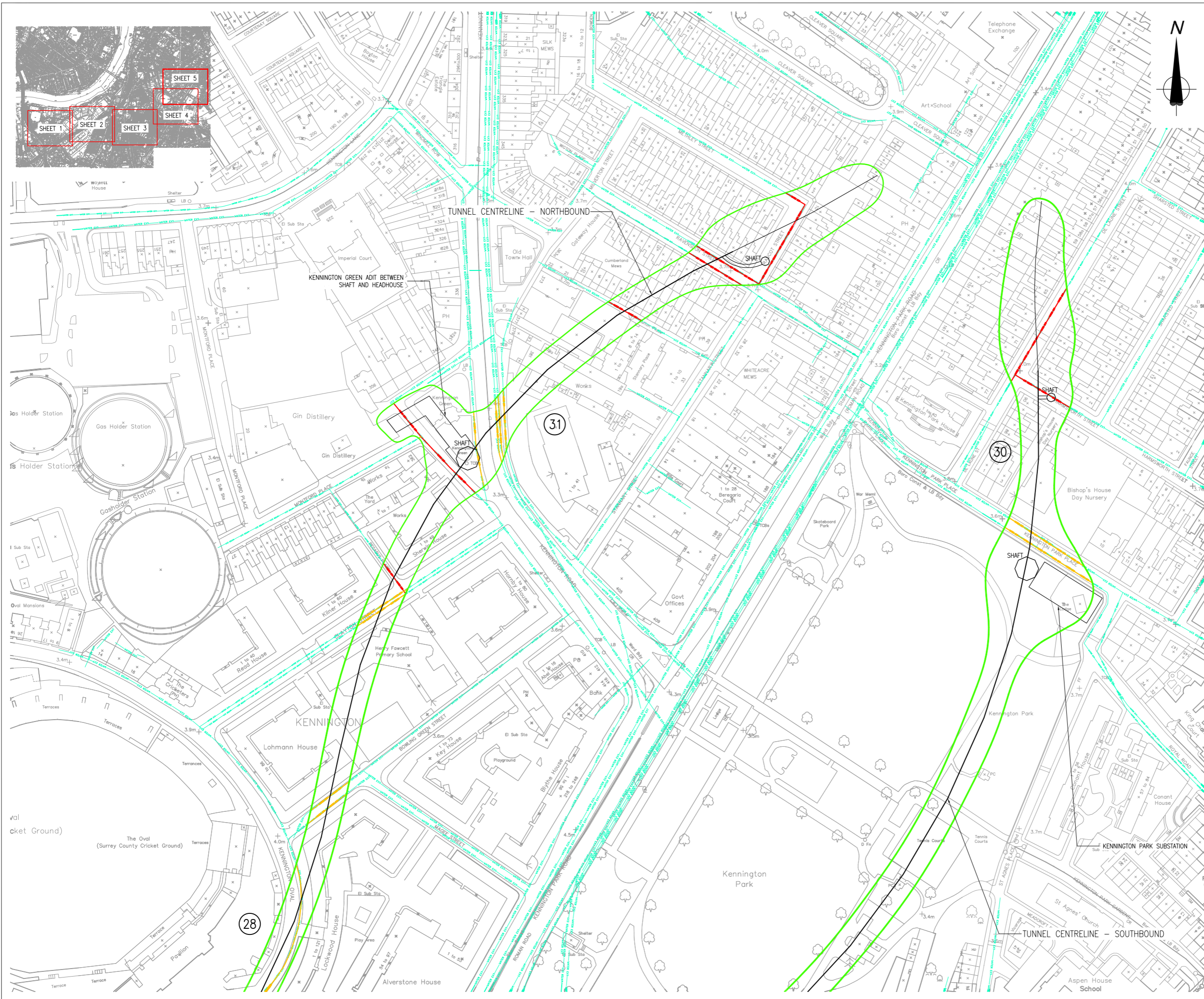
Project: **NORTHERN LINE EXTENSION TO BATTERSEA TWAO FOR TIL**

Drawing: **UTILITY DAMAGE ASSESSMENT WATER - SHEET 4 OF 5**

Submittal: **S4 - FORMAL ISSUE TO CLIENT**

Drawn by: JMB Date: 13/03/13
 Checked by: JD Date: 13/03/13
 Approved by: SL Date: 13/03/13
 Drawing Scale: 1:1000

Drawing No.: **GRNLEB-BHD-00-XX-DR-GEO-14623** Revision: **04-01**



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 5. CROSS PASSAGE LOCATION IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-20042-01-01.
 6. SUBSTATION AT KENNINGTON PARK IS BASED ON DRAWING GRNLEB-BHD-ST-XX-DR-STR-13120-01-01. ADIT BETWEEN SHAFT AND HEADHOUSE AT KENNINGTON GREEN IS BASED ON DRAWING GRNLEB-HGL-00-XX-DR-TUN-20009-01.
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 - WATER UTILITIES AFFECTED
 - WATER UTILITIES CRITICAL
- (18)** CROSS REFERENCE TO THE SETTLEMENT REPORT GRNLEB-BHD-00-XX-TNT-GEO-00049

Rev	By	Chkd	Appvd	Date	Description
04-01	JMB	JD	SL	13/03/13	NOTES AMENDED
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Project: **NORTHERN LINE EXTENSION TO BATTERSEA TWAO FOR TIL**

Drawing: **UTILITY DAMAGE ASSESSMENT WATER - SHEET 5 OF 5**

Suitability: **S4 - FORMAL ISSUE TO CLIENT**

Drawn by: JMB	Date: 13/03/13
Checked by: JD	Date: 13/03/13
Approved by: SL	Date: 13/03/13
Drawing No.: GRNLEB-BHD-00-XX-DR-GEO-14624	Revision: 04-01