(1) a

Scott McFadzen/Project Management/Civil/Bberger
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To bob.dawson@tie.ltd.uk
cc steven.bell@tie.ltd.uk, matthew.crosse@tie.ltd.uk, Ralf Honeck/bilfingerberger/LNN/DE@BUB, Daniel Goedecke/bilfingerberger/LNN/DE@BUB, David
bcc
Subject ETN, Earthworks

Bob,

I have reviewed the Earthworks Design information (for Phase 1a) issued on 3 January 2008.

In general terms the information is not sufficient to enable us to quantify (and therefore price) the earthworks and is not good enough for us to assess earthworks risk.

Some examples;

There is no Designer's assessment of the extent of removal of soft or silty material below embankments except where there is a specific requirement for a starter layer.

The depth of the starter layer is only given as a minimum.

There is no Designer's assessment of any requirement for excavation and disposal of contaminated material.

On drawing 29 a requirement for a drainage layer is stated between CH 522,680 and 522,710 to detail A1. Detail A1 does not have a drainage layer.

While specifying the extent of the drainage layer by chainage is better than nothing, we would expect the drawing of that area (No 15) to show this information.

The note for the drainage layer detail specifies a "Class 6" material. Which Class 6 material is required?

The table on drawing 29 in the column "Minimum Capping Required" states in a number of cells; "to be advised by the Contractor". We require the Designer to assess the capping requirements for all sections of the earthworks and to specify the testing required to confirm on site, to be agreed with us.

The table on drawing 29 also in the column "Minimum Capping Required" refers to Note 2 in a number of cells. Note 2 refers to the risk of low (2%) CBR. We require the Designers assessment of the extent of these low CBR areas.

There are still significant gaps in the Earthworks Design,
e.g.1 Gogar Landfill (note in Register of Cuttings and Embankments states that Final Design being progressed.
e.g 2 Depot (the Depot Earthworks drawing is on a superseded base plan.
e.g. 3 Other sections between the Depot and the Airport.
e.g. 4 Drawing 29 only covers 5B and 5C

Regards
Scott

Actions from Geotechnical & Earthworks Meeting
Brunel Room, City Point, Edinburgh
11am, Friday 2nd November 2007

In Attendance: D Raeside Halcrow
A Johnstone Bilfinger Berger

Points Discussed:

1) Historical Landfill site, Gogar
2) Soils Edinburgh Airport – Gogar
3) Drainage Edinburgh Airpoart – Gogar
4) Carrickknowe – soils in cut / fill
5) Section of the works and where SI NOT taken
6) The trench excavations – Mudfa

1) **Historical Landfill Site**
   Although plastic bags are mentioned in the trial pit logs, this is basically a construction material tip – possibly over 40 years old. Some methane was present in the excavation due to the breakdown of timbers and a process has been installed to monitor any gas behaviour.
2) **Soils, Edinburgh Airport – Gogar**
   D. Raeside did produce preliminary results from the Norwest Holst and the majority of results from the horizon 1.0m were in the region of 3% - the top metre of soil comprise topsoil and soft silty clay with organics. More research is to be carried out using historical information from previous site investigations in this area. On completion of this research, the information will be added to that processed by Norwest Holst.
   Drainage, Edinburgh Airport – Gogar
   Consideration has been given to intercepting the existing field drainage system and constructing a suitable cut off drain and outfall – possibly both sides as proposed track wayleave.
   This would ensure that the formation will be relatively unaffected as a foundation for the earthworks infill associated with the track bed formation.
3) **Edinburgh Park – Carrickknowe**
   Again an exercise to establish the CBR values will be taken from historical data & construction works – Bus system CERT. This material is of alluvial nature and comprises mainly fine silty sands and sands and gravels.
   Further investigation will be carried out in the ground water behaviour for structures below 2.0m
4) **Carrickknowe**
   Very undulating ground between golf course and railway – more information required as the effect of soils by cut / fill apportions.
   D. Raeside will produce CBR and engineering criteria.

5) **Section of works and where SI NOT taken**
   An overall review was taken for each section of proposed Tram corridor, section 1, 2 and 3. Section 3, Russell Road – Airport, has the most site investigation as this is open ground and agricultural land.
6) **MUDFA**
   In the built up areas where services diversions are ongoing, a continuous site logging system should be set in place with photographs and thickness of road make-up and formations.

Notes on TIE meeting 12 th December 13, 2007

To summerise the last part of the meeting , Halcrow have the expertise to provide sections and TIE should instruct them on this matter .The non—logical part of the Halcrow design strategy is that the sections have been taken to suit the duct and drain levels at specific points(section nodes)and the ground between the sections has been deemed to be linear and even—ie following the rail profile. In the section Balgreen to Carrickknowe Bridge which is 900 lim long , there are only 4 cross sections . This presents a consider able scope for erroneous quantities and BB should insist that Halcrow ARE SOLELY RESPONSIBLE .

Classification of Materials ----ref to Document Outline Project Specification --- GEOTECHNICAL DESIGN ----14 /2/07
Halcrow stated only volumes would be presented and the contractor would have to make his own assessment .This contary to to te responsibility in design Scope 3.1.1 where the design of the phased ground investigation and supervision were in the Halcrow domain. Furthermore , the contractor cannot make any assumptions on the excavated materials as they have not been furnished with the conforming specification for the earthworks. Thus Halcrow should be responsible for quantifying and clasiffying ---3.3.1 @3.4.2 , the materials to be encountered during the entire works. classifies .

You should then outline the sections as described by halcrow and the delivery dates.

Engineering Appraisal on Northwest Holst Factual Report
Scope of Works
61 boreholes –shell /auger
25 boreholes –rotary
46 trial pits
4 hand excavated hand pits
L2 volume 2 part 1 ---page 13 / 372 identifies that made ground is present in the majority of the investigation works.
From the definitions provide in the text the following distinction is made : ---
FILL –material placed under engineering control .
Made Ground ---material placed without any control.

Boreholes
From the 47 borehole logs, 40 identify that made ground is present at the commencement of drilling to various depths. (85 %). The remainder are described as non man made strata or natural soils.

Rotary
The rock cores indicate that there are poor solid recoveries and RQD values. The point loading tests on the rock indicate the Mudstone is weak and the Sandstones are weak to moderately strong.

Empiracle Information from the Borehole Operations .

These are basically using Standard Penetration Testing or SPT and relating them to a soil strength and bearing capacity. These can be carried out in both granular and cohesive soils .
The method of counting the blows for a U tube undisturbed sample is best suited to cohesive soils.
Little or no cognizance should be taken for such tests carried out on MADE GROUND due to the variability of the imported material and the method of placement.

CBR Material has been sampled at various depths. The soil samples were compacted into a mould using a 2.5 kg rammer.
From the 18 tests taken, the following analysis:--
2 no are of embankment quality with values of 24 and 28 –note the gravel content
2 no are between 6 –9 % note varying moisture contents---9.1% and 22%. Marginal
5 no are between 3 –5 % -- with moistures ---9% to 16 %
9 no are 3% --0.4 % with moistures 17 to 31 %.
Thus 77% of the results indicate poor and variable ground within the top 1.5 metres, 11.5 % can be classed as marginal and 11.5 % can be classified as satisfactory and fit for purpose.

Atterberg Limits

each construction activity the analysis should be carried on the long-term settlement and on the materials prevailing.

OMC and MDD

Three sets of results were taken for the above using a 2.5 kg rammer and the results are; -

omc	max dry density	air voids
12%	1.98 mg/m3	5%
11%	1.91mg / m3	5—10%
9%	1.91 mg /m3	5—10 %

If the material was to be used in construction as per the Highways specification the moisture content range would be specified as omc +/- 2% .
The ill-sorted manner in which the made ground has been formed and the total lack of compaction will provide materials with very high moisture contents which will not conform to the above range.

Volume 3
This section contains MCV results and the chemical testing results.

MCV Results

This test is easy to carry out and is one of the criteria in acceptance for Class1 material in SRBW The sample size is 1.5 kg from which the material above 20 mm is removed and recorded. In Made Ground, due to the extensive variability of soil types present, it is difficult to obtain a representative sample for this test.
On material described as brown sandy gravely clay, 4 sets of calibration were taken and two individual results were also taken. It should be noted that none of the samples were within the area of track bed interest as the depths ranged from 1.5 –5.0 metres.

Bh/tp	depth	Soil description	mcv	%mc	Mcv	%mc	mcv	% mc	sens	Ret 20mmm
Bh27a	2.30	Brown sandy gravely clay	11	12.4	6.3	14.5	8.1	13.1	1.9	0
Bh30	1.50	ditto	6.9	9.5	14.2	6.9	7.9	10.2	2.3	7.5
Bh30	3.50	ditto	13.8	10.5						6.2
Bh32	4.00	ditto	15.1	18.7						4.9
Bh34	5.00	ditto	15	10.3						0
Tp43	3.50	Grey sandy gravely clay	3.8	14.3	14.5	8.5	11	11.5	2.0	3.1
Tp45	2.40	ditto	16.5	10.3	10.8	12.3	7.0	13.5	3	12.2

The sensitivity values are high and these equate to 1 % change of moisture effects the

mcv by the value i.e. m cv of 8 at 10 % and the sensitivity is 3 this equates to an mcv of 5 at 11 % moisture
This sensitivity will be extremely variable in samples of made ground material due to the variable source and mode of deposition.

Chemical Testing by Al chem

The chemical testing is factual and awaits an interpretative report.

Organics
The presence of organics has been identified both in the made ground and alluvial fine samples . The test results do vary and one reading is 2.40 % .

Volume 4

Basically the photograph are extremely poor in clarity and contrast and consequently the different soil arising cannot be readily identified.

They do however; identify the presence of plastic, wood, asphalt arisings, concrete and the ground water behaviour.
It would have been beneficial if photographs had been taken at each change of soil type horizon change and identified. In many of the photographs only the information board is present.

Unsuitable for Testing

Some 60 number samples could not be tested of which 10 number were for CBR evaluation. These missing test results were in the area of Bankhead Drive , Carrick knowe and ch710500 to ch711500 and would have provided vital information on which an engineering assessment could be based.

Conclusion

The fieldwork specified by the Engineer and his Geotechnical consultant and associated testing is basically for the Structure loadings but not for the construction of the track bed as the majority of works is within MADE GROUND.
In addition the soil profile between Gogar Depot and Edinburgh Airport comprise of Soft Clay and these soils extend to significant depths. Also in this section is a land fill site, which will require some pre contract works on the east side of the proposed Gogar Burn? Bridge in the form of abutment and wing wall footings and a pre load platform for settlement.
The designer may have taken the major aspects of the report into the construction design details as he has identified the use of geotextile in this section.
The designer may consider addition testing in the relation to CBR values to identify the areas which require treatment works to provide value of 10 % and above .

The design of the Track bed should be the equivalent to that used in West Edinburgh Bus or WEBS for the bus carriageway which comprised of 400mm of compacted crushed aggregate on a geotextile as it is being constructed on exactly the same formation – MADE GROUND with low CBR values.

Summarising Geotechnical Report

This report was collected from the TIE offices on Thursday 6 th December.

This report is basically in four sections and replicates information which is available in the data room files .
The sections are as follows :---

1) A collation of the laboratory testing and empiracle data corresponding to the soil types identified in the Norwest Holst factual S I report.
2) A folder of borehole logs from previous contracts which had no supporting laboratory testing results.
3) A suite of geological maps furnished by the BGS on the superficial deposits prevailing in the sections of the proposed tramway
4) A précis on each section of the proposed route which identified the topography and geology.

To conclude the summarising report does not assist in providing engineering interpretation for construction of the track bed or the associated embankments.
This engineering information is imperative in the progression of the works in terms of works programming, resourcing, and provision of quantities for tender costings.

test type	depth/other	mg/fine	m/grcoarse	alluv fine	alluv coarse	glacial s/g	weather till	glacial till	
moisture	chart 37 base 13%	23% suitable 77% u/s		15%suit 85%unsuit	18%suit 82% unsuit	27%suit 83%unsuit	31%suit 69% unsuit	70% suit 30%unsuit	
PL/LL		CL 75 % CI MI 25% CH Mh	none	60% 40%	none	none	99% suit	100% suit	
L Index	minus1--0 0--1 suit 1--2 unsuit	5% 78% 17%	none	4% 64% 32%	none	none	17% 66% !7%	25% 70% 5%	
Cohesion	poor(soft) firm stiff good	20 % 40 % 30 % 10 %	none	77 23 % 0	none	none	75 25 0 0	75 25	
SPT	4--10 loose med--loose 10 -30 dense50	not applicable	not applicable	loose 37% med-dense 15% dense 48%	loose 16% meddense 50% dense 34%	loose50% med dense38%dens e 12%	firm 80% stiff 20%	firm 5% stiff 95%	

CBR	poor 2-5 marginal 5-7 good 10	73 17 10	73 27 0	80 20 0	none	64 36 0	80 20 0	none	
PSD		none	none	silt 60 sand22 gravel 18	silt 20 sand 40 gravel 40	silt 15 sand 45 gravel 40	clay /silt50 sand 40 gravel 10	silt55; sand35 gravel 10	

TIE --- detailed response to Summarising Geotechnical Report.

This report was collected from the TIE offices on Thursday 6 th December at 10.30 a.m. The report has been divided into two sections for Line1 and Line 2. Since Line 1 is virtually on street and follows the existing levels, a detailed précis based on the information contained in the report has been carried out for Line2.

General

This report has been compiled using the recent Ground Investigation carried out by Norwest Holst, Ritchies in conjunction with Historical Information for previous engineering works.

Credence should be placed only on the recent ground investigation as this has been carried out on the exact line of the proposed works.

Line 2 Sections 5---7 –Murrayfield to Edinburgh Airport.

a) Murrayfield—Edinburgh Park Bridge---made ground.
b) Edinburgh Park Bridge –Gogar Depot –Predominantly made ground and fine alluvial /lacustrine material.
c) Gogar Depot ---Prior to the excavations by McAlpine , this area was competent glacial till.
d) Gogar depot ---Gogar Burn Bridge----Land fill tip and fine alluvial
e) Gogar Burn Bridge ---Park and Ride ----fine alluvial / lacustrine --soft clays.
f) Park and Ride ---Edinburgh Airport----Fine alluvial / lacustrine –to significant depths. Also made ground at airport retaining walls .

It should be noted that the area between Ch 710000—Ch711120 has been extensively excavated to provide archeological information. This area should be treated as highly disturbed ground if the backfilling was not carried out without proper compaction or engineering supervision and supporting test results.

PRECIS of Geotechnical Information

Basically this is a suite of laboratory testing and empiracle data corresponding to all the soil types identified by the factual ground investigation. (present and historical).

Since no technical information was forwarded with the file containing the historical boreholes , Bilfinger Berger has had to rely on the Norwest Holst report on the soils within the top 2.0 m of ground to assess the geotechnical conditions for the trackbed and the supporting formation.

To exacerbate matters , the coloured drawings ULE sw—geo---1---41 indicates the geological deposition of sediments which have been extensively overlaid by man made ground and comprise a variety of imported soils from unknown sources.
In cognizance of the foregoing and the supporting text from Norwest Holst L2 volume 2 part1 page 13/372, the majority of the investigation should have been done

on the made ground to forward engineering parameters to design the trackbed and supporting embankment and this has not happened.
With reference to the report section 6.32 f , concerning CBR testing , it states "the majority of which were below 5% " . The information on Chart 46 indicates that 80 % of the results are below this value.
A chart has been prepared incorporating the 7 soil types and the interpretation of the testing data based on the information from the Norwest SI report
The summarizing report has omitted the MCV and OMC/MDD information and both are key factors in accessing engineering properties of the soils.
To conclude, the summarizing report fails to provide an engineering interpretation from the GI report.
In section 7, drawing ULE 90130—07---DRG---00104, the CBR values are extremely low and the designer has identified a requirement for a Geotextile

Bilfinger Berger have assessed the earthworks quantities on the following premise

1) At existing Level deduct 800 mm

2) Embankments deduct 800 mm

3) Shallow cuts deduct 800mm

And the 800mm comprises of 400mm of trackbed and 400mm of capping layer on a geotextile.

The only exclusion to the above is in cuttings where the CBR at formation is greater than 5 %.

Proposed Engineering Solutions - For Discussion with Halcrow

	CBR:3 Formation		CBR:5 Embankment		CBR:10 Base Track Bed	Cut off drains	Use of site won material - fill	Remove
Section	Treat	Treat	Add	Add				
Edinburgh Airport - Gogar	Geotextile 400mm Granular	Lime Improvement 3-4% Lime	200mm Granular C/run onto CBR3	200mm c/run onto Lime improved	200mm - 75mm C/run / Granular	✓	No - soft clay and made ground material from depot - good fill	Top 1.0m
Edinburgh Park LTP 31 - 33 Carrickknowe	Geotextile 300mm Red Blaes	-	200mm C/run onto CBR3	-	200mm - 75mm C/run / Granular	✓	Possible due to granular material in made ground	Top 0.6m
Carrickknowe LTP 21 - 27	Geotextile 300mm Red Blaes	-	200mm C/run onto CBR3	-	200mm - 75mm C/run / Granular	✓ if suitable outfall	No soft clay 4/7 trial pits. CBR below 3	Top 1.0m
Murrayfield LTP 8 - 11	Geotextile 300mm Red Blaes	-	200mm C/run onto CBR3	-	200mm - 75mm C/run / Granular	?	Made ground - but contains coal / shale	Top 1.0m

Granular = Red Blaes
Lime Improvement

Geotechnical Report

Gogar Depot (West) – Hotel Edinburgh Airport

Location Sheets 40/41 39/41 38/41 37/41

No Information Sheet 38/41 Trial Trenches

Sheet 37/41
The tip identified by blue colour extends to the south as identified by the log description of BH 35 & 36.
This tip is in close proximity to the Gogar Burn and information on leachate or ground water should be requested in view of the potential environmental aspect of disturbing this area of tipped waste.
In the extreme western area of the Gogar Depot, trial pits 47 & 49 indicate a change of soil types over a relative short distance.
In tip 47, the clayey sand at 1.60 metres has a remoulded CBR value of 2.5% and a moisture content of 12%. Material from TP49 at 1.0m depth is identified as a sandy gravely clay and has remoulded CBR value of 27% and moisture content of 16%.

Sheet 38/41
No location of trial pits of boreholes are identified.
There are 4 No CBR results from TPs 51-53 and the values range from 0.4 – 24 with moisture content ranging from 14 – 24%. These CBR results indicate the significant variation in the engineering properties in soil horizon 0 – 1.0m.

Greenfield Section Location 40/41
From eight trial and borehole logs, the descriptions indicate that 6 number are soft clay, one is firm and one comprises "made ground".
There are no remould CBR values in this section.
From the Attenberg Limits taken at various horizons, the range of moisture contents are 16 – 32% and the plastic index range is 12 – 24%.

Investigation Adjacent to Hotel
Both trial pits 58 & 59 have approximately 1.50m and 2.30 depths of made ground.
In trial pit 59 between 1.10 – 2.30, the description log identifies organic debris and strong hydrocarbon odour. This material should have a chemical analysis carried out to establish the degree and type of potential contamination.
The moisture contents are 37% at 1.10m depth in TP58 and 16% at 0.70 depth in TP59.

Conclusion
A drainage system should be designed to maintain the stability of the soft clay.

To construct a formation on the soft clay which has poor CBR values (less that 3%) either consider a lime improvement treatment or a geoxtile/granular blanket. This matter was raised at the geotechnical meeting with tie on 2/11/07.

5 D

Report on Soil Conditions on Bilfinger Berger Section
Gogar Roundabout to Murrayfield

Location sheets --- 26/41 to 35/41 part

No site investigation -----29/41 to 31/41 and 34/41 and these areas will be covered by Historical Information drawn from previous works.

Special -26/41 –Baird Drive Window Sampler and Dynamic Probe –Results awaited

Detailed summary of ground conditions 0 –1.0 metre from Ground level

	Made ground	soft clay	Silty Sand	firm clay	Gravel
Trial pits –22 no	11	6	3	2	
Bore holes –14 no	12	1	1		
Total	23	7	4	2	
Percentage ----------64 %		20 %	11 %	5 %	

From the foregoing, 85 % of this soil horizon is highly variable and contentious when the aspects of differential settlement and long term consolidation are calculated.

Also 11 % -- the silty sands are susceptible to moisture changes and this factorshould be considered in long term settlement .

The designer will have taken the vagrancies of these ground conditions in his detailed solution to contend with the foundation treatment and support of the track bed . In addition the designer will need to take cognisance of the Historical Data and especially in the case of location 34/41 which relates to the present Edinbugh Park Construction Complex . This area was extensively used for various excavations and disposal of surplus spoil and the line of the proposed tram is through landscaped areas .

At Carrickknowe , rock was encountered in two areas within 1.50 m of the surface.

Engineering Information from the Site investigation .

1) CBR ---from remoulded samples taken from bulk sampes.
2) Atterberg Limits-----various soil types.
3) Moisture condition value---M CV
4) Particle Size Distribution and moisture contents.

Comments on the results from Made Ground --test results

- The sample taken for CBR testing may not be compatible with the variable material components present in the excavation.
- Bulk samples from the pit at 1.0-m depth may only represent 1 –1.5 % of the varying soil types and foreign matter present in the excavation.
- Test 16 Bs 1377 requires all material above 20 mm to be recorded and removed from the test sample. The test can be carried out in a dry or soaked condition.

- A 2.5 kg proving ring should be used for soft/wet soils.
- The engineering properties of the material above 20mm are not analysed.
- Since the material is not homogenus - in made ground, the moisture contents will vary and are dependent not only on the soil type –granular/ cohesive but on the degree of compaction exercised when deposition took place.
- The effects of any organics present as either rotted topsoil or tree roots. An organic content of 2—4 % can greatly reduce the mechanical stability of the soil present.

Analysis from the CBR results --12 no test results with a range of CBR values from 1.1 % to 8.4 % and moistures ranging from 9 to31. 5 % with the overall average being 16.5 %.

These are low values and since the materials present within the top 1.0 metre horizon are susceptible to moisture changes then significant changes in CBR values can occur.

Summary of results –12 no ---CBR 0—3 % ---- 5 no: 3—5 % ----1no: 5—10 % ----6 no.------from soil types comprising ---made ground; soft clays and firm clays : and weathered sandstone.

In the geological logs , many of the made ground materials were described as " recovered as soft"

MCV ---these results are normally carried out on homogenous soils and the test sample size is 1.5 kg and the material above 20 mm is recorded and removed from the test regime. No results are in the preliminary report.

Atterberg Limits 15 no results ----Soil horizon 0 ---1.0 metre

There is a wide variation in the results for both the moisture content and plastic limit and this may be attributed to the cohesive nature of the Made Ground which are probably reworked clays and the natural soft clays. The range of values for the Plastic Limit are 2 –25 and the moisture contents range from 9 –29 % .

Information from the Trial pit excavations.

Stability—most of the excavations were stable . The trial pits where material collapsed into the excavation are those with poorly compacted made ground or where there is strong groundwater inflows .

Additional Site Works

Given the large variation of materials and the fact that the test results give cause for concern in terms of sustainability and longterm engineering capability , it may be prudent to carry out Plate Bearing Testing . This insitu testing would provide load bearing critera and more accurate CBR evaluations on the material present at any proposed formation level. This test is easy to carry out and will provide quick results .

One further area of investigation could be an compacted embankment comprising made ground ---either granular or cohesive excavated materials .Similar testing could be carried on compacted formation.

This is the only practical way in which relevant information can be assessed to promote confident decisions on the engineering parameters and overall suitability of the site materials.

Recommended Treatment on Soil Horizon 0—1.0 metre from Groundlevel

Based on the Geological Logs and Engineering Test data.

- Strip all vegetation
- Compact exposed ground to assess the suitability and test .
- Two Alternatives now as an option.------Geotextile with granular material compacted in layers as Table 6/4 or improve the formation by lime application and test again.
- Compact with granular fill to 300mm below the track level ---as above.
- Compact a crushed granular material --300mm to provide a CBR with a value of 10 or more at track bed level .
- Testing could be ---Plate bearing , Kleg hammer or Mexi probe
- In soft areas , either excavate the areas out and replace with granular or pre -load the embankment ---surcharge ---time related.

tp / bh	soil type	soiltype	soiltype	soil type	stability	water	depth	m/cont	CBR	m/cont	PI
L2tp8	madeground	sand /gravel			u/stable	dry					
	800	1200			1300						
L2 tp 9	made ground	madeground	silty sand	sand /gravel	u/stable	heavy					
	900	900	900	300	2000	2700	1200			25%	21
L2tp 10	made ground	made ground			u/stable	med					
	500	1800			700	2000					
L2tp11	madeground					drain					
	700					600					
L2tp11A	made ground	made ground			u/stabe	dry					
	1700	1400			2000						
baird	drive	window	sampler	and	dynamic probe						
L2 tp16	made ground	soft clay			stable	dry					
	1400	1000									
L21tp17	Topsoil	firm clay ?	soft clay/peat	clayey s/grv	stable	dry	700	17%	2.9	29%	13
	300	1300	500	1400							
L2 tp18	topsoil	soft clay	silty s/gravel	firm clay	stable	light					
	300	700	1900	600		2900	600	31%	3.1	31%	25
L2tp19	topsoil	silty sand	sand /gravel	firm clay	stable	med					
	300	600	1500	900		2400					
L2tp20	made ground	sandy silt	sand gravel		u/stable	seep					
	1200	1000	800		1800	2200	700			14%	18
L2tp21	topsoil	soft clay			stable	dry	800	22%	8.4	22%	11
	200	1000									
L2tp22	topsoil	sand/ gravel	s/grv cobbles		stable	dry					
	400	1300	1100								
L2tp23	topsoil	soft clay	soft clay/		stable	dry	900	20%	4	20%	14
	100	1700	600								
L2tp24	topsoil	soft clay	wtherdsand/st		stable	dry	700	9.10%	7.4	9.10%	17
	200	900	100					9.1			
L2tp25	topsoil	soft clay	soft clay		stable	seep					
	200	2000	400			2400	800	16%	3		
L2tp26	topsoil	silty clay sand	silty s/gravel		stable	dry					
	300	400	2400								
L2tp27	topsoil	firm clay	clay/grv sand		stable	dry	700	18%	2.4	18%	11

	300	1300	1500								
	Carrickknowe to Edinburgh park										
L2bh16A	made ground	made ground	made ground	v stiff clay	stable	dry					
	1200	400	900	3200							
L2 tp 28	topsoil	made ground	made ground	vstiff clay	stable	dry					
	300	1200	700			tiledrain	800			8.00%	10
L2tp 29	topsoil	made ground	vstiff clay		stable	light					
	200	2400	900			1800	600			14%	11
							1200			26%	29
L2 tp30	topsoil	made ground	made ground		u/stable	heavy					
	200	1400	600		1900	2300	600			12%	9
L2tp31	topsoil	made ground	clay sand /cb		u/stable	heavy					
	100	1400	600		1700	2000	800	14%	5.5	14%	10
L2tp32	topsoil	made ground	made ground	clay sand	u/stable	seep					
	200	1600	900	800	2400	2800	1000	12%	5.2	12%	9
L2 tp33	topsoil	madeground	sand /gr/cb	v stiff clay	stable	seep					
	200	2200	1000	400		2900	500	9.5	4.7	9.50%	17
L2 bh17	top[soil	clay sand	stiff clay		stable	dry					
	200	1100	9000								
L2 bh18	topsoil	madeground	soft clay	clay sand		flow					
	380	520	400	600		2800					
L2bh19	topsoil	made ground	clay sand /grv	clayey sand		flow					
	350	350	500	4400		2200					
L2 bh19a	topsoil	soft clay	v stiff clay			flow					
	200	3300	4000			3400					

TECHNICAL QUIERIES EARTHWORKS ___EDINBURGH TRAM

1) ADDITIONAL SECTIONS Further cross sections are required for 1A ---1C, 5A---5C, and &. These sections should be at regular intervals---- 20 metres and the issue for information on the sections marked in abeyance are urgently required so that quantities can be calculated.
2) ARCHEALOGICAL Details of the logs and method of backfilling and compaction required. If the backfilling has occurred without compaction please forward detail s of Remediation works.
3)GOGAR BURN BRIDGE details of levels and bearing capacity for the East Wing walls ---Reinforced earth .In addition details of the Abutments are required if within the landfill zone and the process and programme for remediation
4) Land fill tip at Gogar Burn . The extent of this tip and area of the tipping operation is more than indicated on drawing –ground investigation plan 37 of 41 and the borehole log for Bh 35 identifies waste .Details of pre—earthworks loading or similar treatment to remediate are required.
5) CBR---In Norwest Holst factual report , many of the areas of the contract have no information. Since the majority of the proposed works are to be constructed on made ground , the requirement for CBR information is essential to complete the trackwork design and earthworks quantities.
6) Details of Track Types and Finishes ----On street and Off street
Details of lengths of section are required ----drawing ULE 90130 saw drug 00071requires to be completed. The lack of this information is delaying finalization of quantities and programme constraints.
7) SoftGround DrgULE 90130 –07---00103and 00104 identifies the use of a Geotextile to accommodate the areas of Poor CBR. Details of type and specification are required and also the width and lengths. Again this is required for programme and resorting implications.
8)Treatment of Soft Ground –the designer was requested to investigate the possibility of improving the soft clay by the addition of lime Please advise as this involves windows of inactivity and intensive testing which again effects the programme for the works.
9)Norwest Holst Factual Report This includes the chemical analysis from Alchem who have reported the results and not an interpretation on the various classifications. To complete risk assessments , disposal implications and PPE for the operatives a report on the contamination levels is required.
10) Red Site ---during the ground investigation carried out by Ritchies at Network rail Haymarket depot, the area of investigation was classed as a red site and required special precautions. Will future works in this are come under the same restrictions.
11) Made Ground ---Off Street ---Since 80% of the contract is to be constructed on this variable media , a detailed interpretative report is required for the suitability any remediation that may be required
Alternatively a similar design and construction technique as used in the WEB project could be adapted as the ground conditions are identical.
12) Embankment Slopes. Could these be redesigned to a batter of 1:1.5 as oppose to 1: ~~w~~ 2.

This would assist in accommodating the U1 material as fill.

13) Finish to designated path. Could the specification for the finished surface of the line side path be furnished?
14) Delineation on LOD boundary Details are required of any works required and when these works are to be completed. This information is required for programme restraints and resourcing plant, labour and materials.
15)Drain outwith the LOD boundary –The cross sections indicate that in some instances , the cut off is outwith the boundary . Are there any restrictions on the way leave to construct these drainage works?
16) Cut –Off Drains ---are these at a standard depth or do they incorporate the field /agricultural tile drains.
17) Toe of Slope Drains –There are no toe of slope drains on the sections. Could you clarify this is the case.
18) Influence of the Carrier Drains on the Trackbed Stability---From the cross sections the drain alignment is within the 45 degree stress zone of the outer rail. What are the backfilling requirements for the drain construction? Again there is a programme implication to carry out these works which may require shoring in poor ground conditions.
19) Raise the Embankment to accommodate Duct lines. Again the cross sections show the ducts adjacent to the drain excavations and consequently the degree of compaction may be difficult to achieve. Could the duct lines be accommodated in a raised embankment which could also be used as the footpath?
20)Duct manholes and Drainage Manholes–these are in the close proximetry to the trackworks and consequently do they require any special engineering treatment.
21) Carrier Drain ---what are the general sizes of these pipes which have dual functions ----carry water and store water in times of storm conditions.
22) Alternative system for Attenuation. Could the larger carrier pipes which are close to the track bed be redesigned on the basis of smaller pipes and purpose built tanks or ponds .23) A Combined Drainage System could the cut off drain and the carrier drain be relocated to allow a single excavation out with the tracked influence and allow manholes as catch pits to store water.

item	Detail Ref	description	Unseen=U	other
1a	A1 Embk	From the GI ,BB have interpreted the requirement to remove 300mmtopsoil : 500 mm subsoiland the upfilling is site won material with a CBR of 5% on a lowgrade Geotextile.		
		The Designer has not specify an spec for the formation and a classification for disposal	U	O
1b	A1 Embk	Detail identifies the top 1200 mm to be class 1 or 2 with a CBR of 5% with 300mm capping layer of CBR 15%--this gives an o/all embk height of 2.0 m to rail lvl from g/lvl.		
		Designer no information on loading the formation	U	
		Could the designer identify and quantify – Emb -0—2m : 2—4m , 4—6 m etc		O
2a	A2 Wide embank	Relocation of services –pre-contract requirement or MUDFA	U	
2b	Ditto	Hydraulic Conductivity Designer to clarify and provide engineering details to accommodate . .	U	
2c	Ditto	Benching		
		This starts at formation lvl	U	
		In a 2.o m high emb the benching would be 2 steps of 4.0m wide Does this apply to D2 D3 and the Murrayfield / baird drive/roseburn reinforced earth retainwalls	U	
2d	Ditto	Starter Layer –Does the thickness correspond to the 600mm steps	U	
		Designer to provide details --horizontal and vertical for continuous drainage.		
3a	A3 Embk	The use of site won materials can only be used in embankments above 2.0 m---see 1b		
3b	ditto	Width of embankment vague –embanks of 7.50 m high –as as shallow embanks.----2 by 3.0m onto track corridor width.	U	

4a	A4 Emb	Top 600mm –capping layer –CBR 15% and lower is class1/2 with CBR 5% . SHW used to have 660mm on a formation of 3%CBR. BB with geotextile should attempt to reuse all excavated material except topsoil.		O
5a	B1	What level does starter/drainage layer-at ground or stripped ground IS THERE A MEMBRANE AT INTERFACE .	U	
5b	B1	Minimum thickness can be qualified –are the volumes remeasurable especially in made ground	U	O
5c	B1	Details of filter drainage every 10 metres—is this necessary		O
5d	B1	Details of ditch—width /depth. Is it lined / short /long term maintenance	U	O
5e	B1	Details of material between toe and ditch . Else should the starter layer extend into the ditch	U	O
6	C1 /C2	Rather elaborate and plant /labour intensive could 6B/rockfill be incorporated rather than class1—that is point loading as oppose to compaction.		O
7	D1---D3	Quantification of extent of works should be provided by the designer in the BOQ	U	
8	E1	Detail of drainage required and what provisions are present to accommodate existing field drain and ground water	U	
9	E2	Details of relief drain –at grade and cuttings in trackbox . The embankment makeup is 10 00 mm –of material with a compacted CBR of 15 %. Does the BOQ take full cognizance of the material to be generated when the subformation is at grade or cutting.		

10	G1/H1	Probably applies to very few areas –but on the grounds of safety could the following be considered a) berm with drain b) rock blanket c) gabion /reno mattress d) CDM Adjudication. These alternatives would reduce the depth of the verge drain.		
11		Comments on Notes Earthwork Standard Details Bottom page Note1—designer should identify the poor ground conditions on a drawing. Note 2 settlement calculations for embankments Any special treatment at formation level—i.e 1a material Note 5 stone size in table 6/1, 6B cannot be placed in a 500mm layer maximum Note 6 The designer should identify the sources / location / quantity of site won rock. Note8 to avoid floding is there a provision for swales / u/ground storage. Note 9 New embankment to be proof rolled . Method compaction –SHw table 6/4 as opposed to performance . Note 10 Details appendix 7/1 Note11 the designer should forward method statement for construction of benches---ie especially on poor ground or soft formation Notes in LHS COLUMN Note3 Appendix 6?1 specification is required Note4 Geotextile alternative design should be issued by the designer to maximise the use of site won material.	U U U U	

		. Note 5 Surcharge of embankments full details of methodology and location any any instrumentation Advance works contract –include these operations and works for earth retaining walls ULE 90130 -05 –Geo –00029 This is a classification rather than a detailed quantification allied to engineering and geo technical principles and site conditions. BB can only price the quantities and instruction given by the designer. From the notes in the table of scope of works sections 5band 5c. Notes 1 Thedesigner should forward the testing schedule and frequency guidance. 2 CBR value of existing ground is solely the responsibility of the designer and any pre start testing should be included in the advance works package –or BOQ –provisional sum. 3 No detail appendix 6/1 in data room. 4 No dive amount of details of drw—00052—54 in data room. 5 An extensive amount of testing can be carried very quickly –insitu CbR – machine or by hand. Drw Sections ule 90130—07---00103 Note there is no reference by the designer in above drawing table geotextile / cbr below 2 % Contamination –no mention –serious potential problem as experienced in previous contracts at the network Rail Haymarket complex.		

Gogar Landfill ---Halcrow Report .

Having walked this section of the works on Friday 14th December and carried out a rough level survey on 16 th December, several TQs have been forwarded to TIE .
A site meeting was held to day 17 th December with Neil Hobson of TIE to discuss the line of the works and extensive land take for LDO. This meeting was extremely informative and the excavation of the land adjacent to the south abutment was examined. Neil explained that the material disturbed was demolition rubble and soils and the excavation was dry.

With regard to the report from Halcrow , there are several options and the engineering methodology on these proposals have been requested for evaluation and technical appraisal.

A suggestion was presented to Neil Hobson that given the extensive length of time that this tip has been in place ----will the weight of the tram cause excessive settlement ---and this tip may act as a soft soil –CBR 2—5 %, should plate bearing tests not be carried out to establish the Loadings as well as CBR. Such tests would require a machine for several hours and input from a testing house like Stanger.
Once the test results are established – the remedial action for the landfillarea –which almost 400m in length ----may 2—3 days compaction with a heavy roller and then a further set off CBR tests taken .
If the CBR values were given to Tensar, then a geotextile solution could be evaluated.

Further points to consider ----
Are the Reinforce earth wall necessary and could they be replaced by reinforced earth embankment
At the A8 this burn is culverted ---could the same design not be considered .
The stream is approximately 5.5 m wide.

(7)D

EDINBURGH TRAM

Enclosed is the draft geotechnical summary for the extent of works within the Bilfinger Berger Section—Murrayfield to Edinbugh Park This summary is based on the information based on the Preliminary Report.
The section from the Airport to the Depot at Gogar is being prepared.
Norwest Holst Factual Report was submitted to T.I.E on 16/11/07.
The Interpretative report, which is being prepared by Halcrow, will be forwarded to T.I.E on 23/11/07 and will include Historical data extracted from previous Site Investigations.
During the induction with T.I.E , they mentioned that there would an archaeological presence during the excavation activities whilst in areas of designated interest.
It would appear that the majority of bulk excavations have been completed in the depot area and the access gates are locked. TIE have forwarded a contact and telephone number for anyone who wishes to visit the area.
It would be prudent to examine the condition of the excavations and any drainage measures taken to protect the formation. This visit would also include taking photographs for record purposes.

CROSS SECTIONS WILL ALSO BE PROVIDED AS PART OF HALCROW SUBMISSION

7C

Technical Query

Chain age 710100---710400 ---- Old Landfill Site

To ameliorate the surrounding land on both sides of the tram corridor, could this area be utilized for landscaping by incorporating surplus materials arising from the excavations in Section 7 of the contract.
The final landscaping proposal could be incorporated in the overall scheme of the works .

Clay 2C ---Barr at Gogar Depot

It is anticipated that 80000m3 of re useable 2C material will be available.

Section of works	transport	quantity	comments
Gogar—Edinburgh airport	moxy	20000m3	Awaiting sections ***toquantify 711120--711250
A8 –Edinburgh Park Br north	road	10000m3	Depends on made ground in Edinburgh Park
Edinburgh Park South BR	road	17750m3	Depend on made Ground
Carrick knowe Br--Balgreen	road	18000m3	
	total	655750m3	****to be added

David these are rounded up quantities ---the surplus should be accommodated in the last 1400 metres of the tram line.

Note there is sand adjacent to the A8 –which has been taken for fill and this material could utilized for duct line surround /cable sand.
In addition there is a source of rock near the surface at Carrickknowe and this may be exploited for a small borrow pit .

Site Visit with tie, Gogar Depot
20th November 2007 @ 14:00

Attendees: **N Hobson** **tie**
A Johnstone **BBS**

Subjects Discussed:

The depot site has 4 separate excavated cells of varying depths. The two deepest cells or voids to the east of the site are holding water which is percolating from the severed field drainage system.

In addition, the 800mm high pressure water main is leaking at the massive concrete thrust block adjacent to the Railway Embankment.

On the northern face of the excavation which is parallel to the airport boundary fence, there is slight seepage at the interface of the silty sand and grey boulder clay.

Tie intend to bring pumps to remove the ponding water and deal with the ingression of water from the field drains. The original area of land which was designated for the depot has been extended to accommodate:

1) Diversion of the 800mm HP water main
2) Replace a second pile retaining wall with a 1:2 batter from the area adjacent to the A8/Gogar roundabout
3) To locate the Tram depot scarcement toward the airport

Neil Hobson stated that approximately 110,000m³ which included the roadside bunds had been removed from site.

The diversions for the 1200mm HP Gas Main and 800 HP water main are scheduled for early 2008.

To the western end of the site, tie have a licence to enter the adjacent fields, and this will release a wayleave for any future works to construct settlement bunds on the area of the former infill tip.

The site visit was completed at 15:30

Murphy's Works **Sighthill Drive**
A brief inspection of the excavations associated with the gas main diversion was carried out. Tie excavations were adjacent to the cycle path and comprised of made ground in the form of reworked gravely clays with demolition waste which was predominantly tar & kerb stones.

The cycle track had been constructed as follows:

1) Layer of terrain/geotextile
2) 150mm of compacted sub-base
3) 100mm of blacktop

This corridor of lane ~~fasts~~ Falls to the railway and will require a cut/fill operation to achieve a formation to accommodate the track bed levels.

The surface was water logged with ponds of standing water. Part of the proposed wayleave from the Tram system was occupied by travelling people – is this a future source of aggravation?

Points to consider on the present condition of the depot:

1) Who accepts the condition of the present excavations carried out so far, especially the ingress of water into the works.
2) Is the area to be surveyed for quantities
3) Establish the additional land take into the airport property, and the consequential works – ie present 2.0m security fence.
4) The provision of a cut off drain and outfall (Gogar Burn)

To conclude, Neil Hobson raised the point of the route of the tram across the A8. He is looking for an innovative scheme to construct the tram void with the minimum of traffic disruption. It was suggested that a form of tunnel be considered for this which would be in the region of 8.0 m square – 8.0m in height x 8.0 m in width.

a) mine/excavate/cast box/push
b) box shield – mine segments
c) What is the largest boring tunnel machine

The boulder clay is compact material in which to drive a tunnel. Bilfinger Berger are experts of tunnelling – any suggestions?

It is difficult to judge whether Neil Hobson has any influence with the tie project managers to influence any change from the cut & cover system in the specimen designs. There is much merit in reducing disruption to the main arterial road into the city.

7a

MUDFA
Leith Walk Surveys of Trenches
Albert Street – Pilrig Street
7th November 2007, 8.00am

A site inspection of the trench works was carried out in the above area and the road formation was logged and photographs taken.

In the middle of Leith Walk Carriageway, remnants of the old tram system were present in the form of rails and grass ties.

The depth of rail was approximately 300mm and the ties were of 1200 centres. Below the rail system was an additional thickness of 40mm concrete – approximately 300mm.

The road formation thickness decreased adjacent to the pavements.

Typical Section – Middle Leith Walk

100mm	Wearing Course
200mm	28-20mm, Base course
150 – 200mm	40mm Concrete formation
200mm	75mm Hardcore / C run
100mm	Fine Brown Sand
Below (1.0m)	Dark Brown fine silty sand with gravel

The other area examined in the survey was the trench appearing at Jane Street and again some 450mm of road thickness was present.

Samples of the concrete and dark brown silty sand were taken.

It should be noted that the sand face was dry and stable over a height of 1.0m.

McAlpine the contractor would be obliged if tie could consult with MUDFA so that any representative carrying out the surveys would be properly inducted – Graham Strachan, Health & Safety Manager.

Observations on Series 500 Drainage E...T.N

a) pipe bedding details as previous --graded or all in aggregates : Type B ; no fines conc
b) Pipe testing by air or water / also chambers to be water tested.
c) Filter/carrier -- perforation or holes to the top
d) Filter drains to be wrapped –terram 1000 or similar to top of filter media . This is also the case for contaminated land --- ULE—90130-sw-rep-00383---not in data room and forwarded to TIE in December 2007 by Hal crow.
e) Backfill—as Class 6 and table 6/1 and the infill has to conform to " the equivalent adjacent pavement layer "----ie could have a mixture of 2c and granular material

Also compaction at depth greater than 1.5 m and any testing . In the loading influence of the tram –a solid compacted media is required and a TQ will be raised to clarify this point.

Across the fields and verges , class 8 material is specified.

f) Land d rains –they are to be incorporated into the new system and a TQ should be raised for the Detail --ie on jointing and any lateral support.
g) Chambers are to be water tested ----can a proprietary system be forwarded for approval.
h) Pollution Control devices and Flow control devices with alarms –detailed in drawings
i) SEPA---early meeting and discussions to be arranged . Implement a joint system for site liason and presentation of records.
j) Maintenance of existing drains and register of cleaning ----disposal of material who will be responsible. Should a TQ be raised on this matter ---as road sweeper brush arisings may also come under this consideration.
k) Contaminated ground –clarification should be sought on the status of the made ground --especially those with old road tar etc ---potential leacheate.

In section 5b and5 c---the following drain depth and element of works are

	5b	5c
0-----1. 5m dig	70 %	44%
1.5----2.5 m dig	30%	30%
2.5----3.5 m dig		10%
3.5 ----4.5m dig		5%
4.5 ----5.5 m dig		9%
Deeper than 5.5 m		2%

Also v dicth with assumed csa of 1.om2 ---lined or as dug / soiled and seeded. ---A TQ requires to be raised. –lencth 2695 m in 5c

Costings of Mobilization and Advance Works Contract

item	section	Testing	duration	plant	equipment	material	Approx costings
1	7a gogar landfill	Loading settlement	1 week	15 ton exc	Steel plate Skips levels	20/30ton of cheap fill	£2000
2	ditto	Trial pits Plate brg	2 days	ditto	Plate/gauges Etc-	nil	£1000
3	5c edinburgh park	ditto	ditto	ditto	ditto	nil	£2000
4	ditto	Soil samples	1 day	ditto	sampling	nil	£1200
5	5b balgreen to Edinburgh park	Trial pits Load bearing tests	3 days	ditto	Plate /gauges	nil	£3500
6	5aMurrayfield backpitches	Tria;lpits soil conditions water table	2days	ditto	sampling	nil	£1700
7	Trial embankment 5b carrickknowe golf course	Plate bearing	5 days	Ditto compaction	Sampling Site /lab testing	3 sources clay gogar made ground imported and crusher run Geotextile	£30000 ***
8	Trial holes 5c /A 8 5b carrickknowe	Soil samples	2 days	15ton excavator	Sampling site /	nil	£2000

£42400: 00

In addition, there will be laboratory costs for gradings and conformance testing ----Mcv and OMC determination and a provisional sum of £5000 should be included.

***This proposed operation will be part of the paid works along the Carrickknowe embankment . The main reason for this work is to assist in sourcing the site won material and assessing the performance of the material under compaction. BB roads intended to have a simple ongoing testing which would involve the use of shear vane and Kleg hammer calibrated against the field and laboratory test values to ensure the formations are compliant with the CBR requirements.

Item 1, this would be priority as the site loading test using loaded skips on a steel plate of known dimensions would provide a load bearing value of the landfill site. The designer should be involved and provide the settlement limits and any further considerations should be quantified and incorporated in these proposed trials.

If the designer requires any further testing, then these works can be accommodated in the programme

Geotechnical Requirements in Mobilisation and Advanced Works

1 Insitu Testing ----CBR by hand and machine (plate bearing) and Klegg Hammer / Shearvane for result comparision
Areas--------section 5 and 7 and Grahams section
2 Gogar Landfill -----Plate Bearing testing and trial compaction with detailed engineering
Surcharge if designer instructs --details of embankment heights and Instrumentation
Remove trees and vegetation and roots
Construct temporary road for site and piling equipment
Construct piling platforms both sides of Gogar burn
Licence from SEPA –for Stream crossings ---Gogar and small

streams toward airport—preferably pipecrossings or RSJ brige abutments -----Note this will be the main access unless agreement can be reached with Highland Prproperties ---Gogar Mains
May have to construct temp haul roads adjacent to tarmac road.
r landfill from abutment SEPA exemption to tip adjacen t
Construct Reinforced Earth Embankment.

3 Section7 Culvert stream crossings
Excavate pre-earthworks drains both sides and connect existing Landdrains and construct outfall into MH / headwall. Improve the bearing capacity of the formation –lower the natural moisture content.
Remove fencing and hawthorn hedges
Royal Bank Mounds (2) at Gogar Church and Radio Mast—Remove
Improve present access for traffic / small layby at present.
4 Murrafield Baird drive Balgreen (Jenners) Rose burn corridor

Remove trees and vegetation and roots Stability Railway bank
Cut and form benches and starter layer
Form the Formation of theReinforced Earth Structure Drainage / Starter layer and up to 1 st strap level. Any concrete founds.
Form temporary access roads on terram.
5 Balgreen –Carrickknowe ---Bridge

Remove vegetation and trees /bushes,
Carryout cut and fill exercise
Pre eartworks drains and outlets
Construct road on capping layer as temporary road and
Make up the rest as main haul road to bridge –steel/ conc/ fill
Down takings –cadet hut..
South Gyle Brige downtakings conc founds etc reinforced earth

M9 EXTENSION / A90 WIDENING
MAINLINE AND SIDEROAD VOLUMES

UPPER FILL

	EARTHWORK AREA						ROAD BOX		IMPROVEMENT LAYER				Below EW Outline: SOFT AREAS	Above EW Outline: TOPSOIL	CUT										
	Cut / Fill Area	Section	Contractor	Start Chainage	End Chainage	Length	Depth	Volume	Section Length	% Length requiring improvement layer	Depth	Volume	Volume	Removal	Gross Cut	Existing Road Excavated	Cut including existing road box excavation	% Acceptable	% Rock	% Unsuitable	Acceptable (a)	Rock (b)	Unsuitable (c)	Environmental Measures (d)	General Fill (e)
1a	Airport to Depot	7A	Farrans	712,600	709,805	2795					0.6	21330		9136	16926								14926	✓	25276
		5C(p)	Farrans	531,700	531,290	410																			
	Depot at Gogar Burn	6	Barr	531,500	531,500										30000										
	Depot to Murrayfield	5C(p)	BB	531,290																					
		5B	BB																						
		5A(p)	BB		510,880	20,[illegible]						57600		23773	28500						14895		10697		7820
	Murrayfield to Haymarket	5A(p)	Graham	510,880	510,000	880				Class 6		(11700)		750									2500		
		2A	Graham	200,800	200,000	800						2112			2138						800		4928		2775
		1D (p)	Graham	131,250	131,100	150	0.6	540																	
	Haymarket to St Andrew's Sq	1D(p)	BB	131,100	130,000	1100	0.6	3960																	
		1C(p)	BB	130,000	121,243	8757	0.6	31525																	
	St Andrew's Sq to McDonald Rd	1C(p)	BB	121,243	120,000	1243	0.6	4475																	
	McDonald Rd to Foot of the Walk	1B	BB	111,250	110,000	1250	0.6	4500																	
	Foot of the Walk to Newhaven	1A	McLeod	102,720	100,000	2720	0.6	[illegible]																	
1b	Roseburn to Granton Square	3	BB	300,000	400,000																				
	TOTAL							-				-	-	-	-	-	-				-	-	-	-	-

Rock Bulking @ 15% -

Total Suitable Fill (a+b) = -

Fill to be im

NOTES :-

1. [illegible]
2. [illegible]
3. Embankment [illegible]
4. Sections [illegible]
5. Section 5B [illegible]
6. Section 7 [illegible]
7. Bulk excavation [illegible]
8. [illegible]
9. General Fill – [illegible]
10. Soft [illegible]
11. [illegible]

ETN Earthworks Schedule
Rev A
Issued to MCL 7/6/06

30/01/2008

12. In the on-street [illegible]

CEC01511679_0038

(1C)

Murrayfield Stadium Concourse Retaining Wall / Steps

With reference to the report by PB on the above , enclosed is the reply and alternative solution

BH2 005 / 006
Very little test or technical information on the soft brown clay . In addition the water table is sub artesian and is fed from the underlying sand and gravels which contain cobbles and see boreholes notes.

Option 1 is fraught with difficulties due to the strata and water problem.
The piling will be extremely slow and the intergretity of the piles will be dependent on the number of obstructions. Difficulty in assessing the founding depth .

Option2 –Would need sheet pile cofferdam approximately 8.0m and the driving in the last 3.0 m will be hard driving -----high vibration and noise . The logistics will be difficult –short of room . The spoil will be wet due to the water table and will require special disposal costs due to the element of diesel element.

Option 3 The embankment is 6.0 m high and there is a high element of temporary works
The problem with the loading adjacent to bankseat could be achieved by loading with concrete kentiledge blocks ---high plant costs and removal .
Is there any instrumentation involved in the settlement assessments.
The 12 month delay ---does this included 120 no piles construction period .

SYNTH

There three alternatives

1 Polystrene /polythene/ geotextile –approx £80 ;00 perm3 + fixing and placing . / Recycled clayed - small pellets 0.5T/m3
2 Use of PFA ----reduce surcharge –1.50 kg /m3 as oppose to 2.20 kg/m3
3 A steel structure on spread foundations to carry pre -cast steps and landings
4 The bankseat could be founded on large bored piles ---with polystyrene backfill.

The description of the layer of soft brown clay has traces of gravel and sand and there was a U tube---U18 -- sample taken at 5.0-- 5.50 m depth and any test information would assist in any analysis . Given the hugh implications of the presence of this soft layer it may be prudent to sink another borehole to obtain the relevant information.
To conclude , any excavations in this ground should be minimized due to the diesel smells emitted from the soil horizons