In relation to the

Adjudication

between

Bilfinger Berger – Siemens - CAF Consortium (the Referring Party)

and

tie Limited (the Responding Party)

Expert Report

regarding

Estimate in Respect of INTC No. 429

MUDFA programme Revision 8

Delay and Disruption Resulting from

Incomplete Utility Works

in relation to

The Edinburgh Tram Project

Prepared by:

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Specialist Fields: Planning, programming, contractual and financial aspects of construction contracts

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On behalf of: **tie** Limited

under the instructions and directions of:

Susan Clark, Deputy Project Director, **tie** Limited

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Merlin House
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5 May 2010

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Section 1 Executive Summary

1.1 Introduction

1.1.1 I have been instructed by **tie** to provide an independent expert report in respect of the Estimate submitted by the Infraco entitled "INTC 429 - MUDFA Programme Revision 8 – Delay and Disruption Resulting from Incomplete Utility Works". It is my understanding that my report is to be submitted as part of **tie**'s response to the Infraco's referral to adjudication.

1.2 Structure and contents of this report

1.2.1 In this report I provide my views on the Infraco's contractual obligations in relation to programme, delay mitigation and the extent to which it has fulfilled these in relation to the matters in dispute.

1.2.2 I articulate my observations, findings, analysis and opinions on the Infraco's Estimate submission, highlighting its deficiencies and question its reliability.

1.2.3 I also provide my opinion on, and assessment of, what I consider to be the requirement to revise the Sectional Completion Dates as a direct result of the revised forecast completion dates contained in the MUDFA Rev.8 programme.

1.3 Conclusions

1.3.1 I am of the opinion that the Estimate submission is incomplete, inadequate and contractually incompetent. It appears to me that the Infraco's failure to provide all of the required information is frustrating the proper operation of the **tie** Change mechanism set out in the contract.

1.3.2 I consider the Infraco's assessment of the requirement for extension of time to be calculated on the basis of erroneous and unreliable information used in, and produced from, an inappropriate method of delay analysis. The manner in which it proposes the implementation of this **tie** Change is not, in my opinion, cost effective and will result in unnecessarily late completion of the Infraco Works and will give rise to significant additional cost to the Project as a whole.

1.3.3 I note that the manner in which the Infraco has conducted its delay analysis ignores, for the most part, its obligations to mitigate delay, minimise cost and progress the Infraco Works

with due expedition. It is my opinion that the projected requirements for revision of the four Sectional Completion Dates are greatly exaggerated.

1.3.4 I conclude that there would appear to be ways in which this **tie** Change can be implemented in a much more cost effective manner than currently submitted by the Infraco. In my opinion, adopting certain measures, as detailed in this report, could mitigate all of the MUDFA Revision 8 projected delays to the extent that there would be no requirement to extend any of the four Sectional Completion Dates.

Section 2 Introduction

2.1 Formal Details

Name:	Iain McAlister
Position:	Associate Director
	Acutus Merlin House Mossland Road Hillington Park Glasgow G52 4XZ
Nature of Business:	Construction Contracts Consultants
Specialist Fields:	Technical, contractual and financial aspects of construction contracts. Construction planning, programming and analysis of delay.

2.2 Synopsis

2.2.1 On 14 May 2008 **tie** Limited (**"tie"**) contracted with Bilfinger Berger UK Limited and Siemens PLC to carry out the Infraco Works on the Edinburgh Tram Project. On that same date Bilfinger Berger UK Limited and Siemens PLC entered into a minute of variation with Construcciones y Auxiliar de Ferrecarriles SA whereby the three companies became the consortium for the delivery of the Infraco Works (the "Infraco" and "BSC").

2.2.2 From the outset, delivery of the Infraco Works has been subjected to various delays. As a consequence of these delays the Infraco is projecting significant over-runs on the four contractual Sectional Completion Dates and is claiming entitlement to extension of time. I am advised that **tie** acknowledges that there have been a number of delays for which it is liable but also that there are other delays that are the contractual responsibility of the Infraco. **tie** believes that the Infraco has presented its claims for entitlement based on its current projected completion dates. **tie** is of the opinion that these projections make no

attempt to allocate responsibility for delay nor do they implement comprehensive mitigation measures. As such, **tie** considers the Infraco's claims lack sufficient information on which to fulfil its contractual obligations in relation to assessing such claims and to allow **tie** to make fair and reasonable assessment of any required adjustments to the Sectional Completion Dates. The failure of the parties to agree the requirement for an extension of time in relation to the submission made by the Infraco has resulted in the Infraco referring the matter for adjudication in accordance with the contract Dispute Resolution Procedure.

2.3 Appointment

2.4 On 8th April 2009 Acutus was appointed by **tie** to challenge the delay assessment work already undertaken by its own planning team and to provide independent forensic planning analysis to inform and advise **tie** in its administration of the Infraco contract. A copy of Acutus' initial brief is enclosed at Appendix 2/1.

2.5 That brief has been developed and extended during the period of Acutus' engagement to include:

a) the analysis of subsequent programme submissions and claims by the Infraco; and,

b) technical and contractual analysis and advice in relation to time related disputes being progressed through the DRP.

2.6 Report

2.6.1 In accordance with the developed brief and **tie**'s subsequent directions, this report:

a) provides my view on the Infraco's contractual obligations in relation to programme, delay mitigation and the extent to which it has fulfilled these;

b) provides my observations, findings, analysis and opinions on the Estimate submitted by the Infraco; and,

c) provides my opinion on a reasonable assessment of the requirement to revise the Sectional Completion Dates as a direct result of the revised forecast completion dates contained in the MUDFA Rev.8 programme.

2.6.2 I have been assisted in the preparation of this report by following members of Acutus staff:

i) Robert Burt, Director;

ii) John Hughes, Consultant;

iii) John Q Hughes, Consultant; and,

iv) Hugo Dickson, Senior Consultant.

2.6.3 I was assisted, advised and informed by the following members of **tie**'s staff:

i) Tom Hickman, Programme Manager;

ii) Susan Clark, Deputy Project Director;

iii) Dennis Murray, Commercial Director;

iv) Steven Bell, Project Director;

v) Fiona Dunn, Strategic Commercial Manager;

vi) Damian Sharp, Design Manager;

vii) Frank McFadden, Infraco Director;

viii) Andrew Scott, Project Manager;

ix) Tom Cotter, Project Manager;

x) Malcolm Butchert , Project Manager;

xi) Michael Jesuarul, Project Planner;

xii) Clare Norman, Project Planner; and

xiii) Kirsty Wilson, Assistant Project Manager.

2.7 Opinions Expressed in Relation to Law / Legal Matters

2.7.1 Opinions expressed in this report that touch upon the interpretation of the contract, or of the law, are given in my capacity as a construction contracts and construction planning expert with formal education in construction law. Those views are given only where it is necessary for them to explain the basis upon which I have come to my opinions. I am not qualified to provide legal advice.

2.8 Disclosure of Interests

2.8.1 I am unaware of any conflict of interest that would prejudice me in relation to providing independent and objective opinion in relation to this dispute.

2.9 Curriculum Vitae

2.9.1 A curriculum vitae detailing my experience, qualifications and specialist fields is included at Appendix 2/2 of this report.

Section 3 Background to the Dispute

3.1 Background

3.1.1 **tie** has contracted with the Bilfinger Berger – Siemens – CAF Consortium (the Infraco) to deliver the Infraco Works for the Edinburgh Tram Project. Separately, in general, **tie** has contracted with others to divert utilities away from the Infraco Works. The utilities diversion works are referred to in the various contracts and by the parties as the "MUDFA Works". For many parts of the route the MUDFA Works required to be complete in advance of the Infraco Works.

3.1.2 It is my understanding that during the bidding process for the Infraco contract, **tie** provided the Infraco with a MUDFA Works programme. The Infraco used this to inform the preparation of its Infraco Works programme. That programme became the Programme contained within the Infraco contract.

3.1.3 The Infraco's method of aligning its planned order, sequence and timing of the Infraco Works with the MUDFA Works programme was to create 10 No. "MUDFA" milestones within the Infraco Works Programme. This arrangement is explained in the Infraco contract Schedule Part 15 - "Programming Assumptions (12 May 2008)" at point 3.1 and noted in Schedule Part 4 – "Pricing" at point 3.4.24 as a Pricing Assumption.

3.1.4 The MUDFA Works have experienced significant delay and change at many locations along the route. Consequently, the MUDFA Works have not been completed in accordance with the MUDFA Works programme used by the Infraco in the preparation of the Programme. As such there have been significant over-runs in many locations and this has impacted on the commencement of and progress on many parts of the Infraco Works.

3.2 MUDFA Rev. 8 Estimate

3.2.1 The Infraco has submitted a claim for extension of time arising from this late completion, and projected late completion, of the MUDFA Works as communicated to the Infraco by **tie** issuing Revision 8 of the MUDFA programme under cover of the letter reference INF CORR 1371/FMcF, dated 30 April 2009. It is presented pursuant to Clause 80 of the Infraco Contract as the Estimate associated with a notified **tie** Change (Ref. INTC 429).

3.2.2 The document takes the form of a letter dated 6th August 2009 entitled "Estimate in Respect of Notice of **tie** Change Number 429 - MUDFA programme Revision 08 – Delay and

Disruption Resulting from Incomplete Utility Works". It contains several hard and soft copy appendices. Appendices C & D are copies of the Programme into which delays have been impacted. The soft copies of these programmes were initially presented in "pdf" format. This file format does not permit examination and analysis of the network logic, resource allocations and other programming data that does not appear on the printed output.

3.2.3 Following requests from **tie**, the Infraco, subsequently, provided full soft copy of the programmes contained in Appendices C & D (in Primavera "xer" format). These were received by **tie** on 18th August 2009[1].

3.2.4 On 3 September 2009 representatives of the parties met to discuss this Estimate. The Infraco produced minutes of this meeting on 9 September 2009.

3.3 Referral to the Dispute Resolution Procedure

3.3.1 On 4 September 2009 the Infraco served notice referring the matter of agreeing the Estimate to the contract Dispute Resolution Procedure.

3.3.2 On 16th and 17th March 2010 attempts were made to resolve this matter through mediation. This provided unsuccessful and the Infraco subsequently referred the matter for resolution by adjudication in accordance with the contract Dispute Resolution Procedure.

3.3.3 This report has been prepared for use in that adjudication.

[1] Email from Stephen Sharp (BSC) to Tom Hickman (tie).

Section 4 Contract provisions in relation to time and tie Change

4.1 Review of contract provisions

4.1.1 I have reviewed the Infraco contract and examined in some detail the sections that deal with matters of time, change, delay, access, mitigation, acceleration, liquidated and ascertained damages, pricing and programme. In relation to the matters I address in this report, I consider the following provisions and obligations of particular relevance:

4.1.2 General Obligations

a) Project Partnering

i) *"The Parties agree to work in mutual co-operation ..... and apply their expertise ...."* (clause 6.1);

ii) Each party shall *"approach all Permitted Variations on a collaborative and Open Book Basis"* (clause 6.3.1);

iii) Each party shall *"take reasonable steps to mitigate any foreseeable losses and liabilities ....."* (clause 6.3.5); and,

iv) Each party shall *"take all reasonable steps to manage, minimise and mitigate all costs"* (clauses 6.3.6).

b) Duty of care and general obligations in relation to the Infraco Works

i) *"The Infraco shall (and shall procure that the Infraco Parties) use reasonable endeavours to ensure that in carrying out the Infraco Works, it:"*

- *"maximises productivity by reference to Good Industry Practice ....."* (clause 7.5.1)
- *"minimises costs"* (clause 7.5.5)

4.1.3 Programme

i) *"The Infraco shall progress the Infraco Works with due expedition and in a timely and efficient manner without delay, to achieve timeous delivery and completion ....."* (clause 60.1); and,

ii) *"The Infraco shall take all reasonable steps to mitigate the effects of any delay to the progress on the Infraco Works."* (clause 60.9)

4.1.4 **tie** Changes

a) Clause 80 in its entirety, and in particular

i) *"The Estimate shall include the opinion of the Infraco (acting reasonably) in all cases on:*

.....

any impact on the Programme and any requirement for an extension of time" (clause 80.4.3);

*proposals to mitigate the impact of the proposed **tie** Change"* (clause 80.4.8);

ii) "The Infraco shall include in the Estimate evidence demonstrating that:

the Infraco has used all reasonable endeavours to minimise (including by the use of competitive quotes where appropriate in the case of construction works and where reasonable in the circumstances that new or additional sub-contractors are required to deliver in the case of Maintenance Services or where construction works are undertaken during the maintenance phase) any increase in costs and to maximise any reduction of costs (clause 80.7.1);

*the Infraco has investigated how to mitigate the impact of the **tie** Change* (clause 80.7.4); and,

*the proposed **tie** Change will, where relevant, be implemented in the most cost effective manner ....."*

4.1.5 Pricing[2]

a) Relevant Pricing Assumptions are:

i) *"That in relation to Utilities the MUDFA Contractor and/or Utility shall have completed the diversion of any utilities in accordance with the requirements of the Programme save for utilities diversions to be carried out by the Infraco*

[2] Schedule Part 4

pursuant to the expenditure of the Provisional Sums noted in Appendix B." (Schedule Part 4, clause 3.4.24)

ii) *"That the programming assumptions set out in Schedule Part 15 (Programme) remain true in all respects."* (Schedule Part 4, clause 3.4.32)

b) *"7.0 UTILITIES DIVERSIONS TO BE CARRIED OUT BY INFRACO*

7.1 Although tie has let the MUDFA Contract (Multiple Utilities Diversion Framework Arrangement) to carry out the diversion of utility apparatus in the path of the proposed tram route prior to Infraco Works, it will be necessary for some of these works to be delivered by Infraco for the reasons such as:

• they may be unrecorded and not discovered until the Infraco Works are commenced

• they may be discovered during the MUDFA Works but left to avoid a programme overlap or other technical reason

• they may be intrinsically linked to the Infraco Works

• they may require such significant reinstatement work that to carry out under MUDFA may result in significant abortive works.

7.2.1 Where Infraco has been advised of the existence of utility apparatus in advance, whether identified to date or following discovery during the MUDFA Works, any adjustment to the Contract Sum will be made by applying the provisions of Clause 80 (tie Changes)."

4.1.6 Programme assumptions[3]

a) Programming Assumptions (12 May 2008)

"3 MUDFA & UTILITIES

3.1 The programme is based on MUDFA having completed all works and all utilities being diverted that would conflict with INFRACO operations by the following dates;

[3] Schedule Part 15b – Section 3

1A *31 October 2008*

1B *01 August 2008*

1C *31 October 2008*

1D *19 December 2008*

2A *16 May 2008*

5A *No constraint*

5B *11 April 2008*

5C *16 May 2008*

6 *SGN Diversion, 18 April 2008*

Watermain Diversion 30 May 2008

7A *16 May 2008*

3.2 No enabling works shall be required to be undertaken by INFRACO before MUDFA (or other Utilities) can complete their works. The programme is based on the Utilities in the Victoria Dock Access Bridge and Tower Place Bridge area being temporarily diverted away from INFRACO works by MUDFA in advance of the INFRACO works." (Schedule Part 15, clauses 3.1 and 3.2.)

4.2 Interpretation of these contract provisions

4.2.1 It appears to me that, read together, these clauses and the contents of the contract schedules provide the contractual basis from which the MUDFA Rev.8 Estimate should be prepared, examined, discussed, assessed and agreed.

4.2.2 I have been made aware that the Infraco considers that clause 18.1.2, which refers to non-exclusive and exclusive licence to enter and remain upon the Permanent Land and the Designated Working Area, has some relevance in relation to the Estimate. I have found no reference to clause 18 in the Estimate or the preceding notifications and associated correspondence between the parties. In the examination of the Infraco's delay analysis I have found nothing factual that appears to me to turn on the interpretation or application of this clause. I therefore offer no further comment on it.

4.2.3 From all of the foregoing I consider that:

a) The Programme is based on the Intermediate Section Dates for completion of the MUDFA Works as set out in paragraph 3 of Schedule Part 4 and that if the MUDFA Works within each Intermediate Section are not complete by the date stated, this constitutes a Notified Departure which is by definition a Mandatory **tie** Change and hence **tie** is deemed to have issued a **tie** Notice of Change.

b) In accordance with clause 80 the Infraco is required to submit an Estimate for this **tie** Change for discussion and agreement with **tie**.

c) The specific requirements of the Estimate are set out in clauses 80.4 and 80.7.

d) With regard to the preparation of the Estimate and the proposed implementation of the **tie** Change, the Infraco shall:

i) take all reasonable steps to manage, minimise and mitigate all cost (clause 6.3.6);

ii) progress the Infraco Works with due expedition and in a timely and efficient manner without delay, to achieve timeous delivery and completion (clause 60.1);

iii) take all reasonable steps to mitigate the effects of any delay to the progress on the Infraco Works (clause 60.9); and,

iv) implement the **tie** Change in the most cost effective manner (clause 80.7.4).

e) The parties shall work in mutual co-operation and on a collaborative and Open Book basis to agree the Estimate (clauses 6.1 and 6.3.1).

Section 5 Review of the Infraco Estimate

5.1 Overview

5.1.1 I have examined, in some detail, the Estimate submitted by the Infraco under cover of its letter reference 25.1.201/WIM/3230, dated 6th August 2009.

5.1.2 I note from the content of the letter that the Estimate addresses only the Infraco's opinion on its requirement for extension of time. It does not include information on, among other things increased costs and proposed adjustments to any sums due.

5.1.3 It also does not include evidence demonstrating that:

a) the Infraco has used all reasonable endeavours to minimise any increase in costs and maximise any reduction of costs (Clause ref. 80.7.1);

b) the Infraco has investigated how to mitigate the impact of the **tie** Change (Clause ref. 80.7.3); and most significantly,

c) the **tie** Change will be implemented in the most cost effective manner (Clause ref. 80.7.4).

5.1.4 I note that the Infraco seeks to depart from the Estimate requirements prescribed in Clause 80 by addressing in isolation the time element of the delay and disruption arising. I am advised that **tie** has not agreed to this. Having considered the nature of this **tie** Change and its certain adverse impacts on the Programme and the Price, I cannot find reason or justification to support the Infraco's proposed approach to the Estimate. I consider that without information on adjustment of costs, particularly in relation to time, methods of delivery and potential methods of time and cost mitigation, it is nigh impossible to conduct meaningful discussions on how this **tie** Change can be implemented in the "most cost effective manner" (Clause 80.7.4). Consequently any actual requirement for extension of time cannot be properly or reasonably accurately assessed.

5.1.5 For these reasons I am of the opinion that the Estimate is incomplete, inadequate and contractually incompetent. It appears to me that the Infraco's failure to provide all of the required information is frustrating the proper operation of the **tie** Change mechanism set out in the contract.

5.1.6 Notwithstanding, I have been directed to examine the delay analyses contained within the Estimate and, presented with the information currently made available, provide my opinion on whether it properly projects a reasonable requirement for extension of time in accordance with the requirements and obligations set out in the contract.

5.2 The Infraco opinion on requirement for Extension of Time

5.2.1 As noted in the Infraco's covering letter, the Estimate is limited to the impacts resulting from delays to the completion of the Utility Works as set out in the MUDFA programme Revision 8. It takes the form of a document consisting solely of four appendices; A, B, C and D. These are titled as follows:

A. Impacts on Programme Pursuant to Clause 80.4.3;

B. Increases in Sums Due to be Paid to Infraco Pursuant to Clause 80.4.10;

C. Programme Revision 1 extended by MUDFA programme Revision 8 – Original Logic and Sequencing; and

D. Programme Revision 1 extended by MUDFA programme Revision 8 – Mitigated through Re-sequencing and Revised Logic.

(Appendix B consists only of a title page with the note "*To be confirmed following agreement on respect of extension of time*".)

5.2.2 Appendix A is a narrative describing the delay analysis undertaken by the Infraco. There follows my observations and comments on each section of this document using the Infraco's headings for ease of cross-referencing.

5.2.3 "**Introduction**"

a) The tenor of the first paragraph is generally, but not strictly, consistent with the contract documents. Schedules Part 4 and 15 set-out the pricing and programming assumptions on which the contract is based. However, they also note there are utilities diversion works that will or may be undertaken by the Infraco (Schedule Part 4 – clauses 3.4.24 and 7.0 refer). They also contemplate the requirement for the Infraco to deliver some of these works through the expenditure of Provisional Sums and the instruction of **tie** Change.

b) I have found very little, if indeed anything, in the contract that supports the specifics cited in the second paragraph. They appear to me to be references to pre-contract philosophies and or discussions that may or may not be correct. I note that the contract is an entire agreement and therefore offer no further comment.

5.2.4 "**Programme Revision 1**"

a) I note that the Infraco has used the Programme Revision 1 as the platform for its analysis. I am advised that this is the current Programme for the Infraco contract.

b) A comparison of the milestones shown in the MUDFA & Utilities section of the Programme with the dates listed in the programming assumptions contained at paragraph 3 of Schedule Part 15 is shown below.

Programme Assumptions Schedule 15 Para 3 - Descriptions	Programme Assumptions Schedule 15 Para 3 - Dates	Revision 1 Programme - Descriptions	Revision 1 Programme - Dates
1A	31/10/2008		
		MUDFA & Utilities work area 1 completion	31/10/2008
1B	01/08/2008		
		MUDFA & Utilities work area 2 completion	01/08/2008
1C	31/10/2008	MUDFA & Utilities work for sub section 1C	31/10/2008
1D	19/12/2008	MUDFA & Utilities work for sub section 1D	19/12/2008
2A	16/05/2008	*(No apparent equivalent entry)*	
5A	No constraint		
		MUDFA & Utilities work area 5	05/11/2007
5B	11/04/2008	MUDFA & Utilities work for sub section 5B	11/04/2008
5C	16/05/2008	MUDFA & Utilities work for sub section 5C	16/05/2008
6 – SGN Diversion	18/04/2008	Depot - SGN Diversion	18/04/2008

Programme Assumptions Schedule 15 Para 3 - Descriptions	Programme Assumptions Schedule 15 Para 3 - Dates	Revision 1 Programme - Descriptions	Revision 1 Programme - Dates
Watermain Diversion	30/05/2008	Depot Watermain Diversion	30/05/2008
7A	16/05/2008	MUDFA & Utilities work area 9 completion	16/05/2008

c) By inspection, the two sets of data do not fully align either in terms of descriptions or dates. I make this comment solely in the interest of clarity. It would appear on more detailed examination that the differences can be reconciled and appear to be merely the use of different descriptions and the use of an early date on one milestone to represent the "No constraint" noted in the programming assumptions.

d) The Infraco's Estimate states that the 10 No. dates constitute the start milestones for the Infraco Works in the corresponding Intermediate Section. Examination of the Programme in its native software format evidences that this is an inaccurate statement. I cite as an example Section 1A. Along the length of this intermediate section there are three locations where different sequences of work activities commence. These are:

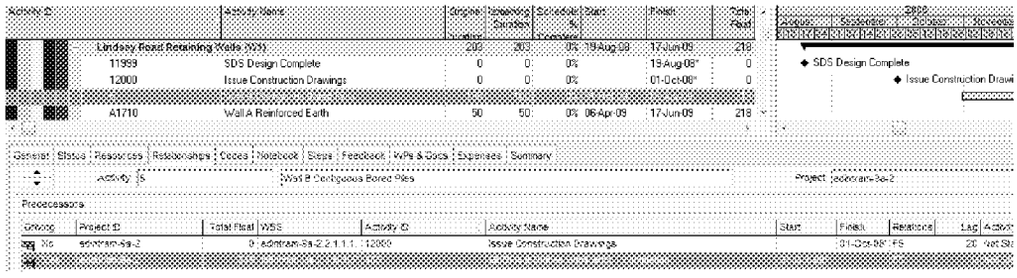
i) Lindsay Road Retaining Walls (W1)

ii) Ch 600 -700 Road and track works

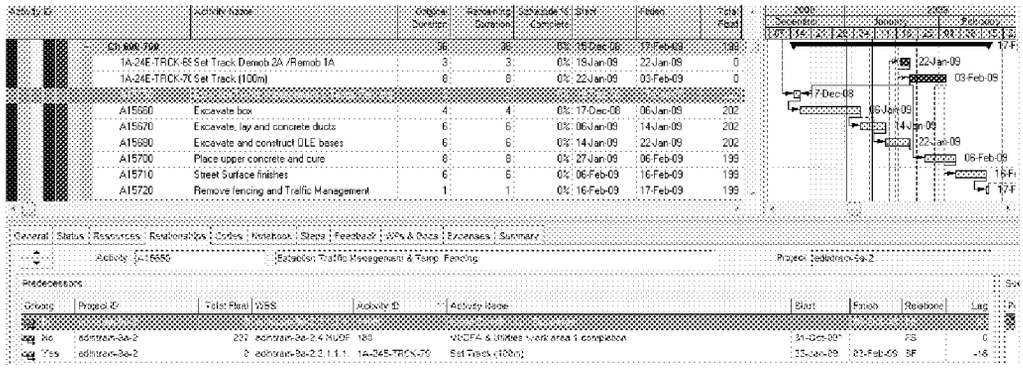
iii) Tower Place Bridge (S17)

e) The programme logic network for Lindsay Road Retaining Walls (W1) shows that construction of the wall has two predecessors. The first is the "Issue for Construction Drawings" which has a finish-to-start relationship (with a 20 working day lag). It is shown to have zero total float and is therefore on the critical path. The second is the "MUDFA &Utilities work area 1" milestone which also has a finish-to-start relationship but with zero lag. It is shown as having 249 days of total float although by inspection this would appear to be incorrect as the start of the wall construction coincides with the milestone date. The extract below from the Rev.01 programme

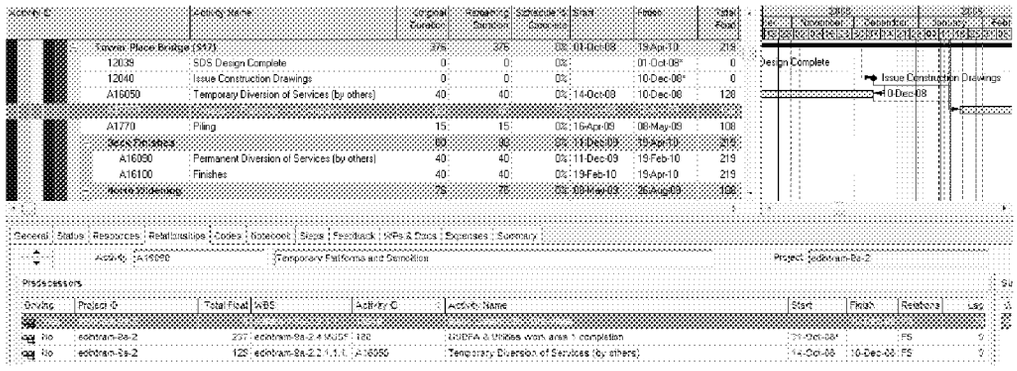
evidences these observations which show that the MUDFA milestone date is not on its own the "start milestone" for the Infraco Works.



f) The Ch 600 – 700 road and track activities set have three predecessors. The first two, "Issue Construction Drawings" and "MUDFA & Utilities work area 1 completion" are not driving activities. It is the third predecessor, a start-to-finish link (with a minus 16 days lag) to the "Set Track (100m)" activity that is determining the start of the road works, as shown on the programme extract below. The start of that activity is being driven by a preferential logic link to track laying in Intermediate Section 2A. This is a work activity located approximately 6km to the west of this location. Clearly, there is no physical interdependency between these activities. (Refer to paragraph 5.2.5f) for explanation of physical and preferential interdependencies.)



g) The first construction activity on Tower Place Bridge (S17) also has three predecessors. As can been seen from the programme extract below, the driving activity is the date for "Issue Construction Drawings" and not the utilities work.



h) Throughout the Rev. 1 programme construction activities can be found which are not driven by, and in many instances have no dependency on utility diversions. I make this point to highlight the fact that not all of the Infraco Works in each intermediate section are dependent on, or driven by, the corresponding utilities diversions dates. In many instance the commencement of on-site work is driven by the date for the issue of construction drawings, preferential logic links from other Intermediate Sections and/or other fixed dates and constraints contained within the Programme.

i) I also note that the critical paths to each of the Sectional Completion Dates (A, B, C & D) are not constructed solely by physical logic. By that I mean that the length of the critical paths is not determined by the sequence of truly physical interdependency between activities that lead from commencement to overall completion. The programme contains constraints and preferential logic which elongate the critical paths. I understand that many of these were inserted into the Programme by the Infraco to accommodate its preferences and self-imposed resource constraints.

5.2.5 "**Initial Analysis**"

a) From the description provided and examination of the output produced, it appears to me that the Infraco has conducted what is in effect an "as-planned – impacted" form of delay analysis. It projects what the Infraco claims to be the requirements for extension of time in circumstances where progress actually achieved is ignored and no mitigation measures are applied. I consider such an analysis to be unreliable and inaccurate. It projects Sectional Completion Dates that have been calculated in a manner that I consider to be contrary to the contract provisions for the seeking and agreeing any requirements for extension of time.

b) It is my opinion that the analysis output enclosed at Appendix C of the Estimate over-states the extension of time requirements and does not accord with the requirements of the contract. I say that because this method of delay analysis has been much criticised in the courts for the following reasons. It:

i) takes no account of the effect of actual progress;

ii) takes no account of any changed intentions, construction methods, re-sequencing or re-ordering;

iii) ignores any duty to mitigate;

iv) does not establish the actual effect of the delaying events;

v) can be easily manipulated to give different results; and

vi) tends to accrue relief to the author's benefit.

c) In addition to these general criticisms of the method of delay analysis adopted, the Infraco has taken for each Intermediate Section the latest completion date for any MUDFA Works detailed on the MUDFA Rev. 8 programme, irrespective of its nature, location and actual likely impact on progress of the individual elements of the Infraco Works. Applying this latest date unilaterally across the entire length of an Intermediate Section (typically around 2km long) does not appear to me to be correct or reasonable. The results do not accord with the Infraco's contractual obligations and, in particular, do not; progress the Infraco Works with due expedition; mitigate delay; minimise cost; and implement **tie** Change in the most cost effective manner.

d) As an example I enclose at Appendix 5/1 a time-chainage diagram that indicates the location of the delayed utilities diversions within Intermediate Section 1A. The information is presented in 100m long bandings to coincide with the format of the MUDFA Revision 8 programme. It is apparent from this diagram that the Infraco's method of impacting the MUDFA milestone adjustments into the Rev. 1 programme over-states the actual delay to the individual elements of the Infraco Works. As identified by the black arrows, the delay to the commencement of the Infraco Works on the 1,400 metre long section from Newhaven to Victoria Dock Entrance Bridge is

over-stated by approximately 4 weeks and the delays to commencement of both the Tower Place Bridge and the Victoria Dock Entrance Bridge itself are over-stated by approximately 31 weeks. I note as of particular significance that in the Estimate the Infraco states that Tower Place Bridge is on the critical path of its projections of Sectional Completion Dates C and D.

e) From my examination of the Infraco's impacted programme it is clear to me that these over-stated delays are contributing to the overall projected delay to the four Sectional Completion Dates.

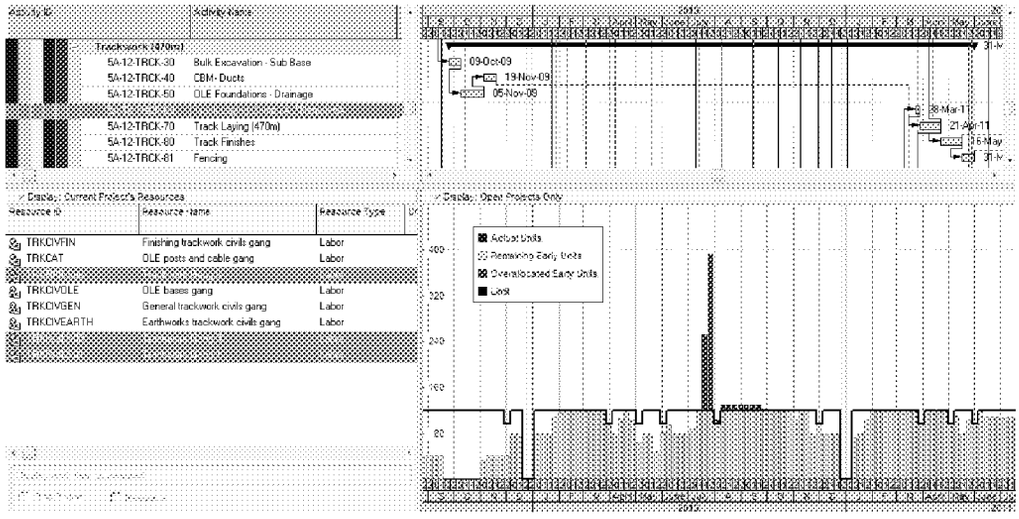
f) Of even greater significance to the accuracy of the Infraco's delay analysis is the network logic I have examined within the soft copy of the programme. It contains both physical and preferential logic links[4]. Much of the critical path is driven by the preferential logic links. For the most part these preferential links have been inserted to effect contractor imposed constraints on the availability of certain resources (i.e. 3 No. track laying gangs and 2 No. overhead line gangs). By impacting the MUDFA delays by revising the date for the 10 No. MUDFA milestones these preferential logic links greatly exaggerate the true impact of overall delay. This is because they rigidly adhere to the original resource constraining activity sequences despite the relative timings of the different activities being changed by the different amounts of delay being impacted into each Intermediate Section of the programme. The following paragraph and Appendix 5/2 evidence this exaggeration of projected delay.

5.2.6 "Corrected Logic to the Programme Revision 1"

a) Within Appendix A of the Estimate, in the paragraphs headed "Corrected Logic to the Programme Revision 1", the Infraco explains, in general terms, adjustments it has made to the programme network. It appears to me these adjustments do not fully address what I consider to be underlying shortcomings in the programme logic. The result is that the impacted programmes produce unreliable results. This is most noticeable in the programme relationship between completion of preparatory civil engineering works and the commencement of the corresponding sections of track laying. The schedule in Appendix 5/2 of this report lists (on the left hand side) for the

[4] "Physical logic I define as true interdependency between programme activities which cannot be changed (at least not without employing exceptional measures.) "Preferential logic" I define as interdependency introduced to effect preferences of the programme author and which can be changed (albeit there may be some practical and/or commercial consequences from doing so.)

Appendix C submission, 36 instances where there is a significant time lapse between these two types of construction activity. Normal construction practice would be that one would immediately follow the other and possibly even overlap with it to some degree. I note that these time lapses range from 4 days to 622 calendar days and average 135 calendar days of delay. To exemplify, the Appendix C programme extract below shows a 17 month delay between completion of the CBM ducts and commencement of a 17 working day long activity for track laying near Murrayfield Tram Stop. The lower half of the programme extract shows the track gang resource usage during this period. I understand that the heavy line on the chart at "120" indicates the resource constraint imposed by the Infraco (i.e. 120 = 3 gangs @ 40 hours per week). To me, it is readily apparent that even without exceeding this limit there are track gangs available to carry out the track work when the "CBM – Ducts" were complete. It appears that this 17 month delay is without justification and that it arises as a consequence of unnecessary preferential logic links within the programme network.



b) This type of unnecessary and inappropriate logic is not unique and I have not been selective in using it as an example. It is repeated many times throughout the Infraco's delay analysis and along the length of the route, as evidenced in the schedule at Appendix 5/2. It is clear to me that this is significantly distorting the output from the Infraco's delay analyses and is giving rise to greatly over-stated projections of overall delay.

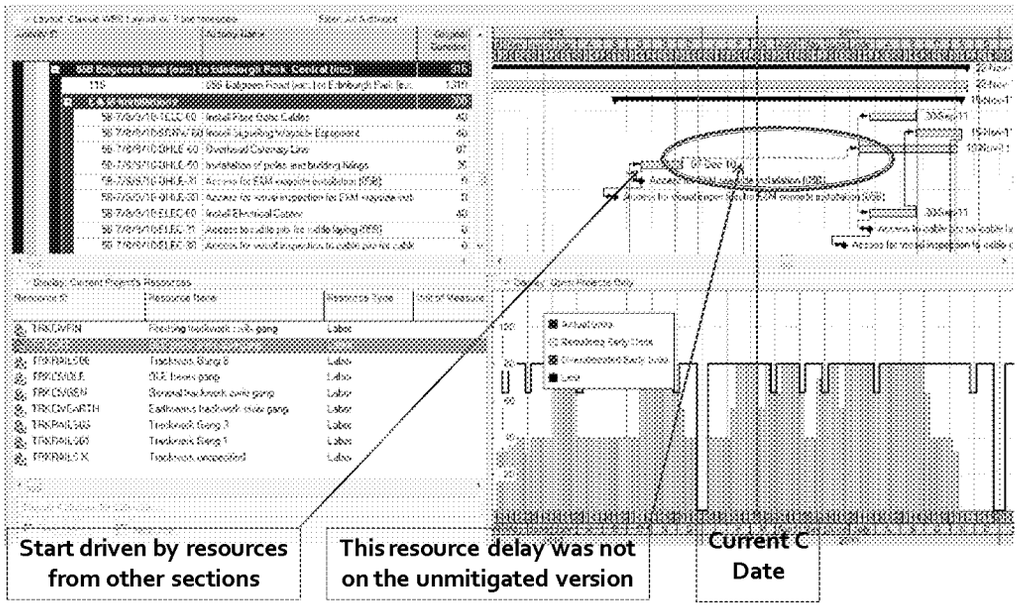
c) I conclude that the logic network contained within the Infraco's delay analyses does not accurately model the true interdependency of the individual elements of the Infraco Works and, consequently, produces unreliable and erroneous results.

5.2.7 "Mitigation"

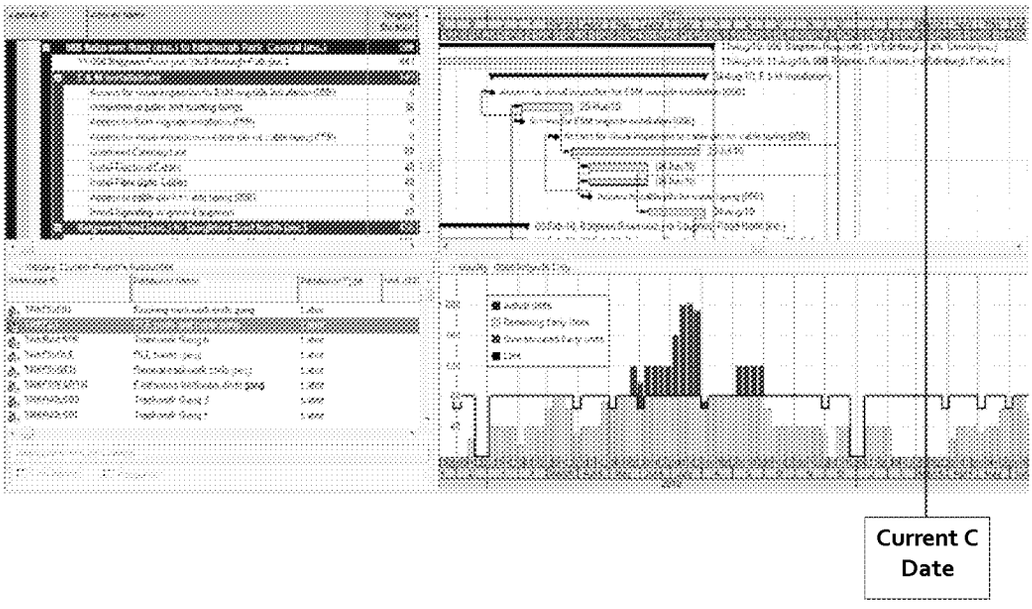
a) I note that in the first paragraph of the Infraco's "mitigation" narrative it states *"Several measures were employed by Infraco* (i.e. the Infraco) *with a view to reducing the overall delay resulting from the delayed completion of the Utility Works including the removal of resource constraints, the incorporation of instructed acceleration measures and re-running the resource levelling".* There follows several paragraphs of further explanation on each of the employed mitigation measures. The product of the application of these mitigation measures is the programme contained at Appendix D of the Estimate and it is from this document that the claimed extension of time to the four Sectional Completion Dates is derived.

b) I have examined the programme at Appendix D to consider the effectiveness of the mitigation measures that have been applied. I note there is no improvement on the projected delay for Section A (Depot), a five and a half month improvement for Section B (Test track) and an eight month improvement for Sections C (Completion of construction) & D (Open for revenue service). On closer examination it appears to me that the mitigation measures applied by the Infraco are, for the most part, adjustments to the programme network to address some, but certainly not all, of the superseded and unnecessary preferential logic links. I also note that there remain a significant number of preferential logic links associated with imposed resource constraints and these links continue to drive the critical paths for each of the Sectional Completion Dates. I refer to the right hand section of the schedule contained at Appendix 5/2. It shows that the Infraco's "mitigated" delay analysis programme contains 28 instances where there is a significant time lapse between the road and track construction activities. These time lapses range from 27 days to 379 days and average 73 days of delay. While this is an improvement on the equivalent figures calculated from the Infraco's "unmitigated" delay analysis programme (as referred to at 5.2.6a) above) there remains a significant amount of inactivity which leads to unnecessary projected delay on both the critical and near-critical paths.

c) I cite as an example the E&M Installation on Section 5B Balgreen Road (exc.) to Edinburgh Park (inc.). (This is the final section of the critical path to Sectional Completion Date C on the Infraco's delay analysis contained at Appendix D of the Estimate.). Below is the relevant extract from the Appendix D programme. It also shows the resource demand histogram for the overhead line gangs. To this I have added a vertical red line to show the Sectional Completion Date C from the Rev. 1 Programme (i.e. the Sectional Completion Date C current at the time the Infraco submitted the Estimate.) It is readily apparent that four activities and two milestones are projected to over-run the current Sectional Completion Date C by almost 9 months. However, as I have noted by the use of red text and arrows, this projected completion is not being driven by a continuous series of interdependent activities. The installation of poles and building fixings is not starting as soon as it physically could. Its start is being dictated (driven) by a finish to start link from completion of similar work on another section of the project. The work involved is relatively simple and requires a small amount of resources that should be readily available in the market place. The Infraco's apparent strict adherence to its self-imposed resource constraints and the imposition of preferential logic to effect this is creating unnecessary delay to its critical path calculation. I also note that once the poles and building fixings are complete the next item on the critical path (Overhead Catenary Line) is further delayed by approximately seven months by another preferential logic link which I associate with constraining the resources for overhead line works. I again note that there would appear to me to be no reason why additional resources could not be procured to eliminate (i.e. mitigate) this very long delay on the critical path. That said, I note from the overhead line gang resource histogram that within the Infraco's self-imposed resource constraint there is already some availability and that this would increase if the installation of the poles and building fixings was not delayed by similar Infraco imposed resource constraints (as referred to above). I also note that the over-running section of work shown on this programme extract did not extend beyond the current Sectional Completion Date C in the Infraco's unmitigated programme (Appendix C of the Infraco's Estimate). I cite this as further evidence that the projected requirement for extension of time is driven to a great extent by the preferential logic inserted into the programme by the Infraco to meet its self-imposed (and in my opinion inappropriate) resource constraints.



d) To demonstrate the delaying impact of these preferential logic links I have removed them from this section of the programme network and used the computer software to re-scheduled the programme. The result is shown below.



e) By removing the computer generated resource constraint, not only is the delay reduced, but this part of the Infraco Works now has a projected completion 7 months **ahead** of the current Sectional Completion Date C. The peak demand for OHLE resource has exceeded the Infraco limit of two gangs but there would appear to be no reason why this could not be overcome by employing an additional gang of men and equipment (thereby increasing the available resource from 80 units to 120

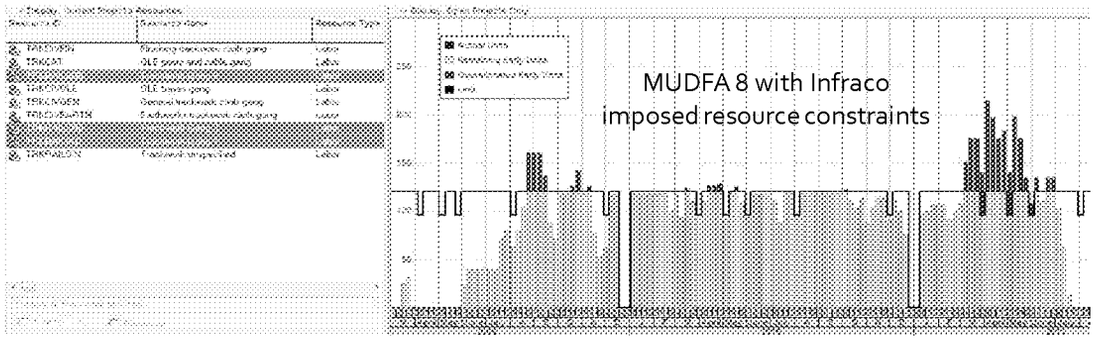
units) for a period of several months. I am advised that such resources are readily available in the market place and that there is more than enough time to procure them in an efficient manner. This is a much more cost effective manner in which to implement this tie Change than that currently put forward by the Infraco in its Estimate. This is the type of mitigation measure that the Infraco undertook to consider on 3 September 2009 (only to proceed on 4 September 2009 to refer the matter to the Dispute Resolution Procedure).

f) This exemplifies one of the basic flaws of this entirely theoretical analysis of delay. The computer software is projecting significant delays that can readily be mitigated. To construct the Infraco Works on the basis of the Infraco's programme would make no economic sense.

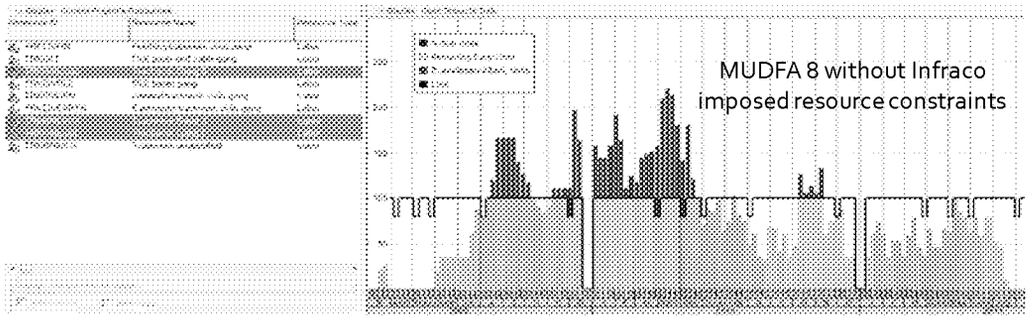
g) This example of what I consider to be clearly missed opportunities to mitigate projected delay is not unique. Similar situations are repeated, throughout what the Infraco claimed to be a programme *"Mitigated through Re-sequencing and Revised Logic"*.

h) I acknowledge that a programme cannot be based on an infinite availability of resources. From a practical point of view it is also necessary to be able to plan and procure resources in advance and deploy them in an efficient manner. If resource constraints are lifted, a prudent construction planner would check the demand created by such action and then address the issue of any unrealistic and/or unmanageable levels of demand.

i) Below is the track gang resource demand profile from the Infraco's "mitigated" delay analysis programme (i.e. Appendix D of the Estimate). It, generally, although not strictly, adheres to the Infraco's stated resource constraint of three track laying gangs.



j) Removing just some of the Infraco imposed resource constraints brings completion of a large proportion of the Infraco Works ahead of the current Sectional Completion Date C. The revised resource demand arising from this partial mitigation is shown below.



k) It is apparent that there is a requirement for more than three track gangs during the earlier stages of the programme. It would appear that this could be satisfied by one additional gang, given some programming refinement (i.e. increasing the available resource from 120 units to 160 units) and then smoothing the resource demand by using available float on non-critical activities. More importantly, it greatly reduces the demand on resources during the later stages of the construction period thereby freeing the critical path from resource constraint and allowing other mitigation measures to be implemented in a practical and cost effective manner.

l) All of the foregoing time mitigation measures are achievable by revising preferential logic and revising resource constraints in a measured, controlled and cost effective manner.

m) It is my opinion that there is further scope for mitigation through adjusting certain interdependency relationships between the individual activities. The Infraco "mitigated" programme contains a great number of finish-to-start relationships. That

in itself is not unusual, nor necessarily incorrect, but where such relationships are between significant packages of work within a relatively large working environment, normal practice would be to consider when one activity might sensibly start before the preceding one is entirely complete. Having examined the detail of the Infraco's programmes I consider there to be many opportunities where finish-to-start relationships could be reviewed and revised to mitigate delay. I cite as an example the Infraco's projected critical path to Sectional Completion Date A. The Depot Building "building services" and "fit-out and finishes" are both linked finish-to-start to the "install workshop equipment". Noting that the majority of the building services and fit-out are in the accommodation part of the Depot Building and the major items of workshop equipment are in the workshop part of the building, it appears to me there is clear scope to introduce a negative lag to the dependency links. Indeed this principle has been discussed at meetings with the Infraco and its representatives have acknowledged that this is a practical mitigation proposition/proposal. It's Estimate, however, fails to consider/implement same.

n) In my detailed examination of the activities on the projected critical paths I have also noted that many of the individual activity durations are longer than I would have expected, given the nature and scope of work involved. While I recognise that when preparing the original Programme the Infraco was at liberty to allocate whatever durations it wished, providing the Programme complied with the contract requirements, I consider it correct and reasonable that these durations may be subsequently reviewed and revised, if required or appropriate. The requirement to mitigate delay and implement the MUDFA Revision 8 **tie** Change in the most cost effective manner is, in my opinion, a justifiable reason for such review and revision. I acknowledge that doing so may have an impact on the actual direct costs of the individual activities. However, having considered the large amounts of money associated with time related preliminaries and the liquidated and ascertained damages provisions contained in the contract, it is my opinion that informed judgement is required to make decisions in relation to revising resource availability, increasing the number of working hours and taking other actions that may be required to reduce individual activity durations. It appears to me that the **tie** Change mechanism contained within Clause 80 of the contract requires the provision of such information as part of the Estimate. In that it has not been provided within the

Infraco's Estimate submission I can only use my experience and professional judgment to form an opinion as to what *could* reasonably be achieved in implementing this **tie** Change in the most cost effective manner.

o) In my assessment, contained in Section 6 of this report, I have used my experience and professional judgement to estimate reductions to some of the activity durations to mitigate delay.

5.2.8 "Critical Paths"

a) The narrative of the Infraco's Appendix A concludes with a summary of the two principal critical paths. These are (i) a path that runs through Section A & B Completion Dates; and (ii) another that runs through the Section C & D Dates.

b) I note the Infraco's statement that the critical path driving the end date (that is Section C, and through to Section D) has been calculated by resource levelling. To me, this affirms the existence of the programming issues that form the basis of much of my criticism of the Infraco's method of delay analysis.

c) Reviewing these critical paths in turn I note that many of my criticisms feature in each. I summarise as follows.

i) Section C / D Critical Path

- *"MUDFA Works completion Intermediate Section 1A"* - The impacted MUDFA Revision 8 date does not align with the dates on the MUDFA Revision 8 programme for access to the first sections of work within Section 1A. Consequently, the projected delay is overstated by approximately 4 weeks. (Ref. paragraphs 5.2.5d) and 5.2.5e) above.)

- *"Tower Place Bridge widening"* - The Revision 1 Programme contains a specific activity for the "Temporary Diversion of Services (by others)" for the utilities diversion works required to allow work to proceed on Tower Place Bridge. I am advised that these utilities diversions were identified by both **tie** and the Infraco as critical to the overall programme because of the nature and scope of works required on Tower Bridge and its interdependency with the other critical works in Intermediate Section 1A.

It was important that the diversions affecting this bridge were completed as soon as possible to allow work on the bridge to commence at the earliest possible date. In the delay analysis programmes contained in Appendices C & D of the Estimate, the Infraco shows the utility diversions for the bridge as being complete on 10 June 2009. However, work on the bridge itself is not shown as starting until 17 December 2009, which coincides with the MUDFA Revision 8 date for completion of the last utility diversion in Intermediate Section 1A. This last utility diversion is BT cabling which has no impact on the commencement of the bridgeworks. Consequently, the Infraco's delay analysis over-states the actual physical delay to the commencement of critical works in Intermediate Section 1A by approximately 31 weeks. (Ref. paragraphs 5.2.5d) and 5.2.5e) above.)

- *"Road and Track works Rennies Isle to Casino Square"* – the Infraco's programme for its assessment of the work required extends to 82 working days. I observe that this is a 470m long, relatively straight forward section of the Infraco Works. The durations allowed for each of the activities appear to me to be generous and could be reduced by increasing resource and or working longer hours. The cost effectiveness of taking such action to mitigate delay, and the degree to which it should be applied, would depend on the amount of any increase in direct cost, if any, compared with the additional cost associated with the delay that could be mitigated or indeed eliminated.

- *Victoria Dock Access Bridge and associated road and track works"* – Utilities diversions to allow work to commence on Victoria Dock Access Bridge were treated by both parties in a similar manner as those for Tower Place Bridge (as noted above). In the delay analysis programmes contained in Appendices C & D of the Estimate, the Infraco shows the utility diversions for the bridge as being complete on 10 June 2009. However, work on the bridge itself is not shown as starting until 18 April 2011, some 22 months later. The programme network logic is driving this later commencement date from commencement of roadworks in the surrounding area. It appears to me that where the roadworks may have or are likely to be

delayed by such a long period of time the Infraco is obliged to mitigate the delay by re-sequencing the works. I note that the works to Victoria Dock Access (Entrance) Bridge consist, primarily, of re-profiling and deck waterproofing. the Infraco has allowed 30 working days for these tasks. I consider that by taking access at an earlier date when the works could be done, this 30 day duration could readily be taken-off the critical path.

- *"OHLE works to Intermediate Section 1A"* - I note that in the "E&M Installation" section of the Infraco's mitigated delay analysis programme (Appendix D) the commencement of the OHLE is delayed by two and a half months by a preferential resource constraint logic link. As I have noted earlier in this report, I consider such a resource constraint to be unjustifiable given that there is likely to be relatively little additional cost, if any, associated with removing it and that the savings in time related additional costs would be very much greater.

- *"OHLE works to Intermediate Section 5B"* - I note that the only reason why this work is at the end of the critical path is because there is a preferential logic link (resource constraint) to its commencement from completion of the similar activities in intermediate section 1A. As I have shown at paragraph 5.2.7c) above, by increasing the available resource by just one gang, 7 months of delay to this work can be removed. (It would also appear possible to save a further 7 months on the completion of this work if one additional track laying gang was also introduced.)

ii) Section A / B critical path

- *"MUDFA Completion of water main at Depot"* – The MUDFA Revision 8 programme does not show a projected completion date for the water main. It is my understanding that this is because the water main diversion had already been completed prior to the issue of the MUDFA Revision 8 programme. I am advised that the water main diversion was complete by

17 February 2009, which is two weeks earlier than the date used by the Infraco in its delay analysis[5].

- *"Depot earthworks"* – the Infraco's delay analysis programmes link completion of the water main diversion in a finish to start relationship with commencement of the Depot earthworks. I have examined the drawings for the Depot and observed that the majority of the Depot earthworks consist of the removal from site of existing soils thereby generally lowering the entire area to the formation level required for the construction of the Depot Building and the extensive areas of track required for tram stabling and shunting. The Pricing Assumptions state that the volume to be removed is 80,000m^3. I am advised that during Autumn 2008 it became apparent to both parties that this volume was significantly underestimated and that approximately 170,000m^3 would have to be removed from the Depot site. I have examined the detail of the water main diversion and estimated that until it is completed approximately 25,000 to 30,000m^3 of this bulk excavation cannot be undertaken. (This is to prevent the risk of disturbing the existing water mains that are to be abandoned and removed after the water main diversion is operational.) Of this volume approximately 10,000 m^3 affects the critical path activities for the Depot. I am aware that during the period August 2008 to January 2009 **tie** wrote to the Infraco on several occasions confirming the availability of access to commence the available bulk earthworks. The Infraco would appear to have decided not to progress with this available work despite the fact that it was then and is now claiming it to be on the critical path to Sectional Completion Date A. I consider this to be a missed opportunity to mitigate the later than planned completion of the water main diversion. This failure to progress available work with due expedition appears to me to have unnecessarily increased the projected requirement for additional time to achieve Sectional Completion Date A. I am informed[6] that the Infraco did not actually commence the Depot earthworks until 7 April 2009, some 7 weeks after the completion of the water main diversion. From this it

[5] Source : Andrew Scott (**tie** Project Manager)
[6] Source: Andrew Scott (**tie** Project Manager)

appears to me that completion of the water diversion was not driving commencement of the Depot earthworks. This makes me question what is actually driving the critical path. The water main diversion was not on the critical path of the Rev.1 programme and it appears it is not on the actual critical path for the construction of the Depot. I cite this as another example of the unreliable results that arise from using the "as-planned impacted" method of delay analysis, particularly in the circumstance prevailing on this contract. The failure to consider in the delay analysis what has actually happened produces results that do not align with the facts.

- *"Foundations"* – I consider the duration allowed for the foundations to be generous and capable of being reduced by re-sequencing and increasing resources. I am advised that the actual time taken for construction of the foundations on the critical path to have been significantly shorter than that shown on the Infraco's programme. From this it appears to me that there is scope within the programme to mitigate delay within the time allowances contained within the Infraco's programmes. I also note that in the Infraco's programmes the start of the foundations is linked "start to start" with the Depot earthworks but with a 25 day lag. This indicates to me the planned intent to commence the foundations 25 days after commencement of the Depot earthworks. This logic makes practical and economic sense in that priority would be given to the earthworks required for the most critical works (i.e. the foundations for the Depot Building) thereby allowing them to commence at the earliest possible date. I am advised that this did not happen and that the foundations did not actually commence until 3 June 2009, **some 10 weeks after** the earthworks in the *entire* depot area had been completed. From this it appears to me that completion of the Depot earthworks was not driving commencement of the foundations. Matters other than the sequence of water main diversion followed by earthworks would appear to be driving the actual critical path for the Depot. Consequently, the projected critical path to Sectional Completion Date A, as presented by the Infraco, does not appear to accord with the facts. I cite

this as yet another example of the unreliable results that arise from using this entirely theoretical "as-planned impacted" method of delay analysis.

- *"Building Envelope"* – I consider the duration allowed for the Building Envelope to be generous and capable of being reduced by re-sequencing and increasing resources. The unit rates for productivity appear to be very conservative and given the size of the building it is clear to me that several work fronts can be accommodated without adverse impact on efficiency. Indeed, working on several work fronts at one time would appear to me to make economic and practical sense.

- *"Building Services"* – I consider the duration allowed for the Building Services to be overly generous and capable of being significantly reduced by re-sequencing and increasing resources. The overall duration of 160 working days (32 working weeks) I would associate with a highly complex and heavily services building. The Depot is not such a building.

- *"Fit-out and finishes*" – The fit-out and finishes activity is also 160 working days long and runs concurrently with the Building Services. My observations on this activity are the same as those noted above for the Building Services.

- *"Install workshop equipment"* – As referred to at paragraph 5.2.7m) above there is scope to mitigate delay by revising the finish to start relationship between this activity and the Building Services, Fit-out and Finishes. Such re-sequencing of the programme appears to me make practical and economic sense. I note again that the Infraco has acknowledged the practicality of such re-sequencing. It has, however, failed to include same in its current submission.

- *"Inspection and testing"* – I note the duration for this activity to be 20 working days, linked finish to start from completion of the Installation of the workshop equipment. It is my opinion that there is scope to reduce the projected delay by revising this relationship, thereby re-sequencing this work so that in can commence, in some areas and on some equipment, prior to completion of preceding sets of activities.

d) I note that in the Appendix A narrative of the Estimate the Infraco goes on to state that there are also *"several additional near-critical paths"* as a result of the delay in completion of the Utility Works and that the resource levelling (to comply with the constraints imposed by the Infraco) has effectively made critical any construction sequence concluding with track-laying or OHLE activities. I consider that to be an inevitable consequence of the manner in which the Infraco has prepared its delay analysis programme. By using preferential logic links to constrain resource demand to the limits it has set, the Infraco's has engineered a delay analysis programme that does not accurately model the time required to deliver the Infraco Works in a cost effective manner and in accordance with the Infraco's obligations under the contract. It appears to me to be a construction aimed at maximising the projection of delay beyond that actually required.

e) I do not agree with the Infraco's assertion that *"criticality* (is) *now inherent within every construction phase"*. By inspection, the Infraco's Appendix D delay analysis programme shows float available on the great majority of the activities it contains. I do, however, acknowledge that by mitigating delay, the risk profile of the project will change from that upon which the contract is based. I consider that to be an inevitable consequence of change and a matter that requires to be addressed as part of the various change mechanisms contained within the contract and within the Infraco's Estimate.

5.3 Conclusion

5.3.1 I note the Infraco's conclusions but, for the reasons noted above, consider them to be calculated on the basis of erroneous and unreliable information used in, and produced from, an inappropriate method of delay analysis. I also note that the manner in which the analysis has been conducted ignores a significant number of the Infraco's obligations to mitigate delay, minimise cost and progress the Infraco Works with due expedition. It is my opinion that the projected requirements for revision of the four Sectional Completion Dates are greatly exaggerated.

Section 6 Assessment of requirement for Extension of Time

6.1 Introduction

6.1.1 I have been asked to provide my own opinion as to what I might consider to be a reasonable assessment of the requirement for extension of time that may arise from the issuing of the MUDFA Revision 8 programme. I find that I must do that in the absence of what I consider to be most pertinent information from the Infraco in relation to resourcing, procurement, methodology, productivity and their associated costs. It appears to me that the provision of such information should have been part of the Estimate submission and the subject of discussion at subsequent meeting(s) to agree it. Notwithstanding, I have undertaken a detailed examination of the delay analyses submitted by the Infraco and used my own experience and judgement to consider the practicalities and relative cost (if any) in mitigating delay to implement this **tie** Change in the most cost effective manner. I accept that this necessarily requires the making of certain subjective assessments of various factors affecting logic and durations and that this can lead to imprecise outcomes. It does, however, indicate that the actual requirement for extensions to the Sectional Completion Dates is likely to be considerably less than those sought by the Infraco.

6.2 Process

6.2.1 The process I undertook involved:

a) checking and, where appropriate, adjusting the factual information contained within the submitted programmes. (Some of the actual progress dates used by the Infraco were different from **tie**'s contemporaneous records.)

b) examining the network logic contained within the impacted programmes to check that it was logical and justifiable, and to determine if it was physical logic (i.e. true interdependency) or preferential logic (e.g. logic added by the Infraco for its own preferences in relation sequencing and constraining demands on certain resources).

c) tracing, through the programme network, the critical and near critical paths that were driving the Sectional Completion Dates to identify why the Infraco's analyses were projecting the magnitude of delay being claimed.

6.2.2 In each and every case it became apparent that the critical path was being driven by a number of preferential logic links and/or resource constraints that the Infraco had built

into its programmes. There appears to be little justification for strict adherence to most of these. Much of the preferential logic I found to be superseded and required removal or revision. Preferential logic links included in the original programme to effect resource constraints on track laying and overhead line work were driving a large proportion of the projected delays despite the fact that they were no longer serving their original intended purpose. I acknowledge that the Infraco has made some minor adjustments to the logic network (claiming such action to fulfil its obligation to mitigate delay) but these are relatively limited in nature and only partly reduce the projection of delay.

6.2.3 Having completed these examinations, I then used the delay analysis presented by the Infraco as the starting points to establish my own assessment of the requirements for extensions of time. This took the form of reverse (back) analysis of the Infraco's impacted programme. Following adjustments for errors in baseline factual data, the critical paths of all activity strings that were projecting delay beyond the current Sectional Completion Dates were examined. They were each traced back from the link to the Sectional Completion Date milestones. Where criticality was found to be driven by what I considered to be: unnecessary/superseded preferential logic; errors in the network, unjustified/unnecessary/superseded constraints; and the like, I made what I consider to be an appropriate assessment of the delay that could be mitigated. By this process I was able to identify means by which the requirement to adjust the Sectional Completion Dates for delayed work in particular areas could be reduced or eliminated. This was an iterative process as each adjustment had the potential to, and often did, change the route of the critical path.

6.2.4 I then examined in more detail the sections of the programme that continued to project beyond the current Sectional Completion Dates. For each of these I scrutinised the individual activity durations and the manner in which they were linked together in the programme network. For each activity I considered whether, in my opinion, cost effective delay mitigation measures could be applied. For the most part, the delay mitigation measures I considered applicable were: increasing resources to overcome the Infraco self-imposed constraints; increasing the number of working hours; and/or opportunities to reduce some activity durations where the allowance made by the Infraco appeared to be overly generous. In relation to this latter point, this was particularly where I considered the logic relationship between activities to project unnecessary delay (i.e. there appeared to be

float hidden in the Programme through overly generous duration allowances and unnecessary finish-to-start interdependency links).

6.3 Findings

6.3.1 A summary of my assessments from this exercise is included at Appendix 6/1 of this report. It concludes that it would appear to be possible to mitigate all of the MUDFA Revision 8 projected delays to the extent that there would be no requirement to extend any of the four Sectional Completion Dates.

Section 7 Opinion and Conclusions

7.1.1 It is my opinion that the Infraco's Estimate submission produced in support of its claim for extension of time has not been made in accordance with the terms of the contract. The contract, and in particular clause 80, sets out the mechanism for dealing with **tie** Change and how its impact on obligations relating to time should be considered and dealt with. The Infraco has not complied with that prescribed mechanism and, I am advised, seeks to impose an alternative process. I can find no justification for such a departure from the contract.

7.1.2 I consider that the Infraco's Estimate is incompetent for the following reasons:

a) It does not include sufficient and appropriate supporting information as is required by the contract;

b) It does not properly and clearly link cause with effect;

c) The method of delay analysis used by the Infraco is inappropriate in relation to the terms of the contract;

d) The actual impact of the revised MUDFA programme has not been accurately impacted into the Programme resulting in over-stated results;

e) The programme network used in the delay analysis contains errors, omissions, superseded logic and unnecessary constraints, all of which combine to produce unreliable and over-stated results;

f) It does not appear to consider or apply readily available and applicable cost effective mitigation measures;

g) It does not properly consider the impact of delays in relation to the events and activities that are the Infraco's responsibility under the terms of the contract;

h) It is entirely theoretical in its approach and does not accord with the actual facts.

7.1.3 As noted above, the manner in which the Infraco has analysed delay does not accord with the requirements of the contract. It contains factual errors and produces unreliable results. I consider that the Infraco's Estimate greatly over-states the requirement for extension of time and does not implement this **tie** Change in a cost effective manner.

7.1.4 Notwithstanding the criticisms made at 7.1.1 to 7.1.3 above, it is clear that there have been delays to completion of the MUDFA Works and liability for the consequences of those delays lies with **tie.** I consider that the Infraco has an entitlement to seek revision to the Sectional Completion Dates but only to the extent that such revision is required as a consequence of implementing this change in the most cost effective manner. I say that based on my interpretation of the change mechanism set out in Clause 80 of the contract as explained in more detail in Section 4 of this report.

7.1.5 To determine the most cost effective manner in which to implement this **tie** Change requires some form of cost–benefit analysis. I consider that to carry this out with any degree of precision requires both parties to work together sharing information and considering options. Clearly, cost information, as it relates to the various ways in which the **tie** Change could be implemented is an essential element of such an analysis. The fact that the Infraco has not responded positively to **tie**'s requests for such information and to engage with it in discussions to consider how best to implement this **tie** Change appears to me to be frustrating the proper operation of the change mechanism set-out in Clause 80.

7.1.6 In the absence of cost information from, and engagement with, the Infraco, it appears to me that **tie** is being impeded in any attempt it may make to assess the Infraco's fair entitlement to extension of time as it may relate to this **tie** Change. I have been similarly impeded in my task to form an independent assessment of the Estimate and have had to rely heavily on my own experience and knowledge to form an opinion on what can be readily achieved by way of cost effective mitigation. Consequently, my assessment lacks precision and in many places is based on value ranges rather than specific numbers. That said, I still consider it to be sufficiently accurate to enable me to arrive at my opinion.

7.1.7 My assessment concludes that there would appear to be cost effective ways to implement this **tie** Change with no requirement to extend the four Sectional Completion Dates. To do so is likely to increase some of the direct costs associated with delivering the Infraco Works but these would, in my opinion, be far outweighed by the additional time related costs that would arise if this **tie** Change was implemented in the manner set-out by the Infraco in the Estimate.

Section 8 Statement of Truth

I Iain McAlister declare that;

8.1.1 I understand that my duty in providing written reports and giving evidence is to assist the Adjudicator and this duty overrides any obligation to the party by whom I am engaged. I confirm that I have complied with and will continue to comply with my duty.

8.1.2 I confirm that, insofar as the statements made within my report are within my own knowledge I have made clear which they are and I believe them to be true and that the opinions I have expressed are correct, are within my field of expertise, and represent my true and complete professional opinion.

8.1.3 I have endeavoured to include in my report those matters of which I have knowledge or of which I have been made aware that might adversely affect the validity of my opinion. I have clearly stated any qualifications to my opinion.

8.1.4 I have not, without forming an independent view, included or excluded anything which has been suggested to me by others including my instructing client's (**tie**'s) representatives.

8.1.5 I will notify those instructing me immediately and confirm in writing if for any reason my existing report requires any correction or modification.

8.1.6 I confirm my understanding that this report is to be submitted by into an adjudication between the Bilfinger – Siemens – CAF Consortium and **tie** Limited, and that this matter, if it goes further, may ultimately be taken into litigation.

8.1.7 I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of this adjudication.

8.1.8 This report is submitted in compliance with, and acknowledgement of, my responsibilities and associated obligations.

Signed Date: 5 May 2010

Iain McAlister, ACUTUS

Section 9 Appendices

Appendix 2/1 – Initial brief from **tie** to Acutus.

Appendix 2/2 – Curriculum Vitae for Iain McAlister

Appendix 5/1 – Time-Chainage programme showing actual impact of MUDFA Rev.8 dates in Section 1A.

Appendix 5/2 – Schedule of periods of inactivity between roadworks/groundworks and the start of track laying.

Appendix 6/1 – Summary of Assessment of Delay Mitigation Opportunities and requirements for extension of time.

Appendix 2/1 – Initial brief from **tie** to Acutus

Subject : Brief for Forensic Planning Exercise in relation to the Edinburgh Tram Project

Date : 8th April 2009

Client : Dennis Murray, Commercial Director, Edinburgh Trams

Background

The Edinburgh Trams Infraco contract was awarded to the consortium Bilfinger Berger Siemens (now BSC) on 8th May 2008 and this included as Schedule Part 15 to the contract, a contract programme. An immediate change to this programme was expected due to the movement in the design programme from finalisation of the programme and the signing of the contract (this is notified departure 001 and relates to the V26 and V31 design programme movements). The time for this has been agreed between **tie** and BSC.

However, a number of delays have been experienced subsequently – both due to tie and to BSC and this is indicating a delay to the overall programme duration. **tie** has recorded the reasons for these delays but now needs to prepare for the discussions on liability for those delays with a view to agreeing responsibility for those delays, potential extensions of time, or relief and liability for costs.

Scope of Brief

To support and challenge the internal work completed to date, **tie** requires an independent forensic planning exercise to :

- Review the contract to understand the mechanics of the programme within this bespoke contract ;
- Review planned v's actual progress and verify both the **tie** and BSC view of the programme progress and projections;
- Review the history of programme analysis to date and relevant contractual correspondence;
- Analyse and quantify any delay, disruption and prolongation in the context of specific contractual requirements, including a cause and effect analysis, concurrency of delays and identify responsibility for addressing same;
- Challenge programme and commercial approach to date and identify strengths and weaknesses in process and evidence/actions to date;
- Provide view on opportunities for improving confidence in **tie**'s ability to negotiate a successful conclusion to programme delay and mitigate costs; and
- Identify/recommend opportunities for recovery or acceleration if evidenced.

Timescales

tie expects that this exercise will last for a period of 4 – 5 weeks and needs to report back on key milestones. The timescale will be reviewed and agreed based on initial review of the scope, programme and contract.

Deliverables

tie would expect to receive as deliverables the following:

1) Initial response to the scope including confirmation/proposals of timescales, deliverables and costs. This should include an assessment of access required to tie personnel.
2) Weekly interim reports to identify strengths and weaknesses identified so that immediate corrective action can be taken
3) Final report to include:
    - Executive summary
    - Explanation of the process used and analysis conducted
    - Detailed outputs from the analysis
    - Conclusions on strengths/weaknesses of the **tie** position including validation of the arguments used to date
    - Recommendations for any changes in processor actions which can be implemented to immediately strengthen the tie position but also identify longer term areas for improvement.

Appendix 2/2 – Curriculum Vitae for Iain McAlister

Iain McAlister

BSc (Hons.), LLM (Const. Law), CEng, FICE, FIHT, MCIArb

email: imcalister@acutus.co.uk
mobile: [redacted]

SPECIALISATIONS

Resolution of disputes through negotiation, mediation and third party determination. Project management, planning and programming. Construction methodology, design and value engineering. Risk management. Analysis of delay and disruption. Claims preparation and investigation. Management of PPP projects in both construction and operational phases. Application of information technology in construction. Professional education and training.

HIGHLIGHTS

Chief Engineer for major multi-discipline contracting organisation. Chief Engineer on major PPP motorway project managing design, construction, routine operation and maintenance.
Development and implementation of award winning information management system.

EDUCATION AND PROFESSIONAL STATUS

Chartered Engineer, Honours Degree in Civil Engineering, Masters Degree in Construction Law, Fellow of Institution of Civil Engineers, Fellow of Institution of Highways and Transportation. Member of the Chartered Institute of Arbitrators. Member of Society for Construction Law. Approved Expert Witness. Member of ICE Scotland Management Committee. Past Vice Chairman of Glasgow & West of Scotland ICE. Member of Industry Advisory Panel at Glasgow University. Regular speaker at professional development and education events.

BRIEF SUMMARY

Drawing on 26 years in contracting, Iain has a wide range of technical, contractual and managerial knowledge. Having successfully delivered many major projects in building, civil engineering, manufacturing, quarrying and waste management, he brings a wealth of practical experience and know-how to every task he undertakes. He has operated many forms of contract including both the D&B and operational phases of PFI / PPP. His skills in strategy development and business planning have been honed through participation in bid management and organisational change. A logical thinker who's intuition and vision cut through the minutiae to get to the real issues. Through a carefully considered, pragmatic approach he delivers reasoned and well informed output. An experienced team player and effective communicator, he works well with all disciplines.

MANAGEMENT AND ADVISORY ROLES

- Castlehill Hospital PPP, Cottingham
- M6 DBFO Motorway
- Glasgow Royal Concert Hall
- Scotland Gas Project, Mossmorran & Braefoot Bay
- A71 / A72 Garrion Bridge, South Lanarkshire
- Inverurie Paper Mill & Power Station
- Argyll & Bute Education PPP
- M74 Motorway (Cleuchbrae to Dinwoodie Green)
- East Fife Waste Water Treatement Project
- A6091(T) Melrose Bypass
- Methil Dock Improvements
- Gattonside Suspension Bridge
- Vatersay Causeway
- Paisley Inner Ring Road
- Supermarket developments
- Design, manufacture & erection of precast concrete
- Midlands Bank Domes, Poultry, London
- Housing Repairs & Maintenance Framework, London
- Stadium developments
- Commercial and residential developments
- Water treatment projects
- Rail bridge replacements (various)
- Pipeline and drainage projects (numerous)
- Power transmission and distribution projects
- MoD / Defence Estates developments
- Landfill site development and licensing
- Minerals extraction, planning and permitting
- IT planning and implementation groups (various)
- Waste management strategy groups (various)
- Health & Safety in construction (various)
- Total quality management system
- Environmental management systems

EXPERT ADVISORY ROLES

- Delay Analysis & Assessment of Disruption on:
  - Major transport infrastructure projects including D&B and PFI
  - New build and refurbished schools and colleges
  - Major City Centre office and Residential Developments
  - Energy facilities including gas, wind power and EfW
- Critical analysis of design development liabilities for standard and bespoke contracts
- Independent examination of claims and counterclaims on building and civil engineering projects
- Resolution of disputes on partnering contracts between public and private sectors
- Independent advisor and expert in mediations, adjudications and litigated disputes

CAREER SUMMARY

2006 **Associate Director with Acutus.**

1999 - 2005 **Chief Engineer with Barr Limited.** Following re-organisation of the Barr Group (turnover circa £200M), appointed Chief Engineer across the three operating divisions of Construction, Industrial and Manufacturing. Responsible for: contract planning & risk assessment; engineering; design management and Planning Supervisor functions; strategy development; bid and project management (including contractual and commercial reviews); quality and environment management; planning consents, licensing and permitting; professional development, education and training.

1997 - 1999 **Chief Engineer with M6 Joint Venture.** Worked as a senior member of the M6DBFO Joint Venture Management Team (Amey, Sir Robert McAlpine, Taylor Woodrow, Barr),responsible for all functions provided by the Central Services Department including design development, project management, planning and programming, progress monitoring, data management, staff and operative training, health, safety and welfare, environmental management and temporary works design. (Contract value £330M over 25 years, £110M of new build motorway).

1994 - 1997 **Director with Barr Construction Services.**
Director of Manufacturing, Plant and Transport division within the Barr Group, responsible for general management, estimating, design, contractual and commercial matters, production co-ordination and forward planning. Head of Department responsible for proposals management, planning, programming, progress monitoring, temporary works and alternative designs for the majority of building and civil engineering works undertaken by Barr Limited.

1993 - 1994 **Chief Engineer with Barr Construction.**
Worked as part of a major design and build project team (M74 Cleuchbrae to Dinwoodie Green), responsible for all planning, programming, progress monitoring and temporary works design. Co-ordinator of the design and build elements of the project including the River Annan Bridge.

1991 - 1993 **Contracts Manager (Director Designate) with R J McLeod (Contractors) Ltd.**
Worked in an overseeing role providing management, advice, guidance and back-up to on-site construction teams. Responsible for overall project co-ordination, planning, construction and contractual / commercial control.

1988 - 1991 **Commercial Manager with R J McLeod (Contractors) Ltd.**
Established, developed and operated a centralised commercial department responsible for all of the company's Central Scotland contracts valuations and claims.

1987 - 1988 **Design Engineer with Kenchington, Little, and Partners, Glasgow.**

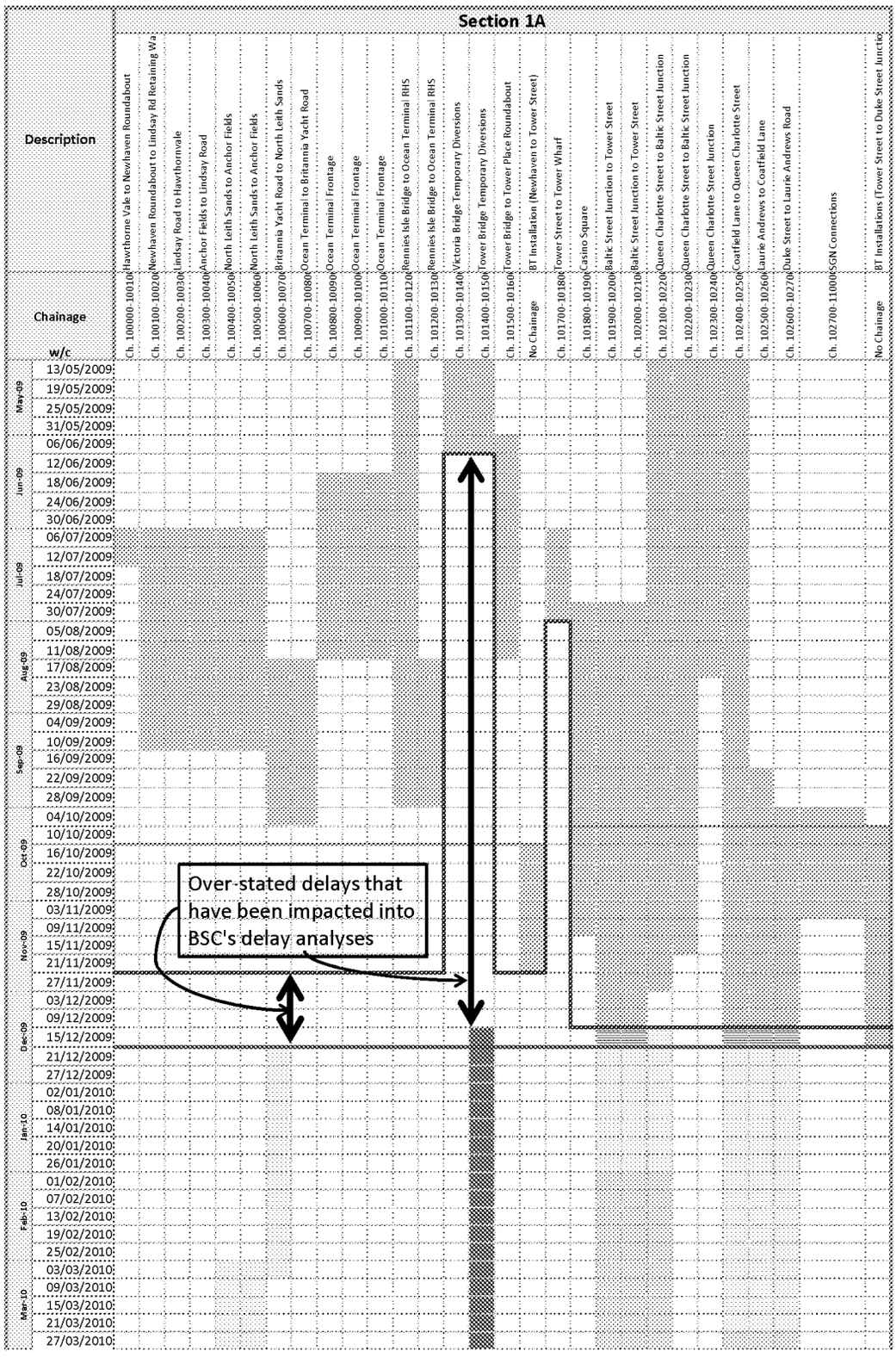
1984 - 1987 **Agent / Senior Project Manager with R J McLeod (Contractors) Ltd**

1981 - 1984 **Planning Engineer with R J McLeod (Contractors) Ltd**

1980 - 1981 **Site Engineer with R J. McLeod (Contractors) Ltd.**

Appendix 5/1 – Time-Chainage programme showing actual impact of MUDFA Rev.8 dates in Section 1A.

Appendix 5/1 - Time-Chainage programme showing actual impact of MUDFA Rev.8 dates in Section 1A



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Appendix 5/2 – Schedule of periods of inactivity between roadworks/groundworks and the start of track laying.

Edinburgh Tram Project
Expert Report in respect of INTC 429 - MUDFA Rev.8 Estimate

Appendix 5/2

BSC "Unmitigated" Delay Analysis - Appendix C of the Estimate submission)

Periods of inactivity between roadworks/groundworks and the start of tracklaying.

Intermediate Section	Location	Chainage	Activity Code Roadwork	Roadwork Durations Finish Roadwork	Roadwork Durations Set Track	Period of Inactivity between Roadwork competion and Trackwork Laying (days)
Section 1A						
	Chainage	0-265	1A-24A-TRCK-	23/03/2011	03/05/2011	41
	Chainage	265-425	1A-24B-TRCK-	25/08/2010	08/12/2010	105
	Chainage	475-600	1A-24D-TRCK-	23/03/2010	10/05/2010	48
	Chainage	700-850	1A-24F-TRCK-	22/11/2010	11/05/2011	170
	Rennies Isle to Casino Square	1410-1880	1A-23C-TRCK-	22/03/2011	22/06/2011	92
	Casino Square to Baltic Street	1850-1880	1A-22A-TRCK-	01/12/2010	23/12/2010	22
	Casino Square to Baltic Street	1880-2110	1A-22B-TRCK	04/02/2010	13/10/2010	251
	Baltic to Queen Charlotte	2110-2340	1A-21A-TRCK-	06/06/2011	05/09/2011	91
	Queen Charlotte to Foot/Walk	2340-2730	1A-21B-TRCK-	01/04/2010	16/03/2011	349
Section 1B						
	Foot of the Walk	0-100	1B-20A-TRCK-	25/02/2010	26/04/2010	60
Section 1C						
	York Place	700-850	1C-17H-TRCK-	24/03/2011	21/04/2011	28
	York Place	850-1000	1C-17J-TRCK-	05/07/2011	05/09/2011	62
	St Andrews Square to Waverley Bridge	1000-1360	1C-16-TRCK-	15/10/2010	04/02/2011	112
Section 1D						
	Lothian Road Junction - Phase 2 - 1st Half	280-440	1D-15B-TRCK-	03/11/2009	17/03/2010	134
	Lothian Road Junction - Phase - 3a - 2nd Half	280-440	1D-15F-TRCK-	21/06/2010	03/11/2010	135
	Haymarket - Phase 3 - 1st Half	1125-1250	1D-14C-TRCK-	11/11/2009	26/03/2010	135
	Haymarket - Phase 5 - 2nd Half	1125-1250	1D-14H-TRCK-	27/07/2010	12/11/2010	108
	Torphichen - Phase 1 - 1st Half	940-1125	1D-14M-TRCK-	24/05/2010	14/07/2010	51
	Torphichen - Phase 2 - 1st Half	940-1125	1D-14O-TRCK-	23/02/2011	24/03/2011	29
	West Maitland Phases 2&3 - 1st half	850-940	1D-14U-TRCK-	26/11/2010	10/03/2011	104
	West Maitland Phases 2&3 - 2nd half	850-940	1D-14V-TRCK-	30/03/2011	01/06/2011	63
	Shandwick Place - Phase 1	440-850	1D-14W-TRCK-	28/07/2010	05/10/2010	69
Section 2A						
	Trackwork	(1135m)	2A-13B-TRCK-	19/01/2009	04/06/2010	501
Section 5A						
	Trackwork	(470m)	5A-12-TRCK-	19/11/2009	24/03/2011	490
	Trackwork	(1006m)	5A-11-TRCK-	12/07/2010	23/09/2011	438
Section 5B						
	Trackwork - Ballasted Track (1160m)	(1690m)	5B-10A-TRCK-	31/08/2009	15/12/2009	106
	Trackwork - Concrete Slab (590m)	(590m)	5B-10C-TRCK-	21/07/2009	05/02/2010	199
	Trackwork	(1260m)	5B-09-TRCK-	08/01/2009	03/11/2009	299
	Trackwork	(854m)	5B-07-TRCK-	23/10/2008	07/07/2010	622
Section 5C						
	Trackwork - Gyle Centre to Depot Stop	(562m)	5C-02-TRCK-	06/04/2010	07/07/2011	457
	Trackwork - Depot Stop to Gogarburn	(562m)	5C-02-TRCK-	04/03/2010	13/09/2010	193
Section 6						
	Total	(3492m)				
	Trackwork - Ballasted		6A-01-TRCK-	08/02/2009	12/02/2009	4
	Trackwork - Ballast & Embedded		6A-01-TRCK-	26/03/2009	24/07/2009	120
	Trackwork - Column Track		6A-01-TRCK-	25/05/2009	19/08/2009	86
Section 7						
	Trackwork	(1750m)	7A-04-TRCK-	01/06/2010	27/10/2010	148
	Trackwork	(833m)	7A-05-TRCK-	31/08/2010	10/02/2011	163
	Average period of inactivity (days)					135
	Total Duration of Inactivity (days)					6085

BSC "Mitigated" Delay Analysis - Appendix D of the Estimate submission)

Periods of inactivity between roadworks/groundworks and the start of tracklaying.

Intermediate Section	Location	Chainage	Activity Code Roadwork	Roadwork Durations Finish Roadwork	Roadwork Durations Set Track	Period of Inactivity between Roadwork competion and Trackwork Laying (days)	Difference in durations between no mitigation and mitigation programmes
Section 1A							
							41
							105
							48
	Chainage	700-850	1A-24F-TRCK-	22/11/2010	13/04/2011	142	28
							92
	Casino Square to Baltic Street	1850-1880	1A-22A-TRCK-	02/11/2010	16/12/2010	44	-22
	Casino Square to Baltic Street	1880-2110	1A-22B-TRCK	04/02/2010	14/09/2010	222	29
	Baltic to Queen Charlotte	2110-2340	1A-21A-TRCK-	05/11/2010	21/03/2011	136	-45
	Queen Charlotte to Foot/Walk	2340-2730	1A-21B-TRCK-	01/04/2010	21/07/2010	111	238
	Ocean Terminal	850-1080	1A-23A-TRCK-	02/12/2010	07/04/2011	126	-126
Section 1B							
							60
Section 1C							
	York Place	700-850	1C-17H-TRCK-	10/09/2010	11/01/2011	123	-95
	York Place	850-1000	1C-17J-TRCK-	28/01/2011	24/02/2011	27	35
	St Andrews Square to Waverley Bridge	1000-1360	1C-16-TRCK-	10/05/2010	14/06/2010	35	77
Section 1D							
							134
	Lothian Road Junction - Phase - 3a - 2nd Half	280-440	1D-15F-TRCK-	06/04/2010	14/05/2010	38	
							97
							135
	Haymarket - Phase 5 - 2nd Half	1125-1250	1D-14H-TRCK-	27/05/2010	05/07/2010	39	69
	Torphichen - Phase 1 - 1st Half	940-1125	1D-14M-TRCK-	23/03/2010	27/04/2010	35	16
	Torphichen - Phase 2 - 1st Half	940-1125	1D-14O-TRCK-	19/11/2010	01/02/2011	74	-45
	West Maitland Phases 2&3 - 1st half	850-940	1D-14U-TRCK-	18/06/2010	08/10/2010	112	-8
							63
	Shandwick Place - Phase 1	440-850	1D-14W-TRCK-	23/03/2010	26/04/2010	34	35
	Lothian Road Junction - Phase - 3a - 1st Half	280-440	1D-15F-TRCK-	13/01/2010	17/03/2010	63	
							-63
	Lothian Road Junction - Phase - 4 - 1st Half	280-440	1D-15F-TRCK-	08/06/2010	14/10/2010	128	
							-128
	Lothian Road Junction - Phase - 4 - 2nd Half	280-440	1D-15F-TRCK-	04/11/2010	07/02/2011	95	
							-95
	Princes Street	0-280 / 1360-1980	1D-15/16-TRCK-	30/04/2009	03/06/2009	34	
							-34
	Haymarket - Phase 3 - 2nd Half	1125-1250	1D-14C-TRCK-	04/01/2010	17/02/2010	44	-44
	Haymarket - Phase 6 - 1st Half	1125-1250	1D-14I-TRCK-	27/07/2010	05/10/2010	70	-70
	Torphichen - Phase 1 - 2nd Half	940-1125	1D-14M-TRCK-	25/05/2010	06/10/2010	134	-134
Section 2A							
							501
Section 5A							
	Trackwork	(470m)	5A-12-TRCK-	19/11/2009	16/06/2010	209	281
	Trackwork	(1006m)	5A-11-TRCK-	12/07/2010	17/11/2010	128	310
Section 5B							
							106
							199
	Trackwork	(1260m)	5B-09-TRCK-	14/07/2009	28/07/2010	379	-80
	Trackwork	(854m)	5B-07-TRCK-	28/07/2009	03/08/2010	371	251
Section 5C							
							457
	Trackwork - Depot Stop to Gogarburn	(562m)	5C-02-TRCK-	06/04/2010	13/12/2010	251	-58
	Trackwork	(760m)	5C-06-TRCK-	03/12/2009	10/09/2010	281	-281
Section 6							
							4
Section 7							
							148
							163
	Average period of inactivity (days)					73	63
	Total Duration of Inactivity (days)					3485	2394

Appendix 6/1 – Summary of Assessment of Delay Mitigation Opportunities and requirements for extension of time.

Appendix 6/1 - Summary of Assessment of Delay Mitigation Opportunities and requirement for extension of time

Ref No	Activity set/Group	Over run date on BSC mitigated programme	Over run on current Section Completion Date (Calendar days)	Driving Activities / Further mitigation	Resultant estimated requirement for EoT (Calendar Days)	Comment
1	Final track works Lindsay Road Ch 700-850	12/05/2011	63	Re-programme this entire section to reduce overall duration from 26 months to approx. 12 months. (Work scope = 850m of road and track with 250m of retaining wall.)	0	More recent programme produced by BSC show a significantly shorter overall duration for the actual design that has to be built.
2	Newhaven Tram Stop	23/05/2011	74	Projected delay to be mitigated as part of the Lindsay Road works, referred to at 1. above.	0	There is no apparent reason why this tram stop cannot be constructed during 2009 - 2010.
3	Leith Sands Sub-station	13/06/2011	95	There appears to be no physical reason why this work cannot commence at a much earlier date.	0	The logic driving this activity does not appear to be justified in terms of the nature of the work and its interdependency on other activities.
4	Victoria Dock Entrance Bridge (S16) - Re-profile and waterproof deck (dummy)	31/05/2011	82	This activity is driven by trackwork at Ocean Terminal to Rennies Isle. These works are being driven by Tower Place Bridge which is being driven by the MUDFA milestone. The access date to commence Tower Place Bridge appears to be over-stated by over 30 weeks in BSC's delay analysis.	0	Refer to Section 5 of this report for further details.
5	Tower Place Bridge	25/03/2011	15	In BSC's analysis, this activity is being driven by the MUDFA milestone for "Area 1". The access date to commence this work appears to be over-stated by over 30 weeks as it should be driven by the specific utilities diversions associated with this structure and not the "Area 1" milestone.	0	
6	Roadworks Ocean Terminal to Rennies Isle Ch 1080-1410	01/07/2011	113	This is part of a chain of activities driven by the delay impacted on Tower Place Bridge. As this delay appears to be over-stated by over 30 week, the delay to this activity is likewise over-stated.	0	

Ref No.	Activity Set/Group	Over run date on BSC mitigated programme	Over run on current Section Completion Date C (Calendar days)	Driving Activities / Further mitigation	Resultant estimated requirement for EoT (Calendar Days)	Comment
7	Trackworks Ocean Terminal Ch 850-1080	03/06/2011	85	This is part of a chain of activities driven by the delay erroneously impacted on Tower Place Bridge. Consequently, the projection of the delay to this activity appears to be over-over 30 weeks.	0	
8	Trackworks Rennies Isle to Casino Square Ch 1410-1880	13/04/2011	34	This is part of a chain of activities driven by the delay erroneously impacted on Tower Place Bridge. Consequently, the projection of the delay to this activity appears to be over-stated by over 30 weeks.	0	
9	Trackwork Ocean Terminal to Rennies Isle Ch 1080-1410	04/07/2011	116	This is part of a chain of activities driven by the delay erroneously impacted on Tower Place Bridge. Consequently, the projection of the delay to this activity appears to be over-stated by over 30 weeks.	0	
10	Ocean Terminal Tram Stop - Commissioning of SIG - interlocking cubicle.	11/08/2011	154	Driven by E&M Newhaven to Ocean terminal the delay to which, as noted below, is over-stated by over 200 days as a result of Infraco imposed resource constraints.	0	
11	Port of Leith Tram Stop	10/06/2011	92	This is part of a chain of activities driven by the delay erroneously impacted on Tower Place Bridge. Consequently, the projection of the delay to this activity appears to be over-stated by over 30 weeks.	0	It appears to me that there is no apparent reason why this tram stop cannot be constructed well in advacne of Section Completion Date C.
12	Trackworks Baltic to Queen Charlotte Ch 2110-2340	26/04/2011	47	This activity set is presented with 4 months delay between initial civil works and "Set Track". This appears to be a delay driven by two resource constraints from logic linking Finish to Start with other "Set Track" activities. Lifting the resource constraints by addition an additional gang would appear to me to eliminate the projected delay beyond the current Section Completion Date C.	0	
13	Bernard Street Tram Stop	28/04/2011	49	This driven by the traffic management set-up on track works at Baltic to Queen Charlotte Ch 2110-2340 which in turn is driven by track work on Queen Charlotte to Foot/Walk Ch 2340-2730. This later set of activities includes an 81 day "Set Track" delay that appears to arise from preferential logic and/or resource smoothing. By increasing the track resources by one gang this delay can be avoided.	0	It appears to me that there is no apparent reason why this tram stop cannot be constructed well in advacne of Section Completion Date C.

Ref No.	Activity Set/Group	Over-run date on BSC mitigated programme	Over-run on current Section Completion Date C (Calendar days)	Driving Activities / Further mitigation	Resultant estimated requirement for EoT (Calendar Days)	Comment
14	E&M Installations - Newhaven to Ocean Terminal	04/10/2011	208	This activity set is initially driven by resource links to from Section 5B. It is then further delayed by what appears to be resource levelling arising from high demand in the over-run period. This constraints could be relieved by the introduction of an additional OHE gang. This could mitigate the delay to the extent that there would be no over-run on the current Section Completion Date C.	0	
15	E&M Installations - Ocean Terminal to Foot of Walk	06/09/2011	180	This activity set is initially driven by completion of track works in several parts of Section 1A. These activities have been delayed by an erroneous linkage to the Section 1A MUDFA milestone and the consequential projected delays to the Tower Place and Victoria Dock Entrance bridges referred to above. Correction of this error has the potential to save approx. 6 months (182 days) of delay. Increasing the available resources would add further to the mitigation that could be achieved, if required.	0	
16	Foot of the Walk (inc.) to McDonald Road (exc.) - E&M Installation	08/08/2011	151	This activity set is driven by the series of activities sets for the works along Section 1B. The BSC's submission is based on the MUDFA milestone for this area being 24 September 2009. I have examined the detail of the MUDFA Rev.8 programme and note that access is available to commence work in many parts of this intermediate section 8 to 10 weeks (56 to 70 days) earlier that shown in BSC's delay anlyses submissions. I consider that there is also scope to mitigate delay by reducing durations and/or breaking the unnnecessary Finish to Start chains of logic through the many phases on this intermediate section. Examination of the durations allowed for each of the numerous activities indicates to me scope for time savings. Production rates on excavation, kerbing, ducts and drainage appear overly generous. Track laying durations may also provide opportunity to recover time. There would also appear to be opportunity to increase the number of hours worked each week. I estimate that by saving a few days on each of the longer activities, approximately 100 to 150 calendars days of delay can be mitigated in what I consider would be a cost effective manner.	0	I have been unable to conducted a more accurate assessment and cost benefit analysis because of the lack of actual resource and cost information and what I am advised to be BSC rejection of tie's requests to jointly investigate such mitigation measures.
17	Roadworks and track works on Section 1B	Varies	Varies	See notes on item 16 above. These works are all part of the activity chains that lead to the E&M installation on Section 1B.		

Ref No.	Activity Set/Group	Over run date on BSC mitigated programme	Over run on current Section Completion Date (Calendar days)	Driving Activities / Further mitigation	Resultant estimated requirement for EoT (Calendar Days)	Comment
18	McDonald Road (inc.) to Princes Street West (exc.)	07/07/2011	119	This set of activity groups is driven by the MUDFA Area 1 milestone. In reality, this work is dependent on the Area 1C diversions. These are planned to be complete approximately 107 days earlier. The activities are also linked to the summer and Xmas embargo calendars. I am advised that this is incorrect and that the principle of relaxing these types of embargos as a mitigation measure has previously been established. This has the potential to save a further 56 days of delay.	0	Further time could be saved on these activities, if required, by applying some of the mitigation measures noted at 16. above.
19	Picardy Place	13/09/2011	187	In BSC's delay anlysis, these works are driven by completion of works at Shandwick Place. It is understood that this linkage is superseded logic associated with traffic management. Removing this logic reduces the delay by approximately 80 days. The final two phases on Picardy Place are outwith the requirements for Section Completion Date C and therefore a further 102 days can be deducted from the overall delay. Phases 3 & 6 of Picardy Place have been linked to the Festivals embargo calendar which could be relaxed. This leads to a further delay reduction of 56 days.	0	
20	Cathedral Sub-station - Testing & Commissioning.	14/07/2011	126	The start of this activity group is driven by the civil engineering and building works at Picardy Place Tram Stop. As noted at item 19. above, this work is being projected with unnecessary delay of over 200 days. The final commissioning is also linked to Section 1C works.	0	
21	Princes Street (inc.) to Haymarket (exc.) - E&M Installation	20/05/2011	71	These activities are being driven by the various traffic management phases through the Haymarket / Torphichen Area. This is driven by the MUDFA Area 1D milestone, currently set at 29/9/09. These works are projected through three "festival" embargo calendars which add 77 days of delay. Relaxation of these should provide sufficient time to mitigate the projected delay. The chain of activity groups through this area also appear to be being prolonged due to resource constraints (Track resources). Addressing the BSC imposed resource constraints will save significantly more time.	0	

Ref No.	Activity Set/Group	Over run date on BSC mitigated programme	Over run on current Section Completion Date (Calendar days)	Driving Activities / Further mitigation	Resultant estimated requirement for EoT (Calendar Days)	Comment
22	Lothian Road Junction Ch 440-280 - Phase 4a	11/04/2011	32	Track resource constraints appear to be prolonging the duration of these activity groups. If this constraint is released and cognicance taken of the revised programme of works for this area, the projected delay beyond the current Sectional Completion C date should be significantly mitigated.	0	
23	Balgreen Road (exc.) to Edinburgh Park Central (inc.)	15/11/2011	250	The delay to this activity set , prior to Infraco resource smoothing and delay mitigation was only 61 days. It appears that the increase of 189 days is resource driven. Additionally, the commencement date for the first activity in the set is resource driven by the comletion of track works on a different section of the route. Lifting these constraints reduces the projected completion to within the current Sectional Completion Date.	0	
24	Edinburgh Park Central (exc.) to Gogarburn (inc.) - E&M Installations	13/04/2011	34	Delayed by track laying which is resource driven. Lifting the resource constraint would appear to save several months of time.	0	
25	Gyle Centre Tram Stop	27/05/2011	78	This activity set is driven by the track works referred to at item 24. above. If the resource constraint is lifted the projected over-run can be mitigated.	0	

Ref No.	Activity Set/Group	Over run date on BSC mitigated programme	Over run on current Section Completion Date A (Calendar days)	Driving Activities / Further mitigation	Resultant estimated requirement for EoT (Calendar Days)	Comment
26	Depot building & Equipment	13/12/2010	195	The MUDFA 8 date impacted into BSC's delay analyes is approximatley 16 days later than what I am advised is the actual date for completion of the water main diversion. The logic netwrok in BSC's analyses is based on the premise that none of the bulk earthworks can commence before the water main is diverted. As I note in Section 5 of this report, there would appear to me to be no justifyiable reason why the bulk of the earthwork should not have been removed earlier. I understand that tie directed BSC to do so but that direction was not followed. I estimate that should have saved at least 28 days of the projected delay. I also consider that by re-sequencing the building construction works and increasing resources another 40 to 80 days could be saved on the programmed allowance for the building envelope. The building services and fit-out activities also appear to have overly generous allowances which have scope for reducing by re-sequencing and revised resourcing. I also question the strict finish to start logic link between testing and commissioning the building and the commencement of the equipment installation. As noted in Section 5 of this report, I consider there is scope to mitigate delay by introducing a significant negative lag to this relationship in the order of 60 to 90 days. I note that in discussions with BSC's representatives the practicalities and potential time savings from such action have been acknowledged.	Potentially zero	I also note that the projected consequences of late completion of the water main diversion do not accord with what has happened on site. As noted in Section 5 of this report, the water main diversion would not appear to be on the actual critcal path for the Depot. This brings into question whether the water main is in fact playing any part in the actual cause of delay.
27	Depot track works	05/07/2010	34	The MUDFA 8 date impacted into BSC's delay analyes is approximatley 16 days later than what I am advised is the actual date. The Depot trackwork are programmed to take almost 1 year using only 1 tracklaying squad. Adding an additional squad (potentially saving up to 6 months of time) will reduce the projected over-run to within the current Section Completion Date A. I also note that some of the issues noted at item 26 above would further significantly reduce the projected delay.	0	

28	Depot E&M works	06/12/2010	188	Mitigation of the projected delay to the track works, as noted at 27. above, will allow earlier commencement of this activity set. The introduction of additional resource would greatly reduce the overall duration. I also note that the E&M works are linked finish to start with completion of the entire 3,500 linear metres of track within the Depot site. I consider this logic relationship to project an unnecessarily long delay and that there is realistic scope to introduce a negative lag of at least three month. The combined effect of these two mitigation measures would bring the projected delay within that projected for item 26. above.	0	