



Street Smart. World Wise.

May 6, 2014

Our Ref: 100224

City of Ottawa
Planning and Infrastructure
Rail Implementation Office
110 Laurier Avenue West
Ottawa, ON, K1P 1J1

Attn: Nancy Schepers (City Representative)

Dear Madam,

**Re: The Confederation Line (Ottawa LRT) Project Milestone #2 – Revision Review (Draft)
Description and Acceptance Criteria Modifications – Certification Services Variation**

I. Scope

In a letter dated April 24, 2014, from City of Ottawa and copied to Rideau Transit Group General Partnership (RTG, Project Co), the Independent Certifier (IC), Altus Group Limited, has been asked to proceed with a review of the proposed changes to the definition of Milestone #2 (Interim Completion of Mainline Tunneling), and answer certain questions outlined in that letter (appendix 1 of this report).

Subsequent to that letter, the IC The process has been calls and interactions with the City and with RTG to gather background and information.

The IC also has a role as the “Independent Engineer” pursuant to the Contribution Agreements between the City of Ottawa and Transport Canada and the Ministry of Transport Ontario.

The Independent Certifier has been provided with the following documentation, which has been considered in our review of the proposed revisions to the description and acceptance criteria for Milestone #2:

- April 24, 2014 letter issued by the City of Ottawa to Altus Group Limited, RE: Certification Services Variation Price Request (appendix 1 to this report)
- April 22, 2014 letter issued by RTG to the City of Ottawa, RTG-OTT-00-0-LET-0067, RE: Proposed Revision: Milestone #2 – Description and Acceptance Criteria, Interim Completion of Mainline Tunneling (appendix 1 to this report)
- Draft Milestone 2 Proposal Technical Evaluation by the City of Ottawa, provided in Draft form on April 24, 2014, and then updated as a formal submission on May 5, 2014 (appendix 2 to this report)

The IC’s review is based on the documentation provided as noted above, as has been confirmed with the City and RTG in previous phone conversations and in subsequent emails.

II. Review

Through several conference calls with the City of Ottawa and in review of the documentation provided (and noted above) to the Independent Certifier, in brief the proposed revisions to Milestone #2 are summarized as follows:

Milestone #2	As per Schedule 19, Project Agreement	As per RTG Proposal Submitted April 22, 2014
<p>Interim Completion of Mainline Tunneling</p>	<ul style="list-style-type: none"> • 50% of the tunneling activities and support of excavation has been completed for the mainline tunnels • Percentage completion shall be measured based on length of mainline tunneling work completed (in meters) as a percentage of total mainline tunnel length (in meters). Does not include mainline tunnels within the limits of the underground stations limits or non-mainline work such as station access tunnels, adits, ventilation tunnels or cross passages. • Completion of mainline tunneling work shall be defined by achievement of the following: <ul style="list-style-type: none"> • Complete excavation and installation of temporary excavation support for cut-and cover structures and initial support for all bored tunnels and mined structures. • Cut-and-cover structures, bored tunnels and mined structures are ready to receive permanent support and lining 	<ul style="list-style-type: none"> • <i>Equivalent of 50% of total running tunnel volume excavated and supported has been completed</i> • <i>Percentage completion shall be measured (in cubic meters) based on volume of excavation as a percentage of total running tunnel volume (in cubic meters). Volume measured to include running tunnel, station transitions and stations. Does not include adits, ventilation tunnels or cross passages.</i> • <i>Completion of equivalent total running tunnel excavated volume shall be defined by achievement of the following:</i> <ul style="list-style-type: none"> • <i>Complete excavation and installation of temporary excavation support for all mined structures.</i> • <i>Mined structures are ready to receive permanent lining where applicable.</i>

Project Co’s tunneling activities have been delayed at the East Portal from the sinkhole event on February 20, 2014 for approximately 2 months. This delay has directly impacted Project Co’s ability to achieve the 50% of the tunneling work for the mainline tunnels pursuant to Schedule 19 of the Project Agreement.

We understand that Project Co’s rationale for proposing the amendments to the description and acceptance criteria for Milestone #2 were to allow continuation with their tunnel construction strategy and continue to achieve the critical path objectives of the construction schedule. Project Co has confirmed that they can achieve Milestone #2 as currently defined, however this would require them to depart from their current construction schedule and redeploy the roadheader, currently working east at Parliament Station cavern, and turn the roadheader back to the Intermediate shaft to complete mainline tunneling activities west towards Lyon Station. In brief, Project Co has confirmed this would redeploy resources from a critical path activity to a non-critical path activity solely to achieve Milestone #2 as currently defined.

We note that the Independent Certifier has not carried out an independent quantity check, technical feasibility or detailed schedule analysis on the proposal from Project Co. We have relied on the City’s Technical Evaluation as confirmation of applicable schedule and volume calculations.

The RTG memo of April 22, 2014 (attachment B of this report) proposes applying a coefficient of 1.68. This is because excavating the station areas is less productive than the tunnel mainline. This in effect would mean that if the volume calculation were utilized, the term “equivalent” would mean applying this coefficient to the volume excavated from the station areas for overall volume calculation.

Attachment A of the RTG memo of April 24, 2014 notes the volumes calculated and the 1.68 volume adjustment coefficient applied to the station excavation areas. Based on that Attachment, the expected volume excavated as of June 13, 2014 (Milestone #2 date) would be:

- If the coefficient of 1.68 is applied: 65,944.52m³
- If the coefficient of 1.68 is not applied: 55,019m³
- Per existing Milestone #2 definition: 55,114m³

The following table provides IC’s review and comments on the questions asked from the IC.

<p>1. Is there a reduction in the value of the works as defined in the proposal compared to the original definition?</p>
<p>The proposed revisions involves a change in methodology to measure the milestone criteria, from mainline tunnel (excluding stations) lineal meter calculation to tunnels (including stations) volume of work excavated. Based upon the City’s confirmation of the quantities, the proposed revisions would be roughly the equivalent value of work achieved, albeit a different calculation methodology. The value is being measured differently; however, the value of the accomplished work can be comparable. The effort would be equivalent; however, the unit of measure would have changed from linear meter to cubic meter.</p> <p>Based on the City’s technical evaluation, the calculation of the “1.68 adjustment co-efficient” would seem reasonable and has been proposed to be applied to the volumes excavated in areas where the production level is lower (i.e. station transition and drift mining) than the mainline tunneling areas. However, in this regard, we have reviewed the volume calculations provided (Attachment A of RTG’s April 24, 2014 proposal) and are of the opinion that Project Co would achieve the required volume of excavated material (55,114m³) without applying the “1.68 adjustment co-efficient”.</p>
<p>2. Is there a reduction in the overall work accomplished against the schedule objectives compared to the accomplishment of the work originally defined?</p>
<p>Effort would be equivalent, but unit of measure would have changed – noting that progress in completion can be compared. Ultimately, in the overall project, the work accomplished would be the same.</p> <p>Ultimately, in the overall project, the work accomplished would be the same. The work accomplished against the schedule is roughly equivalent for reasons discussed in the above answer to Question No 1, above.</p> <p>We note that regardless of the methodology change, the responsibility for meeting the schedule requirements would not change.</p>
<p>3. If the RTG request was not approved, how will the critical path be impacted?</p>
<p>The current critical path will likely be adversely impacted if Project Co’s proposal is not approved. City’s evaluation of 4-6 weeks impact given current circumstances is plausible, and without a change in work methodology, a delay to Milestones 7, 8 and 10.</p>
<p>4. What are the potential impacts to the achievement of future milestones, in particular milestones 7, 8 and 10 in terms of timing and value? Include a list of the other milestones that may be affected.</p>
<p>We have reviewed the City’s technical evaluation of the adverse impact to the critical path and the achievement of the future milestones if Project Co’s proposal is not approved and this appears to be reasonable. The current float in the schedule will be eradicated for the achievement of Milestone #7, and a 4-6 week delay appears to be a reasonable assumption for the achievement of Milestones 7, 8 and 10. There should be no impact, either in their achievement or requirements, to any other milestone as a result of accepting the proposal.</p>
<p>5. Do you consider that the description of future milestones, in particular milestones 7, 8 and 10, may have to be amended? Include a list of the other milestones as applicable.</p>

There should be no further amendments to the description or criteria of the future milestones as a result of accepting this proposal. There are risks to the achievement dates for milestones 7,8, and 10, as they are linked to the tunnel works as currently scheduled, if Project Co's proposal is not accepted (see above answer to Question No 7)


6. Could the milestone be measured using both the originally agreed to methodology and the RTG proposal? Achieving the same?

The proposed measure is different. Yet, altogether, the project objectives would be the same considering all milestones.

This letter and the findings enclosed are based on the documentation supplied to us as noted above. We trust the above is satisfactory and please contact the undersigned with any questions or comments.

Yours truly,

ALTUS GROUP LIMITED


Per: Mehran Avini
Independent Certifier

Cc: Lorne Gray, Lead, Contract Administration, RIO
Monica Sechiari, Altus Group Limited

APPENDIX 1 –

- April 24, 2014 letter issued by the City of Ottawa to Altus Group Limited,
- April 22, 2014 letter issued by RTG to the City of Ottawa, RTG-OTT-00-0-LET-0067, RE: Proposed Revision: Milestone #2 – Description and Acceptance Criteria, Interim Completion of Mainline Tunneling



April 24, 2014

Mr. Mehran Avini
Altus Group
33 Yonge Street, Suite 500
Toronto, ON M5E 1G4

Re: Certification Services Variation Price Request

Dear Mr. Avini:

On behalf of the City of Ottawa and the Rideau Transit Group General Partnership, you are hereby requested under the terms of the Independent Certifier Agreement to submit a notice to both parties with respect to the effect on your fee for performing the services as described below.

In your capacity as the Independent Engineer in accordance with the Contribution Agreements between the City of Ottawa and our funding partners, Transport Canada and the Ministry of Transport Ontario, you are to perform a review of a proposal submitted by the Rideau Transit Group GP as set out in the attached letter reference RTG-OTT-00-0-LET-0067 and provide your opinion on each of the following key questions for both a yes or no disposition to the proposal where applicable.

1. Is there a reduction in the value of the works as defined in the proposal compared to the original definition?
2. Is there a reduction in the overall work accomplished against the schedule objectives compared to the accomplishment of the work originally defined?
3. If the RTG request was not approved, how will the critical path be impacted?
4. What are the potential impacts to the achievement of future milestones, in particular milestones 7, 8 and 10 in terms of timing and value? Include a list of the other milestones that may be affected.
5. Do you consider that the description of future milestones, in particular milestones 7, 8 and 10, may have to be amended? Include a list of the other milestones as applicable.
6. Could the milestone be measured using both the originally agreed to methodology and the RTG proposal?

City of Ottawa
Planning and Infrastructure
Rail Implementation Office
110 Laurier Avenue West
Ottawa, ON K1P 1J1

Ville d'Ottawa
Urbanisme et Infrastructure
Mise en œuvre du réseau ferroviaire
110, avenue Laurier ouest
K1P1J1

We also confirm that you are instructed to commence this work immediately upon receipt of this request.

Yours truly,



Nancy Schepers
Deputy City Manager / Directrice municipale adjointe

cc : Antonio Estrada, CEO, Rideau Transit Group GP
Lorne Gray, Contract Administrator, RIO
Gary Craig, Chief, Light Rail Design and Construction, RIO
Claudio Colaiacovo, Manager, Rail Program Management, RIO
Mona Monkman, Deputy City Treasurer, Corporate Finance

Encl. Letter reference RTG-OTT-00-0-LET-0067



22 April, 2014

City of Ottawa
 Rail Implementation Office
 110 Laurier Avenue West,
 Ottawa, ON, K1P 1J1
 Mail Code: 23-10

Our Reference:	RTG-OTT-00-0-LET-0067
Project Agreement Reference:	Schedule 19 – Milestone Payments

Attention: Nancy Schepers,
 Deputy City Manager Planning and Infrastructure and
 Director (A), Rail Implementation Office

Subject: Proposed Revision: Milestone #2 – Description and Acceptance Criteria
 Interim Completion of Mainline Tunnelling

Dear Ms. Schepers,

As discussed in recent Works Committee and other meetings, RTG hereby proposes a revision to the **Description/Milestone Acceptance Criteria** of Milestone Payment #2 (Interim Completion of Mainline Tunnelling) to provide a more relevant means of valuing construction performed for this milestone.

Per the Project Agreement, Milestone 2 is achieved when "50% of the tunneling activities and support of excavation has been completed for the mainline tunnels". When the definition was established it was predicated on a Tunnel Boring approach and a corresponding preliminary schedule. Since that time, RTG has implemented a mined tunnel methodology and the Works Schedule has been revised accordingly.

RTG is proposing that the defining milestone criteria be a function of running tunnel and station excavated volume, as opposed to strictly mainline tunnel length. RTG believes that this is a more applicable measure of work and value completed to date and is more reflective of the overall tunnel work scheduled. A volume based milestone requires the same construction effort, the same resource and cost allocation and, correspondingly, yields the same construction value as the mainline tunnel methodology.

The proposed change in the definition of Payment Milestone #2 does not imply further changes in the definitions of the other tunnel related Payment Milestones (M7 Completion of Tunneling, M8 Tunnels-Post Excavation and M10 2017 Readiness).

Despite the setback encountered at the East Portal, RTG is confident that the original milestone criteria of 50% of mainline tunnelling length complete could still be achieved by the milestone date.

To achieve the original "mainline tunneling" version of the milestone, RTG would:

1. Divert the road header from Parliament Station (after reaching the start of the transition) to the Intermediate shaft and start mining westward toward Lyon Station
2. Mine at East Portal 24 hours/day, 7 days/week towards Rideau Station

However, maintaining this "mainline" approach would have the following consequences:

- a) The underground excavation (mainline tunnel and stations) will become a critical path item of the overall project schedule as we would lose between 1 to 1½ months of float.
- b) The other tunnel-related Payment Milestones (M7 Completion of Tunneling, M8 Tunnels-Post Excavation and M10 2017 Readiness) would be delayed between 1 to 1½ months. Achievement of 2017 Readiness by April 12, 2017, could therefore be jeopardized.
- c) While maintaining similar progress on construction costs, delays in payments corresponding to milestones 7, 8 and 10 will create a financial gap in the project. Overall construction costs will continue to essentially be the same as forecast, however the payments lag by 4 – 6 weeks. (see Attachment C)

In summary, RTG believes that while plausible, the mainline only scheme would not be an effective use of time and resources, would result in reduced float in the overall tunneling schedule and would generate unnecessary and unforecasted financial costs for RTG.

The most challenging tunnel activity is in the station transitions and caverns, for which progress is presently excluded from the milestone definition. RTG is suggesting that a more pragmatic and representative approach to signifying progress and value achieved at Milestone #2 while maintaining production momentum, would be to also consider progress achieved in these key areas.

RTG proposes that progress complete be based on a volume calculation equivalent to 50% of mainline tunnel length volume. Completion shall be measured based on actual volume of excavation in cubic meters as a percentage of total mainline tunnel volume in cubic meters. RTG has calculated 50% of Mainline Tunnel volume as 55,114 m³. The milestone would be met (along with other prerequisites) when this volume of excavation has been met.

As the production level is lower for stations mining, and the construction more complex than straight tunnel mining, RTG proposes an adjustment coefficient be applied to Station transition and drift mining.

The coefficient is established by dividing the average daily production for Stations between the average daily production for mainline tunneling. Based on station and mainline tunnel daily productions taken from Revision 2 of the Works Schedule, the coefficient is calculated as:

$$\frac{\text{Tunnel m}^3/\text{day}}{\text{Stations m}^3/\text{day}} = \frac{208}{124} = 1.68$$

Running Tunnel - Stations	Duration (Working days)	Quantity (m³)	m³/day	Coefficient Stn/Tun
Running Tunnel	563	116,832	208	1
Stations	1,181	146,014	124	1.68

- 3 -

RTG is already tracking overall tunnel excavation volume progress as part of their ongoing monitoring. To validate total volume achieved by the milestone date, we would summarize the results in a table as presented in Attachment A of this letter.

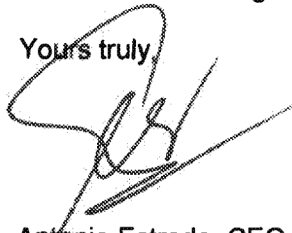
We propose that the Description/Milestone Acceptance Criteria be modified as suggested in the "Proposed" column shown in Attachment B of this letter.

RTG would appreciate the City's consideration of the aforementioned revision as we believe it to be a more fitting representation of value of work established at the milestone date.

Should RTG be required to follow the mainline tunnel approach, we would appreciate notification from the City no later than 01 May as this is the date that the Contractor would cease station excavation and turn the Parliament Station roadheader around and focus on mainline tunneling westward from the intermediate shaft.

Should you have any questions, or require any additional information, please do not hesitate to contact the undersigned.

Yours truly,



Antonio Estrada, CEO
Rideau Transit Group General Partnership

Cc.: Claudio Colaiacovo, RIO
Gary Craig, RIO
Lorne Gray, RIO
David Whyte, OLRT
Humberto Ferrer, OLRT
Peter Lauch, RTG

Attachment A – OLRTC Forecasted Production
Attachment B – Proposed Revised Description / Milestone Acceptance Criteria
Attachment C – Financial Model Ramifications



Attachment A

OLRTC Forecasted Production

Attachment A – OLRTC Forecasted Production

<u>West Portal</u>					Equivalent
	L(m)	S(m2)	V(m3)	Coefficient	V(m3)
Top heading	393.62	51.40	20,232.07	1.00	20,232.07
Bench	330.00	3.93	1,296.90	1.00	1,296.90
Lyon transition	31.76	61.00	1,937.36	1.68	3,254.76
Adit W. evt.					
Shaft	6.00	50.00	300.00	1.68	504.00
Drift 1A	36.00	36.30	1,306.80	1.68	2,195.42
Drift 1B	36.00	36.30	1,306.80	1.68	2,195.42
Drift 1A	24.00	36.30	871.20	1.68	1,463.62
Drift 1B	24.00	36.30	871.20	1.68	1,463.62
Central pillar	28.00	36.84	1,031.52	1.68	1,732.95
Total WP June 13th					34,338.77

<u>Intermediate shaft</u>					Equivalent
	L(m)	S(m2)	V(m3)	Coefficient	V(m3)
Top heading	121.00	51.40	6,219.40	1.00	6,219.40
Top heading	62.00	51.40	3,186.80	1.00	3,186.80
Bench	100.00	3.93	393.00	1.00	393.00
Transition	43.25	127.42	5,510.92	1.68	9,258.34
Drift 1A	32.00	45.63	1,460.16	1.68	2,453.07
Drift 1B	32.00	45.63	1,460.16	1.68	2,453.07
Total IS June 13th					23,963.67

<u>East Portal</u>					Equivalent
	L(m)	S(m2)	V(m3)	Coefficient	V(m3)
Top heading	22.06	52.90	1,166.97	1.00	1,166.97
Top heading	9.00	52.90	476.10	1.00	476.10
Pilot tunnel	36.00	31.50	1,134.00	1.00	1,134.00
Transition	15.00	42.20	633.00	1.00	633.00
Top heading	80.00	52.90	4,232.00	1.00	4,232.00
Total EP June 13th					7,642.07

Total					65,944.52
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As the production level is lower for stations mining, and the construction more complex than straight tunnel mining, RTG proposes an adjustment coefficient be applied to Station transition and drift mining.

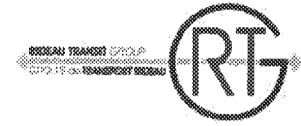
The coefficient is established by dividing the average daily production for Stations between the average daily production for mainline tunneling. Based on station and mainline tunnel daily productions taken from Revision 2 of the Works Schedule, the coefficient is calculated as:

$$\frac{\text{Tunnel m}^3/\text{day}}{\text{Stations m}^3/\text{day}} = \frac{208}{124} = 1.68$$

Running Tunnel - Stations	Duration (Working days)	Quantity (m ³)	m ³ /day	Coefficient Stn/Tun
Running Tunnel	563	116,832	208	1
Stations	1,181	146,014	124	1.68

The Running Tunnel and Stations Working Days duration values were extracted from the following Rev 2 Schedule excerpt:

Tunnel Area	From	To	Start	Finish	Duration (Working days)	Running Tunnel Working Days	Stations Working days
Excavation							
1	West Portal (East)	Transition Lyon (West)	04-Nov-13	09-Apr-14	108	108.00	
	Transition Lyon (West)	Lyon Station (West)	10-Apr-14	18-Sep-14	48		48.00
	Lyon Station (West)	Lyon Station (East)	07-May-14	07-Dec-15	399		399.00
2	Lyon Station (East)	West of Intermediate Shaft	04-Feb-15	30-Mar-15	38	38.00	
	Intermediate Shaft	Transition Parliament (West)	05-Mar-14	30-Apr-14	40	40.00	
	Transition Parliament (West)	Parliament Station (West)	01-May-14	23-Jun-14	37		37.00
3	Parliament Station (West)	Parliament Station (East)	24-Jun-14	31-Dec-15	382		382.00
	Parliament Station (East)	Rideau Station (West)	04-Jan-16	28-Apr-16	82	82.00	
	Rideau Station (West)	Parliament Station (East)	23-Oct-15	29-Apr-16	131	131	
	Rideau Station (West)	Rideau Station (East)	18-Aug-14	22-Oct-15	297		297.00
	Rideau Station (Hard Rock) (East)	Transition Rideau (East)	05-Aug-14	13-Dec-14	18		18.00
	Transition Rideau (East)	East Portal (West)	06-Dec-13	01-Aug-14	164	164.00	
Total					1744	563	1181



Attachment B

Proposed Revised Description / Milestone Acceptance Criteria

Attachment B – Proposed Revised Description / Milestone Acceptance Criteria

Below in red is a draft replacement prerequisite description to the milestone:

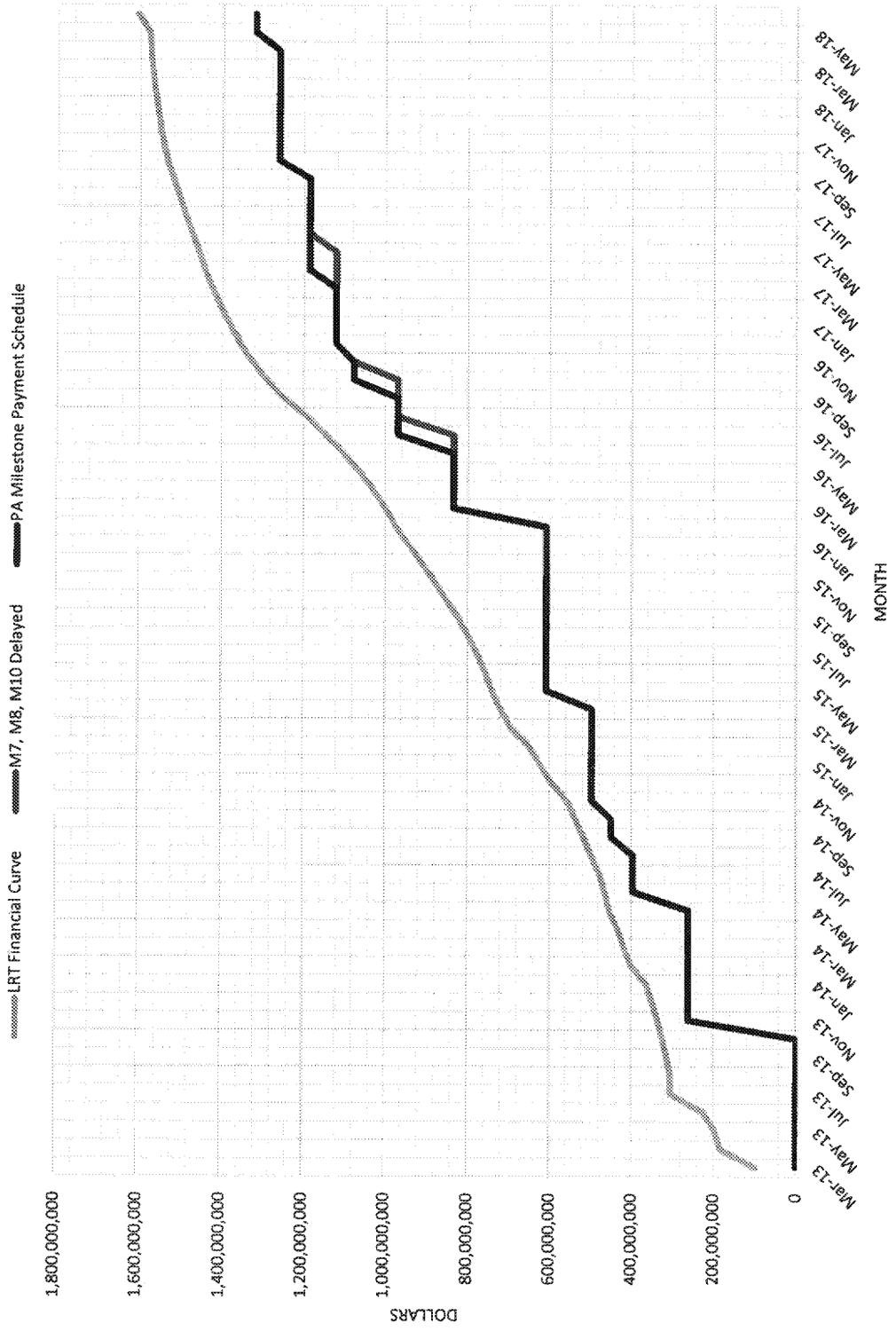
	Existing	Proposed
Interim Completion of Mainline Tunnelling	<ul style="list-style-type: none"> • 50% of the tunneling activities and support of excavation has been completed for the mainline tunnels • Percentage completion shall be measured based on length of mainline tunneling work completed (in meters) as a percentage of total mainline tunnel length (in meters). Does not include mainline tunnels within the limits of the underground stations limits or non-mainline work such as station access tunnels, adits, ventilation tunnels or cross passages. • Completion of mainline tunneling work shall be defined by achievement of the following: • Complete excavation and installation of temporary excavation support for cut-and-cover structures and initial support for all bored tunnels and mined structures. • Cut-and-cover structures, bored tunnels and mined structures are ready to receive permanent support and lining 	<ul style="list-style-type: none"> • Equivalent of 50% of total running tunnel volume excavated and supported has been completed • Percentage completion shall be measured (in cubic meters) based on volume of excavation as a percentage of total running tunnel volume (in cubic meters). Volume measured to include running tunnel, station transitions and stations. Does not include adits, ventilation tunnels or cross passages. • Completion of equivalent total running tunnel excavated volume shall be defined by achievement of the following: <ul style="list-style-type: none"> ○ Complete excavation and installation of temporary excavation support for all mined structures. ○ Mined structures are ready to receive permanent lining where applicable.



Attachment C

Financial Curve vs Milestone Payment Schedule

Attachment C - Financial Curve vs Milestone Payment Schedule



APPENDIX 2

- Draft Milestone 2 Proposal Technical Evaluation by the City of Ottawa, May 5, 2014



MEMO / NOTE DE SERVICE

To / Destinataire	Agreement Oversight Committees	File/N° de fichier:
From / Expéditeur	Claudio Colaiacovo (A) Manager, Rail Program Management Office	
Subject / Objet	OLRT Milestone Description #2, Proposal Evaluation	Date: May 5, 2014

The following is RIO's (including its' technical advisors CTP) evaluation of RTG's proposal to amend the Milestone Acceptance Criteria for Milestone 2 (Interim Completion of Mainline Tunneling) as set out in their letter reference RTG-OTT-00-0-LET-0067 dated April 22, 2014.

The evaluation has focused on the following key areas;

1. The merits of the rationale for changing the Milestone Acceptance Criteria
2. The relative value of the works accomplished under the current and proposed definitions
3. The impact on risk allocation
4. The potential impact on future milestones

1. The merits of the rationale for changing the milestone acceptance definition

RTG's rationale for proposing this amendment to the Milestone Acceptance Criteria is based on 2 critical factors.

- A. The desire to preserve the tunnel construction strategy and achieving the schedule critical path objectives
- B. Receiving the Milestone Payment on time and thus avoiding financial issues with the Lenders

RTG have indicated that their tunnel construction strategy is driven by the construction of the downtown stations at Lyon and Parliament, the completion of both stations being on the critical path of the schedule.

Because the Milestone Acceptance Criteria excludes the station transitions and caverns, this meant that the contribution towards completion of 50% of the mainline tunnel from the roadheaders employed at the west portal and the Intermediate Shaft would be limited to the length of mainline tunnel from the west portal to Lyon transition and the Intermediate Shaft to Parliament transition. The balance of the length required to meet the milestone was planned to be delivered by the roadheader employed at the east portal heading north to the Rideau Station transition.

The tunneling works from the east portal have been at a standstill due to the sinkhole event that occurred on February 20, 2014. As a result of this delay, RTG indicate that they will not be able to achieve enough linear mainline tunnel excavation from the roadheader at the east portal to contribute to the balance required to meet the 50% requirement for Milestone #2, even if it is operated 24/7. To compensate for this loss of tunnel length RTG would have to stop the roadheader at Parliament Station cavern working east and redeploy the roadheader back to the Intermediate Shaft and mine the mainline tunnel west towards the east transition of Lyon Station.

Whilst this action would allow RTG to achieve the milestone as currently defined, they will have to depart from their construction strategy in order to do so, resulting in a suspension of the critical activity at Parliament Station. The suspension of these works for approximately 8 weeks, as outlined in RTG's letter, could have a knock on effect to the completion of other tunnel related milestones and the 2017 Readiness Milestone. Subject to our validation of the forecast delay to the Parliament Station works, the potential impact of such a delay and the relative value of the works should the definition be amended, covered later in this report, we consider that the redeployment of resources from a critical activity to a non-critical activity to achieve the milestone definition does not help achieve the overall project objectives.

Based on the above we therefore consider that rationale for the proposed change to the acceptance definition of milestone 2 has merit and warrants further consideration.

2. The relative value of the works accomplished under the current and proposed definitions

RTG have proposed to change the method of measurement of Milestone 2 from a linear measurement to a volumetric measurement. Since the proposal is only changing the method of measurement rather than the level of effort it is a given that one linear metre of tunnel measured in linear metres would have the same value as one linear metre of tunnel measured in cubic metres. Therefore, in terms of assessing whether the proposal has comparative value, the following components require validation.

- A. The calculation to determine the exact length of mainline tunnel as defined in the milestone and subsequently the calculation of 50% of mainline tunnel.
- B. The calculation of the volume (m³) of 1 linear metre of mainline tunnel based on the design drawings.
- C. The forecast daily production volumes in the mainline tunnel.
- D. The forecast daily production volumes in the station transitions/caverns.
- E. The co-efficient used to compare tunneling production (m³) in the station transition/cavern and the tunneling production (m³) on the mainline tunnel on a like for like basis.

Validation

A. We have checked the tunnel drawings and confirm that the figures provided by RTG are consistent with our calculations and these are therefore validated.

B. A sample of sections in the running tunnel and the station caverns were checked to validate the volume calculations provided to support the request. This validation represented approximately 65% of the total volume. Note the transition volumes were not validated as they

represent a small percentage of the overall volume. The results of this due diligence did not identify any errors and support the volumes of excavated material.

C. We have reviewed the projected production rates provided for the mainline tunneling and confirm that they are reasonable.

D. We have checked the figures provided for the station transition/cavern against the scheduled production rates for this work and confirm that they are the same. Given our experience and knowledge of the complexity of the tunneling technique in the station caverns we consider the estimated production rates to be reasonable.

E. We agree that the use of a coefficient to reflect the additional effort required to complete the excavation of the transitions and station caverns is appropriate. We recommend that this concept be accepted for application in the definition however the acceptance of what this coefficient will be should be based on actual work accomplished in the station caverns over a reasonable period of time, say 2 to 4 weeks.

Given that the level of effort is the same for either way of measuring the milestone, in conclusion, we confirm that the proposal to measure the milestone by volume, applying the co-efficient, will provide, as a minimum, an equal value of the works described under the current and the amended milestone acceptance definition.

3. The impact on risk allocation

The acceptance of this proposal will not provide any relief to RTG in respect to their obligations under the Project Agreement and as such we do not foresee any risk transfer between the parties. However, should RTG fail to achieve the 2017 Readiness Milestone as a result of a rejection of their proposal, it could result in a negative impact to the City of Ottawa's reputation.

4. The impact on future milestones

In order to determine the impact, if any, to the future milestones the following items had to be validated.

- a) The milestones directly linked to the Parliament Station works
- b) The estimate of the 4-6 week delay to Parliament Station

Our analysis of the Draft Rev 2 Works Schedule submitted by RTG and our review of the Schedule 19 Milestone Definitions has confirmed that the Milestones directly linked to the construction of Parliament Station are:

- Milestones 7 – Completion of Tunneling;
- Milestone 8 – Tunnels Post Excavation; and
- Milestone 10 – 2017 Readiness.

To validate the estimated 4-6 week delay to the Parliament Station works we applied the production rates for mainline tunneling to the calculated length from the Intermediate Shaft to Lyon Station west transition and confirm that to excavate this length will take approximately 30 days. This equates to 6 weeks at 5 days per week. This is the estimated time that the roadheader

will be redeployed before returning to Parliament Station and therefore the estimated delay to Parliament Station of 4-6 weeks is reasonable.

To determine the magnitude of the delay to Milestones 7, 8 and 10 as result of the 4-6 week delay to Parliament Station, we performed Monte Carlo analysis (schedule outcome predictor software) on the Draft Rev 2 Works Schedule with a status update to 21 March.

To properly account for the continued delay in mining from the east portal we added this duration to the 'stalled' excavation activity and ran comparative Monte Carlo analyses for the schedule in 2 scenarios – one with their current baseline for the mining of the west transition to Parliament; the other with an assumed 30 working day delay in starting the activity (i.e. an overall 30 day increase in that activity's duration)

The summarized results are tabulated below.

Payment Milestone #n*	PA Schd 19 Date	Baseline Schedule Date	Date after Accounting for delays
7	2-Jul-2016	28-Mar-2016	30-Jun-2016
8	7-Oct-2016	19-Sep-2016	7-Oct-2016
10	12-Apr-2017	12-Apr-2017	12-Jun-2017

OS Dec 2016
 (*) for Loran Gyn
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 M. Avila
 2016.09.26

In conclusion, we have validated that the schedule float for Milestone 7 is eradicated; therefore any further delay will not be recoverable. This is similar for Milestones 8 but Milestone 10 is showing a potential 8 week delay. RTG's estimated 4-6 week delay to future milestones 7, 8 and 10 is therefore considered a reasonable estimate.

Conclusion

This technical evaluation has concluded that RTG's proposal to amend the definition of Milestone 2, in an attempt to preserve their construction schedule and avoid finance issues now and into the future, has merit, offers equal value and the technical components and technical assumptions are sound. We would therefore recommend the approval of this approval.