Mount Nansen Closure Options Evaluation

Report Prepared for

Government of Yukon

Report Prepared by

SRK Consulting (Canada) Inc.
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Government of Yukon

Energy, Mines & Resources Assess & Abandoned Mines K-419
Box 2703
Whitehorse, Yukon Y1A 2C6

SRK Consulting (Canada) Inc.
Suite 2200 – 1066 West Hastings Street
Vancouver, BC V6E 3X2

e-mail: vancouver@srk.com
website: www.srk.com

Tel: +1.604.681.4196
Fax: +1.604.687.5532

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Author:
Daryl Hockley, P. Eng.
Corporate Consultant

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1 Introduction

The Government of Yukon contracted SRK Consulting (Canada) Inc. (SRK) to facilitate two workshops related to the Mount Nansen Closure Options as described in the report Mount Nansen Options for Closure prepared by Lorax (March 2011). A risk assessment workshop was held in July 2011, and served as input to an options evaluation workshop held one week later. Both workshops were attended by representatives of the Yukon Government, Aboriginal Affairs and Northern Development Canada, and the Little Salmon Carmacks First Nation. This report provides a summary of the two workshops and their outcomes.

2 Purpose

The overall objective of the Mount Nansen risk assessment and options evaluation process was to provide further input to the three governments to inform decision making in selecting the final closure plan for the site. The specific purpose of the risk assessment workshop was to identify and come to agreement on any risks associated with each of the proposed closure options; that level of agreement was fundamental to the subsequent evaluations. The objectives of the options evaluation workshop were to examine how well each of the proposed options would meet the closure objectives of each party, and to do so in a manner that allowed the perspectives of each party to be taken into account by the other groups.

3 Mount Nansen Closure Options

Six closure options for the tailings and waste rock at the Mount Nansen site have been developed and evaluated:

- Options 1A and 1B: Tailings Dam Upgrade with Water Cover (Option A denotes waste rock in place; Option B denotes pit backfill with waste rock);
- Options 2A and 2B: Tailings Dam Upgrade with Saturated Soil Cover (Option A denotes waste rock it in place; Option B denotes pit backfill with waste rock);
- Option 3: Tailings (Wet) Backfill into Pit with High Infiltration Cover, Waste Rock in Place; and
- Option 4: Tailings (Dry) and Waste Rock Backfill into Pit with Low Infiltration Cover.

There are also common elements that must be closed. These include the mill site, haul roads, transmission lines, etc. All of the options are documented in the 2011 Lorax report, and that report served as the basis for the risk assessment workshops. In other words, it was assumed that the report presents a complete picture of the options. Some changes to the options were added after the risk workshop, but these were limited to editorial changes or minor modifications to dealt with specific risks without significantly changing the options.

4 Risk Assessment Workshop

4.1 Participants

The one and a half day risk assessment workshop was held in the SRK offices in Vancouver, BC on July 14 and 15, 2011. The following individuals participated:

Yukon Government:	Frank Patch
	Stephen Meade
	Patricia Randell
AANDC:	Kriss Sarson (AANDC Yukon Region)
	Jason Berkers (AANDC Yukon Region)
	Lou Spagnuolo (AANDC HQ)
LSCFN:	Robert Moar
	Leta Blackjack
	Bill Slater
Technical Consultants:	Leslie Gomm (Gomm Consulting)
	Justin Stockwell (Lorax Environmental Services)
	Kendall Thiessen (AECOM Canada)
SRK representatives:	Daryl Hockley and Dirk van Zyl (workshop facilitator).

Members of the Technical Advisory Committee of the LSCFN met in a separate room and the three representatives above consulted with them during breaks to get their inputs.

4.2 Risk Assessment Process

The risk assessment was carried out using a consequence-likelihood method based on AANDC's risk rating procedure. A summary of the procedure was distributed to all participants before to the workshop. Appendix A provides that summary. This document provided an overview of the process as well as the likelihood, consequence-severity and risk matrices that were used in the workshop.

The next step was to review each of the options, identify risks, and agree on their rating. To make the reviews as efficient as possible, the following sequence of options was adopted:

- Tailings with water cover
- Tailings with soil cover
- Waste rock reclaimed in place
- Waste rock backfilled in pit
- Common elements
- Option 3
- Option 4

4.3 Risk Assessment Results

The results of the risk assessments are provided in Appendix B. Appendix C shows the risks re-grouped by option. The latter form was used as input to the options analysis workshop.

The results are included as appendices only, because their primary purpose was as input to the options evaluation process described in the remainder of this report.

5 Options Evaluation Workshop

5.1 Participants

The one and a half day options evaluation workshop was held in Whitehorse, YK on July 20 and 21, 2011. The following individuals participated in the workshop:

Yukon Government:	Frank Patch
	Stephen Meade
	Patricia Randell
AANDC:	Kriss Sarson (AANDC Yukon Region)
	Jason Berkers (AANDC Yukon Region)
	Lou Spagnuolo (AANDC HQ)
LSCFN:	Robert Moar
	Leta Blackjack
	Bill Slater
Technical Consultants:	Justin Stockwell (Lorax Environmental Services)
SRK representatives:	Dirk van Zyl and Daryl Hockley (workshop facilitator).

Members of the Technical Advisory Committee of the LSCFN met in a separate room and the three representatives above consulted with them throughout the development of the options analysis.

5.2 Options Analysis Process

Over the last two years, the three governments had developed a set of closure objectives for the Mount Nansen site. These are provided in Appendix D.

A series of statements was developed by SRK to rephrase the closure objectives in a manner that allowed easy tracking of agreement and disagreement. Table 1 shows the statements. The initial objectives and the rephrased statements are compared in Appendix E.

In the workshop, each group reviewed each statement as it applied to each of the tailings and waste rock closure options. The process included first reviewing the components of an option and then working in groups to determine responses to each statement. The options were "strongly disagree", "disagree", "neutral", "agree" and "strongly agree". Each group presented its assessment and a summary table was created. Items where there was significant differences of opinion were discussed, and groups were then given an opportunity to review their assessment. Groups were asked to keep notes of their deliberations about each option. Transcripts of those notes are provided in Appendix F.

To get a sense of priority amongst the various closure objectives, the groups were next asked to provide their opinions about the importance of each closure objectives to their stakeholders. The options were: "high importance", "medium high importance", "medium low importance" and "low importance".

Table 1: Statements Used to Evaluate Closure Options

1	This option will remove physical hazards to human safety
2	This option will minimize the risk of human exposure to contaminants
3	This option will minimize contamination of harvest animals and vegetation
4a	This option will minimize contamination of receiving waters
4b	This option will minimize erosion impacts on receiving water
5	This option will allow vegetation to return to natural succession
6	This option will support traditional land uses
7	This option will support other non-traditional land uses
8	This option will maximize job opportunities for LSCFN
9	This option will minimize adverse socio-economic effects on LSCFN and the local community
10	This option will maximize economic benefits to other Yukoners/northerners
11	This option will minimize long-term maintenance requirements
12	This option is financially practicable
13	This option is technically feasible

The workshop participants were then next asked to provide individual rankings of the options. To further examine individual preferences, the participants were asked to select one of the following statements for each option: "this is one of my favourite options", "this is not my favourite but I would accept it", and "this option would be unacceptable to me". The individual assessments were intended only to validate the workshop process by confirming that individuals agreed with the general sentiment of their group ratings.

5.3 Options Analysis Results

The final results of the group assessments of each option are shown in Tables 2 to 7. For ease of comparison, Tables 8 and 9 show all of the options analysis results on one page.

Table 10 summarizes the opinions of the importance of each objective to each group. The outcomes of the individual ranking are shown in Appendix G.

As noted above, the individual rankings were only intended to validate the workshop process. Tables 2 to 9, showing the group ratings, received much more careful deliberation and review, and should therefore be considered the definitive results of the options assessment.

Table 2: Evaluation of Option 1a

Objective		LSCFN	YG	AANDC	Notes
1	This option will remove physical hazards to human safety	Disagree	Disagree	Agree	LSCFN - Open pit is still there over long term. Installation of liner on dam face is also risky. YG - Berm will mitigate but not remove long-term open pit, plus open water area on tailings impoundment. AANDC - Berms will reduce hazards.
2	This option will minimize the risk of human exposure to contaminants	Disagree	Agree	Agree	LSCFN - High risk of ongoing seepage. Spillway icing, permafrost thawing - earthquake causes of tailings releases. YG - Related the seepage and tailings release risks to receiving water than to human exposure. Little potential for human exposure. AANDC - Same as YG. Water cover reduces tailings exposure.
3	This option will minimize contamination of harvest animals and vegetation	Disagree	Agree	Agree	LSCFN - Concern about caribou and moose contacting tailings, as well as fish downstream. There will be a perception of contamination. YG - No pathways leadings to harvest animals. Also fish are well downstream. Tailings are covered. No vegetation pathways.
4a	This option will minimize contamination of receiving waters	Disagree	Neutral	Neutral	LSCFN - Risk assessment notes risk of tailings releases, risk that attenuation will be less than estimated. AANDC - Modeling indicates this is option has lower arsenic loadings. But waste rock still a source. YG - Although there are differences in the predicted water quality, residual risks of catastrophic failure remain and dominate YG's water quality concerns.
4b	This option will minimize erosion impacts on receiving water	Disagree	Neutral	Agree	LSCFN - Diversion and spillway construction and maintenance, and failure risk. AANDC - Water cover provides time for settling of sediments. Waste rock still there but far from receiving waters. YG - Diversion failure risk.
5	This option will allow vegetation to return to natural succession	Disagree	Disagree	Neutral	LSCFN - Pit still there and pond on tailings. AANDC - Pond will become wetland habitat. YG - No growth on dam itself. Aquatic habitat in pond would not be "natural succession"
6	This option will support traditional land uses	Disagree	Disagree	Neutral	LSCFN - Presence of tailings will discourage use of area. YG - Same. Perception of risk will restrict traditional land use. AANDC - Pond would support wildlife.

Objective		LSCFN	YG	AANDC	Notes
7	This option will support other non-traditional land uses	Neutral	Neutral	Agree	AANDC - Would allow re-processing of tailings, and access to pit. LSCFN - Community willingness to accept mining would not be resolved, so likelihood of a successful mine permit application is low. YG - Tailings are not a high value resource. Landform aesthetics would be a negative for other recreational land uses.
8	This option will maximize job opportunities for LSCFN	Disagree	Agree	Agree	LSCFN - This option would provide the least employment. Mostly small contractors for specialized work. YG - Job opportunities will largely be driven by implementation approach, rather than by total volume of work. More opportunities for long-term monitoring and maintenance work. AANDC - Agree there is less volume but the work requires less specialized equipment so that local opportunities would be greater.
9	This option will minimize adverse socio-economic effects on LSCFN and the local community	Disagree	Agree	Agree	LSCFN - Jobs would be short duration only, with higher potential for negative impacts on community. AANDC - Similar to above. YG - Agree that there are differences but don't think there will that much difference amongst the options.
10	This option will maximize economic benefits to other Yukoners/northerners	Disagree	Agree	Agree	LSCFN - Other options provide more economic benefits. YG - Less technically complex so might allow for more local opportunities. Local contractors might benefit from shorter time frame.
11	This option will minimize long-term maintenance requirements	Strongly Disagree	Disagree	Disagree	
12	This option is financially practicable	Disagree	Disagree	Agree	LSCFN - Risk of additional costs for shear key, and long-term monitoring and maintenance costs. AANDC - It is the lowest cost option. There is a long-term risk but low likelihood. There are cost risks but most can be mitigated in the design phase. YG - High risk of major cost consequence, likely to be incurred long after FCSAP funding is exhausted. Option might be lower in current estimate but uncertainties and possible cost over-runs overlap. Maintenance costs require institutional control over long term.
13	This option is technically feasible	Neutral	Neutral	Agree	YG - Long-term uncertainty about maintaining frozen conditions. Also concern about effectiveness of diffusion barrier. LSCFN - Also seepage flows.

Table 3: Evaluation of Option 1b

Objective		LSCFN	YG	AANDC	Notes
1	This option will remove physical hazards to human safety	Agree	Neutral	Strongly Agree	All parties agree that filling of the pit reduces hazards to human health. LSCFN - Still a risk associated with installation of liner. YG - And on remaining pit wall. AANDC - Remaining pit wall will have a berm.
2	This option will minimize the risk of human exposure to contaminants	Disagree	Agree	Agree	
3	This option will minimize contamination of harvest animals and vegetation	Disagree	Agree	Agree	
4a	This option will minimize contamination of receiving waters	Disagree	Neutral	Agree	AANDC - Modeling indicates a significant reduction in cadmium and zinc concentrations. LSCFN - Agree it is better than 1a, but still concern about long-term risks.
4b	This option will minimize erosion impacts on receiving water	Disagree	Neutral	Agree	
5	This option will allow vegetation to return to natural succession	Disagree	Neutral	Neutral	
6	This option will support traditional land uses	Disagree	Disagree	Neutral	
7	This option will support other non-traditional land uses	Neutral	Neutral	Agree	
8	This option will maximize job opportunities for LSCFN	Neutral	Agree	Agree	LSCFN - More work moving waste rock, likely available to LFCSN citizens. Also possible capacity development that could be carried forward to other projects. YG - Agrees but still thinks that differences are in range of uncertainties in implementation. AANDC - Agree.
9	This option will minimize adverse socio-economic effects on LSCFN and the local community	Neutral	Agree	Agree	LSCFN - More work moving waste rock, likely available to LFCSN citizens. Also possible capacity development that could be carried forward to other projects.
10	This option will maximize economic benefits to other Yukoners/northerners	Neutral	Agree	Agree	LSCFN - More work moving waste rock, likely available to LFCSN citizens. Also possible capacity development that could be carried forward to other projects.
11	This option will minimize long-term maintenance requirements	Strongly Disagree	Disagree	Disagree	
12	This option is financially practicable	Disagree	Disagree	Agree	YG - High risk of major cost consequence, likely to be incurred long after FCSAP funding is exhausted. Option might be lower in current estimate but uncertainties and possible cost over-runs overlap. Maintenance costs require institutional control over long term.
13	This option is technically feasible	Neutral	Neutral	Agree	

Table 4: Evaluation of Option 2a

Objective		LSCFN	YG	AANDC	Notes
1	This option will remove physical hazards to human safety	Disagree	Disagree	Agree	See 1a
2	This option will minimize the risk of human exposure to contaminants	Disagree	Agree	Agree	See 1a
3	This option will minimize contamination of harvest animals and vegetation	Disagree	Neutral	Agree	YG - Vegetated cover on tailings could attract animals and lead to increase in contaminant uptake.
4a	This option will minimize contamination of receiving waters	Disagree	Neutral	Neutral	See 1a
4b	This option will minimize erosion impacts on receiving water	Disagree	Neutral	Neutral	AANDC - Greater likelihood of erosion from soil cover. LSCFN - Also discussed this but it didn't change rating.
5	This option will allow vegetation to return to natural succession	Disagree	Disagree	Agree	AANDC - Tailings are now revegetated. YG - Agree with respect to tailings, but pit and waste rock areas would not reach natural succession. LSCFN - Also discussed this but concluded that there still wouldn't be natural succession.
6	This option will support traditional land uses	Disagree	Disagree	Neutral	See 1a
7	This option will support other non-traditional land uses	Neutral	Neutral	Agree	See 1a
8	This option will maximize job opportunities for LSCFN	Disagree	Agree	Agree	See 1a
9	This option will minimize adverse socio-economic effects on LSCFN and the local community	Disagree	Agree	Agree	See 1a
10	This option will maximize economic benefits to other Yukoners/northerners	Disagree	Agree	Agree	See 1a
11	This option will minimize long-term maintenance requirements	Strongly Disagree	Disagree	Disagree	See 1a
12	This option is financially practicable	Disagree	Disagree	Agree	See 1a
13	This option is technically feasible	Neutral	Disagree	Agree	YG - Would be difficult to maintain long-term saturation of cover, and at same time keep channel over cover. LSCFN - Also discussed this but did not change rating.

Table 5: Evaluation of Option 2b

Objective		LSCFN	YG	AANDC	Notes
1	This option will remove physical hazards to human safety	Agree	Neutral	Strongly Agree	See 1b
2	This option will minimize the risk of human exposure to contaminants	Disagree	Agree	Agree	See 1b
3	This option will minimize contamination of harvest animals and vegetation	Disagree	Neutral	Agree	YG - Vegetated cover on tailings could attract animals and lead to increase in contaminant uptake.
4a	This option will minimize contamination of receiving waters	Disagree	Neutral	Agree	See 1b
4b	This option will minimize erosion impacts on receiving water	Disagree	Neutral	Neutral	AANDC - Greater likelihood of erosion from soil cover. LSCFN - Also discussed this but it didn't change rating.
5	This option will allow vegetation to return to natural succession	Neutral	Neutral	Agree	AANDC - Tailings are now revegetated. YG - Same reason. LSCFN - Also discussed this but concluded that there still wouldn't be natural succession on tailings. However pit and waste rock areas are revegetated.
6	This option will support traditional land uses	Disagree	Disagree	Neutral	See 1b
7	This option will support other non-traditional land uses	Neutral	Neutral	Agree	See 1b
8	This option will maximize job opportunities for LSCFN	Neutral	Agree	Agree	See 1b
9	This option will minimize adverse socio-economic effects on LSCFN and the local community	Neutral	Agree	Agree	See 1b
10	This option will maximize economic benefits to other Yukoners/northerners	Neutral	Agree	Agree	See 1b
11	This option will minimize long-term maintenance requirements	Strongly Disagree	Disagree	Disagree	See 1b
12	This option is financially practicable	Disagree	Disagree	Agree	See 1b
13	This option is technically feasible	Neutral	Disagree	Agree	YG - Would be difficult to maintain long-term saturation of cover, and at same time keep channel over cover. LSCFN - Also discussed this but did not change rating.

Table 6: Evaluation of Option 3

Objective		LSCFN	YG	AANDC	Notes
1	This option will remove physical hazards to human safety	Agree	Agree	Agree	
2	This option will minimize the risk of human exposure to contaminants	Neutral	Agree	Neutral	
3	This option will minimize contamination of harvest animals and vegetation	Agree	Agree	Agree	
4a	This option will minimize contamination of receiving waters	Neutral	Neutral	Disagree	AANDC - This option has the worst water quality performance, plus there are relatively high risks associated with performance. YG and LSCFN agree with that rationale, but overall performance of options is similar.
4b	This option will minimize erosion impacts on receiving water	Neutral	Agree	Neutral	YG - Risk is primarily during the tailings transfer, but would be short term.
5	This option will allow vegetation to return to natural succession	Disagree	Neutral	Neutral	LSCFN - Some area on tailings will remain unvegetated, where we want water to infiltrate. AANDC - There will be some vegetation on the tailings and partial revegetation on the waste. YG - Large area of waste rock is not entirely revegetated.
6	This option will support traditional land uses	Agree	Agree	Agree	
7	This option will support other non-traditional land uses	Agree	Agree	Neutral	AANDC - Removal of trails and roads would limit ATV access. Presence of tailings would limit future exploration. YG - Agree that future mining would be restricted. But public road will still provide opportunity for any other access to area, and mine footprint will be small. YG - Future mining would not be that limited because it would be underground access. New mill and tailings would be needed - better than before.
8	This option will maximize job opportunities for LSCFN	Strongly Agree	Agree	Strongly Agree	
9	This option will minimize adverse socio-economic effects on LSCFN and the local community	Agree	Agree	Agree	
10	This option will maximize economic benefits to other Yukoners/northerners	Strongly Agree	Agree	Strongly Agree	
11	This option will minimize long-term maintenance requirements	Neutral	Neutral	Neutral	YG - Requirement to inspect/maintain dam and spillway. Requirement to monitor tailings saturation and water in pit, waste rock seepage, and vegetation success. AANDC - Dam may not be classified as requiring long-term monitoring. YG - Long-term monitoring costs would be different that Option 4.

Objective		LSCFN	YG	AANDC	Notes
12	This option is financially practicable	Disagree	Agree	Disagree	AANDC - Cost and risk associated with slurry/blending operation and consolidation are high, leading to operational risk and a wide uncertainty in cost estimates that will persist even after design is advanced. YG - Agrees that there are cost uncertainties, but not enough to rule it out. Costs still remains within range of uncertainty in others. LSCFN - Agree with concerns about operational cost risks.
13	This option is technically feasible	Disagree	Neutral	Disagree	AANDC - Water volumes are uncertain. Slurrying, blending and consolidation are significant concerns, as is installation of cover on saturated base. Three to four year window might be questionable. LSCFN - Tailings can be moved, and risks get transformed to costs. Blending remains a challenge. YG - Agree that this has the highest degree of uncertainty. Could turn into Option 4 if it doesn't perform well.

Table 7: Evaluation of Option 4

Objective		LSCFN	YG	AANDC	Notes
1	This option will remove physical hazards to human safety	Strongly Agree	Agree	Strongly Agree	
2	This option will minimize the risk of human exposure to contaminants	Agree	Strongly Agree	Strongly Agree	
3	This option will minimize contamination of harvest animals and vegetation	Strongly Agree	Strongly Agree	Agree	
4a	This option will minimize contamination of receiving waters	Agree	Agree	Agree	
4b	This option will minimize erosion impacts on receiving water	Agree	Agree	Neutral	
5	This option will allow vegetation to return to natural succession	Strongly Agree	Agree	Agree	
6	This option will support traditional land uses	Agree	Strongly Agree	Agree	
7	This option will support other non-traditional land uses	Agree	Agree	Neutral	
8	This option will maximize job opportunities for LSCFN	Agree	Agree	Strongly Agree	
9	This option will minimize adverse socio-economic effects on LSCFN and the local community	Agree	Agree	Agree	
10	This option will maximize economic benefits to other Yukoners/northerners	Strongly Agree	Agree	Strongly Agree	
11	This option will minimize long-term maintenance requirements	Agree	Neutral	Agree	AANDC - Significantly less monitoring and maintenance than other versions.
12	This option is financially practicable	Agree	Agree	Disagree	AANDC - This is the most expensive option, even if it goes as planned. And there are cost risks associated with moving the tailings and constructing a liner.
13	This option is technically feasible	Agree	Agree	Neutral	AANDC - Concern about the tailings relocation process. Assumption of frozen tailings and winter construction could delay progress. Long-term water balance is also a concern.

Table 8: Summary of Evaluations by Option

Option 1a

	LSCFN	YG	AANDC
1	Disagree	Disagree	Agree
2	Disagree	Agree	Agree
3	Disagree	Agree	Agree
4a	Disagree	Neutral	Neutral
4b	Disagree	Neutral	Agree
5	Disagree	Disagree	Neutral
6	Disagree	Disagree	Neutral
7	Neutral	Neutral	Agree
8	Disagree	Agree	Agree
9	Disagree	Agree	Agree
10	Disagree	Agree	Agree
11	Strongly Disagree	Disagree	Disagree
12	Disagree	Disagree	Agree
13	Neutral	Neutral	Agree

Option 2a

	LSCFN	YG	AANDC
1	Disagree	Disagree	Agree
2	Disagree	Agree	Agree
3	Disagree	Neutral	Agree
4a	Disagree	Neutral	Neutral
4b	Disagree	Neutral	Neutral
5	Disagree	Disagree	Agree
6	Disagree	Disagree	Neutral
7	Neutral	Neutral	Agree
8	Disagree	Agree	Agree
9	Disagree	Agree	Agree
10	Disagree	Agree	Agree
11	Strongly Disagree	Disagree	Disagree
12	Disagree	Disagree	Agree
13	Neutral	Disagree	Agree

Option 3

	LSCFN	YG	AANDC
1	Agree	Agree	Agree
2	Neutral	Agree	Neutral
3	Agree	Agree	Agree
4a	Neutral	Neutral	Disagree
4b	Neutral	Agree	Neutral
5	Disagree	Neutral	Neutral
6	Agree	Agree	Agree
7	Agree	Agree	Neutral
8	Strongly Agree	Agree	Strongly Agree
9	Agree	Agree	Agree
10	Strongly Agree	Agree	Strongly Agree
11	Neutral	Neutral	Neutral
12	Disagree	Agree	Disagree
13	Disagree	Neutral	Disagree

Option 1b

	LSCFN	YG	AANDC
1	Agree	Neutral	Strongly Agree
2	Disagree	Agree	Agree
3	Disagree	Agree	Agree
4a	Disagree	Neutral	Agree
4b	Disagree	Neutral	Agree
5	Disagree	Neutral	Neutral
6	Disagree	Disagree	Neutral
7	Neutral	Neutral	Agree
8	Neutral	Agree	Agree
9	Neutral	Agree	Agree
10	Neutral	Agree	Agree
11	Strongly Disagree	Disagree	Disagree
12	Disagree	Disagree	Agree
13	Neutral	Neutral	Agree

Option 2b

	LSCFN	YG	AANDC
1	Agree	Neutral	Strongly Agree
2	Disagree	Agree	Agree
3	Disagree	Neutral	Agree
4a	Disagree	Neutral	Agree
4b	Disagree	Neutral	Neutral
5	Neutral	Neutral	Agree
6	Disagree	Disagree	Neutral
7	Neutral	Neutral	Agree
8	Neutral	Agree	Agree
9	Neutral	Agree	Agree
10	Neutral	Agree	Agree
11	Strongly Disagree	Disagree	Disagree
12	Disagree	Disagree	Agree
13	Neutral	Disagree	Agree

Option 4

	LSCFN	YG	AANDC
1	Strongly Agree	Agree	Strongly Agree
2	Agree	Strongly Agree	Strongly Agree
3	Strongly Agree	Strongly Agree	Agree
4a	Agree	Agree	Agree
4b	Agree	Agree	Neutral
5	Strongly Agree	Agree	Agree
6	Agree	Strongly Agree	Agree
7	Agree	Agree	Neutral
8	Agree	Agree	Strongly Agree
9	Agree	Agree	Agree
10	Strongly Agree	Agree	Strongly Agree
11	Agree	Neutral	Agree
12	Agree	Agree	Disagree
13	Agree	Agree	Neutral

Table 9: Summary of Evaluations by Organization

LSCFN

	1a	1b	2a	2b	3	4
1	Disagree	Agree	Disagree	Agree	Agree	Strongly Agree
2	Disagree	Disagree	Disagree	Disagree	Neutral	Agree
3	Disagree	Disagree	Disagree	Disagree	Agree	Strongly Agree
4a	Disagree	Disagree	Disagree	Disagree	Neutral	Agree
4b	Disagree	Disagree	Disagree	Disagree	Neutral	Agree
5	Disagree	Disagree	Disagree	Neutral	Disagree	Strongly Agree
6	Disagree	Disagree	Disagree	Disagree	Agree	Agree
7	Neutral	Neutral	Neutral	Neutral	Agree	Agree
8	Disagree	Neutral	Disagree	Neutral	Strongly Agree	Agree
9	Disagree	Neutral	Disagree	Neutral	Agree	Agree
10	Disagree	Neutral	Disagree	Neutral	Strongly Agree	Strongly Agree
11	Strongly Disagree	Strongly Disagree	Strongly Disagree	Strongly Disagree	Neutral	Agree
12	Disagree	Disagree	Disagree	Disagree	Disagree	Agree
13	Neutral	Neutral	Neutral	Neutral	Disagree	Agree

YG

	1a	1b	2a	2b	3	4
1	Disagree	Neutral	Disagree	Neutral	Agree	Agree
2	Agree	Agree	Agree	Agree	Agree	Strongly Agree
3	Agree	Agree	Neutral	Neutral	Agree	Strongly Agree
4a	Neutral	Neutral	Neutral	Neutral	Neutral	Agree
4b	Neutral	Neutral	Neutral	Neutral	Agree	Agree
5	Disagree	Neutral	Disagree	Neutral	Neutral	Agree
6	Disagree	Disagree	Disagree	Disagree	Agree	Strongly Agree
7	Neutral	Neutral	Neutral	Neutral	Agree	Agree
8	Agree	Agree	Agree	Agree	Agree	Agree
9	Agree	Agree	Agree	Agree	Agree	Agree
10	Agree	Agree	Agree	Agree	Agree	Agree
11	Disagree	Disagree	Disagree	Disagree	Neutral	Neutral
12	Disagree	Disagree	Disagree	Disagree	Agree	Agree
13	Neutral	Neutral	Disagree	Disagree	Neutral	Agree

AANDC

	1a	1b	2a	2b	3	4
1	Agree	Strongly Agree	Agree	Strongly Agree	Agree	Strongly Agree
2	Agree	Agree	Agree	Agree	Neutral	Strongly Agree
3	Agree	Agree	Agree	Agree	Agree	Agree
4a	Neutral	Agree	Neutral	Agree	Disagree	Agree
4b	Agree	Agree	Neutral	Neutral	Neutral	Neutral
5	Neutral	Neutral	Agree	Agree	Neutral	Agree
6	Neutral	Neutral	Neutral	Neutral	Agree	Agree
7	Agree	Agree	Agree	Agree	Neutral	Neutral
8	Agree	Agree	Agree	Agree	Strongly Agree	Strongly Agree
9	Agree	Agree	Agree	Agree	Agree	Agree
10	Agree	Agree	Agree	Agree	Strongly Agree	Strongly Agree
11	Disagree	Disagree	Disagree	Disagree	Neutral	Agree
12	Agree	Agree	Agree	Agree	Disagree	Disagree
13	Agree	Agree	Agree	Agree	Disagree	Neutral

Table 10: Opinions on the Importance of Each Objective to Each Party

Objective		LSCFN	YG	AANDC
1	This option will remove physical hazards to human safety	Medium - High	High Importance	Medium - High
2	This option will minimize the risk of human exposure to contaminants	High Importance	High Importance	High Importance
3	This option will minimize contamination of harvest animals and vegetation	High Importance	High Importance	Medium - High
4a	This option will minimize contamination of receiving waters	High Importance	High Importance	High Importance
4b	This option will minimize erosion impacts on receiving water	Medium - High	Medium - High	Medium - High
5	This option will allow vegetation to return to natural succession	High Importance	Medium- Low	Medium- Low
6	This option will support traditional land uses	High Importance	Medium - High	Medium - High
7	This option will support other non-traditional land uses	Low Importance	Medium - High	Medium- Low
8	This option will maximize job opportunities for LSCFN	Medium - High	Medium - High	Medium - High
9	This option will minimize adverse socio-economic effects on LSCFN and the local community	Medium- Low	Medium - High	Medium - High
10	This option will maximize economic benefits to other Yukoners/northerners	Medium - High	Medium - High	Medium - High
11	This option will minimize long-term maintenance requirements	Medium - High	High Importance	Medium - High
12	This option is financially practicable	Medium - High	Medium - High	High Importance
13	This option is technically feasible	High Importance	High Importance	Medium - High

Prepared by

Daryl Hockley, P.Eng.

Corporate Consultant

All data used as source material plus the text, tables, figures, and attachments of this document have been prepared in accordance with generally accepted professional engineering and environmental practices.

6 References

Lorax Environmental, 2011. "Mount Nansen Options for Closure", Prepared for Assessment and Abandoned Mines Branch, Department of Energy, Mines and Resources, Government of Yukon.

Appendices

APPENDIX A – Risk Assessment Methodology

Appendix A-1: Risk Rating Tools

Appendix A-2: Consequence Severity Matrix

Appendix A-3: Likelihood Terminology

Appendix A-4: Risk Matrix

Appendix A-1: Risk Rating Tools

The risk rating method employs the three charts on the following pages.

The "Consequence-Severity Matrix" lists various types of negative outcomes, and classifies their severity from "Low" to "Critical". The matrix shown here is taken from the INAC-CSP guidance.

The "Likelihood" chart defines a series of terms used to define the likelihood that a consequence (from the previous chart) will be realized. The columns of the table give examples to guide the selection of the appropriate term.

The "Risk Matrix" assigns each combination of severity and likelihood to a "risk" level. Different parties will place different priorities on each level of "risk".

Appendix A-2: Consequence Severity Matrix

Consequence Categories	Very Low	Minor	Moderate	Major	Critical
1. Environmental Impact	No impact.	Minor localized or short-term impacts.	Significant impact on valued ecosystem component.	Significant impact on valued ecosystem component and medium-term impairment of ecosystem function.	Serious long-term impairment of ecosystem function.
2. Special Considerations	Some disturbance but no impact to traditional land use.	Minor or perceived impact to traditional land use.	Some mitigatable impac to traditional land use.	Significant temporary impact to traditional land use.	Significant permanent impact on traditional land use.
3. Legal Obligations	Informal advice from a regulatory agency.	Technical/Administrative non-compliance with permit, approval or regulatory requirement. Warning letter issued.	Breach of regulations, permits, or approvals (e.g. 1 day violation of discharge limits). Order or direction issued.	Substantive breach of regulations, permits or approvals (e.g. multi-day violation of discharge limits). Prosecution.	Major breach of regulation – wilful violation. Court order issued.
4. Consequence Costs	< $100,000	$100,000 - $500,000	$ 500,000 - $2.5 Million	$2.5-$10 Million	>$10 Million
5. Community/ Media/ Reputation	Local concerns, but no local complaints or adverse press coverage.	Public concern restricted to local complaints or local adverse press coverage.	Heightened concern by local community, criticism by NGOs or adverse local /regional media attention.	Significant adverse nationa public, NGO or media attention.	Serious public outcry/demonstrations or adverse International NGO attention or media coverage.
6. Human Health and Safety	Low-level short-term subjective symptoms. No measurable physical effect. No medical treatment.	Objective but reversible disability/impairment and /or medical treatment injuries requiring hospitalization.	Moderate irreversible disability or impairment to one or more people.	Single fatality and /or severe irreversible disability or impairment to one or more people.	Multiple fatalities.

Appendix A-3: Likelihood Terminology

Likelihood	Descriptor 2	Frequency Descriptor	Probability of occurrence over twenty years	Probability of occurrence in any one year
Almost Certain	Happens often	High frequency (more than once every 5 years)	98%	17.8%
Likely	Could easily happen	Event does occur, has a history, once every 15 years	75%	6.7%
Possible	Could happen and has happened elsewhere	Occurs once every 40 years	40%	2.5%
Unlikely	Hasn't happened yet but could	Occurs once every 200 years	10%	0.5%
Very Unlikely	Conceivable, but only in extreme circumstances	Occurs once every 1000 years	2%	0.1%

Appendix A-4: Risk Matrix

Likelihood	Consequence Severity				
	Low	Minor	Moderate	Major	Critical
Almost Certain	Moderate	Moderately High	High	Very High	Very High
Likely	Moderate	Moderate	Moderately High	High	Very High
Possible	Low	Moderate	Moderately High	High	High
Unlikely	Low	Low	Moderate	Moderately High	Moderately High
Very Unlikely	Low	Low	Low	Moderate	Moderately High

APPENDIX B: Risk Assessments Results

Appendix B-1: Tailings in Options 1a and 2a

Appendix B-2: Tailings in Options 2a and 2b

Appendix B-3: Waste Rock and Pit in Options 1a and 2a

Appendix B-4: Waste Rock Backfilled into Pit in Options 1b and 2b

Appendix B-5: Wet Tailings in Pit

Appendix B-6: Dry Tailings in Pit

Appendix B-7: Common Elements

Appendix B-1: Tailings in Options 1a and 2a

B1	Tailings in Options 1a and 2a					
		Consequence		Likelihood	Risk Rating	NOTES
		Type	Severity	Probability	Descriptive	
1	Flooding causes erosion of the spillway inlet and loss of tailings material into Victoria Creek	Env. Imp.	Moderate	Possible	Moderately High	Do we know the flood event required to cause this? Current design has erosion protection on inflow but not at outlet. Could be less severe if tailings volume is small.
2	Degradation of permafrost below shear key is not detected or repaired, in combination with earthquake, causing liquefaction and ultimately leading to settlement of dam crest, breach and release of about 1/3 of tailings to Victoria Creek.	Env. Imp.	Major	Unlikely	Moderately High	If permafrost is "almost certain" to degrade, then likelihood is driven only by what level of earthquake is needed to liquefy zone of degraded permafrost. But there will be monitoring of thermosyphon performance. Thermosyphons are expected to work for 60-70 years under linearilly increasing climate. Then soil would take some additional time to thaw.
2		Conseq. Costs	Major	Unlikely	Moderately High	Cost for cleanup of spilled tailings PLUS cost of stabilizing the remaining tailings. Could go into the Extreme category.
3	Spillway blockage by ice leading to overtopping breach of dam and release of about 1/3 of tailings	Env. Imp.	Major	Possible	High	There is an option to use the current diversion as a secondary spillway, bu not in the current design. There is 1 m of freeboard that may store some freshet flows - need to check that and reduce likelihood if storage is significant.
3		Conseq. Costs	Major	Possible	High	Cost for cleanup of spilled tailings PLUS cost of stabilizing the remaining tailings. Could go into the Extreme category.
4	Flood event greater than design event, either due to flood being large or design event being incorrectly estimated, leading to breach and release of 1/3 of tailings.	Env. Imp.	Major	Very Unlikely	Moderate	Current design is for 1:10,000 flood.
5	Earthquake greater than design event leading to breach and release of about 1/3 of tailings.	Env. Imp.	Major	Very Unlikely	Moderate	
6	Piping along abutments or possibly related to spillway, above level where toe berm filter is constructed, resulting in breach and release of about 1/3 of tailings.	Env. Imp.	Major	Very Unlikely	Moderate	Gradients do not increase significantly above the current situation. There is some additional mitigation from the repair of the liner on the dam face.
7	Degradation of permafrost below shear key is detected and leads to a requirement to adopt alternative stabilization measures.	Conseq. Costs	Major	Possible	High	A number of factors could lead to a requirement to adopt alternative measures, including climate change, excessive seepage, other factors discovered in detailed investgation or design.
8	Climate change results in tailings becoming dry and releasing acidity.	Env. Imp.	Minor	Very Unlikely	Low	Humidity cells remain neutral after one year of testing, so tailings would need to be exposed for many years.
9	Seepage quantity is higher than expected causing increase in loading to downstream environments, leading to exceedance of downstream water quality objectives.	Env. Imp.	Minor	Unlikely	Low	Localized exceedance of water quality objectives only.
10	Contaminant concentrations in seepage are higher than expected, leading to exceedance of downstream water quality objectives.	Env. Imp.	Moderate	Unlikely	Moderate	Root cause is a loss of contaminant attenuation and/or a change in contaminant source term. Senisitivity analyses show possibility of exceedances in winter low flow conditions.
		Conseq. Costs	Moderate	Unlikely	Moderate	A range of mitigation costs is conceivable, including active treatment with higher costs that would rate as Major-Very Unlikely.
11	Contaminant concentrations in water cover are higher than expected, not addressed, and dicharged into creek.	Env. Imp.	Moderate	Unlikely	Moderate	Root cause is diffusion layer not functioning properly or change in source term. Water quality in current pond is much better than seepage quality, even without the diffusion barrier. But re-routing of Dome Creek will increase flows, meaning that loadings could go up even if concentrations do not increase. How it is built needs to be addressed in feasibility design.
12	Difficulty in constructing the upstream liner in the tailings beach.	Conseq. Costs	Moderate	Possible	Moderately High	Bill reports that people who worked on the original construction say that there is a liner in place, so this activity might not be necessary. Water treatment cost is not included in current design.
12		Human H&S	Major	Very Unlikely	Moderate	Needs to be dealt with in further design and planning.
13	Spillway failure leads to requirement for replacement of armouring	Conseq. Costs	Minor	Possible	Moderate	Current cost estimate for ditch protection does not indicate that it will be built for long term.

Appendix B-2: Tailings in Options 2a and 2b

B2	Tailings in Options 2a and 2b	Consequence		Likelihood	Risk Rating	NOTES
		Type	Severity	Probability	Descriptive	
1	Flooding causes erosion of the spillway inlet and loss of tailings material into Victoria Creek	Env. Imp.	Moderate	Very Unlikely	Low	Surface channel across tailings is armoured.
2	Degradation of permafrost below shear key is not detected or repaired, in combination with earthquake, causing liquefaction and ultimately leading to settlement of dam crest, breach and release of about 1/3 of tailings to Victoria Creek.	Env. Imp.	Moderate	Unlikely	Moderate	Consequence is lower than in Option 1 because there is no pond to drive the outflow and breach. (If permafrost is "almost certain" to degrade, the likelihood is driven only by what level of earthquake is needed to liquefy zone of degraded permafrost. But there will be monitoring of thermosyphon performance. Thermosyphons are expected to work for 60-70 years under linearilly increasing climate. Then soil would take some additional time to thaw.)
2		Conseq. Costs	Major	Unlikely	Moderately High	(Cost for cleanup of spilled tailings PLUS cost of stabilizing the remainin tailings. Could go into the Extreme category.)
3	Spillway blockage by ice leading to overtopping breach of dam and release of about 1/3 of tailings	Env. Imp.	Major	Possible	High	There are differences from Option 1 but not enough to change categories. (There is an option to use the current diversion as a secondary spillway, but not in the current design. There is 1 m of freeboard that may store some freshet flows - need to check that and reduce likelihood if storage is significant.)
3		Conseq. Costs	Major	Possible	High	Cost for cleanup of spilled tailings PLUS cost of stabilizing the remaining tailings. Could go into the Extreme category.
4	Flood event greater than design event, either due to flood being large or design event being incorrectly estimated, leading to breach and release of 1/3 of tailings.	Env. Imp.	Major	Very Unlikely	Moderate	Current design is for 1:10,000 flood.
5	Earthquake greater than design event leading to breach and release of about 1/3 of tailings.	Env. Imp.	Moderate	Very Unlikely	Low	Lower consequence than Option 1 because there is no pond to drive breach or tailings outflow.
6	Piping along abutments or possibly related to spillway, above level where toe berm filter is constructed, resulting in breach and release of about 1/3 of tailings.	Env. Imp.	Moderate	Very Unlikely	Low	Lower consequence than Option 1 because there is no pond to drive breach or tailings outflow. (Gradients do not increase significantly above the current situation. There is some additional mitigation from the repair of the liner on the dam face.)
7	Degradation of permafrost below shear key is detected and leads to a requirement to adopt alternative stabilization measures.	Conseq. Costs	Major	Possible	High	A number of factors could lead to a requirement to adopt alternative measures, including climate change, excessive seepage, other factors discovered in detailed investgation or design.
8	Climate change results in tailings becoming dry and releasing acidity.	Env. Imp.	Minor	Very Unlikely	Low	Even less likely than in Option 1, because soil cover would tend to remain wet. (Humidity cells remain neutral after one year of testing, so tailings would need to be exposed for many years.)
9	Seepage quantity is higher than expected causing increase in loading to downstream environments, leading to exceedance of downstream water quality objectives.	Env. Imp.	Minor	Unlikely	Low	Localized exceedance of water quality objectives only.
10	Contaminant concentrations in seepage are higher than expected, leading to exceedance of downstream water quality objectives.	Env. Imp.	Moderate	Very Unlikely	Low	Water overflows in channel rather in pond of Option 1, so less likely. (Root cause is a loss of contaminant attenuation and/or a change in contaminant source term. Sensitivity analyses show possibility of exceedances in winter low flow conditions.)
		Conseq. Costs	Moderate	Unlikely	Moderate	A range of mitigation costs is conceivable, including active treatment with higher costs that would rate as Major-Very Unlikely.
11	Contaminant concentrations in water flowing over soil cover are higher than expected, not addressed, and dicharged into creek.	Env. Imp.	Moderate	Unlikely	Moderate	Root cause is diffusion layer not functioning properly or change in source term. Water quality in current pond is much better than seepage quality, even without the diffusion barrier. But re-routing of Dome Creek will increase flows, meaning that loadings could go up even if concentrations do not increase. How it is built needs to be addressed in feasibility design.
12	Difficulty in constructing the upstream liner in the tailings beach.	Conseq. Costs	Moderate	Possible	Moderately High	Bill reports that people who worked on the original construction say that there is a liner in place, so this activity might not be necessary. Water treatment cost is not included in current design.
12		Human H&S	Major	Very Unlikely	Moderate	Needs to be dealt with in further design and planning.
13	Spillway failure leads to requirement for replacement of armouring.	Conseq. Costs	Minor	Possible	Moderate	Current cost estimate for ditch protection does not indicate that it will be built for long term.
14	Surface water escapes channel and erodes soil cover.	Conseq. Costs	Very Low	Possible	Low	Settlement of tailings creates distortions in channel and requires channel to be repaired.
15	Uptake of contaminants by vegetation.	Env. Imp.	Minor	Unlikely	Low	

Appendix B-3: Waste Rock and Pit in Options 1a and 2a

B3	Waste Rock and Pit in Options 1a and 2a					
		Consequence		Likelihood	Risk Rating	NOTES
		Type	Severity	Probability	Descriptive	
1	Degradation of water quality during and immediately after regrading of waste leading to increased contaminant in Dome Creek (or Pony).	Env. Imp.	Minor	Unlikely	Low	Movement of waste will expose surfaces that have not been flushed, leading to increases in contaminant concentrations in seepage, lasting for 5 years.
2	Contaminant source terms predictions higher than expected, no additional measures taken, deep groundwater pathway ultimately delivers higher than expected level of contaminants into receiving water.	Env. Imp.	Moderate	Unlikely	Moderate	Current predictions use conservative estimates of groundwater flow and seepage chemistry. Upper estimates in model runs show excedances of zinc and cadmium at least 50% of the year in Victoria Creek.
2		Conseq. Costs	Moderate	Unlikely	Moderate	This is less than the cost difference between the "a" options and the "b" options, under the assumption that incremental measures would be taken.
3	Pit lake water quality degrades over long term leading to risk of exposure.	Env. Imp.	Very Low	Possible	Low	No receptors that would contact the pit water directly. Outflow via groundwater is covered under scenario 2
4	Pit water level rises and hydraulic bulkhead fails, leading to release of water to Pony Creek and then to Victoria Creek.	Env. Imp.	Moderate	Very Unlikely	Low	Current design includes allowance for building hydraulic plug.
5	Vegetation islands do not propagate as planned, leading to need for additional measures.	Conseq. Costs	Minor	Likely	Moderate	
6	Uptake of contaminants in vegetation and then by wildlife.	Env. Imp.	Minor	Possible	Moderate	
7	Loss of life due to ATV or snow machine going over pit wall.	Human H&S	Major	Very Unlikely	Moderate	
8	Safety issues during pit backfill.	Env. Imp.	Very Low	Very Unlikely	Low	NOT RELEVANT IN THIS CASE
9	Dust dispersion during waste rock regrading.	Env. Imp.	Very Low	Likely	Moderate	Less of a concern than in relocation cases.

Appendix B-4: Waste Rock Backfilled into Pit in Options 1b and 2b

B4	Waste Rock backfilled into Pit in Options 1b and 2b					
		Consequence		Likelihood	Risk Rating	NOTES
		Type	Severity	Probability	Descriptive	
1	Degradation of water quality during and immediately after relocation of waste rock leading to increased contaminant in Dome Creek (or Pony).	Env. Imp.	Minor	Possible	Moderate	Longer period of time and higher volume increases risk in comparison to "a" options. Movement of waste will expose surfaces that have not been flushed, leading to increases in contaminant concentrations in seepage, lasting for 3-5 years.
2	Contaminant source terms predictions higher than expected, no additional measures taken, deep groundwater pathway ultimately delivers higher than expected level of contaminants into receiving water.	Env. Imp.	Moderate	Unlikely	Moderate	Deposition of waste rock into pits leads to a change in geochemical conditions that would lead to increased arsenic concentrations. But tailings are still by far the dominant source of arsenic. Waste rock accounts for a greater proportion of cadmium and zinc. Relocation of the waste rock to pit could change zinc and cadmium concentratins slightly, but the flux through pit is much less than through the pile, and pit lake water quality is already bad. Upper estimates in model runs show excedances of zinc and cadmium at least 50% of the year in Victoria Creek, very similar to "a" options.
2		Conseq. Costs	Moderate	Unlikely	Moderate	This is less than the cost difference between the "a" options and the "b" options, under the assumption that incremental measures would be taken. In this case covering the waste would be lower cost than water treatment.
3	Pit lake water quality degrades over long term leading to risk of exposure.	Env. Imp.	Very Low	Very Unlikely		NOT RELEVANT IN THIS CASE
4	Pit water level rises and hydraulic bulkhead fails, leading to release of water to Pony Creek and then to Victoria Creek.	Env. Imp.	Moderate	Very Unlikely	Low	Current design includes allowance for building hydraulic plug.
5	Vegetation islands do not propagate as planned, leading to need for additional measures.	Conseq. Costs	Minor	Likely	Moderate	Footprint of former waste rock area and backfilled pit.
6	Uptake of contaminants in vegetation and then by wildlife.	Env. Imp.	Minor	Possible	Moderate	
7	Loss of life due to ATV or snow machine going over pit wall.	Human H&S	Major	Very Unlikely	Moderate	Remaining pit slope would be much less.
8	Safety issues during pit backfill.	Human H&S	Major	Unlikely	Moderately High	Further stabilization or safe work processes to be defined during further design.
9	Dust dispersion during waste rock relocation.	Env. Imp.	Minor	Likely	Moderate	Needs further consideration during design.

Appendix B-5: Wet Tailings in Pit

B5	Wet tailings in Pit	Consequence		Likelihood	Risk Rating	NOTES
		Type	Severity	Probability	Descriptive	
1	Failure of the pumping or piping system leads to uncontrolled discharge to the environment.	Env. Imp.	Minor	Possible	Moderate	
2	Costs of controlling the dredging operation to achieve blended material are significantly higher than expected.	Conseq. Costs	Moderate	Likely	Moderately High	Wide range. Additional field control would only add $200,000, but a thickener could be $1,000,000.
3	Costs for treating water are greater than expected.	Conseq. Costs	Minor	Likely	Moderate	Current cost estimate is based on treating one porewater volume, but includes a significant capital cost.
4	Increase in seepage during dredging operation.	Env. Imp.	Moderate	Unlikely	Moderate	Seepage capture system is in place but sized for smaller flows.
5	Pond level increase to initiate dredging leads to dam failure.	Env. Imp.	Major	Very Unlikely	Moderate	Pond was drained to improve stability, but pond would only need to be raised for only a few weeks.
6	Risk of human fatality during dredging operation.	Human H&S	Major	Very Unlikely	Moderate	
7	Risk of fatality in the pit during dam construction, tailings deposition or tailings covering.	Human H&S	Major	Unlikely	Moderately High	
8	Tailings do not consolidate as rapidly as expected, and cover construction is delayed.	Conseq. Costs	Very Low	Likely	Moderate	90% consolidation could take up to 20 years, but it is logarithmic so much of it will happen in first year. There is allowance for cover maintenance, but could it be delayed enough to require remobilization. This has limited cost implications - mob costs only.
9	Poor consolidation during tailings deposition leads to delay in tailings relocation.	Conseq. Costs	Moderate	Likely	Moderately High	Could also be solved by a thickener.
10	Failure of pit wall dam over long term, leading to discharge of tailings.	Env. Imp.	Minor	Very Unlikely	Low	Dam would be founded on pit bedrock and constructed of waste rock with a liner on face. Waste rock is available for buttressing. Most of the time there would be no water available to push tailings out of pond. Tailings would not even reach Dome Creek valley.
11	Drought conditions lead to dry tailings and increased oxidation, leading to need to install Pony Creek diversion or other source of water.	Conseq. Costs	Minor	Possible	Moderate	
12	Blending of tailings is incomplete, leading to dry areas and higher oxidation, and deep groundwater pathway ultimately delivers higher than expected level of contaminants into receiving water.	Env. Imp.	Moderate	Unlikely	Moderate	Need blend of fine and coarse tailings to get desired soil moisture characteristics, so plan is to dredge fine and coarse and blend slurries. Slurry would then be deposited into pond. If tailings are dry, source concentrations would reach those of Option 4, but infiltration rates would be much higher.
13	Higher rates of contaminant sources, loading and/or transport are detected and additional mitigation measures are taken.	Conseq. Costs	Moderate	Possible	Moderately High	Range of mitigation measures are conceivable, with different costs associated with different times of detection.
14	Leakage around Adit Plug discharges contaminated water to Pony Creek.	Env. Imp.	Moderate	Very Unlikely	Low	Plan includes additional adit plug
15	Complete failure leads to release of tailings and water to Pony Creek.	Env. Imp.	Moderate	Very Unlikely	Low	Plan includes additional adit plug
16	Water overflowing to Pony Creek carries contamination from tailings.	Env. Imp.	Minor	Unlikely	Low	Outflow is only expected under extreme wet years.
17	Tailings remain saturated as predicted, but some combination of contaminant concentrations, flowrates, and attenuation leads to contaminant loadings to Dome Creek that are higher than predicted.	Env. Imp.	Moderate	Unlikely	Moderate	Source terms are conservative. Groundwater flowrates through pit are uncertain. Attenuation may be less than assumed.
17		Conseq. Costs	Major	Unlikely	Moderately High	Assumes nothing is done until problem is in the environment. But then water would be collecetd from pit and treated.
18	Volume of contaminated soils below tailings is greater than expected.	Conseq. Costs	Minor	Possible	Moderate	Assumes six inches of soil will be moved to the pit and that the contaminates will be contained in the organic layer. May be more optimizing of pit volume and dam height. ~350,000 for half a meter; this material is not intended to be moved by dredge.

Appendix B-6: Dry Tailings in Pit

B6	Dry Tailings in Pit	Consequence		Likelihood	Risk Rating	NOTES
		Type	Severity	Probability	Descriptive	
1	Spillage of tailings along haul routes.	Env. Imp.	Very Low	Likely	Moderate	
2	Costs of the excavation operation is higher than expected.	Conseq. Costs	Moderate	Possible	Moderately High	Assumption is that freezeback will create traffic layer that trucks can run on.
3	Costs for treating water are greater than expected.	Conseq. Costs	Minor	Unlikely	Low	Much less water than Option 3.
4	Increase in seepage during dredging operation.	Env. Imp.	Very Low	Very Unlikely		NOT RELEVANT IN THIS CASE
5	Pond level increase to initiate dredging leads to dam failure.	Env. Imp.	Very Low	Very Unlikely		NOT RELEVANT IN THIS CASE
6	Risk of human fatality during excavation operation.	Human H&S	Major	Very Unlikely	Moderate	
7	Risk of fatality in the pit during dam construction, tailings deposition or tailings covering.	Human H&S	Major	Unlikely	Moderately High	
8	Tailings do not consolidate as rapidly as expected, and cover construction is delayed.	Conseq. Costs	Very Low	Possible	Low	Less water than Option 3.
9	Unfrozen conditions lead to increased costs of depositing tailings into pit.	Conseq. Costs	Minor	Possible	Moderate	
10	Failure of pit wall plug over long term, leading to discharge of tailings.	Env. Imp.	Very Low	Very Unlikely	Low	Waste rock in this Option 3 forms a wide plug that would be even more stable than the Option 3 dam.
11	Drought conditions lead to dry tailings and increased oxidation, leading to need to install Pony Creek diversion or other source of water.	Conseq. Costs	Very Low	Very Unlikely		NOT RELEVANT IN THIS CASE
12	Blending of tailings is incomplete, leading to dry areas and higher oxidation, and deep groundwater pathway ultimately delivers higher than expected level of contaminants into receiving water.	Env. Imp.	Very Low	Very Unlikely		NOT RELEVANT IN THIS CASE
13	Higher rates of contaminant sources, loading and/or transport are detected and additional mitigation measures are taken.	Conseq. Costs	Moderate	Very Unlikely	Low	This is rated very unlikely because of difficulty in detecting problems, and lack of immediately available mitigation measures other than collection and treatment (see Scenario 17).
14	Leakage around Adit Plug discharges contaminated water to Pony Creek.	Env. Imp.	Moderate	Very Unlikely	Low	Plan includes additional adit plug
15	Complete failure leads to release of tailings and water to Pony Creek.	Env. Imp.	Very Low	Very Unlikely		NOT RELEVANT IN THIS CASE
16	Water overflowing to Pony Creek carries contamination from tailings.	Env. Imp.	Very Low	Very Unlikely		NOT RELEVANT IN THIS CASE
17	Relocation and covering perform as predicted, but some combination of contaminant concentrations, flowrates, and attenuation leads to contaminant loadings to Dome Creek that are higher than predicted.	Env. Imp.	Moderate	Unlikely	Moderate	Tailings are assumed to go acidic. Source terms are thought to be conservative. Groundwater flowrates through pit are uncertain. Attenuation may be less than assumed.
17		Conseq. Costs	Major	Unlikely	Moderately High	Assumes nothing is done until problem is in the environment. But then water would be collecetd from pit and treated.
18	Volume of contaminated soils below tailings is greater than expected.	Conseq. Costs	Minor	Possible	Moderate	Assumes six inches of soil will be moved to the pit and that the contaminates will be contained in the organic layer. May be more optimizing of pit volume and dam height. ~350,000 for half a meter; this material is not intended to be moved by dredge.
19	Cover needs to be replaced at some point in future.	Conseq. Costs	Moderate	Possible	Moderately High	

Appendix B-7: Common Elements

B7	Common Elements						
		Consequence		Likelihood	Risk Rating	NOTES
		Type	Severity	Probability	Descriptive	
1	Other sources of additional contamination to Dome Creek.	Env. Imp.	Very Low	Very Unlikely	NOT RATED	Contaminant loadings in Dome Creek are already high belwo mill; tailing and pit area add relatively little. Possible sources above or around mill include Heustis Adit, unknown buried adit, and historic tailings below mill. Potential sources during remediation also include contamination released by mill demolition.

APPENDIX C: Risk Assessments for Each Option

Appendix C-1: Risk matrix for Option 1a

Appendix C-2: Risk matrix for Option 1b

Appendix C-3: Risk matrix for Option 2a

Appendix C-4: Risk matrix for Option 2b

Appendix C-5: Risk matrix for Option 3

Appendix C-6: Risk matrix for Option 4

Appendix C-1: Risk matrix for Option 1a

Likelihood	Consequence Severity				
	Very Low	Minor	Moderate	Major	Critical
Almost Certain					
Likely	a.9E	a.5c			
Possible	a.3E	1.1C, 1.13C, a.6E	1.1E, 1.12C	1.3E, 1.3C, 1.7C	
Unlikely		1.9E, a.1E	1.10E, 1.11E, 1.10C, a.2E, a.2C	1.2E, 1.2C	
Very Unlikely		1.8E	a.4E	1.4E, 1.5E, 1.6E, 1.12S, a.7S	

Appendix C-2: Risk matrix for Option 1b

Likelihood	Consequence Severity				
	Very Low	Minor	Moderate	Major	Critical
Almost Certain					
Likely		b.5C, b.9E			
Possible		1.1C, 1.13C, b.1E, b.6E	1.1E, 1.12C	1.3E, 1.3C, 1.7C	
Unlikely		1.9E	1.10E, 1.11E, 1.10C, b.2E, b.2C	1.2E, 1.2C, b.8S	
Very Unlikely	b.3E	1.8E	b.4E	1.4E, 1.5E, 1.6E, 1.12S, B.7S	

Appendix C-3: Risk matrix for Option 2a

Likelihood	Consequence Severity				
	Very Low	Minor	Moderate	Major	Critical
Almost Certain					
Likely	a.9E	a.5C			
Possible	2.14C, a.3E	2.13C, a.6E	2.12C	2.3E, 2.3C, 2.7C	
Unlikely		2.9E, 2.15E, a.1E	2.2E, 2.10E, 2.10C, a.2E, a.2C	2.2C	
Very Unlikely		2.8E	2.1E, 2.5E, 2.6E, 2.11E, a.4E	2.4E, 2.12S, a.7S	

Appendix C-4: Risk matrix for Option 2b

Likelihood	Consequence Severity				
	Very Low	Minor	Moderate	Major	Critical
Almost Certain					
Likely		b.5S, b.9E			
Possible	2.14C	2.13C, b.1E, b.6E	2.12C	2.3E, 2.3C, 2.7C	
Unlikely		2.9E, 2.15E	2.2E, 2.10E, 2.10C, b.2E, b.2C	2.2C, b.8S	
Very Unlikely	b.3E	2.8E	2.1E, 2.5E, 2.6E, 2.11E, b.4E	2.4E, 2.12S, b.7S	

Appendix C-5: Risk matrix for Option 3

Likelihood	Consequence Severity				
	Very Low	Minor	Moderate	Major	Critical
Almost Certain					
Likely	3.8C, a.9E	3.3C, a.5C	3.9C		
Possible		3.1E, 3.11C, 3.18C, a.6E	3.2C, 3.13C		
Unlikely		3.4E, 3.16E, a.1E	3.12E, 3.17E, a.2E, a.2C	3.7S, 3.17C	
Very Unlikely		3.10E	3.14E, 3.15E	3.5E, 3.6S	

Appendix C-6: Risk matrix for Option 4

Likelihood	Consequence Severity				
	Very Low	Minor	Moderate	Major	Critical
Almost Certain					
Likely	4.1E				
Possible	4.8C	4.9C, 4.18C	4.2C, 4.19C		
Unlikely		4.3C	4.17E	4.7S, 4.17C	
Very Unlikely	4.10E		4.13C, 4.14E	4.6S	

APPENDIX D – Mount Nansen Closure Objectives

Mt. Nansen Mine Closure Project Objectives

The following closure objectives were established by Yukon Government (GY), Government of Canada (Indian and Northern Affairs Canada (INAC), Environment Canada (EC) and Department of Fisheries and Oceans (DFO)), and Little Salmon Carmacks First Nation (LSCFN).

1. **Protect human health and safety.**

LSCFN

- People using the area will be safe from remaining mine hazards.
- Animals, plants and berries around the mine site are safe to harvest and will stay that way.
- Water at mine site and downstream will be as clean and safe for people to use.
- Mine dust will not be able to build up on plants and soils in years to come so that people are safe.

GY

- Protect human health and safety.

INAC

- Reduce, mitigate and eliminate, where possible and financially practical, risk to human health and safety.

2. **Protect and restore the environment including land, air, water, as well as fish and wildlife and their habitats.**

LSCFN

- People and animals using the area will be safe from remaining mine hazards.
- Water at the mine site, in the ground, and downstream will be as clean and safe as possible for the health of animals, plants and bugs.
- Mine dust will not be able to build up on plants and soils in years to come to make the health of plants, animals and soils better.
- Restore the land and water so that plants and animals can live there in the way they did before the mine.

GY

- Reduce and mitigate current and future negative environmental impacts.
- Protect ground water and surface water quality.
- Ensure the protection of and restore to the extent possible, aquatic and terrestrial habitat. Reclamation conducive to natural regeneration where practical.

INAC

- Reduce, mitigate and eliminate, where possible and financially practical, risk to environmental health.

DFO

- Reduce the risk of current and future impacts from the Mt. Nansen mine on the aquatic resources and fish habitat to support healthy, productive fish populations in the Victoria/Nisling watershed.
- The valley of Dome Creek should be reclaimed to the extent practicable, to ensure physical stability and reduce the risk of transport of particulate matter to Victoria Creek.

EC

- Adverse impacts of surface and groundwater from the site are reduced to the extent possible and otherwise do not alter the value of the receiving environment.

3. Return Mine Site to an acceptable state that reflects original, traditional and pre-mining land use.

LSCFN

- Quality of water at mine site and downstream will be as clean and safe as possible so it will not limit traditional use. - Move to 2
- The opportunity for traditional uses of the area will be restored and as close to before mining use as possible.
- Make the clean up so good that, as the years go by, we will not have to do much work at the minesite to keep it clean and safe. – Move to 5

GY

- Return land to an acceptable state that doesn't inhibit future land use.
- Ensure the protection of and restore to the extent possible, aquatic and terrestrial habitat. Reclamation conducive to natural regeneration where practical.

INAC

- Return mine site to an acceptable state that reflects original use where possible and financially practical.

4. Maximize local, Yukon and First Nation benefits.

LSCFN

- Local people will be hired to help clean up at the mine. The economic development chapter of the LSCFN Final Agreement should be followed.

GY

- Provide economic opportunities for Little Salmon Carmacks First Nation members, Carmacks area residents and Yukoners in general.

INAC

- To maximize the social and economic benefits that may accrue to First Nations, and northerners when carrying out activities.

5. Manage risk in a cost effective manner.

GY

- Reduce long term risk in a cost effective manner.
- Design of reclamation to minimize to the extent possible, long-term maintenance activity at the site.

INAC

- Reduce federal liability for this site in the long term.
- Reduce long term site risk in a practical and cost effective manner.

APPENDIX E – Rephrased Objectives

	Rephrased Mt. Nansen Closure Objectives LSCFN: Little Salmon Carmacks First Nation GY: Yukon Government INAC: Indian and Northern Affairs Canada DFO: Department of Fisheries and Oceans EC: Environment Canada	Remove Physical Hazards to Human Safety	Minimize the Risk of Human Exposure to Contaminants	Minimize Contamination of Animals and Vegetation	Minimize Contamination of Receiving Waters	Minimize Erosion Impacts on Receving Water	Allow Vegetation to Return to Natural Succession	Technically Practicable	Financially Practicable	Minimize Long-Term Maintenance Requirement	Maximize Economic Benefits to Other Yukoners/ Northerners	Maximize Job Opportunities for LSCFN	Allow for Other Land Uses	Support Traditional Land Uses
1. Protect human health and safety														
LSCFN	People using the area will be safe from remaining mine hazards	✓	✓											
	Animals, plants and berries around the mine site are safe to harvest and will stay that way			✓										
	Water at mine site and downstream will be as clean and safe for people to use				✓	✓								
	Mine dust will not be able to build up on plants and soils in years to come so that people are safe.	✓	✓	✓										
GY	Protect human health and safety	✓	✓											
INAC	Reduce, mitigate and eliminate, where possible and financially practical, risk to human health and safety	✓	✓					✓	✓					
2. Protect and restore the environment including land, air, water, as well as fish and wildlife and their habitats.														
LSCFN	People and animals using the area will be safe from remaining mine hazards	✓	✓	✓										
	Water at the mine site, in the ground and downstream will be clean and safe as possible for the health of animals, plants and bugs			✓	✓	✓								
	Mine dust will not be able to build up on plants and soils in years to come to make the health of plants, animals and soils better			✓										
	Restore the land and water so that plants and animals can live there in the way they did before the mine			✓	✓	✓								✓
GY	Reduce and mitigate current and future negative environmental impacts			✓	✓	✓								
	Protect groundwater and surface water quality				✓	✓								
	Ensure the protection of and restore to the extent possible, aquatic and terrestrial habitat. Reclamation conducive to natural regeneration where practical						✓	✓	✓					
INAC	Reduce, mitigate and eliminate, where possible and financially practical, risk to environmental health			✓	✓	✓		✓	✓					
DFO	Reduce the risk of current and future impacts from the Mt. Nansen mine on the aquatic resources and fish habitat to support healthy, productive fish populations in the Victoria/Nisling watershed			✓										
	The valley of Dome Creek should be reclaimed to the extent practicable, to ensure physical stability and reduce the risk of transport of particulate matter to Victoria Creek.				✓	✓		✓	✓					
EC	Adverse impacts of surface and groundwater from the site are reduced to the extent possible and otherwise do not alter the value of the receiving environment				✓	✓		✓	✓					
3. Return Mine Site to an acceptable state that reflects original, traditional and pre-mining land use.														
LSCFN	The opportunity for traditional uses of the area will be restored and as close to before mining use as possible													✓
GY	Return land to an acceptable state that doesn't inhibit future land use												✓	✓
	Ensure the protection of and restore to the extent possible, aquatic and terrestrial habitat. Reclamation conducive to natural regeneration where practical							✓	✓					✓
INAC	Return mine site to an acceptable state that reflects original use where possible and financially practical							✓	✓					✓
4. Maximize local, Yukon and First Nation benefits.														
LSCFN	Local people will be hired to help clean up at the mine. The economic development chapter of the LSCFN Final Agreement should be followed											✓		
GY	Provide economic opportunities for LSCFN members, Carmacks area residents and Yukoners in general										✓			
INAC	Maximize the social and economic benefits that may accrue to First Nations, and northerners when carrying out activities										✓			
5. Manage risk in a cost effective manner														
LSCFN	Make the clean up so good that, as the years go by, we will not have to do much work at the mine site to keep it clean and safe									✓				
GY	Reduce long term risk in a cost effective manner								✓	✓				
	Design of reclamation to minimize to the extent possible, long term maintenance activity at the site									✓				
INAC	Reduce federal liability for this site in the long term									✓				
	Reduce long term site risk in a practical and cost effective manner							✓	✓					

APPENDIX F – Participant Notes

From the workbench of:
Date:

Assumption: [illegible] vs [illegible]

(3-5)

YG Option 1a

1. Pit risk still present - open water on tailings area (thin ice in water) created

→ assume berm NOT fence - sided wall

-

2. Risks during construction working in tailings - mitigable & small scale - assume no risk to humans thru' contact

(- dust issues?) !!

3. Minimal contact through waste rock contact - vegetation limit - d/s creek browsing.

4a. Moderate risks identified due to [illegible] issues - most are unlikely to very unlikely, however, residual risk remains of catastrophic failure leading to significant effects attenuation issues

4b. Minor erosion during construction - acknowledged that in future likely to need significant construction - residual risk of dam failure

5. Water cover / open pit & vegetation islands - !!

From the workbench of:
Date:

6. Large flooded tailings area; open pit ⇒ physical restrictions & increased perception risk leading to reduced trad. use.

7. Landform aesthetic may influence rec use in long term reducing opps for local operators (tourism) etc. - hunting/trapping - even though access same & minimizing impacts future ~~imp~~ exploration same

(Perceived risk ⇒ greater jobs) *

8. Job opps materially driven by implementation approach (20% less person hours than 03 - could go neutral)

9. Impacts driven by implementation approach - schedule shorter but not significant enough)

10. Less technically complex but shorter term & lower requirements ⇒ mainly driven by implementation approach.

11. Maintain dam - frozen condition & spillway = thermosphere
Monitoring
Berms & warning barriers
Maintenance of water management structures - diffusion layer - aprons etc. cost higher & likelihood of major construction/replacement more likely.

From the workbench of:
Date:

12. Major uncertainty or cost issues related to short-term integrity & construction of liner issues → associated risks to institutional ability to pay in 100 yrs.

13. Tech uncertainty about our long term ability to maintain the frozen condition
- long term issues related to both physical integrity & performance of diffusion layer

→

Option #1A **Group** AANDC

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	AGREE	- BERMS AROUND PIT
2	This option will minimize the risk of human exposure to contaminants	AGREE	- TAILINGS COVERED
3	This option will minimize contamination of harvest animals and vegetation	AGREE	- COVER TAILINGS
4b	This option will minimize erosion impacts on receiving water	AGREE	- WASTE ROCK POTENTIAL LOW - WATER COVER ELIMINATES SEDIMENT IN ~~PIT~~ TAILINGS FACILITY
5	This option will allows vegetation to return to natural succession	NEUTRAL	- WASTE ROCK NOT COVERED - PIT WOULD NOT HAVE ANY VEGETATION
6	This option will support traditional land uses	~~AGREE~~ NEUTRAL *	- WASTE ROCK NOT COVERED - POND SUPPORTS WILDLIFE
7	This option will support other non-traditional land uses	~~STRONGLY~~ AGREE *	- TAILINGS CAN BE REPROCESSED
8	This option will maximize job opportunities for LSCFN	AGREE	- SHORTER TIMEFRAME - LOWER RESOURCE REQ'TS
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	AGREE	- SAME AS #8
10	This option will maximize economic benefits to other Yukoners/northerners	AGREE	- SAME AS #8
11	This option will minimize long-term maintenance requirements	DISAGREE	- THERMOSYPHONS (DAM MAINTENANCE), SPILLWAY, ETC - LITTLE/LOW MONITORING OF PIT/WASTE ROCK
12	This option is financially practicable	AGREE	- LOWEST COST -
13	This option is technically feasible	AGREE	- WATER BALANCE - THERMOSYPHONS

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a minize contamination of receiving waters NEUTRAL - WASTE ROCK POTENTIAL NOT ADDRESSED

Option 1(a) **Group** LSCFN

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	Disagree	- open pit - Dam liner installation
2	This option will minimize the risk of human exposure to contaminants	Disagree	- seepage - Failure + tailings outflow - Dam liner installation - pit pollution not addressed
3	This option will minimize contamination of harvest animals and vegetation	Disagree	- caribou + moose scratching drinking downstream - fish
4(a) 4(b)	This option will minimize erosion impacts on receiving water 4(a) 4(b)	Disagree Disagree	- High risks of tailings release due to ice blockage of spillways - mod high risk of failure due to earth - seepage not addressed fully - eliminated. - attenuation risk - diversion + spillway issues
5	This option will allows vegetation to return to natural succession	Disagree	Pit remains, Tailings area remains
6	This option will support traditional land uses	Disagree	Tailings in valley will discourage use
7	This option will support other non-traditional land uses	Neutral	- better for future mining - aesthetics poor - won't resolve controversy over mess which would promote mining ed.
8	This option will maximize job opportunities for LSCFN	~~strongly~~ disagree	This will be provide the minimum employment to LSCFN
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	Disagree	shorter term jobs
10	This option will maximize economic benefits to other Yukoners/northerners	~~strongly~~ Disagree	- other option clearly provide more economic benefits
11	This option will minimize long-term maintenance requirements	strongly Disagree	- Dam, thermosyphons, spillway, diversions, water monitoring make this the worst.
12	This option is financially practicable	Disagree	- Risk that rock caissons have to be installed already rated as mod to High - ongoing endless costs of monitoring + maintenance
13	This option is technically feasible	Neutral	- risk of thermosyphon failure, seepage ⇒ big cost risks

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

From the workbench of:
Date:

Option 1b

1- Pit gone, tailings in place
→except wall → mitigable

2- Same as before
+dust from regarding tailing,
+PPE mitigation

3- Minimal contact - with waste rock
→less due to placement
in pit.
+possible minimal through
seepage areas.

4a- Moderate ~~risks~~ risks identified - most are unlikely to very unlikely
catastrophic risks remain

4b, Minimal difference but performance remains

5, Is improved due to reveg on ~~soil~~ underlying material rather than waste rock enough

6, Our perception - filled pit but maybe perception driven by dam?

7. Not change

From the workbench of:
Date:

8. Same - few more dozens but not significant enough as 1a to change performance

9 Same as 1a - few changes " " " to change performance

10 → Same as 9

11 → Requirements driven by dam & tailings

12 ~~Different~~ No difference - cost risks remain same - same uncertainties on cost estimates based on performance driven by major cost risks over others

13. Same -

~~Better~~ Same -

Option #1B **Group** A AND C

Objective		Rating*	Notes
①	This option will remove physical hazards to human safety	STRONGLY AGREE	- BERM NEEDED ON ~~ONE~~ ONLY ONE PIT FACE
2	This option will minimize the risk of human exposure to contaminants	AGREE	
3	This option will minimize contamination of harvest animals and vegetation	AGREE	
4b	This option will minimize erosion impacts on receiving water	AGREE	
5	This option will allows vegetation to return to natural succession	NEUTRAL ~~AGREE~~	- ONLY POCKETS ON WASTE ROCK & WHERE IT WAS LOCATED
6	This option will support traditional land uses	NEUTRAL	- TAILINGS IS DRIVER MORE THAN TAILINGS
7	This option will support other non-traditional land uses	AGREE	- REDUCTION DUE TO FILLED PIT NOT SIGNIFICANT ENOUGH TO ADJUST RATING
8	This option will maximize job opportunities for LSCFN	AGREE	- NO SIGNIFICANT CHANGE FROM 1A
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	AGREE	- DITTO
10	This option will maximize economic benefits to other Yukoners/northerners	AGREE	- DITTO
11	This option will minimize long-term maintenance requirements	DISAGREE	- WASTE ROCK NOT LARGE COMPONENT OF MONITORING
12	This option is financially practicable	AGREE	- ——— | ——— COST RISK
13	This option is technically feasible	AGREE	- ——— ⌐ ——— TECHNICAL RISK

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

(4a) MINIMIZE CONTAMINATION OF RECEIVING WATER AGREE - MODELLING

Option 1B **Group** LSCFN

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	A	Dam liner installation Some remaining hazard @ pit
2	This option will minimize the risk of human exposure to contaminants	D	Risks re. failures Sepage flows, Dam liner installation
3	This option will minimize contamination of harvest animals and vegetation	D	Caribou + Moose @ tailings Fish d/s
4½	This option will minimize erosion impacts on receiving water	D	Diversion + spillway issues Potential erosion of tailings cover
5	This option will allows vegetation to return to natural succession	D.	Pond + Dam remain as disturbed area
6	This option will support traditional land uses	D.	Tailings in valley will discourage use.
7	This option will support other non-traditional land uses	N.	
8	This option will maximize job opportunities for LSCFN	N.	More opportunities re. WR relocation
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	N.	More potential for ~~real estate~~ business opportunities + capacity development
10	This option will maximize economic benefits to other Yukoners/northerners	N	see #8
11	This option will minimize long-term maintenance requirements	SD	Dam, thermosiphons, spillway, tailings cover
12	This option is financially practicable	D	See rationale re. 1A. Significant cost risk @ tailings Also, additional benefit from moving rock is small.
13	This option is technically feasible	N	Risks re Thermosiphons

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a option will minimize D
Contamination of receiving waters

Same issues as 1A esp seepage flows through toe key

But some improvmt re. Cd/Zn

From the workbench of:
Date:

Option 2a

- TEMPORAL CONSTRUCTION RISKS ⊖ LINER REPLACEMENT

1. PIT STILL OPEN - SLIGHTLY LESS STANDING WATER

2. WATER INGESTION ONLY IF WE GET POORER WQ THAN EXPECTED - VERY UNLIKELY.

3. INCREASE FREQUENCY OF WILDLIFE USE DUE TO WETLAND ⇒ UPTAKE FOR VEGETATION

4a. HIGHEST LOADINGS FOR ZINC AND CADMIUM + DIFFUSIONAL LAYER PERFORMANC + RESIDUAL DAM FAILURE RISK

b. SOIL COVER & WATER COVER ⇒ ↑↑ EROSION ISSUES MORE THAN COST → RESIDUAL DAM FAILURE

5. Ratio of pit/waste rock : tailings ⇒ 3x Open pit remains although tailings

6. Pit & dam ⇒ ↓↓ likelihood of restricted T.

7. Marginally better than 1a - not significant

8. → Implementation Plan
→ long-term monitoring opp. - revegetation efforts.

9- Implementation planning.

10- " "

11- Dam, spillways, diversion, environmental monitoring.

From the workbench of:
Date:

12 - Cost consequences.
- certain that there will be a future req for future action d.o. a cost risks.
- institutional risks → cov. ability to expend resources at an unknown time.

13 - - Dam → permafrost erosion same as 1
- maintaining uniform saturation more difficult relying on permanence of the cover eg.

Option 2b

1. Pit risk removed
2. No change: 2a
3. Impacts of moving waste rock limited
4a. No change: 2a
4b. Minimal addition to waste rock relocation - not significant
5. No difference to 2a
6. Perceptual driver
7. Improvement due to pit & waste rock - not significant
8. A
11. No difference
10. A
12. D
13. D.

2a & 5
↓ D.5

Option # 2A **Group** AANDC

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	AGREE	- BERM AROUND PIT
2	This option will minimize the risk of human exposure to contaminants	AGREE	- CAP TAILINGS - WASTE ROCK STILL PRESENT (BUT [redacted] NOT BIG CONTRIBUTION)
3	This option will minimize contamination of harvest animals and vegetation	AGREE	- POTENTIAL STILL EXISTS W/ WASTE ROCK ALTHOUGH LOW - THICKER COVER
4b	This option will minimize erosion impacts on receiving water	NEUTRAL	- WASTE ROCK STILL AN ISSUE BUT FAR FROM WATER - TAILINGS COVER IS POTENTIAL ALTHOUGH VEGETATION SHOULD MINIMIZE - ARMOURED CHANNEL
5	This option will allows vegetation to return to natural succession	AGREE	- TAILINGS REVEGETATED - WASTE ROCK ONLY RECEIVES MINIMAL VEGETATION
6	This option will support traditional land uses	~~AGREE~~ NEUTRAL	- TAILINGS AND DAM STILL EVIDENT
7	This option will support other non-traditional land uses	AGREE	- PIT AVAILABLE FOR INVESTIGATION, TAILINGS COULD BE REPROCESSED - TRAILS / ROADS RECLAIMED
8	This option will maximize job opportunities for LSCFN	AGREE	- RELATIVELY HIGH EMPLOYMENT OPPORTUNITIES
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	AGREE	- SEE #8
10	This option will maximize economic benefits to other Yukoners/northerners	AGREE	- SEE #8
11	This option will minimize long-term maintenance requirements	DISAGREE	- DAM MAINTENANCE (THERMOSYPHONS) - COVER MAINTENANCE - PIT/WASTE ROCK SHOULD BE STABLE
12	This option is financially practicable	AGREE	- BIGGEST RISK IS DAM (COST) - LOW OVERALL COST
13	This option is technically feasible	AGREE	- HAS BEEN DONE AND CONTINUES TO BE DONE.

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a MINIMIZE CONTAMINATION OF RECEIVING [redacted] WATER NEUTRAL [redacted] - CADMIUM/ZINC HIGH (MODELING)

Option 2A **Group** LSCFN

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	D	Pit Hazard Hazard of Dam liner installation
2	This option will minimize the risk of human exposure to contaminants	D	Long term risks of exposure re: tailings in valley + dam risks
3	This option will minimize contamination of harvest animals and vegetation	D	Potential contamination risks re: "wetland" @ tailings
4b	This option will minimize erosion impacts on receiving water	D	Similar to 1A re erosion risks @ spillway + diversion
5	This option will allows vegetation to return to natural succession	D	pit + Tailings area remain affected → vegetation on tailings not likely to be "natural succession."
6	This option will support traditional land uses	D	still remaining perception + aesthetic issues that will affect traditional use.
7	This option will support other non-traditional land uses	N	
8	This option will maximize job opportunities for LSCFN	D	smallest employment requirements. similar to 1A
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	D	short term jobs
10	This option will maximize economic benefits to other Yukoners/northerners	D	See no. 8.
11	This option will minimize long-term maintenance requirements	SD	Dam, thermosyphons, spillway.
12	This option is financially practicable	D	Risks re: rock cuttings, long term maintenance costs
13	This option is technically feasible	N	Risks re: thermosyphons especially managing seepage flows through the key

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a This option will minimize contamination of receiving waters D

Concerns re: seepage from tailing, attenuation risks, pit W.Q not addressed.

Option 2B **Group** LSCFN

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	A	Most of Pit Hazard is gone some remaining hazard re: dam lines installation
2	This option will minimize the risk of human exposure to contaminants	D	Long term exposure re: tailings in valley + dam risks
3	This option will minimize contamination of harvest animals and vegetation	D	Potential Contamination re: "wetland" @ tailings
4	This option will minimize erosion impacts on receiving water	D	Similar to other options with dam in valley – concern re: spilling, diversion
5	This option will allows vegetation to return to natural succession	N	Pit will be revegetated. still concern re: "natural succession" in wetland
6	This option will support traditional land uses	D	Some impairment from 2A re: pit backfill, but ~~primary~~ primary issue of concern re: tailings in valley still relevant
7	This option will support other non-traditional land uses	N	
8	This option will maximize job opportunities for LSCFN	N	Waste rock relocation offers better opportunities
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	N	More opportunities for contracts that will bring capacity building
10	This option will maximize economic benefits to other Yukoners/northerners	N	
11	This option will minimize long-term maintenance requirements	SD	Dam, threnosyphons, spillway
12	This option is financially practicable	D	Risks re: rock caissons, long-term maintenance costs
13	This option is technically feasible	N	Risks re: threnosyphons, especially managing seepage flows through toe

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a This option will minimize Contamination of receiving water D. Concerns re: seepage from tailings, attenuation risks. WR in pit addresses cd/zn, but not enough to change category

Option #2B **Group** AANDC

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	STRONGLY AGREE	- PIT FILLED
2	This option will minimize the risk of human exposure to contaminants	AGREE	- WASTE ROCK NOT BIG CONTRIBUTION
3	This option will minimize contamination of harvest animals and vegetation	AGREE	- SAME AS #2
4b	This option will minimize erosion impacts on receiving water	NEUTRAL	- SAME AS #2
5	This option will allows vegetation to return to natural succession	AGREE	- WASTE ROCK NOT SIGNIFICANTLY
6	This option will support traditional land uses	NEUTRAL	- SAME AS #2
7	This option will support other non-traditional land uses	AGREE	- ALTHOUGH PIT IS FULL
8	This option will maximize job opportunities for LSCFN	AGREE	- SAME AS #2A OPTION
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	AGREE	— 1 —
10	This option will maximize economic benefits to other Yukoners/northerners	AGREE	— 2 —
11	This option will minimize long-term maintenance requirements	DISAGREE	— 1 —
12	This option is financially practicable	AGREE	— 1 —
13	This option is technically feasible	AGREE	— 1 —

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a MIN CONT AGREE - BETTER CD/N/ MODEL RESULTS

From the workbench of:
Date: July 20 2011 Klondike (YG)

Option 3

1 Pit lake & side walls + tailings pond

- hazards & risk during construction will be difficult to mitigate & pit walls (reduced) have been remediated to avoid HH&S risks in long term.
- risk is temporal & limited to construction period

2 Construction hazard to workers remains
- long term all sources of contamination mitigated - only exposure may occur if human drinks water that may be contaminated - very unlikely.
- construction risk related to health relies on inhalation / human contact - mitigated thru' PPE so assuming failure of worker controls

3 Risks 1/4/5/10/12/14/15/16/17
- Risks to environment fall midrange between options from the risk assessment
- ~~assuming~~ option has worst predicted water quality for most COC between options - assuming risks of COC showing in receiving env. drives contamination of animals & veg. ~~uptake is~~ minimal

From the workbench of: * Calibration Assumption

Date: pro 49

4b Over long term - stability & erosion of reclaimed valley minimal ; during construction and in the immediate post construction phase - risks remain of erosion.

≡ Strongly Agree → Agree due to temporal risk

- recognize smaller/limited risk due to removal/regrading of waste rock - no water involved & after construction, risks minimal → long distance to receiving aquatic environment

5. Valley bottom presents good opportunity for natural vegetation succession - risks remain due to 'unassisted' natural vegetative processes on waste rock pile - footprint of waste rock exceeds footprint of tailings footprint [50ha vs 15ha]

+

6. Physical barriers mainly removed

- habitat largely restored in the long term
- likelihood of aquatic impact to fish (Victoria Creek) is low
- mostly mitigated issues on plants/berries ∞ residual

From the workbench of:
Date:

issues (minimal) to wade rock productivity

Perception remains - maybe impacted by dam removal, but LSCFN is better placed to answer (spillway & new dam removes & pit still present ⇒ agree)

7. Only non-traditional use impacted likely to be future mineral usage ⇒ Strongly to Agree

8. Large number of labourers - but benefits to LSCFN will largely be effected by implementation approach meaning little difference options

9. Long schedules - less boom / bust
More likelihood of external labour which may impact socially & economically (both +ve/-ve)
- can establish implementation approaches to mitigate.

10. More likelihood of external labourers due to reaction but more local opps due to revegetation

From the workbench of:
Date:

11. Dam requires annual inspection
- Water levels require monitoring } may result in maintenance
- Significant monitoring of vegetation efforts ∴ possible need for additional work
- Long term env. monitoring required

12. Several (5) moderate cost risks remain which speaks to financial surety
- overall cost range between range is ± 30% of ~~the~~ cheapest rage - actual costs of each option fall within rage of (estimate accuracy + contingency).

13. Highest degree of uncertainty: tailings backfill → consolidation - behaviour of saturated tailings & sat levels
- ability to maintain saturation (which may lead to option 4)
- construction risks - volumes

Option #3 **Group** AANDC

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	AGREE	-SOME RESIDUAL RISK W/ PIT REMAINS - SOME ~~SIGNIFICANT~~ CONSTRUCTION H&S RISKS
2	This option will minimize the risk of human exposure to contaminants	NEUTRAL	- RISKS ASSOCIATED W/ PERFORMANCE (RELATIVELY HIGHER) - CURRENT HH RISKS ALREADY LOW
3	This option will minimize contamination of harvest animals and vegetation	AGREE	- REMOVES TAILINGS FROM VALLEY - RISKS ASSOCIATED W/ PERFORMANCE (RELATIVELY HIGHER) - NEUTRAL ON WASTE ROCK
4a	This option will minimize ~~erosion impacts~~ CONTAMINATION on receiving water	DISAGREE	- RISKS ASSOCIATED W/ PERFORMANCE (RELATIVELY HIGHER) - WORST WATER QUALITY PERFORMANCE MODELING
5	This option will allows vegetation to return to natural succession	~~AGREE~~ NEUTRAL*	- WASTE ROCK NOT COVERED - NO REVEGETATION OF TAILINGS COVER
6	This option will support traditional land uses	AGREE*	- VALLEY ~~RECLAMATION~~ RESTORED - WASTE ROCK NOT COVERED
7	This option will support other non-traditional land uses	~~DISAGREE~~ ~~NEUTRAL~~ NEUTRAL*	- TAILINGS IN PIT MAY LIMIT FURTHER EXPLORATION - REMOVAL OF TRAILS/ROADS LIMITS ACCESS
8	This option will maximize job opportunities for LSCFN	STRONGLY AGREE	- HIGHEST PY, LABOUR REQ'TS - MOST CONSISTENT WORK LOAD OVER Y YRS
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	AGREE	- BASED ON TIMELINE/RESOURCE REQ'TS
10	This option will maximize economic benefits to other Yukoners/northerners	STRONGLY AGREE	- SAME AS #8
11	This option will minimize long-term maintenance requirements	NEUTRAL	- POTENTIAL FOR LONG TERM MAINTENANCE OF VALLEY (AFTER RECLAMATION) - POTENTIAL FOR LONG TERM CONSOLIDATION ISSUES - CREATION OF A DAM W/ ASSOCIATED MAINTENANCE
12	This option is financially practicable	DISAGREE	- COSTS ASSOCIATION W/ CONSOLIDATION & SLURRY OPERATION AS PER RISK EVALUATION RISK & OPERATIONAL RISK VS DESIGN RISK (4 MODERATELY HIGH)
13	This option is technically feasible	DISAGREE	- WATER RECIRCULATION VOLUMES UNKNOWN - SLURRY + BLENDING - CONSOLIDATION (ADDITIONAL DAM ON NORTH END?) - COVER ON A SATURATED BASE WILL BE A CHALLENGE

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4b EROSION/SEDIMENT NEUTRAL - WASTE ROCK POTENTIAL REDUCED
- VALLEY HAS POTENTIAL FOR EROSION

Option 3 **Group** LSCFN

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	A	~~Risk re: [illegible]~~
2	This option will minimize the risk of human exposure to contaminants	N	~~Risk during [illegible]~~ Risk during tailings relocation Area subject to uptake is medium → re: plants + animals harvested
3	This option will minimize contamination of harvest animals and vegetation	A	Area subject to uptake is medium. LOADING to aquatic env. similar in all options - but risks higher for opt 3
4 b	This option will minimize erosion impacts on receiving water	N	Erosion re: valley restoration, but should be clean material.
5	This option will allows vegetation to return to natural succession	~~A~~ D	pit will remain un-revegetated. Risk re: duration for natural succession.
6	This option will support traditional land uses	A	Placing material back in pit will encourage traditional land use
7	This option will support other non-traditional land uses	A (Tr: d)	
8	This option will maximize job opportunities for LSCFN	SA	
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	A	Longer term job opportunities.
10	This option will maximize economic benefits to other Yukoners/northerners	SA	
11	This option will minimize long-term maintenance requirements	N	Retains maintenance requirements ~~re: in~~ re: pit facilities (spillway, dam). Also re: maintaining pit water balance.
12	This option is financially practicable	~~A~~ N	Operational risks that cannot be resolved by design.
13	This option is technically feasible	N ~~A~~	Potential risks re: tailings relocation by dredging.

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a This option will minimize contamination of receiving waters N — All options similar re: expected performance, but some risks. Sensitivity relatively minor.

Circular/system re: risks for mixing

Option 3 **Group** YG

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	Agree	(would be willing to go to neutral)
2	This option will minimize the risk of human exposure to contaminants	Agree	(could move to strongly agree)
(3)	This option will minimize contamination of harvest animals and vegetation	~~Neutral~~ Agree	
(4b)	This option will minimize erosion impacts on receiving water	Agree	
5	This option will allows vegetation to return to natural succession	Neutral	
6	This option will support traditional land uses	~~Agree~~	
7	This option will support other non-traditional land uses	Agree	
8	This option will maximize job opportunities for LSCFN	Agree	
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	Agree	
10	This option will maximize economic benefits to other Yukoners/northerners	Agree	
(11)	This option will minimize long-term maintenance requirements	~~Disagree~~ Neutral	
12	This option is financially practicable	Agree	
13	This option is technically feasible	Neutral	

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

(4a) Neutral

From the workbench of:
Date:

Option 4

1. Moderate, temporal - moderately high - temporal - S/T
All gone in long term - reduced from SA/A.

2. Minimum for removal & ~~moderate~~ moderate with risk that would be ~~have~~ compounded by someone ingesting in immediate receiving env.

3. Synthetic liner / removed tailings / very minimal exposed waste rock : some risk of uptake in Dore Creek but v. minimal

4a. Agree - recognize risk due to cover performance but related to unlikely and moderate.

b. Erosion / sediment during construction & in valley during reestablishment - construction is dry - mining waste rock & placing cover

5. Need cover maintenance to minimize deep rooting - large revegetation effort.

From the workbench of:
Date:

6. Reduced perception risks & maximised productive habitat

7. Slight aesthetic improvement but no change performance

8. 2nd highest labour requirements - increased light equipment requirement - longer schedule

9. Same as others

10. same as 8

11. No dams/spillways - additional cover monitoring - but like option 3 trading dam vs cover

12. Cost risks focus on temporal issues during construction - lower long term risks than dam-in-place

Logic about capital costs remains

13. Only issue is cover performance - harder to detect an issue but easier to respond.

Option #4 **Group** AANDC

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	STRONGLY AGREE	- PIT IS FULL
2	This option will minimize the risk of human exposure to contaminants	STRONGLY AGREE	- EXTENSIVE CAP
3	This option will minimize contamination of harvest animals and vegetation	AGREE	
4b	This option will minimize erosion impacts on receiving water	NEUTRAL	- VALLEY HAS POTENTIAL - WASTE ROCK STILL PRESENT
5	This option will allows vegetation to return to natural succession	AGREE	- PIT IS RECLAIMED ALTHOUGH WASTE ROCK STILL NOT 100%
6	This option will support traditional land uses	AGREE	- VALLEY RESTORED - WASTE ROCK STILL PRESENT
7	This option will support other non-traditional land uses	NEUTRAL	- TAILINGS + WASTE ROCK IN PIT
8	This option will maximize job opportunities for LSCFN	STRONGLY AGREE	- HIGHEST (2ND) PY EMPLOYMENT - RELATIVELY CONSISTENT EMPLOYMENT OVER 4 YRS
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	AGREE	
10	This option will maximize economic benefits to other Yukoners/northerners	STRONGLY AGREE	
11	This option will minimize long-term maintenance requirements	AGREE	- NO DAM - WATER BALANCE NOT A CONCERN
12	This option is financially practicable	DISAGREE	- HIGHEST COST - RISK OF MOVING FROZEN TAILINGS - POTENTIAL FOR FIXING LINER
13	This option is technically feasible	NEUTRAL	- RISK OF MOVING FROZEN TAILINGS

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

4a MIN CONTAMINATION ON RECEIVING WATER — AGREE — MODELING

Option 4 **Group** LSCFN

Objective		Rating*	Notes
1	This option will remove physical hazards to human safety	SA	Least hazard of all options – very minimal pit wall hazard.
2	This option will minimize the risk of human exposure to contaminants	A	Some hazard during relocation – short term
3	This option will minimize contamination of harvest animals and vegetation	SA	WQ similar on all. Some dust during relocation. Long-term – very minimal over cover.
4b	This option will minimize erosion impacts on receiving water	A	Only remaining risk is restored Stone Creek Channel.
5	This option will allows vegetation to return to natural succession	SA	Best chance of effective re-veg. Almost all area can be re-vegetated.
6	This option will support traditional land uses	A	similar to ~~option~~ option 3. ~~but~~
7	This option will support other non-traditional land uses	A	Similar to option 3.
8	This option will maximize job opportunities for LSCFN	A	~~Less~~ High work requirements + less specialized than option 3.
9	This option will minimize adverse socio-economic effects on LCFSN and the local community	A	Longer term job opportunities – see option 3.
10	This option will maximize economic benefits to other Yukoners/northerners	SA	My offer more opportunities than option 3 due to type of work (not dredging)
11	This option will minimize long-term maintenance requirements	A	Minimum requirements of all options → but still need ongoing monitoring
12	This option is financially practicable	A	Cost risks are smaller than option 3 + some can be addressed in design – e.g. relocation methods.
13	This option is technically feasible	A	Some technical challenges re: relocation, but this has been done.

*Rating choices are: **Strongly Agree - Agree - Neutral - Disagree - Strongly Disagree**

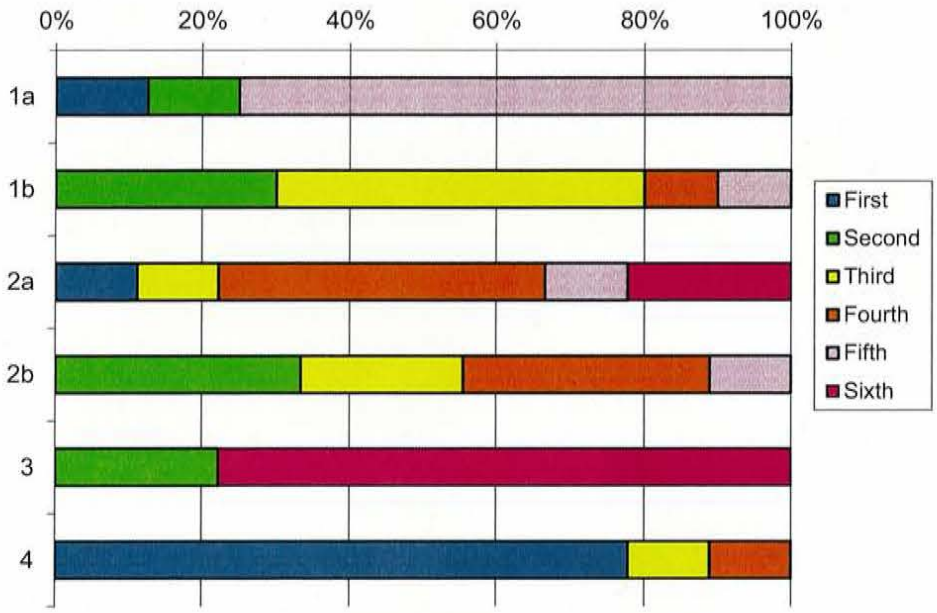
4a Option will minimize contamination of receiving water A

options all similar re expected performance, ~~Re~~ Option not very sensitive re: potential WQ risks. ∴ less risk

APPENDIX G – Individual Ranking of Options/Preference

Appendix G - Individual Ranking of Options/ Preferences

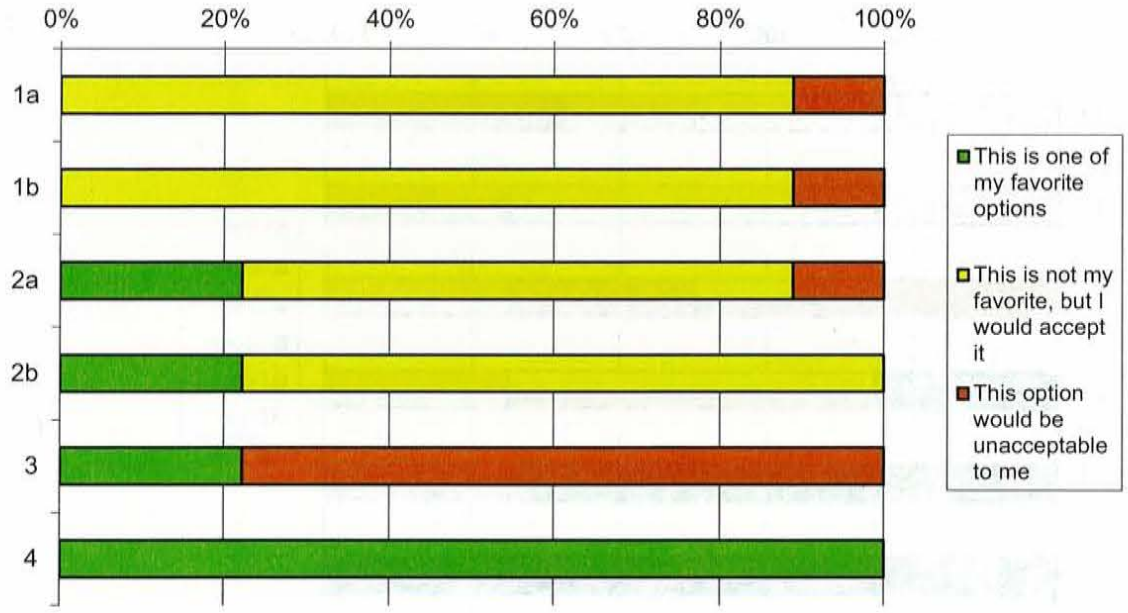
Individual Ranking of Options



Options	First	Second	Third	Fourth	Fifth	Sixth
1a	1	1	0	0	6	0
1b	0	3	5	1	1	0
2a	1	0	1	4	1	2
2b	0	3	2	3	1	0
3	0	2	0	0	0	7
4	7	0	1	1	0	0

Appendix G - Individual Ranking of Options/ Preferences

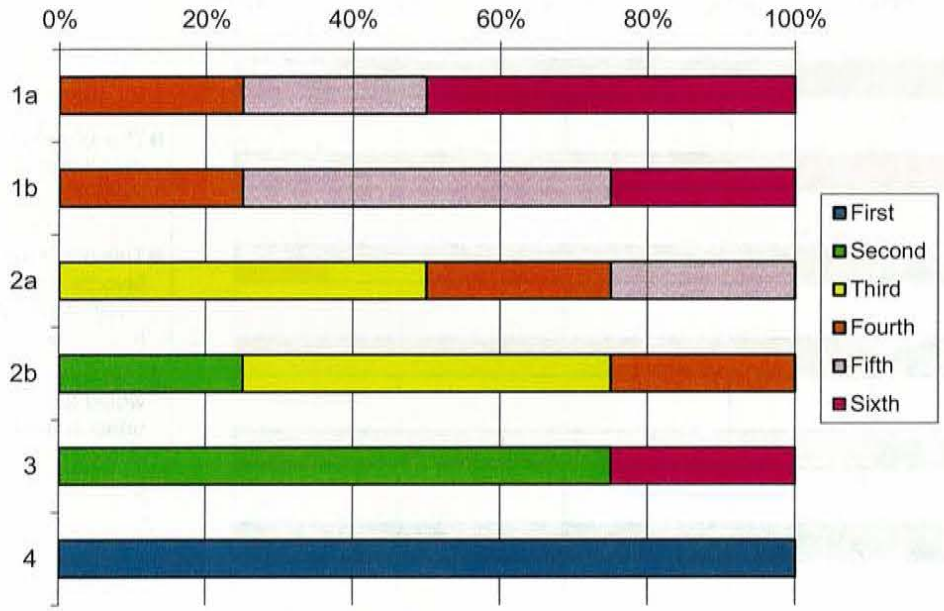
Individual Preferences



Options	This is one of my favorite options	This is not my favorite, but I would accept it	This option would be unacceptable to me
1a	0	8	1
1b	0	8	1
2a	2	6	1
2b	2	7	0
3	2	0	7
4	9	0	0

Appendix G - Individual Ranking of Options/ Preferences

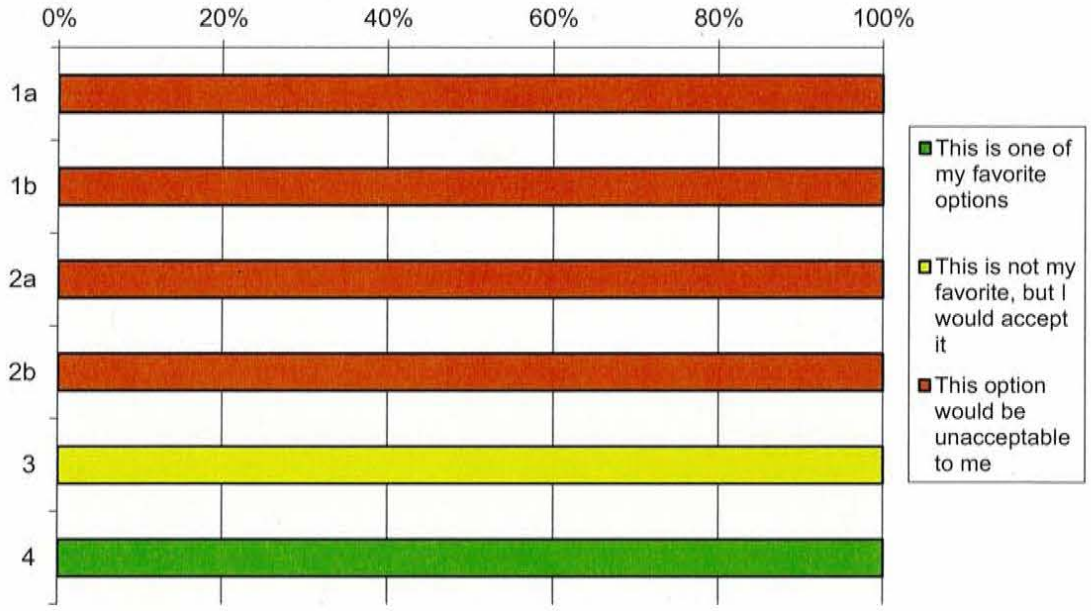
Individual Ranking of Options - LSCFN TAC



Options	First	Second	Third	Fourth	Fifth	Sixth
1a				1	1	2
1b				1	2	1
2a			2	1	1	
2b		1	2	1		
3		3				1
4	4					

Appendix G - Individual Ranking of Options/ Preferences

Individual Preferences - LCFSN TAC



Options	This is one of my favorite options	This is not my favorite, but I would accept it	This option would be unacceptable to me
1a			4
1b			4
2a			4
2b			4
3		4	
4	4		