

7. EARTHWORKS ACCEPTABILITY TESTING

7.1 Application of the Acceptability Criteria

The application of acceptability earthworks testing was controlled by TSL and the works were undertaken by Collins, TSL's earthworks contractor. Acceptability testing was in accordance with Specification Appendix 6/1 and the frequency of testing, as specified in Appendix 1/5. A UKAS accredited materials laboratory, Construction Testing Solutions (CTS) was used by TSL for the duration of the works to verify materials and Collins' work.

A 25m testing grid was adopted by TSL to track the progress of earthworks testing and reference the test results, as shown in Appendix B.

The 'end product compaction' earthworks acceptability testing as stipulated in the Earthworks Specification¹ is summarised in Table 7.

Table 7. End Product Compaction Testing

Compaction Method	Test	Frequency of Testing
End Product Compaction	Moisture Content and Field Dry Density (set of 5 NDG to 1 SRT). SRT shall be the large pouring cylinder method to BS 1377 Part 9.	1 set per 1,000m ²
	Undrained Shear Strength by Hand Vane	1 per 250 m ²
	CBR Plate Load Test	1 test per 625m ² (or maximum grid spacing of 25m) every 3rd layer
	Compaction Trial*	1 per method per source.

Note: Compaction trial to be undertaken for cement stabilisation of fill in Phase 2 of the earthworks.

7.2 Earthwork Acceptability Testing

7.2.1 Moisture Content and Field Dry Density

Compliance testing was carried out in accordance with BS 1377: Part 9 using the sand replacement method, core-cutter and nuclear density method (NDG) for density verification. The moisture content was derived using the oven-drying method carried out in accordance with BS1377: Part 2. A total of 62 NDG results were assessed against the relevant maximum dry densities (MDDs). The results indicate that greater than 95% relative compaction was achieved at all test locations, and all air voids were less than 5%. Dry densities ranged between 1.77 Mg/m³ and 2.01 Mg/m³, and moisture contents ranged between 10% and 17%.

The results of the NDG and sand replacement tests are included Appendix G.

7.2.2 Hand Shear Vane and Mexe Cone

Owing to the high gravel content within the fill material, the use of the Hand Shear Vane to obtain undrained shear strength, even within the more cohesive material, was deemed to be inappropriate. An attempt was made to carry out Mexe Cone tests which, again, consistently met refusal. As an alternative, Dynamic Cone Penetrometer (DCP) tests were undertaken at a few locations, from which an undrained shear strength may be estimated using empirical correlations. However, the results were spurious and it was therefore considered that any method of correlating to shear strength would be misleading.

Results of the attempted Hand Shear Vane, Mexe Cone and DCP tests are included in Appendix H.

7.2.3 CBR Plate Load

107 CBR plate load tests were undertaken on the completed filled areas, at a maximum grid spacing of 25m. Of these tests, 92 tests were at formation level, 8 tests were at the same grid location, on subformation and a top layer at formation layer, and 7 tests were retests following failure to meet the specified CBR of >5.0%. Following rerolling and retesting, all retest locations passed.

Results of the CBR plate load tests are included in Appendix I.

7.3 Results Summary

The results confirm that the materials passed the acceptability criteria on completion of placement and compaction.

Based on the on-site testing, the earthworks are considered to meet the specification requirements for the works completed to date. Areas where testing remains outstanding are beneath the stockpiles at the western edge of the site, and along the alignment where pre-existing piles were excavated and filling has yet to be completed.

The verification data from the material placed to date indicates the fill material and cut at formation level has performed well, achieving a greater than 95% compaction in all locations tested to date. In addition, air voids were limited to less 5%.

Seven CBR plate load tests recorded results less than the specified value of 5% on initial testing, however, all retests at these locations following rerolling, achieved >5%. CBR testing will be undertaken again once the formation surface is cement stabilised in Phase 2 of the earthworks.

7.4 Outstanding Phase 1 Earthworks

It is understood that the larger than anticipated volume of substructure removal was more than anticipated which has led to a shortfall in site won fill to raise the ground to formation level +100mm sacrificial protection layer in the eastern area of the site at test location grid squares, K2 to K4, H4 to H6, H10, J10, K4 to K7 and J10. In addition, the formation beneath the footprint of the recycled aggregate in the southwest corner of the site, in test grids C2, C3, D2 and D3 has not yet been completed. It is intended that completion of the earthworks to formation level, subject to completion of a full topographic survey, and earthwork acceptability testing, will be undertaken during Phase 2 of the earthworks when site is remobilised.

8. SUBGRADE/CAPPING/PAVEMENTS

No subgrade has been prepared or pavement placed to date.

9. DRAINAGE

9.1 Details of Temporary Drainage

Due to encountering groundwater in the excavations formed from removal of the existing foundations, and from rainfall, temporary sump-pumping was adopted where water had become ponded in some excavations. The water was pumped to temporary channels in the southern area of the site where it was filtered before being pumped into local storm water drains.