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LYDIAN ARMENIA

Amulsar Gold Mine

Response to Reports Prepared for Mr. H. Bronozian

18th August 2017

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LYDIAN ARMENIA

Amulsar Gold Mine

Response to Reports Prepared for Mr. H. Bronozian

18th August 2017

PREPARED & APPROVED BY:

David Brignall Director

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1 INTRODUCTION

1.1 Wardell Armstrong International was the principal author for the Amulsar ESIA (disclosed June, 2016) and has been instructed by Lydian Armenia to prepare a response to a number of reports disclosed by Mr. H. Bronozian during July, 2017.

1.2 Four technical reports have been prepared on behalf of Mr. H. Bronozian that review and provide a critical analysis of specific chapters of the Lydian Gold Mine Environmental and Social Impact Assessment (ESIA, 2016) and NI 43-101 (March 2017, Recommendations).

1.3 These reports comprise:

- Blue Minerals Consultancy, 2017. *Summary Report: Evaluation of Lydian Amulsar Gold Mining Project: Assessment of ARD Potential and Effects on Surface Water and Groundwater*. Dated 18 June 2017;
- Blue Minerals Consultancy, 2017. *Evaluation of Lydian Amulsar Gold Mining Project: Assessment of ARD Potential and Effects on Surface and Groundwater*;
- Buka Environmental, 2017. *Evaluation of Hydrogeochemical Issues Related to Development of the Amulsar Gold Project, Armenia: Key Assumptions and Facts*. Dated 19 June 2017; and
- Clear Coast Consulting Inc, 2017. *Review of water treatment at the proposed Amulsar Gold project*. Memorandum to Mr. H. Bronozian dated 13 June 2017.

1.4 These technical reports were accompanied by a summary report entitled:

Lydian Gold Mine Project in Armenia lacks proper Environmental Evaluation and Management: Summary and Recommendations (with no author or date).

1.5 Although the above-mentioned reports contain a critique of the ESIA (dated June 2016) and the recommendations chapter of NI 43-101 (dated March, 2017), it is clear that the reviewers have not taken into account, or been appraised of, the evolution of the ESMP, specifically through the commitments that were defined in the ESIA (2016). As a consequence, the reports lack a contemporary understanding of the programme of ongoing analysis and assessment with respect to ARD treatment and management, together with the comprehensive programme of water monitoring.

1.6 This response to the critical aspects of reports for Mr. H. Bronozian has been prepared by the original authors of the ESIA, specifically:

- GRE Associates response to the recommendations in the Summary report disclosed by Mr. H Bronozian (Annex 1, dated 18 August 2017);
- GRE Associates – Technical Memorandum, dated 18 August 2017, which provides a critic of geochemical baseline, ARD treatment and emissions raised in the reports prepared for Mr. H. Bronozian (Annex 2); and
- Golder Associates – Technical Memorandum (ref: 1660086.555.BO) dated 11 August 2017 – provides a critic of ground and surface water issues raised in the reports prepared for Mr. H. Bronozian (Annex 3).

1.7 The context of the findings in each of the Annexes demonstrates the ongoing development of commitments defined in the ESIA, that are required to mitigate potential environmental and social impacts. These commitments are currently focussed on the construction phase of the Gold Mine, together the programme for further analysis and assessment, in particular ARD treatment and management. Future reporting on all aspects of both ARD and water treatment and management will be subject to ongoing review by Independent Environmental and Social Consultants (IESC, Knight Piésold), who are specialist consultants in mining projects such as that at Amulsar. These auditing requirements will continue during construction, operation and closure phases of the mine. Throughout the Annexes, IESC has been used to reference the role of the independent auditors. The IESC assessed the environmental, social, health and safety (ESHS) performance of the Amulsar project against Equator Principles (EP) III, International Finance Corporation (IFC), Performance Standards (PS), European Bank for Reconstruction and Development (EBRD), Performance Requirements (PRs), Good International Industry Practice (GIIP) guidance and Armenia National Standards. The audit process requires Lydian Armenia to comply with an Environmental and Social Action Plan (ESAP) that includes actions pertaining to the management of ARD and ongoing monitoring of surface and groundwater.

1.8 The current and future programme of technical studies required by the ESAP and informed by ESMP will continue as detailed in the ESIA and associated commitments register. Regular reporting will continue in consultation with National Authorities and IESC.

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Annex 1 GRE Associates - Summary

DATE:	8/18/2017	**PROJECT NO.:**	16-1131
ATTENTION:	Armen Stepanyan	**COMPANY:**	Lydian International
cc:	Robert Carreau		
PREPARED BY:	Larry Breckenridge, PE	**REVIEWED BY:**	David Brignall
SUBJECT:	Response to Reports Prepared by Mr. H. Bronozian		

1.0 INTRODUCTION

Four reports have been prepared and provide a critical analysis of the Amulsar Gold Mine, (owned and operated by Lydian International (Lydian)). The reports have reviewed the Environmental and Social Impact Assessment (ESIA, June 2016), and the recommendations Chapter of NI 43-101 dated March 2017. The comments make specific reference to the management of groundwater and surface water. They highlight the management of Acid Rock Drainage (ARD) that may occur on site and the potential for water contamination from leachable metals and salts. The reports are as follows:

1. Blue Minerals Consultancy - *Summary Report: Evaluation of Lydian Amulsar Gold Mining Project: Assessment of ARD Potential and Effects on Surface Water and Groundwater.* Dated 18 June 2017;
2. Blue Minerals Consultancy - *Evaluation of Lydian Amulsar Gold Mining Project: Assessment of ARD Potential and Effects on Surface and Groundwater.* Dated 17 June 2017. (This is a summary of report 1 above);
3. Buka Environmental - *Evaluation of Hydrogeochemical Issues Related to Development of the Amulsar Gold Project, Armenia: Key Assumptions and Facts.* Dated: 19 June 2017;
4. Clear Coast Consulting Inc., -- *Review of Water Treatment at the Proposed Amulsar Gold Project*. Dated 13 June 2017; and

5. Lydian Amulsar Gold Mine Project in Armenia Lacks Proper Environmental Evaluation and Management: Summary and Recommendations. This is an apparent document by Mr. Bronozian that summaries the four previous documents. (no author or date).

Although the reports contain criticisms of the ESIA (version 10 dated June 2016) and the recommendations Chapter of NI 43-101 (dated March 2017), they fail to provide a comprehensive understanding of the ESIA process together with the management plan programmes that have been developed for the construction, operation, closure and post closure stages of the mine life. Following a review of the documents prepared for Mr. H. Bronozian, this document has been prepared for Lydian and responds to the comments and concerns contained in Reports 5 (above). Additional in-depth responses can be found in the following Annexes:

- Global Resource Engineering (GRE) – Technical Memorandum, dated 18 August 2017, which provides a critic of geochemical baseline, ARD treatment and emissions raised in the reports prepared for Harout Bronozian (Annex 2).
- Golder Associates – Technical Memorandum (ref: 1660086.555.BO) dated 11 August 2017 – provides a critic of ground and surface water issues raised in the reports prepared for Harout Bronozian (Annex 3).

GRE has prepared the following response.

2.0 OVERVIEW OF THE TECHNICAL RESPONSES.

In preparation of the reports prepared for Mr. H. Bronozian, it is clear that the authors have not considered or discussed the current programme of assessment and research that is being undertaken at Amulsar and post-dates the ESIA, published in 2016. This apparent lack of consultation by the authors of Blue Minerals Consultancy, Buka Environmental and Clear Coast Consultancy, with the Environmental and Social team based at Lydian, renders many of the conclusions of the report prepared for Mr. H. Bronozian to be out of date. In addition, the reports do not recognize, or take account of, the Environmental and Social Management Plan (ESMP), which has been subject to an independent review by internationally recognized and qualified Independent Environmental and Social Consultants (IESC) (April/May 2017). This independent review assessed the environmental, social, health and safety (ESHS) performance of the Amulsar project against Equator Principles (EP) III, International Finance Corporation (IFC) Performance Standards (PS), EBRD Performance Requirements (PR), Good International Industry Practice (GIIP) guidance, Armenian standards, IFC Environmental Social Action Plan (ESAP), EBRD ESAP, the ESIA v10, and the Project Commitments Register (CR). The independent audit verified that

environment risks and impacts associated with Surface and Groundwater Management including ARD treatment and management are integrated into the overall ESMP. The audit by IESC, confirmed that the Amulsar Project was in compliance with the Project's commitments.

Currently, the mine is the construction phase, which will be ongoing for a further 12 months, before operations commence at the mine. During this period, time has been allocated to monitor the progress of the detailed requirements of the ESMP, a factor that has not been acknowledged by the authors of the reports prepared for Mr. H. Bronozian. It should also have been identified that the programme of work required by the ESMP includes the ongoing monitoring required by:

- the ARD Management Plan;
- the Surface Water Management Plan; and
- the Preliminary Mine Reclamation, Closure and Rehabilitation Plan (MRCRP).

Information generated by these plans are then compiled within the Environmental Monitoring Plan that supports the database required for the ongoing development of several management plans (including the ARD Management Plan).

3.0 RESPONSE TO CRITICAL COMMENTS

For an item-by-item response to the comments contained in Reports 1-4, please refer to Annex 2 and 3. The following subsections contain a response to the comments identified in the summary report (Report 5) prepared for Mr. H. Bronozian. In the responses below, the comment summarized from the reports is in italics. The comment responses contained herein are contained to text in the Summary Report (Report 5) entitled: *Lydian Amulsar Gold Mine Project in Armenia Lacks Proper Environmental Evaluation and Management: Summary and Recommendations*. They are organized to allow the reader to refer to the organized summary report.

3.1 Page One, Highlighted Bullet

There is an overall recommendation that: "*mining should not start until further investigations have been completed by independent bodies/ consultants."* Independent consultants (IESC) undertook a detailed audit of the progress of the ESMP, which was completed in April/May 2017. The conclusions from this report verified that environment risks and impacts associated with Surface Water and Groundwater Management and ARD Management have been identified and mitigation measures have been integrated into the overall management system and that the Project was in compliance with all project commitments. The recommendation in Report 5 clearly

does not recognize the existing independent oversight of construction activities, and the ongoing environmental monitoring, analysis, and assessment. In addition, the recommendation does not take into account the development of the ESMP and environmental design criteria following completion of the ESIA.

3.2 "Potential Impacts"

Report 5 mentions an insufficient commitment to biodiversity. The fact that biodiversity management is an important factor for development of Amulsar Gold mine has been stated. However, there is no recognition in the reports of the detailed management systems and Action Plans that have been developed as a consequence of the assessment presented in the ESIA, which have been the subject of independent audit (most recently by IESC in April/May, 2017).

Report 5 states that: "*Predicted (modelled) changes in groundwater levels (e.g. up to 60 m lower), redirection and reduction in springs and streams within and around the mine site are of considerable magnitude."* This comment fails to note that this maximum change is predicted in the vicinity of the Barren Rock Storage Facility (BRSF) rather than across the whole site area. Overall, the impact to local and regional water is not significant. The details are contained within the ESIA (see also Annex 3).

Report 5 states that: "*Significant impact to water quality at springs located around the pits is predicted with respect to beryllium, cobalt, nickel and nitrate as a result of leakage from the pits".* The statement referred to, in the ESIA, is relevant only to the springs around the pits and not to the BRSF. There is an existing natural acidic discharge from the springs around the pit with elevated metals concentrations. The actual impact of these changes in chemistry on quality in the rivers surrounding the operation (Vorotan, Darb, Arpa) is presented in Section 6.10 of the ESIA and is demonstrated to be low or negligible.

Report 5 states that: *"There is also a significant impact predicted to groundwater quality adjacent to the Vorotan River as a result of leakage from the pits.* This statement is incorrect. The level of significance to the Vorotan River, is assessed in Section 6.10 of the ESIA (Table 6.10.8), based on this assessment, it is concluded that the magnitude of the impact (on the Vorotan River) is low and, therefore, the significance is negligible. Therefore, no additional mitigation is required.

Report 5 states that: "*There is a potentially significant predicted impact to groundwater input to the Spandaryan-Kechut Tunnel."* This statement is incorrect. The significance to the Spandaryan-Kechut Tunnel, is also assessed in Section 6.10 of the ESIA, where it is concluded that the

magnitude of the impact is low and the significance is negligible. Therefore, no additional mitigation is required.

Report 5 states that: "*Most importantly, there is a significant risk of ARD generation and discharge from this site that will continue long after mining ceases. This risk exists in spite of measures proposed by Lydian to prevent ARD generation after closure of the proposed mine".*

The current ARD management systems are considered appropriate to mitigate the closure-phase ARD risks. Furthermore, additional studies are budgeted and planned to provide evidence of the feasibility of passive treatment methods to mitigate ARD post-closure. If these studies find that the proposed plans are insufficient, then alternative treatment methods will be applied. Importantly, these additional studies are planned to ensure that there is sufficient time for alternative studies to be identified, evaluated and implemented in the unlikely event that they are required. However, it is important to recognize that the commitment to meet Armenian water quality regulations post-closure remains unchanged.

3.3 "Insufficient Geochemical Testing"

Report 5 states that: "*Significantly more mineralogical and geochemical testing is required for prediction of acid rock drainage rates and their evolution with time. This testing should include a significant number of long-term laboratory kinetic tests and pilot-scale field tests.*"

The recommendations in NI 43-101 are feasibility-level documents intended to provide the technical background for a +/- 10% cost estimate. As a result, prior studies were designed to formulate an ARD management plan to be implemented at onset of construction. To that end, it is considered that the management plans are sufficient for construction phase of mining development. They are not intended to be the only study performed on ARD, but instead the first round of ARD sampling, analysis, and geochemical predictions.

Additional studies will be carried out in 2017 to develop the ARD Management Plan for the Amulsar Mine. Recently completed drilling has provided further information on the barren rock quantities that will be managed during each phase of operations. The additional studies will provide further geochemical information on materials from the ground investigation. Furthermore, the passive treatment system and PD-7, are not required until after four years of mining operations. This period provides sufficient time for the detailed studies, and final design of the treatment system.

3.4 "Inaccurate Assessment of Acidity"

The contributions to acid generation from alunite and jarosite need to be properly defined and accounted for in the management plan.

The potential for acid release from barren and ore bearing rock has been considered in a number of sections of the Feasibility Study (FS) and ESIA, including Jarosite and Alunite, which have been assessed and have been identified as non-acid generating. Specifically, Section 6.2 of the Geochemical Characterization Report (GRE 2014) describes which humidity cell samples had Alunite and Jarosite, and Section 8.0 of the same document shows that long-duration kinetic tests with Alunite and Jarosite failed to produce acidity. Due to this strong evidence, rocks with high Alunite and Jarosite have been categorized as non-acid-generating in the ARD Management Plan

3.5 "High Levels of Potential Metal Release"

The initial concentrations of arsenic released from Upper and Lower Volcanic rocks were significant; with one instance of arsenic concentration over being recorded at 20× greater than the US, European Union, Australian, Canadian, and South African drinking water standards.

It is important to clarify that the water management at Amulsar has been designed such that the mine either consumes or treats all contact water. This includes the Lower Volcanic (LV) leachate identified above which may contain elevated arsenic concentrations. The "one instance" discussed above where an Upper Volcanics (UV) contained elevated arsenic concentrations is an outlier and the only example of such behavior in a large data set. Additionally, it is customary to discard the "first flush" of a humidity cell, which is the only occurrence of elevated arsenic in UV rocks. The reviewers are welcome to evaluate the Synthetic Precipitation Leachate Procedure (SPLP) results for UV rocks, or all other leachate analysis of the UV performed to-date. These tests are a much better characterization of leachate from UV rocks on site. Finally, additional studies planned at the Amulsar mine will further define and clarify the metals leaching potential of UV and LV rocks.

Estimates should be made of mercury released to the atmosphere, including from active heaps, carbon columns, carbon regeneration, and the mercury retort, and mercury capture methods should be proposed to limit mercury releases to workers and the environment. In addition, mercury concentrations in the Arpa River and in groundwater downgradient of the heap leach facility should be estimated using a range of predicted heap leach drain-down concentrations.

The purpose of the mercury retort proposed, is an environmental protection measure. Spent ore is retained in the fully-lined heap leach facility and based on metals testing in the rock, does not contain elevated mercury concentrations. If any mercury is present in the ore, and if this mercury leaches into the process solutions, it will report to the gold treatment plant and will be precipitated out of the process solutions. The precipitate will then be treated melted in furnace equipped with a mercury retort recovery system. This has been included in the design together with a condenser as a precaution to ensure that mercury will be safely captured. All recovered mercury will be properly disposed of in a manner consistent with the site-wide hazardous waste management plan. There will be no mercury exposure to workers, groundwater or the environment.

Furthermore, the leached ore and process solutions are fully contained on a low permeability/clay soil and poly-ethylene geomembrane composite liner, with transport of solutions by double contained piping systems. At closure, all heap leach drain-down solutions will be captured and treated prior to final release.

3.6 "Untested and Insufficient Mitigation Strategies"

Report 5 claims that several mitigation strategies contained in the ESIA are insufficient, or unproven.

3.6.1 BRSF Encapsulation

Encapsulation of potentially acid generating Lower Volcanic rock in Upper Volcanic barren rock as a means to control acid and metal release must be tested.

Studies presented in the ESIA predicted that the encapsulation method would mitigate ARD formation. Used in conjunction with passive treatment, the system is predicted to be sufficient to control acid and metals releases. Encapsulation is an industry-standard ARD management approach at mines around the world (INAP, 2009). Planned testing will be performed over the next 12 months to further confirm the assumptions and predictions of the encapsulation design.

3.6.2 Pit Dewatering during Operation

During operations, pit water will be managed to provide a supply of water for operational use, via contact water pond (PD 8). The project will have no discharge requirement until after year 4 of operations. Thereafter, after year 4, excess water from PD 8, not consumed as process water to the Heap Leach Facility (HLF) will be treated in the Passive Treatment System (PTS).

3.6.3 Passive Water Treatment

Passive treatment of mine-impacted water is a standard method for treating and managing water quality concerns from metals mines (INAP, 2009).

Passive treatment is an effective method to mitigate mild ARD and drain down from a spent HLF and rapidly becoming the industry-standard for all but the most severe ARD. Please see (A.M. Moderski, 2013), [(INAP, 2009), Section 7.5.2.]. Passive treatment was successfully applied, for example, at the Santa Fe Mine in Nevada, USA to treat HLF drain-down (R. Cellan, 1997). Predictions performed to-date and reviewed by IESC confirm that the predicted ARD and HLF drain down fall well within the range of acceptable chemistry that is treatable with passive treatment technology.

The passive treatment system outlined in the ARD Management Plan is consistent with successful designs world-wide. Furthermore, a detailed programme of studies will confirm the efficacy of the design of the passive treatment system. The treatment system will be assessed using laboratory and field scale trials, which have been discussed with, and reviewed by, independent consultants. The testing will be completed by August 2018.

3.6.4 Heap Leach Facility Post-Closure Leachate Management

Post closure treatment of drainage water (leachate) from the HLF includes a two-stage management plan:

- Active treatment to remove for a period of 12 months following closure of the heap, or until such time as the drainage can be treated in a Passive Treatment System.
- Passive treatment to remove residual potential contaminants. This system will be in operation until the leachate meets regulatory discharge standards.

3.6.5 Pit Drainage Post-Closure

Chapter 6.10 of the ESIA considers the potential impacts associated with closure of the pits, which includes:

- Tigranes-Artavazdes pit will be backfilled with barren rock. The barren rock will comprise permeable loose mixed Upper Volcanics and Lower Volcanics and is estimated to have a permeability of approximately $1x10^{-4}$ m/s. The backfill will be graded to facilitate surface water runoff and to prevent ponding to minimize infiltration. The backfill will be capped with an engineered evapotranspiration cover, comprising cover soils. The dynamics of infiltration through this cover and leakage through the base of the facility over the life

cycle of the mine has been modelled. The model results identify modest seepage similar to the pre-mining hydrogeologic system.

- Erato pit will be partially backfilled with barren NAG rock comprising permeable loose Upper Volcanics estimated to have a permeability of more than $1x10^{-4}$ m/s. The backfill will not have a soil cover so as to allow infiltration of pit runoff into the backfill. It is important to note that the ESIA found no significant impact to local or regional water quality resulting from pit drainage or pit seepage post-closure.

3.7 "Monitoring and Risk Assessment"

This section contains several critical comments that have been addressed in the following sections:

"*Amulsar Project falls short of leading practice in the industry because it does not propose multiple mitigation measures to minimize the effects of Acid Rock Drainage….".*

This statement is incorrect. The Amulsar mine segregates and encapsulates potentially-acid generating material within encapsulation cells in the Barren Rock Storage Facility. Furthermore, the facility is covered with an evapotranspiration cover to minimize infiltration of precipitation and the diffusion of oxygen, both of which are required to generate ARD. Finally, passive treatment is proposed to treat potential acidic leachate. The Global Acid Rock Drainage Guide (GARD Guide) (INAP, 2009) discusses the encapsulation of waste, passive treatment, and other key elements of the ARD Management plan. The programme at Amulsar accords with good industry practice.

"…Seek International Expertise to evaluate the ARD risk.":

Amulsar has followed a rigorous program of permitting, environmental impact assessment, and independent review. The ESIA and the ESMP have undergone extensive review and have been found to be sufficient. The last review of the ESMP was performed in April/May 2017 by IESC. The audits have included detailed discussions on the programme for design of treatment systems for ARD management.

"….Groundwater Inflow to the Pit"

This has been discussed in Section 3.6.2 above.

"…A longer period of monitoring is needed." and "Legal responsibility for remediation of mine discharges after closure."

The preliminary closure plan includes a 5-year post closure monitoring period. This plan formed part of the ESIA and is therefore legally binding. The costs of post closure monitoring are included in the cost estimate for closure which are regulated under Armenian law. The estimation of the costs of rehabilitation is regulated by Decree N365-N by the Ministry of Nature Protection (MNP) "On laying down the procedure of cost estimation and indexing of reclamation works" dated 24 December 2012. Decree N365-N replaced Decree N 95-N of MNP dated 22 April 2004. Decree N365-N regulates requirements regarding responsibilities and the cost estimates and assessment for rehabilitation activities by mining companies.

It is important to note that the closure plan includes on-going monitoring and maintenance of the passive treatment systems until such time as discharge meets the standards.

In addition, the monitoring and evaluation is not yet complete. The ESMP (including ARD Management Plan) states that further studies are required to develop the detailed strategy for ARD treatment, and the NI 43-101 (Section 26.5) clearly states the budget for ongoing work on this issue. This testing and analysis is specifically-designed to develop an assessment of ARD treatment technologies. The approach adopted is in line with the best international industry guidance and has been subject to detailed scrutiny by the independent consultants appointed by the Financial Institutions supporting the project, who have approved the programme developed in the ESMP.

"….No Clear Responsibility"

The responsibility for the ESMP, as a whole, resides with the VP of Sustainability, Mr. Robert Carreau. Mr. Carreau is an accomplished mining executive with more than 25 years of international experience in managing all aspects of environmental stewardship, health and safety programs, and corporate social responsibility. In addition to Mr. Carreau, his team includes specialists with a wide range of experience in environmental management of mining operations. Oversight of the team is provided by IESC through regular auditing and reporting.

References

A.M. Moderski, J. G. (2013). *Demonstration Study: Treatement of Heap Leach Pad Drain Down Solution.* Journal American Society of Mining and Reclamation, 2013 Volume 2, Issue 1.

INAP. (2009). Global Acid Rock Drainage Guide. *International Network on Acid Prevention*.

R. Cellan, A. C. (1997). *Design and Construction of an InSitu Anaerobic Biochemical System for Passively Treating Residual Cyanide Drainage.* Austin, Texas, May 10-15, 1997.: Proceedings of the National Meeting of the American Society for Surface Mining and Reclamation.

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Annex 2 GRE Associates - Technical Memorandum

DATE:	8/18/2017	**PROJECT NO.:**	16-1133
ATTENTION:	Armen Stepanyan	**COMPANY:**	Lydian International
cc:	Robert Carreau		
PREPARED BY:	Larry Breckenridge, PE	**REVIEWED BY:**	Dave Ludwick, PE

SUBJECT: Response to 3rd Party Review Comments on Acid Rock Drainage at Amulsar

1.0 INTRODUCTION

Four 3rd Party Reports have been prepared for Mr. H. Bronozian that contain a critique of the Amulsar Acid Rock Drainage (ARD) Characterization and Management Plans contained in the Environmental and Social Impact Assessment (ESIA, 2016) and NI 43-101 (2017), referred to as the Feasibility Study (FS) in this memorandum. This technical memorandum has been prepared in response to the following submissions:

1. Blue Minerals Consultancy - *Summary Report: Evaluation of Lydian Amulsar Gold Mining Project: Assessment of ARD Potential and Effects on Surface Water and Groundwater.* Dated: 18 June 2017.
2. Buka Environmental - *Evaluation of Hydrogeochemical Issues Related to Development of the Amulsar Gold Project, Armenia: Key Assumptions and Facts*. Dated: 19 June 2017.
3. Clear Coast Consulting Inc. - *Review of Water Treatment at the Proposed Amulsar Gold Project*. Dated: 13 June 2017.
4. *Lydian Amulsar Gold Mine Project in Armenia Lacks Proper Environmental Evaluation and Management: Summary and Recommendations.* no author or date.

All reports were received by Lydian International during week commencing 17 July 2017. The reports have been reviewed by **Larry Breckenridge, P.E.,** Global Resource Engineering Ltd, the author and Qualified Person responsible for ARD issues in the FS and ESIA.

Commentary on the reports has been prepared by reference to both the ESIA and ESMP (disclosed in 2016).

2.0 REPORT 1: FROM BLUE MINERALS CONULTANCY

Summary report comment	GRE Response
Section 3: Insufficient Geochemical Testing	
The authors claim insufficient assessment of ARD in ESIA and FS for detailed analysis.	The reports reviewed are Feasibility-Level documents intended to provide the technical background for a +/- 10% cost estimate. As a result, prior studies are designed to formulate a workable ARD management plan, prior to commencement of construction. The ARD Management Plan is therefore sufficient as a working document to be developed in accordance to the requirements of the ESMP. The assessment that informed the management plan was not intended or identified as the only study performed on ARD. The studies reported provide sufficient data for ARD sampling, analysis, including geochemical predictions and to inform the requirement for additional studies. These additional studies will continue during 2017 to inform the final plan for mining, metallurgy, and site layout. Recently-completed drilling has further informed the quantity of barren rock by phase during mining operations. In addition, facilities, like the passive treatment system and the PD-7 pond, are not required until after year four of mining operations. This provides sufficient time for the studies to be completed, and for any design modifications required by the results of the studies. It has been acknowledged in the FS and ESIA (including ARD Management Plan) that further studies are required to develop a detailed strategy. The FS (Section 26.5) clearly states that additional geochemical characterization is planned and budgeted. This testing and analysis is specifically

Summary report comment	GRE Response
	designed to address the recommendations identified in the report, and these studies will continue during 2017.
The report relies on insufficient baseline to determine the rate of acid release	The potential for acid release from waste and ore bearing rock has been considered in the relevant chapters of the FS and ESIA. The Jarosite and Alunite have been assessed and been identified as non-acid generating and have therefore not been included in the discussion on ARD management. Section 6.2 of the Geochemical Characterization Report (GRE 2014) describes which samples had alunite and jarosite, and Section 8.0 of the same document shows that long-duration kinetic tests with alunite and jarosite failed to produce acidity. The budget identified in the FS has been set aside for on-site kinetic tests to improve the quality and validate data from humidity cell testing. On-site kinetic tests are an internationally-accepted technique (INAP 2009). Therefore, following completion of the study sufficient and detailed baseline data will be available to both validate earlier evidence and provided the data required for detailed design of treatment options. The final report of the ARD management study will include options for locally-sourced neutralizing materials, if available in sufficient quantities.

Summary report comment	GRE Response
Section 4: Inaccurate Assessment of Acidity	
The authors express concern on the Non-Acid Generation (NAG) behavior of Upper Volcanic (UV) encapsulation materials to be used in the BRSF	The long-duration humidity cell testing completed to date have identified that Upper Volcanic (UV) is Non-Acid Generating (NAG). It should also be noted that kinetic testing is performed to determine the difference between potential acid generating behavior and observed acid generating potential. In addition, the kinetic cells represent "worst case" ARD generation conditions. The UV failed to generate acid in the worst-case condition, therefore the potential acid generation is not realized in the field. The planned on-site kinetic tests will be designed to provide further evidence of the categorization of UV with respect to acid generation.
The report refers to incorrect interpretation of ARD from Soviet era waste rock piles	GRE and IESC have both agreed that the Soviet-era waste piles are an in-field empirical example of mild ARD after long-duration exposure. In addition, it should be noted that the evidence in this section was considered in relation to requirements for treatment. A pH 3.5 has been defined as mild because it can be successfully treated using a passive system. It should also be noted that the planned on-site kinetic tests will provide further evidence to in addition to that from the Soviet era waste rock stockpiles.
Authors claim that the ESIA has inadequate data to prove that the passive treatment system is adequate	The existing data confirms that water quality present at Amulsar are within a feasible range for successful passive treatment. The treatment of ARD is predicted to take place after year 4 of mining operations and there is sufficient time to further develop the necessary laboratory and field trials for

Summary report comment	GRE Response
	the design of the treatment system.
The report claims that there is no treatment for ARD seepage from the mine pits envisioned.	During operations, the dewatering water becomes part of the "contact water" circuit. The water in the pits will not be discharged into the environment and will be pumped and fully-consumed by the process. Therefore, this statement is incorrect. Upon closure, the Tigranes/Artavastes pit will be backfilled with Erato waste and graded to facilitate surface water runoff. It will have a cover that minimizes the infiltration of water and the formation of leachate. Erato will form a shallow pit lake. Since the baseline data indicates that pre-mining seeps exist on the mountain with low pH, it is expected that post-mining seeps on the mountain will result in, "no net change" condition. Studies performed by Golder confirmed that there is no significant water quality impact to these seeps (see Annex 3).
The authors claim that there are unclear management responsibilities and referencing of ARD management.	The ARD management plan is a parallel plan to that of Environmental Monitoring Plan, referenced in the ESMP. Within the ARD management plan (Appendix 8.19 of the ESIA), the management responsibilities are clearly stated (Section 2 of the ARD management plan) and Lydian is working to develop the structure identified in the plans. In terms of ARD management it is identified in the project documentation that Lower Volcanics (LV) will be placed in the BRSF.
The report claims that there is insufficient monitoring and maintenance post-closure.	The post-closure responsibilities are detailed in the Mine Reclamation and Rehabilitation Management Plan (MRCRP), which provides for the long-term management of the mine post closure, together

Summary report comment	GRE Response
	with the predicted engineering, environmental, social, and management costs .
In summary, the analysis on the geochemical testing suggest that Lydian lacks the experience and expertise to adequately define the ARD risk, and to construct and operate the geochemical and engineering required to control the ARD that will result from the Amulsar mine.	All reports relating to ARD were prepared by internationally recognised experts (including Golder Associates and GRE) and not directly by Lydian. These reports have also been subject to addition expert review which demonstrates the importance which Lydian attach to understanding and managing the potential risks associated with ARD. Furthermore, the ESMP advocates additional (and more detailed) studies that are in the programme of continuing analysis, and include laboratory and field studies to both advance the understanding of risk and define the design criteria for ARD treatment during the operational, closure and post closure phases.
Section 5: High levels of potential metals release	
The introduction to this section states (paraphrasing) that: it has been assumed that leachate from the BRSF will be effectively treated to acceptable standards for release by the passive treatment system. The acceptability of such an assumption is questioned as the pH and dissolved solids content of the in-flow to the PTS is based on in-correct and in-complete analyses.	This statement fails to recognize the requirements of the ARD Management Plan (as a part of the ESMP) that further fully costed studies will be undertaken in the years before the construction of the treatment system. There is both sufficient space allocation and budget to make changes to the final design of the treatment system, based on the findings of studies still to be completed.
The report further claims that disruptive changes in groundwater levels – because of redirection and reduction in springs and streams predicted within and around the mine site, which are of	This comment fails to recognize the significant volume of data that has been collected to establish baseline conditions. The augmentation of the database of regional groundwater trends will be ongoing during the construction and operational

Summary report comment	GRE Response
considerable magnitude and have not been taken into account in the ESIA.	phase of the mine's life. Mitigation measures are identified in Golder's Site Wide Water Balance, which will be reviewed on a regular basis to take account of monitoring data analysis (required by the EMP) and in accordance with the detailed stages of design developed during construction.
The authors of the report assume that the potential impacts on water quality will be unacceptable due to pit leakage, together with insufficient mitigation option presented in the ESIA.	The ESIA has determined that pit leakage has no significant impact on local or regional water quality. However, pit water during operation and post closure requires additional characterization and analysis (which has been identified in the ESMP and planned in the early phases of the mine's life). This will include further analysis of nitrates and metals such as beryllium, cobalt, nickel. The analysis and data will be used to develop the ESMP, as required.
Section 6: Untested and insufficient Mitigation strategies	
Characterization of UV & LV for ARD potential is insufficient.	The reports reviewed are Feasibility-Level documents intended to provide the technical background for a +/- 10% cost estimate. As a result, prior studies are designed to formulate a workable ARD management plan, prior to commencement of construction. The ARD Management Plan is therefore sufficient as a working document to be developed in accordance to the requirements of the ESMP. The assessment that informed the management plan was not intended or identified as the only study performed on ARD. The studies reported provide sufficient data for ARD sampling, analysis, including geochemical predictions and inform the requirement for additional studies. These additional studies will continue during 2017 to inform the final plan for mining, metallurgy, and

Summary report comment	**GRE Response**
	site layout. Recently-completed drilling has further informed the quantity of barren rock by phase during mining operations. In addition, facilities, like the passive treatment system and the PD-7 pond, are not required until after year four of mining operations. This provides sufficient time for the studies to be completed, and for any design modifications required by the results of the studies.
The report claims that studies are lacking Jarosite & Alunite characterization.	Jarosite and Alunite have been assessed in detail with static testing and humidity cells and been identified as non-acid generating and have therefore not been included in the discussion on ARD management. The response to comments in Section 3 above addresses this issue.
Sources of neutralizing materials are required	Studies have identified the source of neutralizing materials and these are ongoing during the construction phase to select suitable materials. Final design and selection of materials will be subject to further studies including passive treatment pilot testing, at laboratory and field scale.
Section 7: ARD Management in Construction and Operation Phases	
The report claims that the separation of sulfide (LV) from non-acid generating (NAG) waste is not feasible.	In 2016, with the consultation of GRE, the site implemented an in-field identification methodology to determine the presence or absence of sulphide minerals in construction waste and mine waste. This methodology allows for rapid and conclusive determination of PAG material for proper management (GRE 2016).
The report claims that active treatment systems will be required upon closure.	The predicted effluent concentration is well within the range of feasibility for passive treatment technology. Design of treatment systems will be

Summary report comment	GRE Response
	finalized with data collected from additional planned studies and analysis that will be used to design the laboratory and field scale trials that are required to test the treatment system, prior to construction.
The authors of the report speculate on the Lack of Regulatory experience at Government level.	'It is not for external consultancies (ourselves included) to speculate about the capacities of host country governments. Suffice to say that the Amulsar project is subject both to the regulatory oversight of the Armenian Government in respect of national laws and regulations and International Performance Standards and Requirements, as set out in the ESIA. The ESMP is the overarching document that develops the capacity for both environmental and social standards during the life of the project, including participatory monitoring, regular publication of data and the oversight of its operations by regular independent audits required by investors and lenders, such as EBRD.
The authors claim that the ARD seepage will peak after post closure operations (5 years), and there is a requirement for long term monitoring	Both GRE and IESC disagree with this unsupported prediction. However, monitoring will continue during the closure period, as will the requirements of the ESMP, in particular, that effluents conform to both national and internal guidelines identified in the ESIA.

3.0 REPORT 2: BUKA ENVIRONMENTAL

Buka Environmental comment	GRE Response
Section 1: The mine will never require active treatment.	
The report suggests that water treatment alternatives and risks associated with active treatment have not been identified in the ESIA	The ESIA identifies that active treatment is not required as the primary mitigation technique. Passive treatment is defined as the preferred option, subject to laboratory and field trials. Treatment systems are not required until after Year 4 of the operational phase and there is sufficient time for the results from trials to be thoroughly evaluated to enable design treatment systems for the operational phase. Mine closure requirements will be subject to ongoing monitoring and analysis as a set out in the Mine Reclamation Closure and Rehabilitation Plan (MRCRP).
The author states that current management plan does not develop multiple ARD mitigation measures	The management plan suggested for this stage of operation is sufficient. There is the potential to develop multiple ARD mitigation measures, subject to the results from planned laboratory and field trials.
The author claim that spent ore has an ARD risk and a metals leaching risk.	The management of the HLF, post closure has been addressed in detail in the ESIA and ESMP. Ongoing active treatment will remain in place until the drainage from the HLF can be treated through a passive treatment system to be constructed post closure. Additionally, the ARD risk in the spent ore is mitigated by the added alkalinity introduced to the ore during processing, and the evapotranspiration cover which will limit water and oxygen intrusion into the material.
The author states that amount of completed K-Cell testing is not sufficient for the design requirements for ARD management	The level of testing has been determined as sufficient by IESC. However, the ESIA requires that the design of the treatment system includes laboratory and field scale trials to refine the detailed design of the treatment systems that will be operational, during the operational phase (after year 4) and post closure the mine.

Buka Environmental comment	GRE Response
	Laboratory and field trials will be informed by on-site kinetic geochemical testing.
The authors claim that the LV material does not have ferric iron oxidation resistance. In addition, the authors state that metals leaching is underpredicted.	Ferric iron oxidation has not occurred in old mine waste piles despite the presence of abundant unoxidized sulphides. Planned on-site kinetic tests are planned to further verify if this assumption is correct. Meal leaching is "rare" because, when compared to other sites, the Amulsar ore and barren rock have relatively low concentrations of leachable metals including cadmium, copper, mercury, and zinc. In many cases, these metals are at the average crustal concentration and these metals were not found to be present in the leachate of the humidity cell tests.
LV ARD Characterization is insufficient.	The level of testing has been determined as sufficient by IESC for the current level of study. However, the ESIA and ESMP recognizes that further testing is required to provide sufficient detail on the characterization of LV waste rock for final design
The report claims that there are no detailed studies of Passive Treatment for proof of concept; therefore, reverse osmosis will be required.	The ARD Management Plan requires further detailed studies, which will be ongoing over the next 12 months. This data will be used to develop the laboratory and field based studies to design the treatment process to be installed after year 4 of mining operations. The ESIA provides the general concept for treatment of ARD. This approach has been subject to a detailed review by IESC, which confirmed that the mitigation identified in the ESIA would guarantee the effective treatment and management both during operations and post-closure.
Section 3: The mine plan is firm and includes biodiversity set-asides.	
Permit discrepancies: The company should clarify whether the mining of the Arshak deposit has	Arshak does not for a part of the mine development. There are no plans to mine Arshak and the area has been designated as the biodiversity set-aside in which no

Buka Environmental comment	GRE Response
been included in the mine application, and if it hasn't but it is proposed to be mined, a revised ESIA should be produced that evaluates all effects of the additional disturbance.	mining or ancillary operations will take place. The set aside will be maintained during the construction and operational phases of the Project (page 3.19 of Chapter 3 of the ESIA). We understand that the consultants conducted their work on the basis of only a partial review of the publicly available documentation; with respect to the set aside at Arshak it would appear that they were not aware of the existence of some key material.
Section 4: Mercury emissions will not be a concern during or after mining.	
The authors claim there may be mercury emissions	A small concentration of mercury has been identified in column leach assays. Therefore, as a precautionary measure, because mercury forms a cyanide complex and can load onto the activated carbon in the CIC circuit, a retort will be used to capture and manage any mercury (that exists). There will be no emissions from the retort (see Section 17.4.9 of the FS). The mercury product will be disposed of in a manner consistent with the site-wide hazardous waste management plan. The concentration of mercury in SPLP leaching samples from Tigranes, Artavazdes and Erato barren rock is very low (see Table 24.8 of the FS). In leachability tests performed, mercury has not been identified in spent ore (see Table 24.15 of the FS). Therefore, mercury emissions are predicted to be low and can be managed and mitigated during the operational phase, and during closure / post closure.
Section 5: Mine will have only a few contaminants of potential concern	
The mine has failed to adequately screen for Contaminants of Potential Concern	Contaminants of potential concern have been defined by multiple methods: 1. Applicable standards regulated by Armenian law and 2. Elements or compounds with elevated concentrations. "Elevated" is defined in two

Buka Environmental comment	GRE Response
	ways: either the component is near or above water quality standards, or the element is concentrated with respect to crustal average concentrations in rocks. Ultimately, it is the water quality regulations that determine contaminants of concern. All analysis performed to-date conform to legislative requirements, a process that has been audited by IESC.
Section 6: "Representative Samples"	
Report states that representative sampling to characterize geochemistry of waste rock and ore is not sufficient	The level of testing has been determined as sufficient by IESC. It is important to note that Price and Errington 1994; a reference for samples density, based on the tonnes of waste rock produced at the mine, has been critiqued as an unrealistic standard for sampling density (Runnels & Shields, 1997). However, to corroborate the evidence in the ESIA, additional testing and evaluation will continue for samples of waste rock material and spent ore, to inform the design of the passive treatment system and the requirements of the ARD management plan.
The elevated concentrations of leachable metals/metalloids will occur in the UV rocks, especially arsenic and antimony.	Concentrations of arsenic and antimony are at or near detection limit in the humidity cell samples of UVs. Appendix E of the geochemical report contains the results. It is unclear where the reviewer identified elevated arsenic and antimony.
Recommendations	
The authors recommend that an active treatment plant should be designed and tested for use during operations and likely during closure. Given the mix of constituents, including metals, metalloids, sulfate, mercury, and	Based on observed and predicted ARD conditions, the water quality that must be treated by the PTS is well within the historical proven range of feasibility for passive treatment technology. Based on data provided in the ESIA, preliminary design for passive treatment systems has been proposed for: • Operational phase (after year 4 of mining) to continue

Buka Environmental comment	GRE Response
nitrate/ammonia, a reverse osmosis plant should be required.	through post closure for BRSF. • Post closure HLF, following active treatment that will continue until drainage can be treated through a passive system. The details of the designs will be based on pending and planned detailed analysis, set out in the ESIA, ESMP and ARD Management Plan
The Armenian regulatory agency should ask Lydian to demonstrate that a large-scale acid-generating mine with a heap-leach facility such as the Amulsar Project can be successfully operated and closed without harming the environment using no active treatment during operations. Such a demonstration would include three similar mines around the world that meet these criteria and that have adequate environmental monitoring to substantiate a finding of no significant adverse environmental impact.	We are sure that the reviewer understands that each site is unique and that simply to extrapolate between sites should be avoided. IESC audits have determined that the project has demonstrated independent oversight of the design process that has been completed for the passive treatment system. Passive treatment is an established technology and has been installed at many sites around the world. Buka asked for examples of successful passive treatment facilities. The following provide relevant examples: • Golinsky Mine, California (near Lake Shasta, California); (Gusek, 2011) • Magenta Drain – Empire Mine State Park, California (Gallagher, 2016), (Gusek, 2011) • Iron King PTS - Owned by Freeport McMoRan - Near Jerome, AZ (Gusek, 2013) (Buchanan, 2017) • Santa Fe Mine, Nevada, USA. (R. Cellan, 1997) Passive treatment is an acceptable treatment alternative and has been featured in Section 7.5.2 of the Global Acid Rock Drainage Guide (GARD Guide, (INAP, 2009)). Finally, predictions performed to-date and reviewed by IESC confirm that the predicted ARD and HLF drain down fall well within the range of acceptable chemistry that is treatable using passive treatment technology

Buka Environmental comment	**GRE Response**
The report states that additional seasonal data and additional wells or piezometers are needed around the planned outline of the pits to evaluate the potential for bedrock groundwater to flow into the pits during mining. In the likely event that groundwater will need to be pumped to keep the pits dry, a full-scale reverse-osmosis treatment plant will need to be constructed before mining begins. Neither the ESIA nor any other mine document contains a contingency plan for construction or use of a treatment plant during mining.	During operations, the water from the pits will be incorporated in the contact-water circuit. This water will be consumed by the operation or treated to the appropriate discharge standard prior to discharge. There is no evidence that a reverse-osmosis plant will be required to manage this water. Additional studies on the performance of PTS is planned, but the predicted water quality from the pit is well within the acceptable range for passive treatment technology.
The company should clarify whether the mining of the Arshak deposit has been included in the mine application, and if it hasn't but it is proposed to be mined, or if excavation of any additional areas or depths are planned, a revised ESIA should be produced that evaluates all effects of the additional disturbance.	Arshak does not for a part of the mine development. There are no plans to mine Arshak and the area has been designated as the biodiversity set-aside in which no mining or ancillary operations will take place. The set aside will be maintained during the construction and operational phases of the Project (page 3.19 of Chapter 3 of the ESIA). We understand that the consultants conducted their work on the basis of only a partial review of the publicly available documentation; with respect to the set aside at Arshak it would appear that they were not aware of the existence of some key material.
Estimates should be made of the amount of mercury released to the atmosphere as part of the mining process, including from active	Mercury is not used in the ore processing. Rock samples show trace amount of native mercury in spent ore. In the unlikely event that mercury is recovered in the process, a retort is planned as an environmental

Buka Environmental comment	GRE Response
heaps, carbon columns, carbon regeneration, and the mercury retort, and mercury capture methods should be proposed to limit mercury releases to workers and the environment.	mitigation measure. No fumes will be released, and recovered mercury will be managed in a manner consistent with the site wide hazardous waste management plan.
The authors insist that the list of COPCs identified in the ESIA is too limited and should be expanded to include those listed above. The full list should be considered in the design of additional geochemical testing, treatment approaches, and environmental monitoring.	This is not the case. It is clearly stated that COPCs were representative of all the identified COPCs, which were selected for risk assessment, which is standard practice. The COPCs are selected on the basis of their properties to adequately and conservatively allow the assessment of the potential risks from all the COPCs. The risks from blasting agents are considered and assessed, for example ESIA Section 6.9.6 (page 6.9.28 and 6.9.29) and Appendices 6.9.2 and 6.9.3.
Additional geochemical testing should be conducted, including more acid-base accounting, mineralogy, and humidity-cell testing on samples from all proposed pits, waste rock, and ore. Additional geochemical testing units should be identified based on mineralogy and alteration and used for all testing. The additional HCTs should be run for at least one year, or until concentrations peak and stabilize, even if the samples produce acid rapidly. The results from the additional HCTs can be used to evaluate the “ferric iron resistance” of LV rocks proposed in	This programme of testing has been scheduled to continue over the next 12 months, this requirement has been clearly stated in the ESIA (and Feasibility Studies).

Buka Environmental comment	GRE Response
the ESIA and related documents and to determine if UV rocks should be used for construction materials or instead require special handling because of their contaminant leaching potential	
The numeric results for the geochemical testing program are not included in the current ESIA; this is a transparency issue and should be remedied by including the numeric results of all geochemical testing in a subsequent draft of the ESIA.	Numerical results are included in the Geochemical Characterization Report which as an appendix to the FS. Lydian has been fully-transparent with regards to sample results. The Buka report contains numerous tables of sample results in graphical and tabular form.
The amount of LV and UV rock, and the amounts of each geochemical testing unit identified and expected to be extracted, should be calculated and included in subsequent reports.	The quantities of LV and UV rock are mentioned multiple times in the FS. Please see the sections on the Barren Rock Storage Facility Design. This is a requirement of the ESMP and feeds into the detailed design of the BRSF.

4.0 REPORT 3: CLEAR COAST CONSULTING

Clear Coast Comment	GRE Response
The authors state that provisions for managing contaminated water from the pit, BRSF, and mine expansion are poorly developed. A lime treatment plant likely to be required after 10 years.	The studies completed for the ESIA baseline have indicated that the combination of surface water management together with discharge through a passive treatment system will be effective during the operational life of the site. The chemistry of HLF and BRSF effluent falls well within the range of water quality that can be treated by passive treatment technology. There is no indication that a lime plant is required to manage this water. However, the detailed design will be based on the program of testing and analysis, together with laboratory and field scale trials. These requirements are set out in the ESIA and ESMP and will determine the final design requirements for the passive water treatment system.
The authors state that BRSF seepage and weathering of LV waste within the BRSF will compromise cover.	The LV is not predicted to generate strong ARD. As a result, it will not compromise the cover. However, the ESIA requires a field test of the evapotranspiration cover, to inform the detailed design, this will include further predictions of the oxidation behavior of the LV under ambient conditions.
The authors state that an increased mine life may create problems with the current ARD management plan.	The ESIA and associated management plans, considers the construction, operation, closure, and post-closure phases (all active phases of the mine life). The management plans extent post closure for the period of time required to achieve stable and steady state conditions, monitoring of discharge water will continue throughout this period. Any further mine expansion will require an ESIA and include studies to determine the potential impact of additional waste storage.

Clear Coast Comment	GRE Response
The authors question how compounds like arsenic, mercury or thiocyanate will be removed when the heap is decommissioned.	Geochemistry analysis identifies that there are very low concentrations of arsenic and mercury in spent ore. Thiocyanate has not been tested, because all CN components are at or near the detection limit. After mine closure has been completed, the HLF drawdown will be actively treated until the drainage is stable and suitable for passive treatment, prior to discharge. It should be noted that the HLF passive treatment system is separate to that of the BRSF treatment system.
The authors expressed concern that the water quality from BRSF drain is underpredicted for metals concentrations.	Additional studies are planned to continue for the next 12 months, together with environmental monitoring of both ground and surface water. These include leachability testing from LV materials and will be used to inform the detailed design of laboratory and field trials required for passive treatment.
The authors express concern about the post-closure water treatment of the HLF.	ESIA and ESMP identify that post closure treatment will remain active until drainage can be treated in a passive treatment system separate to that of the BRSF.
The authors state that pit lake seepage and drainage will degrade water quality.	During operations, dewatering becomes part of the “contact water” circuit. The water in the pits will not be discharged into the environment and will be pumped and fully-consumed by the process. Therefore, this statement is incorrect Upon closure, the Tigranes/Artavaztes pit will be backfilled with Erato waste and graded to drain. The mine backfill will have a cover that minimizes the infiltration of water and, as a consequence, the formation of leachate. Erato will form a shallow pit lake. Since the baseline data indicates that pre-mining seeps exist on the mountain with low pH, it is expected that post-mining seeps on the mountain will result in, "no

Clear Coast Comment	GRE Response
	net change" condition. Indeed, studies performed by Golder confirmed that there is no significant water quality impact to these seeps
Conclusions	
The authors state that the proposed passive treatment systems for the closed Amulsar mine will not fully detoxify water.	Based on observed and predicted ARD conditions, the water quality that must be treated by the PTS is well within the historical proven range of feasibility for passive treatment technology. Experts in the field have full confidence in the use of passive treatment for this application. However, additional studies have been planned. The ESIA and ESMP refer to the requirements for further analysis together with lab and field scale testing of treatment system. These will be reported together with the detailed designs for the passive treatment system.
The authors state that there is no treatment of HLF drainage post closure - this is unacceptable because several toxic compounds, including ammonia, arsenic, mercury, thiocyanate and others, will be present for many years in the discharge from the closed HLF and will need to be treated.	This conclusion is not correct. The ESIA states that HLF drawdown and drainage will be actively treated, (predicted 1 year) until such time that the drainage can be treated in the HLF passive treatment system prior to discharge.
There is a broader concern that, with the current proposed mine plan, ARD will be generated for centuries after the mine is closed.	The MRCRP considers the period of time over which active management and mine maintenance will be required. Monitoring of discharge water will continue throughout this period. The drain-down from the BRSF and the HLF will be treated through the passive treatment system. The covers for both facilities are designed to mitigate the formation of ARD.

Clear Coast Comment	GRE Response
	The seeps and springs on Amulsar mountain are currently acidic. The post-closure conditions will be no different from current conditions. Due to the covering of the Tigranes/Artavaztes pit, the seeps may have less discharge. Studies performed by Golder show no significant impact on the local or regional groundwater quality from seeps on the mountain.

5.0 REFERENCES

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GRE welcomes 3rd party review of our technical work. If any of the above responses are unclear, we encourage further communication.

Yours sincerely,

Larry Breckenridge, P.E.

Global Resource Engineering Ltd.

Annex 3 Technical Memorandum

DATE 11 August 2017

REFERENCE NO. 1660086.555.A2 / 0-00-DTD-CIV-17160_1

TO Armen Stepanyan
Lydian Armenia CJSC

CC Robert Carreau

FROM Gareth Digges La Touche

EMAIL gdltouche@golder.com

RESPONSE TO REPORTS FROM MR H. BRONOZIAN

Golder Associates was requested by Lydian Armenia CJSC to provide comment on a number of reports prepared by Blue Minerals Constancy, Clear Coast Consulting Inc and Buka Environmental on behalf of Mr H. Bronozian. We have provided comments below on those aspects of the reports that relate to studies by Golder Associates. We have not provided comments on studies undertaken by others such as GRE Associates (see Annex 1 and 2). It is noted that Golder's assessment of impact on water quality has been based on source terms provided by GRE and design criteria provided by Lydian.

Blue Minerals Consultancy, 2017. Summary Report: Evaluation of Lydian Amulsar Gold Mining Project: Assessment of ARD Potential and Effects on Surface Water and Groundwater. Dated 18 June 2017.

Blue Minerals Consultancy (BMC) correctly states that the groundwater modelling undertaken by Golder Associates calculates a reduction of groundwater levels of up to 60 metres (m), but fails to note that this maximum change is in the vicinity of the BRSF rather than across the whole site area.

BMC go on to state that the "*redirection and reduction in springs and streams predicted within and around the mine site are of considerable magnitude*". While a reduction in spring flows is calculated it is noted, in Section 6.9.6 of the ESIA, that "*the change in groundwater recharge is predicted to have minimal impact on groundwater baseflow to the Vorotan, Darb and Arpa Rivers*" and that the calculated decrease in groundwater baseflow is "*approximately 2 % in the Vorotan River, approximately 2 % in the Arpa River and approximately 1 % in the Darb River*".

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As identified by BMC, it is stated in Section 6.9.7 of the ESIA that "*there are some predicted total losses of springs due to construction of the BRSF and the HLF*" and that the "*impacts are considered significant*". However what is not identified by Blue Minerals is that the total loss of springs is confined to these areas where large scale engineered structures are being constructed. It is stated in the following paragraph that "*Elsewhere, where springs are impacted, the predicted decrease in spring flows is not significant*".

It is stated in Section 6.9.7 of the ESIA that "*Significant impact to water quality at springs located around the pits is predicted with respect to beryllium, cobalt, nickel and nitrate as a result of leakage from the pits*". BMC imply that the only source of release of these minerals is "*the acid reactions in the pits and BRSF*" and that "*These major additions to apparently already high levels should not be acceptable*". It should be noted that the statement to which they refer is relevant only to the springs around the pits and not to the BRSF and that there is an existing natural acidic discharge from the springs around the pit with elevated metals concentrations. The actual impact of these changes in chemistry on quality in the rivers surrounding the operation (Vorotan, Darb, Arpa) is presented in Section 6.10 and is demonstrated to be low or negligible. BMC note a statement that "*No further groundwater mitigation options are presented*", this is because as stated in the previous sentence "*Design mitigation measures are proposed to limit the leakage from the pits*", in addition to ongoing environmental monitoring.

BMC identify that it is stated at Section 6.9.3 of the ESIA that "*There is also a significant impact predicted to groundwater quality adjacent to the Vorotan River as a result of leakage from the pits*". What is not made clear by Blue Minerals, as to why "*no additional mitigation is presented here to limit or avoid this impact*" is that the significance to the ultimate receptor, i.e. the Vorotan, is assessed in Section 6.10, where it is concluded that the magnitude of the impact is low and the significance is negligible. This also applies to the commentary regarding the potential impact on the Spandaryan-Kechut Tunnel.

With regard to the NI 43-101 report prepared by Samuel Engineering (March 30, 2017) BMC highlight that a statement in Section 26.7 that "*Additional studies are required to verify predictive models that were used within the water balance. Site runoff, evaporation, seep and spring flow, surface water flow, and pit dewatering models all require additional model verification against field data*". This is a standard requirement of any water balance model and it is conventional, indeed necessary, that ongoing data collection is undertaken to allow for continual refinement and calibration of the water balance model as operations progress.

Blue Minerals Consultancy, 2017. Evaluation of Lydian Amulsar Gold Mining Project: Assessment of ARD Potential and Effects on Surface and Groundwater.

At page 4 of their report BMC states that "*The discharge from the pits is unacceptable to the local environment, agriculture and communities using water below the mine. It has no planned treatment or mitigation*." As stated above it is demonstrated that the impact on the ultimate receptors (i.e. the Vorotan and Arpa rivers that the magnitude of the impact is low and the significance is negligible (ESIA, Section 6.10). In addition mitigation measures in terms of engineering and monitoring are proposed in the ESIA, Section 6.9).

BMC refers to pages 7 and 8 on the impact on groundwater. As stated above the maximum reduction of 60 m is local to the BRSF and is not site wide. BMC states the impact on groundwater levels "would certainly impact any bore water being used in the region". The impact on groundwater resources (there are no borehole supplies) including springs has been assessed and no significant impact has been identified (ESIA, Section 6.9.6).

The potential impacts on springs and groundwater adjacent to the Vorotan river is addressed in the preceding section and is identified and assessed in Section 6.10 of the ESIA no significant impact on the identified receptors has been identified.

In Chapter 2 of their report BMC highlights a number of activities which it states should have been completed before approval of the project, including seismic studies, further hydrogeological testing and spring flow measurements. It is considered that the level of information presented was sufficient for the NI 43-101 submission and that it is a normal part of any design process that additional studies may be required to advance a design to detailed design level.

Chapter 3 of the BMC report provides a summary of the Non-Technical Summary (NTS) section of the ESIA. It is noted that the final statement in this Chapter that "*no mitigation measures will be put in place for the pits and pit walls*" is incorrect and that mitigation in terms of engineering and monitoring are proposed.

Chapter 8 of the BMC report comprises a summary of and commentary on the water resources impact sections of the ESIA. BMC considers the impact on the Spandaryan-Kechut tunnel and local rivers may be significant along with the impact on agriculture. It does not provide any supporting justification for this speculation. The supporting evidence for the assessed level of impact is presented in Sections 6.9 and 6.10, and supporting appendices, of the ESIA. By way of example BMC states "*Table 8-6 on modelling of changes during operational phases finds only the loss of springs under the BRSF during operations to be of significance which appears at odds with their earlier assessment of some major changes in groundwater levels and flows*". As noted in the ESIA, Section

6.9 and Appendices 6.9.1 – 6.9.4, this is because the changes modelled in groundwater levels are not such as to impact on groundwater flows in other areas. BMC also states that the "v*ery general assessment criteria obscure the actual changes predicted in the earlier Summary of Post-Closure Changes (detailed above) and are not much use in judging potential impacts*". It should be noted that the impacts were based on analytical numerical modelling against both baseline water quality and the MAC II criteria. This is clearly stated in Sections 6.9 and 6.10 and Appendices 6.9.1 – 6.9.4 of the ESIA. The tables using descriptive criteria presented in Sections 6.9 and 6.10 of the ESIA provide a summary of these assessments using standard ESIA risk magnitude and significance terminology.

In Section 8.3 of Chapter 8, BMC concludes that a statement in the ESIA to the effect that the impact on springs in the vicinity of the open pits from metals from the backfill, that are naturally present in this mineralised area is "disingenuous" as "these are only released by the acid reactions in the pits and BRSF". The choice of wording by BMC suggests an intent to deceive, by the authors of the ESIA. This is not the case. The parameters used in the assessment are clearly set out in the ESIA and BMC's attention is drawn to the fact that the springs in the vicinity of the pits are naturally acidic with elevated concentrations of metals.

BMC makes play of statements in the ESIA that "*no further mitigation measures are proposed*", ignoring the fact that the assessment is being made based on design mitigation measures. The statement that "*no further mitigation measures are proposed*" reflects the results of the impact assessment that based on the design measures there is no significant impact.

Chapter 9 sets out a summary of and commentary on the surface water impact section (ESIA Section 6.10) of the ESIA. BMC notes the assessed impact on Beniks pond and streams in the headwaters of the Darb and state that "*No assessment of these considerable increases on down-stream and river catchment activities appears to have been made*". This is not the case, the impact has been assessed and mitigation measures are proposed (Section 6.10.8). The potential for a local significant impact is acknowledged. The impact on the Darb River downstream has also been assessed and it is concluded that there is no significant impact (ESIA, Section 6.10).

For Chapter 10, BMC indicates that it is stated in the Water Management Plan that excess water, comprising contact water (including "*ARD derived from the mining, pit dewatering, potentially acid generating (PAG) waste rock and heap leach areas*") will be released untreated to natural drainages downstream of the Project areas. This is not the case. It is clearly stated in the ESIA and Water Management Plan that water will only be released if it meets regulatory standards.

Buka Environmental, 2017. Evaluation of Hydrogeochemical Issues Related to Development of the Amulsar Gold Project, Armenia: Key Assumptions and Facts. Dated 19 June 2017.

It is noted that Buka Environmental (Buka) refer to the 2015 ESIA rather than the 2016 ESIA. Some of their comments reflect this.

Buka appears to be of the understanding (Section 2) that the ESIA states that no groundwater pumping will be required from the open pits. This is not the case and indeed the potential for groundwater inflow to the pits is modelled and assessed in the ESIA (e.g. Appendix 6.9.1).

Buka's understanding that Lydian "proposes to operate the mine as a zero-discharge facility" is not correct. It is clear in the 2016 ESIA that the mine will have controlled discharges to the environment. Likewise the site wide water balance does consider mining inflows and uses and is presented in the NI 43-101.

Buka's assertion that the potential inflows to the pit are based on an incomplete understanding of the hydrogeology. They are indeed correct to note that groundwater levels have been recorded at elevations higher than the design pit floor. However, based on our understanding of the hydrogeological regime of the area these represent perched groundwater (Appendix 6.9.1). Buka's assertion that the pit will require active dewatering from wells installed outside of the pit cannot be supported by the available data. In addition the uncertainties highlighted by Buka (e.g. fracture flow etc.) have been incorporated and accounted for in the assessment of the hydrogeology and the assessment of risk and impacts from the development.

Buka states that only a limited number of contaminants of potential concern (COPC) were considered in the water impact assessment of the ESIA. This is not the case. It is clearly stated that COPC that were representative of all the identified COPCs were selected for the assessment of risk. This is standard risk assessment practice. Those COPCs are selected on the basis of their properties to adequately and conservatively allow the assessment of the potential risks from all the COPCs.

Buka also asserts that the ESIA "does not consider COPCs added by the use of blasting agents such as ammonium nitrate-fuel oil, which would add ammonia, nitrate, and oil & grease". This statement by Buka is incorrect. The risks from blasting agents are considered and assessed, for example ESIA Section 6.9.6 (page 6.9.28 and 6.9.29) and Appendices 6.9.2 and 6.9.3.

In the summary section of its report Buka refers to the results of the groundwater modelling out of context. They correctly identify that the modelling shows groundwater will flow from the mine facilities to the Arpa and Vorotan rivers, but fail to draw attention to the fact that the risks to these rivers from the identified COPCs have been assessed in the ESIA as not significant. In addition they reiterate their belief that the "*mine plan and associated documents further assume that no*

groundwater pumping would be required to keep the pits dry during mining … and that no mine-influenced water will be discharged to the environment". As stated above this is not correct, the ESIA and NI 43-101 consider the entry of groundwater to the pit, the need for pumping to manage water in the pit and that there will be managed discharges from the project to the environment to meet the local regulatory (MAC II) standard.

Clear Coast Consulting Inc, 2017. Review of water treatment at the proposed Amulsar Gold project. Memorandum to Harry Bronozian dated 13 June 2017.

Clear Coast Consulting Inc (CCC) erroneously states in the second sentence of Section 1 of its memorandum that "*During operations, the mine is proposed to be a zero-discharge facility*". This is not the case and this is not the premise of either the ESIA or the NI 43-101 reports.

It is noted that unlike Buka, CCC recognises that groundwater inflows to the pit will be managed.

CCC correctly states in Section 5.3 of its memorandum that there "*is no contingency plan in case the pit bottoms and walls are sufficiently tight that the pit retains water and creates a pit lake*". Based on our hydrogeological understanding of the area and supporting modelling assessment the development of a permanent pit lake is not anticipated. This will be monitored as part of Lydian's ongoing programme of environmental monitoring.

Anon, 2017. Lydian Amulsar Gold Mine Project in Armenia Lacks Proper Environmental Evaluation and Management: Summary and Recommendations

This document presents a summary of the documents referenced above and no additional issues are reported.

We trust that the above is sufficient for your current needs. Should you have any questions please do not hesitate to contact the undersigned.

Yours sincerely

Gareth Digges La Touche
Principal Hydrogeologist & Associate

Brent Bronson
Project Director & Principal

GDLT/BB/wp

Record of Issue

Golder Associates (UK) Ltd has prepared the original of this report in English. Lydian Armenia CJSC and TransPerfect are responsible for the translation from English to Armenian, and Golder cannot accept any liability for any errors or omissions in the translated text.

«Golder Associates (UK)» ՍՊԸ-ն այս զեկույցի բնօրինակը պատրաստել է անգլերեն լեզվով: «Lydian Armenia» ՓԲԸ-ն և «TransPerfect» ընկերությունը պատասխանատու են անգլերենից հայերեն թարգմանության համար, և «Golder» ընկերությունը պատասխանատվություն չի կրում թարգմանված տեքստում առկա հնարավոր սխալների կամ բացթողումների համար:

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