M E M O R A N D U M

DATE: April 19, 2019

TO: Matthew Newman and Wesley Furlong
Native American Rights Fund (NARF)

FROM: James R. Kuipers, P.E. and Bruno A. Ridolfi, P.E.

SUBJECT: **Preliminary Financial Assurance Cost Estimate for Reclamation and Closure Proposed Pebble Project**

This preliminary financial assurance cost estimate for reclamation and closure of the proposed Pebble Project (Attachment 6A) is based on the limited information provided in the Draft Environmental Impact Statement (DEIS) for the proposed Pebble Project. The estimate is based on the methodology, costs, and information that are identified and described herein. The approach to this estimate relies on standard engineering and financial assurance cost estimation practices; however, the estimates are limited by the lack of detailed information in the DEIS and supporting documents about reclamation and closure plans.

Site Description

The *Pebble Project DEIS Section 2.2.2.1 Mine Site, Closure and Reclamation* provides a brief description of the project facilities. The information from the DEIS is not repeated in this description; however, the various project facilities and their corresponding disturbed acres from the DEIS are provided in Table 1.

Methodology

As there are no detailed plans for any of the facilities describing the reclamation material quantities, locations, thickness, or other details, such as quantities of geotextile or other materials, revegetation plans, and other key information, an accurate cost estimate is not possible. Therefore, the approach taken for this exercise was to use comparable reclamation and closure costs for each facility or process from other analogous sites or based on professional judgement as described in the following sections. Because it has resulted from a similar process for a site located in Alaska, the Donlin Gold Project Reclamation and Closure Plan (RCP) and

associated financial assurance cost estimate is frequently used as an analogous site in this preliminary cost estimate.

Table 1. Proposed Pebble Project Reclamation and Closure Areas

Facility	Disturbed Area (Acres)
Open Pit	608
Bulk Tailings Storage Facility (TSF)	2796
Pyritic Tailings Storage Facility (TSF)	1071
Water Management Pond (WMP)	955
Mine Site Materials	
Quarry A	243
Quarry B	571
Quarry C	301
Mill Site Power Plant	22
Material Sites	241
Mine Container Yard	38
Water Extraction Sites	5
Natural Gas Station	5
Transportation	
Mine Access Road	346
Port Access Road	408
Port Site	30
Port Container Yard	27
Separate Spur Roads	134
Ferry (North Shore)	4
Ferry (North Shore)	23
Total	**7,828**
Total from DEIS	*8,086*

DEIS = Draft Environmental Impact Statement
TSF = tailing storage facility
WMP = water management pond

Items Excluded from the Estimate

Several items have been excluded from this estimate.

- The estimate does not include the cost of reclaiming the mill site power plant that, depending on the time it's needed to support water treatment, would be closed if and when long-term site operations were discontinued in the future.

- The estimate does not include reclamation of water extraction sites, natural gas stations, or transportation sites including roads, port sites and yards, or the ferry, part or all of which will require reclamation and closure either at the end of mine operations or when they are no longer being used to otherwise support post-closure mine site operations.
- The estimate assumes that a catastrophic failure or other critical event due to a major flaw would not occur and thus not allow the described reclamation and closure plan to be carried out.

It should be noted that the purpose of a financial assurance cost estimate is to provide for a situation in which the project operator fails to perform the reclamation and closure, and the regulatory agencies are forced to accept responsibility for reclamation and closure of the mine and mine facilities. The regulatory agencies cannot assume that other beneficial uses will be found for Pebble Project facilities in the future; therefore, the financial assurance cost estimate must include costs for removal of these facilities and final reclamation and closure for each and every facility. The financial assurance cost estimate should include any facilities that could potentially be constructed and used for other purposes in the future. The responsibility and liability for all mine facilities must remain with the mine operator, unless certainty can be provided as to legal transfer of such mine facilities, such as sale and transfer of title agreements for such assets from the mine operator to other owners with provisions that these assets cannot be subject to future bankruptcy court claims.

Basis for Cost Estimates

The following sections describe the basis for the reclamation and closure cost estimates for each facility or activity that is included in this financial assurance cost estimate.

Open Pit

The DEIS for the proposed Pebble Project contains the following description for reclamation and closure of the open pit:

> *Active mining and pit dewatering will stop. Pit water levels will be maintained to provide safe access for placement of pyritic tailings and potentially acidic generating (PAG) waste rock. Once the material has been transferred to the open pit, the water will be allowed to rise to the maximum management level. The open pit water level will be maintained at a level to insure inward flow of surrounding groundwater and prevent contact water from getting into the groundwater.*

This description does not provide information as to actual reclamation of the open pit. In contrast, the Donlin Gold Project Reclamation and Closure Plan (Donlin RCP) (p. 4-18) describes area-specific reclamation of the open pit as follows:

> "During active mining, reclamation activity in and around the open pit(s) would be limited to controlling erosion on the haul roads to prevent undue degradation to adjacent undisturbed area. Upon final mine closure, haul roads in and around the pit would be smoothed of all berms except those necessary for erosion control and public safety. The safety berms would be far enough from the highwalls to prevent them from damage in the event of highwall failure. Road cuts and fills would be recontoured as much as feasible, and the roadbeds would be ripped and scarified where necessary."

In most cases reclamation costs specific to open pits are minimal and primarily address public safety features such as highwalls, berms, and fences. The Donlin RCP cost estimate (p. 308) for open pit reclamation is $143,604 for berm construction around a 438-acre pit. Based on a similar approach, but for a 608-acre pit proposed for Pebble, the preliminary cost estimate for reclamation of the Pebble open pit is $200,000.

Bulk Tailing Storage Facility (TSF)

The Pebble Project DEIS contains the following description for reclamation and closure of the Bulk TSF:

> *The bulk tailings will have a dry closure and be allowed to fully consolidate. Once runoff is demonstrated to meet water quality criteria it will be directly discharged to the NFK catchment area. Bulk TSF seepage water will be pumped to the open pit. A spillway will be constructed from the bulk TSF. Late in the operating phase, tails in the bulk TSF will be spigoted to allow for surface drainage toward the closure spillway. As milling operations cease, free water will be pumped from the surface of the bulk tails, and they will be allowed to consolidate until the surface is suitable for equipment traffic on the surface. The tails will be regraded as needed to facilitate drainage. A capillary break and growth media will be placed over the surface of the tails prior to seeding for revegetation. Growth media will also be placed on the bulk TSF embankments prior to seeding for revegetation.*

The Donlin RCP (p. 4-21 - 22) describes area-specific reclamation of the TSF for that site as follows:

> "The tailings impoundment will require a closure cover to minimize groundwater interaction and reduce salt mobilization. The cover would include coarse non-acid generating (NAG) waste rock overlain by colluvium/terrace gravel, overlain by a peat/mineral growth media mix. In addition, the soil cover would promote surface runoff and reduce the potential for meteoric waters to infiltrate through the consolidated tailings.
>
> The tailings closure cover will be comprised of a minimum 3.3 ft (1.0 m) coarse NAG waste rock overlain by a minimum 1-foot (0.3 m) of colluvium/terrace gravel overlain by an approximately 1.15 ft (0.35 m) of peat/mineral mix. Stripped overburden material temporarily stored in the TSF stockpiles will be used for the closure cover. The resulting runoff from the constructed cover is expected to be suitable for discharge without treatment."

The Donlin RCP cost estimate (p. 308) for TSF reclamation is $9,606 per acre ($23,736 per hectare). Based on a similar approach, the preliminary cost estimate for reclamation of the Pebble TSF is based on a unit cost of $10,000 per acre.

Pyritic Tailing Storage Facility (TSF)

The Pebble Project DEIS contains the following description for reclamation and closure of the Pyritic TSF: *Pyritic tailings and PAG waste rock will be placed into the pit for long term storage below water*. The DEIS does not address how the Pyritic TSF would be dewatered, how the embankment, waste rock, and tailing materials would be handled and transported, or how the materials would be placed in the pit. It does not address the equipment that would be used or how long it would take.

There are very few examples where backfill of an open pit with pyritic tailings and potentially acid-generating (PAG) waste rock has been proposed or where costs for those activities have been estimated. According to the Pebble DEIS (p. 2-12) the pyritic TSF would contain 155 million tons of pyritic tailing material and up to 50 million tons of PAG and/or metal leaching (ML) waste rock until closure. Conservatively, without the development of a more detailed description of the tasks and corresponding cost estimates, and based on professional experience and

judgment, the preliminary cost estimate uses a unit cost of $2.00 per ton for transfer of pyritic tailing material and waste rock to the open pit. In addition, the Pyritic TSF site would then need to be reclaimed to support revegetation at an estimated unit cost of $5,000 per acre.

Water Management Pond, Mine Site Materials, Materials Sites, Mine Container Yard

Specific information is not provided in Pebble Project Description or DEIS for the Water Management Pond (WMP), Mine Site Materials (Quarry B and Quarry C), Materials Sites, or Mine Container Yard. The WMP embankments and liner would need to be removed, all the sites would need to be regraded, growth medium would need to be placed, and the areas would need to be revegetated. This preliminary cost estimate used a unit cost of $10,000 per acre for the activities at the WMP and $5,000 per acre for the mine site materials, materials sites, and mine container yard.

Closure and Post-Closure Water Management and Treatment

According to the Pebble Project DEIS, *the water management plan during the closure phase and post-closure can be summarized as follows:*

Years 0 – 15:

- The open pit WTP would be reconfigured to treat contact water.
- Excess and seepage water from the bulk TSF would be pumped to the main WMP.
- Seepage water from the pyritic TSF would be pumped to the main WMP.
- Water from the main WMP that is not needed for mine or process operations would be treated at the main WTP and released to the downstream environment.
- Open pit water that is not needed for mine or process operations would be pumped to the open pit WTP for purposes of drawing down the water to maintain safe work conditions in the open pit for both removing the PAG waste rock and hauling it to the pyritic TSF, and for extracting the ore and hauling it to the process facility.
- Treated water from the open pit WTP would be released to the downstream environment.
- The open pit WMP would be reclaimed.

Year 16 until the open pit reaches the control elevation (approximately Year 20):

- The main WTP would be decommissioned once it is no longer required.

- The pyritic TSF and associated seepage collection ponds would be reclaimed, and surface water runoff from the area discharged to the downstream environment once the runoff has been demonstrated to meet water quality criteria.
- The main WMP would be reclaimed, and surface water runoff from the area discharged to the downstream environment once the runoff has been demonstrated to meet water quality criteria.
- Bulk TSF and seepage collection pond water would be pumped to the open pit.
- The open pit fills to the control elevation.
- The basis for this phase of the water balance is that no water would be treated during this phase; however, an adaptive management strategy would be used, and water would be directed to the open pit WTP for treatment and released if required to maintain downstream flows.

Post-Closure:

- Year 20 until the bulk TSF consolidation is complete (approximately Year 50):
- Bulk TSF seepage and runoff water would be pumped to the open pit.
- Water levels in the open pit would be maintained below the control elevation by treating and releasing surplus water from the open pit.
- Runoff water from the surface of the reclaimed Bulk TSF would be directly discharged from the TSF surface to the NFK catchment once it has been demonstrated to meet water quality criteria.
- Seepage water that might continue to flow out from under the reclaimed Bulk TSF would be captured and pumped to the open pit.
- Water levels in the open pit would be maintained below the main management level by treating and releasing surplus water from the open pit.

The pit lake will fill during the closure period. Surface runoff from the walls will result in leaching of accumulated metals from the walls. The pit lake is expected to stratify during the closure period with surface waters retaining a neutral to slightly basic pH over time. Water quality parameters showing predictions that exceed discharge limits include hardness and several trace elements (Al, As, Cd, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, and Zn).

Pit lake water quality will be monitored, and appropriate precautions will be taken to manage wildlife activity on the lake. Once the level of the pit lake has risen to about 890 feet elevation, water will be pumped from the pit, treated as required, and discharged to the environment. By maintaining the water level at this elevation, which is at least 50 feet below the elevation at which groundwater flow would be directed outward from the open pit, upset conditions resulting in an unplanned discharge can be avoided, as there is time to address any problems with the WTP before flows reverse. Long-term discharge from the bulk TSF seepage collection systems will be pumped to the pit lake.

The Pebble DEIS does not provide information with respect to the predicted flow rates from the individual facilities and from the whole site as required for water management. Also, the DEIS does not provide information on the capacity or type of water treatment system that will be required.

Three sources of information for the proposed Pebble Project were used to address these crucial data gaps.

1. *RFI 019 Closure Water Management Plan* prepared by Knight Piesold for The Pebble Limited Partnership (PLP) dated September 21, 2018. The document provides estimated total water treatment plant discharge rates for four phases of reclamation and closure as shown in Table 2:

Table 2. Proposed Pebble Project Estimated Water Treatment Plant Discharge Rates

Description	50th Percentile		90th Percentile	
	cfs	gpm	cfs	gpm
Phase 1 (Closure Year 0 – 15)	50	22,442	57	25,583
Phase 2 (Closure Year 16 – 20)	0	0	0	0
Phase 3 (Closure Year 21 – 50)	30	13,465	41	18,402
Phase 4 (Closure Year 51+)	13	5,835	16	7,181

cfs = cubic feet per second
gpm = gallons per minute

2. Memo regarding *Mine Closure Water Treatment Plant Engineering* prepared by HDR for PLP dated January 11, 2019. The memo describes the "…preliminary treatment process designs for the worst-case scenarios during closure and post closure."
    - Phase 1 water treatment would include metals oxidation and co-precipitation, metal sulfide precipitation, nanofiltration, ultrafiltration, and reverse osmosis (RO) together with sludge thickening.
    - Phase 3 and 4 water treatment for the TSF seepage collection pond would include metals oxidation and co-precipitation, metal sulfide precipitation, nanofiltration, ultrafiltration, and reverse osmosis (RO) together with sludge thickening.
    - Phase 3 and 4 water treatment for the open pit would include metals oxidation and co-precipitation, metal sulfide precipitation, and filtration together with sludge thickening.
3. *Pebble Project – Water Treatment Plant Prefeasibility Study Report – 42-foot Mill Option* prepared by HDR for PLP dated September 14, 2012. The report recommended a water treatment process using metals oxidation and co-precipitation, metal sulfide precipitation, ultrafiltration, and reverse osmosis (RO) together with sludge thickening. For a flow rate of 15,000 gallons per minute (gpm), the report estimated an initial capital cost of $194,060,000 and a unit operating cost of $2.29 per 1,000 gallons.

For this preliminary cost estimate, the flow rates provided by Knight Piesold and costs provided by HDR were used. It was assumed that the water treatment plant would require replacement in post-closure year 50.

Post-Closure Monitoring and Maintenance

Specific information is not provided in Pebble Project Description or DEIS for Post-Closure Monitoring and Maintenance.

In contrast to the Pebble Project DEIS, the 2018 Donlin Gold Project Final EIS[1] Section 2.3.2.5.2 CLOSURE AND POST-CLOSURE contained detailed information on long-term monitoring and maintenance. The Donlin RCP includes $146,100 per year for monitoring, $566,686 per year for road maintenance, and $367,640 per year for other maintenance. For the purpose of this

[1] http://dnr.alaska.gov/mlw/mining/largemine/donlin/pdf/dgfeis.pdf

preliminary cost estimate, $150,000 per year was used for monitoring, and $1,000,000 per year was used for road maintenance and other maintenance.

Indirect Costs

The Donlin Gold financial assurance cost estimate used a combined indirect cost percentage of 29 percent for engineering, design and construction, contingency, insurance, performance bond, contractor profit, and contract administration. In addition to these allowances, the Donlin Gold financial assurance cost estimate included costs for mobilization and demobilization. For the purpose of this preliminary cost estimate, an indirect cost percentage of 30 percent was used for all indirect costs.

Results

The computations that support this preliminary financial assurance cost estimate are tabulated in the attached spreadsheets (Attachment 6A-1), and the results are summarized in Table 3 below.

Table 3. Proposed Pebble Project - Preliminary Financial Assurance Cost Estimate

Facility	Units	Quantity	Cost/Unit	Total Cost
Surface Reclamation				
Open Pit	lump	1	$200,000	$200,000
Bulk Tailing Storage Facility (TSF)	$/acre	2,796	$10,000	$27,960,000
Pyritic TSF - Removal	$/ton	205,000,000	$2.00	$410,000,000
Pyritic TSF - Reclamation	$/acre	1,071	$5,000	$5,355,000
Water management pond (WMP)	$/acre	955	$10,000	$9,550,000
Mine Site Materials	$/acre	872	$5,000	$4,360,000
Material Sites	$/acre	241	$5,000	$1,205,000
Mine Container Yard	$/acre	38	$5,000	$190,000
Structure, Equipment and Facility Removal	lump sum	1	$20,000,000	$20,000,000
Direct Costs Sub-Total				$478,820,000
Indirect Costs (30%)				$143,646,000
Total Surface Reclamation Costs				**$622,466,000**
Long-Term Costs				
Water Treatment Capital (Closure Y51)	lump sum	1	$194,060,000	$194,060,000
Water Treatment Operating Flow Rate	gpm			
Water Treatment Operating Flow	M			
Water Treatment Operating	$/year	100	$2.29	$1,242,537,164
Monitoring and Maintenance	$/year	100	$1,150,000	$115,000,000
Direct Costs Sub-Total				$1,551,597,164
Indirect Costs (30%)				$465,479,149
Total Long-Term Costs				$2,017,076,313
Net Present Value (3% Discount Rate)				**$804,545,104**
Total Estimate of Costs				**$1,427,011,104**

Notes:

$/acre = US dollars per acre
$/year = US dollars per year
gpm = gallons per minute
M gallons = millions of gallons
TSF = tailings storage facility
WMP = water management pond

Conclusions and Recommendations

Overall, the preliminary estimate of total financial assurance costs is $1,427 million for reclamation and closure of the proposed Pebble Project. This is a preliminary estimate with an accuracy range of minus 50 percent to plus 100 percent (-50% to +100%). This indicates that the actual financial assurance costs for the proposed Pebble Project could range from $700 million to $2,900 million.

The estimated cost of surface reclamation for the proposed Pebble Project, excluding roads and facilities, is $622 million.

The estimated cost of site water management and monitoring and maintenance for a 100-year post-closure period is $2,017 million. Based on a 3-percent net discounted rate of return (= 6 percent interest minus 3 percent inflation), the net present value (NPV) of the site water management and monitoring and maintenance costs for the 100-year post-closure period is $805 million.

It should be noted that because this preliminary cost estimate does not address significant items, such as removal of roads and facilities and reclamation of the associated disturbed areas, it probably underestimates the actual financial assurance requirements.

This preliminary cost estimate was developed to inform the review of the PDEIS and is conditioned as such. We recommend and expect that the project proponent will develop a financial assurance cost estimate based on a more-detailed reclamation and closure plan (RCP) and using state-of-the-art estimating methodology, such as the Nevada Standard Reclamation Cost Estimator (SRCE) (https://nvbond.org/) tailored specifically to Alaska.