



Giant Mine Remediation Project
PO Box 1500
Yellowknife, NT X1A 2R3

May 8, 2024

Working Group

RE: Climate Change Comment Response Table

Dear Working Group:

The Giant Mine Remediation Project (GMRP) provides the attached responses to comments from the Giant Mine Working Group received on the GMRP's climate projections report (Golder 2020). The GMRP received comments from three stakeholders:

- Alternatives North, received on June 26, 2023
- Giant Mine Oversight Board (GMOB), received on October 1, 2023
- Bill Slater and Core Geosciences, received on July 10, 2023

As discussed in the Working Group meetings, the GMRP acknowledges that it took some time to respond to comments. This is because new climate information came out in early 2023 and the analysis of the new information was relevant to the response to comments. Since the comments were received, the GMRP advanced its analyses on the new climate information for the Yellowknife area as part of the GMRP's climate continual improvement process. This process was presented to the Working Group in June 2023. As part of this process, two new climate-related documents are being drafted by one of the GMRP's design consulting teams, WSP Canada; these documents will be provided to Working Group once available:

- a) A data summary report of the climate projections in the 2022 Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) including the February 2023 regional climate projections for Canada (WSP 2024a).
- b) A review report comparing the designs of the engineered structures from the Closure and Reclamation Plan and Design Plans developed with the projections from the Fifth Assessment Report (AR5) against the updated AR6 projections (WSP 2024b).



The GMRP is pleased to advise that the results from the review demonstrate that the Project's design intent for engineered structures that store water or waste (e.g., sumps, spillways, Baker Creek) can be met under the updated climate predictions. This review process increased the GMRP's confidence that the designs filed with the Mackenzie Valley Land and Water Board will perform as intended. For designs that rely on temperature projections, the Freeze and the tailings containment area dams, an additional review is underway to confirm if the design intent can be met under updated climate predictions. The GMRP will share these two draft documents with the Working Group, once available. The original climate projection document Golder 2020 is not proposed to be edited as the precipitation projections that formed the basis of design are validated; as noted, the designs using temperature predictions are still under review.

The GMRP has provided response to comments including consideration of the results of these two new documents. The agenda for the May 2024 Working Group meeting is focused on the use of climate projections in the remediation designs. The GMRP looks forward to these upcoming discussions.

Should you have any questions or require any further information, please contact Natalie Plato, Deputy Director, by telephone at (867) 669-2838 or by email at Natalie.Plato@rcaanc-cirnac.gc.ca.

Sincerely,

Candace Ross
A/Deputy Director
Giant Mine Remediation Project

Encl. GMRP – GMRP Response to Comments on the Giant Mine Remediation Project's Climate Projection Report (Golder 2020)

Ref #	Reviewers	Reference	Comment / Recommendation	Response
1	Alternatives North		The project’s highest priority should be to conduct an assessment based exclusively on RCP 8.5 in IPCC AR6 as rapidly as possible, and that analysis comparing those assumptions to those in the current assessment should be made available to the Working Group in a timely manner.	The GMRP has prioritized analysis of updated climate information for use in remediation design engineering as follows: 1) The GMRP drafted an analysis of the AR6 climate predictions (WSP 2024a). 2) Subsequently, the GMRP reviewed the design of engineered structures for the Closure and Reclamation Plan and Design Plans originally completed using AR5 projections against AR6 projections (WSP 2024b). The draft conclusions of these documents will be presented in the May 2024 Working Group. Drafts of these two documents will be made available to Working Group..
2	Alternatives North		Are there specific examples where designing to RCP 2.6 or RCP 4.5 assumptions would require more significant accommodation for precipitation volumes in the site design, such as a higher freeboard or a deeper channel? Please provide examples. If any, how many such examples are there, and what fraction of the overall number of points of comparison do they represent? In what percentage of the total comparison would the RCP 8.5 precipitation assumptions represent greater volumes than either of the other two concentration pathways or the average of them which is used in the final report?	As noted in comment 1, the GMRP has reviewed the AR6 projections against the AR5 projections and found the designs can perform as intended. Therefore, no additional review of RCP (Representative Concentration Pathway) from AR5 is proposed. The GMRP proposes to discuss the topic of different pathways and how that might affect design (e.g., how many millimeters of freeboard differences does a climate projection make) during the May 2024 Working Group meeting. Drafts of these two documents will be made available to Working Group
3	Alternatives North		To update temperature assumptions, since the earlier work already uses RCP 8.5, updating the existing assessment should mostly involve a reasonably straightforward updating to any changed values between AR5 and AR6. For precipitation assumptions, an AR6 RCP 8.5 assessment should be begun, and the current framework should also be updated.	The GMRP agrees and has completed this work. See comment 1.
4	Alternatives North		Why did GMRP climate assumptions move away from being based on RCP 8.5 in 2018 to a different approach likely to provide more optimistic but less likely assumptions in 2020?	The GMRP did not change their climate assumptions to a different approach. The approach to climate remains the same as it has since remediation planning began, which is to design conservatively for future climate scenarios. For air temperature, Alternatives North is correct that RCP8.5 provides the most conservative temperature projection, and this was used in the approved Freeze Design. However, the most conservative precipitation projections are not necessarily from RCP 8.5. The GMRP examined multiple projections and return periods and chose what was necessary to achieve a conservative design for engineered structures that rely on precipitation information (e.g., sumps or Baker Creek).
5	Alternatives North		Updated precipitation data for AR6 have been available since February 2023, and other relevant details of AR6 have been available since 2022. Why has no work on updating assumptions based on AR6 yet begun?	The last comments from the June 2023 Working Group meeting were received in October 2023. The teams have been doing on-going analysis during this time. The May 2024 working group meeting is dedicated to discussion of updated climate information and design. As outlined in Comment 1, the GMRP drafted an analysis of the AR6 climate predictions and subsequently, reviewed the design of engineered structures for the Closure and Reclamation Plan and Design Plans originally completed using AR5 projections against AR6 projections. Drafts of these two documents (WSP 2024a, 2024b) will be provided to Working Group when available.
6	Alternatives North		In different aspects of the GMRP, we currently see three different approaches to climate assumptions being unevenly applied. This inconsistent approach suggests that the GMRP is not taking the single largest variable likely to impact project performance into account effectively.	The GMRP does not agree that climate approaches are unevenly applied and strongly disagrees that they are ineffective. The GMRP has worked with Rights holders and stakeholders over many years to discuss conservative approaches to both the freeze and Baker Creek designs. Different mathematical approaches were appropriately used in each to end up with conservative designs. The GMRP does not agree that all climate assumptions need to be identical for them to effectively account for climate effects on remediation (i.e., there is no one future climate scenario that should be used as the basis for every design.) Rather the GMRP put time and resources into developing defensible, conservative approaches appropriate for each project component, as the GMRP believes this is the most effective way to ensure conservative scenarios are considered for each component
7	Alternatives North		GMRP climate approach should be consistent across all aspects of the project, rather than applying differing expectations in different areas	
8	Alternatives North		Why are there differing climate assumptions for different aspects of the GMRP?	
9	Alternatives North		No precipitation study of the most likely climate pathway has been undertaken. Alternatives North requests clarification of the rationale supporting this decision.	The GMRP, following recommendations from the IPCC regarding AR5 projections (IPCC 2013) and AR6 projections (IPCC 2021) has treated all precipitation projections as equally probable and has provided precipitation information in Golder (2020) following the core set of models from the Coupled Model Intercomparison Project Phase 5 (CMIP5). (Refer to https://climate-scenarios.canada.ca/?page=cmip5-intro for more information on models).
10	Alternatives North		How many remediation design elements would be impacted by a changed set of precipitation assumptions? Which of them would have the largest impact on implementation costs? What is the proposed timeline for work to begin and be completed on the first of those changes, and on the largest of them?	Many engineering structures would be impacted by changes in precipitation assumptions (e.g. sumps, spillways, Baker Creek, water treatment plant pumps). The GMRP reviewed the design of engineered structures for the Closure and Reclamation Plan and Design Plans originally completed using AR5 projections against AR6 projections (WSP 2024b). Changes in precipitation assumptions are not anticipated to have a significant affect on the structures The GMRP does not understand the question about implementation costs but proposes opportunities for further discussion at the May 2024 Working Group meeting. Note that the draft conclusions from the review of AR5 versus AR6 (WSP 2024b) demonstrate that the Project’s design intent for engineered structures that store water or waste (e.g., sumps, spillways, Baker Creek) can be met under the updated climate predictions.
11	Alternatives North		The impact of utilizing RCP 8.5 temperature assumptions for the GMRP are most significant to the Freeze program.	Acknowledged. Please also see Alternatives North Comment 4.
12	Alternatives North		To fully meet the project’s needs, a Freeze Program climate assessment should also include a projected date range for the point where passive thermosyphons are most likely to require upgrading to active thermosyphons to maintain frozen shell integrity. Since we haven’t brought our climate expectations for temperature to that point yet, Alternatives North considers climate work relevant to the Freeze Program incomplete, but is grateful that the initial work thus far provides high confidence.	The action levels and contingencies to address the risk that the long term climate response projections are warmer than previously predicted projections are outlined in the Freeze Containment Design Plan and the Arsenic Trioxide MMP, which includes the timing to develop a mitigation strategy to convert thermosyphons to hybrids (with active power).
13	Alternatives North		In addition to defining when that freeze program upgrade is most likely to be necessary, we should also know: how much the upgrade to an active thermosyphon will cost in today’s dollars, how the site manager of that time will be expected to pay for it in the future economy, an analysis of potential risks to long term availability, for all necessary upgrade components, and a clear picture of how much energy active thermosyphons will require to operate.	
14	Alternatives North		It is also difficult to feel fully confident about designing to accommodate a once in 500 year rainfall event when rate of return conventions for rainfall classification prove increasingly inadequate... The precautionary principle should be applied here.	The GMRP agrees that precipitation events assumptions tend to be inadequate in the long term when their return period is based on historical data. For this reason, the GMRP has incorporated climate projections into each precipitation event used for designin precipitation and further addressed with freeboard and adaptive management. Together, this increased our confidence in designs.

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15	Alternatives North		Within any GMRP climate assessment, it is appropriate to consider assumptions at more than one time interval. The current climate assumptions offer projections for the 2050s and 2080s. Depending on whether the active remediation phase is completed within the projected schedule, this may provide projections of likely climate impacts as much as 50 years post remediation. This is insufficient. The GMRP has officially defined the first century after completion of the active remediation phase as the project's "short term."	Climate projections for the site are only available up to 2100. Uncertainty for meeting the closure criteria post 2100 is addressed through adaptive management as described in design plans. A qualitative assessment of climate change beyond 2100 is now provided in the draft AR6 data report (WSP2024a), which will be provided to Working Group. Note that from a regulatory perspective, the project is only approved for 100 years (MVEIRB 2013).
16	Alternatives North		Failure to acknowledge climate as a factor in financial considerations. None of Alternatives North's questions regarding assumptions in that report that lack an official rationale have thus far been answered. Concerns about failure to acknowledge climate in financial considerations have thus far remained unacknowledged and unaddressed.	The GMRP has met with Alternatives North on this topic and has provided descriptions of how climate change has been incorporated into design. The cost estimate for the Project provided to Working Group in 2021 is inclusive of these designs. The GMRP has also offered to support Alternative North should they have capacity to do additional economic analyses.
17	Alternatives North		Updated climate assessment using AR6 and RCP8.5 should be completed within three months and a detailed analysis be made available within six months.	The GMRP has prioritized analysis of updated climate information for use in remediation design engineering as follows: 1) The GMRP drafted an analysis of the AR6 climate predictions (WSP 2024a). 2) Subsequently, the GMRP reviewed the design of engineered structures for the Closure and Reclamation Plan and Design Plans originally completed using AR5 projections against AR6 projections (WSP 2024b). The draft conclusions of these documents will be presented in the May 2024 Working Group. Drafts of these two documents will be made available to Working Group.
18	Alternatives North		Alternatives North requests that an overview Completed Assessment, which evaluates the implication of tipping points (e.g., ice-free summer arctic, accelerated changes to upper atmosphere jet stream) as well as climate impacts to financial expectations for GMRP. This should be produced within six months, and a more detailed analysis, ideally with accompanying recommendations for accommodation, within no more than one year.	The GMRP does not intend to complete this analysis themselves as the focus is on getting final regulatory approvals and continuing with remediation activities such as construction of the new water treatment plant, which is key infrastructure for the project. The GMRP has offered to support Alternative North should they have capacity to do additional economic analyses.
19	Alternatives North		What is the approximate cost of conducting a new or updated climate assumptions assessment?	Costs specifics will not be provided to Working Group. The work was completed from 2023- through Spring 2024 and as noted in Comment 1, the draft reports will be provided to Working Group.
20	Alternatives North		On what date would sufficient remediation work related to precipitation management be completed under the current schedule that it might be considered "too late" to effectively accommodate any potentially updated assumptions?	The GMRP has drafted a report with the check of AR6 against AR5 projections (WSP 2024b). The analysis further confirms that the designs relying on precipitation projections filed with the Mackenzie Valley Land and Water Board (MVLWB) will perform as intended. The GMRP is proceeding with construction of these designs as approved by the MVLWB. The GMRP proposes to follow two processes to address potential future issues related to water management and engineered structures: 1) follow the climate process outlined to Working Group in June 2023 when monitoring data on site or new climate information suggests a concern, and 2) Follow the Design Plan action levels and contingencies which address if a structure is on the trajectory to not meet the closure criteria. Significant time and resources were spent with Rights holders and stakeholders developing design concepts, closure criteria and action levels and contingencies to adaptively address issues should they arise.
21	Alternatives North		Alternatives North and other parties have asked questions regarding climate assumptions frequently during the review of various design plans and monitoring and maintenance plans. Why was the GMRP's climate assumptions document completed in 2020 not made available in response to any of those questions prior to 2023?	The GMRP agrees and acknowledges that this 2020 climate projection report should have been distributed earlier and apologizes for not making this document available sooner. The GMRP assumed that the climate information provided during meetings about the underground, the effluent quality and the water management plan water model scenarios was sufficient. The GMRP thought it had heard from parties that they were more interested in design concept of engineered structures and the action levels if the structures were not performing as expected. The GMRP acknowledges and appreciates Alternatives North reinforcing the Project needs to provide more information about climate projections. The GMRP will improve on this in the future and will provide the draft climate reports (see Comment 1).
	GMOB			
22	GMOB	p.7, par.2 and 3	Climate change has been considered and discussed for the GMRP. However, these efforts and considerations have taken place in isolation and applied to specific plans or designs – representing a piecemeal approach. The new information released by the IPCC could fundamentally change the starting point and baseline assumptions that feed into a climate change risk assessment for the Giant Mine.	The GMRP does not agree that climate change considerations have been done in isolation or in a piecemeal approach. Further discussion is provided below in the response to GMOB.
23	GMOB	p.7, par.4	There seems to have been a step missed between the Project Team compiling climate data and discussing the implications, risks and adaptation/mitigation strategies with the Working Group.	The GMRP agrees in part and as noted in response to Alternative North Comment#21, the GMRP misinterpreted where interest from Working Group was coming from in relation to climate projections for design plans. That acknowledged, the GMRP is now actively sharing climate information and hosting multiple working group meetings on climate topics. The GMRP has also included climate information in annual reports. In addition, the GMRP has engaged extensively on climate-related considerations with respect to development of design. This includes discussions with Working Group on the temperature projections and use in the Freeze Design Plan. The GMRP has also engaged with Working Group, stakeholders and Rights holders, and the Aquatic Advisory Committee on precipitation related topics at a more conceptual level (flooding, ice, closure criteria etc.) and acknowledges that more detailed information on precipitation calculations could have been provided and will be provided in the future.
24	GMOB	p.7, par.5 (rec) p.8, par.2	The nature and way that information has been presented has contributed to an overall lack of clarity and transparency in the data itself and how it is being used. The Golder report was presented as a climate change assessment report, whereas it was actually a climate dataset specifically for the surface water design. The report was a compilation and analysis of available literature and online tools (indicated in the report itself) - no on-site observations were included in the Golder study.	The GMRP gives a high level of attention to climate information and climate change, and is very diligent in reporting on climate information. It is understood that the Golder 2020 report title could have caused confusion and the GMRP apologizes for this impact but instead climate is embedded in every document, each design, monitoring, water licence annual reporting, geotechnical inspections, and the Status of the Environment Report. The Closure and Reclamation Plan, the annual water licence report, the Status of the Environment and the GMOB Annual Report each contain information about on-site observations of climate. The GMRP can discuss this with Working Group in more detail at the May 2024 meeting.
25	GMOB	p.7, par.6	the Golder report for the Giant Mine and the MAC Guide were both being prepared simultaneously by Golder (report released in 2020 and Guide released in 2021). Furthermore, there may be a conflict of interest around the fact that Golder developed both the report and the methodology upon which the report is based.	Appendix B of Golder 2020 provides further details on the approach taken. The MAC Guidance was peer reviewed by multiple mining companies, research institutions and government as part of its development and WSP (formerly Golder Associates) suggest this is not a conflict of interest, but rather demonstrates the GMRP uses current advice and guidance from the Canadian mining sector as appropriate.

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26	GMOB	p.8, par.1	the 2020 Golder report only represents the first two activities for Stage 1 (developing a climate dataset) and not Stage 1 in its entirety as the project team implied during the call.	GMOB is correct, the climate data report (Golder 2020) only provides data calculations. As discussed in the June 2023 working group meeting, the next step after data amalgamation is to apply to design and then to have the design plan reviewed and then approved. This follows the required regulatory process with the MVLWB. The GMRP will discuss how the data to design steps come together with Working Group in more detail at the May 2024 meeting.
27	GMOB	p.9, par.2 (rec) p.13, b.p.1(d)	GMRP has committed to meaningful engagement with land rights holders, Indigenous stakeholders and the public (as outlined in the CRA Plan, the Engagement Plan and the QRA – see Appendix C). The information, studies and reports upon which the GMRP project team has based its assumptions and plans lack this important lens specifically around climate change. Traditional knowledge was not included or mentioned in either the AECOM or Golder report – either as a key source of data or an important lens in reviewing and validating this information over the long term. Recommendation: Including, incorporating and valuing Traditional Knowledge throughout the climate risk assessment process with meaningful and ongoing engagement with and participation from Indigenous leaders, knowledge-holders and community members.	The GMRP believes Traditional Knowledge has played a critical role in the Closure and Reclamation Plan and was given meaningful consideration. The Quantitative Risk Assessment (QRA) is also an example of how the project examined risks to the project with the extensive input from Rights holders and stakeholders; the QRA included a climate lens analysis. The closure criteria demonstrate how knowledge holder concerns about changes in climate were incorporated directly into design (e.g. Baker Creek being designed to the probable maximal flood including climate change and icing). The GMRP agrees that a technical calculation document for precipitation (Golder 2020) did not incorporate Traditional Knowledge and suggest that it is likely not an appropriate location to do so; the Closure and Reclamation Plan and the QRA were the appropriate locations for this as well as upcoming Status of the Environment Reports or other documents where the GMRP is advised that Traditional Knowledge is available and appropriate to share.
28	GMOB	(rec) p.13, b.p.1(e)	Ensure that the climate change risk assessment team includes groups and/or individuals with a strong background and expertise in climate change, climate science and climate change risk assessments in northern regions and preferably experience with projects similar in size and scope.	The GMRP agrees and confirms that its staff and consulting engineers have extensive experience in climate calculations in projects of similar size and scope.
29	GMOB	(rec) p.13, b.p.1(f)	Include and/or engage Working Group members as appropriate in key activities, such as risk characterization, risk identification and adaptation & mitigation strategies. This could be through a facilitated meeting.	The GMRP is strongly committed to communicating with and incorporating feedback from our Rights holders and stakeholders including Working Group, GMAC and the Aquatic Advisory Committee. The GMRP has and continues to hold regular meetings with Working Group to collect and incorporate feedback into the Project's submissions. The Working Group and the Aquatic Advisory Committee have been engaged on risk mitigation in designs and on action levels and contingencies. The May 204 Working Group meeting is focussed on climate and design.
30	GMOB	(rec) p.13, b.p.1(g)	Ensure that the Working Group is appropriately engaged throughout this process, especially around key decision points, particularly the methodology and assumptions used. Share the climate change risk assessment results transparently, using plain and accessible language, including risks identified, how they are classified and the mitigation and adaptation strategies selected.	Please see response to comment#23.
31	GMOB	(rec) p.13, b.p.1(h)	Use the results of this assessment to inform and update approved designs and plans as needed. If no updates are deemed necessary, provide a clear rationale to support this decision. This assessment should clearly outline clear thresholds, trigger points and contingencies should the climate change more quickly/severely than anticipated	As part of the GMRP's climate continual improvement process, as presented to Working Group in June 2023, updated climate projections from the IPCC's AR6 projections have now been calculated (WSP 2024a). The AR6 data has been compared to the AR5 data (WSP 2024b) and designs were reviewed against this to verify that they will perform as intended. These documents will be provided to the Working Group, when available. Ongoing monitoring is included in various MMPs.
32	GMOB	p.9, par.4 (rec) p.9, par.7	There is a clear need to acknowledge the limitations of the data currently available and de-risk this uncertainty in the context of the GMRP through clear and transparent processes and assumptions, ongoing onsite monitoring and incorporating new data into risk assessments and mitigation strategies. Recommendation: There is a strong need to stay up-to-date with the precipitation data for Yellowknife and incorporate it into existing assessments and plans.	The GMRP includes climate assumptions in the design plans. Ongoing monitoring is included in our MMPs. The GMRP will provide updated climate-related reports to Working Group. Please see also response to GMOB comment#24 for more information on reports were updated climate information is monitored and provided.
33	GMOB	p.9, par. 8 (rec) p.10, par.3	Concerns around the selection of percentiles (representing mild, medium and severe changes) and climate change scenarios (RCP 2.6 vs. 8.5) were raised by many Working Group members. Recommendation: We recommend that the GMRP be more clear, transparent and conservative in the underlying assumptions that form the basis for climate modelling and data analysis.	The GMRP has committed to include more information on climate assumptions in forthcoming design plans. The GMRP will provide updated climate prediction reports to Working Group.
34	GMOB	p.10, par.4 and 5	The time horizons used for future climate change projections are shortsighted - they are currently modelled to 2100 - less than 100 years from today, and only 60+ years after project completion. Given the uncertainty around climate change projections and the variability in potential future scenarios and impacts, these time horizons are not sufficiently conservative. Recommendation: Extra caution and consideration should be given to planning the integrity of structures and systems being built with an open-ended outlook - in other words in perpetuity - not the next 100 years. If modelling out to 100 years is considered 'industry standard' then we recommend that industry standard time horizons should be reconsidered and adjusted to assess risk through a climate lens, particularly when it comes to considering perpetual care as is the case with Giant Mine. While climate change projections lose accuracy beyond 100 years, it is still important to consider across a larger time horizon when planning risk and mitigation strategies.	Climate projections for the site are only available up to 2100. The GMRP agrees and has included this approach in its designs, using projections for the 2050s and 2080's for long term infrastructure. Uncertainties associated with achieving the closure criteria is addressed through adaptive management as described in each design plan. A qualitative assessment of climate change beyond 2100 is included in the draft AR6 data report (WSP2024a), which will be provided to Working Group. Note that from a regulatory perspective, the project is only approved for 100 years (MVEIRB 2013),
35	GMOB			
36	GMOB	p.10, par.6 (rec) p.14, b.p.2(c)	With respect to when climate change projections and risks will be reassessed, the Project Team stated an intention to follow the timelines set out in the Environmental Assessment (independent reviews at 20-year intervals). This frequency may also be inadequate in relation to climate change - there should be ongoing - and early - review and reassessment of climate risks so that no one is caught by surprise. Recommendation: Include a thorough update and analysis in Status of the Environment reporting that takes place every 5 years. At minimum, this should be done every 10 years so that each new IPCC Assessment Report can be incorporated and assessed in relation to the GMRP.	The GMRP does not propose to do an update to the climate analysis through the Status of the Environment Report as that report is 'backward looking'; its an update on the environment during remediation. Instead, the GMRP has a climate continual improvement process for review changing predictions, as presented to Working Group in June 2023. This process aligns with the new IPCC assessment reports; it includes review of the updated data from IPCC against approved designs to assess whether projections may impact design, mitigation, and monitoring required for the remediation project. In general, the final design plans for the GMRP will be approved in the coming year and execution/construction of the design will be underway. The process will be used to address updated climate projections over time or monitoring data from site. The GMRP also has action levels in design plans and management and monitoring plans to address if the performance of the design is not as expected. Some of the action levels include triggers related to climate, as appropriate (e.g., the Arsenic Trioxide Frozen Shell MMP).
37	GMOB	(rec) p.14, b.p.2(d)	Recommendation: Establish clear 'trigger points' or 'thresholds' to prompt a stand-alone update and reassessment of climate risks and mitigation strategies if on-the-ground monitoring shows notable differences from modelled or assumed scenarios.	

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38	GMOB	p.10, par.7 (rec) p.13, b.p.1(i)	When asked at the beginning of the call whether the Project Team has current plans to incorporate the data from IPCC AR6 into their climate dataset, the initial answer was that the Project Team does not have scope to do this work. By the end of the call, a commitment was made to include AR6, and to make notes about the implications of using RCP 8.5 specifically during this exercise. It is still unclear when this will take place, how, and by whom and to what degree the concerns raised by the Working Group will be addressed. Recommendation: Updating climate datasets to reflect AR6 and subsequent reports released by the IPCC	As part of the GMRP’s climate continual improvement process presented to Working Group in June 2023, the Project’s climate dataset was updated using IPCC’s AR6 projections (WSP 2024a). Designs were then reviewed to verify that they perform as intended under AR6 projections (WSP 2024b). Drafts of these two documents will be made available to Working Group when available.
39	GMOB	p.10, par.8 (rec) p.13, b.p.1(c)(iii)	The Project Team emphasized that each design goes through an evaluation process and that climate change risk is evaluated at this stage; however, it is not clear how, through which lens and according to what standards or metrics. Recommendation: Determining and using the conservative future climate scenarios (currently RCP 8.5 for air temperature for instance) for all modelling and analysis that form the basis of GMRP plans and structural designs.	The GMRP’s designs are based on conservative assumptions (inclusive of climate change assumptions) consistent with this recommendation.
40	GMOB	p.10, par.9 (rec) p.11, par.2	The Project Team also noted that the GMRP is more advanced than most of the steps in the FCSAP7’s updated guidance around climate change assessments because some plans have already undergone this process and have been approved. However, it is unclear to what degree the Mackenzie Valley Land and Water Board (MVLWB) has the appropriate and necessary expertise to evaluate climate change risks. It is still unclear how designs and plans that have already been filed, evaluated and approved through the MVLWB measure up to new guidance and frameworks that have been released post-approval. Recommendation: The Project Team should put measures in place to address and de-risk the inherent limitations and uncertainties of climate science and data through transparency, conservatism and mechanisms to integrate new data and reassess risks.	The GMRP presented a climate continual improvement process presented to Working Group in June 2023 and has action levels and contingencies outlined through design plans. The GMRP uses these measures (the process and the action levels and contingencies outline in the design plans) to address risks and uncertainty.
41	GMOB	p.12, par.1 (rec) p.12, par.2	While several guides and frameworks were referenced by the Project Team, it is not currently clear which one is being used or why, and the overall approach has not been consistent. Recommendation: It is important to select a climate risk assessment framework for the GMRP that is up-to-date and relevant to this project, to clearly communicate the rationale for this approach and to complete all of the steps outlined in the framework.	The GMRP does not plan to have one framework document as climate information is spread through various regulatory documents as required by the regulatory processes.
	GMOB	(rec) p.13, b.p.1(a)		The GMRP leverages existing climate datasets and has provided the data analysis from AR5 (Golder 2020) and will provide AR6 to Working Group when available (WSP 2024a). The GMRP has also completed a quantitative risk assessment (QRA) including climate. As part of the QRA (CIRNAC 2020), a climate resiliency risk review, following the Climate Lens – General Guidance, Version 1.1 (dated June 1, 2018) from Infrastructure Canada, which is aligned with guidance from the Mining Association of Canada and Environment and Climate Change Canada’s Assessment Climate Change Resilience. This resilience assessment was used to inform the QRA and incorporated into the scenarios considered. All risks were found to be negligible or “as low as reasonably practical” for scenarios considering climate change. The QRA considered both the infrastructure design and the planned monitoring and review cycles.
	GMOB	(rec) p.13, b.p.1(b)	Recommendation: Leverage existing climate reviews and datasets completed for the GMRP as a starting point for a full and thorough climate change risk assessment. Select and use a climate change risk assessment framework relevant and applicable to Giant Mine to re-assess climate risk based on IPCC’s AR6. Recommended frameworks are 1. Infrastructure Canada’s Climate Lens, 2. Mining Association of Canada’s Guide on Climate Change Adaptation for the Mining Sector, and 3. Environment and Climate Change Canada’s Assessing Climate Change Resilience. Recommendation: Complete all of the steps outlined in the selected protocol for climate change risk assessment. Ensure that the assessment is carried out in such a way that it can be easily updated and that climate change risks can be easily re-assessed as new data becomes available. This climate change risk assessment should be considered evergreen (i.e. a living document) and the process should be designed to be iterative.	With the AR5 vs AR6 comparison memorandum (WSP 2024b), it was found that the closure design is robust and encompasses the projected changes from AR6. With no changes in design, the outcomes of the QRA remain appropriate and no re-assessment based on AR6 is required at this time.
42	GMOB	p.14, b.p.2(a)	Recommendation: Incorporate a climate change risk reassessment into the development of the Perpetual Care Plan: 1. Review the baseline assessment and update it based on on-site data collected and new climate information available at that time, 2. Update plans for monitoring and perpetual care accordingly.	The GMRP has a task force for development of the Perpetual Care Plan where these topics can be discussed.
43	GMOB	p.14, b.p.2(b)	Recommendation: Dedicate a distinct section in GMRP’s Annual Report to reporting on climate change risks, adaptation & mitigation efforts, ongoing monitoring and on-site observations and other climate strategies	The GMRP includes information on climate in the GMOB annual report and accepted GMOB’s recommendation to include more information on the climate section in the Status of the Environment Report. The Annual Water Licence report requires reporting of monitoring completed under all management and monitoring plans, including reporting on action level exceedances and actions taken in response to an exceedance. Should an issue arise that is attributed to changes in climate this will be identified through the GMRP adaptive management process, defined by the action levels developed and approved through management and monitoring plans and design plans, as applicable. The GMRP does not agree that an additional section specific to reporting on climate, as outlined, is appropriate in the annual water licence report.

Ref #	Reviewers	Reference	Comment / Recommendation	Response
	CoreGeo			
44	CoreGeo	Section 2.2, p.3	“The IPCC identified four representative concentration pathways; however, this report focuses on the three RCPs (RCP 2.6, RCP 4.5, and RCP 8.5) currently available from ClimateData.ca for the BCCAQv2 model. “ Discuss whether this could introduce a low bias when calculating percentiles, since RCP 6.0 is not included. Also discuss how downscaled projections compare to large-scale projections for the project area and whether large scale projections could be used, should downscaled projections not be available for certain RCPs of interest.	<p>The GMRP looked to determine if there was a method to check for low bias by use of the median with three RCPs (RCP 2.6, RCP 4.5, and RCP 8.5). Each mathematical method has complexity and introduces other biases. The GMRP followed the guidance from IPCC 2021 that all projections are considered equally probable so therefore based on the guidance, different weighting of emissions scenarios is not supported. Instead, the GMRP calculated the new climate projections from AR6 with multiple SSPs (Share Socioeconomic Pathways). The precipitation climate projections for AR5 and AR6 compare well.</p> <p>The GMRP is comfortable with use of the AR5 projections in the designs thus far (WSP 2024b).</p> <p>Large-scale projections originate in the global climate models and are developed on a global scale with a coarse resolution in the orders of hundreds of kilometers. ‘Statistically downscaled projections’, like those used in Golder 2020, start from the global climate models and use known climate relationships and observations to bring the spatial scale down to a regional level. The regional level is approximately 10 km for the Yellowknife area. For technical studies of the site, the Climatedata.ca ensemble was selected for its (i) applicability to Canadian climates (supported by ECCC and use of ECCC station data for bias correction), (ii) large set of climate models to represent uncertainty for technical studies (24 climate models), (iii) high resolution, and (iv) availability of projections for daily temperature and precipitation climate variables. This ensemble includes, low (RCP2.6), moderate (RCP4.5), and high (RCP8.5) projections. RCP6.0 was not available at the time of writing from Climatedata.ca and is no longer available from the Earth System Grid Federation which is home to the original source of CMIP5 projections (see also Alternatives North #9). This is also the case for the large-scale global projections of RCP6.0.</p>
45	CoreGeo	Section 2.2, p.4	PMP estimates use one method only for current conditions (moisture maximization) and two methods for future (moisture maximization and Hershfield). Results for future PMP combine the results from the two methods. Comparison to present conditions may be affected by methodology differences. Discuss how the results compare between the two methods.	<p>In general, the GMRP is using each method appropriately and consistently within each given model.</p> <ul style="list-style-type: none"> • The Hershfield method was used for both current and future climate, while the moisture maximization method was only used for future climate. The reason for this is due to data limitations and simplifying assumptions that can be made for the moisture maximization method applied to current and future climate. • For current climate conditions, the moisture maximization method requires estimating specific humidity for a set of major storms in the area and comparing the 100-year specific humidity for each storm, then using the ratio between them to “maximize” storm rainfall for the estimation of depth-area-duration curves. • Observations available for the site did not include humidity, and simplified methods to estimate humidity were not deemed appropriate for estimating PMP. This is why the moisture maximization method was not used for current climate. • For future climate, estimating projected changes using moisture maximization is simpler. As absolute values are not provided for future climate (only changes) the ratio of specific humidity estimates between current and future climate were used to estimate projected change, assuming that greater specific humidity is associated with more atmospheric moisture driving greater PMP. <p>It is acknowledged that the percentiles from each using the models was put into one table in Golder 2020 and this could create confusion. In any subsequent reports, any selected methods will be kept in separate tables for clarity.</p>
te46	CoreGeo	Section 4.5, p.40	Future evapotranspiration values are obtained using the Hargreaves formula only while current evaporation values were also calculated using the Thornthwaite method, which showed 40% lower results. Please provide rationale for selecting the Hargreaves method only for future climate values.	<p>The Hargreaves method was used for the future period as this method relies on daily minimum, maximum, and mean temperature inputs, which are all projected to change at differing rates (see Table 22 and 23 in Golder (2020)). The Thornthwaite method relies on only monthly mean temperature inputs, which is informed by the daily temperature inputs, by may average out changes to maximum and minimum temperatures. The Hargreaves method potentially captures a wider range of climate change impacts to evapotranspiration by using daily instead of monthly temperature values.</p>
47	CoreGeo	Section 5.0, p.55	“The results from this assessment can be used to help inform the Giant Mine freeze design and provide more detailed information for both temperature and precipitation on a monthly, seasonal and annual basis, based on the most up to date climate science. Further investigation may be considered for the freeze design to incorporate the updated climate values and trends and confirm if these values still fall within the error bands of inputs to the thermal modelling (not provided in previous study).” It is critical that the freeze design (thermal modelling) be revised to incorporate the most up to date climate projection (AR6)	<p>The GMRP is currently reviewing AR6 projections in the context of the freeze design to determine whether thermal modelling updating and /or design revisions are warranted.</p>
48	CoreGeo	Appendix A, Section 2.1, p.A-1	The Yellowknife A station is used for baseline characterization. Local factors such as elevation, and proximity to the lake can have an important influence on climate parameters. Discuss how the Yellowknife A station’s local characteristics compare to those of the project site and why it is considered representative.	<p>The Yellowknife A station is located approximately 4 km west of Yellowknife Bay, at a geodetic elevation of 205.7 m (as reported by Environment and Climate Change Canada). It is also located approximately 4 km from the Project site, as defined by the Project boundary,</p> <p>The distance between the Project site as defined by the Project boundary and Yellowknife Bay varies between 0 km (i.e., at the eastern extend of the boundary) to 3.2 km (i.e., at the northern extent of the boundary). The geodetic elevation within the Project boundary ranges between 156.0 m and 221.7 m, with a mean elevation of 183.9 m, based on the site’s 2018 Light Detection and Ranging Data (LiDAR). The site is located within the Baker Creek watershed (0 km to 22 km from Yellowknife Bay; 156.0 m [based on LiDAR] to 266 m [Spence 2018]) where precipitation runs off as streamflow in Baker Creek and its tributaries.</p> <p>Local climate data have been monitored at the site at C-dry since 2021, and includes air temperature, rainfall (using a tipping bucket), wind speed, and solar radiation). Local precipitation data were reviewed to contribute to the 2021 Annual Water Licence report which summarizes precipitation data. As indicated in the report, the reported precipitation dataset was based on rainfall data from the local station during the month of June to September, and precipitation data from Yellowknife A for remaining months, following a comparison (not explicitly presented in the report) which showed that concurrent datasets between the two stations were similar. A comparison of concurrent temperature data between the two stations was also completed opportunistically, but not explicitly reported. The temperature data between the two stations were found to be consistent.</p> <p>In summary, the Yellowknife A station has historically been assumed to be representative of the site on the basis of close proximity to the site. Opportunistic validation efforts were initiated in 2021 using data from the newly established station at C-dry, where similar temperature and rainfall data have been observed when compared to the data from Yellowknife A.</p>

Ref #	Reviewers	Reference	Comment / Recommendation	Response
49	CoreGeo	Appendix A, Section 3.2, p.A-9	Time horizon for climate projections goes to 2100s. Are there closure considerations that extend beyond that timeframe? If so, a semi-qualitative approach, and discussion of the different emissions pathways and their implications for long-term project design should be included.	Please see response to GMOB comments #34 and #35.
50	CoreGeo	Appendix C	Modelling for freeze design should also consider precipitation, in addition to temperature, as water infiltration in the ground will impact the ability of the ground to stay frozen.	This was considered during the design of the freeze program and rainfall or snowmelt will not penetrate the bulk frozen zone to a significant amount such that it would bring heat with it that will thaw the ground. Any water that does infiltrate to the perimeter of the frozen bulk will itself freeze. No edit is proposed to the modelling to include precipitation.
51	CoreGeo	Appendix C	"The results indicate that site specific projected warming trends, especially greater warming during winter months results in a portion of the arsenic chamber thawing after 90 years. After 85 years, the edge of the chamber appears to warm above -5°C." The design should be adjusted to prevent predicted thawing , for the worst case scenario and longest time horizon, based on the most current climate projections.	The design for the Freeze program is conservative and has been approved by the MVLWB. A monitoring program with adaptive management is also approved. The GMRP does not intend to modify the design at this time. Use wording that we have in the presentation on using mitigation measures
52	CoreGeo	2.1(3)	How was the spring period determined? Why is May 31 the last day of spring? Is this spring period tailored locally to Yellowknife? Is the full transition missed by not including June? Ice break up and freshet may not be fully covered without June included.	This cutoff date of May 31 represents the end of the snowmelt /freshet period for small watersheds (e.g., A1 sub-watershed) in the Yellowknife area. It is consistent with hydrological baseline monitoring information that was part of the Closure and Reclamation Plan and Annual Water Licence Reports.
53	CoreGeo	3.1.2 (5)	Why was 90% chosen as the cut off for representative data?	Ninety percent was chosen as a cutoff based on the recommendation by the Canadian Climate Change Scenarios Network (CCCSN 2008) to avoid bias from missing observations on a daily, monthly, seasonal or annual basis.
54	CoreGeo	3.1.2 (6)	The precipitation variable is inherently different from the temperature variables, that have already experienced a level of statistical analysis (mean, min, max). As daily precipitation values will therefore exhibit more variability, is it appropriate to expect the same level of statistical correlation (R2)? In this case, is the 90th percentile for data completeness an appropriate threshold (Section 3.1.2)? Is the 90th percentile an appropriate threshold for statistical significance (Section 3.2)? Also, climate change results in more precipitation variability, which may not translate into a statistically significant upward or downward trend, but represents a change nonetheless. Recommendation: Total precipitation should be calculated using all three models, to provide a comparison, to observe the potential projected variability in precipitation in the future. In addition, the threshold/criteria for determining precipitation data completeness and statistical significance should be re-evaluated.	<p>Precipitation generally does show more variability than temperature and with that less statistical correlation between sources is expected. The selection of R² above 0.8 is used as a guideline to evaluate the goodness of fit and variability, as this information influences the infilling equation used to create a consistent baseline period.</p> <p>The 90% data availability threshold allows for only months with 90% or greater data availability to be compared between data sources to keep average and total values representative of the site, while using as much observed information as possible to assess long-term (CCCSN 2008)</p> <ul style="list-style-type: none"> The 90th percentile is an appropriate threshold for statistical significance, and below 90th percentile due to the variability it becomes more difficult to detect a clear trend. Trends that are not statistically significant above the 90th percentile are still provided in Section 3.2 for context. The normals and trends for precipitation provided in Section 3.2 are only based on current climate. The future precipitation provided in Section 4.0 considers all three emission scenarios (RCP 2.6, RCP 4.5 and RCP 8.5). <p>The draft AR6 data report (WSP2024a) provides the precipitation projections by emission scenario, as well as across all emission scenarios. Subsequently, the GMRP has reviewed the design of engineered structures for the Closure and Reclamation Plan and Design Plans originally completed using AR5 projections against AR6 projections (WSP 2024b). Drafts of these two documents will be made available to Working Group.</p>
55	CoreGeo	3.6 (25)	Would the increase in evapotranspiration affect residence time of water held in air? i.e. the frequency or return period. Discussion on the impacts of increased evapotranspiration is recommended.	Not necessarily the residence time, but warmer temperatures can drive the upper limit for amount of moisture held in air, leading to greater extreme precipitation events (ECCC 2024; CSA 2019; Kunkel et al. 2013). This can indirectly increase the frequency or return period of precipitation events, as greater precipitation depths in the future means current precipitation depths (for a given duration and return period) would occur more frequently. This effect is captured in the climate model projections used in this assessment.
56	CoreGeo	3.8.3 (29)	Why is the spring transition period the only seasonal focus. What about winter, for snowpack? Summer, Autumn for precipitation?	The climate report (Golder 2020) presents relevant information to inform designs, including water management during the spring transition period in the reports. Summer and autumn precipitation was discussed in Section 4.1, and snowpack in the form of annual maximum values is discussed in Section 3.7. The focus on spring is to inform surface water management designs which consider a spring event (making use of the spring transitional information in the report) and a summer event using annual statistics, following common practice.
57	CoreGeo	Table 33	Why is April 46% for 50th percentile, where as Period 2 (April 1-15) and 3 (April 16-30) are -56% and -100% also for 50th percentile?	Thank you for this comment, there is a transcription error in Table 33. The correct values at the 50 th percentile are 46% for April, 99% for Period 2 (April 1 to 15) and 38% for Period 3 (April 16 to 30).
58	CoreGeo	Table 50	A comparison table for precipitation results between studies would be useful.	Because this is a 2018 document and numerous designs have been approved since this time, edits to this document are not proposed. However, the comment is noted and can be considered for future documents, thank you. Noted, thank you., however . Changes will not be made to the report.
59	CoreGeo	Appendix C, DBR, page 3	"It is interesting to note that baseline scenarios, which do not include any mitigation efforts to constrain emissions, result in pathways that fall between RCP 6.0 and RCP 8.5 . Therefore using a RCP 8.5 projected temperature increase would be considered conservative and the worst case scenario. " Is the quote above still accurate based on current mitigation efforts? This discussion should be added.	No discussion on this is planned to be added to the report as this was from the 2018 design basis report. The Freeze design was approved by the MVLWB using RCP8.5 from AR5.
60	CoreGeo	Appendix C, DBR, page 4	"More detailed temperature projections specific to Canadian regions can be obtained through the Canadian Centre for Climate Modelling and Analysis (CCCma). " Has there been an update to the CCCma 2016 report, as the two scenarios contain a major gap in time? The 2016 to 2035 scenario will end in 12 years	Yes ECCC has released updated climate projection information since 2016. At the time of writing Golder 2020, the most up to date projections were used.
61	CoreGeo	Appendix C, DBR, page 8	How have AECOM's recommendations been considered for the current design?	The design for the Freeze considers AECOM's recommendations. The freeze design is conservative and the Freeze Containment Design Plan is approved by the MVLWB and a monitoring plan is also approved.

Ref #	Reviewers	Reference	Comment / Recommendation	Response
62	CoreGeo	Appendix C, DBR-General	<p>The DBR analysis considers the effects of climate change from an air temperature model basis only. To capture all effects of climate change on a thermal model, SRK's freeze program design model in this case, other climate change factors could impact ground temperatures indirectly:</p> <ul style="list-style-type: none"> - impact from loss of snowpack (less albedo (reflection), insulating capabilities) - Increased precipitation variability (impact to ground temperature and moisture control) - Increased evapotranspiration (impact on atmospheric moisture retention time) - Impact of increased frequency and magnitude of extreme precipitation, snowfall, melting, and temperature events on the design. - Presence of permafrost, in the ground surrounding the stopes/chambers that hold the arsenic trioxide. <p>While these factors may not be able to be incorporated into models, added conservativeness to the design should consider the impacts of these climate change factors as well. Golder's assessment has outlined the changes to precipitation, evapotranspiration, snowpack, snowfall. This information provides a more complete picture of what may occur in ground over time should be considered.</p>	<p>This design basis document referred to in this comment is from 2018. Since that time the Freeze Containment Design Plan underwent public review through the MVLWB and was approved in 2021. The GMRP appreciates the comments but does not plan to update the Golder 2020 report with this information given the design has been approved.</p>

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