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i	Cest un Ground	dertaken -water w	in accordar as encounte	nce with Bo ered at a d	EN ISC epth of 1	2247 80m.	6-2:2005;	Dyanmic	Probe Super Heavy, Method B.						
	Driller		Originator	Struck	Grou Rose T	nd-wa Time	lar (mins) Cı	n on	Water Added         Chiseling         Flush           From         To         From         To         Time(thr)         Returns         Type         To	Depth	R	Fig No	:	سلسيسيس	
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ģ	ampla		ples and Te	sts	Casing		Level (mOD)	Depth	Description of Strata	<u> </u>	Legend	Water Depth	Backfill Q Dep
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CE	ation:	<u></u>		Orie	entation:	Verti	cal	Mir o'n roon	Equipment: Da	indo 2000	***********					Cable F	a cussion	0 7.00	
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_	Driller DP		Originator	Struck 1,60	Groun Rose To	i-wate	nins Cu	on	Water Added From To	Ch From	isolling To	Time(hr)	Relums	Flush Type	To Depth	RAEBU	Fig No:	J	
Č.	hk & A		Status							1						B.	B	et 1 of 1	

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_	Driller DP	-	Orig	inalor	Struc	k Ros	arouni se To	1-vale Time(	it mins) C	ut Off	W: Froi	ater Added Chiselling Flush m To From To Time(hr), Returns Type To D	epih R	Fi	g No:		<del></del>
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-	Drille	r	Originator			Sround			- I	Waler	Added	E	Chiselling	The - 2	I-5	Flush	T7- 6: 11	R■	Fig N	o:		<del></del>
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Engineer Billinger Berget IX Ltd  Interpotion Page 120 200  Service Services and Tests South Corps Cor	SECTION 5A - RETAINING WALLS S21B & S21D  Borehole No:  Client: Billinger Berger UK Ltd	21703 o: DP20
Serrybis and Tests Death  Doth  Result Doth  Doth  Result Doth  Do	Engineer: Bilfinger Berger UK Ltd Inspection P Cable Percu	Pit to 1.20 cussion to 6.00
Remarkets:  1.00		Water Backfill
Agentalists  Agent	#TODAC	Depth Depth
Remarket:  # MADE GROUND (set, save, growl, great and stack fragments)  # MADE GROUND (set, save, growl, great and day)  # MADE GROUND (set, save, growl, great and day)  # MADE GROUND (set, save, growl, great and day)  # Dougrafion based on Dellar's top, # 1	# MADE GROUND (hardcore)	
BOOL STANDED FROM THE PROPERTY OF THE PROPERTY	# MADE GROUND (ash, sand, gravel and brick fragments)	
Britation    State   Continued and Continued	#MADE GROUND (ash, sand, gravel, grass and clay)	
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#### Reply:

The additional GI information demonstrates that the depth extents of soft deposits below the plan areas of Structures S21B and S21D are greater in certain areas than interpreted from the original GI data available at the time of Detailed Design.

The foundation details for the retaining wall (currently shown on IFC drawings as excavation of soft materials to various depths and replacement with compacted granular fill) will need to be revised to account for the change in ground conditions.

The proposed foundation solution will now comprise ground improvement through a combination of:

- 1. Excavation of soft deposits and replacement with compacted granular fill under the supervision of a suitably qualified and experienced geotechnical engineer from the Design Organisation for the more shallow depths of soft materials, as originally proposed;
- In-situ soil improvement via cement stabilisation whereby cement columns are created to
  the base of the Made Ground/Alluvial deposits using in-situ deep dry soil mixing
  techniques with CEM 1 cement binder. This technique will be used to provide a foundation
  solution for the deeper depths of soft materials.

The proposed foundation options are depicted in draft Drg No. ULE90130-05-RTW-00992 v1. The requirements for ground improvement through cement stabilisation are defined in the attached draft performance specification which is currently being incorporated into Appendix 6/13 of the Specification.

The design of the reinforced earth retaining wall elements above the foundations is unaffected by the change to the foundation solution. However, BSC will need to demonstrate to the Designer that in-situ soil improvement has achieved the specified performance requirements via the submission of the results of zone testing before construction of the reinforced earth retaining wall above the foundations can take place.

A Design Change Request will be submitted shortly for revisions required to the Design and Specification packages for Structures S21B, S21D, S21C and S505 to address the change in ground conditions.

Signed:	Name: A Dolan	Date: 25/06/10
for and on behalf of:  External Distribution:	Internal Distribution	on:

# Edinburgh Tram: Structure S21B and S21D, Murrayfleld Reinforced Earth Embankment /Retaining wall

#### **Ground Stabilisation/Improvement Specification**

#### 1 Introduction

This specification presents background information on Structure S21B and describes the reclamation strategy and requirements for stabilisation to allow construction of the reinforced earth embankment structure.

This specification should be read in conjunction with the other specification items, in particular the earthworks specification.

#### 2 Background Information

The site forms part of the Edinburgh Tram Line 1 project, structures S21B and S21D. Both are reinforced earth structures which will be constructed to carry the tram. Both structures will be constructed adjacent/adjoining an existing Network Rail (NR) railway embankment. It has been agreed with NR that construction of the reinforced earth embankment will have limited effect on the existing NR railway embankment.

The preliminary ground investigation indicated ground conditions to be suitable to allow construction of the reinforced earth embankment via excavation and replacement of the weak strata with suitable fill.

However on receipt of addition ground investigation data it was found that the site is underlain by a significant thickness of soft Made Ground and Alluvial Sand/Clay.

The Made Ground and Alluvial Sand/Clay were found to be unsuitable as a foundation stratum, as it would likely result in some places in bearing failure or excessive settlements outside of the design tolerances.

In-situ ground improvement techniques have been proposed to increase the soil strength/stiffness (Young's Modulus) of the formation strata to allow construction of the reinforced earth embankment.

#### 3 Ground Investigation

A significant amount of intrusive ground investigation works have been carried out along the route of the embankment, including boreholes, trial pits, in-situ and laboratory testing, and groundwater monitoring. This is included in the Site Information pack along with the Approval In Principal document (AIP).

The ground investigation data can be summarised as follows:-

Made Ground generally described as soft brown sandy/ashy gravelly clay with cobbles of brick and sandstone, encountered from ground level to between 0.60m bgl (below ground level) and 4.00m bgl. The Made Ground is underlain by a mixture of alluvial Sand and Clay which was found to be very soft/very loose becoming firm/medium dense with depth, generally encountered between 0.60m bgl (S02) and 5.00m bgl (S02). The alluvial sand/clay was predominantly underlain by a medium dense becoming very dense with depth sand/gravel, where the medium dense sand/gravel was absent a stiff becoming very stiff sandy gravelly Clay (Glacial Till) was encountered. Groundwater levels appear to be relatively high within the weak alluvial strata. This specification should be read in conjunction with the Raeburn Drilling and Geotechnical Limited Dynamic Probe Field Testing dated April 2010 in addition to all the previous Ground Investigation results.

#### 4 Health and Safety Considerations/Constraints

The major constraint is the potential instability of the Made Ground/Alluvial strata during construction

Loss of lateral support or lack of groundwater control which could result in serious risk of excessive settlement or shear failure of the (presumably similar) strata beneath the adjacent NR track. In-situ ground improvement techniques are therefore required to prevent any detrimental effects on the existing NR embankment by removal of the need to excavate to significant depths. However care should still be taken to ensure that the stability of the embankment is not detrimentally affected.

#### 5 Stabilisation strategy

#### 5.1 Performance requirements

The requirements for stabilisation are to create a stable and safe formation with will allow minimal settlement of the existing NR embankment (<10mm) and tram embankment (<25mm).

Based on these constraints a stiffness of 35,000kPa shall be achieved at 28days in the upper Made Ground and Alluvial deposits.

Based on programme restrictions preliminary testing trials will not be possible, therefore an insitu trial during the main works to prove the suitability of the binder mix shall be undertaken.

#### 5.2 Stabilisation method

It is envisaged that in-situ deep dry soil mixing techniques are used to form columns, using CEM 1 cement binder at an initial rate of 5% by dry weight. The columns shall be taken to the base of the Made Ground/Alluvium deposits (whichever is deepest). Anticipated depths of treatment are shown in drawing ULE90130-05-RTW-00992. Actual depths will be proven periodically during the works.

Alternative cement binder percentages will be considered if proven to meet the performance criteria. Levels less than 3% cement are considered unacceptable.

Reference should be made to the advice, best practice, design, and construction guidance given in the BRE Design Guide Soft Soil Stabilisation published as part of the EuroSoilStab project, Project No. BE 96-3177.

#### 5.3 Testing

The Contractor shall propose with the returned tender a frequency and means of validation of the ground improvement appropriate to the proposed method, for approval by the Design Organisation.

Testing shall be carried out in accordance with BS 1377;1990 or equivalent standard.

On completion, the contractor shall provide a validation report describing the extent and method of ground improvement, additives, test results and conclusions.

Testing results shall be provided to the design organisation to allow construction of the reinforced earth retaining wall elements to commence.

#### 6 Column Stabilisation

#### 6.1 Pre-installation Procedure

Before installation of the works, the following conditions shall be checked and documented, in accordance with BRE Design Guide Soft Soil Stabilisation BE 96-3177:-

#### Data for binders

- Production date and delivery date.
- Storage conditions.
- Transportation
- Storage temperature.
- Test occupant confirm the binder quality.
- Binder components.
- Water type/quality.

#### Plant/Equipment

- Type of equipment.
- Design of mixing tool.
- All other relevant data.

#### Site description

- · Location and site elevation level.
- Geotechnical conditions.
- · Weather conditions during installation.
- Photos of the site.
- State of eventual soil contamination.

#### Column data

- Diameter (m).
- Amount of binder (kg/m or litre/min).
- Mixing energy (J/m³).
- Lifting speed, (mm/s and mm per revolution)
- · Rotation speed, (rpm).
- Length (m).
- Column top level (m OD).
- Column tip Level (m OD).
- Feeding pressure, max (MPa)
- Exhaust pressure, (inside Kellybar) at mixing tool level.
- Water to cement weight ratio (if applicable).
- Ratio of grout/additives.

#### 6.2 During installation procedure

During installation the following shall be continuously monitored in accordance with BRE Design Guide Soft Soil Stabilisation BE 96-3177:-

- Binder output, (kg/m and kg/m³).
- Mixing energy, (J/m<sup>3</sup>)
- · Lifting speed, (mm/s and mm per revolution)
- Rotation speed, (rpm)
- · Feeding pressure at rig.
- Exhaust pressure (inside Kellybar) at mixing tool level.

Feeding pressure shall be released after installation. Surface heave shall be monitored visually both around one single column and around the whole stabilised area, in accordance with BRE Design Guide Soft Soil Stabilisation BE 96-3177. The accuracy shall be +/-1mm. one point each 200m² will be sufficient.

Edinburgh Tram Project
INTC 625 Section SA - Murrayfield Corridor Ground Improvement ( Chalnage 510594 to 511027 )

#### Summary of Changes Identified

Item	Brief Description		Amounts Infraco	Further Comment
				an " supplied to
\$0	Trenchmix walls solution (Chainage 510594 to 510876)		£ 307,958.06	
2	Vibro Columns solution ( Chainage S10876 to S11027 )		47,882.34 <sup>1</sup> .	
1	Attendances		£ 96,500,03	
4	SDS Design Costs		£ 30,000.00	M
5	Sheet Piling		£ 45,079.92	
6	Temporary Works design ( sheet piling )		£ 20,154.24	
7	Pre-treatment survey works and testing		£ 14,484.00	
	**************************************			
	Construction Warks Value		£ 562,058.59	
	Head Office Overheads and Profit on elements of Actual Cost for Civil Engineering Works	10%	£ 48,697.87	
	No.		£ 610,756.46	
	Consortium Preliminaries	7.40%	£ 41,592.34	
	Other Preliminary Elements	17.50%	£ 98,360.25	
	Estimate Total		750,709.05	

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Edinburgh Tram Project
INTC 625 Section 5A - Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

Estimate		1					MANCO.		H	10 70	100	* contrar or ships
				Quantity			Unit Rate		Value		Item	The state of the s
item	Description	UNIT	BDDI	IFC	+/-	Rate	Source	` BDD1	#FC	4	Allocation	Comment Sc.
1	Trenchmix Solution ( measured by volume of around to be amono and ref dig RTM-991 new 2)	m3		-8,388 00	8,388.00	36.71	Derived from forecast Actual  Cost   ne Appendix C		307,9\$8.06	307,958,08	1	
2 '	Vibro-column Solution ( measured by volume of ground to be improved, reldeg.RTW-992 rev.z.)	m3		2,964.00	2,964:00	16.15	Derived from forecast Actual Cost, see Apoundix C		47,062.34	C38134		
==	<b>₩</b> € 40									Tive Co.		
. 3	GC attendances for Bachy Soletanchet measured by solume of ground to be improved, ref drg RTW-992 rev 2)	m3		8,388.00	8,388.00	6.72	Derived from forecast Actual Cost, see Appendix C		56,398.20	56,796.20	,	{GC}Graham Construction
4	EL attendances for GeMech [ measured by volume of ground to be improved, refdrg RTW-992 rev 2 ]	тЭ	-=1	1,964.00	2,964.00		Destried from forecast Actual Cost, see Appendix C		40,101,83	46301.89		{ EL ) Expanded Ltd
1	SDS Design Costs	Sere		1.00	1.00	30,000.00	Indicative, ref A Dolan		30,000.00	30,000,00		
6	SheetPiling	m2		696,00	696.00	64.77	Sch 4 page 206 item \$1		45,079,92	45,079,92		
7	Temporary Works design ( sheet piling )	Sum		1.00	100	26,154.24	Denved from forecast Actual Cost, see Appendix C		20,354,38	20,154,24	•	en de la companya de la companya de la companya de la companya de la companya de la companya de la companya de
	Pre-treatment survey works and testing	Sum		7 00	1.00	14,484.00	Derived from forecast Actual		14,484.00	14,484.00		
	Total to Summary Page				-				562,058.59	562,058.59		

Section SA Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

Democs							INFRACO"		La Charles Aller	4	-	
		- 9		Quantity			Unit Rate		Aame		Item	Comment
Item	Description	UNIT	8001	IFC	+/-	Fiete	Source	BDDI	IFC	+/-	Allocation	Consider
						7			S-11			
	Estimate Summary Page											# W
	Construction Works Value								562,058.59	\$62,058.59		
	Head Office Overheads and political concelements	of Actual Cost	tor Civil Engine	eering Works			Sch 4 Appendix G Cl 1.3 (a)	10%	1 6 1 188, 3	18,817,87		Applied to items 1, 2, 3, 4, 7 & 8
	Head Office Overheads and Profit on elements	of Actual Cost	for Systems an	nd Track Works			Sch 4 Appendix GCI 1;3 (b)	17%				Transcription of the control of the
												Sign 1
				-	Es	timate Sub-total		3.	Land A	610,756 <sub>x</sub> 46		: 3
							Sch 4 Appendix G Cl 1.3					
_	Consortium Preliminaries							7.40%	rra mar	41,592.34		The second secon
_	Other Preliminary Elements	-			_		Minute of Variation	17,50%	-	98,360.25	-	
	Estimate Total		7-16-3							Napolas		

- Optifications / Ettauloris

  Units listed beliefe, any exclusions / qualifications / assumptions detailed within Graham Construction (GC | letter 17/12/10 or Expanded Lidemailed duotation dated 14/12/10 are not applicable to this estimate and are deemed to be caterad for within the 88UK Risk provision, infragalists used bets endown to provide an accurate estimate for consideration and discussion. Pending selection / finalisation of provide in accurate estimate for consideration and discussion.
- It is continued that infrace has used all reasonable endeavours to establish suitability of proposed design solution. However should for any reason whatsoever, during the evolution of the design up to and including issue of IFC drawings or during the prograss of ground improvement works, the proposed solution changes or is
- rendered unsuitable. Infraco reserves it right to withdraw or amend its estimate.
- Estimate remains open for acceptance until 31 May 2011
- It is assumed each of Expanded to dand Graham Comtinetion works will be undertaken in one visit to site, each.
- No provision within the extimate for dealing with contaminated material, it is assumed this separate Change will, if applicable, he deals with under a separate INTC
- No provision within the estimate for example with contaminated material, it is assumed this contaminated material, it is assumed this contaminated material, it is assumed this contaminated material it is expected by the feather things contaminated and the proposals.

  It is assumed that there will be not restriction; placed on the proposal working by external parties, for example historying fill or SRU. In respect of field working the contamination working contaminated that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed that early fall protection staff. And therefore it is assumed to the staff of the staff
- anteffective solution.
- No provision within the estimate for dealing with services of any nature, known or otherwise, it is assumed these will be dealtwith separately underother INTC's.
- it is acknowledged that there may be a requirement to adjust / amend estimates provided for other INTCs, e.g. to take account of conflicts with ground improvement commencement levels and earthworks detailed on structures drawings.

Edinburgh Tram Project INTC 625

Section 5A - Murrayfield Corridor Ground Improvement (Chainage 510594 to 511027) Drawings Used in the preparation of the Estimate

Item	Drawing Number	Status	Comments
	ULE90130-05-RTW-00992 Rev 2	IEA	
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		+	

Appendix B

Edinburgh Tram Project ....

INTC 625

Section 5A - Murrayfield Corridor Ground Improvement (Chainage 510594 to 511027)

#### Programme Information

It is likely that the additional scope of works will have an impact on programme. Programme impact is excluded from this estimate.

Edinburgh Tram Project INTC 625

5

Appendix C

Section 5A - Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

**Derived Rates** 

Item	Description	on	Quantity	UNIT	Rate	Total
1	Trenchmiz					
	a	refer Graham Construction letter 17. December 2010, incorporating Bachy Soletanche quotation dated 23/11/2010		Sum	£248,855.00	£248 <b>,</b> 855.00
	ь	Graham Construction O&P	12.5%			£31,106.88
	c	BBUK Risk ( to lump sum )	10%			£2 <b>7,</b> 996.19
	r				1	£30 <b>7,</b> 958.06
		Divide by volume associated with footprint between chainage 510594 to 510876		m3		8388
	ľ	Rate per m3				£36.71
3		I Construction attendances for Bachy ; refer GC letter 17/12/10.				
	a	Piling platform	1	Sum	£13,069.80	£13,069.80
	b	Drainage / Pumping / Ground water control, allow £5k set-up/demob £1.5k		Sum	£10,000.00	£10,000.00
		per wk running costs, say	1		1 1	£20,860.00
	d	Water supply , incl deliver etc  Machine in attendance	1	Sum	£20,860.00 £1,644.50	£1,644.50
	ľ	Graham Construction O&P	- 1	Sum	11,044.50	
			12.5%			£5,696.79
		BBUK Risk ( to lump sum )	10%			£5,127.11
						£56,398.20
		Divide by volume associated with footprint between chainage 510594 to 510876		m3		8388
		Rate per m3				£6.72
7		y Works design ( sheet piling ), refer onstruction letter 17/12/10 .				
	а	Tony Gee costs	1	Sum	£17,914.88	£17,914.88
	b	Graham Construction O&P	12.5%			£2,239.36
						£20,15 <b>4.2</b> 4

Edinburgh Tram Project INTC 625

Appendix C

Section 5A - Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

**Derived Rates** 

Item	Descriptio	The second secon	Quantity	UNIT	Rate	Total
2	Vibro-colu	mn Solution			ŀ	
	a	refer Expanded Ltd email 14/12/10			1 1	
		incorporating GeMech quotation dated			1	
		10 December 2010	1	Sum	£40,305.00	£40,305.0
	b	Expanded O&P	8.0%		1	£3,224.4
			1			
	С	BBUK Risk ( to lump sum )	10%			£4,352.9
						£47,882.3
		Divide by volume associated with			ii	,
	, .	footprint between chainage 510876 to			1	
	l)	511027		m3		296
		Rate per m3				£16.1
4	EL attenda	I inces for GeMech				
	а	Working platform 150m x 10m x 0.5 wide	.750	m3	£24.66	£18,495.0
	b	Drainage / Pumping / Ground water				
		control, allow £5k set-up/demob £1.5k			1 1	
		per wk running costs, say	1	Sum	£10,000.00	£10,000.0
	с	Water supply , incl deliver etc	1	Sum		
	d	Machine in attendance	1	Sum	£5,260.75	£5,260.
		Expanded Ltd O&P	8.0%			£2,700.
		BBUK Risk ( to lump sum )	10%.			£3,645.
					1	
		17				£40,101.8
		Divide by volume associated with			1 1	
		footprint between chainage 510876 to 511027		m3		296
		Rate per m3				£13.5
		· ·			l f	

Edinburgh Tram Project NTC 625

Appendix C

Section 5A - Murrayfield Corridor Ground Improvement (Chainage 510594 to 511027)

#### **Derived Rates**

Item.	Descripti	on	Quantity	UNIT	Rate	in the solution	Total
7	Pre-treatment Survey Works and testing		and the special section of the secti				
	а	Pre-treatment survey works, reff Expanded Ltd email 07/12/10	1.	Sum	£ 10,919.00	£, 1	10,919.00
	b	Dynamic Probing ( Raeburn )	3	days	£ 675.00	Ē	2,025.0
	c	Shell & Auger ( Raeburn, £500 mob/demob, 2x20m holes @ £26/m )		Sum	£ 1,540.00	£	1,540.0
		Sum			1	£ 1	14,484.0

Appendix D

#### **Edinburgh Tram Project**

INTC

625

Section 5A - Murrayfield Corridor Ground Improvement (Chainage 510594 to 511027)

#### Other Supporting Information

- 1 Graham Construction letter of 17 December 2010 ref BN/Site/S21B/CE (refer Appendix D to Option A)
- 2 SDS response to TQ 1809 ( refer Appendix D to Option A )
- 3 Expanded email 14/12/10, including GeMech estimate of 10 December 2010
- 4 Expanded email 07/01/10, including breakdown of Expanded Ltd quote.
- 5 Expanded email 07/01/10, including Expanded Ltd Pretreatment Survey works quote.



#### S21B, S21C & S21D Ground Improvement Proposal

Crozier, Allan to: Brian.Walker Cc: Duncan.Lambert, Graeme.Angus, "Grant, Chris", Jim.Donaldson 14/12/2010 16:23

History:

This message has been replied to.

Brian.

Please find attached for your review initial proposal and quotation for vibro stone columns ground improvement treatment to S21B, S21C and S21D as received from specialist contractor GeMech.

Regards,

**Allan Crozier** 

Project Manager Expanded Limited

Edinburgh Tram Network Site Office (c/o Barr Ltd) | Off Gogar Roundabout | Glasgow Road | Edinburgh EH12 8LU

Mob:

www.expandedlid.com

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and do not necessarily represent those of the company. GE763 additional offer 10.12.10.pdf



Our Ref: DW/AMX/AJT/GE763

10th December 2010

Expanded Limited,
Edinburgh Tram Network Site Office,
Off Lockslde Crescent,
Edinburgh Park Station (North),
Edinburgh Park
EH12 9DT

For the attention of Mr. Allan Crozier - Project Manager

Dear Mr. Crozier,

#### Re: Proposed Edinburgh Tram Network Ground Improvement Works

Further to our detailed estimate dated 7th December 2010 for the design, installation and testing of vibro stone columns on the above site, we understand that you wish to supply your client with a rate for continuing the ground treatment beyond the chainages 510877 – 511027 should they determine that this method of improvement will provide a suitable means of support for embankment construction.

We have had difficulty in apportioning the available soils investigation information in relation to more remote chainages but, in general, agree that the perceived criteria for the stone columns is to control settlements produced by the embankment surcharge which would remain the same.

Perhaps the easiest and most appropriate solution would be to introduce a new-ltem to our existing Bill of Quantities to cover extensions to the treatment requirements measured in a rate based on the future footprint area of the proposed embankment.

This item (No. 7) assumes the continuation of stone column construction during the establishment period of the vlbro rig. Should this not be the case, then an additional reestablishment charge of £4,350.00 would be levied on a minimum size of treatment area of  $400m^2$ .

With regard to the technical point raised by the Design Manager, Chris Reid, and concerning minimum levels of shear strength in cohesive soils, we appreciate that cohesive values below  $30kN/m^2$  area unlikely to be positively influenced by the stimulus of vibration or the compression effect introduced by a stone column. However, for groups of closely spaced stone columns, and in a layered soils profile where more responsive material is above and/or below the soft clay now in question, it is necessary to assess actual loadings likely to be imposed. This analysis will be highlighted in detail in our forthcoming design calculations.

/Cont'd.....

GeMech Limited
Unit 12, Kenn Court, South Bristol Business Park
Roman Farm Road, Bristol BS4 1UL
Fax: 01179 784523 E-mail: Info@gemechitd.co.uk
Registered in England No. 6872675

Registered Office: 2, Taibot Road, Rickmansworth, Hertfordshire WD3 1HE. Registered in England No. 6872676

10th December 2010



### Re: Ground Improvement Works - Proposed Edinburgh Tram Network

We hope these explanations will be acceptable and look forward to hearing from you again shortly.

Yours sincerely,

David Walker MEng (Civil Engineering) Senior Contracts Engineer 10th December 2010



### Re: Ground Improvement Works - Proposed Edinburgh Tram Network

#### GE763 - BILL OF QUANTITIES

#### Edinburgh Tram Network - Ground Improvement between Chainages 510877-511027

Item	Description	Qty	Unit	Rate	Amount
1	Visit site to record trial piles and carry out pre- treatment CSW selsmic testing.	1	Item	£3,950,00	.~ CL S⊕F# -£3,950:00
2	To mobilise to site all labour, plant and materials.	1	Item	£4,350.00	£4,350.00
3	To set up at each column position	244	No	£7,50	£1,830.00
4	Construct dense stone columns beneath Embankment footprint area up to 160kN/m² bearing capacity, Passes 1 & 2 (see letter).	244	No	£64.63	£15,770.00
5	Additional stone columns if required.	1	per col. plus set up	£64.63	Rate Only
6	Credit for omitted stone columns (any location).	_ 1	per col.	£19.50	Rate Only
7	Extend vibro treatment beyond above chainages if requested, including pre-boring (testing measured elsewhere)		m²	£22.54	Rate Only
8	Standing/obstruction time for piling rig, associated plant and labour whilst overcoming obstructions either man-made or natural or due to circumstances beyond our control.	1	Hour	£275.00	Rate Only
9	Carry out short duration plate load tests.	4	No	£200.00	£800.00
10	Additional plate load tests if requested.	1	No	£225.00	Rate Only
11	Mobilisation for pre-boring (if required).	1	Item	£1,750.00	£1,750.00
12	Carry out pre-boring up to 2m depth to 2nd pass of stone column construction (see letter).	81	No	ltem	£2,430.00
13	Carry out full-scale zone loading test on working stone columns using 2m x 2m steel plate loaded to 2.5 times W.L. and complete return visit of CSW testing.	1	Item ,	£11,400.00	£11,400.00
14	Issue of revised drawing due to client/engineers changes.	_ 1	No	£175.00	Rate Only
14	Prepare and issue final report of all stone column construction and testing.	1	Item	£1,975.00	£1,975.00

TOTAL £44,255,00

Subject to re-measurement upon completion of our works in accordance with the above items and rates

Payment terms strictly 14 days from date of application/invoice



#### RE: S21D Murrayfield Training Pitches Grant, Chris to: Graeme.Angus Cc: "Crozier, Allan", Brian.Walker

07/01/2011 13:49

Graeme,

Please find attached breakdown as per your request.

Allan will forward drawings in due course.

Regards

Chris Grant Commercial Manager Expanded Limited

Edinburgh Tram Network Site Office | c/o Barr Construction | A8 Gogar Access | Glasgow Road | Edinburgh | EH12 8LU

Tel

www.expandedltd.com

----Original Message----

From: Graeme. Angus@civil.bilfinger.co.uk [ mailto: Graeme . Angus@civil.bilfinger.co.uk]

Sent: 07 January 2011 12:46

To: Grant, Chris

Cc: Crozier, Ailan; Brian.Walker@civil.bilfinger.co.uk Subject: Re: S2ID Murrayfield Training Pitches

Chris,

A further query, your BoQ states 'Ground Improvement works as per GeMech quotation dated 07/12/10' with a rate / sum of £54,434.33.

GeMech quotation dated 10/12/10, as provided by Allan, is for £44,255.00.

Please help clear up this confusion and explain / substantiate different figures.

Any joy with drawings yet?

Regards,

Graeme Angus Section Quantity Surveyor

Bilfinger Berger Civil UK Limited 9 Lochside Avenue Edinburgh EH12 9DJ United Kingdom

Tel:

+44 (7) 131 452 2990 Fax:

Mob: Email:

Graem Angus@civil.bilfinger.co.uk

Web: www.civil.bilfinger.co.uk

Bilfinger Berger Civil UK Limited

Registered Office: 7400 Daresbury Park, Warrington, Cheshire, WA4 4BS Registered in England and Wales

Company No: 2418086

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>   From:	
"Grant, Chris" <cgrant@expandedltd.com></cgrant@expandedltd.com>	ĺ
To:	1
<graeme.angus@civil.bilfinger.co.uk></graeme.angus@civil.bilfinger.co.uk>	
>   Cc:	
"Crozier, Allan" <acrozier@expandedltd.com></acrozier@expandedltd.com>	
>	
16/12/2010 16:20 	,
Subject:	

و د مرس و محمد بن د قدر بنده ندان بندان استان استان استان استان استان استان استان استان استان استان استان استان	
S21D Murrayfield Training Pitches	
Same and the same	

Graeme,

Please find attached our revised price for S21D incorporating the ground improvement works.

We look forward to your further instruction.

Regards

Chris Grant Commercial Manager Expanded Limited

Edinburgh Tram Network Site Office | c/o Barr Construction | A8 Gogar Access | Glasgow Road | Edinburgh | EH12 8LU

Tel

www.expandedltd.com

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· ·

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## www.bilfinger.co.uk

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Ground Improvement Breakdown.xls

q00068 Construction and withdraw after

1.000 m ?MacroQty

Stored: 16/12/10 completion of work of retaining measure; height and details not

Rate: 16/12/10

L=416.75 P=4,844.00 S=44,225.00 Rate=49,485.75

SC40 Ground Improvement

PHB0501 JCB 3CX Sitemaster

PHB0503 CAT312 13t 360 deg Excav

LRC40 Labourer - Banksman PHB3802 13T Breaker

1.00itm\*44225 24.21Hr\*10.5\*3days

25.75hr\*47.5\*3wks 13.23hr\*10.5\*3days

412.00wk\*1wk

= 44,225.00

762.62 = 3,669.38

416,75

412.00

49,485.75

Expanded Pto

3,958.86 (8%).

53, 444.61

CEC02084556\_0094



Grant, Chris to: Graeme.Angus, Brian.Walker Cc: "Crozier, Allan"

07/12/2010 16:12

History:

This message has been replied to and forwarded.

Gents,

Please find attached our estimate for the survey works as has been requested.

We look forward to your instruction.

Regards

Chris Grant Commercial Manager Expanded Limited

Edinburgh Tram Network Site Office c/o Barr Construction | A8 Gogar Access | Glasgow Road | Edinburgh | EH12 8LU

Tel

www.expandedltd.com

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S21B S21C S21D Pre-Treatment Survey Estimate.xls

# TENDER MAKE UP SHEET



PROJECT: A2581 Edinburgh Trams

TEN		L	P	М	] s/c	TOTAL	]
	S21B, S21C & S21D Murrayfield RTW's Pre-treatment survey estimate	¥ .			•	1	
1	GeMech Quotation (3 day duration)	Patrice of the Comment		-	£8,180	£8,180	3950
2	Additional day contingency	AND	70 × 80 × 80 × 80 × 80 × 80 × 80 × 80 ×	1	£2,115	£2,115	1
	:Attendances:	The second secon	namen i inneren				7
3	(JCB3CX + hammer) x 4 days @ £260/day Fuel	ro produc	∉£1,040	£100		£1,040 £100	deliberation and an experimental control of the con
4	Labourer x 4 days @ £150/day	£600	1			£600	- St Mary Mary Control of the Con
5	Transport crowd barriers on/off allowance	1	£500		ŧ	£500	and the same of th
6	Welfare unit (i) Transport on/off (ii) Weekly Hire (iii) Effluent tank empty (iv) Fuel		£1,226 £329 £150	£100		£1,226 £329 £150 £100	Markey was the second of the s
			4	¢ 9		£14,340	10,11
			Add 8%	OH&P		£1,147	1 800
		6	TOTAL	1		£15,487	10,5

Our Ref: DW/AMX/AJT/GE763

2nd December 2010

Expanded Limited,
Edinburgh Tram Network Site Office,
Off Lockside Crescent,
Edinburgh Park Station (North),
Edinburgh Park
EH12 9DT

For the attention of Mr. Allan Crozier - Project Manager

Dear Mr. Crozier,

#### Re: Proposed Edinburgh Tram Network - Ground Improvement

Further to our letter of the 25th November 2010 and meeting with our Consultant on the same day, we now write to confirm our proposals for pre-treatment ground testing as requested.

In order for us to excavate trial pits and carry out a sufficient number of CSW tests, we would need to spend a day on site. Currently the availability of the CSW testing specialists means that this could be arranged for week commencing the 20th December 2010. The total cost of the Engineer to record trial pits, and supervise the CSW testing, as well as the seismic tests themselves, would be £3,950.00 plus VAT.

We believe you may require to carry out further CSW tests on adjacent areas of future embankment construction outside the immediate concept of ground improvement. We should advise you that the cost of additional time on site for the CSW technicians and testing equipment is charged at £2,115.00 plus VAT per day. This figure also includes for overnight accommodation. Obviously travelling costs will have already been accommodated within the previously quoted rate.

As a general indication, we would estimate that SWS Ltd should be able to carry out around 6 No. profiles per day, depending upon ground preparation. In the context of a proposed embankment this represents a total meterage of around 120-140 lin. m per day.

/Cont'd....

GeMech Limited
Unit 12, Kenn Court, South Bristol Business Park
Roman Farm Road, Bristol BS4 1UL
Fel: Fax: 01179 784523 E-mail: info@gemechltd.co.uk
Registered in England No. 6872675

Registered Office: 2, Talbot Road, Rickmansworth, Hertfordshire WD3 1HE. Registered in England No. 6872675

We hope this information is of interest and that we may look forward to hearing from you again shortly. Please note that with regard to trial pits and CSW testing, we have made no allowance within any of our rates for the provision of an excavator and breaker (for areas of existing termac roadway). For CSW testing a narrow surface strip of around 6m long needs to be broken out for each profile trace, and for trial pits an area of around 1.5m x 4m for each pit would be ideal. In the grassed areas no preparation, other than service tracing, would be required.

Yours sincerely,

David Walker MEng (Civil Engineering) Senior Contracts Engineer

CC:

Surface Wave Surveys, FAO Richard Tinsley Edinburgh Tram Project
INTC 625 Section 5A - Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

#### Summary of Changes Identified

Item	Brief Description	Amounts	Further Comment
-		antraco	
i	Trenchmix walls solution	£	
s	Vibro Columns solution ( Chainage 510594 to 511027 )	£ 169,715.49	
3	Attendances	£ 153,588.39	
4	SDS Design Costs	£ 50,000.00	
5	Sheet Piling	£ 45,079.92	
6	Temporary Works design ( sheet piling )	£ 20,154.24	
,	Pre-treatment survey works and testing	£ 14,484:00	
	Construction Works Value	£ 453,022.04	
	Head Office Overheads and Profit on elements of Actual Cost for Civil Engineering Works	£ 35,794.21	
		) is	
711.5		£ 488,816.25:	
	Consortium Preliminarles 7.40%	£ 33,523.63	
	Other Preliminary Elements 17,50%	£ 79,278.86	
	Estimate Total	601,618.74	

Edinburgh Tram Project
INTC 625 Section SA - Murrayfield Corridor Ground Improvement (Chainage 510594 to S11027)

Estimate							7669600		-	-		
MINE				Quantity Unit Rate Value					Item	T.		
Item	Description	UNIT	BDDI	IFC	+/-	Rate	Source	8DDI	- sc	+/-	Aliocation 1	Comment
1	Trenchmic Solution ( measured by volume of o bei	m3				36.71	Derived from forecast Actual Cost, see Appendix C					
2	Vibro-column Solution ( measured by volume of ground to be improved, ref drg RTW-992 rev 2)	m3		11,352,00	11,352.00	14,99	Derived from forecast Actual Cost, see Appendix C		169,715.49	169,715,49	2	
	OF CO.			1				1				
	GC attendances for Bachy Soletanchel measured by volume of ground to be improved, ref drg RTW-992 rev 2)	m3				6,72	Defined zon forecast Actual Cost, see Appendix C					; (GC) Graham Construction
	EL attendances for GeMech (measured by volume of ground to be improved, ref dig RTW-992 rev 2)	m3	-==	11,352.00	11,352.00	13.53	Derived from forecast Actual Cost, see Appendix C		131,584,50	153,589.16		{ EL} Expanded (td
,	SDS Design Costs	lan.		1.00	1,00		Indicative, ref A Dolan		50,600,00	50,000.00		THE STATE OF THE S
-					-			15		-	-111	
6	Sheet Piling	m2		696.00	696,00	64.77	Sch 4 page 206 Item 51		<b>6</b> ДХИ	45,000.50	5	Provisional - allow as for trenchmix option meantime
,	Temporary Works design (sheet piling)	Sum		1.00	1 00	20,154.24	Oerived from forecast Actual Cost, see Appendix C		MEAN	20,154.34		Provisional - allow as for trenchmix option meantime
		1										
1	Pre-treatment survey works and testing	Sen		1.00	1.00	14,484.00	Derived from forecast Actual		14,484,00	14,484.00	í	
	Total to Summary Page				-				453,022.04	453,022.04	-	

Edinburgh Tram Project

Section 5A - Murrayfield Conidor Ground Improvement (Chainage 510594 to 511027)

Estimate							INFINCO			10000			
				Quantity			Unit Rate			Item	Comment		
Item	Description	UNIT	BDDI	IFC	+/-	Rate	Source	9001	IFC	+/-	Allocation	Comment	
20	Estimate Summary Page						200-9				-		
	Construction Works Value						-		452.023.44	452.024.2		E	
	Construction Works value			-	-			-	453,022.04	453,022.04			
	Head Office Overheads and Profit on ele	ements of Actual Costf	or Civil Engine			Sch 4 Appendix G Cl 1.3 (a)	10%		35,794,21	3	Appliedta (terns 1, 2, 3, 4, 7 & 8		
= 7	Head Office Overheads and Profit on ele	ements of Actual Cost f	or Systems and	TrackWorks			Sch 4 Appendix G Cl 1.3 (b)	17%	and a second				
								1					
					Esti	mate Sub-total			ji , ,	488,816:25			
												to difference have	
	Consortium Preliminaries		Sch 4 Appendix G Cl 1,3	7.40%	* 1, . *	35,123.62	2 1						
	Other Preliminary Elements					55,63	Minute of Variation	17.50%	165.0	79,278.86	221 3		
	EstimateTotal									501,618.74	-		

#### Clarifications Leadesions

- Unless litted below, any exclusions / qualifications / assumptions detailed within the BBUK Risk provision.
- Infrace has used best end-awours to provide an about the estimate for considered Provisional in all respects.
- It is confirmed that intraco has used all reasonable enteraward to establish suitability of proposed design solution. However should for any reason what cover a duttion of the design up to and including Issue of IFC drawings or during the progress of ground improvement works, the proposed solution changes or is
- rendered unsultable, infracoreserves it right to withdraw or amend its estimate.
- Estimate remains open for acceptance until 31 May 2011.
- It is assumed works will be undertaken in one visit to site.

- It is assumed works will be undertaken in one visit to site.

  As promistion within the extrimate for dealing withcome improvement works, including temporary works, can be undertaken in a fall safe' manner, without need for Possession working for extributable to the General manner of the proposal for the proposal dealing th solution.
- No provision within the estimate for dealing with services of any nature, known or otherwise. It is assumed these will be dealt with separately under other INTC's.
- It is acknowledged that there may be a requirement to adjust / amend estimates provided for other INTCs, e.g. to take account of conflicts with ground improvement commencement levels and earthworks detailed on structures drawings,

Appendix A

Edinburgh Tram Project

INTC 625

Section 5A - Murrayfield Corridor Ground Improvement (Chainage 510594 to 511027)

Drawings Used in the preparation of the Estimate

Item	Drawing Number	Status	Comments	_
		lii		
-	18 500470 OF DTVM 00003 Day 3	IEA		-
	ULE90130-05-RTW-00992 Rev 2	1 TEA		-
		ļ		_
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				J.
		AND COMPANY OF THE CO		
	2519		The Samuel Control	
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	i a company	Section 1		
	Marie Control of the			-
		-		-
				-
AL D				
				ča
	, .		3	
				-11
	974			
_				

Appendix B

Edinburgh Tram Project...

INTC

625

Section 5A - Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

### **Programme Information**

It is likely that the additional scope of works will have an impact on programme. Programme impact is excluded from this estimate.

INTC 

Section 5A - Murrayfield Corridor Ground Improvement (Chainage 510594 to 511027)

### **Derived Rates**

ltem.	Description	n :	Quantity	UNIT	Rate	Total
1	Trenchmix	   Solution				
	a	refer Graham Construction letter 17 December 2010, incorporating Bachy Soletanche quotation dated 23/11/2010		Sum	£248,855.00	£248,855.00
	ь	Graham Construction O&P	12.5%			£ <b>31,</b> 106.88
	С	BBUK Risk ( to lump sum )	10%			£27,996.19
						£307,958.06
		Divide by volume associated with footprint between chainage 510594 to 510876		m3		8388
		Rate per m3				£36.71
3	Grahams Soletanch	Construction attendances for Bachy e, refer GC letter 17/12/10.				
	а	Piling platform	1	Sum	£13,069.80	£13,069.80
	b	Drainage / Pumping / Ground water control, allow £5k set-up/demob £1.5k per wk running costs, say		Sum	£10,000.00	£10,000.00
	С	Water supply , incl deliver etc	1	Sum	£20,860.00	£20,860.00
	d	Machine in attendance	1	Sum	£1,644.50	£1,644.50
		Graham Construction O&P	12.5%			£5,696.79
		BBUK Risk ( to lump sum )	10%			£5,127.11
						£56,398.20
		Divide by volume associated with footprint between chainage 510594 to 510876		m3		8388
		Rate per m3				£6.72
7		y⊅Works design ( sheet piling ), refer onstruction letter 17/12/10 .				
	a	Tony Gee costs	1	Sum	£17,914.88	£17,914.88
	b	Graham Construction O&P	12.5%			£2,239.36
						£20,154.24

**Edinburgh Tram Project** INTC

625

Appendix C

Section 5A - Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

### **Derived Rates**

Item	Descriptio	<b>n</b>	Quantity	UNIT	Rate	Total
2	Vibro-colu	mn Solution				, i
	a	refer Expanded Ltd email 14/12/10 incorporating GeMech quotation dated 10 December 2010, chainage 510876 to 511027	i.	Sum	£40,305.00	£40,305.00
	b	Extend vibro treatment beyond above chainages	3726	m2	£22.54	£83,984.04
	С	Additional testing to extend vibro treatment beyond above chainages				
		GeMech quote items 9 & 13 pro-rata to area	1	Sum	£18,569.12	£18,569. <b>1</b> 2
	d	Expanded O&P	8.0%			£11,428.65
	<b>e</b>	BBUK Risk ( to lump sum )	10%			£15,428.68
×						£169,715.49
		Divide by volume associated with footprint between chainage 510594 to 511027		m3		11352
		Rate per m3				£14.95
4	EL attenda	nces for GeMech				
	à	Working platform 150m x 10m x 0.5 wide	750	m3	£24.66	£18,495.00
	b	Drainage / Pumping / Ground water control, allow £5k set-up/demob £1.5k per wk running costs, sav		Sum	£10,000.00	£10,000.00
	c	Water supply , incl deliver etc	1	Sum	ŕ	,
	d	Machine in attendance	1	Sum	£5,260.75	£5,260.75
		Expanded Ltd O&P	8.0%	Juin	15,200.75	£2,700.46
		BBUK Risk ( to lump sum )	10%			£3,645.62
	1	u Se				£40,101.83
	1	Divide by volume associated with				
	15	footprint between chainage 510594 to 510876		m3		2964
		Rate per m3				£13.53

**Edinburgh Tram Project** -INTC

625

Appendix C

Section 5A - Murrayfield Corridor Ground Improvement (Chainage 510594 to 511027)

### **Derived Rates**

<u>ltem</u>	Description	on T	Quantity	UNIT		Rate		Total
8	Pre-treati	l ment Survey Works and testing			ŀ			
	а	Pre-treatment survey works, ref Expanded Ltd email 07/12/10		Sum	£	10,919.00	£	10,919.00
	b	Dynamic Probing (Raeburn )	3	days	£	675.00	£	2,025.00
	С	Shell & Auger ( Raeburn, £500 mob/demob, 2x20m holes @ £26/m )	1	Sum	£	1 <b>,</b> 540.00	£	1,540.00
		Sum					£	14,484.00

Appendix D

## Edinburgh Tram Project

INTC 625

Section 5A - Murrayfield Corridor Ground Improvement ( Chainage 510594 to 511027 )

### **Other Supporting Information**

- 1 Graham Construction letter of 17 December 2010 ref BN/Site/S21B/CE (refer Appendix D to Option A)
- 2 SDS response to TQ 1809 ( refer Appendix D to Option A )
- 3 Expanded email 14/12/10, including GeMech estimate of 10 December 2010 (ref Appendix D to Option B)
- Expanded email 07/01/10, including breakdown of Expanded Ltd quote (ref Appendix D to Option B).
- 5 Expanded email 07/01/10, including Expanded Ltd Pretreatment Survey works quote (ref Appendix D to Option B).