

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

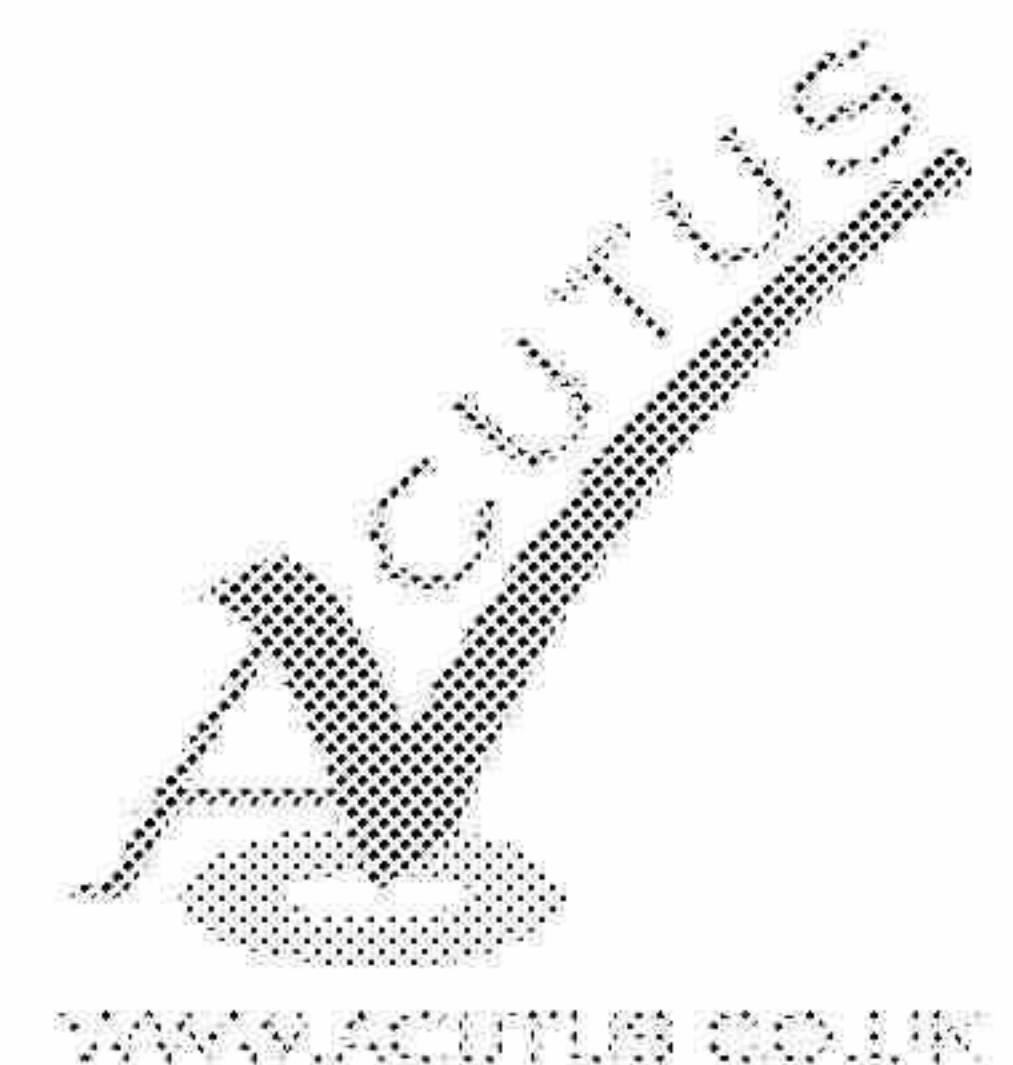
On behalf of: **tie** Limited

under the instructions and directions of:

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

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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 view 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 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 Estimate 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 Ferrocarriles 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, Planning 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.

2.6.4 Acutus personnel also consulted with and presented to the following **tie** consultants and advisers in relation to contractual interpretation and the inter-relationship of delays with other commercial matters and events:

- i) Keith Kilburn, Solicitor, DLA Piper;
- ii) John Mieзитis, Associate, DLA Piper;
- iii) Stuart Jordan, Partner, DLA Piper;



- iv) Andrew Fitchie, Partner, DLA Piper;
- v) Bruce Bentley, Partner, DLA Piper;
- vi) John Nicolson, Consultant;
- vii) Donny MacKinnon, Consultant; and
- viii) Brandon Nolan, Partner, McGrigors.

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 2009¹.

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 Pricing²

- 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 assumptions³

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	<i>(No apparent equivalent entry)</i>	
5A	No constraint		
		MUDFA & Utilities work area 5	05/11/07
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

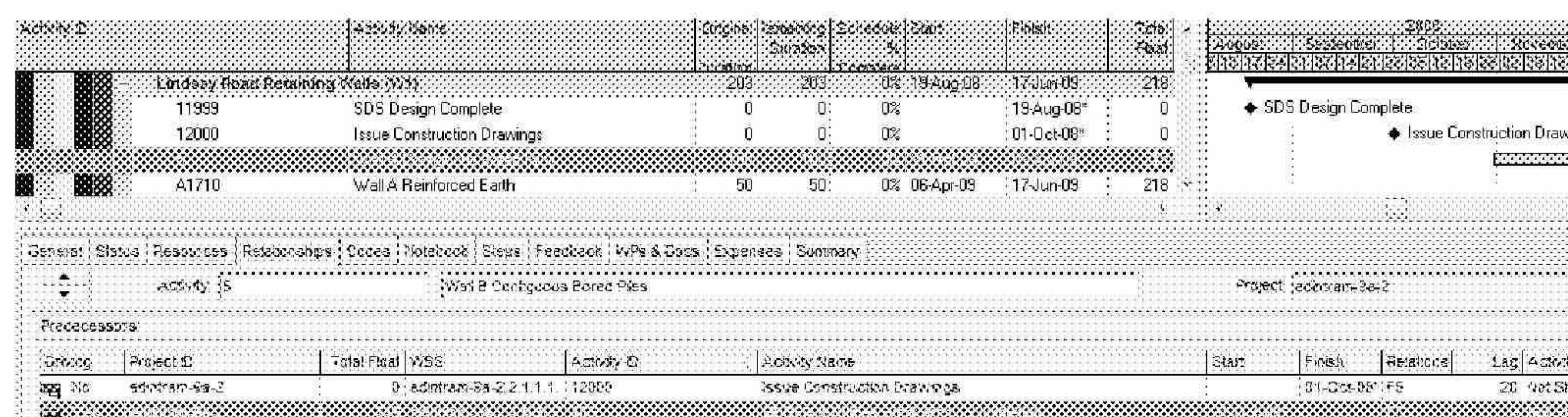


Programme Assumptions Schedule 15 Para 3 Descriptions	Programme Assumptions Schedule 15 Para 3 - Dates	Revision 1 Programme Descriptions	Revision 1 Programme Dates
Watermain Diversion	30/05/2008	Depot Watermain Diversion	30/05/2008
7A	16/05/2008	MUDFA & Utilities work area 9 completion	16/05/2008

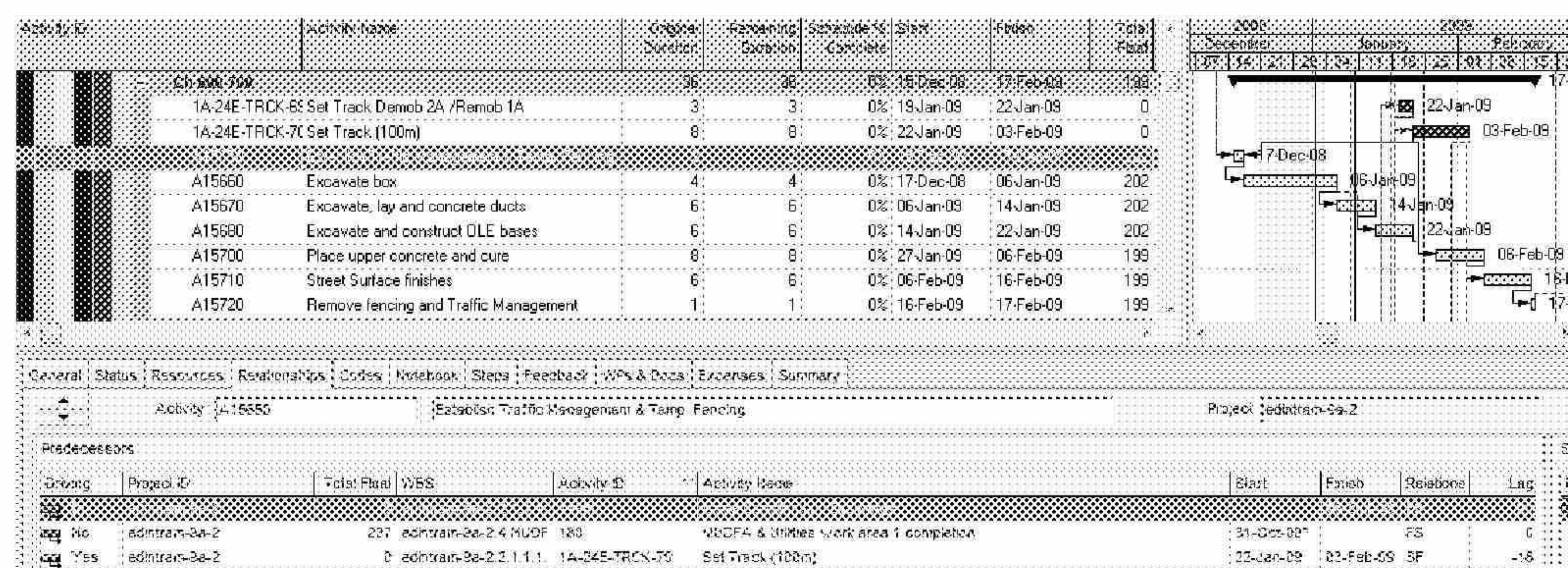
- c) By inspection, the two sets of data do not fully align either in terms of descriptions or dates. I make this comment solely in the interest of clarity. It would appear on more detailed examination that the differences can be reconciled and appear to be merely the use of different descriptions and 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 be seen from the programme extract below, the driving activity is the date for “Issue Construction Drawings” and not the utilities work.



Activity ID	Activity Name	Original Duration	Revised Duration	Schedule % Complete	Start	Finish	Total Float
Tower Place Bridge (A17)							
12039	SDS Design Complete	0	0	0%	01-Oct-08	19-Apr-10	219
12040	Issue Construction Drawings	0	0	0%	01-Oct-08	10-Dec-08	0
A16050	Temporary Diversion of Services (by others)	40	40	0%	14-Oct-08	10-Dec-08	128
Other Activities							
A1770	Piling	15	15	0%	16-Apr-09	06-May-09	108
Other Diversion							
A16050	Permanent Diversion of Services (by others)	40	40	0%	11-Dec-09	19-Feb-10	219
A16100	Finishes	40	40	0%	19-Feb-10	19-Apr-10	219
Other Diversion							
A16050	Temporary Diversion of Services (by others)	75	75	0%	09-May-09	26-Jun-09	198

Activity	Activity Name	Project	Total Float	WBS	Activity ID	Activity Name	Start	Finish	Relation	Lag
12039	SDS Design Complete	edntram-Ba-2	237	edntram-Ba-2.4 MUDF	120	MUDFA & Utilities work area completion	21-Oct-08		FS	0
12040	Issue Construction Drawings	edntram-Ba-2	128	edntram-Ba-2.2 1.1.1	A16050	Temporary Diversion of Services (by others)	14-Oct-08	10-Dec-08	FS	0

- 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 to accommodate the Infraco’s 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 links⁴. 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.

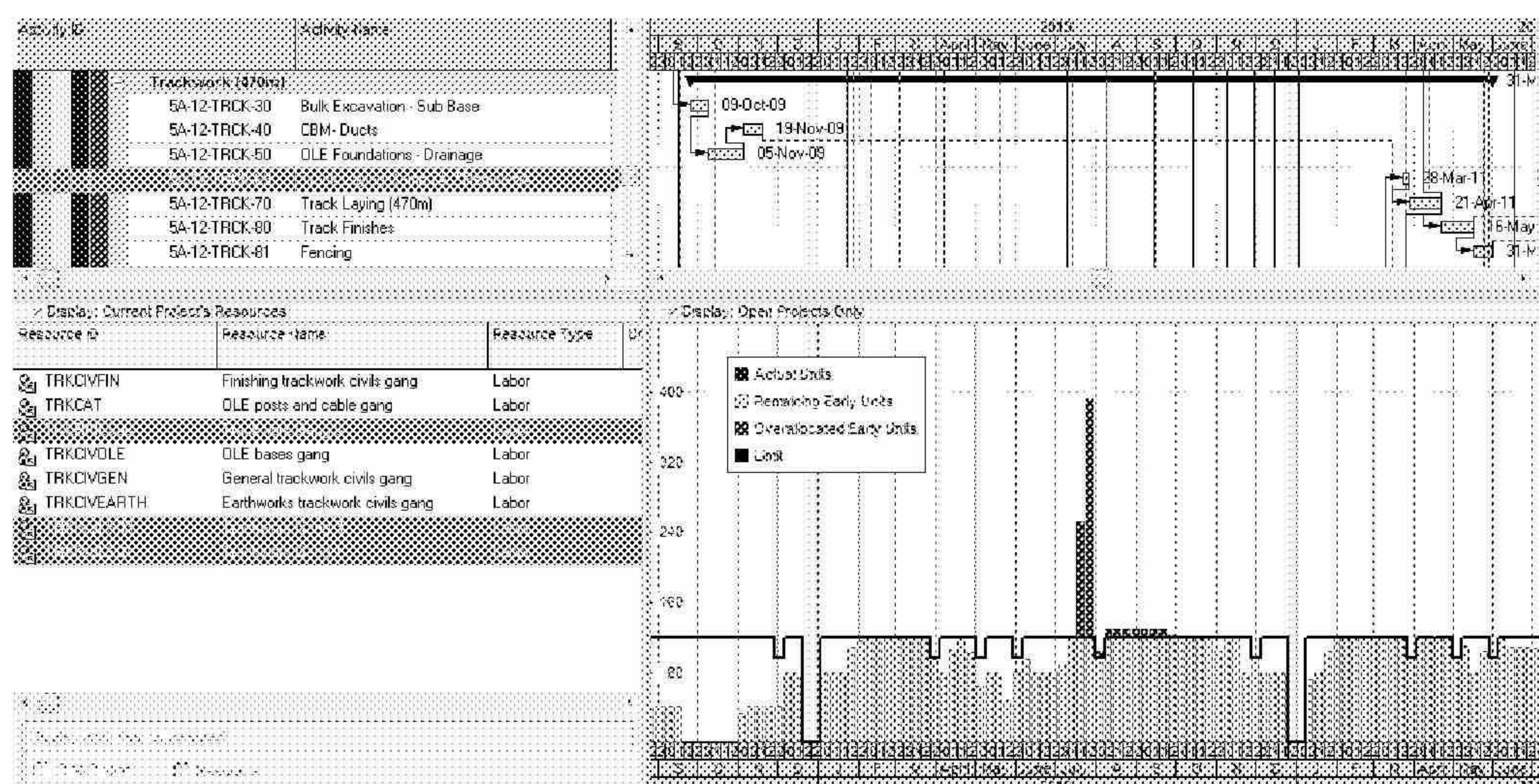
5.2.6 “Corrected Logic to the Programme Revision 1”

- 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.



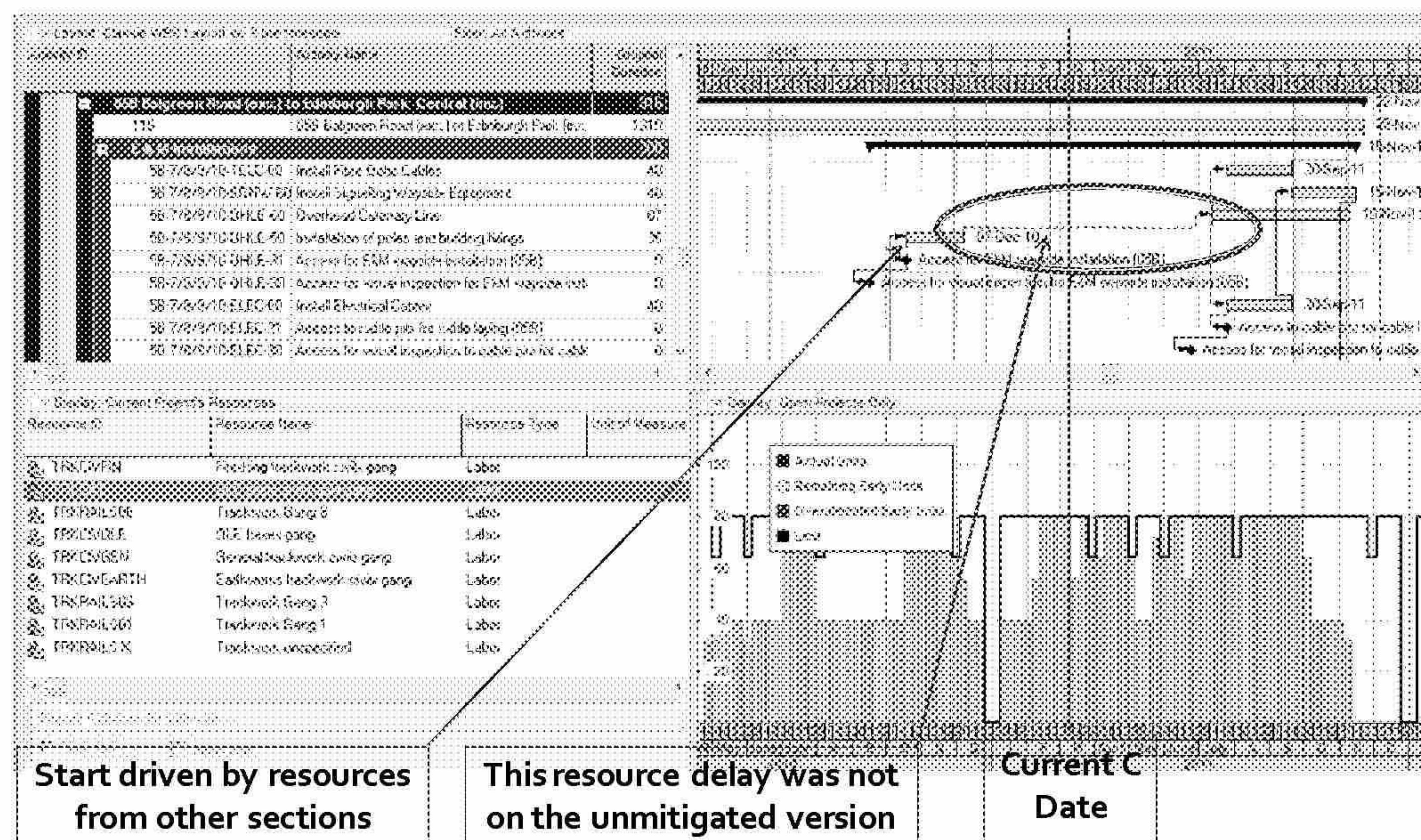
- c) I conclude that the logic network contained within the Infraco’s delay analyses does not accurately model the true interdependency of the individual elements of the Infraco Works and, consequently, produces unreliable and erroneous results.

5.2.7 “Mitigation”

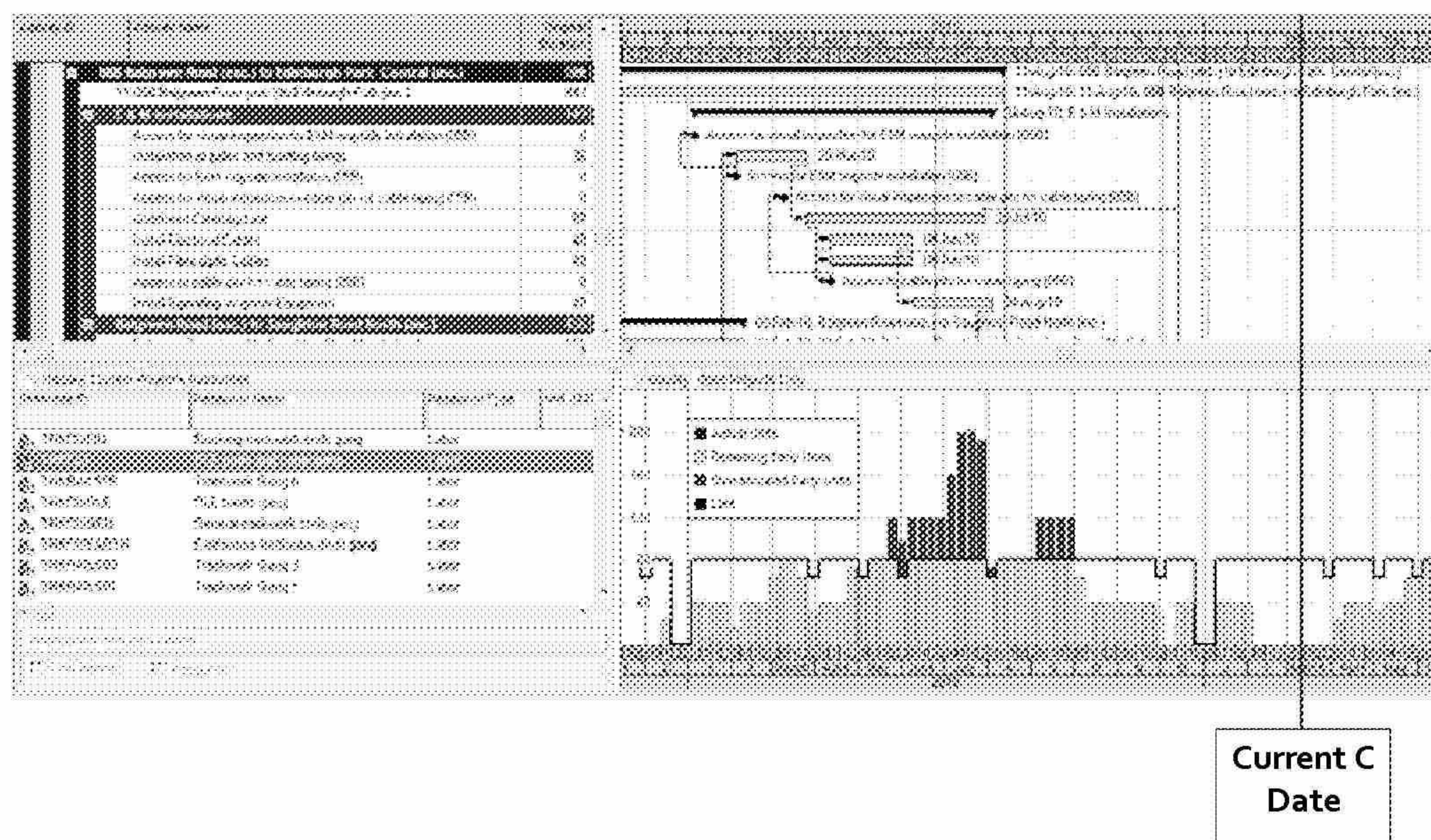
- a) I note that in the first paragraph of the Infraco’s “mitigation” narrative it states *“Several measures were employed by Infraco (i.e. the Infraco) with a view to reducing the overall delay resulting from the delayed completion of the Utility Works including the removal of resource constraints, 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.

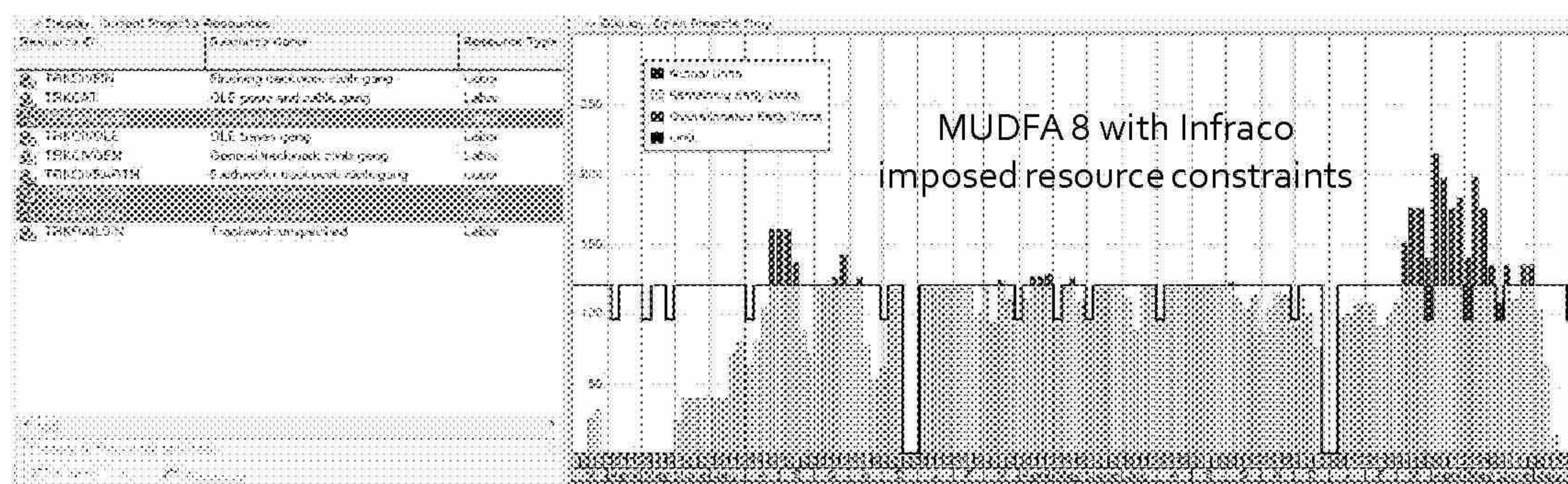


- e) By removing the computer generated resource constraint, not only is the delay reduced, but this part of the Infraco Works now has a projected completion 7 months **ahead** of the current Sectional Completion Date C. The peak demand for OHLE resource has exceeded the Infraco limit of two gangs but 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

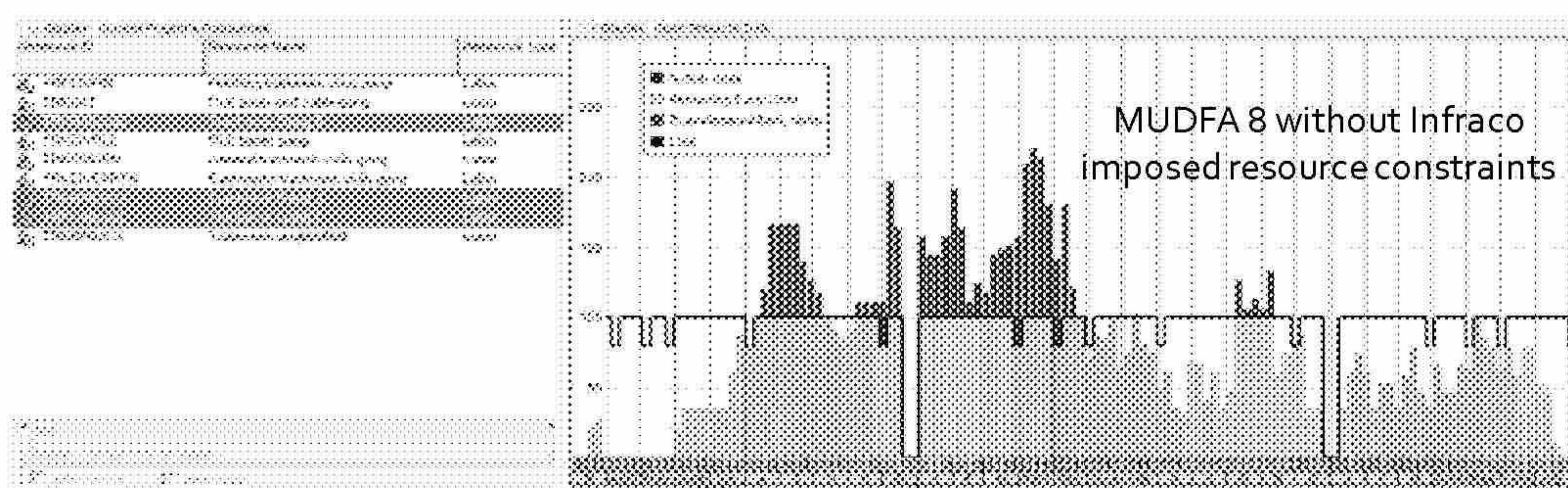


units) for a period of several months. I am advised that such resources are readily available in the market place and that there is more than enough time to procure them in an efficient manner. This is a much more cost effective manner in which to implement this tie Change than that currently put forward 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.