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Alaska Miners Association

Technical Review of the EPA Bristol Bay

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Alaska Miners Association

Technical Review of the EPA Bristol Bay Watershed Assessment

July 23, 2012

Executive Summary

This paper provides a technical review of EPA's May 2012 publication Assessment of Potential Mining Impacts on Salmon Ecosystems. This technical review documents numerous errors in the report.

General Conclusions

EPA's hypothetical mine does not represent any large mine that might be proposed in the watershed.

authors of this technical review know what design will be proposed for the Pebble Project (Pebble) and neither. However, this designed-to-fail EPA other large mining in the bay watershed. It fails to represent a large mine that might be proposed for Pebble.

The Assessment estimates impacts from even the hypothetical mine.

technical review concludes that EPA's Watershed Assessment massively underestimates the likely impacts from the hypothetical mine. EPA's refusal to omitting prevention and mitigation strategies that would decrease or eliminate to recognize EPA's Alaska successful record of protecting the environment, from legacy mines, and other specific measures of that are the focus of that follow.

EPA's methodology fails. The Assessment cannot be fixed.

concludes that EPA's methodology is fundamentally flawed. It cannot be fixed. Ecological risk assessment is an unsupportable cannot produce reliable conclusions.

EPA-7609-0003194_0005

EPA's hypothetical mine in Not Typical of Mining in Bristol Bay

assessment is not an assessment of only Pebble, but purp
watershed. It purports to represent the impacts to Bristol Bay
just Pebble. It does

- ***Error #1: Copper porphyry deposits are not representative of o***
deposits in the Bristol Bay watershed. The assessment applies to all
watershed, not just Pebble. The deposits in the area
documented by BLM and the USGS, including a USGS
undiscovered deposits. That analysis and that there
there are 14 copper-porphyry deposits within the watershed. The
does not consider copper-porphyry deposits do not represent al
large-scale mining in Bristol B

- ***Error #2. EPA's hypothetical mine is the size of the likely n***
Bristol Bay watershed. EPA's hypothetical mine is more than 5
the average open-pit copper mine in Alaska and British Columbia, ar
larger than the average copper mine. It may
disturbance area of Pebble, is unlikely to accurately represe
area another large mine may propose in the Bristol Bay wa
some future. Given that no other project in the Bristol
advanced stage of exploration, no other large mine in
permitting in the next decade.

- ***Error #3. EPA's hypothetical mine is not a reasonable***
GIS analysis completed for this technical review indicates
for the EPA hypothetical mine is likely to impact si
stream habitat than other potential locations the Bris

- ***Error #4. EPA's hypothetical mine is not a typical make***
up. There is no "typical" geochemical make metal ore that
representative of all ores within the region. Therefore,
Pebble deposits cannot be used to represent the geochemical risks
of other deposits in the area. In addition, as t
geochemical risks dependent on particular design parameters.
geochemical risks of a hypothetical mine may not even represent
definitely not represent other potential projects

- ***Error #5. EPA's hypothetical mine omits mitigation a***
likely to be used by other large mines in the Bristol
the design including mitigation and prevention techniques th
protect the environment from mining of an ore deposit
discovered. Given the large variety of possible techniques, it
yet designed to exactly the set of mitigation/prevention

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represent꿿□η**other**꿿□η**locations**꿿□η**in**꿿□η**the**꿿□η**Bristol**꿿□η**Bay**꿿□η**watershed.**꿿□η

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- ***Error** 꿿□η#6. 꿿□η 꿿□η**EPA** 꿿□η**omits** 꿿□η**discussion** 꿿□η**of** 꿿□η**mitigation** 꿿□η**strategies** 꿿□η**that** 꿿□η**would** 꿿□η**eliminate** 꿿□η**or** 꿿□η**significantly** 꿿□η**reduce** 꿿□η**the** 꿿□η**impacts** 꿿□η**it** 꿿□η**predicts** 꿿□η**for** 꿿□η**its** 꿿□η**hypothetical***
  technical꿿□η**review꿿□η**references꿿□η**some꿿□η**design꿿□η**changes꿿□η**that꿿□η**would꿿□η**eliminate**
  impacts꿿□η**that꿿□η**the꿿□η**Assessment** 꿿□η**indicates** 꿿□η**would** 꿿□η**result** 꿿□η**from** 꿿□η**the** 꿿□η**closure** 꿿□η**and**
  moving꿿□η**production꿿□η**operations** 꿿□η**the꿿□η**pipeline,꿿□η**amongst꿿□η**other꿿□η**things.꿿□η**the꿿□η**review**
  shows꿿□η**that꿿□η**many꿿□η**prevention꿿□η**and꿿□η**mitigation꿿□η**strategies꿿□η**must**
  be꿿□η**developed꿿□η**through꿿□η**the꿿□η**permitting꿿□η**process.꿿□η**The꿿□η**impacts**
  imposition꿿□η**of꿿□η**these꿿□η**strategies꿿□η**would꿿□η**not꿿□η**be꿿□η**accurate.**

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- ***Error** 꿿□η#7. 꿿□η 꿿□η**EPA's** 꿿□η**hypothetical** 꿿□η**mine** 꿿□η**does** 꿿□η**not** 꿿□η**meet** 꿿□η**Federal** 꿿□η**Therefore,** 꿿□η**it** 꿿□η**cannot** 꿿□η**represent** 꿿□η**realistic** 꿿□η**mine** 꿿□η**impacts** 꿿□η**because** 꿿□η**for** 꿿□η**the***
  the꿿□η**design꿿□η**used꿿□η**to꿿□η**mitigate꿿□η**include꿿□η**elements꿿□η**minimizing꿿□η**adverse**
  impacts꿿□η**anadromous꿿□η**fish꿿□η**habitat꿿□η**and꿿□η**wetlands,꿿□η**and꿿□η**because꿿□η**it**
  be꿿□η**placed꿿□η**in꿿□η**Upper꿿□η**Talarik꿿□η**Creek꿿□η**violates꿿□η**regulatory** 꿿□η**standards,꿿□η**the꿿□η**
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  under꿿□η**existing꿿□η**laws꿿□η**and꿿□η**regulations꿿□η**for꿿□η**a꿿□η**typical꿿□η**mining꿿□η**impacts꿿□η**in꿿□η**the꿿□η**Bristol**

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Risks꿿□ηfrom꿿□η**Habitat꿿□η**Modification꿿□η**and꿿□η**Water꿿□η**Withdrawal꿿□η**Impacts**

- ***Error** 꿿□η#8. 꿿□η 꿿□η**EPA** 꿿□η**The** 꿿□η**Size** 꿿□η**Assessment** 꿿□η**Section** 꿿□η**Bristol** 꿿□η**Bay

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Risks꿿□ ηfrom꿿□ ηRoad꿿□ ηand꿿□ ηStream꿿□ ηCrossings꿿□ ηare꿿□ ηinaccurate꿿□ ηbecause꿿□ ηof꿿□ η
from꿿□ ηroad꿿□ ηand꿿□ ηstream꿿□ ηcrossings꿿□ ηare꿿□ ηinaccurate꿿□ ηbecause꿿□ ηof꿿□ η

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  be꿿□ ηdeveloped꿿□ ηusing꿿□ ηa꿿□ ηroad.꿿□ η꿿□ ηTherefore꿿□ ηthe꿿□ ηpredicted꿿□
  representing꿿□ ηlarge-scale꿿□ ηmining꿿□ ηin꿿□ ηthe꿿□ ηwatershed.
  꿿□ η
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Risk꿿□ ηAssessment꿿□ ηMode꿿□ η

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  nor꿿□ ηdoes꿿□ ηit꿿□ ηrepresent꿿□ ηthe꿿□ ηprotective꿿□ ηpractices꿿□ ηthat꿿□ ηmini
  governments꿿□ ηrequire.
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water꿿□ ηcollection꿿□ ηand꿿□ ηtreatment꿿□ ηfailure꿿□ ηfrom꿿□ ηtheir꿿□ ηhypothetical꿿□ ηmine꿿□ ηare꿿
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  The꿿□ ηhypothetical꿿□ ηmine꿿□ ηdoes꿿□ ηnot꿿□ ηinclude꿿□ ηdetailed꿿□ ηwater꿿□ ηnecessary꿿□ ηto
  collection꿿□ ηand꿿□ ηtreatment꿿□ ηfailure.꿿□ η꿿□ ηIt꿿□ ηdoes꿿□ ηnot꿿□ ηevaluate꿿□
  present꿿□ ηdata꿿□ ηon꿿□ ηsimilar꿿□ ηfailures꿿□ ηat꿿□ ηother꿿□ ηmines.꿿□ η꿿□ η꿿□
  protective꿿□ ηthan꿿□ ηothers꿿□ ηwithout꿿□ ηdetailed꿿□ ηinformation,꿿□ ηthese꿿□ ηfa
  probabilities꿿□ ηand꿿□ ηconsequences꿿□ ηbe꿿□ ηdetermined;꿿□ ηtherefore,꿿□ ηthe꿿□ ηfa
  analysis꿿□ ηis꿿□ ηmingless.꿿□ η
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- ***Error꿿□ η#17.꿿□ η꿿□ ηThe꿿□ η(lack꿿□ ηof)꿿□ ηinitial꿿□ ηdesign꿿□ ηand꿿□ ηthe꿿□ ηanalysis꿿***
  strategies.꿿□ ηAlaska's꿿□ ηmines꿿□ ηgenerally꿿□ ηhave꿿□ ηsecondary꿿□ ηcaseapes꿿□ η
  from꿿□ ηthe꿿□ ηprimary꿿□ ηcontainment꿿□ ηmechanism꿿□ ηthese꿿□ ηthe꿿□ ηbody꿿
  provides꿿□ ηexamples.꿿□ η꿿□ ηWithout꿿□ ηstrategies,꿿□ ηprobability꿿□ ηof꿿□ ηfailure꿿□ η
  consequences꿿□ ηfailures꿿□ ηare꿿□ ηexaggerated.

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- ***Error 뀀□η#18. 뀀□η 뀀□η The 뀀□η analysis 뀀□η assumes 뀀□η that 뀀□η mines*** 뀀□η have 뀀□η an 뀀□η e
record 뀀□η of 뀀□η protecting 뀀□η water 뀀□η EPA's 뀀□η quality 뀀□η analysis 뀀□η fishes 뀀□η Alaska's 뀀□η r
in 뀀□η developing 뀀□η probability 뀀□η of 뀀□η failure 뀀□η predicti

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- ***Error 뀀□η#19. 뀀□η 뀀□η 뀀□η Assertions 뀀□η about 뀀□η risk 뀀□η are 뀀□η often 뀀□η unsupported. 뀀***
Assessment 뀀□η includes 뀀□η many 뀀□η unsupported 뀀□η (and 뀀□η inaccurate) 뀀□η assertic
this 뀀□η technical 뀀□η review 뀀□η provides 뀀□η examples.

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- ***Error 뀀□η#20. 뀀□η 뀀□η Conclusions 뀀□η in 뀀□η the 뀀□η Assessment's 뀀□η Executive 뀀□η***
conclusions 뀀□η in 뀀□η the 뀀□η body 뀀□η of 뀀□η the 뀀□η Assessment. 뀀□η The 뀀□η Assessment
concludes, 뀀□η "the 뀀□η probability 뀀□η of 뀀□η failure 뀀□η cannot 뀀□η be 뀀□η estimated 뀀□
Executive 뀀□η Summary 뀀□η states 뀀□η that 뀀□η the 뀀□η probability 뀀□η of 뀀□η failure 뀀□η is 뀀□η "H 뀀□η is 뀀□η r
justification 뀀□η in 뀀□η the 뀀□η Assessment 뀀□η for 뀀□η the 뀀□η conclusion 뀀□η in 뀀□η the 뀀□η Exe
Summary. 뀀□η 뀀□η The 뀀□η Executive 뀀□η Summary 뀀□η references 뀀□η data 뀀□η that 뀀□η
declares 뀀□η does 뀀□η not 뀀□η exist 뀀□η and 뀀□η is 뀀□η now 뀀□η in 뀀□η the 뀀□η Assessr

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- ***Error 뀀□η#21. 뀀□η 뀀□η Check 뀀□η on 뀀□η conclusions: 뀀□η EPA 뀀□η came 뀀□η to 뀀□η differe***
mine 뀀□η analysis This 뀀□η technical 뀀□η review 뀀□η discusses 뀀□η two 뀀□η ways 뀀□η in 뀀□η which 뀀□η EPA's 뀀□η was
the 뀀□η lead 뀀□η agency 뀀□η which 뀀□η they 뀀□η do 뀀□η not 뀀□η have 뀀□η jurisdiction 뀀□η over 뀀□η water 뀀□η treatment
and 뀀□η collection 뀀□η failure. 뀀□η 뀀□η concludes 뀀□η that 뀀□η probability 뀀□η is 뀀□η "H 뀀□η the 뀀□η
consequence 뀀□η of 뀀□η failure 뀀□η severe, 뀀□η but 뀀□η the 뀀□η same 뀀□η the 뀀□η issue 뀀□η is 뀀□η
discussion 뀀□η in 뀀□η other 뀀□η recent 뀀□η analysis 뀀□η by 뀀□η EPA 뀀□η on 뀀□η the 뀀□η s

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Risks 뀀□η from 뀀□η Pipeline 뀀□η Failure

- ***Error 뀀□η#22. 뀀□η 뀀□η Assumption 뀀□η of 뀀□η a 뀀□η pipeline. 뀀□η*** It 뀀□η may 뀀□η be 뀀□η presumed 뀀□η to 뀀
mine 뀀□η feasible, 뀀□η but 뀀□η no 뀀□η other 뀀□η mine 뀀□η in 뀀□η Alaska 뀀□η uses 뀀□η a 뀀□η
not 뀀□η use 뀀□η a 뀀□η pipeline, 뀀□η the 뀀□η predicted 뀀□η pipeline 뀀□η risks 뀀□η are 뀀□η
non-Pebble 뀀□η mines 뀀□η in 뀀□η Bristol 뀀□η Bay.

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- ***Error 뀀□η#23. 뀀□η 뀀□η Omission 뀀□η of 뀀□η pipeline 뀀□η related 뀀□η prevention 뀀□η a***
EPA's 뀀□η hypothetical 뀀□η pipeline 뀀□η omits 뀀□η obvious 뀀□η prevention 뀀□η and 뀀□η de
some 뀀□η components 뀀□η are 뀀□η difficult 뀀□η to 뀀□η change, 뀀□η b
be 뀀□η designed 뀀□η to 뀀□η different 뀀□η standards. 뀀□η 뀀□η 뀀□η It 뀀□η is 뀀□η unclear 뀀□η
with 뀀□η an 뀀□η unacceptable 뀀□η risk 뀀□η and 뀀□η not 뀀□η include 뀀□η design 뀀□η chang
actual 뀀□η government 뀀□η permission 뀀□η would 뀀□η require 뀀□η such 뀀□η design 뀀□η changes. 뀀□η The 뀀□η
EPA 뀀□η hypothetical 뀀□η design 뀀□η is 뀀□η permitted 뀀□η under 뀀□η existing 뀀□η la

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- ***Error 뀀□η#24. 뀀□η 뀀□η A 뀀□η check 뀀□η on 뀀□η conclusions: 뀀□η EPA 뀀□η came 뀀□η to***
potential 뀀□η mine 뀀□η pipeline 뀀□η at 뀀□η the 뀀□η Red 뀀□η Dog 뀀□η mine. 뀀□η
Red 뀀□η Dog 뀀□η Mine, 뀀□η EPA 뀀□η came 뀀□η to 뀀□η pipeline. 뀀□η 뀀□η 뀀□η The 뀀□η agency 뀀□η came 뀀□η
very 뀀□η different 뀀□η from 뀀□η this 뀀□η that 뀀□η Assessment 뀀□η "is 뀀□η highly 뀀□η unlikely 뀀□η that 뀀□η
would 뀀□η be 뀀□η compromised."

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Risk 뀀□η from 뀀□η Dam 뀀□η Failure

- ***Error 뀀□η#25. 뀀□η 뀀□η Assumption 뀀□η of 뀀□η a 뀀□η dam; 뀀□η assumption 뀀□η of 뀀□η***
Not 뀀□η all 뀀□η mines 뀀□η have 뀀□η dams. 뀀□η In 뀀□η addition, 뀀□η the 뀀□η Assessment 뀀□η

TSF can be eliminated in the consequences of taking this dam fa added). Despite the potential to eliminate the risk, EPA's wet closure to represent what they [illegible] Alaska. For reference, Red Dog Mine is the only [illegible] Therefore the predicted impacts from EPA's hypothetical mine represent other [illegible] discovered designed mines in the watershed may not represent the risks from Pebble.

- **Error #26.** Some locations are less [illegible] technical review describes locations in the Bristol Bay w significantly less risk than [illegible] chosen [illegible]

Section 1 Introduction

The EPA's May 2012 "An Assessment of Potential Mining in Bristol Bay, Alaska" uses ecological risk assessment methodology "…potential impacts of large-scale mining development on Bristol Bay fis subsequent effects on wildlife and Alaska Native cultures [1] of review [2] (ER) the document is referred to as the "Watershed Assessment" (" Assessment.")

The Alaska Miners Association is submitting this technical revi the information in this document, there are a number of

- EPA's hypothetical mine does not represent large-scale mining in the watershed. The authors of this document know what design will the Pebble Project (and neither does EPA). However, represent large-scale mining in the watershed. design that may be proposed for Pebble.

- The Assessment estimates impacts from EPA's hypothetical mine incorrect predictions regarding prevent and mitigation strategies would decrease or eliminate the impa recognize the Alask record of protecting the environment, relying on analysis number of specific errors that are in technical review

- EPA's methodology fails. Note: The Assessment makes clear concludes that EPA's conclusions theoretically sound. ecological risk assessment is an unsupportable methodology that cann conclusions. The flaws in the methodology are discussed in Working Paper from the Institute of Social and Econom Alaska that is attached as Appendix B.

Assessment Ambiguity: does the assessment predict potential effects of Copper Mines? Or Large Mines? Or Generic?

Assessment is not intended to a specific mine, is not depth assessment of a specific mine, the purpose describe the impacts of a mine in Bristol Bay watershed.

But the actual analysis in the Assessment is ambiguous. to analyze any deposit other than Pebble. watershed other than the location hypothetically, the watershed obviously intended to represent Pebble and yet the stated implication is accurate throughout the watershed.

[1] Page ES-2.
[2] "The assessment was conducted as an ecological risk assessment."
[3] Watershed Assessment, ES-1.
[4] ES-5.

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ecological risk assessment "large-scale mining" development within Bristol Bay.[4]

This wide implication is required if EPA is to use to decide whether to go ahead with a 404(c) veto process that affects the whole general. The agency is planning to initiate a 404(c) veto process that only applies to Pebble, or rather to a large-scale mine within Bristol Bay.

Purpose of this technical review. *EPA has* its word. We know whether EPA has accurately described Pebble's project design has been submitted. Only Pebble Limited Partnership knows EPA has accurately described their design. EPA doesn't know of this to ascertain whether the Watershed Assessment accurately large-mine in the watershed. debate whether EPA's design and impacts. We feel debate to provide a technical review of whether the hypothetical design is large-scale mine throughout the We also review the question of predicted impacts accurately represent the actual impacts of EPA

We find impossible that EPA's hypothetical be representative. We trace the consequences of EPA's errors in the hypothetical predicts.

A note on terminology. Prevention used to describe a strategy a problem from occurring, and mitigation is used to contain occurs. For example, drivers may car crashes (mean minimize) their cars in good working order, keeping the speed limit, a crash happens anyway, airbags and seatbelts can mitigate the severi mining, some activities have characteristics of both. For regime may keep a tailings pond from the only helping prevent (prevention) and also it may detect leakage (mitigation) to limit

[4] Assessment, Page 1

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Section 2

EPA's Hypothetical Mine Typical of Mining in B

This section of the report addresses the question of whether the hypothetical mine assumed in the Watershed Assessment be typical of mining Remember: we are not asking the question of whether it is typical of "large" mines in general throughout the watershed.

This section examines ways in which the Assessment's hypothetical misrepresents likely mining (other than potentially Pebble) in the

- It wrongly assumes porphyry mine is only type in the
- It grossly estimates the likely size of likely mines;
- It uses representation location;
- It assumes representation geochemical make
- It knows mitigation and prevention techniques prevent to mitigate the impacts it predicts;
- It omits processes that would undoubtedly require additiona mitigation/prevention; and
- It analyzes a mine could be permitted under existing law

A. Large Porphyry deposits are not representative of other mineral deposits in the Bristol Bay watershed.

The Watershed Assessment applies to Bristol Bay Area, includ and Nushagak watersheds. This area is approximately the of West Virgin area is geologically diverse, and yet the mineral potential of porphyry characterize potential scale mining in the watershed. There are other potential deposits in the area focuses solely on copper porphyry not other potential large mining in Bristol Bay.

The geologic characterization of the area is limited to a That characterization indicates, "The geologic mapping of Kvichak watersheds have characteristics that indicate that vicinity region is different mineral deposit types include porphyry copper copper and iron skarn deposits, epithermal vein deposits, hot spring mercury deposits, gold deposits, porphyry copper deposits gold deposits are represented prospects within the area that could develop large Copper skarn deposits hold less potential. The Appendix goes on to conclude, the most advanced among the mining prospects in the Bri exploration and preparation for permit submission applications. There potential for scale mining development with the watershed in

[5] Area taken from the Watershed Assessment, Appendix C, Figure 1. and Nushagak watersheds, but not the offshore areas in that figure.

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greatest for porphyry copper deposits. Accordingly, the remai
exclusively on this porphyry copper deposits."

This logic is important to understand, and it is a cont
is not intended to represent one [illegible] the
the watershed. Yet the Assessment indicates that the wat
different deposit types. However, the [illegible] only
deposits, because Pebble is [illegible] to permitti

In contrast, the U.S. Bureau of Land Management recently assessed
in Bristol Bay [illegible] of
Management [illegible] identifies 11 mineral terrains [illegible] 17
types containing a number different mineral commodities.

The Bay and its accompanying Environmental [illegible] of
three-year process that stretched from [illegible] through [illegible] 2007
Assessment, BLM's planning process includes multiple [illegible] 15 [illegible]
meetings and multiple public [illegible] of the Bay
are similar to that of the Assessment.

The EIS Bay [illegible] affected environmental locatable
minerals:[11] The Bay planning area by [illegible] minerals. Terrains whose
geologic settings are considered highly favorable for the existe
resources.... Specific mineral deposit types and models associated [illegible] likely to
exist within terrains based on a terrane geologic particular. Just becau
geologic terrane is more likely to contain certain mineral
mean that economic deposits exist within th

The EIS goes on to list the various [illegible] and the
terrane favorable for [illegible] are listed as favorable for the
copper, molybdenum, tin, tungsten, [illegible] rare earths, [illegible]
byproducts of platinum, palladium, cobalt group [illegible]
by-product silver and gold).

The existence of terrains could potentially contain [illegible] deposits
that metals exist in concentrations [illegible] so that
future exploration may identify deposits or minerals that are not no
according to "The EIS is not [illegible] mapped [illegible] state,
contains very little detailed geologic information. Many of

[6] Information in this paragraph is taken from Watershed Assessment, Appendi
[7] Bay Proposed Resource Management Plan/Final Impact Statement, U.S. BLM.
78.
[8] BLM's work is not included as a reference in the EPA Assessment. of BLM's mineral [illegible] appear [illegible] have been used.
[9] Bay Proposed Resource Management Plan/Final Environmental Impact Statement,
[10] Ibid, Page vii.
[11] The remainder of the information in this subsection [illegible] BLM's

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**B. *Estimate of EPA's hypothetical mine size relative to the size of likely mi*
Bay.

It is impossible to accurately predict the size of new Pebble). There are no discoveries of new mines in the t
mine would be the largest mine of its type. 17 The accuracy of
assume that any new discovery will be largest mine of its type

Review of Alaska and British Columbia mines

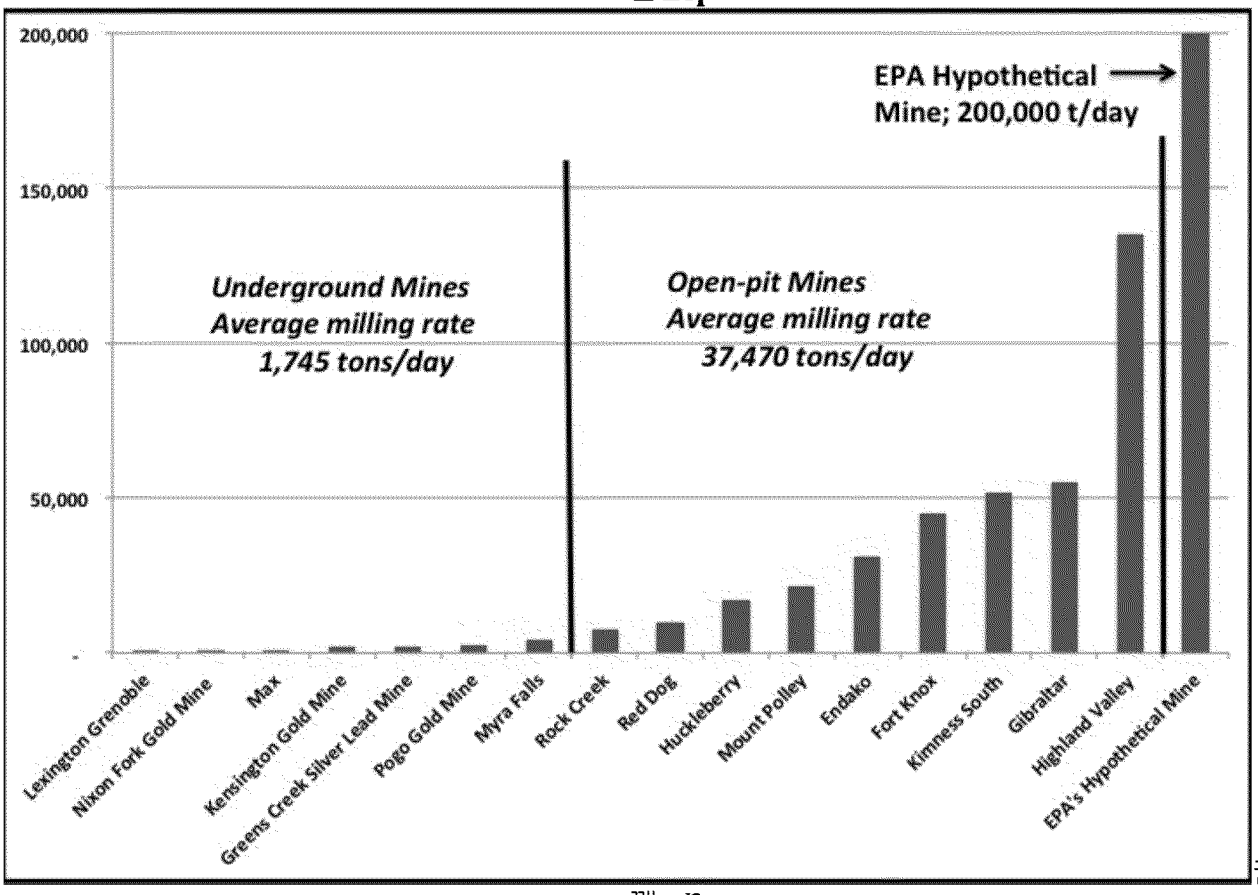
this technical review research sizes that currently exist in Alaska
Columbia. Unfortunately, given time constraints for assessment, this
was not possible to obtain surface area disturbed for these mines. This ana
milling rate as a substitute acreage mine

Figure 5 shows the data for mines in British Columbia and Al
explains the data sources for figure 5 shows assessment the
hypothetical mine is much larger than any mine in Alaska
average mine in the two areas mills an average
hypothetical mine is 200,000 tons per day, more than is five times
this average.

British Columbia includes 5 mines open where Copper is one of major
major target minerals. The average milling rate for those
EPA's hypothetical mine is almost four times that amount.

While it is not possible to estimate the mine size for
discovered, a comparison of mines in British Columbia and Alaska
hypothetical mine is almost certainly is a gross overestimate of
yet to be discovered project

Figure 1. Comparison of Alaska/BC Mines & EPA's Hypothetical Mine



EPA's Draft Assessment comes to a similar conclusion. The Draft Assessment compares Pebble to other copper porphyry deposits. Pebble's tonnage is greater than most other copper porphyry deposits. Pebble's deposit is clearly at the end of the total size range of porphyry deposits in the Nushagak River watershed (emphasis added).[14]

[13] The figure includes underground mines as well. The watershed assessment is applies to underground mines. The EPA's language in public and in the 404(c) process to these mines. There are no hypothetical mine 100 times larger than the average underground mine in these regions.

[14] Assessment, p. 4

Summary. *EPA's* hypothetical mine may or may not accurately represent the disturbance area of Pebble. However, it is likely that the EPA's hypothetical mine represents the disturbance area of yet another large hypothetical mine to be located in the Bristol Bay watershed. The conclusion is based on a review of British Columbia and Canada comments to the Pebble Project 404 Assessment; yet the Assessment comes to the same conclusion. The EPA's hypothetical mine is not representative of any other large hypothetical mine to predict such impacts, because of many other, large scale factors.

C. *Terms* EPA's Hypothetical Mine Representative of Locations

EPA's hypothetical mine covers or blocks between 13.5 and streams. A detailed analysis prepared for this technical review tested EPA's hypothetical mine was representative of other locations

While the analysis prepared for this technical review is similar for EPA's hypothetical mine representative of locations available for other mines, even if there were much smaller acreage of anadromous fish stream, or no acreage at all. locations for facilities for a mine at Pebble would significant anadromous fish habitat. For EPA's hypothetical mine to be considered to be necessarily representative of a location region, and possibly not representative of a mine at Pebble

To determine whether the particular location EPA's hypothetical of potential mining location around Bristol Bay watershed, the review worked with a University of Alaska student to conduct locations in the watershed. The student used GIS approximates a certain size mine disturbance throughout the national and state parks). The object is to determine place a mine within the Bristol Bay watershed is not anadromous fish streams.

To approximate a mine disturbance, the student used two miles. The mixe area is approximately the size of the Knox Gold Mine, Alaska area mine. The area is approximately the size of the EPA's hypothetical mine (25

The student found that, statistically, the vast majority of randomly place these boxes, in the watershed possible to place the disturbing an anadromous fish stream.

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This procedure is obviously extremely more thorough analysis required EPA to extend the comment period. The analysis mine locations that do not conflict with watershed streams because streams in the watershed have not been mapped. In take into account the fact that tailings facilities are usually always a stream in the bottom of the valley (though stream). However, it also did not take into account avoid sensitive areas.

Therefore, while it is not possible to comment on the reg mines of the size and location necessary be located so as to distu fish habitat, the analysis makes it clear that there is a

D. *Error! Bookmark not defined.* EPA's Hypothetical Mine Use Representative Geochemical Make-up

There is no "typical" geochemical make metal ore that is rep deposit in a region. Rather, each deposit is unique. The geochemistry of the Pebble deposit cannot be used to geochemical risks of other deposits in Bristol Bay.

In addition, the EPA acknowledges that geochemical risk is such as new waste rock and tailings are processed and stored. options for doing so, it is possible that the eventual system than EPA's hypothetical mine. Therefore, hypothetical mine may not even represent Pebble.

Courses on geochemistry emphasize that each ore is unique individually.[15] The courses emphasize that is influenced by a factors geology, climate, hydrology, as well as other factors such as processing methods, storage, etc. Source book for Hardrock mining emphasizes the diversity between deposits, and that each requires its own geochemical model and each lith unit.[16] The authors of this report have been involved with mine per Alaska. They have participated in state and federal requi throughout a mine pit because conditions can change in d deposit. Indeed, there is no such thing as a typical deposits or potential undiscovered deposits.

[15] Geochemical Predictions for Mine Wastes, March 2001, Fairbanks Day of Consulting included multiple slides emphasizing the unique factors for each determined potential acid drainage and metals leaching. The multiple fac hydrogeology, metallurgy, climate. In fact, the course listed multiple doze to each project. The course also InfoMine (2001) is similar.

[16] EPA and Hardrock Mining: A Source Book for Industry (2003) Appendix C, Characterization of Ore, Waste Rock, and Tailings.

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Evidence of the importance of geochemical diversity can be
Red Dog Zinc Mine which has potential acid is reported
20% minerals in comparison to the Fort Knox Mine with
minerals within the ore, no acid generating minerals in the
tailings water.[17]

EPA's water assessment recognizes different copper porphyry deposits ca
diverse geochemical characteristics. Assessment Appendix H discusses the ge
and environmental characteristics of porphyry copper deposits.
the potential diversity in the ore, factors that influence
environmental characteristics of deposits range from geologic setting
and regional), hydrologic setting, climatic settings, and mining
beneficiation methods.[18]

The EPA Appendix H quite clear generating acid metals leaching
characteristics of waste rock predicted in generating
potential of the waste rock can span a range from
(PAG) to PAG. The ability of leachate generated from waste roc
and oxyanions will vary, depending in part, on the pH
largely is a function of the pyrite content of the waste
indicates that porphyry deposits vary producing, it recognizes
that some rock types are producing (Figure 5 and 6 on
12), and generating characteristics can be significantly reduced
the sulfide-laden pyrite's are separated and disposed of in a
In summary, geochemical character of ore deposits are unique
deposit type. Even among copper porphyry mines, geoche
be predicted. The geochemical characteristics of the tailings,
similarities among copper porphyry vary significantly between dep
greatly influenced by the beneficiation techniques used, by the
concept of a "typical" set of geochemical characteristics that
various types in Bristol Bay is a fallacy. Such a

[17] Multiple conversations with Fort Knox personnel.
[18] Assessment, Appendix H 10
[19] Ibid, 13
[20] Specifically, Appendix H reads in part: "Pyrite oxidation is found in most mine tailings derived from froth flotation centers on the fate of pyrit porphyry copper mines, the pyrite is discharged with the waste tailings, generating potential of the tailings. However, the option exists to produce more effectively generated risks associated with tailings, to extract gold as or both. The production of pyrite decreases the acid potential of the tailings 11 and 12.

For that reason, the Assessment analyzes only the Pebble of any other deposit in the region. And even for the characteristics of the deposit that are specific to the characteristics tailings without knowing the milling process will be separated and it will be subject to testing a synthetic generation of Therefore, while it is certain that the Assessment does no make-up of other mines in Bristol Bay, because of the pot factors, may even not represent Pebble.

E. *Error! Bookmark not defined.* EPA's Hypothetical Mine Omits Mitigation and Prevention Strategies that are likely to be used by other large mines in Bristol Bay

It is not possible to predict the mitigation and prevention protect the environment from exploitation of an ore deposit discovered. Given the variety of mitigation strategies tailings, pyrite, off-site, lining buildings, would be unusual for any mine used exactly the set of mitigation/prevention strategies hypothetical mine. Therefore, it would be unusual for any stressors, or potential risk of stressors, such as hypothetical mine is unlikely to present the potential undiscovered mines in Bristol Bay.

***Error! Bookmark not defined.* EPA's Omits Mitigation and Prevention Strategies that significantly change the impacts it predicts for its hypo**

There are a number of changes in mine plan design that impacts predicted in the Assessment to assess mitigation impacts inevitable when a design change for would greatly reduce the chance impact. In addition, the hypothetical permitting design The permitting process will force other, as yet unknown design without those changes included will exaggerate the adverse impacts done.

Sections 3 and 4 technical review of the design changes eliminate or greatly reduce the predicted impact from a h examples will illustrate the issue

With respect to dam failure, the impoundment is a dry closure rather than a wet closure, it would be essentially safety risk-free. We do not know what governments would authorize), but EPA is not proposing hypothet with certain risks and ignore design changes that would assume that could be mitigated is "typical" risks for Bristol

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Similarly,꿿□ηthe꿿□ηAssessment꿿□ηmodel꿿□ηfrom꿿□ηbreaks꿿□η100꿿□ηfeet꿿□ηof꿿□ηstream꿿□ηwill꿿□ηenter꿿□ηthe꿿□ηAssessment꿿□ηalso꿿□ηroutes꿿□ηthe꿿□ηpipeline꿿□ηwstream꿿□ηfor꿿□ηa꿿□ηsignificant꿿□ηportion꿿□ηof꿿□ηits꿿□ηlength꿿□ηstream꿿□ηcrossings)ηself-evidently꿿□ηwrong.꿿□ηwere꿿□ηsuch꿿□ηa꿿□ηproblem,꿿□ηmeaning꿿□ηwould꿿□ηcompany꿿□ηor꿿□ηagovernment-permitting꿿□ηagency꿿□ηhave꿿□ηthe꿿□ηpipeline꿿□ηfurther꿿□ηfrom꿿□ηthe꿿□ηstother꿿□ηdesign꿿□ηchanges꿿□ηwould꿿□ηsignificantly꿿□ηreduce꿿□ηor꿿□ηeliminate꿿□ηtAssessment꿿□ηpredicts.꿿□η꿿□ηThese꿿□ηand꿿□ηother꿿□ηexamples꿿□ηare꿿□ηexplainedof꿿□ηthis꿿□ηtechnical꿿□ηreview.

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- The꿿□ηKensington꿿□ηGold꿿□ηMine꿿□ηwent꿿□ηthrough꿿□ηmuch꿿□ηconstructed.꿿□η꿿□ηIt꿿□ηwas꿿□ηoriginally꿿□ηpermitted꿿□ηLynn꿿□ηCThe꿿□ηcompany꿿□ηthen꿿□ηtried꿿□ηunsuccessfully꿿□ηto꿿□ηdispose꿿□ηof꿿□ηtailings.꿿□η꿿□ηFinally,꿿□ηthey꿿□ηpermitted꿿□ηthe꿿□ηcurrent꿿□ηdesign꿿□ηfor꿿Lake,꿿□ηwhich꿿□ηwas꿿□ηenvironmentally꿿□ηpreferred꿿□ηover꿿□ηother꿿□ηoptiochanges꿿□ηoptimized꿿□ηthe꿿□ηmine꿿□ηfrom꿿□ηthe꿿□ηcompany's꿿□ηpoint꿿□ηforced꿿□ηupon꿿□ηthe꿿□ηcompany꿿□ηby꿿□ηthe꿿□ηagencies.꿿□η

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EPA's hypothetical mine is perfectly designed. We do not Pebble will propose that design, or anything similar. How other Alaskan mines, that the proposed design will change and and mitigation strategies yet unknown to agencies, or even the mining company will emerge. These regulatory agencies usually because they will designs significant environmental impacts. A hypothetical subject to the permitting discussion impacts

G. EPA's hypothetical mine does not meet permitting it cannot represent realistic mine in watershed.

EPA assumes hypothetical mine would cover between 13.5 of anadromous fish streams and between 4.7 proposes no mitigation for these impacts inconsistent with permitting standards. The hypothetical mine also assumes that placed in an anadromous portion of Upper Talarik Creek. placement would not be allowed. Thus, permittable under laws. A mine that does not cannot be taken as a realistic example of the impacts

An analysis prepared for Trout Unlimited Bristol concludes, Alaska mines that are currently operating have avoided valuable fish habitat." Alaska has assigned an anadromous fish stream The experience of fisheries allowing anadromous fish habitat only in specific circumstances expanding a community runway where there are always mitigation, generally the replacement habitat similar habitat

The Chuitna Coal Mine is proposed to anadromous streams and then replace that habitat. The company proposes to construct a new habitat to make the yet to be affected habitat, prior discussion with and agencies has taken years and even not though the disruption to habitat is only temporary during reclamation the permitting and mitigation discussions are long and the EPA assessment assumes that orders of magnitude greater disturbance permitted without mitigation conceivable that would permit the destruction of 20.9 3.5 miles of anadromous habitat without mitigation design of EPA's hypothetical mine.

Title 16 Alaska statutes state permitting standards make clear that replacing) anadromous habitat orders lasting years has been historical community (i.e., mining) purposes, and only when there is no

[21] Mining the Pebble Deposit: Issues of 404 compliance and unacceptable Yocum. December 2011 Page 43.

of where it was allowed occurred in Ketchikan. That
fish stream to expand the old stream was filled
new stream channel, with replacement habitat, was created.

EPA's hypothetical mine design proposes to fill portions of
rock. This waste rock of Alaska
would not be allowed.

The loss of wetlands without mitigation presents a similar
cover between 4.7 and 7.1 square miles of wetlands
could be permitted Water 404(c)(1)
EPA's hypothetical mine does not meet the of Al
the federal Clean Water Act. Therefore, it does not
operation of a realistic mine in Bristol Bay. Further,
exploit discovered deposits be designed have different
mitigation and prevention strategies, different impacts EPA the
hypothetical design. Therefore, the The impacts of
ecological risk assessment do not represent the of
the lack of mitigation planned for waste rock in Upper
may not represent the impact of Pebble.

H. Conclusion: EPA's Hypothetical Mine Is Not Realistic for Bristol Bay.

The foregoing analysis demonstrates that EPA's hypothetical mine
predicting mining in Bristol Bay.

- The hypothetical mine uses type of deposit representative
of other potential mines in Bristol Bay.
- The hypothetical size is many times the likely size
- EPA sets the particular mine location that has specific problems
representative of locations in Bristol Bay, sample of which
anadromous fish habitat issues.
- EPA's a geochemical model the ore that is not represent
geochemistry of either other copper porphyry deposits more other
that could be developed in Bristol Bay.
- EPA's hypothetical mine design and mitigation that
would eliminate or reduce the impacts the Assessment
foreseeable yet unknown prevention and mitigation that would result
agency permitting discussions and NEPA analysis.
- EPA's hypothetical mine does not meet federal state
impacts it predicts are not the mine not be permitted

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Section 1.D. Assessment of Failure

This section of the report presents a review of EPA's analysis of the hypothetical mine's impacts. It errors of EPA's analysis.

A. Habitat Modification Water Withdrawal

The habitat modification impacts that EPA predicts are a and the impacts. That is, EPA places a very large particular location and determines over 1,335 miles of and 20.9 miles of anadromous habitat. It also forecasts further impacts at the mine.

Error #8: EPA overestimates the impacts of habitat modification

technical review shows that EPA selects a mine size that represent developed in Bristol Bay. EPA picks a mine site that is copper mines in British Columbia, times the average size of mines in Alaska, and over 100 times the size of an smaller mine would have significantly less impact, and would much more latitude in designing to minimize adverse impacts on fish habitat.

Error #9: EPA uses a particular location for its hypothetical mine that is not representative of other fish habitat

analysis in Section 1.D. of this technical review particular location as of hypothetical may not be representative of other in the Bristol Bay watershed with respect to anadromous likely that the location for the hypothetical mine would exhibit impacts for other watersheds. It may even exaggerate the impacts relative to alternative locations for some of the fa

Error #10: EPA forecasts impacts from a mine that is not reasonable to expect

reasonable to expect typical impacts from mining Bristol Ba hypothetical mine that does not meet permitting standards. If permit standards, then either the ultimate design will be different), or the mine impacts will be because it will not be built.

Error #11: The Watershed Assessment's unrealistic water budget

Watershed Assessment did not realistic water budget for the mine budget is the most important document. This is influenced by the grind, and many other details. Agencies scrutinize water budget permit process. Water budget typically goes through many iterations be developer has incentive and before the agencies are willing budget is final, and until the Department of Natural Resou volume, how much water the mine will need is unknown. uncertainty about the impacts to downstream fish populations, unti process is complete.

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The authors review and follow EPA's water budget. Therefore, comment on EPA's assertion of water withdrawal problems do addition, many groups have applied water rights on the Upp Creek, South Fork Koktuli River, and the North Fork Koktuli EPA's proposed location. EPA implicitly assumes that DNR perception of the mine's water needs, and shutdown the flow water needs. We have no idea whether such an does EPA. If EPA's unstated assumption is correct, wrong, then

In addition, water budgets are generally processing method, water budget for a particular mine, hypothetic representative of the water budget for another mine. The EPA's hypothetical mine (which is not produced adequately so r follow it) likely not be representative of other mines proposed elsewhere.

B. Roads and Stream Crossings

The predicted impacts for EPA's hypothetical mine road do mines in Bristol Bay, and not even be for other hypothetical Bristol Bay may not use a road, and because the road as yet unknown design changes that would greatly reduce we note that EPA came to the different conclusion for Alaska.

EPA forecasts that the road to the hypothetical mine would anadromous and resident salmonids in more than 10 streams. in fish populations cannot be assumed that this is a "problem and road salts making its way into surface waters, filling through undersized and failed culverts. Whereas EPA does not the problem, length of gravel indicates that it is significar fishery.

Error #12: Assumption of Road Impacts. Road may be required to develop However, it is quite possible that other mines within the developed using a wider road, more avoidance sensitive area. Thus, the road impacts likely more than Bristol Bay.

Error #13: Omission of Prevention and Mitigation techniques for road. EPA proposes a specific road alignment and by implicat techniques and then disparages them because of the environm cause. The obvious solution is to provide a higher le and a robust monitoring program to address problems before they cause th For example, they overlooked that impacts can be mitigated. They omit the

to install [illegible] prevention strategies EPA would eliminate [illegible] hydraulic modification by failed or undersized culverts.

Without detailed design, maintenance, and specifications, which not included in the Assessment, it is not possible to determine strategies necessary to [illegible] However, EPA's pretense that these problems would not be identified [illegible] additional prevention strategies, such as [illegible] be required is inc

It may be possible that some of the areas that may deposit are unusually sensitive to road interference. However, likely that the [illegible] more effective prevention and [illegible] mitigatio i.e., higher road construction and maintenance standards.

Error #14: Check on EPA's conclusions for different conclusions for roads. Mine access roads are Alaska's new 1,12[illegible] miles of such roads and bridges.

- Red Dog mine road (Delong Mountain Transportation System
- Pogo mine road, 49 miles
- Greens Creek mine road, 13 miles
- Fort Knox/True North, 12 miles

As another way of EPA's analyzing [illegible] posed by culverts roads, the [illegible] to see if other analyses not associated controversy reached similar conclusions. Those include the Red (2009), the Pogo Project's MEIS (2003), and the Greens Creek [illegible] the Pogo Greens Creek [illegible] the [illegible] two EIS an

- According to the [illegible] access road includes nine bridges, [illegible] culverts, and [illegible] crossings (page 55). While many [illegible] without anadromous fish [illegible] culverts were not identified [illegible] scoping document, public comments, or the EIS.
- The 2003 Pogo Gold Mine Project EIS [illegible] portion that discusses road construction, activities and operation would [illegible] some erosion and sedimentation [illegible] management practices, the overall impacts on fish and aqua low and localized [illegible] effects on fisheries as a r culvert failure are identified.

[22] Most of the analysis concerning the check on culvert failure conclusions Alaska, Institute of Social and Economic Research, Working Paper No. 1. Professor of Public Policy [illegible] Assessing of Proposed Mines: Can Valid Asses Design?" Pages [illegible] 35. [illegible] information is taken verbatim from that

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- Finally, the author's review of the audits of the Fort Knox, Big Creek mines found that some specifically addressed potential none identified failed culverts as an issue.

Overall, a significant incidence of existing roads does not to have been an issue with government agencies, including circumstances, EPA, other agencies, landowners not identified the magnitude or road impacts to streams in the Assessment.

Section 4. Risk Assessment

A. *Error! The Fallacy of Statistical Prediction from Legacy*

Public environmental sensitivity and environmental laws have chan last generation. The practices and impacts that were con a matter of criminal penalty today. There has been a r advent of the first Earth Day and enactment of the Act in 1970. These changes have affected our laws, culture, changes have dramatically affected today's mining practices practices and old mines do not represent today's practices improved pr

The table below shows some of the milestones in this not develop into today's practices immediately at the enactme took years of experimentation and increasingly improvement regulators to develop the practices and standard

At the same time the laws and regulations were changing The best example is in the preceding sections is Acid-base accounting is generally accepted from 1978 (Sobek 1978). Kinetic testing using humidity cells and other means developed still testing improved techniques.

Changes in mining are evident from the changes Red Dog The original EIS in 1985 does not include about the generating properties of the producing Red Dog ore. In EIS includes a section devoted to the geochemistry.

The authors have participated permitting in Alaska. Geochemical issues, acid drainage and metal leaching were par mid-1990s. But in retrospect those discussions superficial relative to the long and detailed discussions today.

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Action	Year
National Environmental Policy Act (NE	
NEPA becomes law	1970
Council on Environmental Quality (CEQ) issue	1978
CEQ guidance on NEPA regulations	1983
EPA, Clean Water Act, and the Army	
EPA established	1970
Clean Water Act Enacted	1972
Significant Clean Water Act amendments	1977
Corps of Engineers Wetlands Regulations	1977
COE Wetlands Manual	1987
Effluent limits for metal mines promulgated	1980
CERCLA enacted	1980
BLM	
Land Policy and Management Act	1976
BLM publishes NEPA Handbook	1988
US Forest Service	
National Forest Management Act	1976
USFS NEPA implementation procedures	1979
USFS Reclamation Bonding Guidance	2004
State of Alaska	
Legislature enacts requirement for bonding	1991
Legislature requires full bonding for mines	2004

The cumulative effect of these changes is obvious to anyo
permitting and mining practices. also demonstrated by examining EPA'
National Priorities Listing sites. The list demonstrates the
environmental protection by modern mining operations. Analysis
from a publication of the Northwest Mining

EPA has prepared a subset of the National Priories List
EPA as the Abandoned Mines List (“EPA AML”). The EP
seeks to use it to suggest the environmental Hardrock Great
Mines because the EPA AML is composed entirely of fa
facilities and inorganic chemical plants that are almost nev
Mining or Hardrock Mines permitted in the United States;
regulation of Hardrock Mines. When one eliminates the
inorganic chemical plants and mineral processing facilities, the
100 sites is immediately reduced to about 53 mining be a
deemed to be “Hardrock Mines.”

[23] Northwest Mining Association, *Hard Rock Facts*, 2012, “Hardrock Mining Reclamation and Re
Developing sustainable Environmental Protection through Changing Values, Changing
A Federal and State Regulatory Success Story,” Executive Summary.

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Of course, the above discussion does not address the [illegible] protections, if any, that had been applied to these [illegible] environment. In fact, [illegible] were [illegible] these [illegible] subject to any [illegible] limitations to protect the environment. EPA's 1985 assess[illegible] management methods at mining facilities indicate that only [illegible] currently [1985] monitor [illegible] controls or liner, [illegible] employ leachate collection, detection, and [illegible] systems. [illegible] practical matter, any discussion of the effectiveness of environmental [illegible] designed and approved [illegible] 1985 [illegible] one would suggest [illegible] General Motors ("GM") [illegible] prohibited from producing cars in [illegible] 1965 Corvair was deemed to be "unsafe [illegible] speed" [illegible] meet 2012 regulatory standards [illegible] 1965 [illegible] Hardrock Mine [illegible] yet both the auto industry and the Hardrock Mining industry [illegible] their role in the U.S. [illegible] economy.

Hardrock Mine regulation can be broadly classified into 3 [illegible] extent of applicable regulation or [illegible] 1970); (2) Transition Regulatory Era (1970 through 1990); [illegible] Hardrock Mine [illegible] The approximately 53 Mining and [illegible] NPL [illegible] following temporal [illegible] classifications:

- Pre-Regulatory Era (prior to [illegible] 1970)
- Transition Regulatory Era (1970 [illegible] 1990)
- Regulated Hardrock Mine [illegible]

The decrease in mining sites on [illegible] EPA's [illegible] and practices. "Obviously and most importantly from the [illegible] success of Hardrock Mining [illegible] Hardrock Mines on the [illegible] List were approved [illegible] 1990."

Other evidence of the improvement in hardrock regulation and [illegible] and USFS. In March 2011 Senator Murkowski of Alaska [illegible] mine plan of operations the agencies had approved since [illegible] approved subject to [illegible] were listed by [illegible] The EPA agreed [illegible] between 1990 and 2011, the USFS had approved 2,685 [illegible] approved 659 [illegible] these required EPA to place them on [illegible] likely to [illegible] operations, the results do show the su[illegible] practices as compared to [illegible] 1990 [illegible]

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[24] EPA, "Report to Congress, Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale," December 31, [illegible]

[25] Nader, Ralph et al., "Unsafe at any speed: The Designed-in Dangers of the American Automobile," Grossman Publishers, 1965.

[26] National Mining Association, "Press Release," August 31, 2012. Executive Summary.

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Because of these obvious differences, the mines are generally referred to the industry and legacy mines were generally constructed and inferior environmental standards and practices, as compared to statistics bear this out.

Conclusion. Assessment statistics gained from legacy mines operation of their hypothetical mine. Given the changes explained above, this error is bound to overestimate the Assessment appears to make this error throughout failure, and possibly in the water treatment and collection they do not discuss, explain, or display the data used

B. Water Collection and Treatment Failure

The predicted of collection and treatment unreliable. It does not accurately represent realistic ecological typical mines that may be EPA's hypothetical mine. The reason for this

- the hypothetical mine lacks detailed design that would the water collection risk. That is, some designs are the lack of detail well what EPA has proposed;
- the (lack of detail) prevention and mitigation strategies the ignores Alaska's excel on the subject;
- EPA makes assertions without any analysis supporting and
- the conclusions in the Executive Summary in the body Assessment.

Error #16: *The lack of design details makes analysis meaningless.*

This section of the Watershed Assessment low ecological risk analy methodology. That methodology requires a detailed design identified, and determinations whether particular endpo This section has none of that.

There are no design details to evaluate: Will the drainage from open pit or away and into the environment? Will system? If so, will there be storage such that they without treated water escaping to the environment? Will measures to catch any drainage that escapes before it get detail presented for the hypothetical mine, answers to questions. Yet these details matter greatly in the evaluation

There is no specific failure mode at this conceptual design details monitoring system, upon closure and the system in place section admits the lack of knowledge. "If the water is nontoxic, in

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standards and its composition is stable or improving, the may be shut down.[27] Otherwise…

Some examples may illustrate the problem. If the waste rock the mine, then uncollected leachate could leach for years w environment. As a second example, if generating potentially reactive rock in the mine was sequestered in a way that the waste rock drainage is much greater than the waste rock piles were recl precipitation did not infiltrate, and were placed to avoid g the drainage from tertiary waste rock piles the volume to affect one environment, whatever its composition. We do not know th Assessment does not specify. Without that detail, we probability or consequence and the failure. can EPA.

Error #17: The (lack of) design and implementation of mitigation strategies. Alaska's mines generally have systems in place to the primary containment mechanism. In some cases, the systems design; in some cases, they are agency permit process.

At Fort Knox Gold Mine all parts of the tailings drain lake will capture a failure at the mill or the heap le a discharge facility with downgradient wetlands. However, downstrea the tailings lake is constructed wetlands complex and a freshwate would provide a large amount of dilution in a well safe back system is inherent in Fortunately, the been needed since the mine began; that is, no seepage complex since the mine began operation in 1996.

At the Pogo Gold Mine the water treatment system discha channel treatment works. The system discharges into a c treatment system water can be mine pit. Goodpasture River. system with a backup safety built in the discharge system to prevent a problem, the outlet of the lake can be blocked until the problem is case of a treatment upset. If mixing is insufficient, more into the mixing tank. company did not propose this system was the company by the agencies during the permitting process system.

At the Red Dog Mine, the tailings pile either to the open pit or to the tailings lake. The treated before discharge. The unused volume in the tailing dam) provides a margin of safety in case the treatment

[27] Assessment, p. 16.

[28] Northern Dynasty Limited's 2006 water rights and dam safety applications sequestered. We do not know what assumed, and provided for Pebble.

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The systems in these examples show how the potential for failure can be minimized. One system of [illegible] EPA's hypothetical mine. The hypothetical mine is presented [illegible] almost did not exist: that is, [illegible] before government required margins of safety [illegible] evaluation of water collection and treatment failure for the [illegible] realistic mitigation and prevention strategies.

Error #119: The analysis ignores Alaska's record [illegible] excellent record with respect to protecting water quality [illegible] monitoring includes water quality above and below the mine, [illegible] fish populations, fish tissue analysis [illegible]

Analysis of the fish/benthic monitoring and [illegible] mine in Alaska [illegible] populations, nor has it resulted in significant [illegible] the water quality and [illegible] quality and fish production before the mine began operation. [illegible] improved both water quality and fish [illegible] populations downstream.

Alaska has an excellent record for mine designs that protect population, fish tissue, benthic invertebrates, and water quality [illegible]

Error #119: Assertions about [illegible] are unsupported. [illegible] failure section Assessment contains many unsupported assertions. [illegible] illustrate the problem. [illegible]

The risk characterization of this part of the Assessment [illegible] "Failure of the water collection system during operation of plan[illegible] closures periods would, like failures of any water treatment [illegible] occurrence of limited duration." [illegible] EPA is quite clearly implying [illegible] treatment system will fail [illegible] contaminate [illegible] The Assessment [illegible] support for that conclusion. In fact, [illegible] contradicts [illegible]

[29] Shall level of fish monitoring is not always required for mines not [illegible]
[30] There is one exception. In 1990 as the Red Dog Mine was [illegible] laden water escaped the confines of mine [illegible] a few years afterward, but [illegible] have recovered and for almost [illegible] healthier than [illegible] occurred before the advent of modern permitting [illegible] likely foreseeable and would probably not occur in today's permitting environ[illegible]
[31] For documentation for the information [illegible] reports at [illegible] DNR Large Mine Permitting website, or on the website [illegible] DF&G's Ha[illegible]
[32] Box 2.16 Page 15 describes an accidental [illegible] tailings water release at [illegible] Mine. The box neglects to mention that DEC concluded that there [illegible] While the spill should not have occurred, the level of [illegible] areas with limited or no risk. It is interesting that EPA cannot [illegible] the environment.

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This and other sections of the Assessment [illegible] that the perpetual water quality. For [illegible] and tr were toxic, "treatment would continue until [illegible] abandonment of the system, at which time [illegible] 6-36). Alaska has never intentionally permitted a mine th quality treatment. Red Dog Mine will need such treatmer modern mine regulatory system, and [illegible] was re issue of perpetual treatment was never discussed during perm whether Alaska would permit [illegible] mine area of significant value. [illegible] area would be designed perpetual treatment and that agencies [illegible] allow

The Assessment [illegible] mine closure, it [illegible] acid be disposed of [illegible] closure could leave w piles in [illegible] added, [illegible] regulation indicate system of reclamation bonding [illegible] agencies have the funds to implem plan if the mine [illegible] mines.

Alaska has had two mining bankruptcies: Illinois Creek and resumed mining, and Illinois Creek was closed and reclaimed. funds and neither [illegible] environmental violations. In fact, Al modern [illegible] bankruptcy, mine failure, or mine closure that closure that was not in compliance with agency requirements and closure. This is true for mines on state, private, spent state or federal funds [illegible] modern

The assertion that premature closure would [illegible] is completely unsupported, contradicts Alaskan experience, and ignores sta concerning reclamation [illegible] assurances

Error #20: Conclusions in Assessment's Executive Summary contradict the conclusions in the body of the Assessment. [illegible] Section Assessment concludes that not quantify or [illegible] risk or treatment failure. This is a reasonable conclusion given the uncerta Specifically, it reads, "The water collection and treatment failu uncertain…. [illegible] of failures is wide and the probability of cannot be estimated from available data." [illegible] most complet design, omission [illegible] mitigation and prevention strategies, it is reasor the Assessment cannot evaluate the risk of water collection

The Assessment Executive Summary summarizes conclusions about these issues [illegible] completely different manner. [illegible] summarizes the probability and cons failure. Despite the problems identified [illegible] despite Section in the Assessment concludes "that the risks are hi estimated from available data" the [illegible] probability collection and treatment as "High" during operation [illegible] High

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text reads 21 p. 3 "Based on a review of historical and current failure of the collection and treatment systems, it is likely du periods." 4 then goes on to describe toxic effects that wo To be clear: the analysis in Section 1 does not Assessme "cannot be estimated from data." However, the Assessment's Ex summarizes the analysis by saying that EPA reviewed the "High." This is especially confusing in light of Assessment frequency of failure.

The Executive Summary contradicts the Assessment's own analysis. documentation of a "review of historical and recently reported Assessment. Their contradicted by Alaska's record. There for this conclusion contradicts statements in the analysis in the body of

Error. EPA's conclusions in other analyses. 7 EPA was the lead agency for the Red D EIS. The potential leachate water from the Red Dog high concentration of metals than that predicted for EPA's does not mention the risk of water collection and treatment Assessment states "during operations hypothetical mine.

EPA was the lead agency for the Environmental Impact Stateme Mine Project in Alaska. The Final EIS, published in Septer risk of water collection treatment and failure. It app significant environmental threats in this Assessment. The EIS's actual, hypothetical the Pogo or Red Dog Mine.

Conclusion. The Assessment's conclusions water collection and treatm failure are unsupported.

- The hypothetical mine lacks the ecologic assessment.
- The hypothetical mine omits and prevention strategies.
- The analysis ignores Alaska's excellent record
- The analysis includes
- The conclusions in the Executive Summary contradict the the Assessment.
- EPA came to different conclusions when analyzing other

The impacts predicted in this section cannot be mines that could occur in Bristol Bay. They are not mine proposed by EPA.

C. Pipeline Failure

EPA's pipeline failure impacts cannot be taken as realistic because many pipelines will not use a pipeline. It also can hypothetical mine because they omit both obvious and unknow would greatly reduce the potential for impacts. Finally, w different conclusion about a pipeline when evaluating another mine

Error #22: Assumption of Pipeline

Mine. However, some pipelines Alaska uses a pipeline. In fac a need for a pipeline is so much more compact than Thus, it is statistically likely that other mines within the pipeline. The pipeline impacts are unlikely to be representativ mines in Bay.

Error #23: Omission of Pipeline-Related Prevention and Mitigation Strategies.

pipeline design omits obvious prevention and mitigation strategies. spill within could flow to that stream. If further away from the stream should other solve strategies. building a berm for containment, or other methods to kee stream and.

EPA calculates that the probability of a spill occurring and one would exceed 5 stream contaminating spills over the duration of th frequency is obviously unacceptable (as EPA answer would be allowed.

Permitting is an iterative process. Applicants design a pr scrutiny. If an agency finds that the project design d the project stops, the agency the design applicant project until it agency requirements. Only after the agencies are convinced th adequate to actually meet the standards may the permitting not proceed with an EIS for a project they believe cannot numerous examples of permitting processes and even EIS proc projects were designed to the point where the agencies believed permit standards[33].

While some components of a mine be designed be designed to different standards. It is an error to assu permitted. The applicant would be required increase t

[33] One example is the permitting process for the Pogo mine southeast entire area while the company there facilities to meet EPA standards for discharge. The company moved all the facilities from the top of the new location in the Liese Creek Valley. Once EPA approved the new would work for those standards, the process resumed.

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factors꿯□ŋin꿯□ŋthe꿯□ŋdesign꿯□ŋuntil꿯□ŋan꿯□ŋ[illegible]

design꿯□ŋa꿯□ŋhypothetical꿯□ŋmine꿯□ŋwith꿯□ŋan꿯□ŋunacceptable꿯□ŋrisk,꿯□ŋand꿯□ŋ

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꿯□ŋ

Error 꿯□ŋ224: 꿯□ŋCheck 꿯□ŋon 꿯□ŋconclusions 꿯□ŋto 꿯□ŋEPA 꿯□ŋ[illegible] different 꿯□ŋconclusion 꿯□ŋfor 꿯□ŋmine 꿯□ŋpipeline 꿯□ŋthe 꿯□ŋRed 꿯□ŋDog 꿯□ŋMine.situation꿯□ŋat꿯□ŋa꿯□ŋdifferent꿯□ŋmi

different꿯□ŋconclusion꿯□ŋ[illegible]

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EPA꿯□ŋwas꿯□ŋthe꿯□ŋlead꿯□ŋagency꿯□ŋfor꿯□ŋthe꿯□ŋSupplemental꿯□ŋEIS꿯□ŋfor꿯□

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access꿯□ŋ[illegible]ludes꿯□ŋnine꿯□ŋbridges,꿯□ŋthree[illegible]

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However,꿯□ŋEPA꿯□ŋconcluded꿯□ŋthat꿯□ŋa꿯□ŋpipeline꿯□ŋwould꿯□ŋbe꿯□ŋthe꿯□ŋenv

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in꿯□ŋanalyzing꿯□ŋthe꿯□ŋpipeline꿯□ŋfor꿯□ŋthe꿯□ŋRed꿯□ŋDog꿯□ŋMine,꿯□ŋEPA꿯□ŋ

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Conclusion. [illegible]ecological꿯□ŋrisks꿯□ŋoutlined꿯□ŋin꿯□ŋthe꿯□ŋpipeline꿯□ŋfailure꿯□

They꿯□ŋdo꿯□ŋnot꿯□ŋ[illegible]

EPA꿯□ŋcalculates꿯□ŋthat꿯□ŋtheir꿯□ŋhypothetical꿯□ŋpipeline꿯□ŋhas꿯□ŋunacceptable꿯□

unrealistically꿯□ŋfails꿯□ŋto꿯□ŋassume꿯□ŋmitigation꿯□ŋor꿯□ŋprevention꿯□ŋstrategies꿯

risk꿯□ŋto꿯□ŋan꿯□ŋacceptable꿯□ŋlevel.꿯□ŋ[illegible]

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E. Dam Failure

Error #25! Assumption of a dam; assumption of a wet closure

large mines have almost, if not, no impact on the mines without dams underground mines (which may or may not, depending on the mine. However, during mine closure activities, tailings with toxic or material and overburden to eliminate water seepage into the ta they become part of the landform, and the dam ceases probability or impacts.

The Assessment acknowledges this possibility. "After mine closure *eliminating the consequences of* (emphasis added)." Despite this potential to eliminate the risk, Assessment uses a wet closure they expect to be minimal impacts. Bristol Bay closure, which would eliminate the risk. For reference, Alaska mines in the modern era: Red Dog, Fort Knox, Illinois the four Dams proposing wet to reclamation plan.

Therefore, it is quite likely that the Dam Failure scenario large mine impacts in the watershed. represe of people. Neither the EPA nor Pebble will closure.

Error #26! Some locations are more susceptible of the hypothetical mine

significant dam failure will likely have more catastrophic consequences, significantly worse than others. The Assessment picked a mine with a higher level of consequence than some poten The location they picked would have tailings from flush tributaries to the Nushagak, thereby potentially polluting drainage below the point of entry

However, approximately a quarter of the Assessment Lake Iliamna than into Nushagak. Mulchatna drainage. tailings spill into one of the Lake could have devastating affects on the tributary. into Lake Iliamna without greatly affecting the remainder of would probably have an important adverse the Lake. But the largest lake in the US, large volume of the lake wou sediment without the same downstream contamination that would to occur in the location selected by EPA. There may or drainage limited to the of any spilled tailings. Therefore, the EPA for their hypothetical mine may greatly overstate the I failure in a significant part of the watershed.

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[36] This calculation was based on area draining into Lake Iliamna watershed.

[37] http://geography.about.com/od/lists/a/10-Largest-Lakes-In-The-US.htm (July 2012).

EPA-7609-0003194_0038

Section 5. EPA's methodology

In January 2012, the University of Alaska, Institute of Soci
published a working paper titled "Assessing Ecological Risk of
Assessments be Time-Dependent That paper concluded that
assessment was a faulty methodology and results in unreliable
the paper concluded:

- Post-design ecological risk assessments are specifically designed to
specific data to come to conclusions regarding without that information,
design risk assessment makes assumptions that are often
incorrect.

- Hard-rock mines are unique, and data from one mine
another.

- A design ecological risk assessment is likely to omit mitigation
strategies that an actual mine will use to decrease
are unknown.

As this technical review has shown, Assessment makes all
errors predicted UAA working paper. It makes assumptions t
accurate (or in some cases obviously inaccurate), and it o
strategies that an operation may use to decrease ecological

In addition, the Watershed Assessment the theoretical errors beyond
considered in the UAA working paper. The Assessment a
impacts from a yet-designed mine, but it attempts to use
assessment methodology to predict what impacts would any other mine in
watershed.

As the UAA paper and this technical review unique, and
are unique. It is Pebble alone, other watershed would
EPA's hypothetical mine. probably however is finally proposed for
also use design details and mitigation/prevention techniques that
hypothetical mine. Given these points of an ecological risk assessment
different.

For all the reasons given above and those in the UAA
assessment methodology is in a yet-designed mine. The UAA
Paper is attached as Appendix B to this technical review.

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Appendix A. Data Sources for the Review of the Alaska

The list of operating mines for British Columbia, where the Mining Association of British Columbia. The list indicated it was is: www.mining.bc.ca/mining_map.htm. The list of mines for Alaska authors' knowledge sources for the milling data from information is following table below.

Alaska Mines	Data Source
Greenscreek Silver Lead Mine	http://www.hecla-mining.com/operations/operations_greenscreek_processing.php
Red Dog Mine	2010 Production Teck powerpoint (http://dnr.alaska.gov/mlw/mining/largemine/reddog/pdf/teck2011ppt.pdf)
Fort Knox Gold Mine	Fort Knox Reclamation Closure Plan 2006
Pogo Gold Mine	Infomine; http://www.infomine.com/careers/eoc/pogo.asp
Kensington Gold Mine	FINAL SEIS, USDA; Dec 2004; Record of Decision
Nixon Fork Gold Mine	Gravity & CIL Plant Capacity; Fire River Gold Website; http://www.firerivergold.com/s/NixonFork.asp?ReportID=508154&_Type=Nixon-Fork-Gold-Mine&_Title=Overview
Rock Creek Gold Mine	Mill Capacity; Nova Gold Resources Presentation; Rock Creek Annual Meeting 2008. http://dnr.alaska.gov/mlw/mining/largemine/rockcreek/pdf/novagold2008ppt.pdf

British Columbia Operating Metal Mines	Data Source
Myra Falls	Infomine; http://www.infomine.com/minesite/minesite.asp?site=myrafalls
Lexington Grenoble	http://www.infomine.com/index/properties/Lexington-Grenoble_-_Greenwood.html
Max	http://www.infomine.com/index/properties/Max.html
Highland Valley Copper	http://www.infomine.com/careers/eoc/highland.asp
Mount Polley	http://www.imperialmetals.com/s/MountPolleyMine.asp
Huckleberry Mine	http://www.infomine.com/careers/eoc/huckleberry.asp
Gibraltar	http://www.tasekomines.com/our-properties/gibraltar/
Endako Mine	http://www.thompsoncreekmetals.com/s/Endako_Mine.asp
Kimness South	2005 Analysis: http://www.kegold.com/editorials_05/zihlmann120305.html

The True North Gold Mine (Alaska) was not included because nearby Fort Knox Mine. The Authors could not find milling Creek (which was a small mine), and so it was not and Table Mountain mines were not included because the information to them, which also indicated that they are not

Appendix B. UAA/ISER Working Paper

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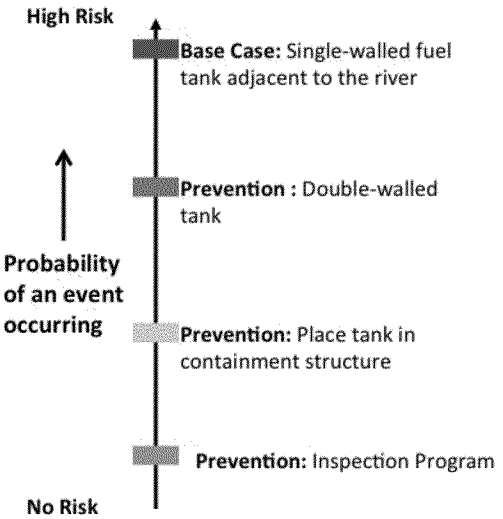

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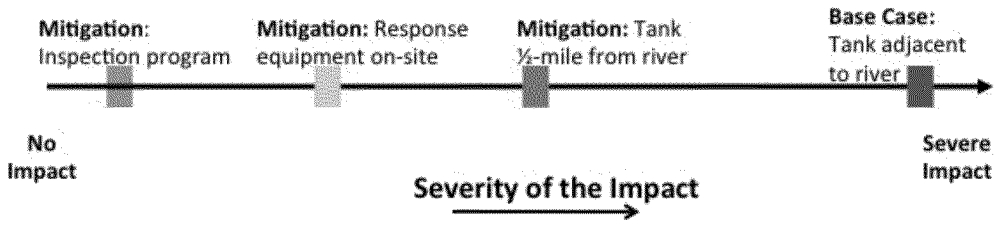

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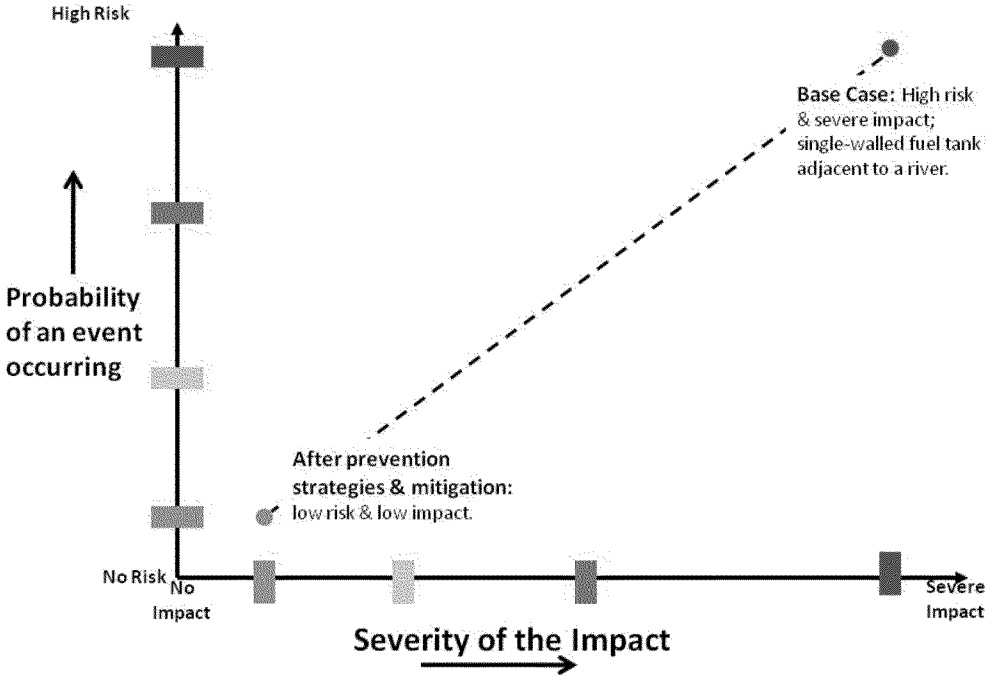

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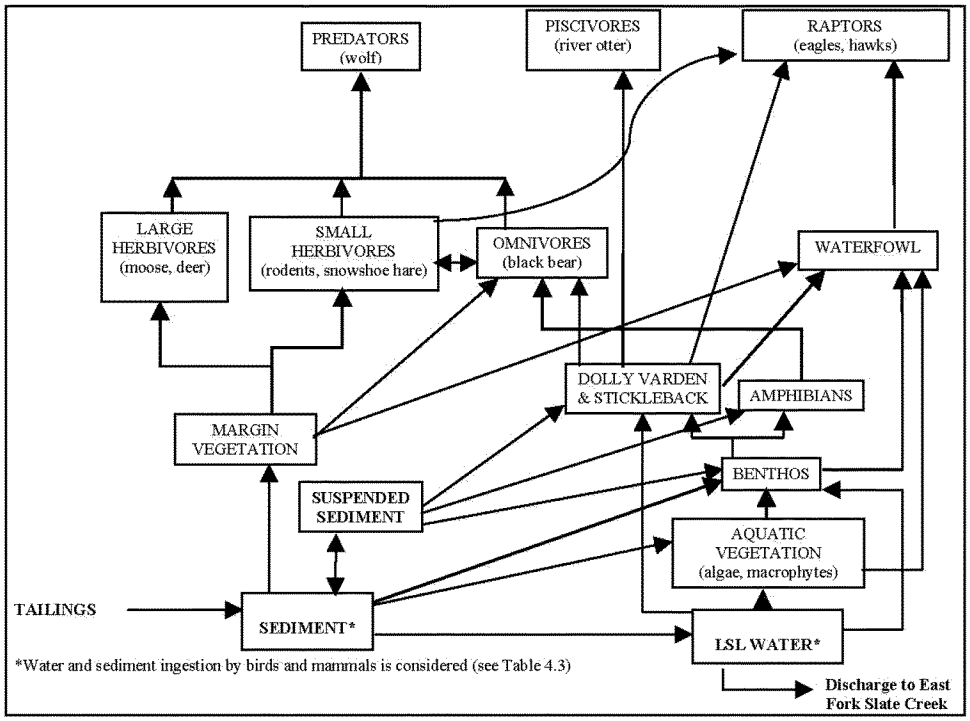

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G2%F/8332/3/ 8□: 4/&V2□,0□/ 7/3%$$+; 230□%□&□3&%8%□/$+;V: %&32/332%$%+□,%□7/3%$F□$ 0□7 &□3$%: E□%$□□□□: %7/3%$E%□0□□%qE%3%$7/3%$/&0 : /)%,%□/-/+;/Y,%0□7 &□3$%: □Q : +&%: /V/44,VF□$$+; 23□3□/ 7/3%$-□,E: %32/3+&8,E0%□Y32 3V4%□FE□%□3□; %32%$—□□: %32/3 0%8$%□%32%F,□7 /-/+;/Y,%0□7 &□3$%: S/&0 □□: %32/30□&□3□

□□+3+□&□33□4□□+Y,%3□0%3%$: +&%2□7 : E82 7/3%$7 +□, Y%/-/+;/Y,%0□7 &□3$%: F$□: □&,V32% 3□3/,&E: Y%$+&32%7/3%$$+; 23□/44,+8/3+□&S/&0 +3+□0+FF8E,33□4$%0+83+: 4/83□7 +32□E3)&□7 +&; 2□7 : E82 7/3%$7□E,0 Y%/-/+;/Y,%F□$0□7 &□3$%: E□%□J/8%0 7 +32 32+□,/8) □F+&F□$: /3+□&S 32%8□&□%$-/&8V□/&/,V□3□□□*E*□□32/3□,, 32%7/3%$+&32%/44,+8/3+□&7□E,0 Y%F□$%%$ □%qE%3%$%0 F$□: 32%%&+$□& %83/&0 □□&□3/-/+;/Y,%F□$0□7 &□3$%: E□%□[b7]

[bM] Q83E/,,VS32%$%7 %$%&&%/44,+8/3+□&□G2$%%+&3+/,/44,+8/3+□&S□&%F□$%82 0$/+&/; %$32/3+&8,E0%0/,,□E$F/8% /&0 ; $□E&07/3%$7 +32+&32%/$%□F32%: +&%/&0 3/+;+&; □F/8+;3+%S/ □%8□&0 □%□F32$%32/34$□-+0%0□□: % /00+3+□&/,+&F□$: /3+□&$%qE%3%0 YV32%□3/3%$/&0 32%&/ F+&/,□%□F32$%%/44,+8/3+□&32/3+0%83+F+%0 □&V32% ; $□E&07/3%$8□: 4□&%83+&8,E0%0 +&32%4$%+□E□/44,+8/3+□&□

[b7] N&F/+$&%□S32%ABBM7/3%$$+; 23/44,+8/3+□&□0□□/V32/3"Q332+□3+: %&□$%3E$&F,□7 □$0+82/$,%□F7/3%$+□ /&3+4/3%0 0E$+&; 8□&□3$E83+□&□$□4%$/3+□&□" BE332/3□%83%8%+□□: %7 2/3Y/,/&8%0 YV/□+: +;/$□%83%8%$&□3+&; 32/332%8□: 4/&V7/□8□&□+0%$+&; "□43+□&□F□$8□: 4%&□/3+&; F□$32%7/3%$/44$□4$+/3%0" H□&%□E82□43+□&: +;23 Y%$F□$%L/: 4,%$4E3+&; 7/3%$Y/8) +&3□32%□3%: I□J+&/,,VS32%/44,+8/3+□&□: /)%8,%$32/3&□3/,,□F32%32$%% □E$8%□7□E,0 Y%E□%0/332%/□: %3+: %$□: %2+&; &□3$%F%$%8%0 +&32%8□&□%$-/&8V□/□%□: %&3□G2% 8□&□%$-/&8V/&/,V□3□8□E,0 2/-%8□&3/83%0 D%YY,%□3/HF3□F+&0 □E3: □$%/Y□E37 2/332%ABBM/44,+8/3+□&□: %&SYE3 32%V0+0&3H&0 +3+□E&)&□7 &7 2%2%$D%YY,%□3/HF7□E,0 2/-%8□□4%$/3%0S+F32%V2/01□

G2%/ E32 □$ 8□: 4,%3?0 32$%%3/ □) □3□0%3?$: +&?%7 2%32%$ 32/ 3/ □E: 43+□&7 / □$% □□&/ Y,%5

CI (□&3/ 83?0 □3/ HF/ 3 32%D?YY,%4$□j%83 3□/ □) 7 2%32%$ / ,, 32%7 / 3?$ +&32%ABBM/ 44,+8/ 3+□&□ 7 □E,0 Y%7 +320$/ 7 &F$□: 0□7 &□3$%: E□%□

AI >%+?7 %0 32%ABBM/ 44,+8/ 3+□&□3□0%3?$: +&?%+F 32%V / $%8□&□+3?&3 7 +32 32%/ □E: 43+□& 32/ 3/ ,, 32%7 / 3?$ 7 □E,0 Y%□%qE%3?$?0 □

bI (□: 4/ $?0 32%7 / 3?$ - □,E: %+&P □$32%&&? V&/ □3V' □ABBM/ 44,+8/ 3+□&7 +32 7 / 3?$ E□%/ 3 32%J □$3 K&□L / &0 >%0 ? □; : +&?%□

□□□*3'* □*3* □*32 D*□□□□□*3' HF*□ □ 2%&8□&3/ 83?0 YV 32%/ E32 □$SD?YY,%□8+?&3+□3□+&0+8/ 3?0 32/ 3 / 44$□L+: / 3?,V □&?%2/ ,F3□ □&?%32+$0 □F 32%3□3/ , / : □E&3□+&32%ABBM/ 44,+8/ 3+□&7 □E,0 ,+) %,V Y% E&/ - / +,/ Y,%F□$ 0□7 &□3$%: E□%□[b]

□*/ 3*□□*T* □□□□*32* □□*44* □□*/ 3*□□□□N&/ : +&?$32%: / j□$ 7 / 3?$ E□%□32/ 3 □%qE%3?$ 7 / 3?$ F$□: 0□7 &□3$%: E□%□/ $?%% / 4□$/ 3+□&S7 / 3?$ $?3/ +&?0 +&3/ +,+&; □67 / □3?$□8) S/ &0 7 / 3?$ $?3/ +&?0 +& 8□&8?%&3$/ 3?%□ +32 : +&□$ %L8?%43+□&□S/ ,, □32%$ 7 / 3?$ E□%□$?8V8,%7 / 3?$—32/ 3+□$□: %7 / 3?$ +□ $?%qE+$?0 / 3 □3/ $3-E4SYE3 32%&32%7 / 3?$ +□E□%0 / ; / +&/ &0 / ; / +&7 +32 □E3 $?%qE+$+&; : □$?%□32%$ 7 / 3?$ +□"E□%0 E4" 0E$+&; 32%4$□8%□/ &0 $?%qE+$?%□$?4,/ 8% %&3□□F □E82 E□%S32%7 / 3?$ $?3/ +&?0 +&32%3/ +,+&; □- □+0 □+□YVF/ $ 32%,/ $; %3E□%□

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Q3: +&?%□7 +32 3/ +,+&; □4□&0□S7 / 3?$ □&32%□E$F/ 8%□F 32%4□&0 +□$?8V8,%0 F□$ E□%+&32%: +,□ ? E$+&; : +,,+&; S3/ +,+&; □/ $?%0+82/ $; %0 +&3□32%3/ +,+&; □4□&0□Q□32%3/ +,+&; □□%3,%□E3S□□: % 7 / 3?$ $% / +&□□&32%□E$F/ 8%S/ &0 □□: %7 / 3?$ +□4%$: / &?&3,V □%qE%3?$%0 +&32%3/ +,+&; □- □+0□□ G2%7 / 3?$ 32/ 3 $?% / +&□□&32%□E$F/ 8%+□3/) %&Y/ 8) +&3□32%: +,,S/ &0 32%4$□8%□$?4%3□G2% - □,E: %□F 7 / 3?$ +&32%3/ +,+&; □4□&0 : / V+&8$?% □%: / $; +&/ ,,V/ □32%4□&0 ; $□7 □3□8□- %$/ ,/ $; %$ 3/ +,+&; □/ $% H$+□3: / V&□3S0%4%&0+&; □&32%; %□ %3$V □F 32%3/ +,+&; □/ &0 □32%$ F/ 83□$□I□ _ □7 %?$S+□3+□32%, □□□F 7 / 3?$ +&32%3/ +,+&; □- □+0 32/ 3 $?%qE+$?%□/ 00+&; F$%2 : /) %E4 7 / 3?$ F$□: □E3□+0%32%: +&?%□

G2%ABBM/ 44,+8/ 3+□&+&8,E0%□/ ,/ $; %- □,E: %F□$ E□%+&32%3/ +,+&; □4□&0 +□%,F□G2%/ 44,+8/ 3+□&□ F□$?8/ □3bbS7BB / 8$%F?%36V%$ F□$ 3/ +,+&; □□+3%QS/ &0 A□SBBB / 8$%F?%36V%$ F□$ 3/ +,+&; □□+3%# □[b9] G2%0+/ ; $/ : □+&32%/ 44,+8/ 3+□&+&0+8/ 3?32%E,3+: / 3?%□E$F/ 8%/ $% □F 32%7 / 3?$ +&32%3/ +,+&; □,/) % / 3 □+3%Q 7 □E,0 Y%/ 44$□L+: / 3?,VbSBBB / 8$%□Q3 32/ 3/ 8$%; %$+FbbS7BB / 8$%F?%3 □F 7 / 3?$ 7 %$% / 00%0 3□32%4□&0 %82 V%$S/ F3?$ AB V%$□32%7 / 3?$ +&32%3/ +,+&; □4□&0 7 □E,0 Y%AA□F?%3

[b] K%&G/ V,□$ / &0 1 +) %□: +32SD. DS4%$□□&/ , 8□: : E&+8/ 3+□&S- / $+□E□0/ 3%□G2+□%3+: / 3?0 □%□&□3+&8,E0%7 / 3?$ F□$ 4□7 %$; %&?$/ 3+□&/ 3 32%□3?$7 2+82 : / V□$: / V&□3 Y%4$□4□%0 / &0 7 / □&□3+&8,E0%0 +&32%ABBM/ 44,+8/ 3+□&□ G2+□4□3?&3+/ , F□$ □&+3?4□7 %$; %&?$/ 3+□&□&,V+&8$?% □%□32%E&8%3/ +&3V / Y□E3 7 / 3?$ E□%□

[b9] G2%%&E: Y%$□/ $%3/) %&F$□: G/ Y,%AS□/ 3?$ +&32%G□J □E4%&&/ 3/ &3 4□&0S+&32%+6AC6BM□E$F/ 8%□ / 3?$ (□: 4,%3?&%□Q44,+8/ 3+□&□N3/ □E: %F$□: 32%/ 44,+8/ 3+□&□32/ 3 32%G/ ,/ $+) ($?%) / &0 □□E32 J □$) 7 / 3?$ +□E□%0 F□$ G/ +,+&; □□+3%QS/ &0 32/ 3 G/ ,/ $+) ($?%) / &0 P □$32 J □$) 7 / 3?$ +□E□%0 F□$ G/ +,+&; □□+3%# □

0%%4 [illegible] G2+ / &E&$%, +3+8 $%E,3OAB P%%30%%4 7 E,0 Y%: $%3V4+8/ , R- %&/ 88 E&3+&; F $ %/ 4 $/ 3+ & F C A P%%36V%$S[illegible] $ F $ 7 / 3%$, 37 +32 32%8 &8%%&3$/ 3%%L4 $3S32%0%%432 F AA P%%3 + E&8%, +3+8 G2%8/ , 8E, / 3+ &F $ +3%# 4$ 0E8%/ : +, / $ 0%%432 — AbB P%%3

G2%%/ E32 $" %3+: / 3%— 7 / 3%$: $%32/ &CB 3+: % 0%%4%$ 32/ &E E/ , +&/ 3/ +, +&; 4 &0 —: %& 32/ 3 32%: +&%7 E,0 Y%- %$VE&; +) %V3 %qE%3%$ 32%3 3/ , / : E&3 F 7 / 3%$ $%qE%3%0 +&32%ABBM / 44, +8/ 3+ & 3 +/ , & 3, +) %V32/ 3S/ 32%/ %: %&3/ E: %0S/ ,, 32/ 37 / 3%$ 7 E,0 Y% E&/ - / +, / Y,%F $ 0 7 &3$%: E%

: 4/ 32 3K L / ? 1 / 3%$ E%+&/ : +&%+S+&4/ $3S4$ 4 $3+ &/ , 3 32%- ,E: % F 3/ +, +&; Q &E: Y%$ F 32%$ F/ 83 $ / , / HP%83/ : +&% 7 / 3%$ E%J $ 32/ 3 $% &S+3 & 34 +Y,%3 0+$%83,V 8/ ,8E, / 3% &%: +&% 7 / 3%$ &%%0 YV 8: 4/ $+&; +3 7 +32 E%/ 3 32%$: +&% BE3 8: 4/ $+&; 32%7 / 3%$ E%4%$ 3 & F $%+: 4, +%0 +&32%ABBMP $32%&&? V&/ 3V / 44, +8/ 3+ & 7 +32 E%/ 3 32%37 32%$ 4%&-4+3: +&% +&Q,/) / : / V Y%/ 4/ $3+/ , 82%8) & $%+/ Y+, +3V F 32%- ,E: % 8+3%0 +&32%/ 44, +8/ 3+ & 2%&G2%P / 3E$%(&%$- / &8V / &/ , V 3 / E: %0 32/ 3/ ,, 32%7 / 3%$ +&32%/ 44, +8/ 3+ & 7 E,0 Y%E %0S32%V+: 4, +8+3, V/ E: %0 32/ 3 32% 4$ j%83 7 E,0 E%Y%37 %%&CM / &0 ACB; / ,, &63 & F $%[illegible] G2%J $3K&L D$ j%83 7 / 3%$ >% E$8%1 / &/ ; % %83D, / &HC99UI +&0+8/ 3%0 32/ 3J $3K&L 7 E,0 E%9B 3 CCB; / ,, &63 &S 0%%4%&0+&; &32%4$ 8% +&; 8%&/ $+[illegible] G2%>%0 ? ; 1 +&% / 83E/ , E%F$: C999-ABBU 7 / CBC; / ,, &63 &[illegible] 1 +&% / $%/ ,, 0+HP%$%83S/ &0 32%$%+ & 3/ &0/ $0 F $ 7 / 3%$ E%63 &S YE3 32% 0+HP%$%&8%Y%37 %%&32%8 &%$- / &8V / E: 43+ & / Y E3 7 / 3%$ E%/ 3 32%D%YY,%+3%S/ &0 E%/ 3 32%37 4%&-4+3: +&% 4%$/ 3+&; +&Q,/) / S; + %8 &F+0%&8%3 32%8 &8,E + &32/ 3 & 3/ ,, F 32% 7 / 3%$ +&32%ABBM/ 44, +8/ 3+ & 7 E,0 Y%E&/ - / +, / Y,%F $ 0 7 &3$%: E%

T 3/ 3 G2%32$%%: %32 0 F 82%8) +&; 0%8$+Y%0 / Y - % 2 7 32/ 3/ E: +&; H 32% 8 &%$- / &8V / %: %83 0 %I & &%% F 32%7 / 3%$ $%qE%3%0 +&32%ABBM/ 44, +8/ 3+ & 7 E,0 Y% $%3E$&%0 3 32%3$%: +, +) %V 7 $ &; G2%$%+ 8 & +0%$/ Y,%qE%3+ &/ 3 2 7 : E82 F 32% 7 / 3%$ +&32%ABBM/ 44, +8/ 3+ &7 E,0 Y%/ - / +, / Y,%F $ 0 7 &3$%: E%S/ &0 %%&: $% E&8%$3/ +&3V / Y E3 7 2%32%$ 32/ 3/ 44, +8/ 3+ &7 +, Y%$%4$%%83/ 3+ % F 32%F+&/ , : +&%/ 44, +8/ 3+ &

[LB] G2%/ 44, +8/ 3+ & 0 & 3 +&8, E0%%& E; 2 0%3 +, %%&3 8/ , 8E, / 3%32+ &E: Y%$ 7 +32 / &V 8 &F+0%&8% G2%/ 44, +8/ 3+ & +&0+8/ 3%32/ 3 +3%# 7 E,0 Y%0%+; &%0 3 +&8, E0%A Y+, , + & 3 & F 3/ +, +&; H / 8+, +3%? %8$+43+ & + & E44 $3 F/ / 3%$ > +; 23 Q44, +8/ 3+ &S E32 J $) K) 3E, +> + %$/ 44, +8/ 3+ &76ABBM$4/ ; %bI J 3& 3%b E&0%$ G/ Y,%A F 32% 96ACBM(: 4,%3%&% > %4 & %+&0+8/ 3%/ 0%4 3+ & $/ 3% F 9B: +, + & 3 & 4%$ V%$S; + + &; / 0%4 3+ &, +P%F $ 32% 3%F AA V%$ G2E SbbS7BB / 8$%P%%36V$ 3+: % AB V%$ 0+ +0%0 YV bSBBB / 8$%; + % / 44$ L+: / 3%V AA 0%%432 3 32%3/ +, +&; , /) %G2%/ : %8+3/ 3+ &/ &0 8/ , 8E, / 3+ & H & VF $ 32%P $32 J $) K) 3E, +/ 44, +8/ 3+ &I F $ +3%Q ; + % / &/ 44$ L+: / 3%AbB-F 30%%432

[UC] _ V0$: %3%$, ; V > %4 $3 JE&%C9SABBM$4/ ; %U EY: +3%0 7 +32 32%ABBMP $32%&&? V&/ 3V E$F/ 8% / 3%$ >+; 23 / 44, +8/ 3+ & G2%$%4 $3 +&0+8/ 3% CU +&82% F, /) %% / 4 $/ 3+ &/ &&E/ ,, V/ 3 32%+3%

[UA] (/ , 8E, / 3+ & + / F , , 7 J $ +3%Q59B: +, + & 3 & 6V%$ ÷ HG 3/ , F E32 J $) K) 3E, ++ T 44%$ G/ , / $+) ($%%) 7 / 3%$ E%[C + A9 8F [ ] B 8F] I QF3%$ $%qE+$%0 E&3 / 0jE3: %83 S7 / 3%$ E%8: %3 ACB; / ,, &63 & J $ +3%# 5 +: +, / $ 8/ , 8E, / 3+ & %L8%43 E+& 3 3/ , FP $32 J $) K) 3E, ++ T 44%$ G/ , / $+) ($%%) HbU+ A9 8F [Mb 8F I QF3%$ $%qE+$%0 E&3 / 0jE3: %83 S7 / 3%$ E%%qE/ , CM ; / ,, &63 &

[Ub] J $3K&L D$ j%83 / 3%$ > % E$8%1 / &/ ; % %83D, / &S4$%4/ $%0 YV J / +SY/ &) # , 0 1 +&+& SN88 S1 / $82 C99US J +; E$%b-C / &0 b-A G7 8%&/ $+ +& , - %bMBBBB G60/ V G2%F$ 3 $%qE+$% A7 B; / ,, &4%$: +&E3%+&: /) %E4 7 / 3%$ OB2%%8 &0SAAU ; / ,, &4%$: +&E3% +32 / 44$ 4$+/ 3%E&3 82/ &; % 32%%- ,E: %%qE/ , 9B / &0 CCB ; / ,, &63 &

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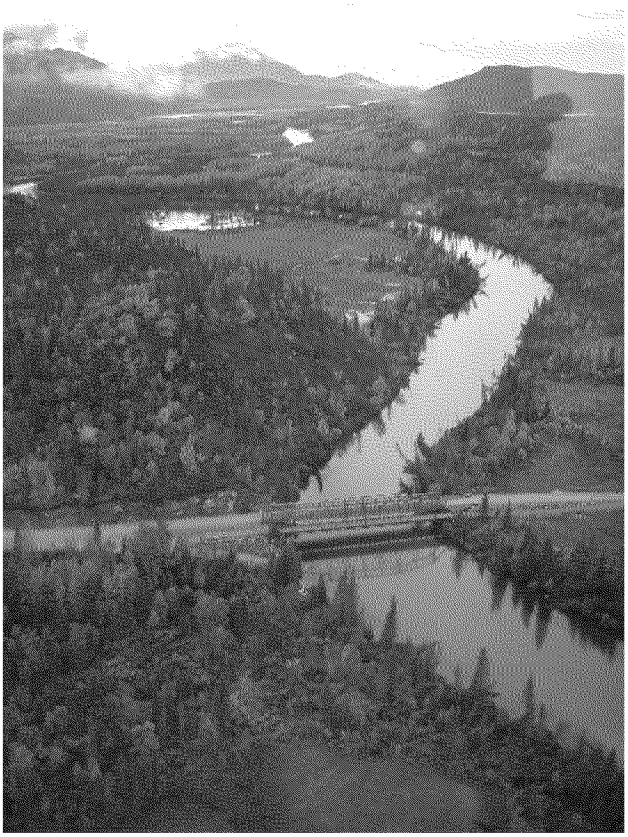

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- *RN*

R ***?*** ***E: 43***

Q,

Red Dog Mine 2003 Average Grade		
	Lead	Zinc
Ore	5.6%	20.7%
Waste	1.2%	1.2%
Tailings	1.7%	3.8%
Lead Concentrate	54.5%	13.0%
Zinc Concentrate	3.2%	55.5%

[9] G2%

[MB] E:

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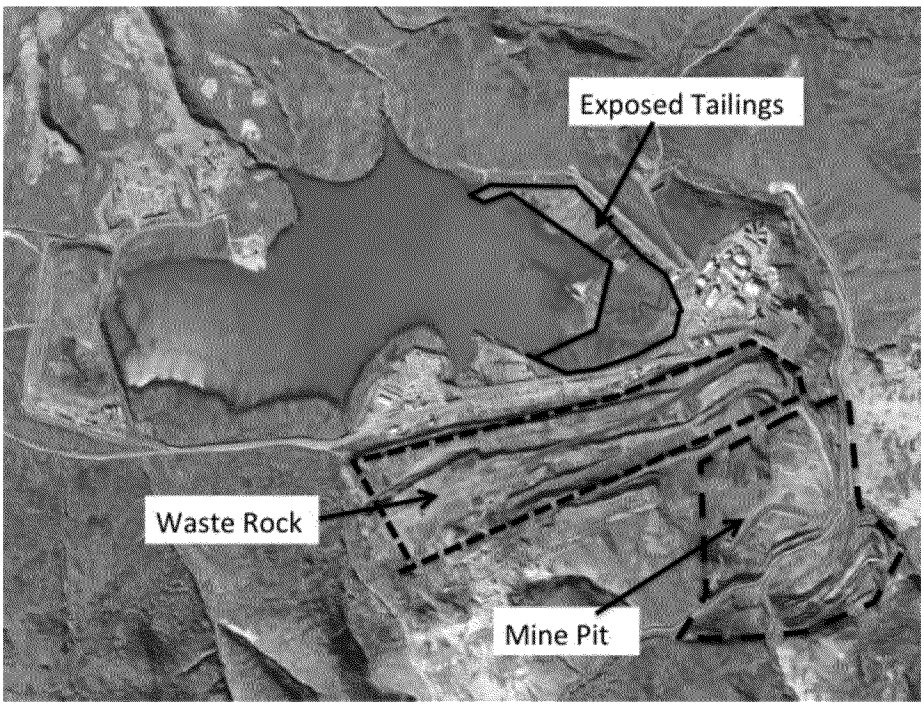

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