

EAGLE GOLD PROJECT

Response to October 2012 YESAB Request for Additional Information
(YESAB Assessment 2010-0267)



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Attachment C	Letter from Knight Piesold re Eagle Gold Project – Updated Site Water Balance Model

1 INTRODUCTION

On October 24, 2012, the Executive Committee requested that Victoria Gold (VIT) provide supplementary information to the proposed Eagle Gold Project (YESAB Project No. 2010-0267) to enable completion of the Final Screening Report. The request includes five individual information requests resulting from Executive Committee review of comments received on the Draft Screening Report completed by YESAB on September 1, 2012. VIT is providing this report as an addendum to the Project Proposal to assist the Executive Committee towards completion of the screening assessment. This report is organized similarly to earlier responses to comments. The report is organized to provide:

1. **Background Information**—provided in the YESAB request for Additional Information
2. **Information Requests**—each individual information request as provided by YESAB
3. **Response**—supplementary information to the Eagle Gold Mine Project Proposal for each information request

Some of the individual responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as attachments to the report. The text immediately below provides context for supplementary information provided in this response, and also provides an update on the status of review of the Eagle Gold Project Proposal by the YESAB Executive Committee.

YESAA Overview

The Eagle Gold Mine Project Proposal is undergoing assessment under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) administered by the Yukon Environmental and Socio-economic Assessment Board (YESAB). YESAA provides an environmental assessment process whereby affected governments (territorial, federal or First Nations) use an assessment report and recommendation prepared by an arms-length assessment body to evaluate whether a project can proceed to the regulatory approvals process (permits, authorizations and licenses). Based on the size and complexity of the proposed project, the Eagle Gold Project requires a screening by the YESAB Executive Committee. During the screening, there are two opportunities for the public including governments (First Nations, Federal, and Territorial) and non-governmental organizations to comment on the Project. Notice of these opportunities is published, and all comments may be viewed on the YESAB Online Registry (YOR). During the screening, the Executive Committee evaluates public comments to determine whether YESAB requires additional information from the proponent to complete the assessment. The Executive Committee uses information provided by the Proponent to complete a Screening Report, which

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includes the Project Proposal and any supplementary information required by the Executive Committee.

There are four main stages of the Executive Committee review process as required by YESAA:

- **Adequacy**—YESAB determines adequacy of information provided by proponent
- **Screening**—YESAB completes assessment and drafts screening report
- **Recommendation**—YESAB provides recommendation to Decision Bodies that the project should proceed, proceed with terms and conditions, or not proceed
- **Decision**—Decision Bodies issue a Decision Document accepting, varying or rejecting the YESAB recommendation.

Timeline for Eagle Gold Project Proposal review

Currently, the Eagle Gold Mine Project Proposal is undergoing a screening by the Executive Committee of YESAB. Once complete, YESAB will provide a Screening Report with a recommendation to relevant Territorial and Federal Government Decision Bodies.

On December 20, 2010, Victoria Gold submitted the Eagle Gold Project Proposal as required by YESAA to the YESAB Executive Committee. The following is a brief summary of YESAA review milestones (also available via the YOR).

- December 20, 2010—Submission of Eagle Gold Mine Project Proposal to YESAB
- January 21, 2011—YESAB Executive Committee determined that Victoria Gold (VIT) met the statutory requirement under s. 50(3) of YESAA relating to consultation
- January 21, 2011—YESAB begins Adequacy Review period to review Project Proposal
- March 23, 2011—YESAB extension of Adequacy Review period
- March 29, 2011—YESAB provides Adequacy Review Report to Victoria Gold that requests supplementary information
- May 24, 2011—Victoria Gold submits supplementary information to YESAB
- June 23, 2011—YESAB extension of Adequacy Review period to review supplementary information
- July 15, 2011—Victoria Gold submits revised Project Proposal including supplementary information
- July 18, 2011—Adequacy Review Complete/YESAB Publishes Notice of Screening
- July 22, 2011—YESAB issues Preliminary Statement of Scope of Project
- July 22, 2011—Screening Review/Public Comment Period begins

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- August 12, 2011—YESAB Extension of Public Comment Period to August 31, 2011
- August 24, 2011—YESAB sponsored Public Meeting held in Mayo
- August 31, 2011—Public Comment Period ends
- September 1, 2011—Screening Review/Considering Comments stage begins
- September 14, 2011—YESAB issues revised Preliminary Statement of Scope of Project
- September 16, 2011—YESAB issues Victoria Gold a request for supplementary information as a result of Public Comments
- December 2, 2011—Victoria Gold submits response to YESAB request for supplementary information.
- February 27, 2012—Victoria Gold submits letter to YESAB regarding proposed modifications to the Project
- March 2, 2012—YESAB sends letter to Victoria Gold requesting revised Project Proposal information
- May 11, 2012—Victoria Gold submits Supplementary Information Report (SIR) to YESAB.
- June 25, 2012—YESAB issues Victoria Gold a Request for Additional Information.
- July 26, 2012—Victoria Gold submits Supplementary Information Report (SIR) to YESAB.
- September 1, 2012—YESAB issues Draft Screening Report.
- September 4, 2012—YESAB opens Public Comment Period seeking comment on Draft Screening Report.
- October 4, 2012—YESAB closes Public Comment Period seeking comment on Draft Screening Report.
- October 24, 2012—YESAB issues request for additional information to complete Final Screening Report.
- November 23, 2012—Victoria Gold submits Supplementary Information Report (SIR) in response to YESAB request for additional information (this report and attachments).

2 HEAP LEACH FACILITY

2.1 WATER BALANCE AND WATER MANAGEMENT

Background information from YESAB

A clear understanding of how water and process leach solution will be managed in the Heap Leach Facility (HLF) is necessary to ensure that adequate infrastructure is available to manage normal and upset conditions on-site. The First Nation of Na-Cho Nyak Dun (NND) has expressed concerns about the HLF water balance and operational draindown in their comments on the DSR (YOR #2010-0267-346-1). The Executive Committee has taken these concerns into account in preparing this information request.

The Proponent provided additional information on the HLF water balance in response to a request for additional information issued June 20, 2012. This information included details on modeling assumptions including sequencing of ore loading and leach solution application, changes to total amount of process leach solution inventory over time, and estimates of draindown timing and leach solution travel times. Part of the response included a technical memorandum titled "Eagle Gold Heap Leach Facility Water Balance – Revision 2" (YOR# 2010-0267-323-1) which provides additional information on the HLF water balance. NND has expressed concern that the tables included in this technical memorandum indicate that the HLF water balance does not account for sequencing of leaching and ore placement.

The HLF water balance tables appear to assume that, once the moisture content of ore under leach reaches 13.3 percent, it will not be released until mining and leaching are finished over the entire HLF. This does not appear to be a correct assumption as sequencing of leaching and ore placement will result in varying degrees of moisture content within the HLF. As indicated by the Proponent (VIT 2012), areas under active leach will have moisture content around 13.3 percent as process leach solution is recycled to that area. Once active leaching ceases in that area, moisture content will decrease, to between 5-13 percent, as leach solution drains down.

By not accounting for sequencing of leaching and ore placement, the predictions from the HLF water balance model may significantly underestimate the amount of process leach solution draining from areas where active leaching has ceased. Furthermore, predictions of makeup water required may be overestimated. This may lead to a surplus of water that must be managed through containment and/or treatment and discharge. Accurate predictions from the HLF water balance model are critical to ensure that there are adequate storage capacities and management strategies to deal with process leach solution and water with the HLF.

The Executive Committee requires additional information in order to determine potential effects relating to the storage, use, and management of water and process leach solution related to the HLF.

Therefore, please provide the following information:

- R1. Provide additional information on the Heap Leach Facility water balance model addressing concerns outlined by the First Nation of Na-Cho Nyak Dun including:**
- a. how the model accounts for the sequencing of leaching and ore placement, and;**
 - b. extent to which the model is able to predict operating conditions.**

R1 Response

Victoria Gold and its consultants have carefully reviewed this request for additional information and information submitted to date by VIT for YESAB review. Specifically, certain assumptions used by and results from the HLF WBM (revision 2), HLF draindown model, and the overall Site Water Balance Model (SWBM) submitted to YESAB on July 26, 2012 underestimated total process solution inventory at closure by incorrectly calculating the total volume of solution at the onset of draindown and by failing to reconcile the calculated volume of moisture in the heap from the HLF WBM (revision 2) and the July 2012 draindown model..

The Eagle Gold Heap Leach Facility Water Balance Model (HLF WBM) has been revised to address these errors and to respond to this request for additional information from YESAB, and specifically in response to concerns outlined by the First Nation of Na-Cho Nyak Dun. Revision 3 of the HLF WBM that serves as the basis for this response supersedes Revision 2 previously submitted on July 26, 2012. A technical memorandum entitled “*Eagle Gold Heap Leach Facility Water Balance – Revision 3*” that describes the revised HLF WBM is appended to this report as Attachment A.

The revised HLF WBM provides an improved and more detailed accounting of solution inventory over time via a monthly accounting of process leach solution, estimation of fresh make-up water requirements and environmental contributions while considering the sequencing of ore loading and leaching. The previous version of the HLF WBM (Rev 2) was used to conservatively predict make-up moisture requirements on a monthly basis (i.e., to maintain the optimum moisture content of 13.3% by mass) and did not provide a cumulative monthly accounting of solution inventory.

The revised HLF WBM accounts for inactive areas within the heap that are draining during operations, therefore solution is assumed to be released from the heap on a monthly basis. The previous HLF WBM assumed that once the stacked ore on the heap reached the optimal water content for leaching, it remained at the optimal moisture content with no solution released.

The following changes have been made to the HLF WBM:

- Segregation of active from inactive leach areas using pad phases,
- Calculation of an average moisture content based on expected drainage rates from active leached areas for each phase of the HLF,
- A set of operational process solution storage limits for the In-Heap Pond that governs the amount of solution that can be stored at any one time during operations, and
- Estimation of surplus process solution that exceeds the operating limits of the In-Heap Pond. For the purpose of modeling, this surplus is released to the Mine Water Treatment Plant (MWTP) for subsequent cyanide destruction and metals removal to ensure effluent criteria as regulated by MMER and receiving water quality objectives are met prior to discharge to Haggart Creek.

As a result of these changes, the revised HLF WBM provides the total volume of solution in the heap at any given month during operations. This provides a revised and accurate estimate of the cumulative process solution volume that will begin draining at closure.

After mining and ore loading to the HLF is complete leaching of stacked ore will continue for supplemental gold recovery via solution recirculation through previously actively leached areas. Residual leaching will cease once supplemental gold recovery decreases to unprofitable levels. Upon cessation of residual leaching the HLF will be detoxified via cyanide removal, and continue for a period of approximately 2 to 3 years. This process includes rinsing the HLF with a treated solution and raw water. The objective of rinsing the heap is to reduce the concentration of cyanide, cyanate, ammonia and nitrate in the heap. HLF solution will be processed through the cyanide detoxification circuit, which removes cyanide by oxidation, cyanate by acid hydrolysis, and ammonia by air stripping. The rinse solution will be recycled through the HLF after the initial cyanide oxidation step and/or after the complete detoxification circuit. Excess solution will be transferred to the Mine Water Treatment Plant (MWTP) for final treatment prior to discharge to Haggart Creek.

After cyanide, cyanate, and ammonia concentrations have been reduced to meet effluent criteria and receiving water quality objectives, the HLF will then be rinsed with raw water to further reduce cyanide, cyanate, ammonia, and nitrate. Following rinsing, the HLF will begin

to draindown which will be rapid during the first several months and will attenuate over time. The draindown rate and duration may require recycling excess solution in the event that the combined storage capacities of the in-heap pond and events ponds is exceeded and the rate of draindown exceeds the maximum treatment capacity of the MWTP. During the first year of draindown, the HLF will be re-contoured and capped with a store and release cover which will minimize infiltration and allow the heap to reach a steady drainage rate or equilibrium between infiltration and seepage. Once the residual draindown flow rate or heap seepage reaches a lower flow rate it may be routed through a passive treatment system prior to discharge to Haggart Creek if required to meet effluent criteria and receiving water quality objectives.

Based on the revised HLF WBM results, an updated HLF draindown model has been completed and accounts for the greater cumulative process solution volume at closure. Attachment B: Tetra Tech, *Revision to July 24, 2012 Seepage and Draindown Evaluation Memorandum* provides the results from the updated HLF draindown model. The model described in the memorandum represents the base case only, and does not incorporate the effect of assuming various water management strategies (i.e., recycling water back to the heap to manage the higher flows associated with draindown) or closure concepts (i.e., the effect of a store and release cover on reducing infiltration). These strategies are considered in the overall SWBM (Attachment C: Knight Piesold, Eagle Gold Project – Updated Site Water Balance Model).

The revised draindown model indicates that rate of HLF draindown will begin at the design irrigation rate of 2,770 m³/hr and decline quickly. It is estimated that after the completion of rinsing, approximately 344,000 m³ of rinsate solution will draindown from the heap in the first ten days and this grows to approximately 399,000 m³ after 30 days and approximately 536,000 m³ after 90 days. During this initial period of draindown, the combined storage capacity of the In-heap Pond and Events Ponds will be sufficient to store at least 382,000 m³ of rinsate (i.e., In-heap Pond of 199,400 m³ + Events Ponds of 183,000 m³) before requiring discharge to the MWTP. The total storage capacity of the system is 733,000 m³. Recirculation of rinsate back to the top of the heap will be conducted so that the capacity of the MWTP is not exceeded. The actual amount of rinsate that will be delivered to the MWTP is a function of the rate of other flows also reporting to the MWTP. This is described more fully in Attachment C (Knight Piesold 2012).

As shown in Figure 1, the draindown model predicts that baseline rate of draindown continues to decrease quickly to approximately 91 m³/hr (~25 L/s) after 90 days, 80 m³/hr (~22 L/s) after one year, 70 m³/hr (19 L/s) after two years, and approximately 35 m³/hr (~9.7 L/s) by the end of Year 10, ultimately approaching a meta-stable state associated with the average environmental contribution (i.e., precipitation – evaporation) of approximately

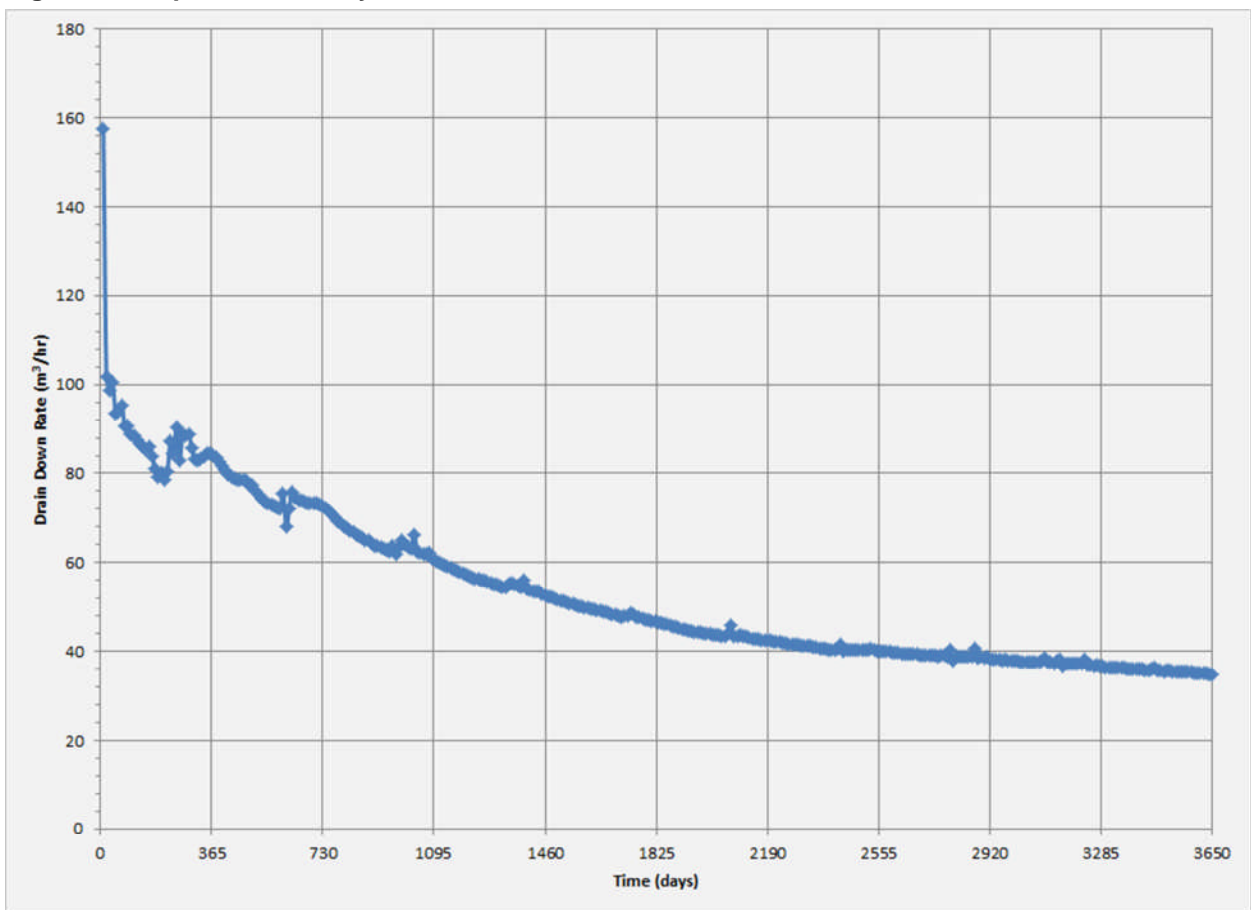
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30 m³/hr (~8 L/s). These rates are based on the baseline draindown rate and as mentioned above assume that the HLF is not covered and recycling of rinsate back to the heap is not conducted. It is expected that a cover would reduce infiltration by one-third to one-fourth of that amount, which would ultimately reduce HLF seepage rates by a proportionate amount.

The conceptual closure and reclamation plan includes a store and release cover that will reduce the draindown rate by reducing meteoric water inputs to the heap. As described in Attachment C (Knight Piesold 2012), the effect of the cover and recycling on the draindown process has been incorporated into the SWBM which shows that recycling rinsate back to the heap results in an extended period when the MWTP inflow rate of effluent will be maintained near the upper limits of operational capacity for approximately two more years during closure than previously reported.

Figure 1. Heap Leach Facility Draindown Curve



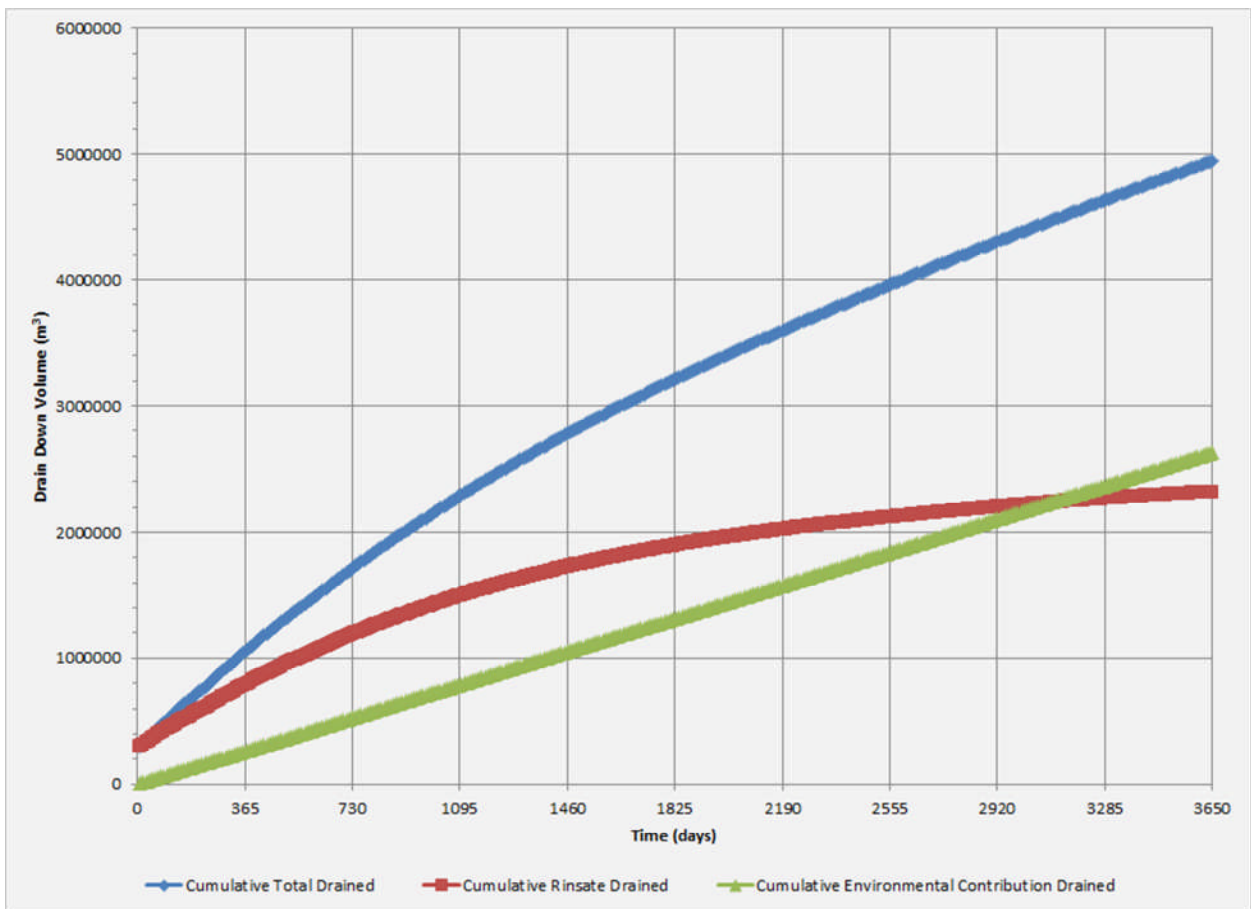
The revised HLF WBM indicates at the beginning of draindown (after the end of the rinsing period) there will be approximately 7,684,174 m³ of rinsate solution stored in the heap. As

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draindown proceeds, each year the environmental contribution adds to the total moisture content, so that over time rinsate is slowly replaced by the accumulating net environmental contributions (precipitation – [evaporation + sublimation]). Figure 2 presents the simulated cumulative draindown volume as the total cumulative volume drained, the cumulative rinsate drained, and the cumulative environmental contribution drained. In the early years of draindown, the rinsate quantity is the majority of the total cumulative solution draining. After approximately 8.5 years, water from environmental contribution is greater than rinsate solution volume. The addition of a closure cover over the heap surface will decrease the environmental water contribution to the heap during closure.

Figure 2. Heap Leach Facility Cumulative Draindown Volume



The overall SWBM has been updated to account for the changes to the estimates for make-up and excess water, and the updated draindown curve (see Attachment C: Knight Piesold, *Eagle Gold Project – Updated Site Water Balance Model*).

In summary, the updated HLF WBM with subsequent revisions to the heap draindown model and SWBM conclude the following:

- Total HLF solution storage capacity is adequate during operations with supplement recycling and/or water treatment and release starting in Year 4.
- Decreased requirements from previous estimate for fresh makeup water starting in Year 4.
- Total solution inventory at end of mine life including free solution and residual moisture content has increased from 1.7 million m³ to 7.7 million m³.
- HLF draindown during closure, without a cover, will take considerably longer (10-20 years compared to a few years) to reach a meta-stable seepage rate of approximately 8 L/s; comparatively, the previous draindown model predicted the meta-stable seepage rate would be less than 2 L/s within 2 years. This period would be slightly extended perhaps up to a few years by having to recycle rinsate back to the heap.
- HLF draindown during closure, with a cover that reduces infiltration of net precipitation, indicates draindown rates will be approximately 25% to 33% of the seepage rates without a cover.
- Mine Water Treatment Plant capacity is adequate to treat up to 600 m³ of solution per hour during operations and closure.
- The SWBM results indicate that the total solution storage capacity of the in-heap pond, ore moisture content, and events ponds is adequate to safely store all the process solution or rinsate at any time during operations and closure. This includes the discharge of treated waters through the MWTP (maximum capacity of 600 m³/hr) and the proper management of the heap draindown by utilizing the combined capacities of the in-heap and events ponds while at the same time recycling rinsate when the MWTP is receiving substantial flow from other facilities from the Project site. *total storage capacity of the in-heap pond and events ponds is 642,000 m³ without freeboard (freeboard accounts for an additional 81,000 m³).

R1a Response - provide a discussion on how the model accounts for the sequencing of leaching and ore placement.

The Heap Leach Facility Water Balance Model (HLF WBM) accounts for sequencing of ore placement on the pad, which may not have been clear in the previous Technical Memorandum titled *Eagle Gold Heap Leach Facility Water Balance – Revision 2* dated July 24, 2012. The model utilized a preliminary ore stacking plan prepared as part of the 2012 Feasibility Study. The use of a preliminary stacking plan is mentioned in Section 4.3 of the

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Technical Memorandum titled *Eagle Gold Heap Leach Facility Water Balance - Revision 2* however, the incorporation of the plan into the HLF WBM was not explained thoroughly.

As part of the response to R1a and R1b, Tetra Tech has revised the HLF WBM. A Technical Memorandum describing the revised model, assumptions and results titled *Eagle Gold Heap Leach Facility Water Balance – Revision 3 dated November 20, 2012* is included with this response as Attachment A.

The revised HLF WBM includes additional details regarding how the model accounts for sequencing of leaching and ore placement on the heap. Additional details regarding the use of the preliminary stacking plan have been included. These additional assumptions and calculations are provided in the spreadsheet Attachment C to the appended *Eagle Gold Heap Leach Facility Water Balance – Revision 3 dated November 20, 2012*. As indicated above the previous HLF WBM was not reconciled with the calculated volume of moisture in the heap used by the July 2012 draindown model. To resolve the solution inventory discrepancy between HLF WBM – Revision 2 and the July 24, 2012 Draindown Model report, estimates for solution inventory at closure and the initial drain-down volume were reconciled by re-running the draindown model using the HLF WBM Revision 3 estimated cumulative volume at closure.

Revision 2 of the HLF WBM assumed that all of the ore loaded on the pad is required to reach the optimal leaching moisture content of 13.3% by mass (or 22.8% by volume) and would remain at that moisture content during operations. This was a simple and conservative way to determine how much water is required to operate the HLF on a monthly basis. This estimate was *reduced* to account for inactive areas within the heap that are draining down during operations by the revised HLF WBM.

The revised HLF WBM includes the following modifications to account for the leaching, draining, and recycling processes:

- Leaching to achieve the optimal moisture content of 13.3% (22.8% by volume) is assumed to occur in active leaching areas only. Moisture content of ore located in previously leached areas will decrease to approximately 8.6% water content by mass (14.7% by volume) by draining after irrigation ceases in each active area. Optimal and residual moisture content was derived via laboratory test work results provided in the document titled *Eagle Gold Project Master Composite, 2009 Report of Conventionally Crushed Metallurgical Test Work* by KCA dated June 2011, which was provided as part of the 2012 Feasibility Study. This report is available upon request.
- For the purposes of the model (which is based on computing an average solution inventory over an homogeneous active zone), it is assumed that the solution

available for recycling each month is represented by the volume released from the previous month's lift assuming the moisture content decreases from 13.3% (by mass) to 8.6% (by mass) each month in the active area. Although in actuality, the process is continual and the moisture content remains at 13.3%, this assumption provides a method of monthly accounting of the recycled portion which flows through each lift.

- The calculated cumulative solution inventory assumes that the volume of solution can be approximated by averaging across the entire heap for the active and inactive leaching areas. The inventory calculation relies upon the ore loading (stacking) plan by HLF phase. Thus, the derived cumulative volume of solution is averaged across the entire heap and not by individual lifts or zones.

The HLF WBM includes several assumptions to calculate an estimated solution inventory by month. A detailed three dimensional stacking and leaching plan has not yet been prepared for the Project, so a method to estimate the changing moisture content in active and inactive leaching areas by each HLF phase was developed as part of the revised HLF WBM. A detailed three dimensional stacking and leaching plan will be prepared for the Project to support operations to further refine process solution and fresh makeup water requirements.

The HLF will be constructed in three phases as follows:

- Phase 1 – leach surface area is limited operationally by the geometry of the valley and a maintained stacking rate, while obtaining the best leach coverage.
- Phase 2 – major area expansion of HLF pad to increase ore capacity.
- Phase 3 – minor area expansion of HLF pad to increase ore capacity, with 'thick leach' blocks until the last year or so when pyramid-shape building starts and surface area on the top block is constrained.

Active leaching areas vs. inactive areas were estimated using preliminary stacking plans by calculating the percentage of area under active leaching relative to total ore that includes both active and inactive areas. The percentages of active vs. inactive areas were calculated for each stacking lift and average percentages were calculated for each phase of the HLF. The active and inactive area averages by phase accounts for the ratio of leached area in comparison to the total area of the current lift. The estimated percentages of active vs. inactive areas for each phase of the HLF are summarized in Table 1.

Table 1. Percentages of Active and Inactive Leaching Areas by HLF Phase

Heap Phase	Active Area Under Leach at 13.3% Optimal Moisture Content (by mass)	Inactive Area Draining to 8.6% Residual Moisture Content (by mass)
Phase 1	78%	22%
Phase 2	74%	26%
Phase 3	54%	46%

To determine the monthly fresh make-up water requirements, an Average Stacking Water Content was calculated as a percentage for each phase of the HLF using the Active and Inactive Area estimates from Table 1 (by mass). Average Stacking Water Content is the total moisture content throughout each HLF phase that includes all lifts and solution volume contained within active leaching areas and inactive areas. The Average Stacking Water Content is calculated by multiplying the Phase 1 Active Leaching Area (%) and Optimal Leaching Ore Moisture Content (%) and adding this to the product of Phase 1 Inactive Leaching Area(%) and Residual Ore Moisture Content after draining (%).

For example this assumes that 78% of the ore in Phase 1 of the HLF is being actively leached at 13.3% optimal moisture content (by mass) and 22% of the ore in Phase 1 is draining down to reach an equilibrium value of 8.6% moisture content (by mass). This results in an average stacking water content of 12.2% (by mass). Calculations of average water content for each HLF phase are summarized in Table 2.

Table 2. Average Ore Stacking Water Content

Heap Phase	Average Operating Water Content	
	% by mass	% by volume
Phase 1	12.2%	21.0%
Phase 2	12.1%	20.7%
Phase 3	11.1%	19.1%

For each month during operations, the incremental volume of process solution draining from inactive areas and available for recycling was calculated by subtracting solution volume at residual moisture from the total solution volume required for optimal leaching. This method calculates cumulative solution inventory using the key assumption that a homogenous moisture content will be maintained throughout the heap. In actuality the moisture content will vary throughout the heap from the optimal moisture content (13.3% by mass) to a drained down moisture content (8.6% by mass). The assumptions of homogenous moisture content throughout the heap and residual moisture content for inactive areas provide a reasonable estimation of process solution inventory over time.

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In conclusion, the revised HLF WBM (Rev 3) results in the following differences from the previously submitted HLF WBM (Rev 2):

- decreased makeup water requirements
- increased surplus moisture estimates
- an increase of total cumulative volume of heap solution inventory from 1.7 million m³ to 7.7 million m³

Revision 2 of the HLF WBM submitted to YESAB in July 2012 included a summary table (Table R1-2: Eagle Gold Project – Summary of Estimated Heap Leach Facility Solution Inventory). This table provides estimated volume of additional solution applied during each year of operations, estimated cumulative volume of solution in the heap at the end of each year, and the average operating volume of in-heap pond solution.

Table 3 provides revised results and additional information from what was previously provided in Table R1-2 in the July 2012 submission including estimated cumulative ore volume at the end of each period, total annual freshwater make up requirements, total annual excess solution released to MWTP, estimated cumulative volume of solution in the heap at the end of each year, the average heap moisture content for each year, and the average operating volume of in-heap pond solution per year. Attachment A: Tetra Tech, *Eagle Gold Heap Leach Facility Water Balance – Revision 3* provides additional detail including model assumptions results by month throughout operations.

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Pursuant to the Yukon Environmental and Socio-economic Assessment Act

Table 3. Summary of Estimated Heap Leach Facility Solution Inventory

	Phase 1	Phase 2					Phase 3			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Estimated Cumulative Ore Volume at end of Period (m ³)	4,097,222	9,833,333	15,569,444	21,305,556	27,041,667	32,777,778	38,513,889	44,250,000	49,986,111	51,012,875
Total Annual Freshwater Make-up Requirements (m ³)	210,513	212,122	62,151	0	0	0	0	0	0	0
Total Annual Excess Water Released to MWTP (m ³)	0	0	0	12,363	11,709	0	75,847	70,944	62,599	0
Estimated Cumulative Volume of solution stored in Heap at end of period (Solution Inventory) (m ³)	652,638	1,509,269	2,474,020	3,340,488	4,186,154	5,024,035	5,872,414	6,718,081	7,563,747	7,684,174
Average Heap Moisture Content at end of Period (% Mass) *includes active and inactive leaching areas	9.3	9.0	9.3	9.1	9.0	8.9	8.9	8.9	8.9	8.8
Average Operating Volume of In-Heap Pond (m ³)	35,718	38,708	117,020	172,315	182,226	174,743	184,300	186,710	186,270	172,451

R1b Response - discuss the extent to which the model is able to predict operating conditions

As discussed in Response R1-A, the revised HLF WBM is a monthly time-stepped solution inventory model that calculates average monthly conditions over the entire heap, as well as the cumulative volume of solution inventory. The HLF WBM does not predict the short-term on-pad individual block moisture content per lift over time. During operations, solution draining from both active and inactive areas will be processed continuously through the ADR plant and recycled for re-wetting of the active block for gold leaching. Thus, the revised HLF WBM is constructed to estimate monthly fresh water make-up requirements and monthly excess solution volume requiring release to the MWTP, while providing the cumulative solution inventory over time. While the model provides an estimate of excess moisture, it conservatively assumes that this volume would be released to the MWTP for treatment and discharge to the receiving environment. However, excess solution inventory will be managed using the following options as follows in priority:

1. Used as make-up water to yield zero discharge to the MWTP.
2. Recycling additional fluid to inactive areas on the pad where it is put into short term storage to yield zero discharge.
3. Transfer of excess solution to the Event Ponds for short-term storage and recycling in the HLF process circuit to yield zero discharge.
4. Delivery of excess solution directly to the MWTP for treatment prior to discharge.

In case of an emergency power shutdown and short-term draindown, backup generators will pump solution and recycle the fluid back on to the pad, to the Events Ponds, and/or to generator-powered MWTP to treat solution prior to discharge. Once grid power is restored, leach pad water balance will be stabilized. In the event back up power generation is not available, the in-heap pond and events ponds are sized to contain all solution freely draining from the heap in a 72 hour period without pumping capacity. The largest possible 72 hour draindown volume is the nominal application rate of 2,770 m³/hr multiplied by 72 hours which equates to 199,440 m³.

The cumulative solution inventory throughout operations is calculated by the revised HLF WBM. Since any short term (< one month) operational drain down and recycling sequence has no material impact to the monthly water balance, the averaging assumptions allow the HLF WBM to calculate the growth of solution inventory over time without tracking individual zones or areas of varying moisture content.

The physical stacking sequencing of ore for leaching is included in the revised HLF WBM. Moisture content has not been modeled for each leach block and analysis of shortened leach cycles (leach impairment) has not been incorporated. Although the leach cycle is

assumed to be 150 days to complete the cycle and maximize gold recovery, the current stacking plan compresses the cycle in many lifts to expedite gold recovery which results in a short-cycling of some leach blocks. This means that full cycle leaching terminates 'early' for some blocks, and solution irrigation lines are moved off before full leaching is completed. The next fresh (unleached) lift of ore is stacked on top of ore just leached and leaching resumes in a much more compressed time frame that is not optimal from a material handling and gold recovery perspective. The residual leaching period after stacking is complete prior to detoxification will allow for this supplemental gold recovery from leach blocks that had shortened leach cycles. The revised HLF WBM, includes simplified operational drainage and recycling assumptions as described by the three phased approach in response R1a above.

2.2 IN-HEAP POND FREEBOARD

Background information from YESAB

The HLF in-heap pond will have an operational volume between 60 000 and 194 000 m³ and a total volume of approximately 459 000 m³. The Proponent has indicated that the HLF in-heap pond will include one meter of freeboard which will allow a total volume of approximately 507 000 m³. Comments from Environment Canada (YOR #2010-0267-339-1) and Government of Yukon, Department of Environment (YOR #2010-0267-337-1) have expressed concern with the suitability of one meter of freeboard for the HLF in-heap pond.

The nature of the HLF is such that the pore space of the ore within the HLF constitutes the volume of the in-heap pond. Typically, one meter of freeboard is suitable for dams that retain only water. Given that much of the volume within the one meter of freeboard proposed by the Proponent will be occupied by ore, it is unclear whether there is adequate freeboard. The Executive Committee requires additional information in order to determine potential effects relating to the suitability of the freeboard within the HLF in-heap pond. Therefore, please provide the following information:

R2. A discussion on the suitability of one meter of freeboard within the in-heap pond portion of the Heap Leach Facility to manage potential surplus water.

R2 Response

The proposed design, construction, operation, maintenance and surveillance of the HLF including the embankment and spillway are derived from the Canadian Dam Association Dam Safety Guidelines (2007). The Yukon Water Board Licensing Guidelines for Type A Quartz Mining Undertakings recognizes the CDA guidelines. The guidelines state that the

objective of freeboard is to ensure a safety margin is maintained at all time to prevent overtopping of the dam.

Dams are designed with spillways to safely convey flood flows around or through the dam to prevent overtopping and potential failure. In any impoundment, once fluid level reaches the elevation of a spillway invert, the fluid level is controlled by the conveyance capacity of the spillway. In simple terms, if the inflow rate to the spillway exceeds the outflow rate overtopping is possible. To prevent this scenario, the HLF embankment spillway has been conservatively designed to convey the Probable Maximum Flood (PMF) flow rate of 27 m³/s.

The Project Proposal and accompanying documents (i.e., Tetra Tech's February 9, 2012 Technical Memorandum entitled "In-Heap Pond, Spillway and Events Ponds Sizing"), indicates that a minimum of 1.0 m of freeboard is required to meet CDA guidelines, and so may have implied that the current design has only 1.0 m of freeboard; however, the current design exceeds this minimum requirement.

The maximum design in-heap pond level is established primarily by the HLF spillway invert elevation. Freeboard is defined as the difference between the embankment crest elevation and the elevation of the maximum design in-heap storage level. The design crest elevation of the embankment is 891 m asl, and the elevation of the spillway invert is 889 m asl. There is a 2.0 m difference in elevation between the embankment crest and spillway invert, therefore the current design includes 2.0 m of freeboard – not 1.0 m. Because the water surface elevation in the in-heap pond at the embankment cannot rise above the spillway invert during the PMF, 2.0 m of freeboard is sufficient to meet CDA guidelines.

As stated in previous submittals, the total in-heap pond storage capacity is 459,000 m³ plus 48,000 m³ of freeboard. The total events ponds storage capacity is 183,000 m³ plus 33,000 m³ of freeboard. Combined the total storage capacity of the HLF system (in-heap pond and events ponds) is approximately 642,000 m³ plus 81,000 m³ of freeboard. .

2.3 PROJECT COMPLIANCE WITH THE METAL MINING EFFLUENT REGULATIONS

Background information from YESAB

The *Fisheries Act*, including the Metal Mining Effluent Regulations (MMER), provides Environment Canada with legislative authority to control water pollution, including mining effluent. In their comments (YOR #2010-0267-339-1) Environment Canada indicates that the liner system in the upper portion of the HLF may not comply with MMER. MMER requires effluent flow rates from all discharge points to be measured within 15 percent accuracy (Section 9) and prohibits dilution of effluents prior to monitoring and discharge

(Section 6). Therefore, design changes or modifications may be required in order to comply with MMER.

The Executive Committee believes that if outflow volumes or water quality cannot be appropriately measured, the effluent will be difficult to properly monitor and regulate. This could result in significant adverse environmental effects due to effluent discharge. Please provide the following information.

R3. Demonstrate and explain how the proposed Heap Leach Facility liner system in the upper portion will comply with the Metal Mining Effluent Regulations (Sections 6, 9 and 19).

R3 Response

VIT appreciates comments from Environment Canada regarding whether the current liner design in the upper zone of the HLF may comply with Metal Mining Effluent Regulations (MMER). VIT understands that MMER will apply to the Project during the operations and post-closure phases. During operations, VIT proposes that the MMER compliance point will be the final discharge point from the Mine Water Treatment Plant (MWTP), as all affected water from the HLF, WRSAs and open pit will be routed to MWTP prior to discharge. As the Project transitions from operations through closure and reclamation and into post-closure, the MMER compliance points will be located at discharge points from the passive treatment systems of the HLF and two waste rock storage areas.

All final discharge points have been preliminarily identified for the Project. VIT will work with Environment Canada, Yukon Environment and the Yukon Water Board Secretariat towards finalizing all MMER compliance points. VIT will ensure that effluent volume from each final discharge point will comply with Sections 6, 9 and 19 and will be measured according to the MMER and achieve an accuracy to within 15% of measured flow rate or volume. No effluent will be diluted prior to monitoring or discharge.

VIT is confident that MMER will not apply to the upper portion of the HLF because of the overall design of the HLF, including the natural features of the hydrographic basin, the solution management system, and the design criteria for the composite liner system. The HLF system is designed with the primary design criteria to prevent discharge of process solution to surface water bodies, other than at the final discharge points noted above. The following points provide additional rationale.

- The HLF valley-fill design results in Phase 2 and 3 (the upper zone) to occur wholly within a single hydrographic (or groundwater) basin. This means that any subsurface drainage from the basin would flow downgradient within the basin and be captured by the underdrain system, such that any subsurface drainage that might

occur in the upper zone of the HLF will report directly to the underdrain sump below Phase 1.

- The HLF solution management system, including the various components such as the embankment and spillway, upper and lower composite liner designs, pond storage facilities, and piping conveyances to the cyanide detoxification plant provide a boundary to contain ore and process fluids. This system has been designed to prevent the discharge of process solution to surface water bodies and therefore does not meet MMER's criteria for the identification of a final discharge point.
- Design criteria for the composite liner system indicates that it is highly unlikely that measureable leakage of effluent will occur through the HLF liner in the lower and upper zones. Specifically regarding permeability, the proposed liner system design criteria calls for a 1×10^{-9} m/s permeability soil layer which corresponds to a maximum leakage rate of 3.5 L/day. The proposed permeability criteria is an order of magnitude lower than that required by the Nevada State Guidelines. A detailed discussion of the overall suitability of the composite liner system and its ability to prevent measureable leakage and protection of groundwater is provided in Response R6 of the Supplementary Information Report submitted to YESAB on July 26, 2012.

The MMER were developed under Section 36 of the Fisheries Act to regulate the deposit of mine tailings, and other waste matter produced during mining operations, into natural fish bearing waters (DFO 2012). The principal objective of the MMER pertains to surface water bodies and applies to the total effluent collected and sent to a final discharge point(s) and to the deposit of deleterious substances in water or under conditions where the deleterious substance could reasonably enter water. Minor leakage into unsaturated ground that will report to underdrains in the HLF by following fundamental unsaturated and saturated flow processes do not amount to 'effluent' as contemplated by the MMER. The HLF is designed so that leaks will not enter receiving water that are frequented by fish or are classified as fish habitat.

The HLF system is designed to discharge to the MWTP, such that there will not be a MMER compliance point emanating directly from the HLF. As described in the July 2012 response to YESAB request for additional information, the Eagle Gold HLF design has been prepared in accordance with generally accepted engineering practices and Best Available Technology to provide a high level of protection to both surface water and groundwater. The HLF and associated facilities are designed to operate without structural failures that may result in discharge of process leach solution to the environment.

The HLF liner system has been designed so that it will not leak or result in measureable leakage. As described in previous supplementary information provided by VIT, the

proposed liner system in the upper zone of the HLF is a single composite system that includes a Linear Low Density Polyethylene (LLDPE) geomembrane and reinforced Geosynthetic Clay Liner (GCL) that will consist of a layer of sodium bentonite between two nonwoven geotextiles, which are needle punched together. Sodium bentonite swells when wetted and through this expansion creates a hydraulic seal with very low hydraulic conductivity (5×10^{-9} cm/s). The material properties will greatly inhibit the flow of process leach solution (PLS) through or within the GCL layer of the composite liner system. Thus, it is highly unlikely that measureable leakage of effluent will occur through the HLF liner in the lower and upper zones due to the design of the composite liner system.

In the event unplanned measureable leakage would occur from the upper liner system, an underdrain system will provide leak monitoring capability for the upper HLF area. The underdrains will be placed at regular intervals and below PLS header pipe corridors where flows will be concentrated during leaching operations, thereby providing leak monitoring of critical areas most likely to have fluid present on the liner system during much of the operational life of the facility. The underdrain system has been designed to drain any fluid occurring near the liner interface with the objective to limit upward pressure on HLF liner system.

The HLF underdrain system enhances drainage of collected water beneath the lined facility. However, the depth to groundwater below Phase 2 and 3 of the HLF (upper zone) is currently 15-25 m below ground surface (see R6-b in the July 2012 Supplementary Information Report). The depth of groundwater below ground surface is predicted to decrease a substantial amount over time because groundwater recharge will be inhibited by the liner that will cover almost the entire basin. Thus, while the underdrains are required components of the design, they will most likely be dry throughout the upper zone of the HLF.

The underdrains will be spaced at regular intervals throughout the HLF basin and will be constructed with geofabric wrapped around granular drain rock backfill materials and perforated pipes. The entrenched underdrain pipes will convey fluid to non-perforated header pipes located along the valley bottom which will drain by gravity flow from the HLF area beneath the in-heap pond and confining embankment to an underground monitoring sump. The sump will be designed to accommodate an automated pump arrangement that will be capable of pumping flows back to the HLF, if needed. The sump will be monitored for flow quantity and water quality.

Thus, while the liner system is designed to prevent discharge of effluent, in the unlikely event of leakage from the upper zone of the HLF, the underdrain system and sump provide for the collection, monitoring and recirculation of any leakage such that the system remains closed. This will prevent discharge to receiving water.

Further, as part of the Project's Environmental Monitoring Program, monitoring wells will be installed in specific areas downgradient of the HLF to provide both collection of groundwater that will have originated from within the HLF valley-filled hydrographic basin, and detection of affected groundwater. These wells will be monitored on a regular and periodic basis in compliance with a Type A Water Use License. In the very unlikely event that process solution is detected in these monitoring wells, mitigation would include the use of interceptor wells or drains to prevent discharge to receiving water - if concentrations and flow dynamics indicate there would be a risk to downgradient receptors.

The release of process solution from the upper (and lower) zone of the HLF to the receiving environment is highly unlikely due to a series of impediments and monitoring, including the HLF liner, the underdrain and collection system, the natural confinement of flow lines by the hydrographic basin, the downgradient monitoring, and the considerably arduous subsurface travel pathway from the HLF to a receiving water body.

VIT is confident MMER does not apply to the HLF liner and that the liner as designed offers a degree of protection to ensure that significant effects to Valued Socio-Economic and Environmental Components will not occur for the above reasons.

However in the event regulatory agencies require additional information regarding the HLF liner design to ensure it meets applicable regulations and guidelines, VIT will be pleased to provide it as required during a regulatory review process. Specifically, VIT will be pleased to provide additional information during the review of the Type A WUL application to ensure the Project complies with MMER.

Reference DFO 2012. Metal Mining Effluent Regulations, Fisheries and Oceans Canada, <http://www.dfo-mpo.gc.ca/habitat/role/141/1415/14156-eng.htm>.

3 DELINEATION OF PERMAFROST

Background information from YESAB

Construction of major mine infrastructure on or adjacent to areas of ice-rich soils and permafrost may result in decreased terrain and infrastructure stability. In the Draft Screening Report (DSR), the Executive Committee determined that additional mitigations were required in order to mitigate significant adverse effects related to terrain and infrastructure instability. With respect to the HLF, this included the following recommendations (DSR p.137):

69. The Proponent shall implement the mitigations recommended by their geotechnical consultants (BGC Engineering) regarding the stability of the Heap Leach Facility and embankment including:

- a. conduct additional investigations to delineate and characterize ice-rich soils/permafrost and the risk on stability;
- b. excavate foundation to bedrock in area of HLF confining embankment and the diversion embankment; and
- c. installation of geotechnical instrumentation within and below the HLF to monitor and verify that the facility components are performing as expected and to provide sufficient warning in the event of problematic conditions.

70. The Proponent shall identify and excavate ice rich soils/permafrost beneath the footprint of the HLF.

In their comments, NND (YOR #2010-0267-346-1) and Yukon Conservation Society (YCS) (YOR #2010-0267-341-1) expressed concern regarding the outcome of these recommended additional subsurface investigations and excavation of ice-rich soils/permafrost. NND and YCS agreed that these recommendations are necessary. They indicated, however, that there are concerns and uncertainties related to the outcome of those investigations. Results of additional sub-surface investigations may lead to unanticipated outcomes. For example, increased volumes of ice-rich soils/permafrost may be delineated and will need to be managed accordingly. Sub-surface investigations may also result in required changes to mine-site infrastructure in order to account for unanticipated outcomes.

The Executive Committee requires additional information in order to understand the proposed approach to dealing with uncertainties relating to additional subsurface investigations. Therefore, please provide the following information:

- R4. Provide a discussion on how unanticipated outcomes as a result of recommended additional sub-surface investigations and removal of ice-rich soils/permafrost (term and conditions number 69 and 70 from the DSR) will be managed including:**
- a. contingency measures to deal with unanticipated volumes of ice-rich soils/permafrost, and;**
 - b. design of mine-site infrastructure, in particular the Heap Leach Facility**

R4a Response

VIT conducted additional investigations in the summer and fall (2012) to further delineate and characterize ice-rich soils, including work along the Dublin Gulch Diversion Channel (DGDC) and other areas. To support the applications for Quartz Mining and Type A Water Use Licenses subsurface data from these new and previous geotechnical studies

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throughout the project site have been used to develop estimated quantities of ice-rich material for specific functional areas (i.e., HLF, DGDC, crusher pads, truck shop, etc.) that will require management. Thus, we now have sufficient information to develop methods to manage ice-rich materials including the stripping, excavation, drainage of a known quantity of ice-rich soils and the specific need for design attributes that provide containment, drainage and control of this material.

VIT and predecessor companies involved with development of quartz mining at Dublin Gulch have engaged in numerous and extensive site investigations which have examined subsurface conditions at the locations of proposed mine site infrastructure, using a variety of field and laboratory techniques. Given the presence of discontinuous permafrost in the area, close attention was given to observing and describing frozen ground in all of these investigations, including observations of excess ice where encountered. These investigations have resulted in a high degree of confidence in the volume estimates of ice-rich material throughout the Project site.

Site subsurface conditions observed at the Project site prior to 2012 have been described in several reports as follows:

- Report on 1995 Geotechnical Investigations for Four Potential Heap Leach Facility Site Alternatives, First Dynasty Mines, Dublin Gulch Property. (Knight Piésold, 1996a).
- Report on Feasibility Design of the Mine Waste Rock Storage Area, First Dynasty Mines, Dublin Gulch Property. (Knight Piésold, 1996b).
- Field Investigation Data Report, Dublin Gulch Project, New Millennium Mining. (Sitka Corp, 1996).
- Hydrogeological Characterization and Assessment, Dublin Gulch Project, New Millennium Mining. (GeoEnviro Engineering, 1996).
- BGC Engineering Inc. 2009. Site Facilities Geotechnical Investigation Factual Data Report. Eagle Gold Project, Victoria Gold Corporation.
- Stantec. 2010. Project Proposal for Executive Committee Review. Pursuant to the Yukon Environmental and Socio-Economic Assessment Act. Eagle Gold Project, Victoria Gold Corp.
- BGC Engineering Inc. 2011a. 2010 Geotechnical Investigation for Mine Site Infrastructure, Factual Data Report. Eagle Gold Project, Victoria Gold Corporation.
- BGC Engineering Inc. 2012a. 2011 Geotechnical Investigation for Mine Site Infrastructure, Factual Data Report. Eagle Gold Project, Victoria Gold Corporation.

As described above, additional subsurface investigation work was completed by BGC Engineering Inc. in the summer and early fall of 2012. Results of this work will be made

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available with applications for a Quartz Mining License and Type A Water Use License in early 2013 pending completion of the YESAA screening. The objective of the 2012 investigation work was to obtain additional subsurface data in critical design areas that had relatively high uncertainty, due to relative lack of existing data. This work included test pits and drill holes along the alignment of the DGDC and at the proposed truck shop and crusher locations, plate load tests and outcrop mapping at the proposed crusher locations, and test pits within the proposed topsoil storage areas.

A total of 463 test holes have been made within the Project footprint with observations about the presence and character, or absence, of ice-rich material and permafrost. This includes a total of 122 observations within the footprint of the HLF, which includes three phases of pad development, the heap embankment, events ponds, and the DGDC. The DGDC has been subdivided into three sub-components – upper, middle and lower reaches – as it passes through different physiographic settings in these three areas. Using compiled data and observations from the numerous test pit and borehole logs, average thicknesses of ice-rich material have been quantified for each of these areas, as well as for all other areas of proposed development on site. Most areas within the footprint of the proposed HLF, other than parts of the DGDC, have low expected average thicknesses of ice-rich material (i.e. ranging from 0.00 m for phase 3 of the heap leach pad to 0.28 m for the heap embankment). The confidence in these estimates, based on spatial density of subsurface data and proportion of observations where the full depth of permafrost was explored, is high in all areas of the HLF except for somewhat less confidence in the areas for HLF phases 2 and 3 (which will not be developed until well into mine operation), where the expected average thickness is very low (0.00 to 0.03 m). Anticipated thicknesses of ice-rich material are higher in the upper and middle reaches of the DGDC, where the expected average thicknesses are 0.42 m and 3.71 m, respectively. Although some permafrost will not be ice-rich and this material will not require management, VIT is developing plans to address the range of expected quantities of ice-rich material from the entire project site that will require various types of management and so do not need to develop contingencies for an unspecified quantity. The overburden and waste rock management plan that will be submitted as part of application for a Quartz Mining and Water Use License includes an ice-rich soils management plan.

A total of approximately 770,000 m³ of ice-rich material has been delineated throughout the Project site. It is expected that this material will require some type of management throughout the Project construction and operations phase, including up to 489,000 m³ in the first year of construction, 115,000 m³ in the second year and 165,000 m³ in subsequent years. Over half of the first year's material occurs within the middle reach of the DGDC, the HLF Phase 1 pad and along rockdrain footprint of the Eagle Pup WRSA. . The

management of these volumes will be sequenced throughout the two year construction period and the development of the three phases of HLF pad construction. Therefore, not all ice-rich soil will require management at once or in a short time period.

VIT is in the process of preparing a waste rock and overburden management plan to support applications for a Quartz Mining License and Type A Water Use License. The plan will include a sub-component plan specifically addressing the management of ice-rich soils encountered during site development activities. The plan will include engineering controls for management of these materials, and may include some or all of the following options as specific components of the plan:

- Stripping of the insulating layers from areas known to have relatively thin zones of ice-rich material to encourage thawing and drainage into appropriately sized and designed sediment control plans to effectively remove total suspended solids prior to discharge of water. Once thawed and drained the materials will be used in place or excavated for use elsewhere (e.g. construction or closure activities) depending on facility-specific foundation requirements;
- Excavation, removal and then deposition of ice-rich materials in isolated or closed basins (without discharge to surface waters) in existing borrow sites located within placer tailings deposits in the Haggart Creek valley; and
- Excavation, removal and then deposition of ice-rich materials in engineered facilities with free-draining rockfill berm retention structures, either as valley fill, side-hill fill, a partition within the proposed Platinum Gulch waste rock storage area, or, co-disposed in controlled proportions with waste rock in one or both waste rock storage areas.

The appropriate management method(s) will depend to some degree on the character of the excavated ice-rich materials, particularly their grain size distribution and ice content. Finer-grained materials with a higher ice content will thaw and drain more slowly, and will be stored at relatively flat angles of repose. These materials once thawed and drained may be suitable for re-use in closure applications as topsoil or fine-grained cover material. Coarser-grained materials with lower ice content can be expected to drain more quickly on thawing, and will be segregated from the finer materials. As stated, some of the permafrost on site is not ice-rich and this material will not require the same degree of management.

While there remains some uncertainty about the precise distribution of permafrost in some areas of the Project site, due in large part to its sporadic presence, the distribution of ice-rich material at the locations of proposed facilities is well understood for the purpose of planning, design and construction of mine site facilities. Because confidence in the quantities of ice-rich permafrost in the HLF is high, uncertainties in volume estimates can easily be incorporated into the current development of management plans.

R4b Response

With respect to potential changes to mine-site infrastructure in certain areas, as described above, new subsurface data was obtained along the DGDC in 2012 suggest the need for some minor design modifications for proposed cut slopes adjacent to the middle reach of the DGDC where ice-rich materials tend to be thicker. While the cut slope design modifications are underway as part of detailed engineering design and will support applications for Quartz Mining and Water Use licenses, the probable modifications will include a protective layer of granular material over exposed ice-rich material. The purpose of the protective layer is not to preserve the ice-rich material, but rather to buttress and drain. Further, based on the work recently conducted, we have a high confidence of the overall quantities of ice-rich material in the Phase 1 HLF pad, embankment and events ponds and have determined that specific design modifications associated with the presence of these materials is not required. The current management strategy to handle the ice-rich material within the foundation of the heap leach pad, embankment or ponds, consists of excavation and removal, followed by replacement with stable materials. This is consistent with recommended term and condition #70 which states “The Proponent shall identify and excavate ice-rich soils/permafrost beneath the footprint of the HLF”.

4 WATER QUALITY MODEL

Background information from YESAB

Several concerns were raised with regards to the source term predictions and the water quality model. Environment Canada (YOR #2010-0267-339-1), YCS (YOR #2010-0267-341-1), and Government of Yukon, Department of Environment (YOR #2010-0267-337-1), indicated that the lack of geochemical characterization leads to uncertainties in source term predictions. NND (YOR #2010- 0267-346-1) expressed concern related to the lack of an updated water quality model. These uncertainties have implications for water quality predictions and the effectiveness of the mine water treatment plant (MWTP).

Government of Yukon, Department of Environment (YOR #2010-0267-337-1) has also expressed concern with regards to cyanide predictions in the water quality model. The water quality model presented in Appendix 25 to the Project Proposal (Technical Data Report: Water Quality Model) outlines contact water input predictions to and effluent discharge predictions from the MWTP. It appears that contact water input parameters for Cyanide include weak acid dissociable (WAD) Cyanide, total Cyanide, and cyanate. However, the water quality output, or effluent discharge criteria from the MWTP, is free Cyanide. Furthermore, Government of Yukon has indicated that leachate quality from column tests conducted for the HLF were not used as input to the water quality model.

The Executive Committee is aware that the Proponent is developing an updated water quality model to take into account the changes to the Project including using updated input data. This model will be available and submitted as part of the Type A Water Use License application. The Executive Committee requires additional information in order to address concerns raised. Therefore, please provide the following information:

R5. Provide a discussion on the development of the updated water quality model including:

- a. how the model is consistent or different from the original water quality model presented in the proposal;**
- b. how differences will be accounted for, and;**
- c. how the updated water quality model will address concerns related to input and output parameters for Cyanide**

R5a Response

The revised water quality model has been under development since May 2012. The model is consistent with the previous model in that they are both conservative mass-mixing models. However, significant improvements have been made and include:

1. the use of GoldSim, rather than the Excel-based spreadsheet platform,
2. the incorporation of updated project information (from the May 2012 SIR) associated with the larger footprints,
3. the simulation of various water management strategies that optimize the flow of water to the minewater treatment plant, while meeting water quality compliance objectives,
4. an extension of the model boundaries to below the confluence of Haggart and Lynx Creeks (i.e., to monitoring station W23),
5. the use of updated baseline water quality data (through October 2012), and the consideration and review of potential changes from background conditions using suitable SSWQOs,
6. the use of updated geochemical source terms, and
7. results that indicate the location where downstream water quality complies with water quality guidelines and/or SSWQOs:
 - i. without active or passive treatment,

- ii. with active and passive treatment options for the expected performance, and
- iii. with active or passive treatment at MMER release limits.

The water quality model presented in the Project Proposal (Stantec 2011) is a spreadsheet-based conservative mass loading and mixing model that was integrated with spreadsheet-based water balance model with geochemical source term predictions for discharge from Project facilities and the background environment to develop predictions of water chemistry in the receiving environment.

The updated water quality model that will be submitted for the Type A Water Use License application employs a similar conservative mass-mixing approach, but it is now integrated on the same GoldSim platform as the updated SWBM. GoldSim provides a substantially more robust platform to simulate water balance and water quality variability to address a number of water management challenges, including probabilistic modeling of precipitation conditions using stochastic analysis, enhanced capabilities for water-storage routing (including the ability to account for short-term retention in water-storage facilities), and the ability to maintain common linkages between the water balance routing and water quality conditions for each model node.

While the GoldSim water quality model is functionally similar to a spreadsheet-based mixing model, it is built upon a highly modular platform where the interconnected cells representing mine facilities are laid out in a visually intuitive manner. Element source concentrations will be predicted for discharges (i.e. contact or mine influenced water) from waste rock storage areas, open pit and the heap leach facility prior to and post treatment during operations, closure/reclamation and post closure. The benefits of the updated GoldSim water balance model have been fully described in previous submissions to YESAB information requests (December 2011, May 2012).

The revised water quality model to be submitted with the Type A Water Use License considers the larger footprints of the key Project facilities (e.g. open pit, WRSAs and HLF), Feasibility Study design changes to water management structures, as well as the inclusion of water management strategies (e.g. HLF solution recycling, short-term pond retention storage) that can be effectively simulated in GoldSim.

The updated model utilizes an optimized water management scenario to simulate the recycling of excess discharge from the HLF back to the HLF or events ponds in that event that:

- the inflow to the mine water treatment plant (MWTP) in any month exceeds the design capacity and/or;

- The dilution ratio in Haggart Creek is less than 10:1 for a given discharge from the MWTP (i.e., 10 parts Haggart Creek flow to 1 part MWTP discharge).

The water balance and water quality model boundaries have been extended downstream to below the confluence of Haggart and Lynx Creeks Further in recognition of the recommended term and condition #33 from YESAB in the September 2012 Draft Screening Report. The extended boundary conditions will provide additional capability to predict water quality farther downstream than the previous model and beyond the Project influence to demonstrate compliance with water quality guidelines and/or SSWQOs.

Differences in the model input will also arise from updates to the baseline water quality data on receiving streams and geochemical source terms that account for larger mine waste and ore facilities. Source terms are also being updated for the HLF based on empirical data from ongoing heap leach metallurgical and detoxification testwork using spent ore samples from the deposit.

The revised water balance and water quality models have also added complexity in areas where flow paths and timing require more consideration. For example, infiltration flow through the waste rock does not report immediately to the sediment pond; it is delayed by one month to match observed delays in toe seepage, which is particularly important at the onset of freshet. The water quality model emulates this nuance of the waste rock hydrograph by creating a matching mass flux delay to the seepage. The addition and evaluation of the effectiveness of mine water treatment results is straight forward on the GoldSim platform. This is an added benefit to the evaluation of the effectiveness of active and passive treatment systems.

R5b Response

As part of the WUL application, differences in model results will be accounted for in a similar manner as the approach taken in previous submittals to YESAB when comparing results of various stages of the revisions to the SWBM (i.e., using graphs and tables to compare the predictions of specific parameters over time at specific nodes of interest). An explanation will be provided that addresses substantial or critical differences in predictions and/or interpretation.

R5c Response

With respect to addressing the need for input and output parameters for cyanide, the revised water quality model will also benefit from empirical data generated from bench-scale testwork of the proposed mine water treatment plant system that is undergoing in support of the Water Use License application. These data were not available as part of the Project Proposal. Feed waters for the bench-scale testwork have been derived from the

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Response to October 2012 YESAB Request for Additional Information
YESAB Assessment 2010-0267

heap leach facility column metallurgical and detoxification/rinsing testwork. Drainage waters from the column testwork have been collected and are undergoing bench-scale testing of the proposed treatment technology to develop effluent discharge criteria. In this testwork, cyanide species in influent and effluent will be directly measured, including total cyanide, weak acid dissociable cyanide (CN_{WAD}), thiocyanate and cyanate. The water quality model will predict effluent concentrations of total cyanide, weak acid dissociable cyanide (CN_{WAD}), thiocyanate, and cyanate to compare total cyanide to receiving water quality criteria in place of free cyanide. While free cyanide is the cyanide species considered in CCME water quality guidelines, free cyanide is challenging to measure accurately. Total cyanide by definition will include free cyanide and weak acid dissociable cyanide. The prediction of each will be a conservative proxy for receiving water criteria.

Eagle Gold Project

Response to October 2012 YESAB Request for Additional Information
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**Attachment A -
Tech Memo from Tetra Tech re Eagle Gold Heap
Leach Facility Water Balance – Revision 3**

Technical Memorandum

To:	Steve Wilbur (Victoria Gold)	From:	Ronson Chee, P.E.
Company:		Date:	November 20, 2012
Re:	Eagle Gold Heap Leach Facility Water Balance – Revision 3	Doc #:	114-320905X-5.3
CC:	Troy Meyer, P.E. (Tetra Tech Inc.) Eric Fier, CPG, P. Eng (Tetra Tech Inc.) Randy Powell, P.E. (Tetra Tech Inc.)		

1.0 Introduction

This technical memorandum explains the methodologies and assumptions used to create an updated water balance model that has been developed for the Eagle Gold Heap Leach Facility. The intent of the water balance model is to determine the monthly fresh make-up water requirements for the Heap Leach Facility (HLF) as well as estimate the solution inventory within the HLF over the operational life of the facility. The draindown process and long term solution inventory after closure is addressed in separate Technical Memorandums based on the conclusions of this report.

The water balance model accounts for a three phase Heap Leach Pad and a 100-day stockpile, with an ore production rate of 29,500 tons per day for 350 days a year. For 250 days (March-November), ore will be processed through three stages of crushing and stacked on the heap leach pad. For the remaining 100 days (November-February), ore will be sent through the primary crusher only and stored on the 100-day stockpile. When the 250 day stacking period begins the following year, the ore from the stockpile will be sent through remaining crushers (secondary and tertiary) and stacked on the heap leach pad.

The water balance model accounts for all water that enters or leaves the HLF either through environmental contributions/losses, natural ore water content and solution application. Any excess water accumulated during high precipitation/runoff conditions will either be reintroduced (recycled) back into the HLF circuit or will be sent to the cyanide detoxification/minewater treatment plant (CD/MWTP) and discharged. Optimal use of the excess water released from the HLF will be determined by the overall site-wide water balance model. The updated HLF water balance is setup on a monthly time increment with monthly and yearly make-up quantities summarized. Additionally, estimated solution inventory quantities over the operational life of the HLF are summarized.

2.0 Water Balance Model Overview

The Heap Leach Facility water balance model is shown in Figure 1. Ore is assumed to be mined 350 days year at a constant rate of 29,500 tons per day. For 250 days beginning in March of the first year, 29,500 tons of raw ore each day goes through three (3) stages of crushing, then is stacked on the heap leach pad. Halfway through November of the first year, stacking of the

heap will cease and the same rate of ore will go through primary crushing only and will be placed on a stockpile for 100 days. The stockpile exists for the purpose of continued mining and storing partially crushed ore in the wintertime (November-February), when snowpack on the heap leach pad interferes with stacking and the heap leaching. Beginning in March of the second and every subsequent year, the 29,500 tons of ore mined each day will return to the three stages of crushing, followed by stacking. In addition, the ore stockpiled during the previous winter will also go through the last two stages of crushing and will be stacked during the same 250 days. It is assumed that the stockpiled ore will be moved to the heap at 11,800 tons per day (an even rate over the 250 stacking days.) Thus, a total of 41,300 tons of ore per day is added to the heap from March through part of November beginning in Year 2.

All water movement into, out from, or within the entire water balance system (characterized by the large green box) is represented by arrows in Figure 1. Red arrows signify ore movement and the associated water content that naturally occurs with it, which is considered an input (positive) to the water balance. Crushing is assumed to neither contribute nor take water from the ore; therefore it is assumed that ore water content stays constant during the crushing process. Ore from the stockpile is assumed to have an additional water content due to environmental exposure, however, this additional amount is assumed to stay constant during crushing after storage. Blue arrows represent water/solution that is added or removed from the system by the HLF process operator. This includes leaching solution and fresh make-up water. Environmental contributions/losses are highlighted using purple arrows, and symbolize the amount of water that is added or removed from the stockpile and heap due to exposure to the environment.

The stockpile and the heap leach pad are the two areas of primary focus, because they are the areas mainly affected by the inflows and outflows of the water balance. Because stockpiling and stacking take place in different locations, at different rates and during different times of the year, the two areas are treated as two separate masses that contribute to the entire water balance.

Environmental contributions change seasonally, therefore a monthly time step was used in the water balance model to reflect the changes. For the heap leach water balance analysis, only average climate conditions (precipitation, evaporation and sublimation) were simulated for each month.

As shown in Figure 1, leaching solution is assumed to be added to the crushed ore after being stacked on the heap. Because this water balance considers the entire HLF (i.e., and not just the active leaching area), the leaching requirement is defined as the amount of water required to meet the Average Stacking Water Content for leaching (explained in Section 4.0). The leaching application solution used during leaching is composed of two parts: recycle water and freshwater. Recycle water is the water/solution that is released from the ore to the In-Heap Pond and then pumped out and sent to the ADR Plant. Fresh make-up water is the water that must be supplied by an outside source (i.e., groundwater or collected surface water) to meet the water demands of the HLF after recycling is utilized. The fresh make-up water requirements calculated from the HLF water balance model does not include requirements for the ADR Plant.

Water/solution that is released from the ore is assumed to be temporarily stored in the In-Heap Pond. The In-Heap Pond provides a maximum capacity of 459,349 m³ (Tetra Tech, 2012a). For modeling purposes, minimum and maximum (199,440 m³) operating volumes of water/solution in the In-Heap Pond were also assumed to establish controls on whether to:

- recycle water/solution to supply make-up water,
- maintain a minimum operating volume of 33,240 m³, or

- determine whether there is excess water/solution that would need to be discharged to the CD/MWTP.

The minimum operating volume is based on having a sufficient volume in the In-Heap pond to prevent cavitation in the pump sumps while sustaining a minimum pumping period of 12 hours at the nominal pumping capacity of 2,770 m³/hr (i.e., 12 hrs at 2,770 m³/hr = 33,240 m³). The maximum operating volume is defined as the difference between the maximum design capacity (459,349 m³) and the total from two low probability events (maximum snowmelt and 72-hr draindown) occurring simultaneously (i.e., 459,349 m³ – 65,469 m³ – 199,440 m³ = 199,440 m³).¹ The derivation and volumes of the maximum snowmelt and 72-hour draindown are described in (Tetra Tech 2012a).

The Event Ponds were not modeled as part of the water balance system as they were designed only to store extreme event conditions such as the overflow from the 1:100 year 24-hr rainfall event. The Event Ponds, however, may be used as temporary storage for excess water for wet months in which the heap experiences excess rainfall or serve as temporary storage for recycle water. The need to use the Events Ponds will be based on actual climate conditions and HLF solution inventory, and would be determined by the heap operator.

3.0 Water Balance Inflows and Outflows

Figure 1 includes a visual representation of the water balance inputs and outputs that will be considered for this model.

System inflows include:

- Ore Water – Water that naturally occurs in the mined ore.
- Rainfall – Rainfall that is collected within each contributing area (further defined in Section 4.3). The contributing areas are defined by the Heap Leach Pad geometry and estimated Stockpile geometry.
- Snowmelt – Snow accumulates over the winter, but is not released into the system as water until it melts during the warmer months. Snowfall within the contributing areas (further defined in Section 4.3) is considered as an input (positive) into the water balance. Snowmelt is distributed each month as a percentage of total yearly snowmelt. The snowfall and snowmelt distribution percentages over the year can be found in Attachment A.
- Leaching Solution – The solution applied to the Heap to raise the water content of the ore to the Average Operating water content. It is comprised of:
 - Recycle Water – PLS from the heap minus gold that is reintroduced back into the leach cycle.
 - Fresh Make-up Water (Fresh Water) – Water required from an external source to make-up any water shortages for the HLF.

System outflows are:

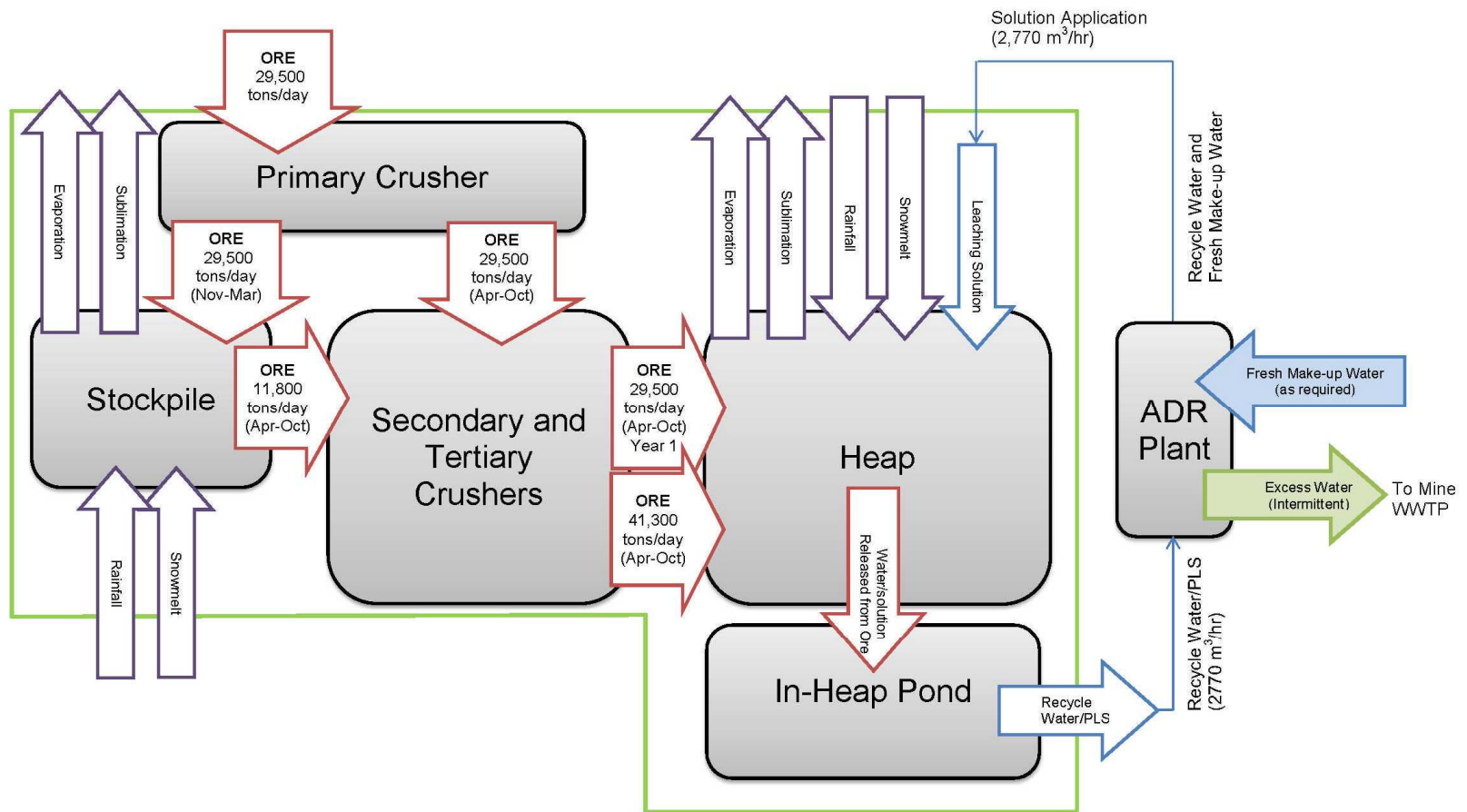
¹ This minimum condition differs from and supersedes the previously reported (Tetra Tech, 2012a) average or nominal operating volume of 132,960 m³ which assumed 48 hours at 2,770 m³/hr, and the minimum and maximum operating values of 133,000 m³ and 200,000 m³ cited in Knight Piesold (2012b)



- Evaporation (from precipitation) – Precipitation that vaporizes on the top surface area of the ore due to warmer temperatures. Evaporation varies with area and is assumed to occur over the entire area occupied by the ore on the HLP and Stockpile area.
- Evaporation (from leaching solution) – Percent of leaching solution that vaporizes upon application.
- Sublimation – Water that vaporizes from the winter snowpack, reducing snowpack available for snowmelt. This is estimated at 20% of the snowpack (Knight Piesold, 2012a).
- Excess Water – Water that is released from HLF in excess of the operating storage capacity of the In-Heap Pond (after gold is extracted).

The total amount of recovered leachate solution is assumed to be available for recycle to the HLF for leaching and any surplus water not completely used in a given month is assumed to be available for use in the following month.

Figure 1 Heap Leach Facility Water Balance Model Schematic



4.0 Water Balance Model Assumptions

4.1 Heap Ore Leaching and Draining Moisture Contents

The natural water content of the raw ore when removed from the pit, before processing is 5.0% by mass or 8.6% by volume (Wardrop, 2011a). All ore processed and sent directly to the Heap Leach Pad (HLP) during the 250 stacking days contributes 5.0% water content (by mass) into the water balance. The ore bulk density is assumed to be 1,800 kg/m³ (Wardrop, 2011a). All ore processed and sent to the Heap via the temporary stockpile is assumed to have an average ore water content of 7.9% by mass (13.6% by volume). All environmental water accumulated on the stockpile is assumed to contribute to the total water content of the ore stockpile. The sum of all contributing water for the entire year is divided evenly per cubic meter of ore, assuming an even distribution of the accumulated water throughout the stockpiled ore. See Attachment B for calculations.

It is assumed that makeup water will be added to the ore during irrigation (after being crushed and stacked on the HLP). Even though the water content for ideal leaching is 13.3% by mass (Wardrop, 2011) and occurs only under the active leaching area, for practical modeling purposes it is assumed that to reasonably account for solution inventory over time, the ore water content of the previously leached areas will decrease to about 8.6% water content by mass or 14.7% by volume (Wardrop, 2011a). It is assumed that solution will be able to drain from a water content of 13.3% (by mass) to 8.6% (by mass) in approximately one months' time (average) regardless of ore lift heights, during operation of the HLF.

The "Water Content" worksheet in Attachment B shows the calculations for the water quantities listed above. In summary, the ore properties used in the water balance are (Wardrop, 2011a):

- Natural ore water content = 5.0% by mass (8.6% by volume);
- Optimal ore water content = 13.3% by mass (22.8% by volume); and
- Residual ore water content after leaching = 8.6% by mass (14.7% by volume).

Water content within the ore on the HLP is constantly changing during operations and is a complex process as some portions of the ore are being actively leached while previously leached areas are draining down (with overall moisture contents ranging from 13.3% to 8.6% by mass). Estimating moisture content throughout the heap is complex and is a function of ore stack height, leach time, solution travel time, ore stack geometry and placement of the solution irrigation system. At this level of design and for practical purposes, a simplified leaching, drainage and recycling process was incorporated into the water balance model to account for variation in water content throughout the Heap.

In order to account for the variation of water content and solution movement through the ore, approximate percentages of active areas (leaching) vs. inactive areas (draining) were estimated for each phase of the Heap. These active vs. inactive areas were estimated from preliminary stacking plans (Tetra Tech, 2012b) taking into account the percentage of area being leached in comparison to the overall area of the ore lifts, as well as accounting for the changes in geometry of the stacked ore as the height of the Heap increases. The percentages of active vs. inactive areas were calculated for each stacking lift then a combined average was estimated for each phase of the Heap. The estimated percentages of active vs. inactive areas for each phase of the Heap are summarized Table 1 below.

Table 1. Heap Leach Pad Active vs. Inactive Leaching Area Percentages

Heap Phase	Active Area (Leaching) 13.3% by mass	Inactive Area (Draining) 8.6% by mass
Phase 1	78%	22%
Phase 2	74%	26%
Phase 3	54%	46%

Using the active and inactive areas estimates from Table 1, an Average Stacking Water Content for the ore was calculated. The Average Stacking Water Content is the assumed average water content that any volume of ore going onto the HLP would reach after being stacked. This Average Stacking Water Content collectively accounts for ore that is actively being leached and for ore that has started draining. It is calculated using an area weighted average of active vs. inactive area multiplied by its respective assumed water content. For example, from Table 1, Phase 1 active vs. inactive area estimates are 78% and 22% respectively. These values are then multiplied by the optimal water content (13.3% by mass) and residual moisture content (8.6% by mass) (i.e., $0.78 \times 13.3\% + 0.22 \times 8.6\% = 12.2\%$ by mass as shown in Table 2). The resulting Average Stacking Water Content values associated with its respective phase are presented in Table 2 below.

Table 2. Ore Average Stacking Water Contents

Heap Phase	Average Stacking Water Content (volume)	
	% by mass	m ³ /m ³ ore (by vol.)
Phase 1	12.2%	0.210
Phase 2	12.1%	0.207
Phase 3	11.1%	0.191

4.2 Heap Ore Stacking and Stockpiling

Stacking and stockpiling rates are based on an ore production rate of 29,500 tons of ore per day for 350 days a year, and stockpiling takes place for 100 of those days. Figure 1 reflects the following stacking and stockpiling information and assumptions:

- 29,500 tons/day of ore is processed through three stages of crushing and stacking on the HLP for 250 days (March through part of November every year);
- 29,500 tons/day of ore is processed through the primary crusher and placed on the stockpile for 100 days (the last part of November through February every year beginning in November of the first year);

- 11,800 tons/day of partially crushed ore from the stockpile is sent through the secondary and tertiary crushers and is stacked on the HLP for 250 days (March through part of November after the first year);
- 41,300 tons/day of fully processed (crushed) ore is placed on the HLP for 250 stacking days (March through part of November after the first year).

For the purposes of this water balance, March 1, 2015 is assumed to be the beginning of the 250 day stacking season in the first year.

Preliminary stacking plans were incorporated into the HLF water balance to estimate active vs. inactive areas as described in section 4.1 to account for environmental effects, as well as leaching and drainage effects.

4.3 Heap Leach Pad and Stockpile Contributing Area

The HLP will be constructed and stacked in three phases. Preliminary stacking plans developed by Tetra Tech (2012b) were utilized to determine the amount of ore being placed on the HLP throughout the life of the HLF. These preliminary stacking plans are essential to estimating the amount of environmental losses and contributions to the ore water content. The cumulative area (occupied by ore) at each elevation was used to calculate the amount of evaporation and sublimation. The preliminary stacking plans were also used to estimate the ratio of active vs. inactive areas of the ore that is being stacked as described in Section 4.1.

It is assumed that temporary diversion channels will be placed upstream of each lined pad phase area. These diversion channels delineate the contributing watershed areas. Since each area is lined, all precipitation (minus evaporative losses) that falls within that area is assumed to directly add to the water balance.

The stockpile area also contributes to the water balance, and its contribution is assumed to remain at a constant rate when stockpile ore is added to the crushing circuit during the life of the mine. All precipitation (minus evaporative losses) that falls within the stockpile area is assumed to add to the water balance. It is also assumed that all precipitation runoff from higher elevations will be diverted from the stockpile area.

The contributing areas that collect precipitation for each phase of the Heap Leach Pad and 100 day stockpile are as follows:

- Phase 1: 410,007 square meters;
- Phase 2: 940,920 square meters;
- Phase 3: 1,134,970 square meters;
- 100-day Stockpile: 185,425 square meters.

The stockpile areas were estimated using an approximate footprint and contributing area, and are assumed to increase evenly during the 100 days of stockpiling. Similarly, the stockpile area is assumed to decrease incrementally during 250 stacking days. As the physical geometry and layout of the stockpile is further designed, the water balance may be adjusted accordingly.

4.4 Climate Data Input

Monthly climate data was provided by Knight Piesold (2012a) for a site near the proposed HLF. Averages were calculated from the entire dataset, collected between October 2006 and June 2011. This data includes monthly values for;

- Precipitation (rainfall and snowfall),
- Snowmelt, and
- Evaporation.

Evaporation data provided by Knight Piesold is based on values that have been corrected for evaporation from rock surfaces. This climate data input can be found in Attachment A. Evaporation calculations from the leaching solution drip emitters is included on the “Environmental Contribution Water” sheet in Attachment C

4.5 Leaching Solution and Recovered Solution

Leaching solution is applied to the HLP top area at a rate of 2,770 m³/hr and consists of two sources: recycle water from the recovered solution and fresh make-up water from an external source (either groundwater or collected surface runoff). The amount of freshwater required is determined from the water balance. Recycle water is the recovered Pregnant Leach Solution (PLS) minus the gold that is available for reuse. It is assumed that the amount of leaching solution and recovered leachate solution are equal, therefore negligible in the overall water balance calculations. The leaching solution and recovered solution (PLS) are represented using two blue line arrows as shown in Figure 1.

5.0 Results

Calculated monthly freshwater make-up requirements, recycle water, In-Heap Pond volumes and excess water discharge to the CD/MWTP are displayed graphically in Figures 2 through 5, representing Phases 1, 2, and 3, respectively. The numeric data can be found in Attachment C in the “Monthly Makeup Water Requirements” table. The following sections discuss the results for each phase.

5.1 Phase 1 Results

Phase 1 (Figure 2) exhibits roughly the same pattern in freshwater demand in the first two (2) years. In the first year, the fresh make-up water demand appears smaller than the subsequent year because the maximum production rate is 29,500 tpd in the first year, as there is no stockpile inflow of ore onto the HLP. Less ore going to the pad requires less water to wet the ore. The make-up water demands peak in March and in August during the first year. The largest peak in year two (2) occurs during March, corresponding with the month that stacking begins on the HLP. Make-up water decreases in April of both years, when precipitation begins to contribute larger amounts to the water balance. By May, most of the winter snowpack has melted, resulting in an increased amount of recycle water. From June through October, water demand rises again and remains high, as ore loading increases to 41,300 tpd. November experiences a decreased demand for freshwater as stacking occurs for half of the month. December through February does not exhibit any demand for water, because ore is not being

loaded on to the HLP. Recycle water remains constant in the In-Heap Pond over the winter and is used for recycle beginning in February.

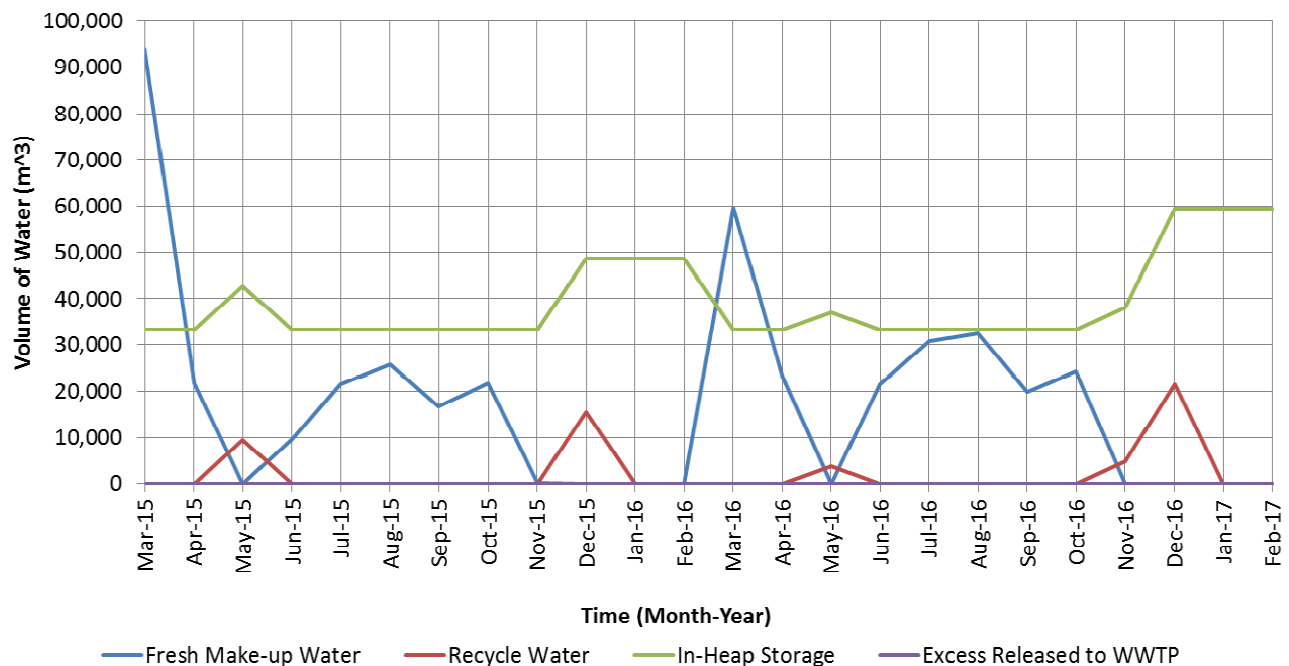
As shown in Figure 2, Year 1 monthly demand extremes are:

- Maximum fresh make-up water requirement of 93,775 m³ occurring at startup (March 2015) – includes initial In-Heap Pond solution inventory/minimum operating volume of 33,240 m³.
- Minimum fresh make-up water requirement of 77 m³ in November 2015;
- Zero (0 m³) fresh make-up water requirements in May 2015 and from November through December 2015;

Phase 1 (Year 2+) monthly water demand extremes are:

- Maximum fresh make-up water requirement of 59,617 m³ occurring in March 2016;
- Zero (0 m³) freshwater make-up requirements in January 2016 through February 2016, May 2016, and November 2016 through February 2017.

Figure 2 Phase 1 Summary



5.2 Phase 2 Results

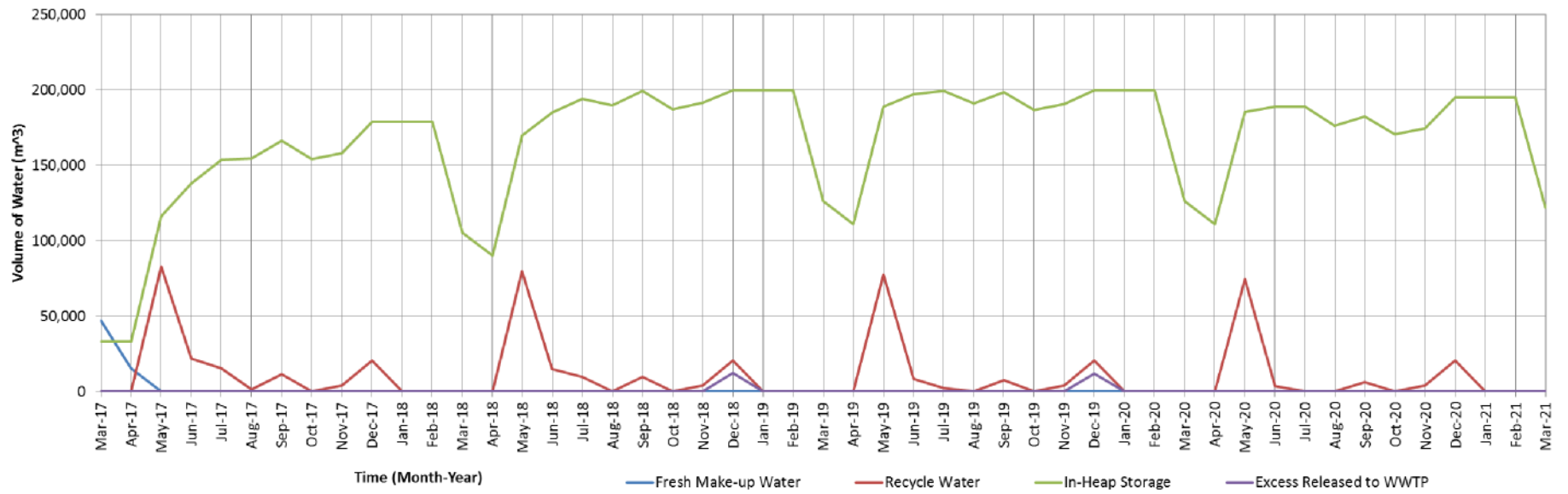
Freshwater demand exhibits the same pattern year to year throughout Phase 2 (Figure 3). Fresh make-up water requirements are minimal in Phase 2 with an initial peak usage in March 2017. In May 2017, the freshwater demand drops to zero, due to the notably larger Phase 2 area collecting more precipitation. Throughout Phase 2, the water available for recycle as a result of environment contributions is greater than the water demand, resulting in extra recycle water available for subsequent months.

As shown on Figure 3, Phase 2 monthly water demand extremes are:

- Maximum fresh make-up water requirement of 49,062 m³ in March 2017;
- Zero (0 m³) fresh make-up water requirements throughout the remainder of Phase 2 starting in May 2017.

As shown on Figure 3, the amount of recycle water increases from April through August as the result of increase environmental contributions. This charges the In-Heap Pond storage for the subsequent months which allows recycling of most of the water. Minimal excess water is released to the CD/MWTP throughout Phase 2 with a maximum of 12,363 m³ occurring in December 2018.

Figure 3 Phase 2 Summary

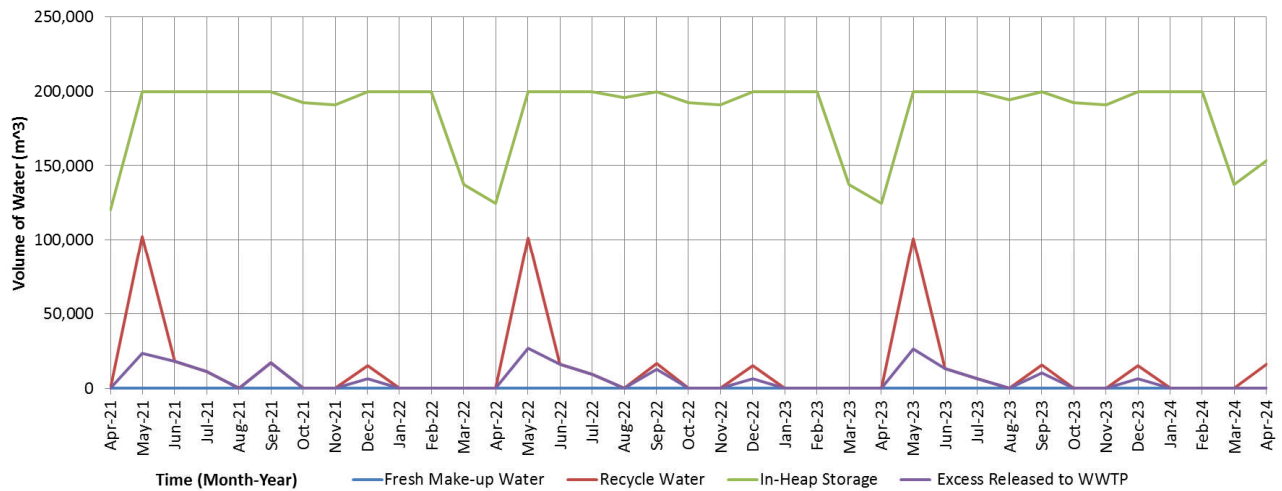


5.3 Phase 3 Results

Freshwater demand exhibits the same pattern year to year throughout Phase 3 (Figure 4). There are no fresh make-up water requirements during Phase 3. Also, throughout Phase 3, the water available for recycle as a result of environment contributions is greater than the water demand, resulting in extra recycle water available for subsequent months.

As shown on Figure 4, the amount of recycle water increases from April through August as the result of increase environmental contributions. This charges the In-Heap Pond storage capacity for the subsequent months which allows recycling of most of the water. Excess water released from the HLF (to the CD/MWTP) is the greatest in Phase 3. Phase 3 has a maximum excess discharge of 26,929 m³ occurring in May 2022.

Figure 4 Phase 3 Summary



5.4 Fresh Make-up Water and Excess Water Summary

Overall, the HLF water balance model shows a decreasing need for freshwater make-up over its operational life. The first year (year 2015) requires the greatest amount of water, at approximately 210,513 m³ for the year. The first year assumes a required initial startup volume of 33,240 m³ and this volume of solution must remain in the heap at all times.

Rinsing estimates are also included and assume that the same application rate (2,770 m³/hr) comprised of recycled water from the ADR plant (ongoing gold leaching) or the CDP plant is applied over the HLP. As calculated from the HLF water balance, at the end of operations there is an estimated 150,000 m³ of solution/water in the In-Heap Pond. This volume of solution/water in addition to environmental contributions is adequate to be used for detoxification and rinsing. Thus, no additional fresh makeup water is required for rinsing. The HLF water balance during rinsing and draindown are considered in the Site Water Balance Model (Knight Piesold, 2012b).

The HLF water balance model shows an increasing release of excess water over the operational life. The first release occurs in year 4 (2018) and occurs in the subsequent years until year 9 (2023). The maximum excess water released is 75,847 m³ in year 7 (2021).

Table 1 Total Fresh Make-up Water and Excess Volumes

Mine Phase	Year	Fresh Make-up Water	Excess Water (Released to CD/MWTP)
		(m ³)	(m ³)
10 Months Operation	2015	210,513	0
12 Months Operation	2016	212,122	0
12 Months Operation	2017	62,151	0
12 Months Operation	2018	0	12,363
12 Months Operation	2019	0	11,709
12 Months Operation	2020	0	0
12 Months Operation	2021	0	75,847
12 Months Operation	2022	0	70,944
12 Months Operation	2023	0	62,599
4 Months Operation	2024	0	0
8 Months Additional Gold Recovery	2024	0	0
4 Months Additional Gold Recovery	2025		
8 Months Rinsing	2025	0	0
12 Months Rinsing	2026	0	0
4 Months Rinsing	2027	0	0

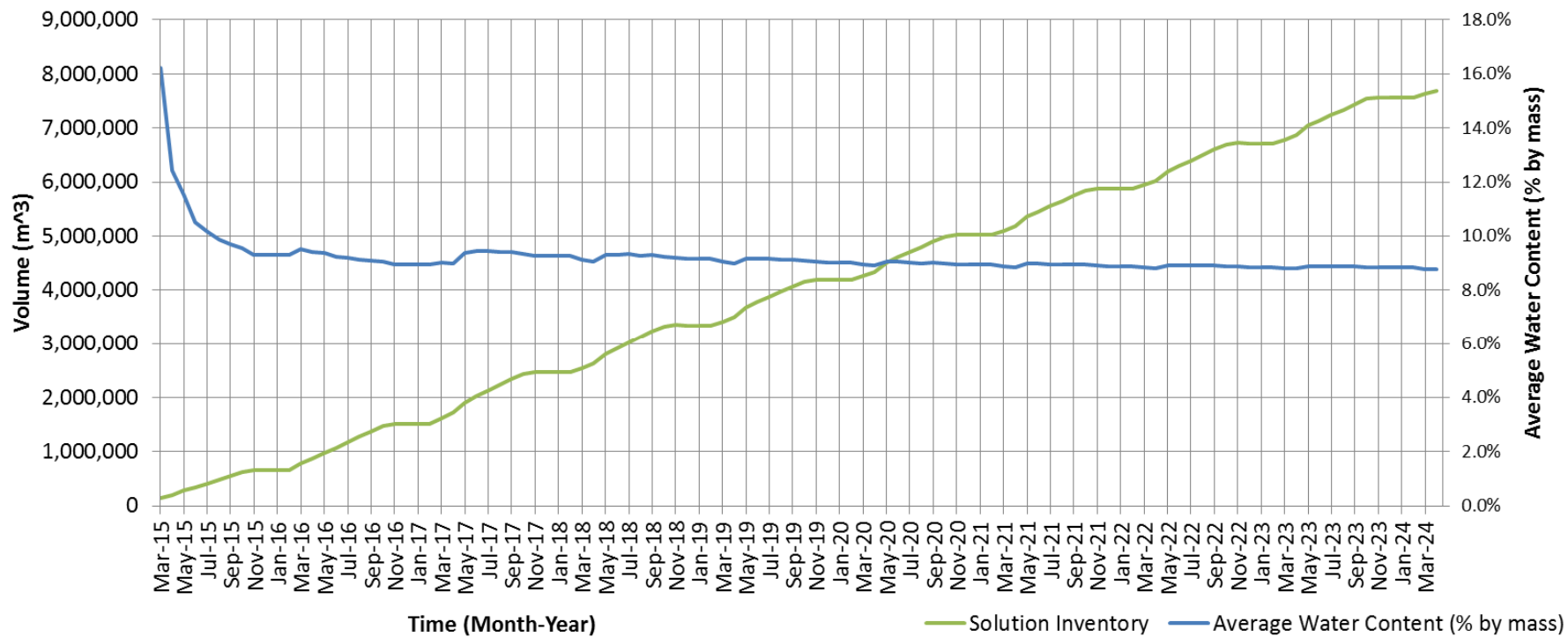
5.5 Solution Inventory Summary

Estimates of the HLF solution inventory are shown on Figure 5. It shows a steady net increase in total solution retained in the ore over time. The total solution inventory in the HLF at the end of operations is estimated to be 7,684,174 m³. At the same time, the total average water content is initially high (over 12% by mass or over 20% by volume) in the first year, rapidly decreasing to



9.3% by mass (16.0% by volume) within the first year and then slowly decreasing over time (Figure 5). The total average water content within the HLF at the end of operations is estimated to be about 8.8% by mass (15.1% by volume). It is estimated that over time into post-closure the HLF will maintain a moisture content of from 5% to 7% by mass depending on long-term environmental conditions and the HLF drainage process. The draindown process is described in Tetra Tech 2012c.

Figure 5 Solution Inventory Summary



6.0 Conclusion

In general, assuming average climate conditions and a phased approach to active and inactive leaching areas, the HLF water balance requires fresh make-up water up until year 3. After year 3, the HLF does not require fresh make-up water; instead the HLF will release excess water to the CD/MWTP as it becomes a net positive system. The In-Heap Pond capacity allows for solution/water to be stored and used for recycle, thus limiting the amount of freshwater required for operations. Maximum fresh make-up water is required during Phase1 and at the beginning of Phase 2. Assuming average climate conditions, there are no fresh make-up water requirements for the remainder of Phase 2 and for all of Phase 3.

The estimates generated by this water balance are limited to the assumptions presented. As more detailed stacking plans for the heap and stockpile are created the water balance model may be revised to more accurately predict fresh make-up water requirements and solution inventory.



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ATTACHMENT A
HEAP LEACH WATER BALANCE CALCULATIONS
MODEL INPUTS



Input Data

	Year Round	Mar - Oct from stockpile	April - Oct Total	
Ore Production Rate =	29,500	11,800	41,300	tons/day
	16,388.89	6,556	22,944	m ³ /day
	Heap Leach Pad	Ore Stockpile		
Heap Contributing Area (phase 1)=	410,007	185,425	m ²	assumes diversion channels in place upstream
Heap Contributing Area (phase 2)=	940,920		m ²	
Heap Contributing Area (phase 3)=	1,134,970		m ²	
Ore Bulk Density=	1.8		t/m ³	
Density of Water=	1,000		kg/m ³	
Solution Application=	66,480		m ³ /day	
Sublimation Losses=	20.0%			
Natural Ore Water Content=	5.0%	by mass		
Optimal Leaching Water Content=	13.3%	by mass		
Residual Ore Water Content=	8.6%	by mass		
	# Stockpiling days	# heap days		
Jan	29.75			
Feb	26.75			
Mar		29.75		
Apr		28.75		
May		29.75		
Jun		28.75		
Jul		29.75		
Aug		29.75		
Sep		28.75		
Oct		29.75		
Nov	13.75	15		
Dec	29.75			
	100	250		



Average Monthly Climate Data

Month	Rainfall (mm)	Snowfall SWE (mm)	Snowmelt Distribution per month (%)	*Evaporation (mm)	Est. Emitter Evaporation (%)
Jan	0.00	26.04	0.00%	0	0.0%
Feb	0.00	20.50	0.00%	0	0.0%
Mar	0.00	26.79	0.00%	0	0.0%
Apr	0.17	23.28	8.02%	0	0.0%
May	23.26	7.69	67.88%	22	1.0%
Jun	84.16	2.11	8.42%	48	1.3%
Jul	99.96	0.00	0.00%	53	1.2%
Aug	72.49	0.56	0.23%	38	1.0%
Sep	52.47	13.65	5.67%	15	0.6%
Oct	4.28	47.00	9.77%	0	0.0%
Nov	0.00	36.55	0.00%	0	0.0%
Dec	0.00	36.32	0.00%	0	0.0%
Total	336.79	240.49		176.00	

*Evaporation estimates corrected for evaporation from bare rock from Knight Piesold (2012b)

**ATTACHMENT B
HEAP LEACH WATER BALANCE CALCULATIONS
STOCKPILE WATER AND
ORE WATER CONTENT**



Stockpile Precipitation and Sublimation Calculations

Stockpile Contributing Area (all phases)= 185,425 m² Heap Leach Pad
Sublimation losses 20.0% assumes diversion channels in place upstream of Pad

Date	Climate Data			Top Area (m ²)	Rain on Heap Area (m ³)	Snowfall SWE on Heap Area (m ³)	Sublimation from Snowpack (m ³)	Snowfall SWE Minus Sublimation (m ³)	Snowmelt (m ³)	Stockpile Precipitation and Sublimation (m ³)
	Rainfall (mm)	Snowfall SWE (mm)	Snowmelt Distribution per month (%)							
Jan	0.0	26.0	0.0%	108,242	0	4,828	966	3,863	0	0
Feb	0.0	20.5	0.0%	160,624	0	3,801	760	3,041	0	0
Mar	0.0	26.8	0.0%	174,392	0	4,968	994	3,974	0	0
Apr	0.2	23.3	8.0%	152,697	32	4,317	863	3,453	2,861	2,893
May	23.3	7.7	67.9%	131,003	4,313	1,426	285	1,141	24,216	28,529
Jun	84.2	2.1	8.4%	109,308	15,605	391	78	313	3,004	18,609
Jul	100.0	0.0	0.0%	87,613	18,535	0	0	0	0	18,535
Aug	72.5	0.6	0.2%	65,548	13,441	104	21	83	80	13,522
Sep	52.5	13.7	5.7%	43,853	9,729	2,531	506	2,025	2,023	11,752
Oct	4.3	47.0	9.8%	22,158	794	8,715	1,743	6,972	3,485	4,279
Nov	0.0	36.6	0.0%	18,311	0	6,777	1,355	5,422	0	0
Dec	0.0	36.3	0.0%	53,078	0	6,735	1,347	5,388	0	0
Totals		240.5				44,593		35,674		98,118



Stockpile Water

Input Data

To Stockpile: To Heap: Nov-

Ore Production Rate = 29,500 11,800 tons/day
 16,389 6,556 m³/day

Total Stockpile Area 185,425 m² assumes diversion channels in place upstream of Pad
 As-Delivered Ore Water 0.09 m³/m³ ore from Water Content Sheet
 Total Stockpiling Days 100

Ore Destination	Date	# days per month	# Stockpiling days	# Heap days	Evaporation Data (mm)	Average Stockpile Area (m ²)	Ore Water (m ³)	Precipitation and Sublimation (m ³)	Evaporation (m ³)	Monthly Stockpile Water (m ³)
Stockpile	Jan	31	30	0	0.0	108,242	41,792	0	0	41,792
Stockpile	Feb	28	27	0	0.0	160,624	37,577	0	0	37,577
Heap	Mar	31	0	30	0.0	174,392	0	0	0	-
Heap	Apr	30	0	29	0.0	152,697	0	2,893	0	2,893
Heap	May	31	0	30	22.0	131,003	0	28,529	2,882	25,647
Heap	Jun	30	0	29	48.0	109,308	0	18,609	5,247	13,362
Heap	Jul	31	0	30	53.0	87,613	0	18,535	4,644	13,892
Heap	Aug	31	0	30	38.0	65,548	0	13,522	2,491	11,031
Heap	Sep	30	0	29	15.0	43,853	0	11,752	658	11,094
Heap	Oct	31	0	30	0.0	22,158	0	4,279	0	4,279
Stockpile/Heap	Nov	30	14	15	0.0	18,311	19,315	0	0	19,315
Stockpile	Dec	31	30	0	0.0	53,078	41,792	0	0	41,792
Yearly Totals			100	250						222,673

Leaching (250 days) 36400

Water Content

Ore Water Content, as delivered (initial conditions)	w	5.00%	Densities			Stockpile Inputs		
			Bulk, initial	yb	1800 kg/m ³	Ore added to stockpile	16,389 m ³ /day	
			Water	yw	1000 kg/m ³	Total Ore	1,638,889 m ³	
Residual Water Content (after draining)	w	8.60%	Dry	yd	1714.29 kg/m ³	Total Water in Stockpile	222,673 m ³	
Optimal Leaching Content	w	13.30%	Specific Gravity**	Gs	2.7			

INITIAL CONDITIONS, VOLUME OF WATER IN ORE				STOCKPILE WATER VOLUME				RESIDUAL WATER VOLUME				WATER VOLUME FOR OPTIMAL LEACHING			
Name	Variable	Amount	Units	Name	Variable	Amount	Units	Name	Variable	Amount	Units	Name	Variable	Amount	Units
Weights*				Weights				Weights				Weights			
Solid, per 1 m ³ ore	Ws	1714.29	kg	Solid, per 1 m ³ ore	Ws	1714.29	kg	Solid, per 1 m ³ ore	Ws	1714.3	kg	Solid, per 1 m ³ ore	Ws	1714.3	kg
Water, per 1 m ³ ore	Ww	85.7143	kg	Water, per 1 m ³ ore	Ww	135.869	kg	Water, per 1 m ³ ore	Ww	147.43	kg	Water, per 1 m ³ ore	Ww	228.00	kg
Volumes				Volumes				Volumes				Volumes			
Water, per 1 m ³ ore	Vw	0.086	m ³	Water, per 1 m ³ ore	Vw	0.136	m ³	Water, per 1 m ³ ore	Vw	0.147	m ³	Water, per 1 m ³ ore	Vw	0.228	m ³
Solid, per 1 m ³ ore***	Vs	0.63	m ³	Solid, per 1 m ³ ore	Vs	0.63	m ³	Solid, per 1 m ³ ore	Vs	0.63	m ³	Solid, per 1 m ³ ore	Vs	0.63	m ³
Air, per 1 m ³ ore	Va	0.28	m ³	Air, per 1 m ³ ore	Va	0.23	m ³	Air, per 1 m ³ ore	Va	0.22	m ³	Air, per 1 m ³ ore	Va	0.14	m ³
Void (Water + Air), per 1 m ³ ore	Vv	0.37	m ³	Void (Water + Air), per 1 m ³ ore	Vv	0.37	m ³	Void (Water + Air), per 1 m ³ ore	Vv	0.37	m ³	Void (Water + Air), per 1 m ³ ore	Vv	0.37	m ³
Porosity	n	0.37		Porosity	n	0.37		Porosity	n	0.37		Porosity	n	0.37	
Void Ratio	e	0.575		Void Ratio	e	0.575		Void Ratio	e	0.575		Void Ratio	e	0.575	
Saturation	S	23.48%		Saturation	S	37.22%		Saturation	S	40.38%		Saturation	S	62.45%	

*weight of air is negligible
 **using assumed value for Gs (Budhu, 2007)
 ***Solid volume calculated using specific gravity

Stockpile Water Content w 7.93%
Water Content Equations:
 $yd = yb / (1 + w)$
 $Ww = w * Ws$
 $Vw = Ws / yw$
 $Vs = Ws / (Gs * yw)$
 $Va = 1 - Vs - Vw$
 $V = Va + Vw + Vs = 1$
 $Vv = Va + Vw$
 $n = Vv / V$

Ore properties provided by Wardrop (Wardrop, 2011a).

ATTACHMENT C
HEAP LEACH WATER BALANCE CALCULATIONS
HEAP LEACH PAD MAKE-UP WATER
REQUIREMENTS



Phase 1 Precipitation and Sublimation Calculations

Heap Leach Pad
 Heap Contributing Area (phase 1)= 410,007 m²
 Sublimation losses 20.0%
 assumes diversion channels in place upstream of Pad

Phase 1
Phase 2
Phase 3

Date	Climate Data			Rain on Heap Area (m ³)	Snowfall SWE on Heap Area (m ³)	Sublimation (m ³)	Snowfall SWE Minus Sublimation (m ³)	Snowmelt (m ³)	Precipitation and Sublimation, Phase 1 (m ³)
	Rainfall (mm)	Snowfall SWE (mm)	Snowmelt Distribution per month (%)						
Jan	0.0	26.0	0.0%	0	10,677	2,135	8,541	0	0
Feb	0.0	20.5	0.0%	0	8,405	1,681	6,724	0	0
Mar	0.0	26.8	0.0%	0	10,984	2,197	8,787	0	0
Apr	0.2	23.3	8.0%	70	9,545	1,909	7,636	6,326	6,396
May	23.3	7.7	67.9%	9,537	3,153	631	2,522	53,545	63,082
Jun	84.2	2.1	8.4%	34,506	865	173	692	6,642	41,148
Jul	100.0	0.0	0.0%	40,984	0	0	0	0	40,984
Aug	72.5	0.6	0.2%	29,721	230	46	184	178	29,899
Sep	52.5	13.7	5.7%	21,513	5,597	1,119	4,477	4,473	25,986
Oct	4.3	47.0	9.8%	1,755	19,270	3,854	15,416	7,707	9,462
Nov	0.0	36.6	0.0%	0	14,986	2,997	11,989	0	0
Dec	0.0	36.3	0.0%	0	14,891	2,978	11,913	0	0
Yearly Totals							78,882		216,957



Phase 2 Precipitation and Sublimation Calculations

Heap Leach Pad
 Heap Contributing Area (phase 2)= 940,920 m²
 Sublimation losses 20.0%
 assumes diversion channels in place upstream of Pad

Phase 1
Phase 2
Phase 3

Date	Climate Data			Rain on Heap Area (m ³)	Snowfall SWE on Heap Area (m ³)	Sublimation (m ³)	Snowfall SWE Minus Sublimation (m ³)	Snowmelt (m ³)	Precipitation and Sublimation, Phase 2 (m ³)
	Rainfall (mm)	Snowfall SWE (mm)	Snowmelt Distribution per month (%)						
Jan	0.0	26.0	0.0%	0	24,502	4,900	19,601	0	0
Feb	0.0	20.5	0.0%	0	19,289	3,858	15,431	0	0
Mar	0.0	26.8	0.0%	0	25,207	5,041	20,166	0	0
Apr	0.2	23.3	8.0%	160	21,905	4,381	17,524	14,518	14,678
May	23.3	7.7	67.9%	21,886	7,236	1,447	5,789	122,880	144,766
Jun	84.2	2.1	8.4%	79,188	1,985	397	1,588	15,242	94,430
Jul	100.0	0.0	0.0%	94,054	0	0	0	0	94,054
Aug	72.5	0.6	0.2%	68,207	527	105	422	408	68,615
Sep	52.5	13.7	5.7%	49,370	12,844	2,569	10,275	10,264	59,634
Oct	4.3	47.0	9.8%	4,027	44,223	8,845	35,379	17,686	21,713
Nov	0.0	36.6	0.0%	0	34,391	6,878	27,513	0	0
Dec	0.0	36.3	0.0%	0	34,174	6,835	27,339	0	0
Yearly Totals							181,025		497,891



Phase 3 Precipitation and Sublimation Calculations

Heap Leach Pad
 Heap Contributing Area (phase 3)= 1,134,970 m²
 Sublimation losses 20.0%
 assumes diversion channels in place upstream of Pad

Phase 1
Phase 2
Phase 3

Date	Climate Data			Rain on Heap Area (m ³)	Snowfall SWE on Heap Area (m ³)	Sublimation (m ³)	Snowfall SWE Minus Sublimation (m ³)	Snowmelt (m ³)	Precipitation and Sublimation, Phase 2 (m ³)
	Rainfall (mm)	Snowfall SWE (mm)	Snowmelt Distribution per month (%)						
Jan	0.0	26.0	0.0%	0	29,555	5,911	23,644	0	0
Feb	0.0	20.5	0.0%	0	23,267	4,653	18,614	0	0
Mar	0.0	26.8	0.0%	0	30,406	6,081	24,325	0	0
Apr	0.2	23.3	8.0%	193	26,422	5,284	21,138	17,512	17,705
May	23.3	7.7	67.9%	26,399	8,728	1,746	6,982	148,222	174,622
Jun	84.2	2.1	8.4%	95,519	2,395	479	1,916	18,386	113,905
Jul	100.0	0.0	0.0%	113,452	0	0	0	0	113,452
Aug	72.5	0.6	0.2%	82,274	636	127	508	492	82,766
Sep	52.5	13.7	5.7%	59,552	15,492	3,098	12,394	12,381	71,933
Oct	4.3	47.0	9.8%	4,858	53,344	10,669	42,675	21,334	26,191
Nov	0.0	36.6	0.0%	0	41,483	8,297	33,187	0	0
Dec	0.0	36.3	0.0%	0	41,222	8,244	32,978	0	0
Yearly Totals							218,359		600,573

Environmental Contribution Water

Solution Application 66,480 m³/day

Phase 1 Max Contributing Area = 410,007 m²
Phase 2 Max Contributing Area = 940,920 m²
Phase 3 Max Contributing Area = 1,134,970 m²

Phase 1
Phase 2
Phase 3

Date	# days per month	Top Area (m ²)	Approximate Elevation (from Stacking Plan) (m)	Evaporation Data (mm)	Est. Emitter Evaporation (%)	Precipitation and Sublimation (m ³)	Evaporation from Precipitation (m ³)	Solution Application Drip Emitter Evaporation (m ³)	Monthly Environmental Contribution Water (m ³)
Mar-15	31	53,597	860	0.0	0.0%	0	0	0	0
Apr-15	30	87,616	870	0.0	0.0%	6,396	0	0	6,396
May-15	31	87,616	870	22.0	1.0%	63,082	1,928	20,609	40,546
Jun-15	30	127,130	880	48.0	1.3%	41,148	6,102	25,927	9,119
Jul-15	31	127,130	880	53.0	1.2%	40,984	6,738	24,731	9,516
Aug-15	31	127,130	880	38.0	1.0%	29,899	4,831	20,609	4,459
Sep-15	30	172,071	890	15.0	0.6%	25,986	2,581	11,966	11,438
Oct-15	31	172,071	890	0.0	0.0%	9,462	0	0	9,462
Nov-15	30	172,071	890	0.0	0.0%	0	0	0	0
Dec-15	31	172,071	890	0.0	0.0%	0	0	0	0
Jan-16	31	172,071	890	0.0	0.0%	0	0	0	0
Feb-16	29	172,071	890	0.0	0.0%	0	0	0	0
Mar-16	31	197,521	900	0.0	0.0%	0	0	0	0
Apr-16	30	197,521	900	0.0	0.0%	6,396	0	0	6,396
May-16	31	223,813	910	22.0	1.0%	63,082	4,924	20,609	37,549
Jun-16	30	223,813	910	48.0	1.3%	41,148	10,743	25,927	4,478
Jul-16	31	249,170	920	53.0	1.2%	40,984	13,206	24,731	3,048
Aug-16	31	249,170	920	38.0	1.0%	29,899	9,468	20,609	-178
Sep-16	30	275,199	930	15.0	0.6%	25,986	4,128	11,966	9,891
Oct-16	31	275,199	930	0.0	0.0%	9,462	0	0	9,462
Nov-16	30	275,199	930	0.0	0.0%	0	0	0	0
Dec-16	31	275,199	930	0.0	0.0%	0	0	0	0
Jan-17	31	275,199	930	0.0	0.0%	0	0	0	0
Feb-17	28	275,199	930	0.0	0.0%	0	0	0	0
Mar-17	31	308,369	940	0.0	0.0%	0	0	0	0
Apr-17	30	346,886	950	0.0	0.0%	14,678	0	0	14,678
May-17	31	346,886	950	22.0	1.0%	144,766	7,631	20,609	116,526
Jun-17	30	346,886	950	48.0	1.3%	94,430	16,651	25,927	51,852
Jul-17	31	382,095	960	53.0	1.2%	94,054	20,251	24,731	49,073
Aug-17	31	382,095	960	38.0	1.0%	68,615	14,520	20,609	33,486
Sep-17	30	417,430	970	15.0	0.6%	59,634	6,261	11,966	41,406
Oct-17	31	417,430	970	0.0	0.0%	21,713	0	0	21,713
Nov-17	30	417,430	970	0.0	0.0%	0	0	0	0
Dec-17	31	417,430	970	0.0	0.0%	0	0	0	0
Jan-18	31	417,430	970	0.0	0.0%	0	0	0	0
Feb-18	28	417,430	970	0.0	0.0%	0	0	0	0
Mar-18	31	455,609	980	0.0	0.0%	0	0	0	0
Apr-18	30	455,609	980	0.0	0.0%	14,678	0	0	14,678
May-18	31	493,642	990	22.0	1.0%	144,766	10,860	20,609	113,297
Jun-18	30	493,642	990	48.0	1.3%	94,430	23,695	25,927	44,808
Jul-18	31	493,642	990	53.0	1.2%	94,054	26,163	24,731	43,161
Aug-18	31	535,175	1,000	38.0	1.0%	68,615	20,337	20,609	27,669
Sep-18	30	535,175	1,000	15.0	0.6%	59,634	8,028	11,966	39,640
Oct-18	31	535,175	1,000	0.0	0.0%	21,713	0	0	21,713
Nov-18	30	583,438	1,010	0.0	0.0%	0	0	0	0
Dec-18	31	583,438	1,010	0.0	0.0%	0	0	0	0
Jan-19	31	583,438	1,010	0.0	0.0%	0	0	0	0
Feb-19	28	583,438	1,010	0.0	0.0%	0	0	0	0
Mar-19	31	583,438	1,010	0.0	0.0%	0	0	0	0
Apr-19	30	583,438	1,010	0.0	0.0%	14,678	0	0	14,678
May-19	31	583,438	1,010	22.0	1.0%	144,766	12,836	20,609	111,321
Jun-19	30	629,675	1,020	48.0	1.3%	94,430	30,224	25,927	38,279
Jul-19	31	629,675	1,020	53.0	1.2%	94,054	33,373	24,731	35,951
Aug-19	31	629,675	1,020	38.0	1.0%	68,615	23,928	20,609	24,078
Sep-19	30	678,491	1,030	15.0	0.6%	59,634	10,177	11,966	37,490
Oct-19	31	678,491	1,030	0.0	0.0%	21,713	0	0	21,713
Nov-19	30	678,491	1,030	0.0	0.0%	0	0	0	0
Dec-19	31	678,491	1,030	0.0	0.0%	0	0	0	0
Jan-20	31	678,491	1,030	0.0	0.0%	0	0	0	0
Feb-20	29	678,491	1,030	0.0	0.0%	0	0	0	0
Mar-20	31	678,491	1,030	0.0	0.0%	0	0	0	0
Apr-20	30	678,491	1,030	0.0	0.0%	14,678	0	0	14,678
May-20	31	735,017	1,040	22.0	1.0%	144,766	16,170	20,609	107,987
Jun-20	30	735,017	1,040	48.0	1.3%	94,430	35,281	25,927	33,222
Jul-20	31	735,017	1,040	53.0	1.2%	94,054	38,956	24,731	30,368
Aug-20	31	735,017	1,040	38.0	1.0%	68,615	27,931	20,609	20,075
Sep-20	30	779,661	1,050	15.0	0.6%	59,634	11,695	11,966	35,973
Oct-20	31	779,661	1,050	0.0	0.0%	21,713	0	0	21,713
Nov-20	30	779,661	1,050	0.0	0.0%	0	0	0	0
Dec-20	31	779,661	1,050	0.0	0.0%	0	0	0	0
Jan-21	31	779,661	1,050	0.0	0.0%	0	0	0	0
Feb-21	28	779,661	1,050	0.0	0.0%	0	0	0	0
Mar-21	31	779,661	1,050	0.0	0.0%	0	0	0	0
Apr-21	30	779,661	1,050	0.0	0.0%	17,705	0	0	17,705
May-21	31	829,840	1,060	22.0	1.0%	174,622	18,256	20,609	135,756
Jun-21	30	829,840	1,060	48.0	1.3%	113,905	39,832	25,927	48,145
Jul-21	31	829,840	1,060	53.0	1.2%	113,452	43,981	24,731	44,740
Aug-21	31	829,840	1,060	38.0	1.0%	82,766	31,534	20,609	30,623
Sep-21	30	851,007	1,070	15.0	0.6%	71,933	12,765	11,966	47,201
Oct-21	31	851,007	1,070	0.0	0.0%	26,191	0	0	26,191
Nov-21	30	851,007	1,070	0.0	0.0%	0	0	0	0
Dec-21	31	851,007	1,070	0.0	0.0%	0	0	0	0
Jan-22	31	851,007	1,070	0.0	0.0%	0	0	0	0
Feb-22	28	851,007	1,070	0.0	0.0%	0	0	0	0
Mar-22	31	851,007	1,070	0.0	0.0%	0	0	0	0
Apr-22	30	851,007	1,070	0.0	0.0%	17,705	0	0	17,705
May-22	31	870,431	1,080	22.0	1.0%	174,622	19,149	20,609	134,863
Jun-22	30	870,431	1,080	48.0	1.3%	113,905	41,781	25,927	46,197
Jul-22	31	870,431	1,080	53.0	1.2%	113,452	46,133	24,731	42,588
Aug-22	31	885,323	1,090	38.0	1.0%	82,766	33,642	20,609	28,514
Sep-22	30	885,323	1,090	15.0	0.6%	71,933	13,280	11,966	46,687
Oct-22	31	885,323	1,090	0.0	0.0%	26,191	0	0	26,191
Nov-22	30	885,323	1,090	0.0	0.0%	0	0	0	0
Dec-22	31	885,323	1,090	0.0	0.0%	0	0	0	0
Jan-23	31	885,323	1,090	0.0	0.0%	0	0	0	0
Feb-23	28	885,323	1,090	0.0	0.0%	0	0	0	0
Mar-23	31	898,569	1,100	0.0	0.0%	0	0	0	0
Apr-23	30	898,569	1,100	0.0	0.0%	17,705	0	0	17,705
May-23	31	898,569	1,100	22.0	1.0%	174,622	19,769	20,609	134,244
Jun-23	30	924,520	1,120	48.0	1.3%	113,905	44,377	25,927	43,601
Jul-23	31	924,520	1,120	53.0	1.2%	113,452	49,000	24,731	39,722
Aug-23	31	924,520	1,120	38.0	1.0%	82,766	35,132	20,609	27,025
Sep-23	30	936,889	1,130	15.0	0.6%	71,933	14,053	11,966	45,913
Oct-23	31	936,889	1,130	0.0	0.0%	26,191	0	0	26,191
Nov-23	30	936,889	1,130	0.0	0.0%	0	0	0	0
Dec-23	31	936,889	1,130	0.0	0.0%	0	0	0	0
Jan-24	31	936,889	1,130	0.0	0.0%	0	0	0	0
Feb-24	29	936,889	1,130	0.0	0.0%	0	0	0	0
Mar-24	31	949,821	1,140	0.0	0.0%	0	0	0	0
Apr-24	30	959,898	1,150	0.0	0.0%	17,705	0	0	17,705



Monthly Summary and Makeup Water Requirements

Nominal Ore Production Rate (tonnes)=	29,500	Stockpile (Nov - Feb)	11,800	From Crusher 3 (Mar -Nov 15)	41,300 tonnes/day
Ore Production Rate (m ³)=	16,389		6,556		22,944 m ³ /day

Solution Application 66,480 m³/day

Legend

Phase 1
Phase 2
Phase 3

(-) denotes negative balance (make-up water required)

Positive value denotes Excess Water

Red Indicates exceedance of In-Heap Capacity

Heap Phases - Active vs. Inactive Area Ratios

	Water Content (volume)		Inactive		Active (leaching)		Average Operating Water Content	
	m ³ / m ³ ore (vol.)	% mass	Heap Phase	(Draining) (%)	(%)	(volume) m ³ / m ³ ore (vol.)	% mass	
Natural Ore Water Content	0.086	5.0%	Phase 1	0.23	0.78	0.210	12.2%	
Optimal Leaching Content	0.228	13.3%	Phase 2	0.26	0.74	0.207	12.1%	
Residual Moisture Content	0.147	8.6%	Phase 3	0.46	0.54	0.191	11.1%	
Stockpile Ore Water Content	0.136	7.93%						

In Heap Max Capacity = 199,440 m³
 In Heap Minimum Operating = 33,240 m³ (In-Heap Min. Vol. - 12 hrs @ 2770m3/hr)
 In Heap Operating range = 166,200 m³

Water Density= 1000 kg/m³
 Dry Density= 1714.3 kg/m³

Date	Year	# days per month	# Heap Days	Ore Stacking				Water In Ore going to HLP				In-Heap Storage													
				Monthly Aproximate Amount of Ore Going on Pad		Cumulative Volume of Ore Going on Pad		Approximate Elevation (from Stacking Plan) (m)	Water In Ore from Pit (ROM) (%)	Water In Ore from Stockpile (7.5%) (m ³)	Total Monthly Water Requirement in Ore going on Pad to Reach Avg. Operating Water (m ³)	Water Deficit to Operating Water Content (m ³)	Vol. of Water Released from Ore at End of Period (Available for Recycle) (m ³)	Environmental Contribution Water to Pad (m ³)	Total Monthly Water Balance (includes Recycling) (m ³)	Makeup Water Required Includes Recycle (m ³)	Excess Available for Recycle (m ³)	Cumulative Banked Volume above Min. Operating (166,200 m ³ range) (m ³)	Total Cumulative Storage (199,440 m ³ max) (m ³)	Total Freshwater Make-up Water Required (includes Recycle) (m ³)	Excess Water Released from HLF (to WWTP) (m ³)	Total Volume of Solution in heap (solution inventory) (m ³)		Average Monthly Moisture Content (% by vol.)	(% by mass)
				(m ³)	(tonnes)	(m ³)	(tonnes)																		
Mar-15	1	31	30	487,569	877,625	487,569	877,625	860	41,792	0	102,327	(60,535)	30,445	0	(60,535)	60,535	0	0	33,240	93,775	0	135,567	27.8%	16.2%	
Apr-15	1	30	29	471,181	848,125	958,750	1,725,750	870	40,387	0	98,887	(58,500)	29,422	6,396	(21,659)	21,659	0	9,432	33,240	21,659	0	204,009	21.3%	12.4%	
May-15	1	31	30	487,569	877,625	1,446,319	2,603,375	870	41,792	0	102,327	(60,535)	30,445	40,546	9,432	0	9,432	9,432	42,672	0	0	286,346	19.8%	11.5%	
Jun-15	1	30	29	471,181	848,125	1,917,500	3,451,500	880	40,387	0	98,887	(58,500)	29,422	9,119	(18,937)	18,937	0	0	33,240	9,504	0	345,356	18.0%	10.5%	
Jul-15	1	31	30	487,569	877,625	2,405,069	4,329,125	880	41,792	0	102,327	(60,535)	30,445	9,516	(21,598)	21,598	0	0	33,240	21,598	0	418,261	17.4%	10.1%	
Aug-15	1	31	30	487,569	877,625	2,892,639	5,206,750	880	41,792	0	102,327	(60,535)	30,445	4,459	(25,631)	25,631	0	0	33,240	25,631	0	490,143	16.9%	9.9%	
Sep-15	1	30	29	471,181	848,125	3,363,819	6,054,875	890	40,387	0	98,887	(58,500)	29,422	11,438	(16,617)	16,617	0	0	33,240	16,617	0	558,585	16.6%	9.7%	
Oct-15	1	31	30	487,569	877,625	3,851,389	6,932,500	890	41,792	0	102,327	(60,535)	30,445	9,462	(21,652)	21,652	0	0	33,240	21,652	0	631,490	16.4%	9.6%	
Nov-15	1	30	15	245,833	442,500	4,097,222	7,375,000	890	21,071	0	51,593	(30,522)	15,351	0	(77)	77	0	0	33,240	77	0	652,638	15.9%	9.3%	
Dec-15	1	31	0	0	0	4,097,222	7,375,000	890	0	0	0	0	0	15,351	0	15,351	15,351	0	48,591	0	0	652,638	15.9%	9.3%	
Jan-16	2	31	0	0	0	4,097,222	7,375,000	890	0	0	0	0	0	0	0	0	15,351	15,351	48,591	0	0	652,638	15.9%	9.3%	
Feb-16	2	29	0	0	0	4,097,222	7,375,000	890	0	0	0	0	0	0	0	0	15,351	15,351	48,591	0	0	652,638	15.9%	9.3%	
Mar-16	2	31	30	682,597	1,228,675	4,779,819	8,603,675	900	41,792	26,498	143,258	(74,968)	42,623	0	(74,968)	74,968	0	0	33,240	59,617	0	780,545	16.3%	9.5%	
Apr-16	2	30	29	659,653	1,187,375	5,439,472	9,791,050	900	40,387	25,607	138,442	(72,448)	41,191	6,396	(23,429)	23,429	0	3,772	33,240	23,429	0	876,364	16.1%	9.4%	
May-16	2	31	30	682,597	1,228,675	6,122,069	11,019,725	910	41,792	26,498	143,258	(74,968)	42,623	37,549	3,772	0	3,772	3,772	37,012	0	0	982,203	16.0%	9.4%	
Jun-16	2	30	29	659,653	1,187,375	6,781,722	12,207,100	910	40,387	25,607	138,442	(72,448)	41,191	4,478	(25,347)	25,347	0	0	33,240	21,575	0	1,074,250	15.8%	9.2%	
Jul-16	2	31	30	682,597	1,228,675	7,464,319	13,435,775	920	41,792	26,498	143,258	(74,968)	42,623	3,048	(30,730)	30,730	0	0	33,240	30,730	0	1,176,317	15.8%	9.2%	
Aug-16	2	31	30	682,597	1,228,675	8,146,917	14,664,450	920	41,792	26,498	143,258	(74,968)	42,623	-178	(32,523)	32,523	0	0	33,240	32,523	0	1,276,952	15.7%	9.1%	
Sep-16	2	30	29	659,653	1,187,375	8,806,569	15,851,825	930	40,387	25,607	138,442	(72,448)	41,191	9,891	(19,933)	19,933	0	0	33,240	19,933	0	1,372,771	15.6%	9.1%	
Oct-16	2	31	30	682,597	1,228,675	9,489,167	17,080,500	930	41,792	26,498	143,258	(74,968)	42,623	9,462	(24,316)	24,316	0	0	33,240	24,316	0	1,474,838	15.5%	9.1%	
Nov-16	2	30	15	344,167	619,500	9,833,333	17,700,000	930	21,071	13,360	72,231	(37,799)	21,491	0	4,824	0	4,824	4,824	33,240	0	0	1,509,269	15.3%	9.0%	
Dec-16	2	31	0	0	0	9,833,333	17,700,000	930	0	0	0	0	0	21,491	0	21,491	26,315	59,555	0	0	1,509,269	15.3%	9.0%		
Jan-17	3	31	0	0	0	9,833,333	17,700,000	930	0	0	0	0	0	0	0	0	26,315	59,555	0	0	1,509,269	15.3%	9.0%		
Feb-17	3	28	0	0	0	9,833,333	17,700,000	930	0	0	0	0	0	0	0	0	26,315	59,555	0	0	1,509,269	15.3%	9.0%		
Mar-17	3	31	30	682,597	1,228,675	10,515,931	18,928,675	940	41,792	26,498	141,553	(73,263)	40,918	0	(73,263)	73,263	0	0	33,240	46,948	0	1,624,507	15.4%	9.0%	
Apr-17	3	30	29	659,653	1,187,375	11,175,583	20,116,050	950	40,387	25,607	136,795	(70,800)	39,543	14,678	(15,204)	15,204	0	0	33,240	15,204	0	1,720,383	15.4%	9.0%	
May-17	3	31	30	682,597	1,228,675	11,858,181	21,344,725	950	41,792	26,498	141,553	(73,263)	40,918	116,526	82,806	0	82,806	82,806	116,046	0	0	1,905,199	16.1%	9.4%	
Jun-17	3	30	29	659,653	1,187,375	12,517,833	22,532,100	950	40,387	25,607	136,795	(70,800)	39,543	51,852	21,971	0	21,971	104,776	138,016	0	0	2,023,045	16.2%	9.4%	
Jul-17	3	31	30	682,597	1,228,675	13,200,431	23,760,775	960	41,792	26,498	141,553	(73,263)	40,918	49,073	15,353	0	15,353	120,129	153,369	0	0	2,140,408	16.2%	9.5%	
Aug-17	3	31	30	682,597	1,228,675	13,883,028	24,989,450	960	41,792	26,498	141,553	(73,263)	40,918	33,486	1,142	0	1,142	121,271	154,511	0	0	2,242,184	16.2%	9.4%	
Sep-17	3	30	29	659,653	1,187,375	14,542,681	26,176,825	970	40,387	25,607	136,795	(70,800)	39,543	41,406	11,524	0	11,524	132,795	166,035	0	0	2,349,585	16.2%	9.4%	
Oct-17	3	31	30	682,597	1,228,675	15,225,278	27,405,500	970	41,792	26,498	141,553	(73,263)	40,918	21,713	(12,007)	12,007	0	120,789	154,029	0	0	2,439,588	16.0%	9.3%	
Nov-17	3	30	15	344,167	619,500	15,569,444	28,025,000	970	21,071	13,360	71,371	(36,939)	20,631	0	3,979	0	3,979	124,768	158,008	0	0	2,474,020	15.9%	9.3%	
Dec-17	3	31	0	0	0	15,569,444	28,025,000	970	0	0	0	0	0	20,631	0	20,631	145,399	178,639	0	0	0	2,474,020	15.9%	9.3%	
Jan-18	4	31	0	0	0	15,569,444	28,025,000	970	0	0	0	0	0	0	0	0	145,399	178,639	0	0	0	2,474,020	15.9%	9.3%	
Feb-18	4	28	0	0	0	15,569,444	28,025,000	970	0	0	0	0	0	0	0	0	145,399	178,639	0	0	0	2,474,020	15.9%	9.3%	
Mar-18	4	31	30	682,597	1,228,675	16,252,042	29,253,675	980	41,792	26,498	141,553	(73,263)	40,918	0	(73,263)	73,263	0	72,136	105,376	0	0	2,542,310	15.6%	9.1%	
Apr-18	4	30	29	659,653	1,187,375	16,911,694	30,441,050	980	40,387	25,607	136,795	(70,800)	39,543	14,678	(15,204)	15,204	0	56,932	90,172	0	0	2,622,982	15.5%	9.0%	
May-18	4	31	30	682,597	1,228,675	17,594,292	31,669,725	990	41,792	26,498	141,553	(73,263)	40,918	113,297	79,577	0	79,577	136,509	169,749	0	0	2,804,569	15.9%	9.3%	
Jun-18	4	30	29	659,653	1,187,375	18,253,944	32,857,100	990	40,387	25,607	136,795	(70,800)	39,543	44,808	14,926	0	14,926	151,436	184,676	0	0	2,915,372	16.0%	9.3%	
Jul-18	4	31	30	682,597	1,228,675	18,936,542	34,085,775	990	41,792	26,498	141,553	(73,263)	40,918	43,161	9,441	0	9,441	160,877	194,117	0	0	3,026,822	16.0%	9.3%	
Aug-18	4	31	30	682,597	1,228,675	19,619,139	35,314,450	1000	41,792	26,498	141,553	(73,263)	40,918	27,669	(4,675)	4,675	0	156,201	189,441	0	0	3,122,781	15.9%	9.3%	
Sep-18	4	30	29	659,653																					

Date	Year	# days per month	# Heap Days	Monthly Aproximate Amount of Ore Going on Pad		Cumulative Volume of Ore Going on Pad		Approximate Elevation (from Stacking Plan) (m)	Water In Ore from Pit (ROM) (m ³)	Water In Ore from Stockpile (7.5%) (m ³)	Total Monthly Water Requirement in Ore going on Pad to Reach Avg. Operating Water (m ³)	Water Deficit to Reach Avg. Operating Water Content (m ³)	Vol. of Water Released from Ore at End of Period (Available for Recycle) (m ³)	Environmental Contribution Water to Pad (m ³)	Total Monthly Water Balance (includes Recycling) (m ³)	Makeup Water Required Includes Recycle (m ³)	Excess Available for Recycle (m ³)	Cumulative Banked Volume above Min. Operating (166,200 m ³ range) (m ³)	Total Cumulative Banked In-Heap Storage (199,440 m ³ max) (m ³)	Total Freshwater Make-up Water Required (Includes Recycle) (m ³)	Excess Water Released from HLF (to WWTP) (m ³)	Total Volume of Solution in heap (solution inventory) (m ³)	Average Monthly Moisture Content	
				(m ³)	(tonnes)	(m ³)	(tonnes)																(% by vol.)	(% by mass)
Oct-19	5	31	30	682,597	1,228,675	26,697,500	48,055,500	1030	41,792	26,498	141,553	(73,263)	40,918	21,713	(12,007)	12,007	0	153,299	186,539	0	0	4,163,431	15.6%	9.1%
Nov-19	5	30	15	344,167	619,500	27,041,667	48,675,000	1030	21,071	13,360	71,371	(36,939)	20,631	0	3,979	0	3,979	157,278	190,518	0	0	4,197,863	15.5%	9.1%
Dec-19	5	31	0	0	0	27,041,667	48,675,000	1030	0	0	0	0	0	0	20,631	0	20,631	177,909	211,149	0	11,709	4,186,154	15.5%	9.0%
Jan-20	6	31	0	0	0	27,041,667	48,675,000	1030	0	0	0	0	0	0	0	0	0	166,200	199,440	0	0	4,186,154	15.5%	9.0%
Feb-20	6	29	0	0	0	27,041,667	48,675,000	1030	0	0	0	0	0	0	0	0	0	166,200	199,440	0	0	4,186,154	15.5%	9.0%
Mar-20	6	31	30	682,597	1,228,675	27,724,264	49,903,675	1030	41,792	26,498	141,553	(73,263)	40,918	0	(73,263)	73,263	0	92,937	126,177	0	0	4,254,444	15.3%	9.0%
Apr-20	6	30	29	659,653	1,187,375	28,383,917	51,091,050	1030	40,387	25,607	136,795	(70,800)	39,543	14,678	(15,204)	15,204	0	77,733	110,973	0	0	4,335,117	15.3%	8.9%
May-20	6	31	30	682,597	1,228,675	29,066,514	52,319,725	1040	41,792	26,498	141,553	(73,263)	40,918	107,987	74,267	0	74,267	152,000	185,240	0	0	4,511,393	15.5%	9.1%
Jun-20	6	30	29	659,653	1,187,375	29,726,167	53,507,100	1040	40,387	25,607	136,795	(70,800)	39,543	33,222	3,340	0	3,340	155,340	188,580	0	0	4,610,610	15.5%	9.0%
Jul-20	6	31	30	682,597	1,228,675	30,408,764	54,735,775	1040	41,792	26,498	141,553	(73,263)	40,918	30,368	(3,352)	3,352	0	155,340	188,580	0	0	4,709,267	15.5%	9.0%
Aug-20	6	31	30	682,597	1,228,675	31,091,361	55,964,450	1040	41,792	26,498	141,553	(73,263)	40,918	20,075	(12,269)	12,269	0	143,071	176,311	0	0	4,797,633	15.4%	9.0%
Sep-20	6	30	29	659,653	1,187,375	31,751,014	57,151,825	1050	40,387	25,607	136,795	(70,800)	39,543	35,973	6,091	0	6,091	149,162	182,402	0	0	4,899,600	15.4%	9.0%
Oct-20	6	31	30	682,597	1,228,675	32,433,611	58,380,500	1050	41,792	26,498	141,553	(73,263)	40,918	21,713	(12,007)	12,007	0	137,156	170,396	0	0	4,989,603	15.4%	9.0%
Nov-20	6	30	15	344,167	619,500	32,777,778	59,000,000	1050	21,071	13,360	71,371	(36,939)	20,631	0	3,979	0	3,979	141,135	174,375	0	0	5,024,035	15.3%	8.9%
Dec-20	6	31	0	0	0	32,777,778	59,000,000	1050	0	0	0	0	0	0	20,631	0	20,631	161,766	195,006	0	0	5,024,035	15.3%	8.9%
Jan-21	7	31	0	0	0	32,777,778	59,000,000	1050	0	0	0	0	0	0	0	0	0	161,766	195,006	0	0	5,024,035	15.3%	8.9%
Feb-21	7	28	0	0	0	32,777,778	59,000,000	1050	0	0	0	0	0	0	0	0	0	161,766	195,006	0	0	5,024,035	15.3%	8.9%
Mar-21	7	31	30	682,597	1,228,675	33,460,375	60,228,675	1050	41,792	26,498	141,553	(73,263)	40,918	0	(73,263)	73,263	0	88,506	121,743	0	0	5,092,325	15.2%	8.9%
Apr-21	7	30	29	659,653	1,187,375	34,120,028	61,416,050	1050	40,387	25,607	125,947	(59,953)	28,695	17,705	(1,329)	1,329	0	87,174	120,414	0	0	5,176,024	15.2%	8.8%
May-21	7	31	30	682,597	1,228,675	34,802,625	62,644,725	1060	41,792	26,498	130,328	(62,038)	29,693	135,756	102,414	0	102,414	189,588	222,828	0	23,388	5,356,683	15.4%	9.0%
Jun-21	7	30	29	659,653	1,187,375	35,462,278	63,832,100	1060	40,387	25,607	125,947	(59,953)	28,695	48,145	17,886	0	17,886	184,086	217,326	0	17,886	5,452,936	15.4%	9.0%
Jul-21	7	31	30	682,597	1,228,675	36,144,875	65,060,775	1060	41,792	26,498	130,328	(62,038)	29,693	44,740	11,397	0	11,397	177,597	210,837	0	11,397	5,554,569	15.4%	9.0%
Aug-21	7	31	30	682,597	1,228,675	36,827,472	66,289,450	1060	41,792	26,498	130,328	(62,038)	29,693	30,623	(1,722)	1,722	0	166,200	199,440	0	0	5,653,481	15.4%	9.0%
Sep-21	7	30	29	659,653	1,187,375	37,487,125	67,476,825	1070	40,387	25,607	125,947	(59,953)	28,695	47,201	16,942	0	16,942	183,142	216,382	0	16,942	5,749,735	15.3%	8.9%
Oct-21	7	31	30	682,597	1,228,675	38,169,722	68,705,500	1070	41,792	26,498	130,328	(62,038)	29,693	26,191	(7,151)	7,151	0	159,049	192,289	0	0	5,844,216	15.3%	8.9%
Nov-21	7	30	15	344,167	619,500	38,513,889	69,325,000	1070	21,071	13,360	65,711	(31,280)	14,971	0	(1,586)	1,586	0	157,462	190,702	0	0	5,878,648	15.3%	8.9%
Dec-21	7	31	0	0	0	38,513,889	69,325,000	1070	0	0	0	0	0	0	14,971	0	14,971	172,434	205,674	0	6,234	5,872,414	15.2%	8.9%
Jan-22	8	31	0	0	0	38,513,889	69,325,000	1070	0	0	0	0	0	0	0	0	0	166,200	199,440	0	0	5,872,414	15.2%	8.9%
Feb-22	8	28	0	0	0	38,513,889	69,325,000	1070	0	0	0	0	0	0	0	0	0	166,200	199,440	0	0	5,872,414	15.2%	8.9%
Mar-22	8	31	30	682,597	1,228,675	39,196,486	70,553,675	1070	41,792	26,498	130,328	(62,038)	29,693	0	(62,038)	62,038	0	104,162	137,402	0	0	5,940,704	15.2%	8.8%
Apr-22	8	30	29	659,653	1,187,375	39,856,139	71,741,050	1070	40,387	25,607	125,947	(59,953)	28,695	17,705	(12,554)	12,554	0	91,608	124,848	0	0	6,024,403	15.1%	8.8%
May-22	8	31	30	682,597	1,228,675	40,538,736	72,969,725	1080	41,792	26,498	130,328	(62,038)	29,693	134,863	101,521	0	101,521	193,129	226,369	0	26,929	6,200,628	15.3%	8.9%
Jun-22	8	30	29	659,653	1,187,375	41,198,389	74,157,100	1080	40,387	25,607	125,947	(59,953)	28,695	46,197	15,938	0	15,938	182,138	215,378	0	15,938	6,296,881	15.3%	8.9%
Jul-22	8	31	30	682,597	1,228,675	41,880,986	75,385,775	1080	41,792	26,498	130,328	(62,038)	29,693	42,588	9,246	0	9,246	175,446	208,686	0	9,246	6,398,514	15.3%	8.9%
Aug-22	8	31	30	682,597	1,228,675	42,563,583	76,614,450	1090	41,792	26,498	130,328	(62,038)	29,693	28,514	(3,830)	3,830	0	162,370	195,610	0	0	6,495,318	15.3%	8.9%
Sep-22	8	30	29	659,653	1,187,375	43,223,236	77,801,825	1090	40,387	25,607	125,947	(59,953)	28,695	46,687	16,427	0	16,427	178,797	212,037	0	12,597	6,595,401	15.3%	8.9%
Oct-22	8	31	30	682,597	1,228,675	43,905,833	79,030,500	1090	41,792	26,498	130,328	(62,038)	29,693	26,191	(7,151)	7,151	0	159,049	192,289	0	0	6,689,883	15.2%	8.9%
Nov-22	8	30	15	344,167	619,500	44,250,000	79,650,000	1090	21,071	13,360	65,711	(31,280)	14,971	0	(1,586)	1,586	0	157,462	190,702	0	0	6,724,314	15.2%	8.9%
Dec-22	8	31	0	0	0	44,250,000	79,650,000	1090	0	0	0	0	0	0	14,971	0	14,971	172,434	205,674	0	6,234	6,718,081	15.2%	8.9%
Jan-23	9	31	0	0	0	44,250,000	79,650,000	1090	0	0	0	0	0	0	0	0	0	166,200	199,440	0	0	6,718,081	15.2%	8.9%
Feb-23	9	28	0	0	0	44,250,000	79,650,000	1090	0	0	0	0	0	0	0	0	0	166,200	199,440	0	0	6,718,081	15.2%	8.9%
Mar-23	9	31	30	682,597	1,228,675	44,932,597	80,878,675	1100	41,792	26,498	130,328	(62,038)	29,693	0	(62,038)	62,038	0	104,162	137,402	0	0	6,786,370	15.1%	8.8%
Apr-23	9	30	29	659,653	1,187,375	45,592,250	82,066,050	1100	40,387	25,607	125,947	(59,953)	28,695	17,705	(12,554)	12,554	0	91,608	124,848	0	0	6,870,070	15.1%	8.8%
May-23	9	31	30	682,597	1,228,675	46,274,847	83,294,725	1100	41,792	26,498	130,328	(62,038)	29,693	134,244	100,902	0	100,902	192,510	225,750	0	26,310	7,046,294	15.2%	8.9%
Jun-23	9	30	29	659,653	1,187,375	46,934,500	84,482,100	1120	40,387	25,607	125,947	(59,953)	28,695	43,601	13,342	0	13,342	179,542	212,782	0	13,342	7,142,548	15.2%	8.9%
Jul-23	9	31	30	682,597	1,228,675	47,617,097	85,710,775	1120	41,792	26,498	130,328	(62,038)	29,693	39,722	6,379	0	6,379	172,579	205,819	0	6,379	7,244,180	15.2%	8.9%
Aug-23	9	31	30	682,597	1,228,675	48,299,694	86,939,450	1120	41,792	26,498	130,328	(62,038)	29,693	27,025	(5,320)	5,320	0	160,880	194,120	0	0	7,339,495		

Eagle Gold Project

Response to October 2012 YESAB Request for Additional Information
YESAB Assessment 2010-0267

Attachment B
Tech Memo from Tetra Tech re Revision to July 24, 2012
Seepage and Drindown Evaluation Memorandum



Technical Memorandum

To:	Steve Wilbur	From:	Amy L. Hudson, REM
Company:	Victoria Gold Corp.	Date:	November 20, 2012
Re:	Revision to July 24, 2012 Seepage and Draindown Evaluation Memorandum	Doc #:	
CC:	Eric Fier, Randy Powell, Ronson Chee, Troy Meyer (Tetra Tech), Erin Rainey (Knight Piesold)		

1.0 Introduction

This technical memorandum presents Tetra Tech's revised infiltration and seepage modeling of the proposed 92 million tonne heap leach facility at the Eagle Gold Project in the Yukon Territory, Canada. The purpose of this modeling was to assess the baseline seepage conditions that would likely exist during closure and post-closure periods and to estimate draindown rates during this period. Model results were also used to estimate the total amount of water and residual process solution that will have accumulated in the heap leach facility after rinsing and detoxification are completed and just prior to commencement of draindown. The modeling was completed using the VADOSE/W program, a variably saturated (unsaturated and saturated conditions) model from the GeoStudio 2007 software package (GEO-SLOPE, 2007). Modeling was performed on a cross-section through the central portion of the heap and the embankment (see Figure 1).

The baseline conditions modeled do not include a closure cover on the upper surface of the facility, and no recirculation of solution to manage flows to the treatment plant was considered. Modeling of these conditions will be presented in the Infiltration, Seepage, and Draindown Modeling Report being prepared for the Water Use License (WUL) application.

2.0 Model Construction

The conceptual model provided as Figure 2, shows the system water balance components of the heap. The system water balance components consist of precipitation (rain and snow which can accumulate on the surface of the facility), evaporation (from soil surface), runoff, infiltration, and seepage. Seepage includes continued drain-down of the residual heap solution, as well as any infiltration of precipitation. Modeling was performed to simulate the conditions during the closure and post closure period of the facility, so the water balance does not include the application of leaching solution or rinse water. The starting point of model is the first day after the completion of rinsing and includes the in-heap pond at its maximum operational level (volume of 199,440 cubic meters [m³]). It is assumed for the purpose of simulating the draindown conditions that the system is free draining.

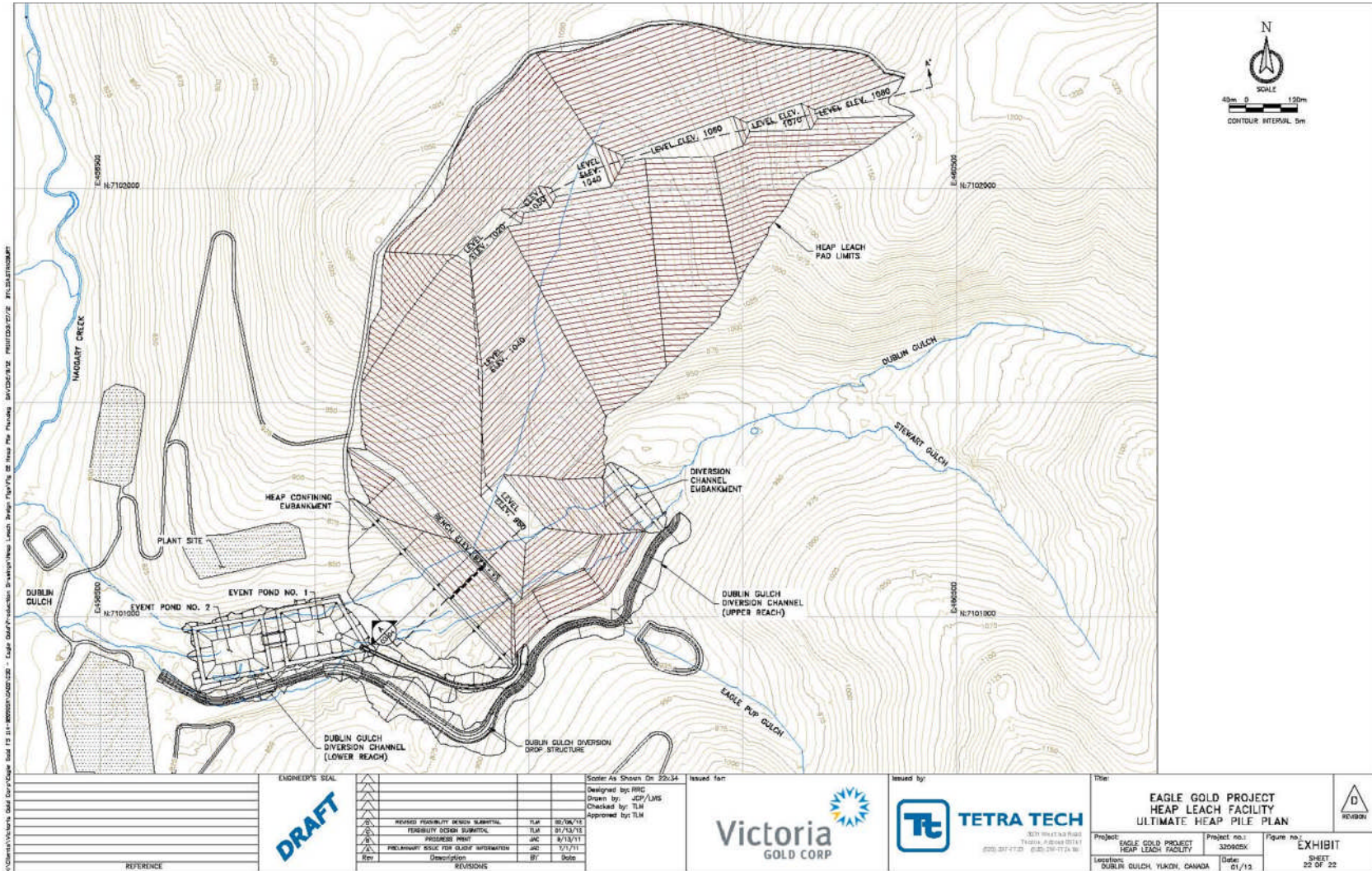


Figure 1 Heap Leach Facility Layout and Model Cross-Section

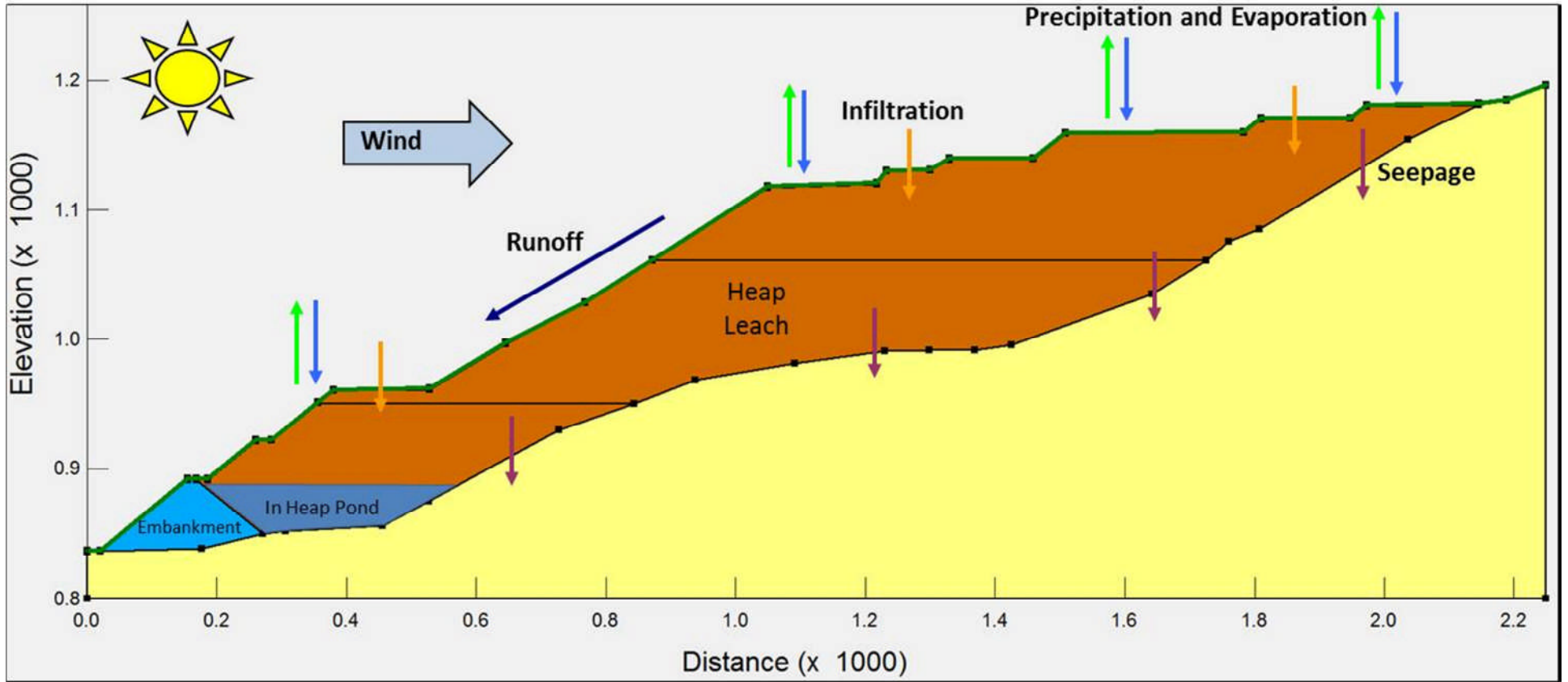


Figure 2 Heap Leach Facility Conceptual Model



2.1 Model Input Parameters

The following sections present the data that was used in the seepage assessment.

2.1.1 Climate Data

The climate data used for this modeling was obtained from the Potato Hills and the Dawson meteorological stations. The parameters in the climate data file included:

- Minimum and maximum daily temperature;
- Daily precipitation;
- Minimum and maximum daily humidity;
- Daily evaporation or net radiation; and
- Average daily wind speed.

The Potato Hills meteorological station is located approximately four kilometers from the heap. The dataset applied to the modeling utilizes the data from period of record for the meteorological station (2007 to 2011). The Dawson meteorological station is located approximately 170 kilometers from the heap and a limited amount of data was utilized to provide information to fill gaps in the precipitation record from the Potato Hills record (monthly snow measurement collection began in 2011 at this station; although spring snow survey data have been collected at Potato Hills, this type of data is not useful for input into the model). The closer Mayo meteorological station was considered but did not provide the necessary data, so the Dawson station was utilized. The climate data was used as an actual conditions file in the modeling so the daily measured data from the station was used to make a ten year continuous data set that represents the site conditions and would provide a long term scenario to minimize the “noise” in the model results and to allow the draindown to reach a near steady state condition. Each year selected for use in the ten year file had a generally average amount of precipitation. The average site precipitation was determined from a regression equation presented in the Surface Water Balance Model Report (Stantec, 2011):

$$y = (0.173x + 203) \text{ site adjustment factor}$$

Where: y = average annual precipitation (mm)

x = median basin elevation (m)

site adjustment factor = 1.4

Using the mean elevation of the heap (1027 meters), the average site precipitation is 533 millimeters (mm).

2.1.2 Material Properties

The most significant difference between saturated and unsaturated flow is the hydraulic conductivity. The hydraulic conductivity in saturated media is a function of the material type. In unsaturated flow, the hydraulic conductivity is a function of the material properties and the moisture content of the material. The equation used to calculate water flow within unsaturated media is:

$$q = -K(\theta)\nabla H$$



Where:

- q = water flow velocity (L^2/t)
- $K(\theta)$ = hydraulic conductivity as a function of soil (or rock) moisture content (L/t)
- ∇H = hydraulic head (L)

The relationship between moisture content and hydraulic conductivity is non-linear, which further complicates the flow dynamics. In saturated material, the physics of flow are relatively simple and are driven by Darcy's Law where the flow is proportional to the saturated hydraulic conductivity, gravity, and pressure gradients. In simple terms, water flows downhill (downward pressure gradient) and flows faster through coarse material than fine material. However, in unsaturated flow, additional controlling forces include matric pressure, absorption, and electrostatic forces.

Matric pressure is the suction created by capillary forces and the interaction of water, air, and solid surfaces. Matric pressure can be observed by placing a thin straw into a body of water. Driven by the surface tension forces, the water rises inside the straw, defying the force of gravity. The thinner the straw, the stronger the suction force will be and the higher the column of water will rise in the tube. The same process occurs in the voids between material particles in a heap.

One of the more curious properties of unsaturated zone flow is that different materials are preferentially conductive with varying moisture contents. Under high moisture conditions, pores are saturated and their suction decreases significantly. In this case, gravity is the strongest force and water will flow downhill from pore space to pore space. At low moisture conditions, the preferential flow changes, and the suction forces become stronger than gravitational forces. In this case, the tight materials are the most conductive with small voids that literally suck water through them. Under low moisture conditions, clay is more conductive than the sandy material.

The material properties used in the VADOSE/W (GEO-SLOPE, 2007) models were based on the design properties of the heap, literature values and previous experience. The embankment material was simulated as low permeability dam material (10^{-6} cm/sec), and the heap material simulated as a generally uniform material with a saturated hydraulic conductivity of approximately 10^{-2} cm/sec (well-sorted sand and gravel [Fetter, 2000]). The ore will be conventionally ground to a P80 of 6.3 mm (fine gravel) and agglomerated with cement. Figure 3 presents the hydraulic conductivity as a function of the matric suction of the heap and embankment materials. Figure 4 presents the water content as a function of the matric suction of the same materials. The units used in these figures are those utilized by the modeling software.

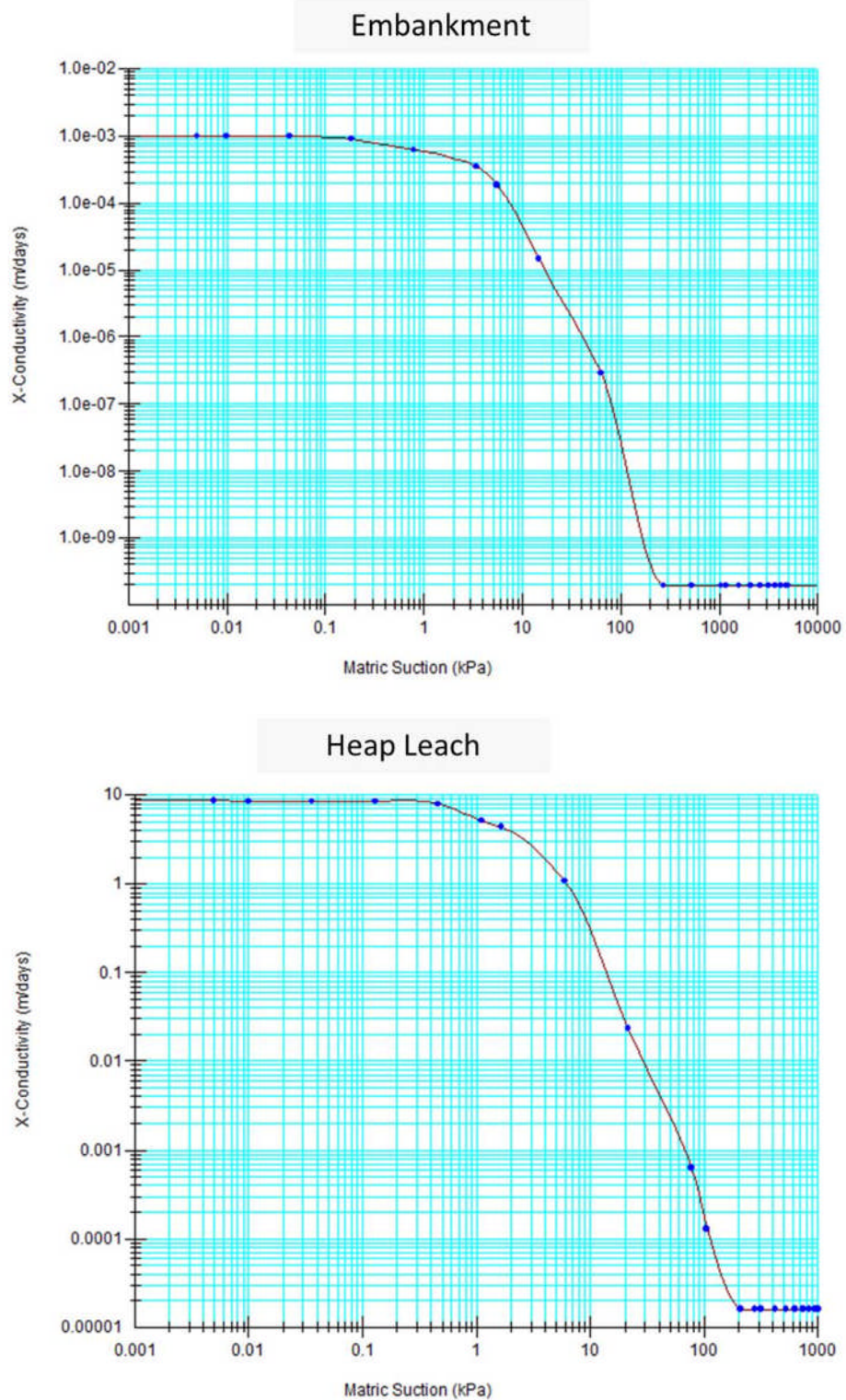


Figure 3 Hydraulic Conductivity Functions

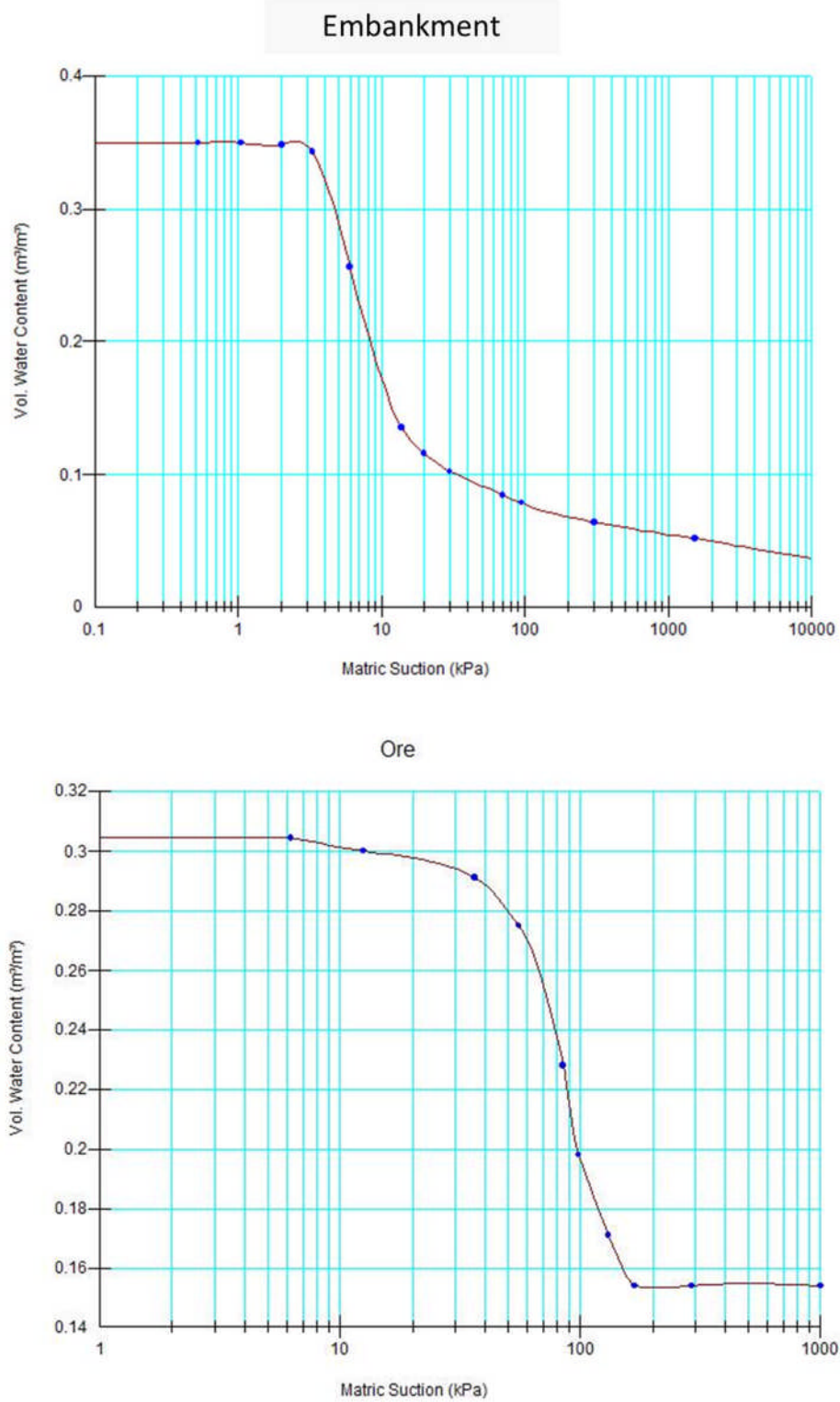


Figure 4 Soil Water Characteristic Curves



2.1.3 Boundary Conditions

The boundary conditions used in this modeling were limited to a zero pressure boundary at the base of the model to ensure the system is free draining, a unit gradient at the base of the heap to represent the drains, initial moisture addition to simulate moisture applied to the system by the emitters during the operational and rinsing phases of the heap, and the climate file. The initial moisture content of the heap leach material that had just finished leaching was defined by applying a very small source of water at the top surface of the model and allowing the model to reach a steady state condition that is representative of the range of moisture contents expected at the beginning of draindown (12% to 20% by volume), including the in-heap pond. Assuming that approximately 32% of the heap is actively being rinsed and 68% is inactive and partially drained, the overall average facility moisture content at the beginning of draindown is 15.1% by volume (8.8% by weight) (Tetra Tech, 2012). A climate file was used in this modeling to ensure an evaluation of the long term behavior of the heap leach material under actual climatic conditions.

2.2 Modeling Technique

2.2.1 Steady State Modeling

Steady state modeling is challenging when analyzing mining sites because the facilities change quickly. Therefore, the objective of the steady state model was to offer non-zero starting values for the subsequent transient modeling scenario and establish the water level of the in-heap pond at an elevation of 870 meters (volume of 199,440 m³). The maximum volume of the in-heap pond is 459,349 m³, at an elevation of 889 meters.

2.2.2 Transient Modeling

Transient modeling provides a reasonable simulation of flow conditions within the heap material. The uppermost layer of the model is a surface region representing the top surface layer of the facility. It is in this part of the model that atmospheric conditions and heap come in contact, driving the water balance. The water within the facility then moves according to the rules of unsaturated flow physics through the heap material. Finally, and if applicable, the water reaches the base of the modeled region, where it moves to the model discharge point.

2.2.2.1 Surface Layer

VADOSE/W (Geo-Slope, 2007) simulates the dynamics of the facility surface by considering climate and soil interactions. VADOSE/W (Geo-Slope, 2007) simulates precipitation using time increments with a maximum size of two (2) hours. The daily precipitation data is distributed according to a sinusoidal function that peaks at noon (normal distribution). This distribution pattern was compared with the constant averaged and the sloped averaged distribution patterns, and it was determined that the sinusoidal pattern resulted in the most stable calculation of the results. Potential evaporation or net radiation measurements are used to calculate the actual evaporation that is possible based on the conditions provided in the surface layer of the model. Evaporation is calculated from the following climate and soil parameters:

- Air temperature;
- Soil temperature;
- Relative humidity;



- Solar intensity (from latitude);
- Soil temperature;
- Soil moisture content;
- Wind speed; and
- Measured pan/modeled actual evaporation.

The combination of the factors listed above provides a reasonable estimate of water evaporation from the system. Infiltration is based on the unsaturated hydraulic conductivity of the material at a given time. Excess rain that has not evaporated or infiltrated is tabulated as runoff. Excess snow is allowed to accumulate on the surface of the heap, and snow that does not sublimate becomes snow melt and can infiltrate into the heap material.

2.2.2.2 Transient Flow within the Facilities

The transient flow dynamics within the heap material are simulated over time and space. The models account for transitions between material types and produces the following data sets:

- Water flux within the model domain;
- Moisture content;
- Water flow velocity; and
- Seepage discharge, if applicable (out of the model domain).

The following sections present the infiltration and seepage model results.

3.0 Model Results

After leaching and rinsing are complete, the spent ore will be allowed to drain freely. For this modeling effort, it was assumed that all of the draindown flow would be removed from the heap to provide a baseline draindown curve. No optimization scenarios (e.g. recirculation of fluid) were considered in this modeling. This assumption results in a faster draindown of the heap than would be realized if solution is recirculated back to the top of the heap to continue the process. This optimization condition will be considered in future modeling efforts in support of the Water Use License application. Additionally, this modeling assumed that the heap would remain uncovered (no closure/reclamation cover placed over heap material) for the period of modeling. This assumption results in a conservative (higher) estimation of the cumulative volume to be drained because there is no reduction of infiltration of meteoric water. The simulated flow rate of the draindown curve for the heap is presented in Figure 5. Note that there are periodic spikes in the curve that represent modeled snowmelt or rain events that provide a short term increased flux of water into the system.

The draindown of the heap will start at the operational flow levels (2,770 m³/hr) and decline quickly. It is estimated that after the completion of rinsing 344,000 m³ will drain down from the heap in the first ten days and approximately 399,000 m³ after 30 days. As shown in Figure 5, the baseline rate of draindown continues to decrease quickly to approximately 91 m³/hr (~25 L/s) after 90 days, 80 m³/hr (~22 L/s) after one year, 70 m³/hr (19 L/s) after two years and approximately 35 m³/hr (~9.7 L/s) by the end of Year 10. For an uncovered heap, the draindown rate will not trend toward zero but instead will become asymptotic with the drainage rate due to net infiltration through the top of the heap (estimated long term draindown rate of approximately 30 m³/hr for this heap). It is assumed that the draindown rate after approximately 20 years will

be representative of the long term drainage conditions of the heap without a cover. Based on the heap leach water balance at the end of the rinsing period and beginning of draindown, there will be approximately 7,684,174 m³ of rinsate solution in the heap material. Figure 6 presents the simulated cumulative draindown volume as the total cumulative volume drained, the cumulative rinsate drained, and the cumulative environmental contribution drained. In the early years of draindown, the rinsate quantity is the majority of the total cumulative solution draining.. After approximately 8.5 years, the environmental contribution water is the larger source of the cumulative total draindown than the rinsate solution. The addition of a closure cover over the heap surface will decrease the environmental water contribution to the heap and it is anticipated that the rinsate solution will represent a greater proportion for a longer period under that scenario.

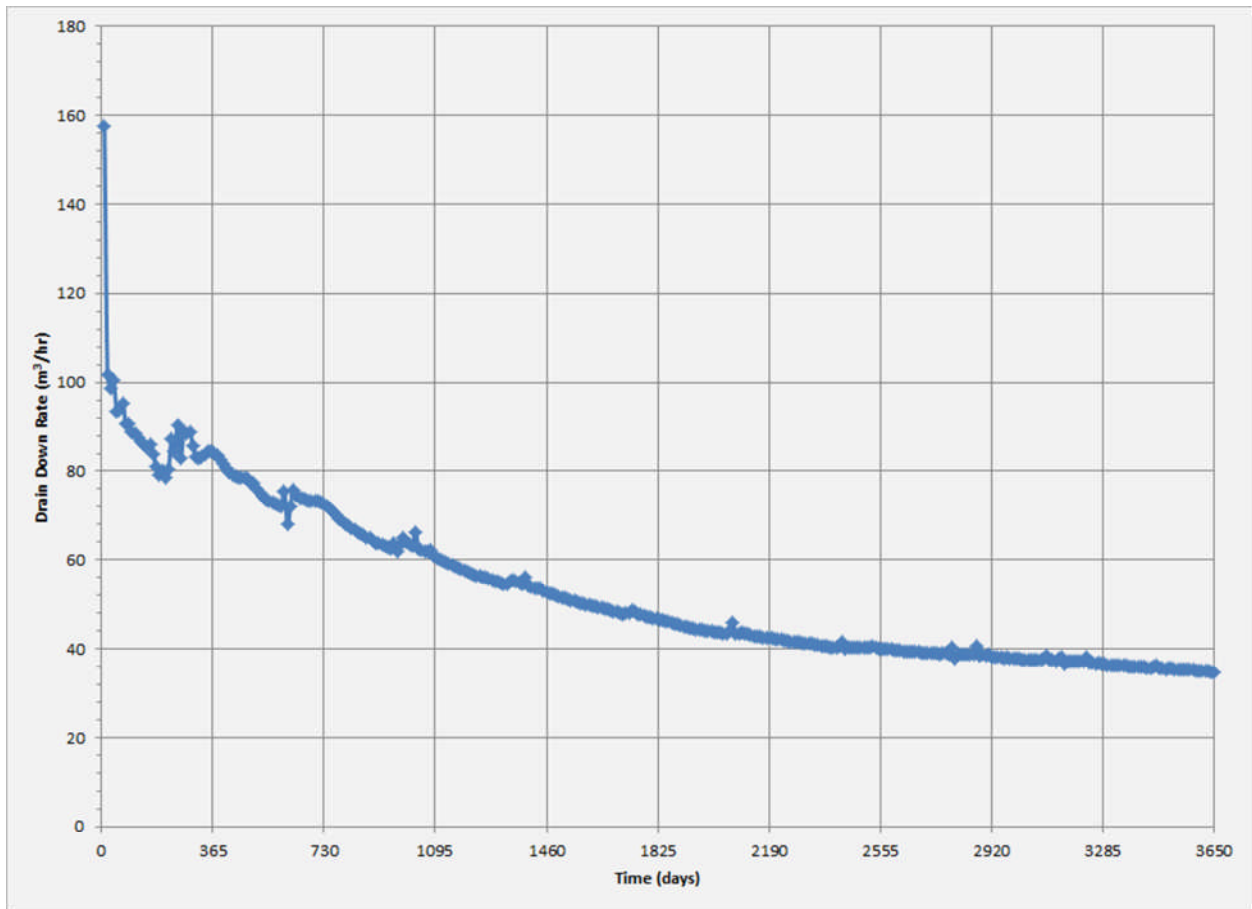


Figure 5 Draindown Curve for Heap Leach Facility

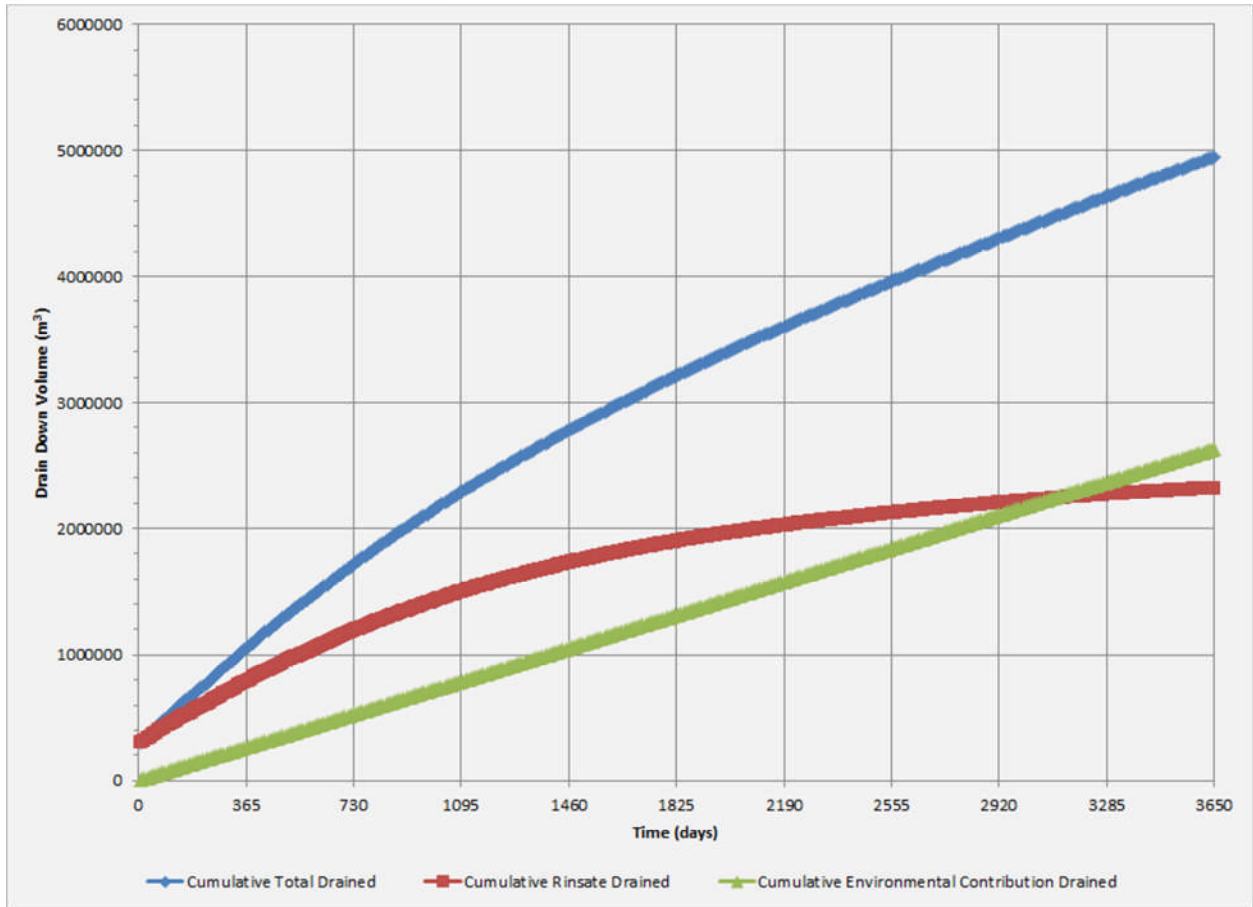


Figure 6 Cumulative Draindown Volume for Heap Leach Facility

4.0 References

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Stantec, 2011. Surface Water Balance Model Report, July 2011.

Tetra Tech 2012. Eagle Gold Heap Leach Facility Water Balance – Revision 3. November 12, 2012.

Eagle Gold Project

Response to October 2012 YESAB Request for Additional Information
YESAB Assessment 2010-0267

Attachment C
Letter from Knight Piesold re Eagle Gold Project –
Updated Site Water Balance Model

November 23, 2012

File No.:VA101-290/6-A.01
Cont. No.:VA12-01954



Mr. Steve Wilbur
Victoria Gold Corp.
Suite 584 – 1055 Dunsmuir Street
Vancouver, BC V7X 1K8

Dear Steve,

**Re: Eagle Gold Project – Updated Site Water Balance Model, Response to October 2012
Supplementary Information Request by YESAB**

1. GENERAL

Knight Piésold Ltd. (KP) has completed an update to the monthly site water balance model for the Eagle Gold Project as part of the response to the October 24, 2012 Supplementary Information Request (SIR) by YESAB. This letter should be read in conjunction with the technical memo by Tetra Tech (2012d) in addressing the Information Request R1. Specifically, Information Request R1 requested additional information on the heap leach facility (HLF) water balance model to address concerns identified by the First Nation of Na-Cho Nyak Dun. Upon review of the YESAB Information Request some assumptions in the HLF water balance model were updated by Tetra Tech (2012d) to address R1.

Tetra Tech was retained by Victoria Gold Corp. (VIT) to provide a heap leach facility design, which included the heap leach water balance created in Excel, as part of the 2012 Feasibility Study (FS) for the Eagle Gold Project (Wardrop, 2012). The site water balance model was created by KP as part of the FS Water Management Plan (KP, 2012a) using the GoldSim© software package and incorporates the framework and assumptions of the Excel HLF model. The site water balance model was subsequently updated for the May 2012 SIR (Tetra Tech, 2012a) and July 2012 SIR (KP, 2012b).

The basic components of the site water balance model remain unchanged from the model presented in the July SIR (KP, 2012b) for the 92 million tonne HLF, but with the following modifications as a result of Tetra Tech's recently revised HLF water balance model (2012d):

- An updated project schedule to commence ore stacking to the heap in March of Year 1 to May of Year 10, with HLF draindown to begin in May of Year 13. The previous model assumed ore stacking to the heap ceased in November of Year 9 and commenced draindown in November of Year 12.
- The revised HLF water balance model accounts for areas within the heap that are draining during operations, therefore water is assumed to be released from the heap on a monthly basis. The previous HLF balance assumed that once the stacked ore on the heap reached the optimal water content for leaching, it remained at this water content with no water being released.
- The annual evaporation value for the heap was revised to 175 mm based on an updated estimate of actual evapotranspiration (AET) from a bare rock surface (described further in a following section), applicable to the entire heap footprint for each phase of heap operation. The previous HLF water balance model assumed an annual value of 299 mm based on an estimate of potential evapotranspiration (PET) or lake evaporation for the project site (Tetra Tech, 2012c), applied to only the top area of the heap under active leaching.
- The HLF, Eagle Pup and Platinum Gulch waste rock storage areas (WRSAs) are assumed to be reclaimed with closure covers, which are functional based on the project schedule (Table 1). The closure covers are assumed to reduce available precipitation infiltration to 25% of net precipitation, with remaining 75% of net

precipitation assumed to be generated as runoff. The previous model assumed 20% infiltration through the closure covers.

- A maximum total volume of water stored in the HLF at closure of 7.7 million m³ (Tetra Tech, 2012d). Previously the model assumed a maximum total volume of 1.7 million m³ (Tetra Tech, 2012b).
- The draindown curve for the heap (without a closure cover) after rinsing was modified to reflect the larger volume stored in the heap at closure (Tetra Tech, 2012e). The revised heap draindown model was incorporated into the site water balance model, and used to estimate the volume of heap rinsate delivered on a monthly basis (after detoxification) to treatment. The draindown model estimates that the HLF will gradually reach a draindown rate of approximately 30 m³/hr 10 years after the initiation of draindown, compared to approximately 5 m³/hr predicted by the previous draindown model (Tetra Tech, 2012b).

2. SITE WATER BALANCE MODEL ASSUMPTIONS

General

A stochastic analysis was carried out on the monthly site water balance using the GoldSim© software package. The intent of the analysis was to estimate the magnitude and extent of any water surplus and/or deficit conditions for the HLF and the associated excess mine site runoff requiring treatment, over a range of possible climatic conditions. The modelling timeline includes two years of pre-production (Year -1 to -2), approximately 9 years of operation at a nominal ore production rate of 29,500 metric tonnes per day (tpd) and approximately 3 years of supplemental gold recovery and rinsing followed by 10 years of draindown. The total precipitation inputs were based on the analyses completed by Stantec and included in the reports “Appendix 7: Eagle Gold Project – Environmental Baseline Report: 2010 Update for Climate” (Stantec, 2011a) and “Appendix 21: Eagle Gold Project – Surface Water Balance Model Report” (Stantec, 2011b). The potential variability of climatic conditions was addressed by using a stochastic version of the water balance model, which involved Monte Carlo type simulation techniques and the modelling of monthly climatic parameters as probability distributions, rather than simply as mean values.

The model is shown schematically on Figure 1 and incorporates the following major project components:

- Open pit
- Eagle Pup (EP) waste rock storage area (WRSA)
- Platinum Gulch (PG) waste rock storage area (WRSA)
- Heap Leach Facility (HLF)
- EP Collection Pond
- PG Collection Pond
- Cyanide Detoxification/Mine Water Treatment Plant (CD/MWTP)
- Events Ponds, and
- Lower Dublin South Pond (LDSP).

The project schedule assumed for the water balance model is summarized in Table 1. The project schedule as presented was assumed only for the purpose of the water balance model and does not reflect the actual project scheduling as this will depend on the timing and terms of the water use and quartz mine licenses. Model assumptions and parameters are discussed in the following sections and summarized in Table 2, which also lists the relevant catchment areas for project facilities.

Evapotranspiration Losses

Potential evapotranspiration (PET) is defined as the amount of evapotranspiration that would occur from a full vegetation cover given an infinite supply of water, and these values are believed to reasonably represent lake

evaporation conditions (Ponce, 1989 and Maidment, 1993). No relevant lake evaporation data are available for the project area. Accordingly, the PET for the project site was estimated based on the empirical Thornthwaite equation. Measured temperature data available from the project climate station at Potato Hills (September 2007- March 2012) were used as input to the equation to generate the monthly and annual estimates of PET, as summarized in the table below. The estimated long-term annual potential evapotranspiration (lake evaporation) value for the project is 350 mm.

Actual evapotranspiration (AET) is limited by the availability of water, and therefore is determined as part of the soil water balance. A simple water balance, considering temperature and soil moisture, was created to estimate the evaporation losses from the bare rock surfaces (waste rock storage areas (WRSA), HLF, and open pit). Based on this, the AET in any given month was assumed to be 0.5 x PET, to represent the relative effectiveness of bare rock to retain water from month to month.

In closure, once the WRSA and HLF are assumed to be reclaimed (with their respective closure covers being effective), the AET in any given month was assumed to be 0.7 x PET, to reflect the relative effectiveness of the natural cover materials to retain some water from one month to the next, and therefore make more water available for evapotranspiration. The table below summarizes the monthly AET losses during operations and closure used in the updated water balance model. The net precipitation in any month is based on available precipitation (rainfall + snowmelt) minus evaporation losses.

Monthly PET and AET losses

Parameter	Monthly Value (mm)												Annual (mm)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
PET	0	0	0	0	44	95	105	76	29	0	0	0	350
AET – bare rock	0	0	0	0	22	48	53	38	15	0	0	0	175
AET – closure cover	0	0	0	0	31	67	74	53	21	0	0	0	245

Operational Constraints

Similar to the previous site water balance models, operational rules were applied to the updated water balance to determine the design requirements (capacity and timing) for water management and treatment facilities. For the HLF and CD/MWTP, the model utilized an optimized water management scenario to simulate the recycling of excess discharge from the HLF back to the HLF or events ponds in that event that:

- The inflow in any month exceeds the design capacity of the MWTP of 600 m³/hr, or
- The ratio of potential discharge from the MWTP versus Haggart Creek flow is greater than 1:10 (i.e. 1 part MWTP discharge to 10 parts Haggart Creek flow).

3. MODEL RESULTS

The predicted monthly inflow to the CD/MWTP for the median scenario as reported in July 2012 (Knight Piesold 2012b, Tetra Tech 2012c), and the updated water balance model are presented on Figure 2. The results illustrate the 'managed' case, in which excess inflow to the CD/MWTP is re-circulated back onto the HLF where it is temporarily stored until there is sufficient capacity in the CD/MWTP to treat it and/or there is sufficient flow in Haggart Creek to provide the required dilution for release (ratio of $\leq 1:10$).

Operations

For the first several years of the operations phase, the updated water balance model (green line labeled "2012 November SIR") predicts higher monthly inflow to the CD/MWTP compared to the previous water balance model (blue dashed line label "2012 July SIR"). This is due to the reduced volume of makeup water required by the HLF on a monthly basis. The updated HLF water balance accounts for the additional source of water released from the inactive areas of the heap during operations, thereby satisfying some of the water needs for the HLF system. Therefore, excess mine site runoff that is generated from the WRSAs and open pit that was need as makeup in the previous model is now assumed to be sent to treatment. After Year 3, the monthly inflow to the CD/MWTP for the updated model is comparable or even less than the previous model. This is likely due to the increased evaporation losses applicable to the entire HLF footprint in the updated model, as opposed to the smaller area under active irrigation assumed in the previous model.

Closure

Both models include the 'optimized' water management strategy, which simulates the recycling of excess water back onto the HLF in the event that the predicted CD/MWTP inflow volume exceeds the operating constraints, outlined previously under the model assumptions. Figure 2 illustrates the resulting managed CD/MWTP inflows. The effects of the managed inflows are particularly evident during Years 11 to 17 (during rinsing and draindown), when the inflows are shown to be controlled at the upper limits.

During the supplemental gold recovery and rinsing phases (May of Year 10 to April of Year 13), ore stacking has ceased but the HLF continues to be irrigated and/or rinsed with the stacked ore under active irrigation is assumed to be at the optimal leach moisture content, without the need for additional makeup water. Both models predict comparable inflow to the CD/MWTP, with inflows being greater than the preceding years of operations. This is likely due to the HLF being in a surplus water condition, as the net precipitation inputs exceed the moisture capacity of the stacked ore.

During draindown (May of Year 13 to May of Year 23) both models predict comparable inflow to the MWTP with exception of the beginning of Year 13 and the latter half of Year 15. The lower flow in the beginning of Year 13 is due to the later timing of the initiation of draindown in the updated model, which does not occur until May of Year 13, compared to November of Year 12 in the previous model. From Year 15 through Year 17, the inflows for the updated model are maintained at the upper limits of the operational constraints. This is primarily due to the increased draindown flow rates predicted in the updated draindown curve that is based on the larger volume (7.7 Mm^3) of water stored in the HLF at the end of rinsing (Tetra Tech 2012d). Although the shape of the draindown curves are similar in that the draindown rates decrease rapidly at first and then taper off over time, the larger draindown volume in the updated model facilitates higher rates of draindown per month compared to the previous model. The updated model estimates that over time (~ 10 years), the draindown rate will decrease to an average rate of approximately $30 \text{ m}^3/\text{hr}$ ($\sim 8 \text{ L/s}$), compared to the lower rate of approximately $5 \text{ m}^3/\text{hr}$ (1.4 L/s) in the previous model.

4. REFERENCES

Knight Piésold Ltd. (2012a). Victoria Gold Corporation, Eagle Gold Project – Feasibility Water Management Plan (Ref. no. VA101-290/5-1, Rev 2). April 18, 2012.

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Stantec (2011a). Appendix 7: Eagle Gold Project – Environmental Baseline Report: 2010 Update for Climate.

Stantec (2011b). Appendix 21: Eagle Gold Project – Surface Water Balance Model Report. June 2011.

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Tetra Tech (2012b). Seepage and Draindown Evaluation of the 92 Million Tonne Eagle Gold Project Heap Leach Facility – Baseline Conditions. July 24, 2012.

Tetra Tech (2012c). Eagle Gold Project Supplemental Information Report. July 2012

Tetra Tech (2012d). Eagle Gold Heap Leach Facility Water Balance – Revision 3. November 9, 2012

Tetra Tech (2012e). Revision to July 24, 2012 Seepage and Draindown Evaluation Memorandum. November 19, 2012.

Wardrop (2012). Victoria Gold Corporation, Eagle Gold Project – Feasibility Study. April 18, 2012.

We trust that this analysis is suitable for your needs. If you have any questions, please contact the undersigned.

Yours truly,

KNIGHT PIESOLD LTD.

Signed:
Erin Rainey, P.Eng.
Project Engineer



Reviewed:
Jaime Cathcart, Ph.D., P.Eng.
Senior Hydrotechnical Engineer

A handwritten signature in blue ink that reads "Jaime Cathcart".

A handwritten signature in blue ink that reads "Ken Brouwer".

Approved:
Ken Brouwer, P.Eng.
Managing Director

Attachments:

Table 1 Rev 0	Water Balance Model Project Schedule
Table 2 Rev 0	Water Balance Input Parameters
Figure 1 Rev 0	Water Balance Schematic – Operations
Figure 2 Rev 0	Optimized Monthly Inflow to the Mine Water Treatment Plant – Median Conditions

/er

TABLE 1

**VICTORIA GOLD CORP.
EAGLE GOLD PROJECT**

WATER BALANCE MODEL PROJECT SCHEDULE

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Operational Mine Life (year) ¹	Mine Phase		Details/Assumptions	
1	Operations		March - mine start up MWTP online HLF ore stacking and irrigation starts - HLF Phase 1 EP WRSA and PG WRSA stacking starts	
2			March - ore stockpile to HLF	
3			March - HLF Phase 2	
4				
5				
6				
7			April - HLF Phase 3 PG WRSA cover becomes functional	
8				
9				
10		Operations/Closure		April - end of ore stacking to HLF May - HLF Supplemental Gold Recovery begins
11	Closure	HLF Gold recovery/HLF Rinse	May - HLF rinsing commences	
12		HLF rinse		
13		HLF rinse/draindown	May - HLF draindown commences EP WRSA closure cover becomes functional	
14		HLF draindown		
15				May - HLF closure cover becomes functional
16				
17				May - Collection pond (EP, PG, Lower Dublin South) discharge routed to passive treatment or DGDC
18				
19				
20				
21				
22				
23	Closure/Post-closure	HLF draindown/Post-closure	May - Events ponds and MWTP decommissioned Reclaimed HLF runoff/infiltration directed to Haggart Creek via passive treatment systems	
24	Post-closure monitoring			

\\van11\prj_file\1\01\00290\06\A\Data\200 YESAB REVIEW - PROJECT DESCRIPTION\220 Support Analysis\Water Balance\Water Licencing WBM - GoldSim\1_Results[Eagle Gold WL WBM_017_results.xlsx]Table 1

NOTE:

1. THE OPERATIONAL MINE LIFE PRESENTED IS ARBITRARILY ASSIGNED FOR THE WATER BALANCE COMPARISON, WITH YEAR 1 ASSUMED TO BE THE FIRST YEAR IN WHICH MINING OPERATIONS COMMENCES AND THEN CONTINUING TO THE END OF THE MODEL SIMULATION IN YEAR 24.

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TABLE 2

**VICTORIA GOLD CORP.
EAGLE GOLD PROJECT**

WATER BALANCE INPUT PARAMETERS

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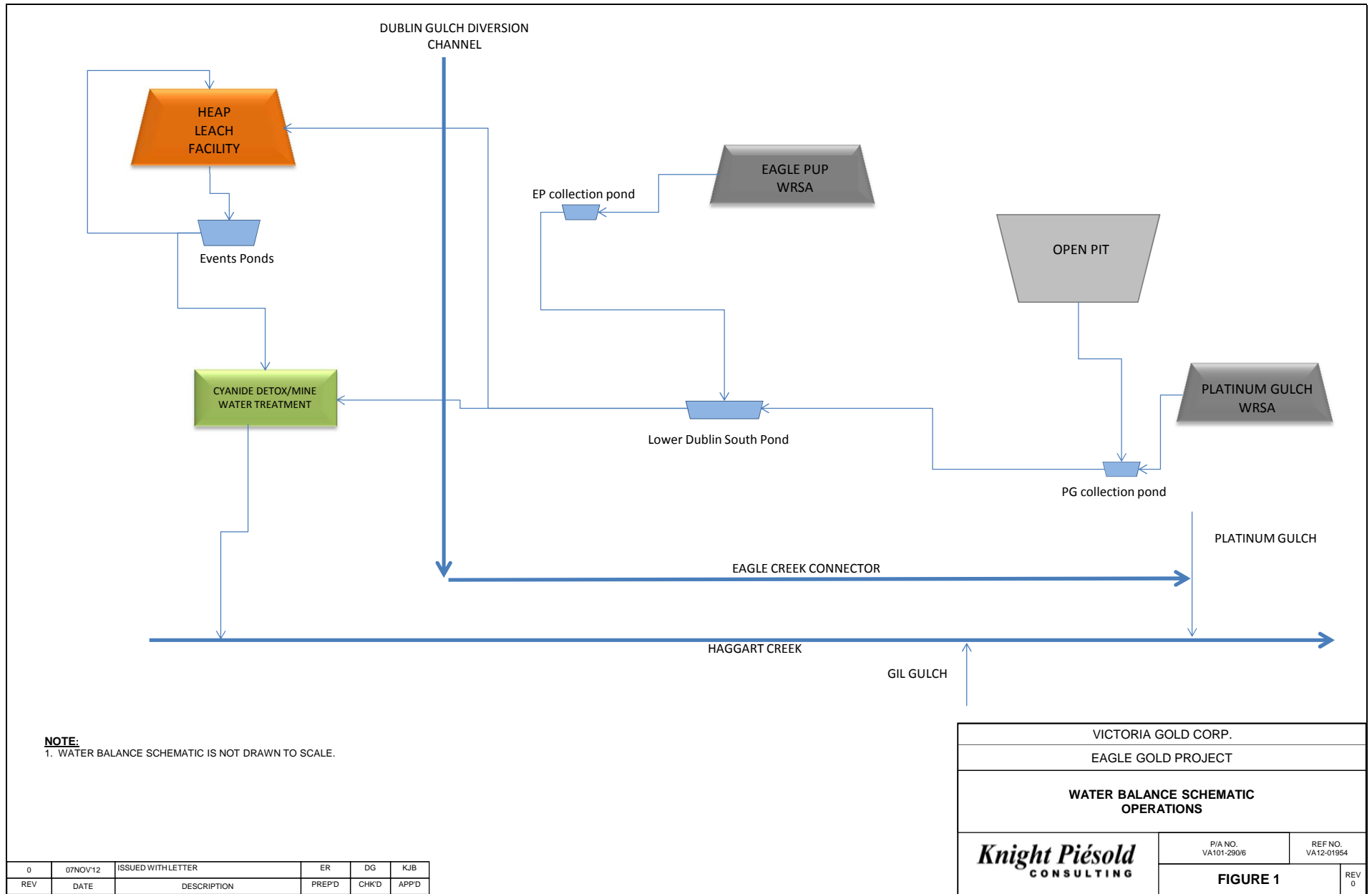
COMPONENT	UNITS	Assumptions
General		
Ore Production	tpd	29,500
Operational mine life	years	9
Physical and Hydrometeorological		
Project Site Median Elevation (reference)	m	1,210
Mean Annual Precipitation	mm	577
Mean Annual Rainfall	mm	337
Mean Annual Snowfall	mm	240
Sublimation	%	20
Mean Annual Pond Evaporation	mm	350
Annual Evaporation (bare surface - Heap, Ore Stockpile) - operations	mm	175
Annual Evaporation (bare surface - Heap, Ore Stockpile) - closure	mm	245
Infiltration Rates		
Waste Rock Storage Areas	%	80
Heap Leach Facility during operations	%	100
Capped surfaces (closure)	%	25
Facilities Areas - final footprint		
Eagle Pup WRSA	m ²	980,000
Platinum Gulch WRSA	m ²	410,000
HLF	m ²	1,135,000
Open Pit	m ²	810,000
Pond Capacities (normal operating capacity)		
Eagle Pup Collection Pond	m ³	25,000
Platinum Gulch Collection Pond	m ³	41,000
Lower Dublin North Pond	m ³	10,500
Lower Dublin South Pond	m ³	30,000
HLF - Events Pond 1 (downstream)	m ³	92,153
HLF - Events Pond 2 (upstream)	m ³	90,693
HLF - Heap Pond (minimum operating capacity)	m ³	33,240
HLF - Heap Pond (maximum operating capacity)	m ³	199,440
Heap Leach Facility		
Water Demand		
Solution Application Rate	m ³ /hr	2,770
Ore Moisture		
Initial moisture content	% by mass	5
Residual moisture content	% by mass	8.6
Leaching moisture content	% by mass	13.3
Open Pit		
Drilling water requirements	m ³ /day	49
Sump capacity (operations)	m ³	49,000
Sump capacity (closure)	m ³	250,000
Waste Rock Storage Areas		
Waste rock dry density	tonnes/m ³	2
Waste rock moisture content	%	2

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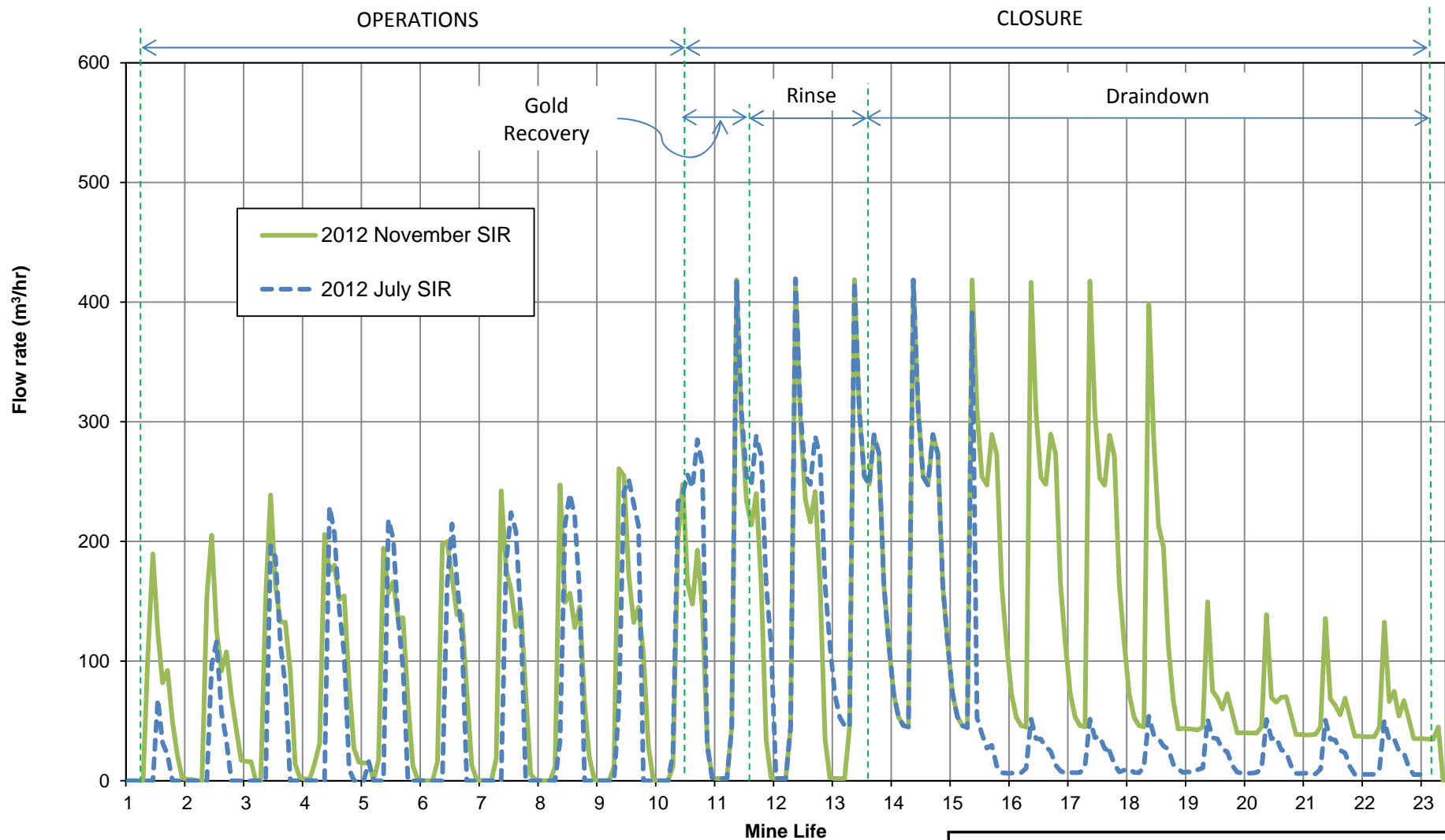
NOTES:

1. THE INFILTRATION RATES SHOWN FOR THE MINE FACILITIES ARE DEFINED AS THE PORTION OF NET PRECIPITATION THAT INFILTRATES THROUGH THE FACILITIES AND/OR COVER, WITH THE REMAINDER OF THE NET PRECIPITATION ASSUMED TO BE SURFACE RUNOFF.
2. THE NORMAL OPERATING CAPACITY FOR THE PONDS DOES NOT TAKE INTO ACCOUNT THE STORM WATER CAPACITY.

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NOTES:
 1. THE PROJECT PHASES SHOWN ARE REFLECTIVE OF THE UPDATED SITE WATER BALANCE MODEL (2012 OCTOBER SIR).

VICTORIA GOLD CORP.	
EAGLE GOLD PROJECT	
OPTIMIZED MONTHLY INFLOW TO THE MINE WATER TREATMENT PLANT MEDIAN CONDITIONS	
<i>Knight Piésold</i> CONSULTING	P/A NO. VA101-290/6
FIGURE 2	
REF NO VA12-01954	
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