

February 4, 2019

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Your Worship and Jeff,

RE Green Line

The risks of cost overruns and time delays present and future Calgary taxpayers will face if we proceed with the Green Line megaproject as presently designed and contemplated are enormous. Calgarians must be very careful. Stage One of this LRT line is several times bigger than anything Calgary has tackled in the past. There is no room for error.

Summary and Conclusions

Green Line (see map attached)

The Green Line is a 44.3 km LRT line that will ultimately run from 160th Avenue North, south to Seton. The present plan is to construct this megaproject in multiple stages. Stage One runs from 16th Avenue North to Shepard in the south, a distance of 20.6 km. The initial plan includes two tunnels, one northbound and one southbound under the Bow River, each four kilometers in length.

Stage One

Construction Costs

The City of Calgary's external engineering advisor calculates the total cost, including all contingencies and risks, of Stage One as presently designed to be \$7 billion (\$4.65 billion plus a risk factor of 50%). Subsequent internal cost estimates of \$6.5 billion with a plus risk factor of 10% reconfirmed the true costs of Stage One with early completion schedule to be \$7 billion (\$6.5 billion plus 10% for risk).

Funding (Sources and Responsibilities)

Stage One is presently funded in the amount of \$4.65 billion with approximately one third coming from each of the City of Calgary, the Province of Alberta and the Government of Canada. In addition to the approved \$4.65 billion, approximately \$300 million has already been spent, principally on land acquisition for Stage One.

- Both external and internal engineering, design and financial analysis points to a probable \$2 billion shortfall before start of the project.
- City of Calgary taxpayers are responsible for 100% of all cost overruns.
- Once started, these projects are virtually impossible to stop – global experience.

Recommendations

1. A complete review of Stage One of the Green Line alignment, scope, design and funding must be conducted before construction is initiated.
2. Managers must never contract anything or commit any future funding for anything that is not fully funded, i.e., known costs plus anticipated risks. It is irresponsible in the extreme to contract out work on unfunded projects. Taxpayers would be justly outraged if the City were to do so.
3. Other alignments to cross the Bow are possible (elevated, i.e., bridge, alignments vs. deep, risky and expensive tunnels). Such a change in scope might be funded within the currently approved funding envelope for Stage One, i.e., \$4.65 billion including a shorter construction period.
4. If no further funds, i.e., additional \$2 billion, can be found to fully fund Stage One, and no changes in design are allowed, the project should be cancelled.
5. To date, approximately \$300 million* has been spent on this project, principally on land acquisition for Stage One. Common sense would suggest that these expenditures be reduced where practical until final alignment and design, together with cost and funding certainty have been attained.
*Note: The oft-quoted cost and approved funding for Stage One of \$4.65 billion has been communicated to taxpayers as 'the full cost of Stage One'. The re-direction of \$300 million from 'other' budgets is inappropriate.

Discussion

Megaprojects

- A megaproject is one whose cost exceeds \$1 billion.
- If you have read the December 22nd edition of the Globe and Mail, you would have read the following article: "*Crazy British rail projects show that taxpayers are getting hosed once again*," written by Eric Reguly. He makes the following points and I quote:
 - ♦ "Megaprojects have a life of their own. Everyone knows they will go over budget, perhaps wildly so, yet governments keep pumping money into them as if they were too expensive to fail."
 - ♦ "Contractors naturally produce figures and time lines that are designed to please, not trigger spasms of alarm among taxpayers."
 - ♦ "Contractors and politicians know that projects, once started, are almost impossible to stop."
 - ♦ "The politicians who backed the project in the first place don't really care about overruns since they know they won't be around in a few years; the bills become the next government's problem."
 - ♦ Finally, and most importantly, Reguly wrote, quoting the Economist magazine, citing a McKinsey report that "overruns on megaprojects are the norm; 98% of them are late or over budget, **the average delay is two years and the average cost increase is 80%**" (underlining is mine). These conclusions have been confirmed directly with one of the McKinsey authors. Their database consists of over 200 megaprojects.
 - ♦ Reguly summarizes that "almost none of these projects gets canceled and asks why this is allowed to happen, again and again."

- Also, here's what Bent Flyvbjerg of the Saïd Business School, University of Oxford, has to say in his article, *"Mega Delusional: The Curse of the Megaproject"* when he examines what drives this enthusiasm for megaprojects in the face of repeated failures – I quote:
 - ♦ "There is the rapture engineers and technologists get from building large and innovative projects – pushing the boundaries for what technology can do."
 - ♦ "Politicians love building monuments to themselves and their projects."
 - ♦ "There is the delight of business people and trade unions in making lots of money and by seeing mega jobs, usually exaggerated, created off megaprojects."
- Canadians, in particular, and North Americans, in general, are hardly immune to staggering cost overruns on megaprojects; think numerous oilsands operations (50-100%) or Churchill Falls (several hundred percent and counting) subway operations in Boston, Seattle and San Francisco (again, several hundreds of percent, all involving tunnels; Northwest Upgrader (100%)). I could go on but you get the point.
- Honolulu LRT/Subway – This 33 km , principally elevated project was originally budgeted to cost \$4 billion (US\$) and be completed five years ago. Today they plan to spend \$9.5 billion (US\$)and have added 5 more years to the completion date.
- Our relatively small and simple to build 69th Street LRT extension was initially budgeted at \$700MM. Its final audited cost was \$1.4 billion – a 100% overrun.
- McKinsey suggests there are three main reasons for failure:
 - ♦ Over-optimism: costs and timelines are systematically underestimated and benefits systematically overestimated.
 - ♦ Poor execution including low productivity. While the manufacturing sector has approximately doubled its productivity over the past 20 years, construction productivity has remained flat or even declined.
 - ♦ Weakness in organizational design and capabilities, i.e., people, skills, experience and organization.
- We need to deliver on the promise made with every new megaproject: *We understand all that but we will do it better THIS time.* Then, the inevitable happens – the project goes over budget, often massively so. All this reminds us of Einstein's famous quote re: the definition of insanity: Doing the same thing time after time and expecting a different result.

Enough general thoughts on megaprojects. Lesson: Politicians and taxpayers need to be very careful, critical and cautious because, from the beginning, they are fighting the odds and the cost of failure – of losing - can, in the case of the Green Line, be catastrophic due to the sheer size of the project.

Tunnels

Tunnels are inherently riskier and far more expensive to build than bridges. The Green Line, as presently designed, calls for two 4 km tunnels (a single, large tunnel is being considered with substantial cost savings).

Tunnels are besieged with the unexpected. Boston, Seattle and San Francisco have each experienced huge issues with their subway tunnel strategies resulting in enormous cost overruns and project delays. San Francisco also encountered unexpected damage to adjacent buildings due to subsidence of surrounding foundations related to their tunnel construction.

The Bow River

Present plans call for driving two Green Line tunnels through Lacrustine (lake bottoms, etc.) and variable deposits of till, pre-glacial gravels and weathered bedrock into the more stable bedrock under the Bow River. The Bow is a young, high energy river consisting of gravels, sands and mud lenses with occasional boulders of varying sizes. By nature, it is heterogeneous.

Tunnel boring machines operate best in homogeneous material and frequently experience slow penetration, even failure, when penetrating heterogeneous material such as will be experienced as each of our two tunnels is driven through it into the more stable underlying bedrock.

The present plan is to build several stations along the course of the two tunnels. The access to these deep stations will need to pass through the unstable, water saturated, pre-glacial gravels. Lesson: Tunnels, particularly through the soil and rock conditions found in the Bow River and adjacent areas, come with very high risk. Witness the number of problems as deep excavations to bedrock have experienced with high water in-flows when building deep garages in downtown Calgary. Unless absolutely necessary, stay away from high cost, high-risk tunnels.

Funding the Green Line

- The total approved funding for Stage One is \$4.65 billion. As already discussed, the City added the \$300 million (from other City budgets) and states that the approved funding is now just under \$5 billion.
- The indicated total estimated 'all-in' costs of Stage One as presently designed is \$7 billion.
- The predictable cost overruns (funding shortfall) on this project is in the order of \$2 billion unless serious alignment changes are incorporated. Reminder: Calgary taxpayers are responsible for 100% of the cost overruns.

Starting Stage One

The City plans to put out bid tenders for the entire 20 km Stage One section including the tunnels, or single tunnel, under the Bow River. As much of the risk in the tunnels as possible will be incorporated in the bidding and construction strategy recognizing that not all risk can ever be covered in this process.

A bidding process could take as much as one year. During that time, pre-construction costs will continue to rise:

- ♦ Contractors will be paid to submit bids – increasing pre-construction costs.
- ♦ The City will continue to spend – 200 employees, consultants, more land acquisition – all adding to pre-construction costs.

We have already incurred \$300 million on this project. The worry is that very soon this project will be too expensive to fail.

The possibility (probability?) of the bids coming in substantially above the presently approved funding must be anticipated. It would be appropriate to advance the design and costing of Plan 'B' – bridges – in preparation of such an eventuality.

The consequence of this bidding strategy is that if the bids for both the tunnel and the bridge options exceed the funds available, the project will be discontinued.

Stage One Demand

The demand forecasts upon which the funding for the Green Line was established were compiled in 2014/15. Much has happened in the intervening years. Evidence from mega-projects globally shows that while costs are consistently underestimated, demand is just as consistently over-estimated.

I need not tell you that Calgary is undergoing dramatic and disruptive change. Unquestionably, the demand forecasts that drove this project at its inception, i.e., prior to the oil and natural gas price collapse, should be revisited and, if found wanting, adjusted with appropriate changes to the project funding.

I would be seriously surprised if the numbers used will stand up to present, real-life, rigorous scrutiny.

Stage Two Demand

The City estimates that 50% of Green Line ridership will be in Stage One and 50% in the rest of the line. While the Stage Two sections are simpler to construct than Stage One, they would, nevertheless, probably add another \$4 or \$5 billion to the \$7 billion cost of Stage One to complete the line producing a total cost of between \$11 & \$12 billion for the entire Green Line once completed.

Careful analysis of the operating costs (and possible subsidies) are required for Stage One before subsequent stages come on line and must be conducted prior to initiating construction of Stage One.

Calgary Today

No reminder should be needed to emphasize the dire present condition of our city – 27% vacancy rate in our downtown core and an unemployment rate of 8% which is one of the highest, if not the highest, of all large cities in North America. Calgary is in no condition to fall into the ever-present megaproject trap. The Green Line is substantially larger than anything the City has previously built. We simply cannot handle – we must not be exposed to – the potential of a multi-billion liability. Such an event would ruin our finances and destroy our ability to invest and grow Calgary. It would devastate our City and our reputation.

If we fail to manage this project with skill, experience and discipline, cost overruns and completion delays could take Calgary down for years and burden our children with the challenge of paying the bills for many, many years.

I am compelled to write this letter not to be negative and obstructionist but, rather, to be objective, constructive and helpful. Of course, the Green Line can generate benefits for the City. That said, we must be very careful. The technical complexity and financial size of the project, particularly Stage One, inevitably comes with high risk.

We can ill-afford large cost overruns and delays at this challenging time in our City's history. We must be critical and disciplined if we are to avoid failure – too much is at stake.

Yours very truly,

James K. Gray

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Green Line Route

