Lions Gate Wastewater Treatment Plant

Risk Register – July 17, 2013

	Category	Title	Description	Probability	Impact	Cost Base
Experience						
3.02	Design & Tender	Owner's Project Management Team Experience	Risk that, during design phases, the Project Management Team does not have sufficient experience to design and manage the procurement model. Risk of inadequate information flow within the Project Team.	LOW, MEDIUM or HIGH	LOW, MEDIUM or HIGH	i.e. Design & Construction
3.12	Design & Tender	Evaluation of DB / P3 submissions	Lack of familiarity with different forms of procurement and evaluating proposals in that context results in delays.			
3.14	Design & Tender	Shortlisted Proponent Withdraws	Risk of prequalified (shortlisted) bidder dropping out after completion of the shortlist. This could lead to reduced competition and higher cost proposals/bids.			
3.15	Design & Tender	Unsuccessful Proponent risk	Risk that an unsuccessful bidder complains and causes a delay award / lawsuit			
5.22	Construction	Project Management Team Experience (Owner)	Risk that the Owner's Project Management Team does not have sufficient experience to manage the contract. Risk that management team is not familiar with the procurement model. Risk of inadequate information flow within the Project Team.			
Stakeholders						
5.30	Construction	Third party stakeholder interruption risk	Risk related to delays or increased cost related to stakeholder complaints/disruption regarding restricted access, noise, etc.			
11.01	Integration	Third party stakeholder interaction	Plant aesthetics fail to meet community expectations			
11.02	Integration	Community amenities	Community amenities fail to meet community expectations			
9.09	Operational	Labour Relations - Disputes	The risks of adversarial union/management relations or inability to settle contract negotiations in a timely, fiscally responsible manner. The risk of not being able to put adequate structures in place (in a timely fashion or not at all) due to contract limitations. This risk can lead to strikes, decreased employee morale and service interruptions.			
Scope Changes / Change Orders						
3.08	Design & Tender	Scope Changes by Owner - During RFP	Risk that the scope of work is changed by the Owner during the RFP/Tender process. This could lead to a lack of confidence in the whole process. A reduced tolerance for risk exhibited by the bidders could result in higher prices. Changes in equipment selection and/or specifications could affect the design requirements (space requirements, power supply, heating/cooling requirements) and could lead to changes in costs. Effect: Increase or Decrease to capital costs			
5.23	Construction	Scope Changes by Owner - During Construction	Risk that the scope of work is changed by the Owner during the construction period, including as a result of equipment selection by the Owner. This could result in additional costs for the construction contractor. Under DBFM, although the risk has been mitigated by transferring the co-ordination to the contractor, there still remains inherent risk in Owner changes.			
8.05	Life Cycle and Residual Risk	Regulatory Changes	Risk associated with imposed regulatory changes that may lead to major alterations to the plant structure, including mechanical and electrical components.			

Lions Gate Wastewater Treatment Plant

Risk Register – July 17, 2013

	Category	Title	Description	Probability	Impact	Cost Base
Contract Documentation						
3.04	Design & Tender	Incomplete RFP / Tender Documentation	Risk that the RFP/tender documentation is not complete or not coordinated. This will result in increased addenda and could give a sense of uncertainty to bidders, resulting in reduced tolerance to risk, resulting in higher bids.			
3.04a	Design & Tender	Technical Specs are not appropriate for procurement - during procurement	Performance specifications are not described in a manner that can be transferred in design and/or specifications or design criteria are not appropriate.			
9.03	Operational	Operation for Intended Use	Risk that appropriate performance specifications do not suit required standards of intended use. Failure to provide services to required standards and quantity.			
4.02	Site Conditions/ Environmental	Site condition information provided by Metro Vancouver is inadequate (i.e. Geotechnical, environmental)	Risk that reports provided to bidders is inadequate and does not sufficiently describe the existing site conditions. This could result in the contractor having a claim for additional time and costs.			
10.01	Project Agreement	Ambiguities in Agreement and Form of Contract	Risk that ambiguities exist in the project agreement and contract that could lead to disagreements at a later stage.			
Design, Construction, Operations Coordination/Interfaces						
5.24	Construction	Interface between Design and Construction	Risk of design coordination/design completion/design gaps - effectiveness of interfaces.			
Delays /Schedule						
1.01	Approval Delay	Internal Approval Delay	Risk that approvals are not received in a timely manner and ultimately leads to delay in the project. Approvals required include: - Internal approvals - Sign off by user departments			
2.02	Approval Delay	External Approval Delay	Risk that approvals are not received in a timely manner and ultimately leads to delay in the project. Approvals required include: - Municipal Approvals - Building permits			
3.16	Approval Delay	CN Interface	Risk of delay of permitting / required changes to design			
3.09	Design & Tender	Contract Award / Commercial/Financial Close Delay	Risk that award of contract is delayed.			
3.17	Design & Tender	Design delay	Risk that design is delayed and therefore delays the completion of the project			
4.03	Construction	Archaeological	Risk that archaeological finds will result in a delay and increased costs.			

	Category	Title	Description	Probability	Impact	Cost Base
5.02	Construction	Construction Schedule - ability to be operational in 2020 (December)	Risk that delays in the construction schedule could result in a delay to the handover of the facility. Delays will result in additional costs for the contractor. This could have detrimental effect on the liquidity of the contractor and ultimately result in bankruptcy. A delay in handover could result in additional or duplicate operating costs for Metro Vancouver.			
5.29	Construction	Interface with inflow / outflow not ready on agreed date	Risk that tie-in connections are not ready on time			
7.01	Completion Commissioning	Commissioning Delays	Risk that commissioning delays could result in a delay to the handover of the facility.			
Market Conditions						
5.08B	Construction	Acute Market Conditions	Risk associated with high demand and cost increases for major equipment, materials and contractor margins negatively impacting the project costs and schedule.			
5.11	Construction	Acute Market Conditions - Exchange rates	Risk associated with exchange rates negatively impacting the project costs and a reduced profit margin for the contractor. Much of the major equipment is expected to be imported. Critical materials may not be available when required, resulting in delays and additional costs. Risk associated with lead time for materials, impact of major commercial and institutional projects sourcing the same materials especially Mechanical Head end equipment and Electrical distribution equipment.			
5.16	Construction	Resource Availability; Labour	Risk that qualified labour resources are not available when required for the project, resulting in delay and increased costs for the construction contractor.			
Deficiencies						
5.03	Construction	Construction deficiencies	Risk that project is not constructed in accordance with the design documents. This could result in a dysfunctional plant. Effect: Contractual fight once you are into construction*			
5.13	Construction	Latent Defects	Risk that latent defects are discovered and remediated after substantial completion and remediation is required and performed. Effect: Increased costs			
7.02	Commissioning	Commissioning Deficiencies	Risk that there are excessive deficiencies upon substantial completion resulting in operational difficulties and overall client dissatisfaction.			
8.07	Operations	Lifecycle and maintenance deficiencies	Risk that maintenance and lifecycle requirements are not performed when appropriate to sustain service requirements and maintain asset value. Can occur due to lack of funding. Effects: Asset residual value is not to plan; handover standard is not met; underperformance of plant			
8.03	Life Cycle and Residual Risk	Unscheduled Emergency Maintenance	Risk that emergency maintenance is required because of life, safety or operational concerns.			
9.01	Operational	Supplier and Contract Management including Maintenance	Supplier and Contract Management Risk is the risk of any contractor, outsourced serviced provider, or supplier failing to provide products or services as agreed. Effect: This risk can increase costs to the Owner and increased exposure to liability.			
Operating Costs						

Lions Gate Wastewater Treatment Plant

Risk Register – July 17, 2013

	Category	Title	Description	Probability	Impact	Cost Base
9.06B	Operational	Un-anticipated Operating Costs - Electricity usage	Risk that energy usage will be higher than projected due to inaccurate estimates and assumptions.			
9.07B	Operational	Un-anticipated Operating Costs - Labour usage	Risk that labour costs will be higher than projected due to inaccurate estimates and assumptions.			
9.08B	Operational	Un-anticipated Operating Costs - Chemicals usage	Risk that chemicals costs will be higher than projected due to inaccurate estimates and assumptions.			
8.06	Life Cycle and Residual Risk	Life-Cycle Maintenance Costs	Life cycle maintenance costs are different than projected. The risk and associated costs of maintaining the plant's interior, exterior and systems in good working order and in a mode of delivery of service or function required. This is the risk that sub-systems identified for life cycle maintenance would require renewal costs higher or sooner than estimated or fail before renewal. Effect: Higher or lower costs			
Default / Termination						
5.18	Construction	Lender Non-Payment: Cost & Delay to Substantial Completion	Risk that the Lender (i.e. contractor's bank) defaults and is unwilling to meet financial obligations, resulting in delays to substantial completion.			
5.19	Construction	Construction Contractor Default	Risk that the construction contractor defaults and has to be replaced. This could result in delays to the delivery of the facility and additional costs for the Owner. In DBFM the Consortium Lead and/or the Lender would take over in this situation.			
10.02	Project Agreement	Termination For Convenience	Risk that Metro Vancouver will terminate the contract prior to the expiration of the term, for convenience – i.e., not for cause thus resulting in the loss of opportunity by the partner.			
10.04	Project Agreement	Termination For Cause - Construction Period	Risk that Metro Vancouver will terminate the contract prior to the completion of construction for non -performance .			
10.05	Project Agreement	Termination For Cause - Operation period	Risk that Metro Vancouver will terminate the contract prior to the expiration of the term, for non-performance.			
Load						
9.14	Operational	Variations in flows and loads	Risk that the plant can't handle or process expected flows and loads.			
Facility Documentation						
12.01	Handover	As built documentation handover	Risk of not completely receiving updated as-built drawings documentation at completion of building and at hand back of plant			
7.03	Completion Commissioning	Handover Agreement	Risk that ambiguities exist in the handover agreement that could lead to disagreements at a later stage.			

Appendix 4 Risk Workshop Results

The results of the risk workshops are as follows:

Risks Thousand dollars	Timeline	DBB					DB					DBFO				
			Prob	P	L	O	Allocation	Prob	P	L	O	Allocation	Prob	P	L	O
Owner's Project Management Team Experience	Pre-Construction (All)	Retained	7.5%	1,879	3,006	7,516	Retained	17.5%	2,255	3,608	9,019	Retained	17.5%	3,758	6,013	15,032
Evaluation of submissions	Pre-Construction (All)	Retained	3.5%	100	250	500	Retained	25.0%	200	500	1,000	Retained	25.0%	200	500	1,000
Incomplete RFP / Tender Documentation	Pre-Construction (All)	Retained	25.0%	1,046	2,092	5,229	Retained	17.5%	1,046	2,092	5,229	Retained	17.5%	1,046	2,092	5,229
Shortlisted Proponent Withdraws	Pre-Construction (All)	Retained	7.5%	-	3,138	15,688	Retained	7.5%	-	3,138	23,532	Retained	7.5%	-	3,138	31,376
Design delay	Pre-Construction (All)	Retained	17.5%	3,000	6,000	12,000	Transferred	3.5%	3,000	6,000	12,000	Transferred	0.0%	-	-	-
Scope Changes by Owner - During RFP	Last Year Pre-Construction	Retained	7.5%	500	1,000	5,000	Retained	17.5%	(3,138)	-	5,000	Retained	17.5%	(3,138)	-	5,000
Contract Award / Commercial Close Delay	Last Year Pre-Construction	Retained	3.5%	500	1,000	2,000	Retained	7.5%	500	1,000	2,000	Retained	7.5%	500	1,000	2,000
Existing Conditions are different than what could reasonably be inferred	Construction (Year 1)	Retained	17.5%	2,050	6,970	10,250	Transferred	17.5%	2,050	6,970	10,250	Transferred	17.5%	2,050	6,970	10,250
Owner's Project Management Team Experience	Construction (All)	Retained	7.5%	1,879	3,006	7,516	Retained	25.0%	2,255	7,215	22,548	Retained	17.5%	2,255	3,608	30,064
Third party stakeholder interaction	Construction (All)	Retained	7.5%	100	200	3,138	Retained	17.5%	100	200	3,138	Retained	17.5%	100	200	3,138
Community amenities	Construction (All)	Retained	7.5%	100	200	3,138	Retained	17.5%	100	200	3,138	Retained	17.5%	100	200	3,138
Scope Changes by Owner - During Construction	Construction (All)	Retained	17.5%	(2,353)	-	3,922	Retained	25.0%	(2,353)	-	3,922	Retained	10.0%	(3,138)	-	4,706
Incomplete RFP / Tender Documentation resulting in Scope Change	Construction (All)	Retained	17.5%	(2,353)	-	3,922	Transferred	17.5%	(2,353)	-	3,922	Transferred	17.5%	(2,353)	-	3,922
Construction Schedule - ability to be operational in 2020 (December)	Construction (Last Year)	Retained	17.5%	600	1,200	2,400	Partially transferred	7.5%	600	1,200	2,400	Transferred	3.5%	600	1,200	2,400
				-	-	-			-	-	-			-	-	-
Un-anticipated Operating Costs - Electricity Usage	Operations (Every Year) [1]	Retained	17.5%	(78)	-	311	Retained	7.5%	(78)	-	311	Transferred	3.5%	(78)	-	311
Un-anticipated Operating Costs - Labour usage	Operations (Every Year) [1]	Retained	17.5%	37	74	186	Retained	17.5%	37	74	186	Transferred	17.5%	37	74	186
Un-anticipated Operating Costs - Chemical Usage	Operations (Every Year) [1]	Retained	17.5%	(28)	-	112	Retained	7.5%	(28)	-	112	Transferred	3.5%	(28)	-	112
Life-Cycle Maintenance Costs	Operations (Every Year) [1]	Retained	7.5%	29	58	145	Retained	17.5%	29	58	145	Transferred	7.5%	29	58	145
				-	-	-			-	-	-			-	-	-
Operation for Intended Use	Operations (All)	Retained	7.5%	200	500	5,000	Retained	17.5%	200	500	5,000	Transferred	3.5%	200	500	5,000

Appendix 5 Risk Analysis

The risk analysis process involves the risk identification and risk quantification processes required to precede the ultimate Monte Carlo analysis that was used to quantify the risks retained by Metro Vancouver and transferred to the private sector.

Monte Carlo analysis involves using a software program that repeatedly runs random simulations of risk values to generate a risk distribution ranging from low to high impact that is referred to as a probability distribution.

The quantified risks discussed in this section were used as inputs to the financial model to calculate the net present value of each procurement option on a risk-adjusted basis

Risk Register & Risk Workshop

The risk identification process started with creation and review of a detailed risk register that included hundreds of potential risks that could apply to a wastewater sector project. Specific risks from water and wastewater sector precedent projects were incorporated into the original risk register.

A risk workshop consisting of Metro Vancouver, KPMG and other external consultants was held. As a result of this workshop and subsequent discussion between the project team, the initial risk register was reduced down to approximately 24 key risks.

The following criteria were used to assess if a risk was quantified:

- There must be a difference in risk between the DBB, DB and DBFOM procurement models analyzed
- A method for quantifying the risk was identified
- The risk was material

Retained Versus Transferred Risks

Risks were quantified separately for both retained and transferred components. Retained risks are the value of the risks retained by Metro Vancouver. Transferred risks are the value of the risk transferred to the contractor and/or concessionaire under either the DBB, DB or DBFOM models.

It is important to note a subtle difference between how the transferred risks are ultimately incorporated into the discounted net present value for the purposes of the VFM Analysis:

- Transferred risks under the DBB and DB options are assumed to be costs that the contractor would price into their construction contract bid price or facilities operator would price into their FM contract bid so are ultimately incurred by Metro Vancouver in either the construction or operations period
- Transferred risks under the DBFOM model are assumed to be costs that the concessionaire prices into their construction and operational cost estimates and are ultimately incurred by Metro Vancouver via the payment of the concessionaire's availability service payment (ASP)

As a result, transferred risks have been added to the cost estimates used to derive the estimated ASP under the DBFOM model.

Risk Workshop & Risk Quantification

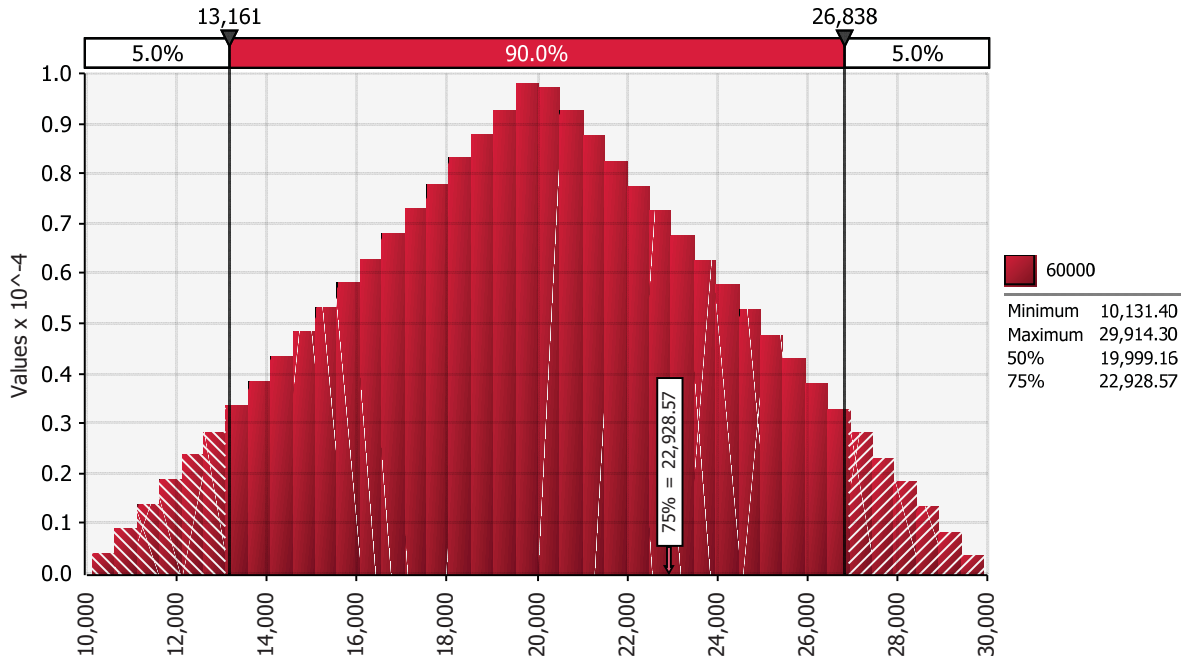
The purpose of the Risk Workshop was to quantify a range of possible risks at the individual risk level. The project team quantified risks using a triangular distribution consisting of three values, summarized from low to high impact below

- Perfect (P) – the smallest quantified impact an individual risk could potentially have, typically considered to be equivalent to the 1st percentile in a probability distribution;
- Likely (L) – the most likely quantified impact of an individual risk; and
- Outrageous (O) – the quantified upper limit impact of an individual risk, typically considered to be the 99th percentile in a probability distribution.

The P, L & O values were quantified for each individual risk resulting in a triangular distribution for each risk.

The example exhibit below shows a simple triangular distribution with $10,000 (P); $20,000 (L); and $30,000 (O) values and 100% probability of occurrence. The 75th percentile, a measure of the level of risk certainty, has been marked on the exhibit below.

Exhibit A5.1 – Example Triangular Risk Distribution



The next exhibit below demonstrates the same triangular risk distribution as above, but presented as a cumulative ascending function which better demonstrates the minimum and maximum level of risk exposure as you move from the P to O value: