

**Northern line extension to Nine Elms and Battersea –
Engineering
Evidence of Jonathan Gammon**

Presentation given during evidence in chief

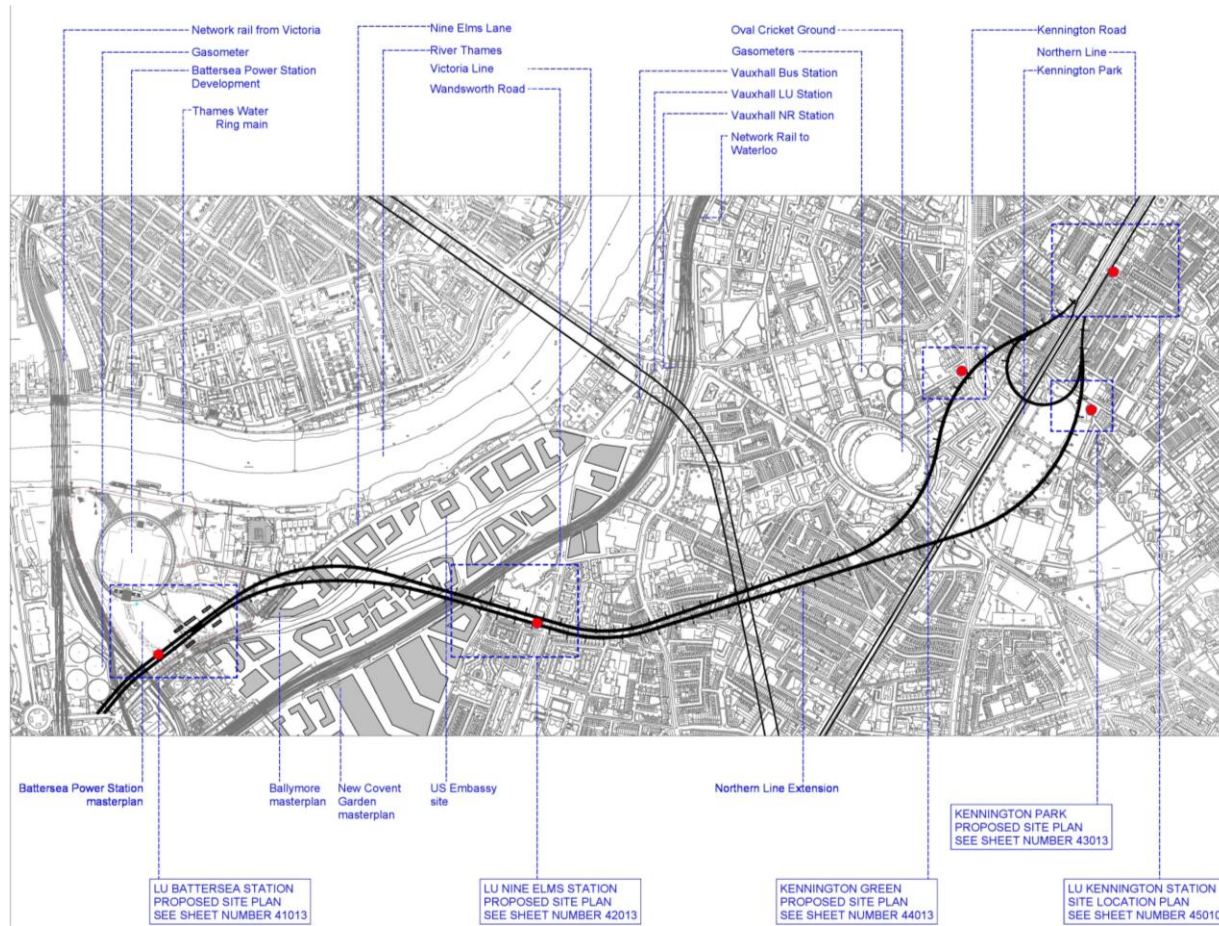
SLIDE (i)
Summary Presentation Slides
Engineering

Summary Contents

- S1. Introduction**
- S2. Scope of Evidence**
- S3. The Scheme and Proposed Works**
- S4. Tunnelling Techniques**
- S5. Ground Movements**
- S6. Code of Construction Practice**
- S7. Response to Statement of Matters and Objections**
- S8. Conclusions**

SLIDE 1

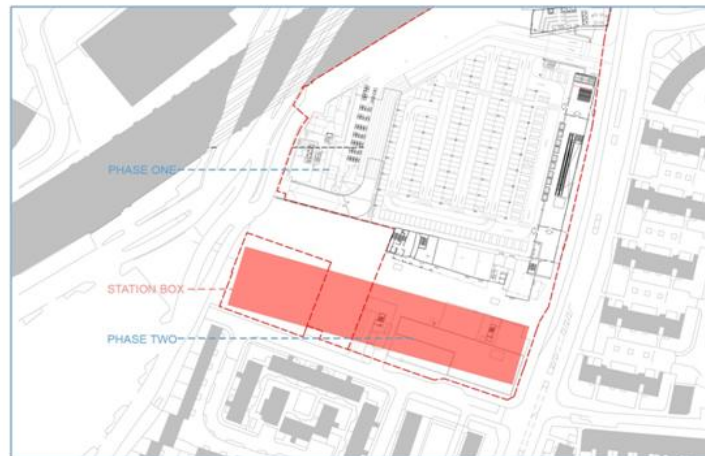
Appendix Figure 1 *Scheme Layout*



SLIDE 2

Appendix Figure 28

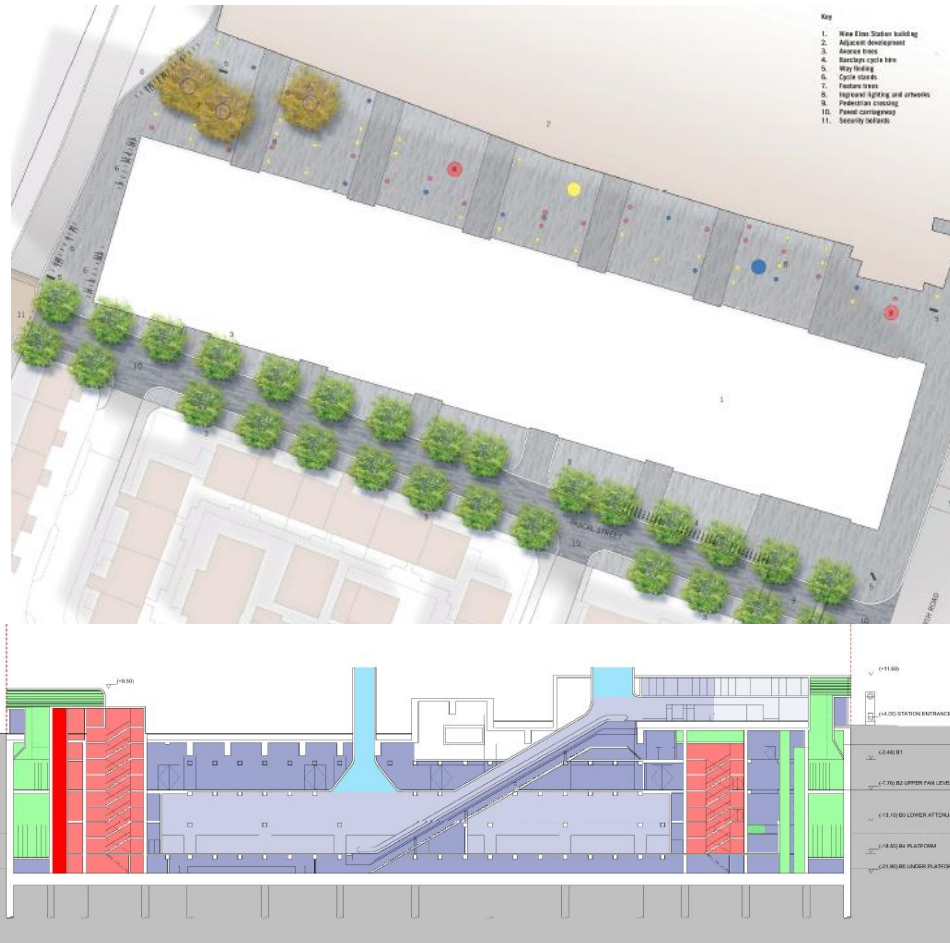
Nine Elms station – configuration (1)



SLIDE 4

NLE/A16/1

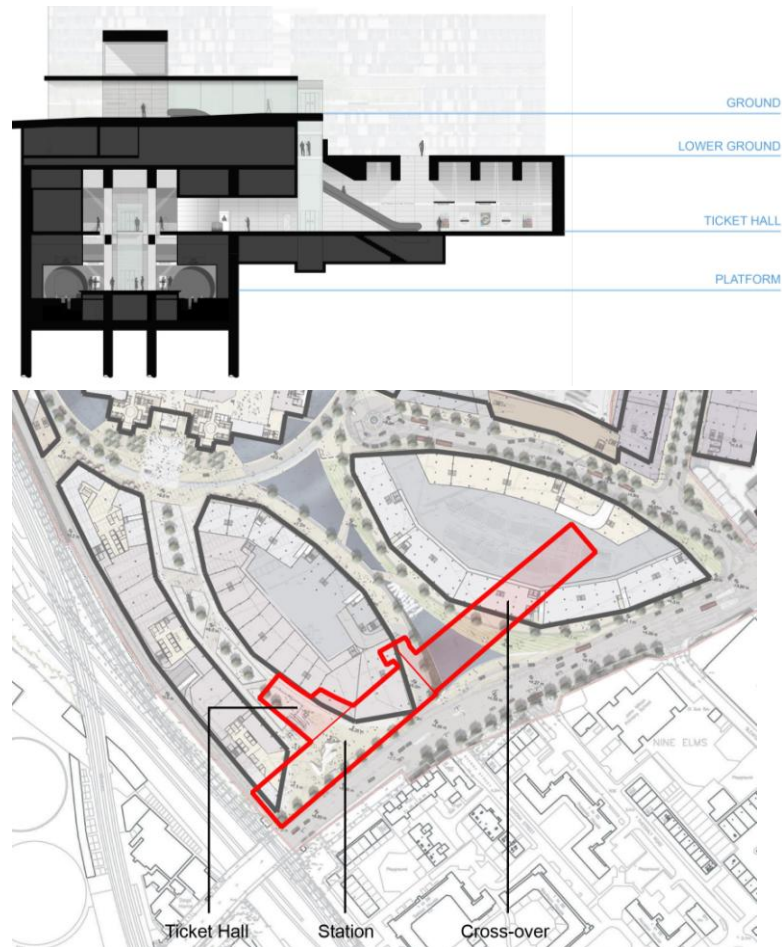
Nine Elms station – configuration (3)



SLIDE 5

Appendix Figure 8

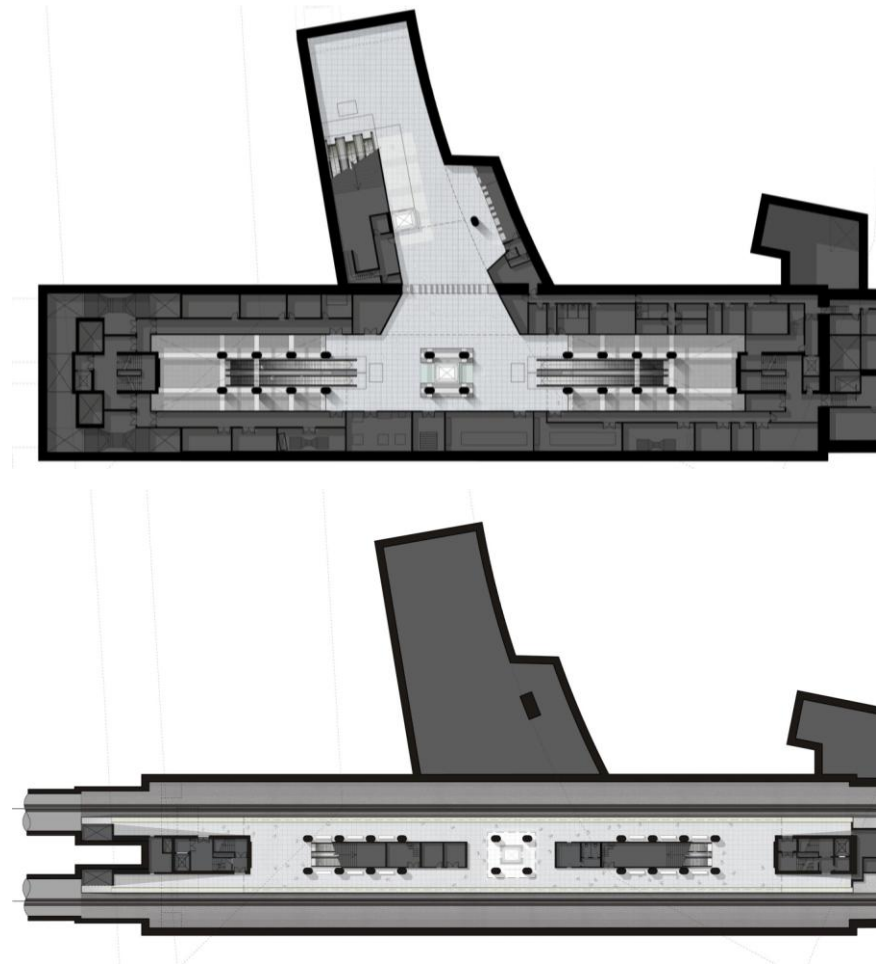
Battersea Station configuration



SLIDE 6

Appendix Figure 9

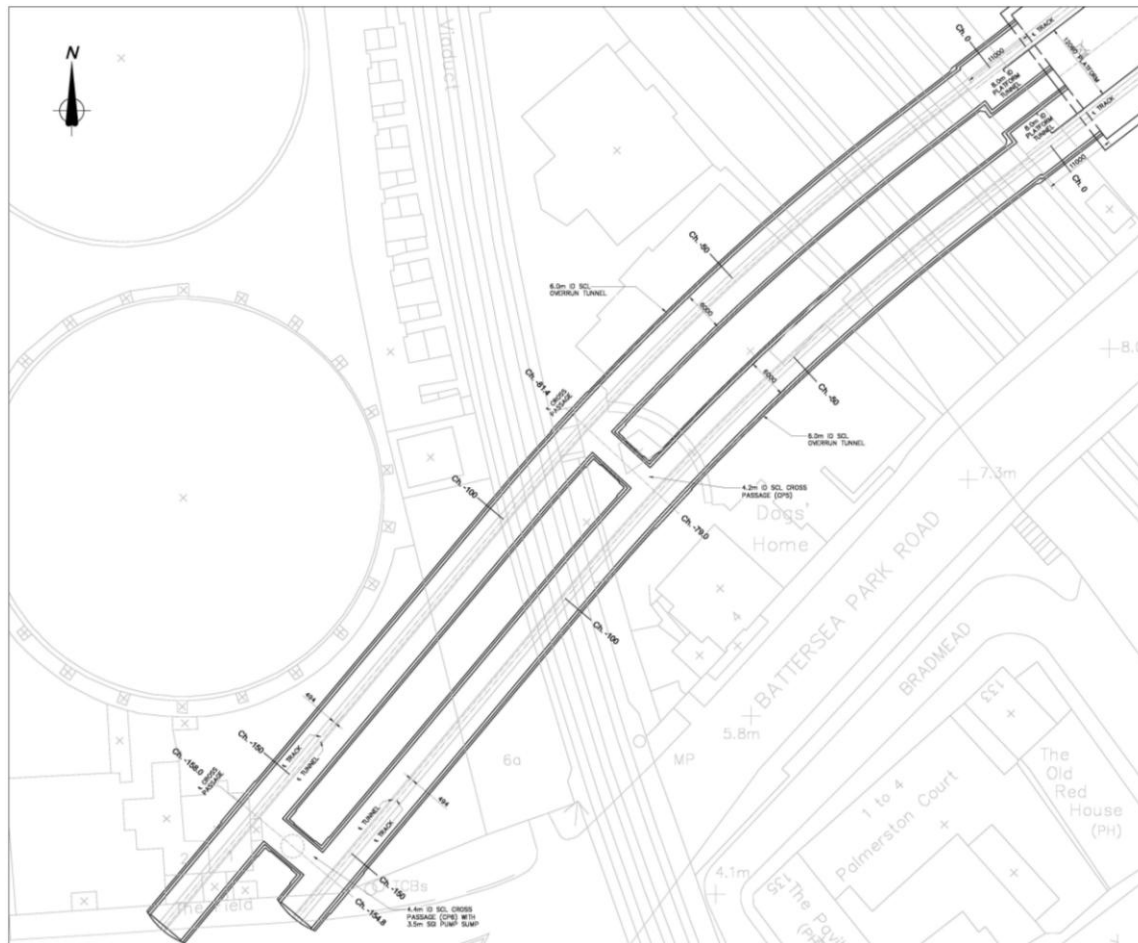
Battersea Station configuration (2)



SLIDE 7

Appendix Figure 11

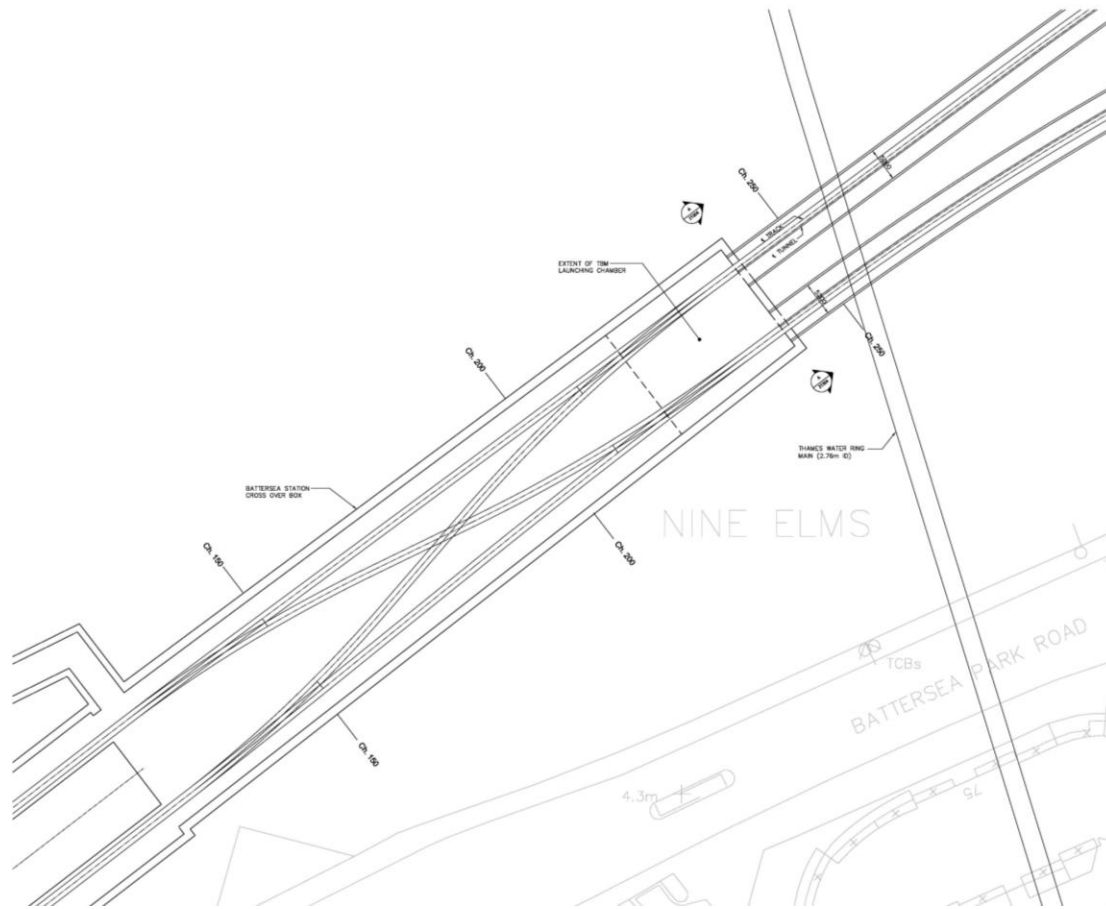
Battersea Station – Overrun Tunnels



SLIDE 8

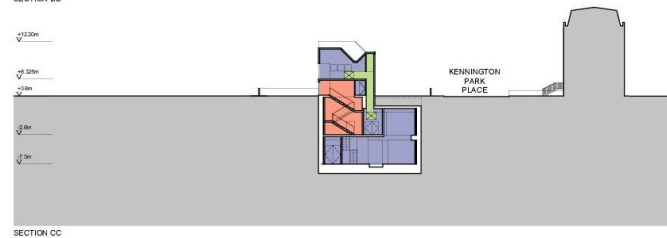
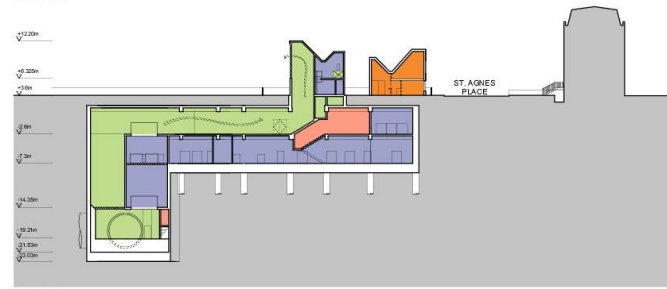
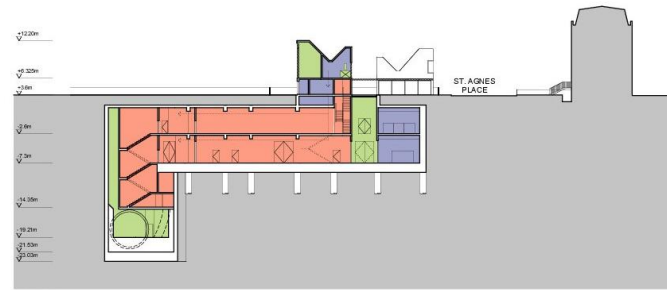
Appendix Figure 10

Battersea Station – crossover box



SLIDE 9

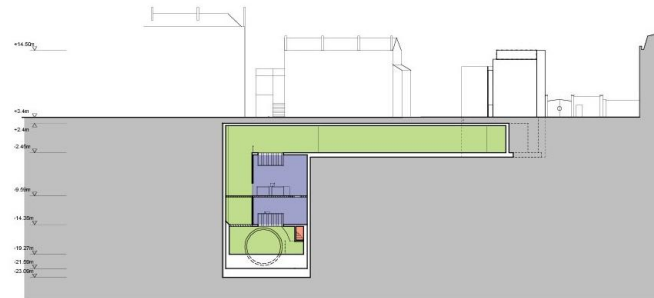
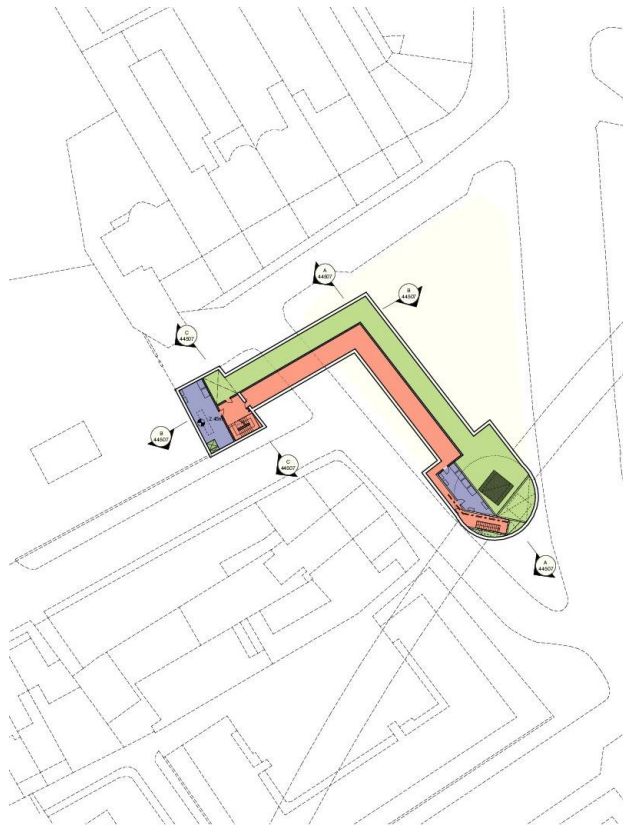
Appendix Figure 36 *Kennington Park configuration*



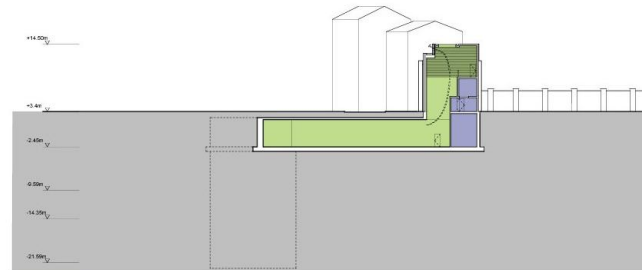
SLIDE 10

Appendix Figure 34

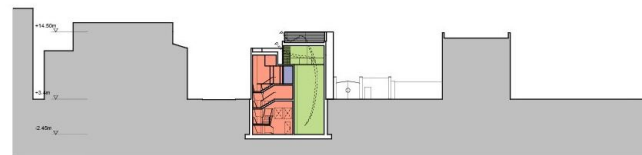
Kennington Green configuration



SECTION AA



SECTION BB

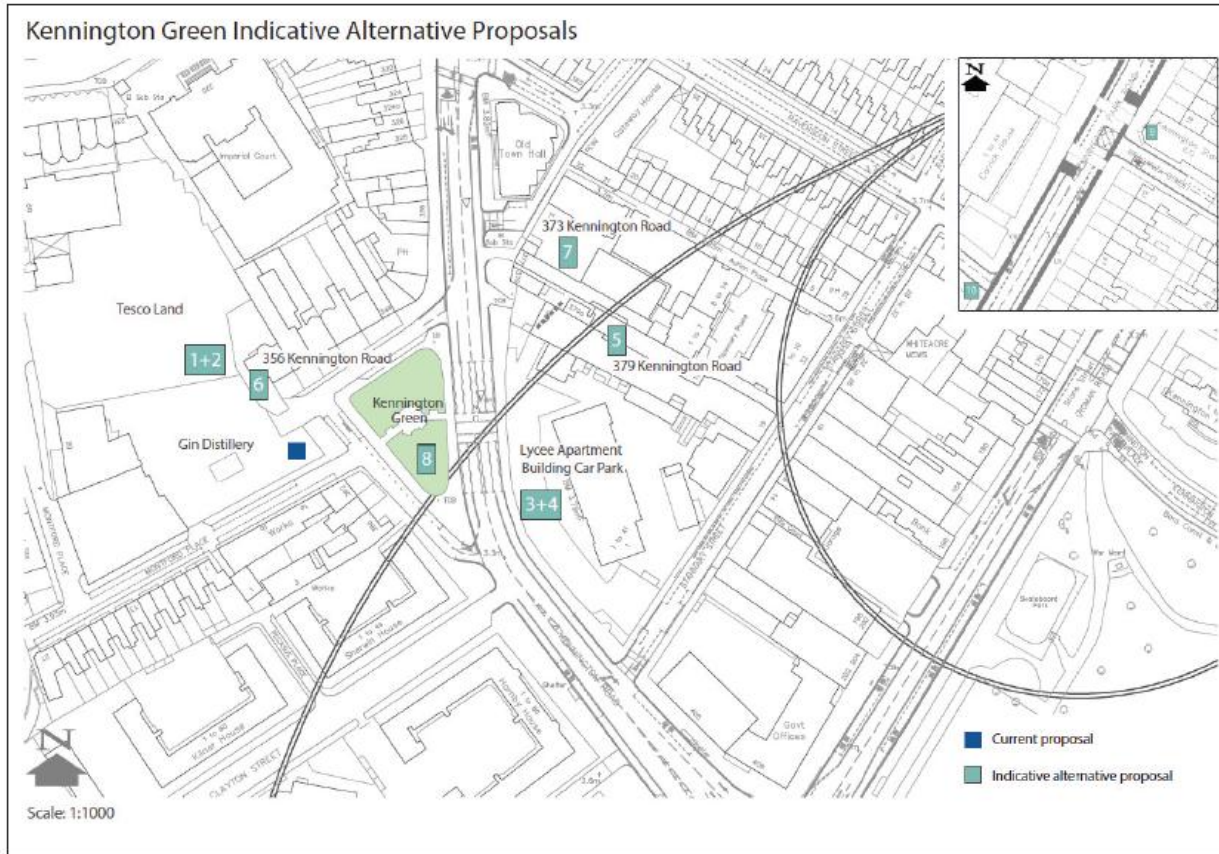


SECTION CC

SLIDE 11

Appendix Figure 33

Kennington Green head house alternatives



SLIDE 12

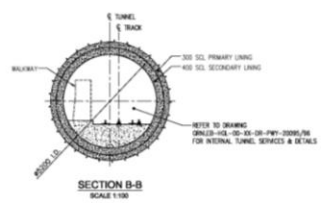
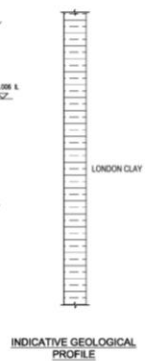
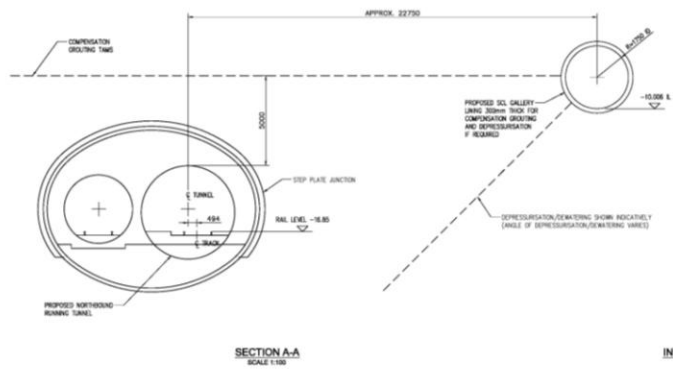
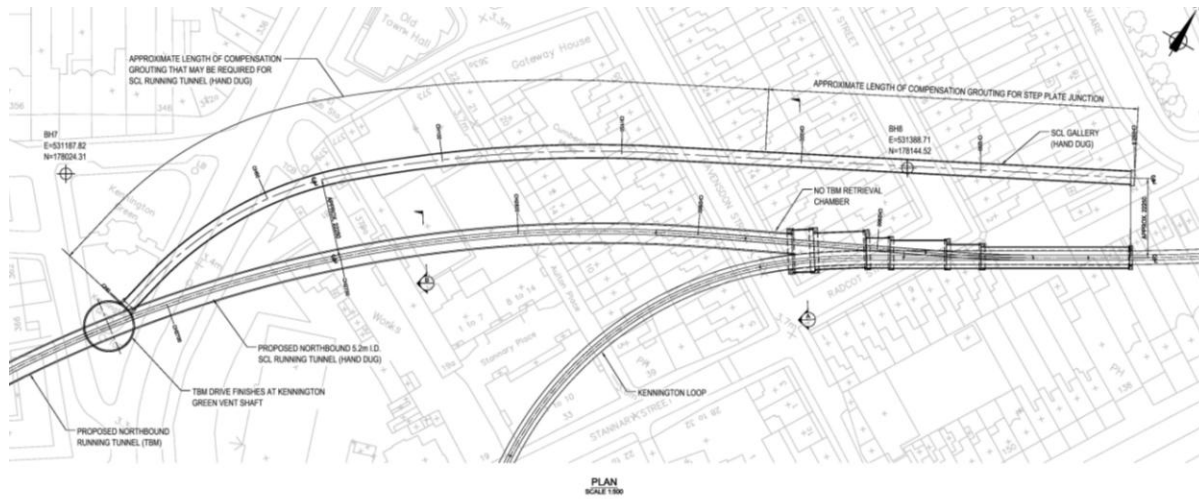
Appendix Figure 40

Kennington Station – cross passage locations



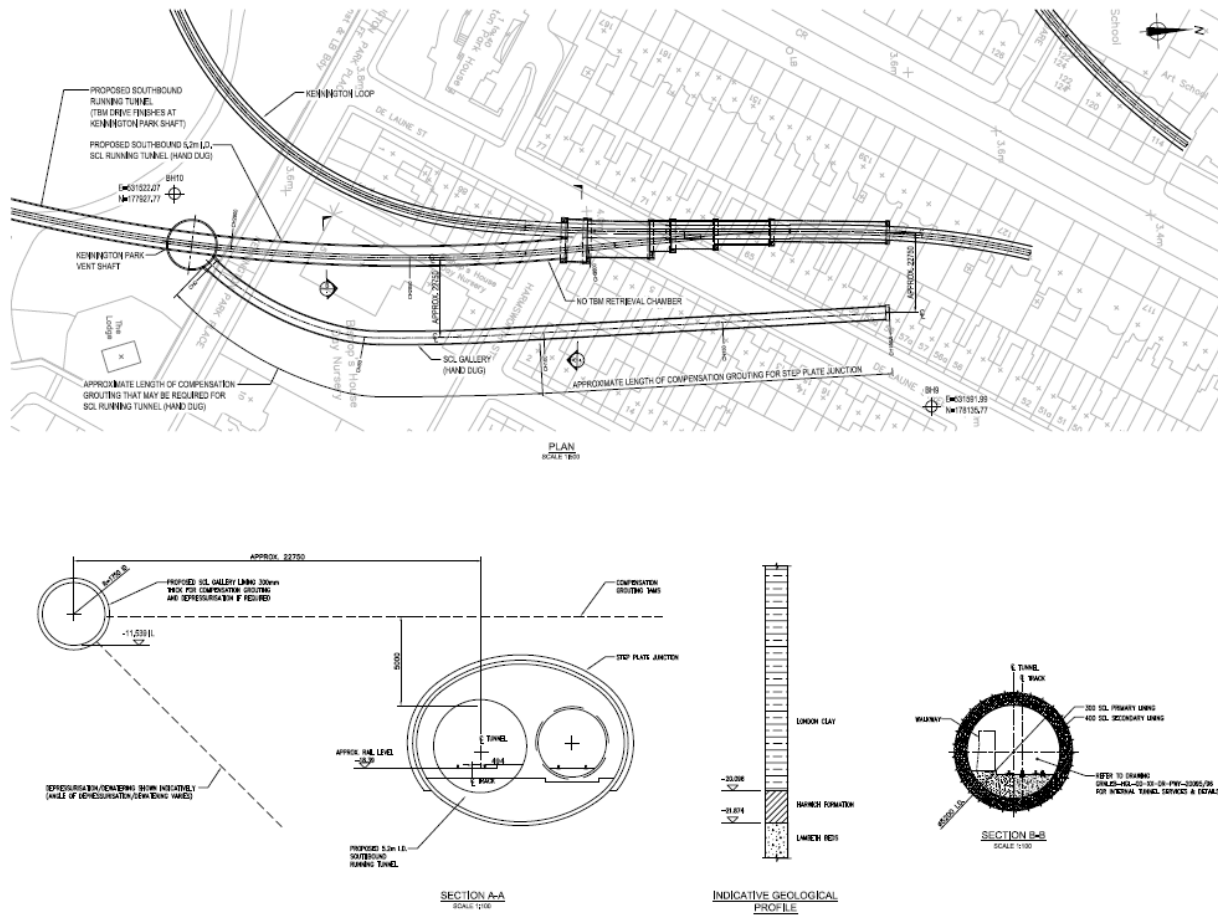
SLIDE 13

Appendix Figure 38 (A) Gallery tunnels (North side)



SLIDE 14

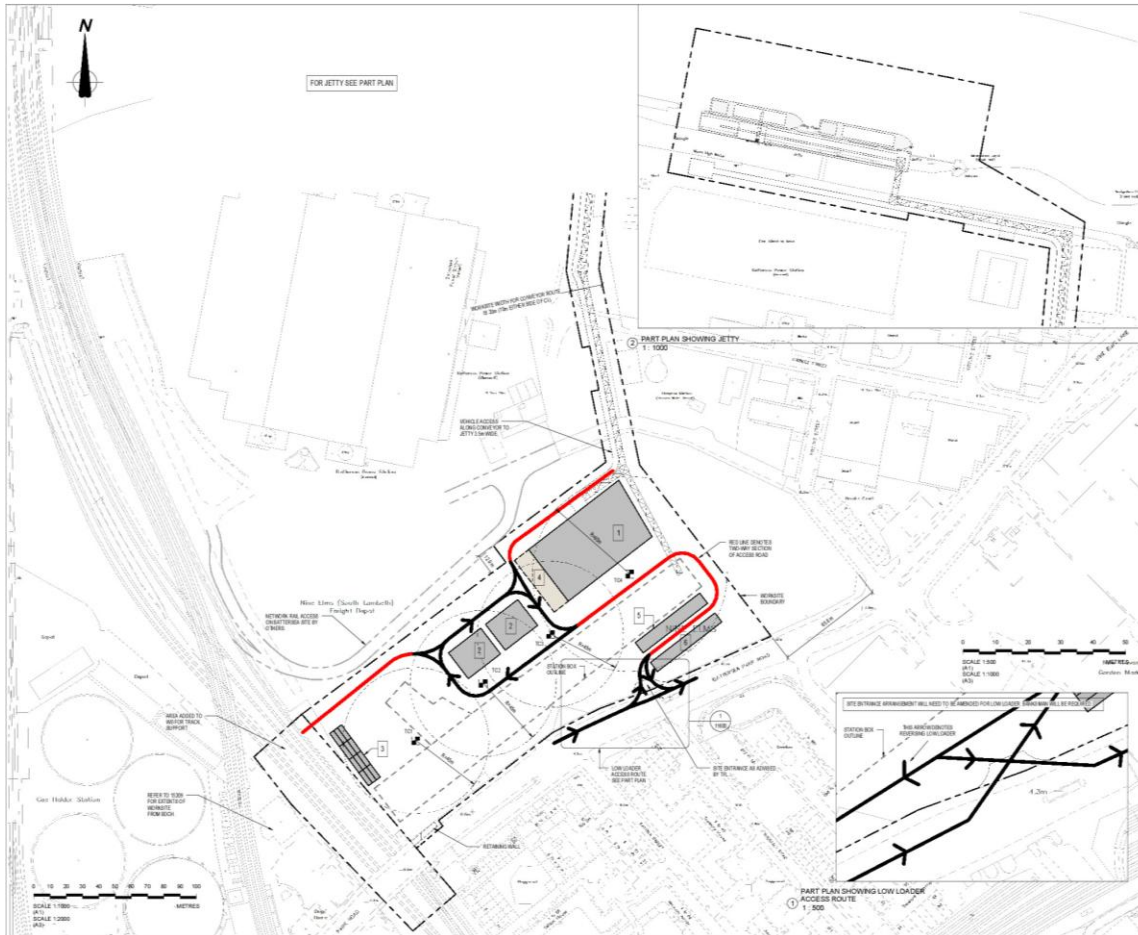
Appendix Figure 38 (B) *Gallery tunnels (South side)*



SLIDE 15

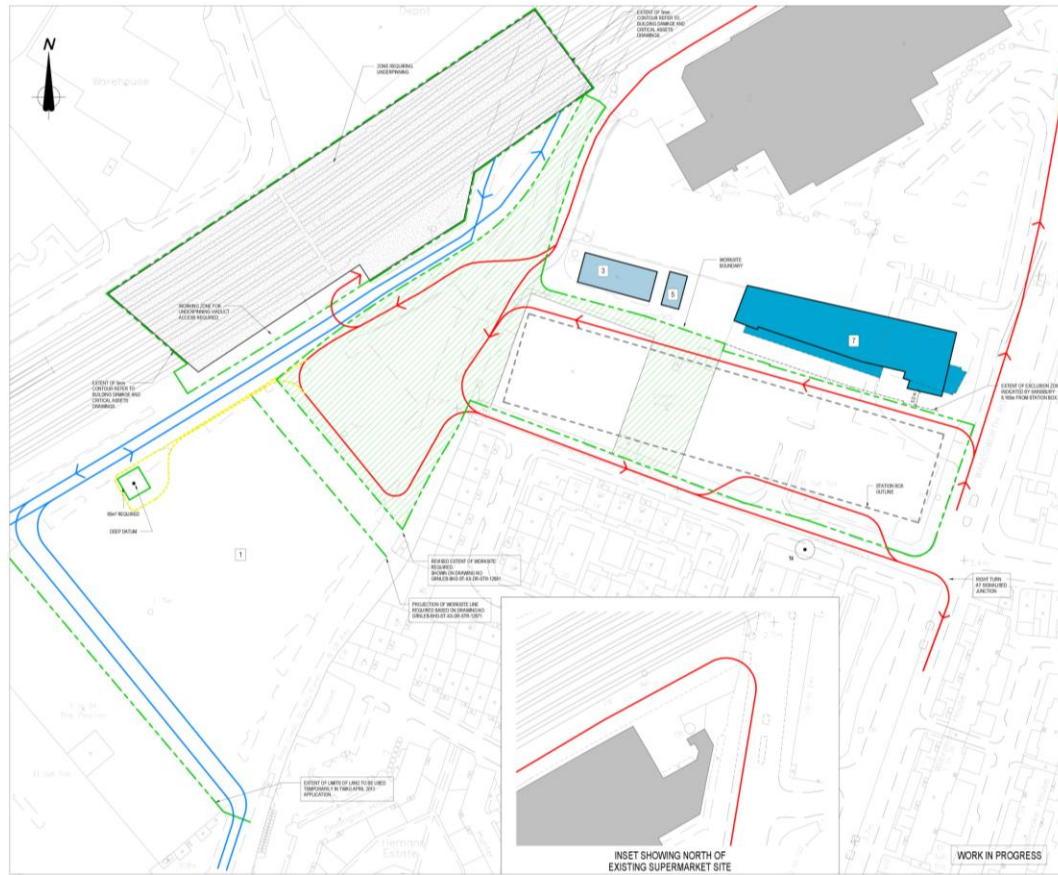
Appendix Figure 11

Battersea Station – worksite layout



SLIDE 16

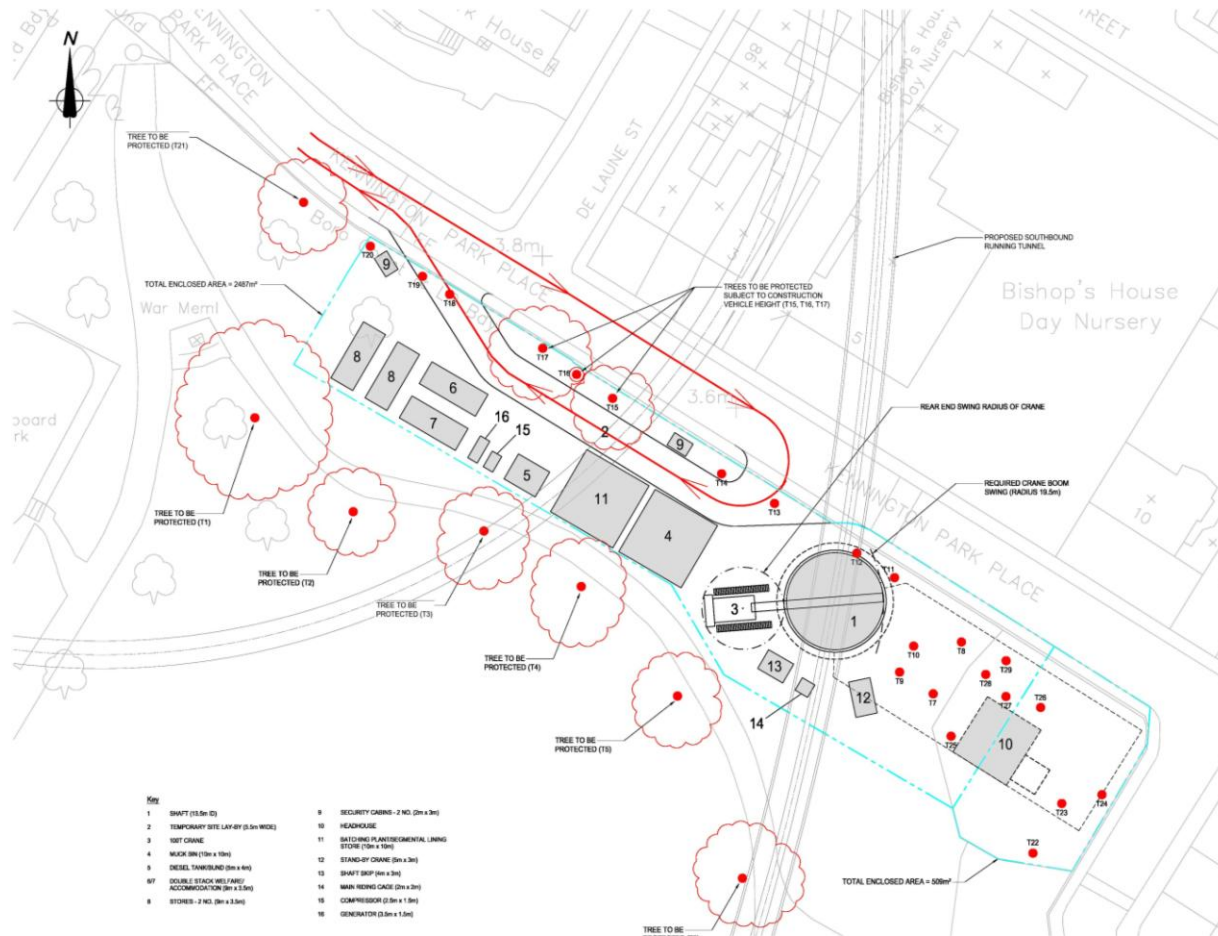
Appendix Figure 30 *Nine Elms station – worksite*



SLIDE 17

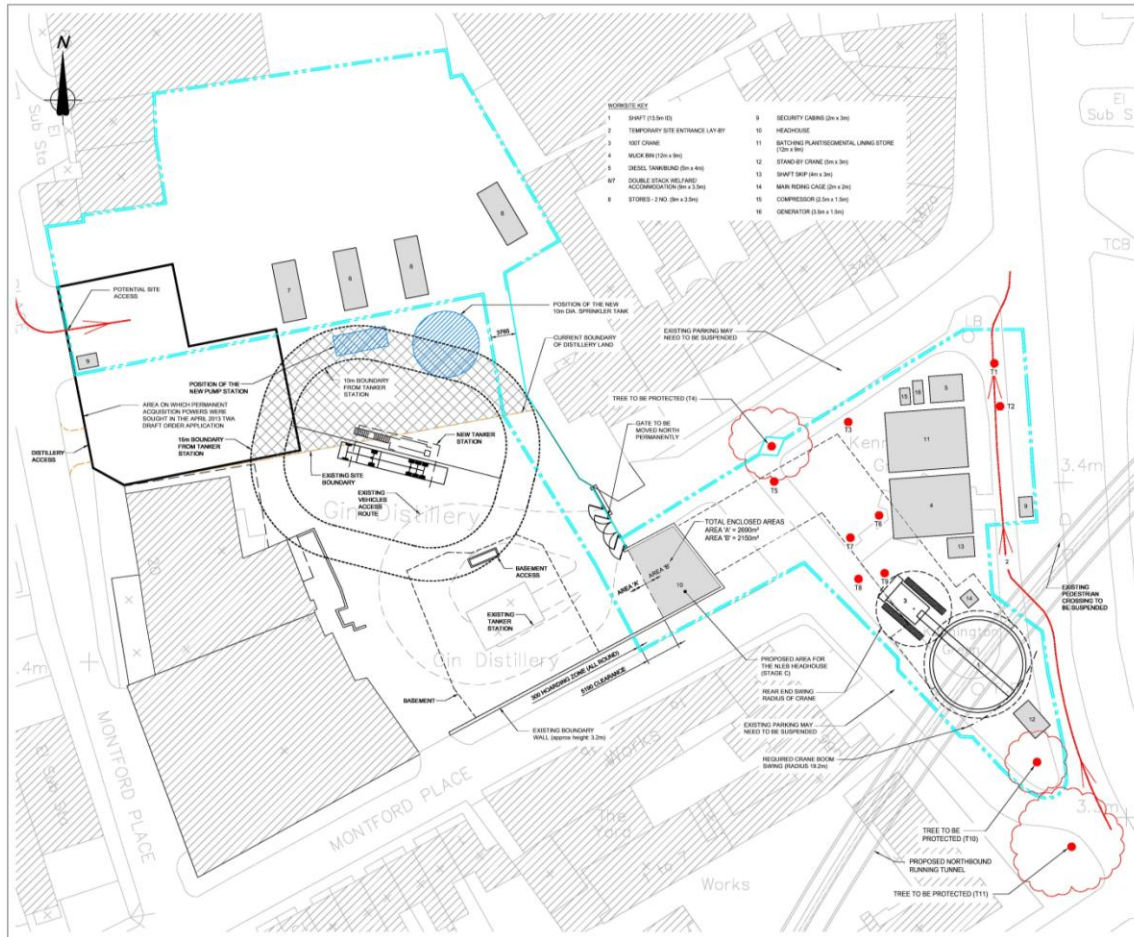
Appendix Figure 37

Kennington Park - worksite layout



SLIDE 18

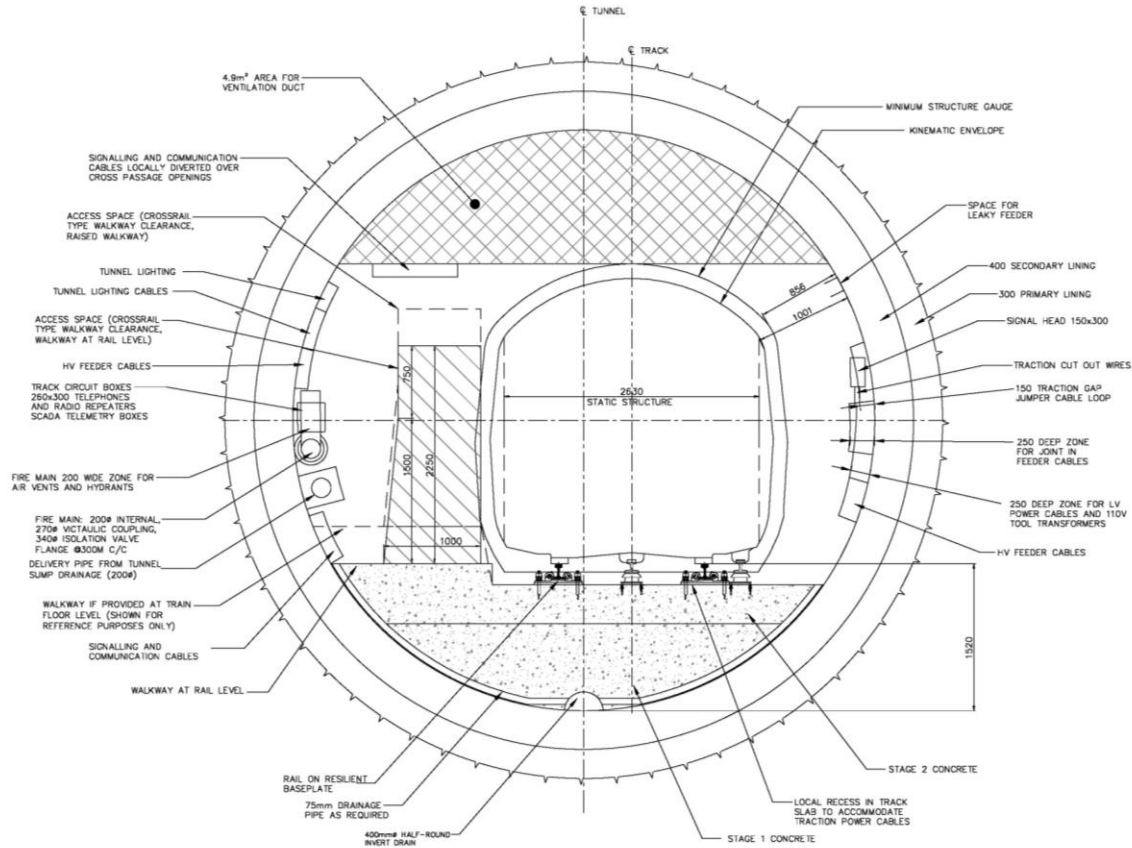
Appendix Figure 35 Kennington Green- worksite layout



SLIDE 19

Appendix Figure 47

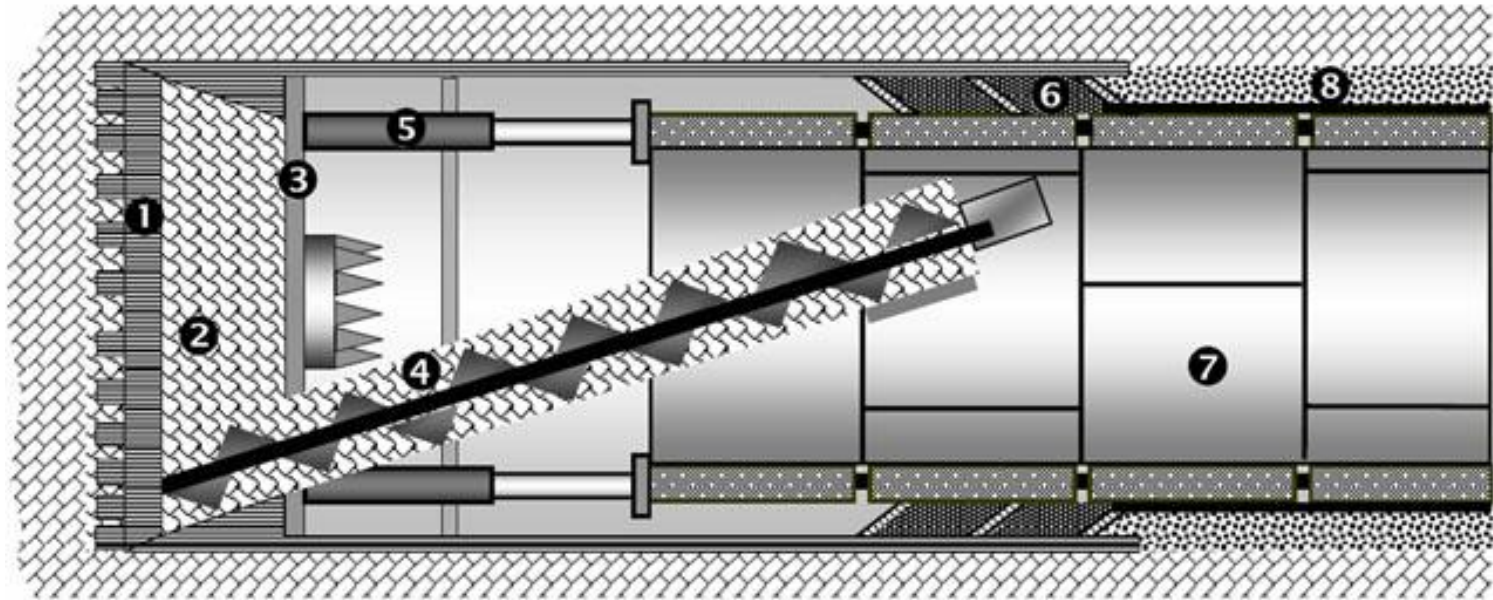
Typical tunnel cross section



SLIDE 20

Appendix Figure 5

Earth Pressure Balance TBM - Schematic



- | | | |
|-------------------|------------------|-----------------|
| ❶ Cutterhead | ❷ Screw conveyor | ❸ Segments |
| ❹ Working Chamber | ❹ Thrust Arm | ❹ Annulus Grout |
| ❺ Pressure Wall | ❺ Tail sealant | |

SLIDE 21

Appendix Figure 6
SCL Lining



SLIDE 22

Appendix Figure 7
SGL Lining



SLIDE 23

Appendix Table 3

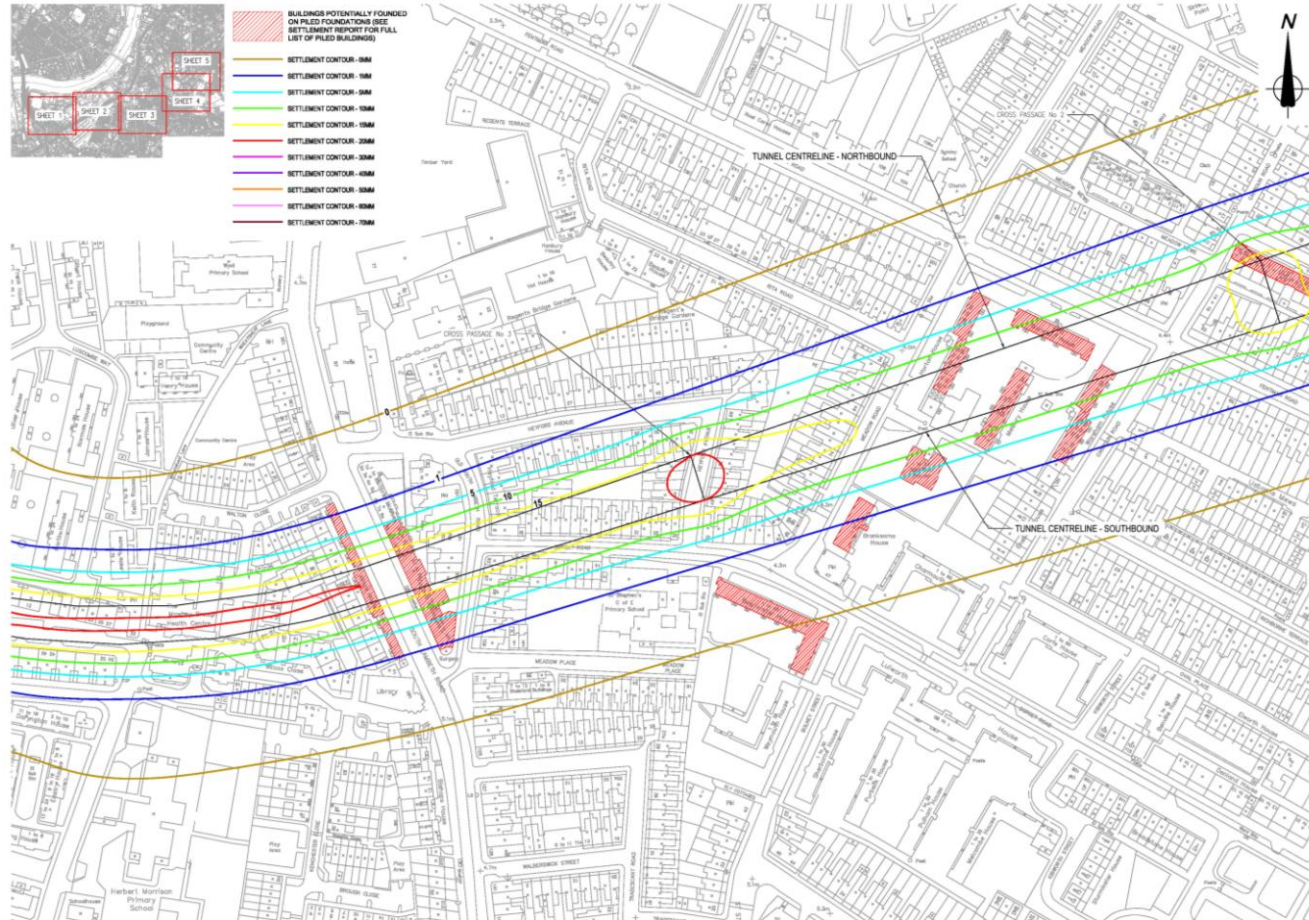
Summary of analysis phases outlined in LUL Standard

Phase	Clause	Description
1 (Green field predictions of settlement)	3.6.1.4 (1-050) or 2.3 (LUL Guidelines)	<p>1. Settlement predictions for bored tunnels should be produced using empirically validated methods such as O'Reilly and New (1982), using parameters for ground loss determine from case histories.</p> <p>2. For excavations, assessment should be undertaken using models validated by empirical data based on case studies of similar excavations.</p> <p>3. For buildings that experience less than 10mm no further assessment is necessary.</p> <p>4. Buildings with settlement or heave greater than 10mm or predicted ground slope of 1:500 or steeper are subject to a Phase 2 assessment.</p>
2	3.6.1.5 (1-050) or 2.4 (LUL Guidelines)	<p>5. The movements predicted for green field conditions are imposed on buildings. (Buildings are assumed to behave flexibly and their own stiffness has no influence on ground settlement).</p> <p>6. The potential for damage is defined using the procedures described by Burland et al. (1977, cited in CIRIA 200, 2001) and placed into one of six risk categories (numbered 0 – 5).</p> <p>7. Buildings assessed to be in risk category 0, 1 or 2 are not subjected to further assessment. (Exceptions include listed buildings or building with shallow foundation in close proximity to excavations),</p> <p>8. All buildings which are placed in risk category 3 or above are subject to a Phase 3 assessment.</p>
3*	3.6.1.6 (1-050) or 2.5 (LUL Guidelines)	Each building is considered separately. The assessment will involve the development of a building specific detail model rather than the more generic model forms used in Phase 2.

***Phase 3 level of detail exceeds the requirements of the Reference Design and should be carried out during the detailed design phase.**

SLIDE 24

Appendix Figure 4 *Surface settlement contours*



END