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Memo

To:	John Roberts, PEng, Vice President Environment	**Client:**	TMAC Resources Inc.
From:	Maritz Rykaart, PhD, PEng	**Project No:**	1CT022.006
Cc:		**Date:**	August 3, 2016
Subject:	Doris Project: Closure and Reclamation Cost Estimates – Response to INAC's July 22, 2016 Submission		

1 Introduction

This memo summarizes a response to INAC's revised closure and reclamation cost estimate provided on July 22, 2016 in both PDF and electronic form.

Since it is INAC's preference to have the cost estimate provided in RECLAIM, SRK has provided this response using the same version of RECLAIM submitted by INAC on July 22, 2016 (IQALUIT-#1084532-v1-2016-07-22_2AM-DOH1323_REVISED_INAC_RECLAMATION_COST_ESTIMATE_-_APPENDIX_A). There was general agreement between the TMAC and INAC cost estimate regarding direct costs; and therefore, the following Tabs in RECLAIM have not been modified in any way:

- Open Pit
- UG Mine
- Tailings
- Rock Pile
- Chemicals
- Bldgs & Equip
- Water Treatment

Changes were made to the remaining Tabs, with all changes highlighted in YELLOW in the electronic RECLAIM file (submitted with this document), and notes added. The remainder of this memo provides additional information related to these proposed changes. Where appropriate, additional supporting information is provided as Attachments.

2 Changes

2.1 Summary Tab

Changes on the Summary Tab of the RECLAIM model are as follows:

- The Surface and Groundwater Management costs have been reduced. Since this cost is pulled from the Water Management Tab, the related changes are described in Section 2.3.
- The Interim Care and Maintenance costs have been reduced, the related changes are described in Section 2.4.
- The most significant cost changes are related to Mobilization and Demobilization. These changes are described in Section 2.6.
- Post-Closure Monitoring and Maintenance costs are described in Section 2.5.
- Engineering costs have been reduced to 5% of direct costs. This was completed based on two benchmarking studies. The first (Attachment A) relates to values currently used and/or proposed by proponents and INAC for four existing Water Licences in Nunavut (Meliadine, Meadowbank, Mary River and Lupin). The second benchmark study (Attachment B) compared published fee guideline structures by Canadian engineering associations for design related work. These guideline values are an upper bound of what the engineering costs at the Project site would be considering the level of effort required, where the only substantive engineering effort entails providing design drawings for a tailings closure cover and the North Dam breach.
- Project Management, Health and Safety Plans/Monitoring & QA, and Bonding/Insurance costs have also been reduced based on the benchmarking study presented in Attachment A.

2.2 Water Management Tab

A significant number of changes have been noted in the RECLAIM Water Management Tab. These include:

- The number of pumps purchased and shipped to site have been reduced from 5 to 3. Water Management on site is limited to pumping water from the Pollution Control Pond to the TIA, and pumping water from the TIA to Roberts Bay. That requires two pumps. An additional pump has been allowed for as a spare.
- The pump maintenance costs have been reduced in two ways. First, the spare pump has been assumed to require less maintenance than the two active pumps, and secondly the unit rate for maintenance has been adjusted to be more realistic. The RECLAIM unit rate proposed by INAC would be similar to 100% of the replacement costs for each pump every year, which is not appropriate.

- There are no large water conveyance structures on site that require inspections and maintenance. There is a single culvert on site that conveys water. It is a 600 mm diameter culvert which can easily be maintained by site staff with the equipment and facilities on site. Inspection by a Consultant is not required; therefore, this task has been removed.

- As described above, dedicated water management staff over and above the Interim Care and Maintenance crew, or the crew present during Active Closure is not required. As a result, all manpower costs have been removed.

- Annual geotechnical inspections, regulatory costs and water sampling and testing is required during the period of Interim Care and Maintenance (18 months), plus the period of Active Closure (117 months, i.e. approximately 2.5 years). The costs of these annual requirements during the 2.5 years of Active Closure is covered here.

- As described earlier, there are no water conveyance channels or structures that require decommissioning that are not covered under Active Closure. The lump sum amount of $500,000 proposed by INAC has therefore been removed.

2.3 ICM Tab

The changes related to the ICM Tab of the RECLAIM model are as follows:

- The on-site requirement for ICM has been reduced from 8 months (240 days) to 6 months (182 days). Seeing that the only activity requiring site presence is water management, required for 4 months out of the year, this is considered generous.

- A full time electrician and mechanic is not required. It has been assumed there would always be at least 2 persons on site, and that the two trades will be present for half the time.

- Fuel is currently being delivered to site at a price of $1.05 per liter, which is considered more realistic than $1.40 per liter. During peak fuel prices a few years ago, the cost was below $1.40.

- The equipment fleet on site for ICM can be used for snow clearing. A dedicated snow machine, at an equivalent rate to that of the heavy equipment, is not realistic. At this price, four new commercial snow machines can be purchased.

- Inspection and maintenance of water management structures have been removed (Section 2.3).

2.4 PostClosure Tab

The only change is in line 25 of the RECLAIM PostClosure Tab. INAC has assumed a discount rate of 0%, and SRK is suggesting that a 2% discount rate is more appropriate.

2.5 Mobilization Tab

There are a significant number of changes highlighted in the RECLAIM Mobilization Tab. Unit Cost changes related to shipping rates are described in Section 2.7. The revised Unit Cost for fuel at $1.05/Liter is based on the actual delivered cost for fuel currently at the Project site. The delivered fuel rate has never exceeded $1.15/Liter, even during peak fuel rates a few years ago.

The Project will experience three mobilization and two demobilization campaigns. The first is associated with the ICM phase. The mobilized fleet is listed in Table 1. There will not be a demobilization phase associated with the ICM phase. The Active Closure phase will immediately follow the ICM phase and all equipment will be transitioned to Active Closure use.

There are however two Active Closure periods. The first period will follow immediately after the ICM, and entails all site closure activities, with the exception of the North Dam breach, the Doris bridge removal and lowering of the Jetty. The second period can only be completed about five years after the TIA has been drained. Therefore, it has been assumed that the equipment will be demobilized after the first Active Closure period. A new fleet will be mobilized and subsequently demobilized when the second Active Closure period commences. Table 1 summarize the complete mobilization and demobilization requirements.

In addition to revising the quantum associated with mobilization and demobilization, SRK has added mobilization and demobilization costs associated with the air-track drills required for quarry development associated with the tailings cover and for removing the frozen core when the North Dam is breached. The cost of the drills is included in the appropriate unit rate calculations; however, it was unintentionally omitted from the mobilization and demobilization sheet in the original cost estimate.

Table 1: Summary of Equipment Mobilization and Demobilisation Requirements

Equipment	ICM	Active Closure (pre Dam Breach)		Active Closure (Dam Breach)	Overall Mob/Demob Compliment
		Additional Mobilized	Total Required		
	A	B	C = A +B	D	E = C + D
Excavators	1	1	2	1	3
Dump Trucks	1	3	4	2	6
Dozers	1	1	2	1	3
Loaders	1	1	2	0	2
Drills	0	2	2	1	3
Light Duty Vehicles	1	4	5	1	6
Shipping Containers	1	9	10	2	12

The final change in this Tab relates to the worker's accommodations (lines 44, 45 and 46). SRK has developed a detailed closure schedule based on equipment and resource loading. This schedule is presented in Attachment C. Table 2 highlights some of the key components of this

schedule as it relates to manpower requirements. This demonstrates a significant increase over the estimated 4 month closure period previously presented by TMAC based simply on manpower demand.

Table 2: Key Active Closure Activities

Activity	Duration	Crew Size
Tailings Cover Quarry Development	116 Days	5
Tailings Cover Construction	98 Days	6
Fuel Tank Demolition (Roberts Bay & Doris)	49 Days	5
Camp/Mill Pad Structures Demolition	96 Days	16
Clear and Regrade Pad and Roads	32 Days	5
Other Miscellaneous Activities	60 Days	5
Drain TIA	25 Months	3
North Dam Breach (+ Doris Bridge and Jetty)	49 Days	9

The Active Closure implementation schedule shows there is a need for 2.5 years of additional camp rentals (over and above the ICM phase). Based on the two camp rates used, there will be 672 days when the smaller camp rate would apply (i.e. fixed cost of $2,000/day if there is less than ten people on site). For the larger camp (greater than ten people), there will be 4,095 person days at a rate of $500/person/day.

INAC's Consultant has not developed an equipment and resource based schedule, but rather provided incomplete benchmark data from a single example project in the Yukon Territory to suggest that TMAC's closure schedule is not realistic.

SRK has therefore provided additional appropriate benchmark data to demonstrate the proposed activity with the longest duration, i.e. tailings cover construction, as proposed for Doris, is not only appropriate, but conservative. This benchmark information is provided in Attachment D. It provides five case studies of cover construction where SRK has been the engineer-of-record for the design and construction quality assurance of tailings cover construction at abandoned mines. These case studies have been carefully selected to demonstrate comparable conditions to those at Doris.

2.6 Unit Costs Tab

Changes refer to lines 188, 189 and 190 of the RECLAIM Unit Cost Tab. SRK obtained rates for barge shipping of equipment and supplies from NTCL, who is the pre-eminent shipping company in this part of the Arctic. NTCL has been in business for a very long time, and also services all of the local communities. NTCL has published shipping rates which apply equally to all their customers. NTCL's rate for shipping a standard 20-foot container is $6,500 as opposed to the RECLAIM rate of $13,400 adopted by INAC.

In addition, a unique feature of NTCL's rate structure is that backhaul of equipment and supplies is at a lower rate, as evidenced by the rates used listed by SRK and subsequently applied in the Mobilization Tab (Section 2.6).

The NTCL shipping rates are considered to be relevant, current and more appropriate to use than the unsupported RECLAIM rate.

3 Closure

Table 3 summarizes TMAC's revised Closure and Reclamation Cost Estimate based on the rationale provided in the memo, as compared to INAC's cost estimate received on July 22, 2016.

Table 3: Summary of TMAC and INAC Closure and Reclamation Cost Estimate

Category	TMAC	INAC
Direct Costs		
Open Pit	$457,188	$457,188
UG Mine	$248,726	$248,726
Tailings	$7,312,645	$7,312,645
Rock Pile	$379,285	$379,285
Doris Camp	$3,876,329	$3,876,329
Chemicals	$632,071	$632,071
Water Management	$370,000	$3,027,500
Interim Care and Maintenance	$2,231,625	$3,105,900
Subtotal: Direct Costs	**$15,507,869**	**$19,039,644**
Indirect Costs		
Mobilization/Demobilization	$6,867,688	$15,766,239
Post-Closure Monitoring	$1,185,701	$1,320,000
Engineering	$775,393	$1,523,172
Project Management	$775,393	$2,094,360
Health & Safety	$155,079	$380,793
Bonding/Insurance	$0	$190,397
Contingency	$3,101,574	$3,807,929
Market Place Factor Adjustment	$0	$0
Subtotal: Indirect Costs	**$12,860,829**	**$25,082,889**
TOTAL Costs	**$28,368,698**	**$44,122,533**

Attachment A: Indirects Benchmarking Study

Project	Engineering		Project Management		Health & Safety Plan/Monotoring, QA/QC		Bonding		Contingency	TOTAL (Excluding Contingency)	
	Company	INAC	Company	INAC	Company	INAC	Company	INAC		Company	INAC
Meliadine Project	5%	10%	5%	5%	1%	1%	1%	1%	20%	**12%**	**17%**
Meadowbank Project	5%	5%	5%	5%	0%	0%	0%	0%	15%	**10%**	**10%**
Mary River Project	5%	5%	5%	5%	0%	0%	1%	1%	10%	**11%**	**11%**
Lupin Mine	4%	4%	4%	4%	0%	0%	0%	0%	10%	**8%**	**8%**
Doris Amendment	1%	8%	2%	11%	0%	2%	0%	1%	20%	**3%**	**22%**

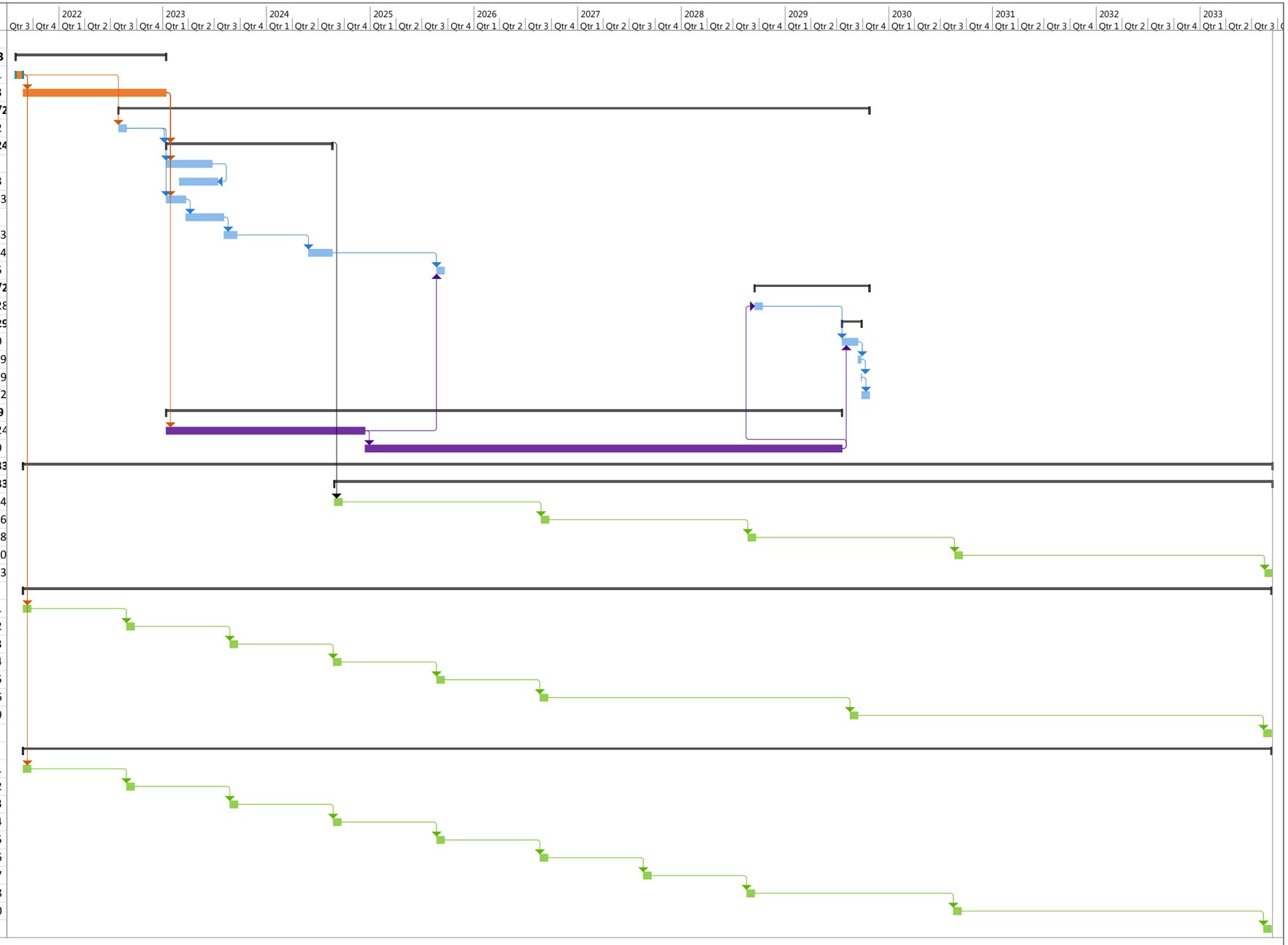
Maximum (Excluding Doris)	**10.0%**	**5.0%**	**1.0%**	**1.0%**	**20.0%**	**17.0%**
Average (Excluding Doris)	**5.4%**	**4.8%**	**0.3%**	**0.5%**	**13.8%**	**10.9%**
Mean (Excluding Doris)	**5.2%**	**4.7%**	**n/a**	**n/a**	**13.2%**	**10.6%**
Minimum (Excluding Doris)	**4.0%**	**4.0%**	**0.0%**	**0.0%**	**10.0%**	**8.0%**

Attachment B: Engineering Association Fees Benchmarking Study

Engineering Design Fee Guidelines - Assuming $20M Contract Value								
Source	**Fee Category/Class**	**Base Fee**		**Secondary Fee**		**Total Fee**	**Equivalent Fee Percentage**
The Consulting Engineers of British Columbia (CEBC) & the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) - 2009	Basic Services of Average Complexity	$ 593,000	On First $15M	3.60%	On Next $5M	$ 1,133,000	5.7%
	Basic Services of Above Average Complexity	$ 828,000		5.20%		$ 1,608,000	8.0%
Association of Consulting Engineers of Québec - July 2013	General Engineering - Category II	$ 690,000	On First $10M	5.90%	On Next $10M	$ 1,280,000	6.4%
	General Engineering - Category III	$ 761,000		6.30%		$ 1,391,000	7.0%
Consulting Engineers of Saskatchewan - January 2016	Projects of Average Complexity	$ 809,000		4.70%		$ 1,514,000	7.6%
	Projects of Above Average Complexity	$ 970,000		5.70%		$ 1,825,000	9.1%
Association of Professional Engineers and Geoscientists of the Province of Manitoba And the Association of Consulting Engineering Companies - Manitoba - January 2016	Complex I	5.60%	On Total Amount	Not Applicable		$ 1,120,000	5.6%
	Complex II	6.70%				$ 1,340,000	6.7%
	Complex III	9.30%				$ 1,860,000	9.3%
	Complex III - Upper Bound	10.80%				$ 2,160,000	10.8%
Consulting Engineers of Nova Scotia (CENS) - Undated	Complex 3	7.90%	On First $16M	5.90%	On Remainder	$ 1,500,000	7.5%
	Complex 4	9.90%		7.90%		$ 1,900,000	9.5%
					Overall Minimum		**5.6%**
					Overall Average		**7.8%**
					Overall Mean		**7.6%**
					Overall Maximum		**10.8%**

Attachment C: Closure Schedule

ID	Task Name	Duration	Start	Finish
1				
2	**Interim Care and Maintainance (ICM)**	**379 days**	**Sun 8/1/21**	**Thu 1/12/23**
3	Mobilize ICM	1 mon	Sun 8/1/21	Thu 8/26/21
4	Execute	18 mons	Fri 8/27/21	Thu 1/12/23
5	**Active Closure (AC)**	**1889 days**	**Fri 7/29/22**	**Wed 10/24/2**
6	Mobilize AC	1 mon	Fri 7/29/22	Thu 8/25/22
7	**Execute**	**417 days**	**Fri 1/13/23**	**Mon 8/19/24**
8	Tailings Cover Quarry Development	116 days	Fri 1/13/23	Fri 6/23/23
9	Tailings Cover Construction	98 days	Tue 2/28/23	Thu 7/13/23
10	Fuel Tank Demolision (Roberts Bay & Doris)	49 days	Fri 1/13/23	Wed 3/22/23
11	Camp/Mill Pad Structures Demolision	96 days	Thu 3/23/23	Thu 8/3/23
12	Clear and Regrade Pads and Roads	32 days	Fri 8/4/23	Mon 9/18/23
13	Other Miscellaneous Activities	60 days	Tue 5/28/24	Mon 8/19/24
14	Demobilize ICM + AC	1 mon	Fri 8/22/25	Thu 9/18/25
15	**Dam Breach (DB)**	**289 days**	**Fri 9/15/28**	**Wed 10/24/2**
16	Mobilize AC_DB	1 mon	Fri 9/15/28	Thu 10/12/28
17	**Execute**	**49 days**	**Fri 7/20/29**	**Wed 9/26/29**
18	Dam Breach	40 days	Fri 7/20/29	Thu 9/13/29
19	Doris Bridge Removal	7 days	Fri 9/14/29	Mon 9/24/29
20	Jetty Lowering	2 days	Tue 9/25/29	Wed 9/26/29
21	Demobilize AC_DB	1 mon	Thu 9/27/29	Wed 10/24/2
22	**Water Management**	**1700 days**	**Fri 1/13/23**	**Thu 7/19/29**
23	Drain TIA	25 mons	Fri 1/13/23	Thu 12/12/24
24	Reflood TIA (Natural)	60 mons	Fri 12/13/24	Thu 7/19/29
25	**Post Closure (PC)**	**3142 days**	**Fri 8/27/21**	**Mon 9/12/33**
26	**Cover Monitoring**	**2360 days**	**Tue 8/27/24**	**Mon 9/12/33**
27	PC 1	1 mon	Tue 8/27/24	Mon 9/23/24
28	PC 3	1 mon	Tue 8/25/26	Mon 9/21/26
29	PC 5	1 mon	Tue 8/22/28	Mon 9/18/28
30	PC 7	1 mon	Tue 8/20/30	Mon 9/16/30
31	PC 10	1 mon	Tue 8/16/33	Mon 9/12/33
32	**Geotechnical Inspections**	**3140 days**	**Fri 8/27/21**	**Thu 9/8/33**
33	ICM 1	1 mon	Fri 8/27/21	Thu 9/23/21
34	ICM 2	1 mon	Fri 8/26/22	Thu 9/22/22
35	AC 1	1 mon	Fri 8/25/23	Thu 9/21/23
36	PC 1	1 mon	Fri 8/23/24	Thu 9/19/24
37	PC 2	1 mon	Fri 8/22/25	Thu 9/18/25
38	PC 3	1 mon	Fri 8/21/26	Thu 9/17/26
39	PC 6	1 mon	Fri 8/17/29	Thu 9/13/29
40	PC 10	1 mon	Fri 8/12/33	Thu 9/8/33
41	**Water Quality Monitoring**	**3140 days**	**Fri 8/27/21**	**Thu 9/8/33**
42	ICM 1	1 mon	Fri 8/27/21	Thu 9/23/21
43	ICM 2	1 mon	Fri 8/26/22	Thu 9/22/22
44	AC1	1 mon	Fri 8/25/23	Thu 9/21/23
45	PC 1	1 mon	Fri 8/23/24	Thu 9/19/24
46	PC 2	1 mon	Fri 8/22/25	Thu 9/18/25
47	PC 3	1 mon	Fri 8/21/26	Thu 9/17/26
48	PC 4	1 mon	Fri 8/20/27	Thu 9/16/27
49	PC 5	1 mon	Fri 8/18/28	Thu 9/14/28
50	PC 7	1 mon	Fri 8/16/30	Thu 9/12/30
51	PC 10	1 mon	Fri 8/12/33	Thu 9/8/33



Project: Doris Phase 1 Closure S
Date: Fri 7/29/16

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

Attachment D: Cover Benchmarking Study

Tailings Cover Benchmark Studies

Benchmark Project	Cover Details	Cover Surface Area (ha)	Total Cover Thickness (m)	Volume of Cover Material Moved (m3)	Borrow Source Distance (km)	Cover Construction Duration (months)	Average Volume of Cover Material Placed per Day (m3)	Number of Trucks	Size of Trucks	Total Number of Truck Loads per Day	Average Truck Cycle Time per Hour (Assuming 10 hour day)	General Comments
Colomac Mine, NWT	Tailings regrading, geotextile, 0.8 m waste rock cover	38.6	0.8	308,800	7	4	2,573	5	30T and 40T (Rock Trucks)	151	3.03	Inlcudes tailings dewatering time, i.e. pump down of ponds; Remote site, winter road access only; Free digging borrow source
Lorado, SK	Tailings regrading, 0.5 m capillary break sand, 0.5 m growth media till	25.4	1	254,000	Variable, 5 on average	9	941	5	30T and 40T (Rock Trucks)	55	1.11	Capillary break sand specification very tight; Rigorous material sorting and screening from 5 different borrow sources; Inlcudes weather delays and fire shutdown (about 1 months total); Remote site, winter road access only
Con Mine, NWT	Nominal tailings regrading, 0.5 m run-of-quarry rock cover	53.0	0.5	265,000	2 km	18	491	2	15T and 20T (Highway Trucks)	49	2.45	Only worked 6 days per week; Not a construction contract; Just hired local truck drivers and loader operation; "Slow and Steady" approach
Emerald Glacier, BC	Tailings regrading, 0.8 m compacted till, 0.2 loose till	0.4	1	4,000	1 km	0.5	267	3		16	0.52	Inlcudes 2 days weather delay.
AMEC YT Case Study	Tailings regrading, cover details not known (assume 1 m)	15.5	1	155,000	Unknown (stated to be "local")	9	574	3	Unknown	34	1.13	Many details unknown; Site not remote, road access; Cover thickness guess
	Tailings regrading, cover details not known (assume 0.5 m)	15.5	0.5	77,500		9	287	3	Unknown	17	0.56	
Doris, NU	Nominal tailings regrading, 0.3 m run-of-qaurry rock cover	44.0	0.3	132,000	1 km	4.25	1,035	3	30T Rock Trucks	61	2.03	Remote site, barge access only; Rock quary developed for borrow