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Via FedEx

September 4, 2009

Rebecca Harvey, Chief
Water Division
Underground Injection Control Branch
United States Environmental Protection Agency
77 West Jackson Boulevard
Mail Code: WN-16J
Chicago, IL 60604-3590

Re: Kennecott Eagle Minerals Company ("KEMC");
Marquette, Michigan;
Underground Injection Wells

Dear Ms. Harvey,

This letter is submitted on behalf of the Keweenaw Bay Indian Community (the "Community"). Enclosed is a memorandum, dated September 4, 2008, prepared by Stratus Consulting, Inc. (the "Stratus Memorandum") on behalf of the Community, addressing a number of the incorrect assertions made by KEMC in its April 28, 2009 letter to you, which responded to your March 13, 2009 letter requesting that KEMC provide to the United States Environmental Protection Agency ("EPA") a Class V underground injection control ("UIC") well inventory form for KEMC's backfilling operations and other information regarding KEMC's use of water in its proposed mine. Briefly, the Stratus Memorandum concludes that EPA should require KEMC to obtain a UIC permit for backfilling and operation of KEMC's proposed underground mine for the following reasons:

- The bedrock aquifer is an "underground source of drinking water" ("USDW") as defined by the UIC regulations promulgated by EPA under the Safe Drinking Water Act ("SDWA"), 42 USC § 300f *et seq*.

- KEMC's activities will result in the injection of water that exceeds health-based drinking water standards and will emplace materials that will generate dissolved contaminants in excess of health-based drinking water standards in violation of the UIC regulations.

- KEMC's monitoring and contingency systems are inadequate to protect the bedrock USDW.

- The examples cited by KEMC of mines that do not have UIC permits for backfilling and underground utility water use are inapposite. All but one

> of the 12 mines listed by KEMC are regulated under state UIC programs. Eight of the mines are in Nevada, a significantly more arid region than Michigan. EPA Region 5 is not obligated to follow the lead of western state UIC programs. The decision by state UIC programs to allow backfilling to proceed under state UIC program permit-by-rule authority does not reflect a national policy. A decision by EPA Region 5 to require KEMC to obtain a UIC permit for backfilling activities and utility water injection prior to construction of the mine would not establish a precedent contrary to national policy, as explained below, and is clearly authorized by and consistent with the UIC regulations.[1] In fact, Stratus's review of the mines listed by KEMC revealed that KEMC's proposal to dewater using sumps within the mine deviates from standard practice at most hardrock mines requiring dewatering. The standard practice is to dewater from outside the mine in order to avoid contamination of groundwater through contact with the mine workings. The dewatering water generated by KEMC will be substantially more contaminated because it will have been in direct contact with the mine workings.

In addition to the issues addressed by the Stratus Memorandum, as explained below, KEMC's April 28th letter incorrectly argues that the mine itself is not a "well"[2] and that the backfill material is not a regulated "fluid" under the UIC program.

I. KEMC's Proposed Underground Mine Shafts And Workings Are A "Well" Regulated Under The UIC Program.

In arguing that the mine shafts and workings are not regulated under the UIC program, KEMC cites the very same EPA document that the Community cited in our May 1, 2008 letter and in which EPA clearly states that a mine shaft is a backfill well in at least three places. Two of those statements were discussed in our May 1, 2008 letter (at pp. 7 – 8), as follows:

> Moreover, EPA's pronouncements on this subject make it clear that the mine shaft itself meets the definition of a "well" under the UIC regulations. Volume 10, Mining, Sand, or Other Backfill Wells, of The Class V Underground Injection

[1] As you know, EPA Region 5 has required KEMC to obtain an individual permit, in lieu of the permit-by-rule authorization under the UIC regulations, for another Class V well to be installed in connection with the KEMC's proposed mine, the treated water infiltration system ("TWIS"). The mine backfill well and utility water injections pose a threat to USDWs that is at least as great as that posed by the TWIS.

[2] The UIC regulations define "well" as follows: "A bored, drilled, or driven shaft whose depth is greater than the largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or, a subsurface fluid distribution system." 40 CFR § 144.3.

Control Study (the "Class V UIC Study") (EPA/816-R-99-014, Sept. 1999), states:

> Piping systems within mine shafts and workings, as well as more "conventional" drilled wells, used to place slurries/solids in underground mines are considered mine backfill wells under the USEPA's UIC regulations. ***Similarly, mine shafts are considered backfill wells if backfill is injected into the shaft.***

Id. at p 2 (emphasis added).

The Class V UIC Study additionally states the following regarding backfill well characteristics:

> Mine backfill materials are typically injected into underground mines through one or more drilled wells or through a pipeline installed in the mine shaft and appropriate portions of the underground workings. ***In some situations, injection may be directly into a mineshaft without a pipeline for distributing the injected material within the mine workings.***

Id. at p 24 (emphasis added).

The third statement, which is the portion of the Class V UIC Study apparently relied on by KEMC (but not quoted in its letter) actually states that: "***Mine shafts*** and pipelines in an underground mine, as well as more 'conventional' drilled wells, used to place slurries ***and solids*** in underground mines are considered mine backfill." Class V UIC Study at 1 (emphasis added).[3]

Moreover, the Class V UIC Study makes clear that mine backfill injection may occur through a number of mechanisms, most of which do not necessarily involve moving backfill through a pipe or similar conveyance: "***Injection*** of backfill into underground mines may be accomplished using hand, ***gravity***, ***mechanical***, pneumatic, and hydraulic placement methods." Class V UIC Study at 26 (emphasis added). KEMC's own description of its backfill injection methods admits that KEMC will utilize two of the placement methods described by EPA in the Class V UIC Study, as follows: (i) the dropping of backfill materials through boreholes (structures meeting the definition of "well" in 40 CFR § 144.3) into the mine, obviously utilizes **gravity**; and (ii) the placement of backfill utilizing underground dump trucks and bulldozers, obviously is a utilization of **mechanical emplacement**.

[3] KEMC cites to this page of the Class V UIC Study on p. 6 of its April 28th letter in the discussion under the heading of "1999 EPA Study."

Thus, contrary to KEMC's arguments at pp. 6 – 7 of its April 28th letter, the Class V UIC Study **did not** articulate a "distinction between the underground mine itself and regulated wells used to inject fluid mixtures into the mines."

As the above analysis demonstrates, and as explained in our June 9, 2006, December 10, 2007 and May 1, 2008 letters, the Class V UIC Study and EPA's regulations clearly provide that a mine shaft itself is appropriately characterized as a "well" under the UIC regulations.

KEMC's April 28th letter (at n. 1) cites an unpublished Environmental Appeals Board ("EAB") order, *In Re Core Energy, LLC*, UIC Appeal 07-02, 2007 WL 4472274 (Dec. 19, 2007), for the proposition that "the UIC program and permitting process is 'narrow in focus'" in support of its argument that a mine can not be a "well" under the UIC program. The *Core Energy* case did not address mine backfill injection in any way. Moreover, it should be noted that the petitioner in *Core Energy* sought review of an **issued** UIC permit for carbon dioxide injection on the following two issues: (i) "who might be liable for any damages that might result from operation of the injection well"; and (ii) as characterized by the EAB, "although not entirely clear from the Petition, it appears Petitioners are arguing that the permit violated property rights of adjacent landowners under whose land the injection will occur ...." Slip Op. at 2. Whether or not the injection was regulated under the UIC program **was not at issue** in the *Core Energy* petition – the injection was clearly regulated because a permit had been issued for the injection in that case. KEMC uses the decision in *Core Energy* in an attempt to argue in its April 28th letter that its proposed mine backfill injection is not regulated at all under the UIC program, which is clearly not the holding in *Core Energy*.

Mine backfill wells are indisputably regulated under the UIC program and EPA, by requiring KEMC to complete an inventory form therefor and to apply for an individual permit, is clearly acting within the scope of the UIC program. Moreover, as discussed below, the legislative history of the SDWA's UIC provisions makes it abundantly clear that Congress intended that the UIC provisions be broadly construed in order to protect USDWs.

II. KEMC's Proposed Backfilling Activities Are An Injection Regulated Under The UIC Regulations.

As described in KEMC's Mine Permit Application to the Michigan Department of Environmental Quality ("MPA") and the Stratus Memorandum, KEMC's backfill material will consist of a slurry of cement and fly ash, mixed with so-called "utility water" that exceeds numerous SDWA health-based drinking water criteria, and development rock and aggregate. The cement/fly ash mixture and the development rock/aggregate will be discharged through boreholes that meet the definition of "well" under the UIC regulations (see footnote 2, above). As discussed in our May 1, 2008 letter (at pp. 6 – 7), the materials will be combined to produce the backfill **slurry,** as follows:

> The MPA states that the cement/fly ash mixture to be used in the backfill "will be discharged to an underground binder bin via a cased 250 mm (~10 in) diameter borehole, feeding a colloidal mixer." MPA § 4.6. The MPA also states that a "2.4 m (~8 ft) diameter raise" will be used to feed aggregate for the backfill to the underground backfill plant. *Id.* The cement/fly ash components of the backfill will be mixed with the utility water in a "colloidal slurry mixer" to form cement which will be combined with the rock used in the backfill. *Id.*

KEMC argues that the backfill materials, including cement and aggregate, are not regulated under the UIC program because: (i) the backfill "does not qualify as a 'fluid'"; and (ii) these individual components of the backfill material are not "a *mixture* of water and sand, mill tailings or other solids [injected] into the mined out portions of subsurface mines." KEMC April 28th letter at 8, quoting 40 CFR §§ 144.3 and 144.81 (emphasis in original). As discussed below, KEMC's position is indisputably incorrect.

A. The Backfill Materials Are A "Fluid" Under The UIC Regulations.

Although KEMC quotes the definition of "fluid" under the UIC regulations in footnote 2 of its April 28th letter, KEMC ignores the fact that dry materials expressly fall within the definition of "fluid" under the UIC regulations: "*Fluid* means any material or substance which flows or moves whether in a ***semisolid***, liquid, sludge, gas ***or any other form or state***." 40 CFR § 144.3 (emphasis added). This definition is taken nearly verbatim from the legislative history of the SDWA.[4] The legislative history of the SDWA makes clear that a liquid (i.e., water as argued by KEMC) need not be present in a "fluid" regulated under the UIC program:

> Finally, section 1421 contains two important definitions. ***The definition of "underground injection" is intended to be broad enough to cover any contaminant which may be put below ground level and which flows or moves, whether the contaminant is in semi-solid, liquid, sludge, or any other form or state.***
>
> . . .
>
> The section also defines "underground injection which endangers drinking water sources." ***It is the Committee's intent that the definition be liberally construed so as to effectuate the preventative and public health protection purposes of the bill.***

[4] *See* 41 Fed. Reg. 36730, 36731 – 32 (Aug. 31, 1976) (quoting SDWA legislative history in explaining definition of "well injection," which uses the term "fluid").

> The Committee seeks to protect not only currently-used sources of drinking water, but also potential drinking water sources for the future. ***This may include water sources which presently exceed minimum intake water quality requirements or maximum contaminant levels or which are not presently accessible for use as a community drinking water supply source.***
>
> Thus, for example, the Committee expects the Administrator's regulations at least to require States to provide protection for subsurface waters having less than 10,000 p.p.m. dissolved solids, as is currently done in Illinois and Texas, even though water containing as much as 9,000 p.p.m. would probably require treatment prior to human consumption.
>
> ***Further contamination of such sources should not be permitted*** if there is any reasonable likelihood that these sources will be needed in the future to meet the public demand for drinking water and if these sources may be used for such purpose in the future.
>
> ***The Committee was concerned that its definition of "endangering drinking water sources" also be construed liberally. Injection which causes or increases contamination of such sources may fall within this definition even if the amount of contaminant which may enter the water source would not by itself cause the maximum allowable levels to be exceeded.*** The definition would be met if injected material were not completely contained within the well, if it may enter either a present or potential drinking water source, and if it (or some form into which it might be converted) may pose a threat to human health or render the water source unfit for human consumption. ***In this connection, it is important to note that actual contamination of drinking water is not a prerequisite either for the establishment of regulations or permit requirements or for the enforcement thereof.***

H.R. Rep. No. 93-1185, 93d Cong., 2d Sess., *reprinted* in A Legislative History of the Safe Drinking Water Act, Ser. No. 97-9, 563 – 564 (Feb. 1982) (emphasis added).

There can be no dispute that solids and semi-solids in granular or particulate form are appropriately characterized as fluids for purposes of the UIC regulations because these materials are capable of flowing, a behavior referred to as "granular flow."[5] As discussed above, the Class V UIC Study stated that the placement of "***slurries and solids*** in underground mines are considered mine backfill" injections. Class V UIC Study at 1 (emphasis added). KEMC can not seriously argue that the slurry of contaminated utility water, cement, fly ash and rock it proposes to use as backfill, even if one could plausibly argue the backfill is not a "semisolid," does not fall under the "any other form or state" criterion in both the regulation and legislative history.

B. The Injection Of Backfill Materials Containing Little Or No Water Is A UIC-Regulated Injection.

As noted above, KEMC attempts to focus the reader's attention on the description of mine backfill wells in 40 CFR § 144.81(8) in support of its argument that its backfilling activities will not fall within the scope of backfilling activities covered by the UIC regulations because KEMC's backfill material will contain only an allegedly small amount water used for the cement component of the backfill material.[6] It is clear, however, that the description in 40 CFR § 144.81(8) is not an exclusive listing of the only backfill injection activities that constitute a regulated Class V UIC mine backfill well. 40 CFR § 144.81, entitled "Does this subpart apply to me?," states in its introductory sentence: "This subpart applies to you if you own or operate a Class V well, ***for example***: ...." (Emphasis added.) Mine backfill wells are included among the 16 examples of Class V wells listed in 44 CFR § 144.81. Given that Class V wells are, by definition, "[i]njection wells not included in Class I, II, III or IV," (40 CFR § 144.80(e)).[7] EPA has described the listing in 40 CFR § 144.81(8) as "a non-inclusive list of 16 types of Class V wells ...." 60 Fed. Reg. 44653 (August 28, 1995); *see also* 63 Fed. Reg. 40596 (July 29, 1998). Thus, KEMC improperly emphasizes language that is intended to serve as only a generally descriptive and clearly non-exclusive example of mine backfilling to argue that water must be included as part of the mixture of backfill material in order for the backfill to be a regulated injection. As observed by EPA in the Class V UIC Study (at p. 3): "Backfill injection is very diverse."

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[5] Internet searches reveal that granular flow is an area of extensive scientific research. For example, the web page of the California Institute of Technology, Granular Flows Group (http://www.its.caltech.edu/~granflow/homepage.html) describes research in the areas of both "dry granular flows" and "liquid-solid flows."

[6] The general description in 40 CFR § 144.81(8) of mine backfill wells that KEMC focuses on in its April 28th letter states: "Sand backfill and other backfill wells used to inject a mixture of water and sand, mill tailings or other solids into mined out portions of subsurface mines whether what is injected is a radioactive waste or not."

[7] This section also provides: "***Examples*** of Class V wells ***are described*** in § 144.81." 40 CFR § 144.80(e) (emphasis added).

It is clear from both the UIC rules and the preambles for the rules that water is not an essential ingredient in a Class V mine backfill injection.[8] Moreover, KEMC nevertheless acknowledges on pages 2 and 3 of its April 28th letter that when it is formulating the backfill material it will incorporate eight gallons of contaminated utility water per minute into the mixture of water, cement, fly ash and rock comprising the backfill material. It is difficult to comprehend how KEMC can reasonably claim that the resulting slurry is not the type of mixture described in 40 CFR § 144.81(8).

C. The Courts Have Held That The Emplacement Of Solid Materials Are An Underground Injection Under The SDWA's UIC Provisions.

In *Natural Resources Defense Council, Inc. v. U.S. Environmental Protection Agency*, 824 F.2d 1258 (1st Cir. 1987) ("*NRDC*"), the petitioners challenged EPA's failure to consider the interrelationship of EPA's rules for the long-term disposal of high level radioactive waste with the SDWA's UIC provisions. In *NRDC*, the First Circuit analyzed the meaning of "underground injection" and the legislative history of the UIC provisions of the SDWA setting forth Congress' intent that the term "underground injection" be liberally construed:

> While Congress may have been especially concerned with a different type of underground disposal when it passed Part C of the SDWA, this does not negate its overall intent to protect future supplies of drinking water against contamination. ***Unusable ground water is unusable ground water no matter whether the original source of the pollution arrived in a loose, free form manner, or in containers injected into the ground***. We find no language in the SDWA showing that Congress meant to regulate only certain forms of underground pollution, while overlooking other forms of contamination of ground water via underground injection. ***Indeed, the legislative history indicates that the phrase "underground injection which endangers drinking water sources" was to have the broadest applicability***:

[8] In the Class V UIC Study, EPA focused not on the potential for USDW contamination arising from the liquid content of backfill injectates, but from the solid component of backfill injectates. For example, the following discussion appears under the heading "Injectate Characteristics":

> A wide assortment of materials are used for backfilling of underground mines. These materials may include waste rock, mining and ore beneficiation wastes (e.g., mill tailings, coal cleaning wastes), coal combustion ash and flue gas desulfurization (FGD) sludge resulting from coal combustion, or sludge from AMD treatment operations. Mill tailings have been reported to be the most commonly used backfill materials, because they are inexpensive and abundant (Underground Injection Council Research Foundation, 1988).

Class V UIC Study at 3.

> ***It is the Committee's intent that the definition be liberally construed so as to effectuate the preventative and public health protective purposes of the bill.*** The Committee seeks to protect not only currently-used sources of drinking water, but also potential drinking water sources for the future....
>
> The Committee was concerned that its definition of "endangering drinking water sources" also be construed liberally. Injection which causes or increases contamination of such sources may fall within this definition even if the amount of contaminant which may enter the water source would not by itself cause the maximum allowable levels to be exceeded. The definition would be met if injected material were not completely contained in the well, and if it may enter either a present or potential drinking water source, and if it (or some form into which it might be converted) may pose a threat to human health or render the water source unfit for human consumption.

H.R. Rep. No. 1185, 93d Cong., 2d Sess., *reprinted in* 1974 U.S. Code Cong. & Admin. News at 6484.

824 F.2d at 1271 (emphasis added).

The First Circuit also reasoned that any contamination resulting from solid materials injected underground would be covered by the UIC regulations if that contamination will flow or move:

> According to the EPA, the waste to be stored underground will be converted, before storage underground, into a solid. ... This does not mean that the contemplated waste disposal system is not an underground injection, since the definition of fluids (following the directive in the legislative history, *see supra*) is very broad and includes waste "in any other form or state" if it flows or moves. 40 C.F.R. § 146.3. ***The dangerous component of this waste, i.e., the radiation, regardless of whatever "form or state" it is emitted from, will flow or move, thus having the capacity to do harm to drinking water sources*** far distant from the original site as more conventional injected fluids would do.

824 F.2d at 1270 (emphasis added, citation omitted).

The First Circuit thus held that underground repositories of containerized radioactive waste "would likely constitute an 'underground injection' under the SDWA." *Id.*

As made clear by the UIC rules, their preambles, Congressional intent manifested in the legislative history of the SDWA and judicial interpretation thereof, the UIC provisions are to be broadly interpreted to protect USDWs, including USDWs that would require treatment before they are capable of being utilized as a drinking water supply. KEMC argues that the bedrock aquifer is neither an aquifer nor a USDW on the basis of both the quantity and quality of water it contains, arguing that the bedrock aquifer does not even qualify as an aquifer. As explained in the Stratus Memorandum, however, the bedrock aquifer easily qualifies as a USDW protected under the UIC regulations on the basis of both the quantity and quality of water it is capable of producing.[9] In addition, the Stratus Memorandum concludes that contaminants from the backfill will not be completely contained within the mine and will flow into the USDW.

III. Conclusion.

KEMC's arguments in its April 28th letter that its backfilling operations are not regulated under the SDWA UIC program ignore the explicit language of the UIC regulations and their preambles, the Class V UIC Study, relevant judicial precedent and Congressional intent as expressed in the SDWA's legislative history and are simply incorrect. In fact, KEMC will mechanically inject backfill material (a slurry of contaminated utility water, cement, fly ash and rock) meeting the definition of "fluid," through a "well" into a USDW and the contaminants from the injected backfill material have the capacity to flow or move through the USDW.[10]

[9] As explained by EPA, to qualify as a USDW, an aquifer need only be capable of producing a quantity of water sufficient to supply 25 individuals:

> In fact, the Agency, aware of the mandate to protect not only those aquifers [which currently supply a public water system] but also "underground waters which can reasonably be expected to supply any public water system," has kept a broad interpretation of these potential sources of drinking water by defining as USDWs any aquifer which currently supplies drinking water *for human consumption* or contains *fewer than 10,000 mg/l of total dissolved solids* as long as it contains a sufficient quantity of water to supply a public water system as defined by the Safe Drinking Water Act (SDWA section 1401(4)). ***An aquifer qualifies under this criterion if it is capable of yielding enough water for 25 individuals. This quantity is actually very small and in most cases is less than the amount normally produced by a single low yield domestic well.*** ... The definition is tied to "public water system" because the SDWA uses precisely this term to describe what the UIC program is intended to protect (SDWA section 1421(d)(2)).

47 Fed. Reg. 4993 (Feb. 3, 1982) (emphasis added and original).

[10] As also discussed in our December 10, 2007 and May 1, 2008 letters, not only is KEMC's proposal to flood the mine by injecting water a UIC-regulated injection, but flooding of the mine by both water that is injected by KEMC and groundwater that flows into the mine will release contamination that will flow into the USDW.

There can be no doubt that KEMC's backfilling is an injection that must be regulated under the SDWA UIC program, whether the UIC provisions are narrowly or broadly construed. Therefore, EPA should require KEMC to submit the requested UIC inventory form and require KEMC to obtain a UIC permit for the backfilling injection prior to construction of the proposed mine.

Please call me if you have any questions. The Community and I would appreciate being apprised of your decision in this regard.

Very truly yours,

HONIGMAN MILLER SCHWARTZ AND COHN LLP

Joseph M. Polito

Enclosure

c: Ross Micham
Robert L. Thompson, Esq.
John R. Baker, Esq.

DETROIT.3780348.9

Memorandum

To: Rebecca Harvey, Director, U.S. Environmental Protection Agency Region 5, UIC Branch

From: Ann Maest, PhD, Stratus Consulting Inc.; Robert Prucha, PhD, PE, Integrated Hydro Systems

Date: 9/4/2009

Subject: Response to Kennecott Eagle Minerals Company's April 28, 2009 Letter to the U.S. Environmental Protection Agency, Region 5, Re: Response to March 13, 2009 Request for Inventory and Other Information Concerning Proposed Kennecott Eagle Mine

Synopsis: The bedrock aquifer at the Eagle Project in the Upper Peninsula of Michigan is not an exempted aquifer and is an underground source of drinking water (USDW), based on both water quality and water quantity/supply considerations. Kennecott Eagle Minerals Company (KEMC) proposes to inject and emplace water and materials that will generate concentrations of drinking water contaminants in excess of health-based limits. The inadequate bedrock hydrogeologic characterization and proposed monitoring system for the area around the underground mine will not allow the mining company or the regulatory agency to determine, with any degree of certainty, if contaminants from the mine have reached the USDWs at the site. The Michigan Department of Environmental Quality is not requiring protection of the bedrock aquifer through a State groundwater permit. For these reasons, an underground injection control (UIC) permit should be required for backfilling and operation of the proposed underground mine.

1. Introduction

In 2006 and 2007, the U.S. Environmental Protection Agency (EPA) requested that KEMC submit inventory information for three components of the proposed Eagle Project in the Upper Peninsula of Michigan: the large capacity septic system, the Treated Water Infiltration System, and the backfilling of the underground mine (U.S. EPA, 2009a). KEMC submitted the requested information on the first two components but did not submit information on the backfill operation until April 2009. In its letter to EPA (KEMC, 2009), KEMC provided information on processes that will use water in the underground mine, sources of the water, how much water will be used, how mine processes will affect the water, the fate of the wastewaters, the backfill process, regulatory issues related to the mine and USDWs, and emergency use of the mine for excess mine water. KEMC, however, did not submit a completed UIC well inventory form with its April 2009 letter, as requested by EPA.

In this memorandum, we respond to KEMC's April 28, 2009 submittal to EPA and discuss the following main issues: whether or not the bedrock aquifer is a USDW, KEMC's plans to inject utility water and emplace materials that will cause exceedence of health-based standards in the USDW, and the adequacy of monitoring and contingency measures to protect groundwater quality.

2. The Bedrock Aquifer is a USDW

KEMC attempts to divide the bedrock aquifer at the Eagle Project site into upper and lower units, based on poorly characterized differences in water quality, hydraulic testing, and groundwater flow conditions. As noted in Stratus Consulting (2009), only one exploration borehole from the lower bedrock groundwater has been examined for water quality, only one seven-day hydraulic pump test for the lower aquifer has been conducted, and no potentiometric surface maps were ever prepared for the upper or the lower bedrock aquifer. KEMC defines the lower bedrock zone as 300 feet below the top of the bedrock aquifer and below (KEMC, 2009), based on minimal information from one borehole. Based on the scant information available, there is no difference in rock type, rock age, or structural features between the two bedrock zones. The extent of the proposed mine would be limited to the lower bedrock zone, but the underground workings would cut through the upper bedrock into the lower bedrock zone, and blasting would likely increase the hydrologic connection between the zones and bring more saline water and contaminants into the upper zone. KEMC's characterization of the geology, hydraulics, and water quality of the bedrock formation is poor and does not support the delineation into upper and lower zones. Available information shows the upper and lower zones are hydraulically connected primarily via water conductive features, and therefore must be treated as one hydrogeologic unit.

Federal regulations at 40 CFR § 144.3 define USDW as an aquifer or its portion:

- Which supplies any public water system; or
- Which contains a sufficient quantity of ground water to supply a public water system; and
    - Currently supplies drinking water for human consumption; or
    - Contains fewer than 10,000 milligrams/liter (mg/L) total dissolved solids (TDS); and
- Which is not an exempted aquifer.

The upper and the lower bedrock aquifers at the Eagle Project site contain a sufficient quantity and quality of groundwater to supply a public water system. The bedrock aquifer is not an exempted aquifer. No aquifers are listed as exempted for the State of Michigan under 40 CFR § 147.1152.

2.1 The Bedrock Aquifer is a USDW Based on Water Quantity

Both the upper and lower bedrock aquifers represent a USDW because they contain a sufficient quantity of groundwater to supply a public water system and contain fewer than 10,000 mg/L of TDS. Even considering major differences in how groundwater flows within the bedrock formations and the interflow of groundwater between the bedrock and the overlying unconsolidated aquifer system and Salmon Trout River are conceptualized, available information clearly shows there is ample water from the bedrock system to sustain a relatively large population.

U.S. EPA (2009b) defines a public water system as:

> A system for the provision to the public of piped water for human consumption, if such system has at least fifteen service connections or regularly serves an average of at least 25 individuals at least 60 days out of the year. Such term includes: (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system, and (2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. A public water system is either a "community water system" or a "non-community water system."

Standard water resources engineering texts refer to typical water demands by category, including residential. For example, Chin (2000) indicates that typical residential water use is 260 liters per person per day. This value represents approximately 69 gallons per day per person. Tchobanoglous and Burton (1991) indicate that domestic water use averages 60 gallons per capita per day.

As shown in Table 1, several lines of evidence support the concept that the bedrock aquifer is capable of producing a sufficient quantity of water to supply a public water system, as defined by EPA:

- Results from KEMC's own 7-day pump test at well 04EA-084, screened over a relatively small vertical section of the bedrock aquifer [249.05 to 302.08 meters (m) below ground surface], show that rates of 6 liters per minute [~1.6 gallons per minute (gpm)] were maintained from just this one well. If KEMC had screened this same well over the entire bedrock interval, which would be typical practice in designing a groundwater supply well, even higher rates would have occurred.

- The Mine Permit Application (Appendix B-5, p. 4) states that well yields ranging from 0.03 to 0.32 gpm/foot were obtained for the bedrock aquifer. This range is well above the 0.01 gpm/foot referenced by KEMC (2009) as a threshold below which is considered poor to infeasible for domestic supply wells.

Table 1. Range of population capable of being sustained by Eagle Project bedrock aquifer

Source	Reference	Low flow rate (gpm)	High flow rate (gpm)	Low water use (gal/cap-d)	High water use (gal/cap-d)	Low population sustained (# people)	High population sustained (# people)	Notes
Available data – well 04EA-084 7-day pump test	Foth & Van Dyke and Associates, 2006b, Appendix B-3	1.6	2	60	69	33	48	Likely higher sustained rate due to being packed off (249.05 to 302.08 m).
Modeling – KEMC estimated mine inflow	Foth & Van Dyke and Associates, 2006a, Appendix E-1	75	215	60	69	1,565	5,160	This estimate is low because mine dewatering levels were not simulated low enough. See Stratus Consulting, 2009, Figure 2.8, p. 2-19.
Modeling – updated KEMC estimated mine inflow	Golder Associates, 2008	60	210	60	69	1,252	5,040	
Modeling – Keweenaw Bay Indian Community (KBIC) estimated mine inflow	KBIC analysis/testimony	280	4,000	60	69	5,843	96,000	280 gpm – from testimony of Robert Prucha (referenced in Chapter 2). Excerpt from Hearing Transcript, Vol. 8, 9, and 40, Petitions of the Keweenaw Bay Indian Community et al. on Permits Issued to Kennecott Eagle Minerals Company (Michigan Department of Environmental Quality, May 7, May 8, and July 16, 2008) (electronic only). 4,000 gpm – see p. 2-22 in Stratus Consulting, 2009 for range of inflows to nearby mines.

- Despite the presumption by KEMC that both the upper and lower zones of the bedrock aquifer are not USDWs (KEMC, 2009), their own estimates of mine inflow based on several FEFLOW modeling efforts (i.e., Golder Associates, 2006, 2008) clearly indicate that enough water is available to support a substantial population (see Table 1). Had KEMC considered the possibility that the bedrock formations can produce substantial quantities of groundwater at the start of their investigations (because the system is fractured and faulted), they would have focused their characterization on these features, rather than trying to show that selected boreholes exhibit low hydraulic conductivities.

- Further evaluation of mine inflows using the KEMC FEFLOW model (Stratus Consulting, 2009) as the basis showed that a more realistic range of groundwater flow is from 280 to 3,000 gpm (see Table 1), and could be as high as 4,000 gpm, based on an evaluation of inflows to mines in the Marquette Iron Mining District (Stratus Consulting, 2009).

Based on the information above and summarized in Table 1, a population ranging from 33 to 96,000 could be supported by groundwater extraction from the local bedrock aquifer system near the proposed mining area. This range exceeds the 25 individuals that constitute a public water system based on EPA's definition of a public water system.

KEMC's letter to EPA (KEMC, 2009) suggestd that a 10,000 foot well through the lower bedrock would be required to maintain a 1 gpm flow rate. KEMC does not provide additional information on how this well dimension was determined, and does not explain why they use an unreasonably low hydraulic conductivity value that is only representative of the bedrock matrix without fractures.

The upper and lower zones of the bedrock aquifer at the Eagle Project are fracture-dominated flow systems, and fractures dominate water flow to wells in these types of systems, and not the matrix (Fetter, 2001). KEMC (2009) states in their letter to EPA that the hydraulic conductivity (K) of the lower bedrock is only 5×10^{-8} centimeters per second (cm/sec). This low value is only representative of the rock matrix of the bedrock without fractures. In its one pump test in the lower bedrock (well 04EA-084), KEMC tested a water-conductive feature, and the hydraulic conductivity was approximately four orders of magnitude higher than the bulk K (3.0×10^{-4} cm/sec; see Foth & Van Dyke and Associates, 2006b, Appendix B-4). Most groundwater will flow into wells through these features in the bedrock aquifers. Moreover, if KEMC had conducted a more complete hydrogeologic characterization of the aquifers, it is very likely they would have intercepted more extensive, connected, and permeable features than the one examined in their single bedrock pump test in well 04EA-084. For example, KEMC did not characterize the permeability of the brecciated zone along the dikes, major faults identified by their own geologists, or the Klasner fault zone (see Stratus Consulting, 2009).

There are notable differences between KEMC's and KBIC's conceptualizations of flow in the bedrock aquifer and flows between the bedrock and overlying unconsolidated aquifers and the Salmon-Trout River. The differences are summarized in Figures 1 and 2. KEMC's conceptual model is shown in Figure 1. In their conceptualization, the upper and lower bedrock have major hydrogeologic and structural differences. For example, KEMC believes that faults exist only in the lower bedrock and do not extend into the upper bedrock, and fractures and joints exist only in the upper bedrock zone. The edge of the peridotite dike/ore body is not noted as being permeable or highly fractured, and flows to and from the unconsolidated glacial aquifer are not noted. In KBIC's conceptual model (Figure 2), there is no difference in rock type and no structural feature or unconformity that define the differences between the two bedrock zones. The faults extend through both the upper and the lower zones of the bedrock aquifer, and enhanced vertical flow is shown along the fractured brecciated edge of the dike/ore body. Fractures and joints are shown in both the upper and the lower zones, and the zones are part of a hydrologically connected bedrock aquifer.

Based on the existing information, including information from KEMC's geologists, we continue to believe that the bedrock and glacial aquifers and the Salmon-Trout River act as an interconnected hydrologic system. The bedrock aquifer is hydrologically linked to the unconsolidated aquifer, which is also a USDW. As a result of these hydrologic connections through faults and fractures, dewatering and mining activities in the bedrock aquifer will affect water quality and quantity in the overlying USDW unconsolidated aquifer. In addition, the bedrock aquifer is very likely in direct hydraulic communication with the Salmon-Trout River. In fact, KEMC's drawings have indicated this (see, for example, Foth & Van Dyke and Associates, 2006a, Appendix B-8, Figure 21). As a result, mining and dewatering operations in the bedrock will affect flows and water levels in the Salmon-Trout River, the overlying wetlands, and the glacial aquifer, and water from the unconsolidated aquifer and the Salmon-Trout River will strongly influence mine inflow rates.

Finally, Foth & Van Dyke and Associates (2006b, Appendix C) identified a water well (Well ID 52000005636) completed in 256 feet of bedrock in the area surveyed by Kennecott. A well survey conducted for KBIC by Wittman Hydro Planning Associates, Inc. identified additional water wells nearby but outside the area surveyed by Kennecott in the bedrock aquifer (Honigman Miller Schwartz and Cohn, 2006).

In summary, the bedrock aquifer qualifies as a USDW based on the fact that it could provide a sufficient quantity of water for a public water system.

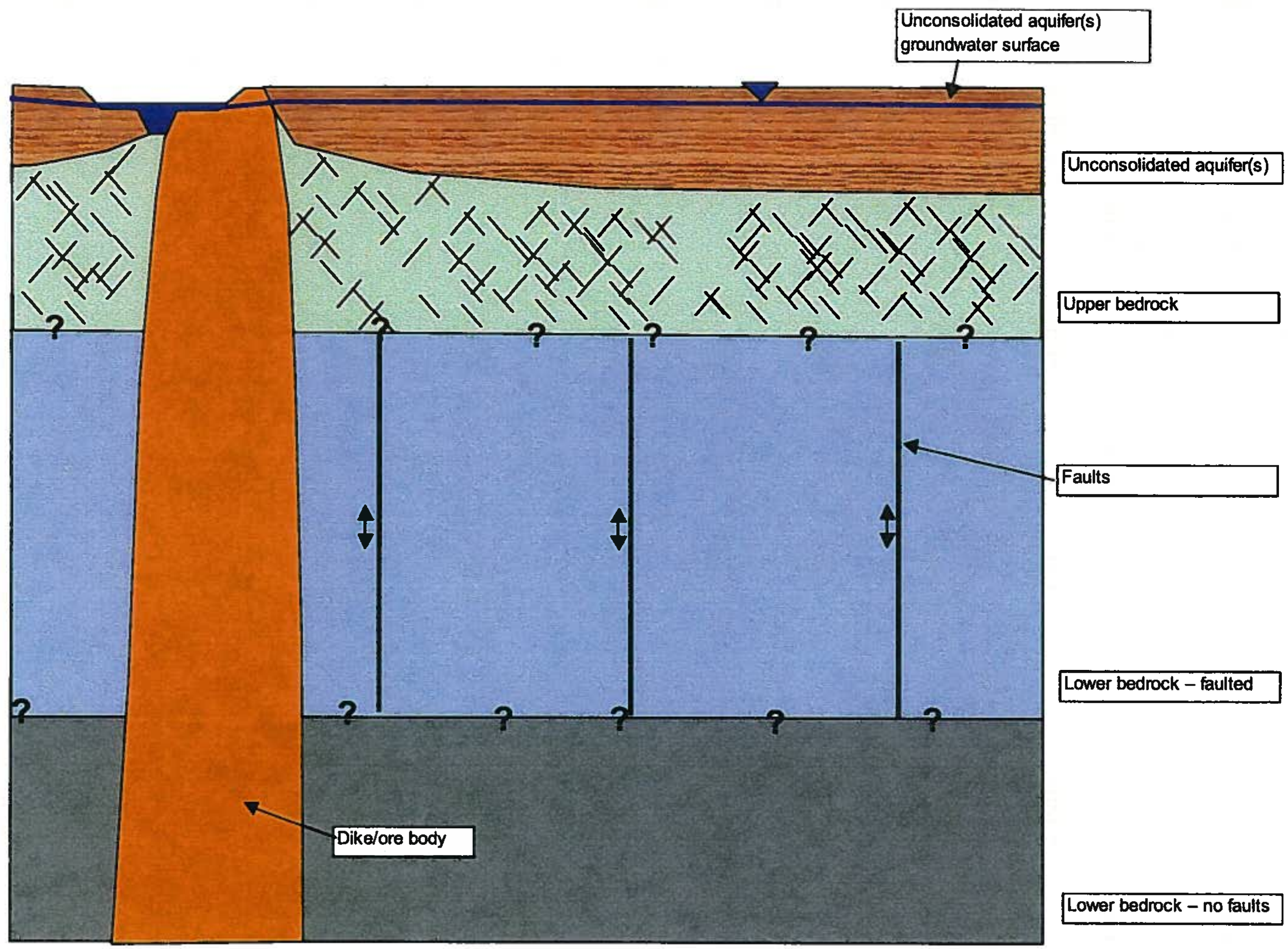

Figure 1. KEMC's conceptual flow model. Note: KEMC's conceptual flow model is based on available information provided in Foth & Van Dyke and Associates, 2006b.

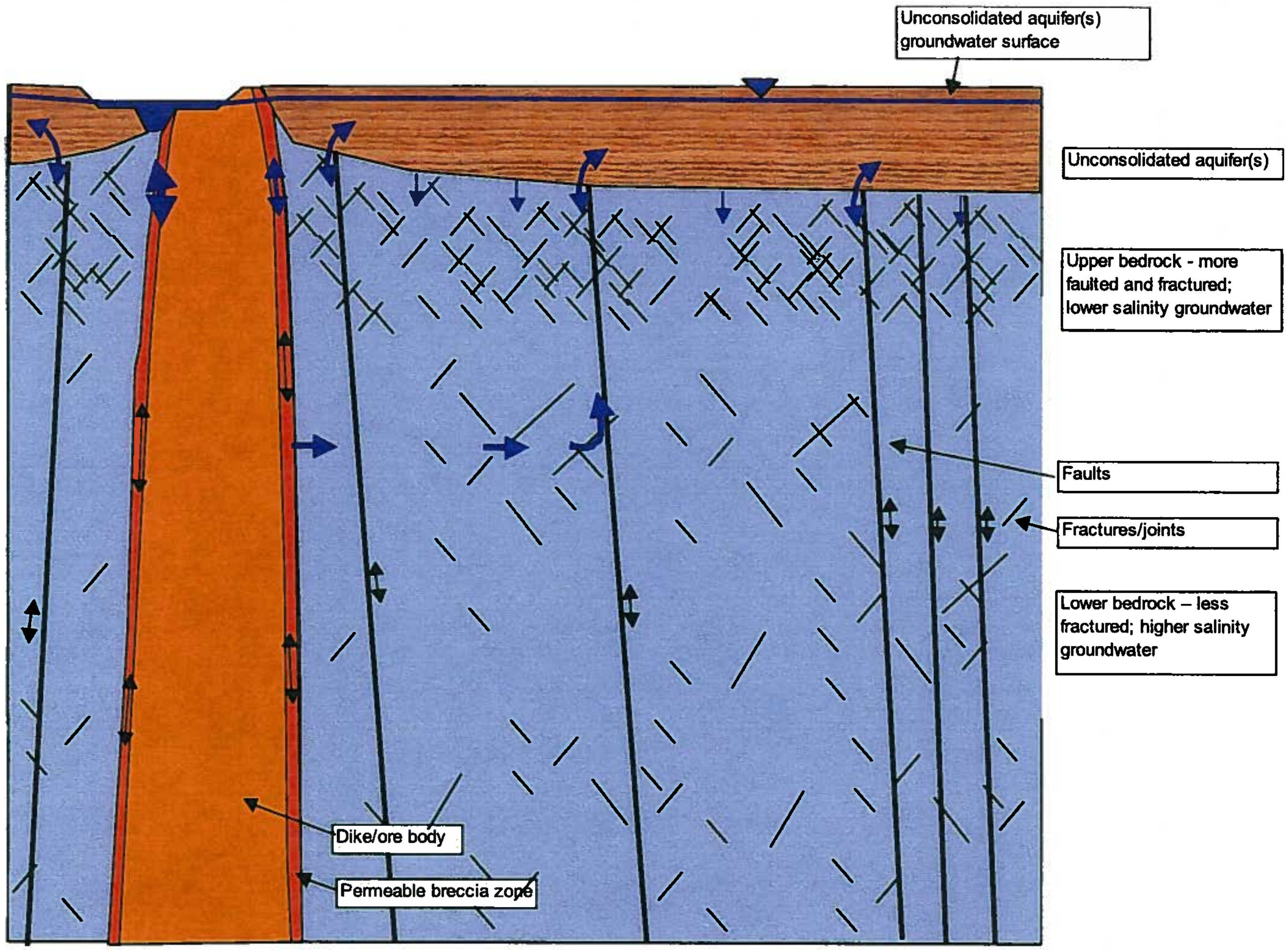

Figure 2. KBIC's conceptual flow model. Note: KBIC's conceptual flow model is based on available information provided in Foth & Van Dyke and Associates, 2006b.

2.2 The Bedrock Aquifer is a USDW Based on Water Quality

The bedrock aquifer groundwater contains less than 10,000 mg/L TDS. Appendix F of the groundwater discharge permit application (Foth & Van Dyke and Associates, 2006a) shows that TDS in bedrock aquifer samples from 2004 ranged from 124 to 272 mg/L in samples 04EA-054A, B, D, and E (North Jackson study) and 1,590 mg/L in sample 04EA-084. In 2005, samples were collected from boreholes 05EA-107 and 04EA-084 at different distances along the borehole length. TDS from 18.2 to 34.9 m along exploration hole 05EA-107 was 168 mg/L; and TDS from greater depths along the same borehole (97.5 to 114 m) was 287 mg/L. TDS values for borehole 04EA-084 (249 to 302 m along the borehole) ranged from 2,540 to 3,060 mg/L. Field values of TDS for borehole 04EA-084 during the pump test on September 22 to 29, 2005 ranged from 1,880 to 3,550 mg/L. Based on these results, the highest TDS value measured in the lower bedrock aquifer is still almost three times lower than the 10,000 mg/L TDS potability standard, and the bedrock aquifer qualifies as a USDW based on water quality.

Therefore, because the bedrock aquifer contains a sufficient quantity of groundwater to supply a public water system, currently supplies drinking water for human consumption, and contains fewer than 10,000 mg/L TDS, the bedrock aquifer at the Eagle Project site is a USDW.

3. KEMC Plans to "Inject" Water that Will Exceed Health-based Standards and "Emplace" Materials that Will Generate Dissolved Contaminants in Excess of Health-based Standards

Under 40 CFR § 144.81(8), one type of a Class V UIC well is:

> Sand backfill and other backfill wells used to inject a mixture of water and sand, mill tailings or other solids into mined out portions of subsurface mines whether what is injected is a radioactive waste or not.

The Eagle Project proposes to backfill a mixture of cement, flyash, development rock, and aggregate into mined out portions of a subsurface mine. The development rock is known to generate concentrations of contaminants that exceed drinking water standards by many times, as shown in by KEMC's laboratory results for leaching of development rock [see Stratus Consulting (2007b) for details].

KEMC (2009) argues that the underground mine is not a "well"; utility water is sent back to the mine through pipes running along the mine declines, rather than through a well; and the development rock and cement are not injected through a well. However, the fly ash cement mixture and the aggregate would be discharged to the underground through large boreholes that meet the UIC definition of "wells." The cement and fly ash mixture will be injected into the underground mine through a 250-mm (10 inch) vertical, cased borehole, and the aggregate will be injected into the underground mine through a 2.4-m (8 ft) vertical borehole/raise (Foth & Van Dyke and Associates, 2006b, p. 43). The injection of cement, fly ash, and aggregate begins after the excavation of the first primary stope. Further, no chemical analyses of the fly ash (alone, or in combination with cement) have been conducted. Fly ash is known to contain highly leachable constituents including arsenic and other contaminants (Mizutani et al., 1996; Yu et al., 2005), and the mine plans to use 3% fly ash by weight of the cemented backfill (Foth & Van Dyke and Associates, 2006b, p. 42). No tests were conducted to evaluate the potential for the backfill mixture (cement, aggregate, fly ash, development rock) to leach contaminants under different conditions in the underground mine. The Mine Permit Application does not explicitly state how the development rock will be moved from the surface development rock facility into the underground mine, only that it will be "returned to the mine" (Foth & Van Dyke and Associates, 2006b, p. 54). The purpose of the UIC regulations is to protect USDWs, and for all intents and purposes, KEMC is proposing to inject water and contaminant-generating materials into a USDW.

UIC regulations do not allow movement of fluid into USDWs that might cause a violation of the primary drinking water standards under 40 CFR part 141, other health-based standards, or may otherwise adversely affect the health of persons [40 CFR § 144.82 (a)]. This "prohibition of fluid movement" applies to well construction, operation, maintenance, conversion, plugging, closure, or any other injection activity.

There is a high degree of uncertainty about the amount and quality of inflow to the underground mine. However, laboratory information is available on contaminant leachate concentrations from development rock, which KEMC proposes to emplace as backfill, and there are predictions about concentrations of contaminants in the backfilled underground mine after mining is completed. Contaminant concentrations in utility water are also predicted by KEMC. In all cases, predicted concentrations of some of the contaminants (notably arsenic, cadmium, copper, lead, and nickel) exceed health-based water quality standards. The potential for migration of contaminants from the mine into USDWs begins as soon as blasting operations begin and intensifies as full mine operations begin, including the circulation of utility and other water through the mine, and the emplacement of backfill into the mine. The potential for migration of contaminants from the mine continues well after mining ends and water levels in the backfilled mine re-establish equilibrium conditions.

3.1 Leachate Concentrations from Development Rock

Eagle Project development rock would largely be composed of intrusive peridotite rock and country rock, in addition to some proportion of massive sulfide and semi-massive sulfide ore (Foth & Van Dyke and Associates, 2006b). Development rock would be stored on the surface for at least three years, when it will be exposed to oxygen and water and will develop acid drainage.

The development of acid drainage will continue when it is emplaced in the underground mine in the secondary stopes during mining. Column leach tests conducted on the country rock showed that copper concentrations in leachate reached over 12 mg/L, which is over nine times higher than the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL) action level of 1.3 mg/L. Leachate concentrations of nickel in peridotite reached almost 800 micrograms per liter (μg/L), which is almost eight times higher than the lifetime health advisory of 100 μg/L. Leachate concentrations of nickel from the ore reached 120 mg/L, or over 1,000 times higher than the health advisory level (U.S. EPA, 2006). KEMC has not conducted any testing of cemented rock backfill.

3.2 Utility Water Concentrations

Utility water is water from the underground mine and other sources that will receive preliminary treatment and then be sent back to the underground mine, incorporated in backfill, or otherwise used in mining operations. The statement in the April 28, 2009 KEMC letter that treated water (implying utility water) will meet all SDWA MCLs is false.

Utility water only receives preliminary treatment. According to Figures 4-1 and 4-2 in Foth & Van Dyke and Associates (2006a), utility water is removed from the treatment plant after initial clarification/filtration but before the main treatment plant processes, which include reverse osmosis. Appendix G1 of Foth & Van Dyke and Associates (2006a) provides calculations of concentrations after clarification/filtration (called "softening" in Appendix G2). As shown in Table 2, antimony, arsenic, boron, cadmium, lead, manganese, nickel, and thallium concentrations in utility water range from 1.7 times health-based water quality standards and advisories (for manganese) to greater than 330 times standards and advisories (for arsenic). Using more realistic higher concentrations for mine inflow (see Stratus Consulting, 2007a), utility water would exceed MCL values by even higher factors.

Under both maximum and average or expected (Figures 4-1 and 4-2, Foth & Van Dyke and Associates, 2006a) mine inflow rates (250 and 75 gpm, respectively), 124 gpm of utility water is routed back to the underground mine, 0 to 8 gpm of the same preliminarily treated water is used for cemented backfill, and 10 gpm is used in the truck wash and crusher operations. An additional 12 gpm of development rock drainage is used in the backfill system and ultimately flows to the underground mine. The development rock drainage is not treated before it re-enters the underground mine with the backfill, and this drainage has even higher concentrations of arsenic, nickel, sulfate, and zinc than the utility water. KEMC's expected development rock drainage composition is compared to health-based water quality standards and advisories in Table 1. The arsenic concentration in development rock drainage exceeds the Maximum Contaminant Level Goal (MCLG) by over 800 times and the MCL by 8.3 times. Using more realistic predictions of development rock drainage concentrations (see Stratus Consulting, 2007a), values would exceed health-based standards by even larger amounts.

Table 2. Comparison of health-based water quality limits with utility water, development rock drainage, and backfilled mine concentrations

Analyte	Units	Most stringent health-based water quality standard[a]	Lime clarifier effluent (utility water)[b]	Exceedence ratio	KEMC development rock drainage[c]	Exceedence ratio	Backfilled mine, Stratus Consulting (75 gpm inflow)	Exceedence ratio	Backfilled Mine, KEMC[d] (180 gpm inflow)	Exceedence ratio
Antimony	µg/L	6	**19**	**3.17**	0.4	0.07	0.54	0.1	0.03	0.01
Arsenic	µg/L	0	**33**	**> 330**	**83**	**> 830**	**1.18**	**> 10**	0.06	–
Boron	µg/L	900	**3,671**	**4.1**	580	0.64	254	0.3	70	0.08
Cadmium	µg/L	5	**11**	**2.20**	0.2	0.04	**11.9**	**2.4**	0.08	0.02
Copper	µg/L	1,300	145	0.11	60	0.05	**11,400**	**8.8**	2.1	0.002
Lead	µg/L	0	**9**	**> 90**	**0.4**	**> 4**	**135**	**> 1,000**	0.03	–
Manganese	µg/L	300	**500**	**1.7**	0.5	0.002	**594**	**2.0**	1.6	0.01
Nickel	µg/L	100	**2,000**	**20**	**8,330**	**83**	**15,500**	**155**	**1,770**	**17.7**
Nitrate (as N)	mg/L	10	0.05	0.01	–	–	**50[a]**	**5**	–	–
Thallium	µg/L	0.5	**7**	**14**	0.05	0.10	0.40	0.8	**8**	**16**

Values in bold = predicted concentrations exceed health-based standards.
Exceedence ratio = predicted concentration/standard (for arsenic and lead, based on detection limits of 0.1 µg/L).

a. U.S. EPA, 2006.
b. Appendix G1, Foth & Van Dyke and Associates, 2006b.
c. KEMC prediction, with limestone addition; Foth & Van Dyke and Associates, 2006a, Appendix F2.
d. Foth & Van Dyke and Associates, 2006a, Appendix D-5.

3.3 Predicted Concentrations at the End of Mining

After mining, KEMC predicts that concentrations in the backfilled underground mine will exceed health-based standards and advisories for nickel and thallium by over 1,000 and 8 times, respectively. Using more realistic higher concentrations for water in the backfilled mining after mining, drinking water contaminants will exceed health-based standards and advisories by over 1 to 15,000 times, as shown in Table 2. U.S. EPA (1988) prioritized Class V wells injecting into USDWs with concentrations greater than 10 times any of the health-based limits as a high priority for enforcement. As shown in Table 2, KEMC-predicted values for utility water, development rock drainage, and water in the backfilled mine all indicate that the Eagle Project has the potential to be a high enforcement priority site for EPA because of its threat to USDWs in the area.

KEMC's conceptual model predicts that water in the underground mine will not move at all after groundwater levels are re-established. KBIC's conceptual model predicts, more realistically, that water will flow downgradient and contaminate the USDW after mining ceases (Figure 3).

4. Planned Monitoring and Contingency Systems are Inadequate to Protect USDW

It is clear that KEMC will inject or emplace fluids and materials in the underground mine that have the potential to cause exceedences of health-based standards in the bedrock USDWs. The mine cannot guarantee containment of these fluids in the underground mine (as opposed to outside of the mined out area) during mining, because pipes conveying the materials and fluids can breach, and contaminated water can escape the hydraulic control of the capture zone, if a capture zone would even exist. If contaminants did move outside the underground mine, they would be released to the environment without treatment. As noted in Section 2 of this memorandum, groundwater flow is controlled by fractures and faults in the bedrock aquifer, and hydraulic control by dewatering is notoriously difficult to control in such a system, especially when the location and extent of faulting is unknown.

An example of a mine that has had difficulties controlling groundwater flow in the underground is the Buckhorn Mountain Mine in Washington State, which violated its water quality permit because it could not maintain a capture zone to contain its operations. The Buckhorn Mountain Mine is a relatively new underground gold mine with a mine development plan almost identical to that of the Eagle Project and that is also developed in fractured bedrock. The mine was found to be in violation of its National Pollution Discharge Elimination System (NPDES) permit in April 2009 because contaminated waters from the underground mine escaped the capture zone and adversely affected downgradient groundwater and surface water. The NPDES permit incorporates an adaptive management plan that requires the capture and treatment of

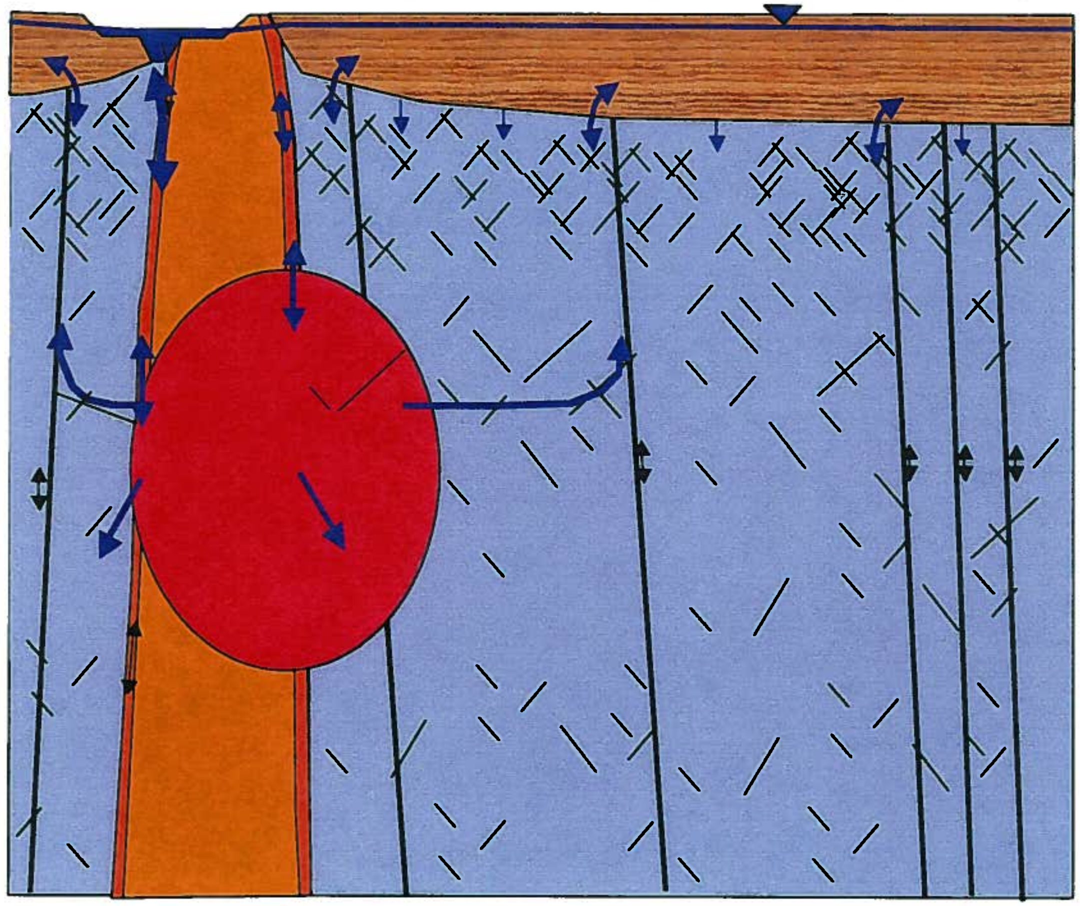

Figure 3. KBIC conceptual flow model after mining. During mining, the dewatered mine will allow downward inflow from the overlying Salmon-Trout River and glacial aquifer into bedrock along faults, fractures, and dike breccia zones. After mining, as pre-mining groundwater gradients are re-established, groundwater in the mine would flow outward and upward along faults/fractures and the brecciated portion of the dike into the upper bedrock, the glacial aquifer, and the river. Note: The red area denotes general area of proposed mine workings shown in Foth & Van Dyke and Associates, 2006b, Figure 7-2.

underground mine waters before discharging to waters of the state. Crown Resources/Kinross Gold, the mine owner, failed to establish and maintain a groundwater capture zone from June 2008 to April 2009. Elevated concentrations of nitrate and ammonia (from blasting) and other contaminants were found in downgradient groundwater and surface water as a result. This condition was noticed by the Washington Department of Ecology because of the groundwater and surface water monitoring system in place. As noted below, essentially no bedrock or alluvial groundwater monitoring downgradient of the mine is required as part of the proposed Eagle Project. The details of the Buckhorn Mountain Mine April 2009 violation are included in the appendix to this memorandum.

According to the mine permit application (Foth & Van Dyke and Associates, 2006b), there are only three bedrock monitoring wells around the mine (not even enough for each of the four directions), and no bedrock monitoring wells will be used for water quality monitoring (see Figure 6-1 figure legend, Foth & Van Dyke and Associates, 2006b). Wells 04EA-074, 04EA-077, and YD02-20 are only for bedrock water level monitoring. Only the Quaternary alluvium (glacial) aquifer wells will be used for water quality monitoring. Clearly, this proposed monitoring system is entirely inadequate for determining water levels in the bedrock aquifer, the direction of groundwater flow, whether or not a capture zone is functioning around the operating mine, and whether contaminants from the underground mine are migrating into the bedrock, or even into the unconsolidated USDWs.

5. Information on UIC Permits for Other Mines

Based on our review of the mines listed in the KEMC (2009) letter, none of the mines are comparable to the proposed Eagle Project operation. In fact, the review found that the proposed Eagle Project operations deviate from standard practice at most hardrock mines requiring dewatering, and this especially affects the amount of dewatering water that would require disposal and the potential effects on groundwater and surface water quality and quantity.

Eight of the 12 mines listed in the table on the last page of the KEMC (2009) letter are in Nevada. Ann Maest spoke to Russ Land and Bruce Holmgren of the Nevada Department of Environmental Protection (NDEP) about their UIC program and the mines on the table. Nevada has primacy for the UIC program for Class II, III, and V wells; Classes I and IV are prohibited in Nevada. Mr. Land noted that NDEP used to require UIC permits for backfilling, but the regulation of backfilling has now been moved to the NDEP Bureau of Mining Regulation and Reclamation, where Bruce Holmgren is the new Supervisor of the Regulation Branch.
Mr. Holmgren said Nevada would take a “closer look” at the Eagle Project, if it were proposed in Nevada. He said the Eagle Project is very different from the Nevada mines because of the much greater depth to groundwater in Nevada and the fact that mines in Nevada are dewatered using wells outside of the underground mine rather than sumps inside the mine. Mr. Holmgren noted

that the reason Nevada uses this dewatering approach is to avoid contamination of groundwater by contact with the underground workings. Mines in Nevada also have sumps, as proposed for the Eagle Project, but the sumps are for protection against an emergency flooding situation rather than as the primary dewatering mechanism. If a mine found that more water was entering the underground mine than could be handled by an in-mine sump, the NDEP would shut down the mine for 180 days while a new permit was evaluated. The depth to groundwater in Nevada is hundreds of feet below the surface; dewatering water is generally discharged to groundwater through rapid infiltration basins, and a groundwater discharge permit is required for these operations. The Buckhorn Mountain Mine in Washington State also dewaters outside of the underground workings to provide water for the mining operations and collect mine water that does not contact the underground workings, in order to protect groundwater quality outside of the mine area (Seattle Daily Journal, 2008). In fact, every mine we can think of with operations below the pre-mining water table uses dewatering wells outside of the underground workings to dewater the mine. If this approach was proposed for the Eagle Project, the predicted amount of water requiring treatment or disposal would increase dramatically. It is likely that dewatering wells will be needed if the Eagle Project opens, and if that is the case, it is likely (because of the limited capacity of groundwater aquifers to hold more water) that an NPDES permit for discharge to surface water will be required.

In terms of utility water, Mr. Holmgren said that the mines do have utility water that is used for drilling and dust suppression. Significantly, most of the mines in Nevada have mills on site or nearby, and utility water is also used for operation of the mill. Some crushing of the rock is proposed for the Eagle Project, but there is no mill onsite, and therefore no utility or "make up" water is needed for operation of the mill. Mr. Holmgren said if excess water was produced in the underground that was not used in the mine processes (milling), this could invoke a major permit and require, for example, discharge to surface water and a NPDES permit. Although the Mine Permit Application (Foth & Van Dyke and Associates, 2006b) states that utility water would be used for dust suppression, operation of equipment, and the backfill plant, substantially more water is leaving the mine than entering it from the surrounding aquifer (see Foth & Van Dyke and Associates, 2006b, Figures 4-18a and 4-18b), implying that not all the utility water is put to industrial use in the underground mine.

Another mine on the KEMC list, the Asamera Minerals Cannon Mine in Wenatchee, Washington, backfilled the underground workings as part of reclamation rather than an integral part of mine operations. The workings were backfilled to eliminate access and minimize subsidence as part of the underground mine reclamation (USGS, 1996). Therefore, this mine is not a good comparison with the Eagle Project because of the timing and purpose of the backfilling operation.

Another mine on the list, the Stillwater Mine in Montana, currently does not have a UIC permit for backfilling or utility water. However, an independent audit conducted in 2002 for Stillwater Mining Company (SMC) and others as part of the existing Good Neighbor Agreement recommended that SMC get a UIC Class V permit for these activities. The independent audit, conducted by Tetra Tech EM, found that the mine does not have a Class V UIC permit for placement of mine and mill waste underground and requested SMC to review the UIC requirements and, if UIC applies, to submit inventory information or, as an alternative, duplicate Class V UIC requirements in their Plan of Operations. Similarly, for vehicle wash water that is routed underground, Tetra Tech EM recommended that the mine apply for a Class V UIC Permit or implement an alternative management system. SMC concluded that the mine was indisputably a "well" and can be classified as an injection well. SMC asked EPA Region 8, Montana Office, to review their operation in relationship to UIC requirements. EPA concurred that backfilling, reinjection of adit water, and the injection of motor vehicle wash water are Class V activities but could be authorized by rule (Tetra Tech EM, 2002).

We found information on internet searches that the Lamefoot Mine in Washington State and the Buick Mine in Missouri used cemented rock backfill, but found no information on utility water or UIC permits. Both Washington State and Missouri have UIC primacy.

EPA's 1999 study on Class V UIC wells found that Idaho, Kansas, Texas, Illinois, and North Dakota used permit by rule (although sometimes general or individual permits were required), Wyoming used a general permit, and West Virginia, Ohio, Indiana, and Pennsylvania used individual or area permitting for Class V UIC wells (U.S. EPA, 1999). Ann Maest learned on a July 13, 2009 telephone call with Nancy Rumrill, of EPA Region 9, that a copper mine in Arizona, Resolution Copper, had requested to inject reserve osmosis (RO) brine into the underground mine. EPA Region 9 runs the UIC program in Arizona, and they did not allow the mine to put the RO brine in the mine because it exceeded drinking water standards and could adversely affect the USDW. Eagle Project's utility water would also exceed drinking water standards. Ms. Rumrill noted that the burden is on the mine proponent to show that the proposed injection or emplacement will not exceed SDWA standards. In our opinion, KEMC has not met this burden.

6. Summary

In summary, the Eagle Project's proposed backfilling is similar to other stoping operations in the western United States, but its plan for dewatering and utility water usage is unique. In particular, most mines dewater outside of the mine boundary to avoid contact of clean groundwater with underground workings, and to ensure that the mining operations are under hydrologic control. Even when mines dewater outside of the workings, plans for hydrologic control can fail, as evidenced by the violation at the Buckhorn Mountain Mine in Washington State. The failure to maintain a capture zone around the workings was largely related to encountering a large fault that was not known before operations began. We have shown that many large faults exist in and around the Eagle Project, and a similar situation could occur under operational conditions. Groundwater flow within the bedrock aquifer system is clearly dominated by fractures/faults, yet KEMC made no attempt to hydraulically test the most likely water conductive features in the mine vicinity that would dominate mine inflow and post-mining groundwater flow conditions. In addition, the Eagle Project does not have a groundwater monitoring system in place that would alert the mine or the agency if and when contaminated water moved from the underground mine into the surrounding USDWs, and the State has not required a groundwater permit of any kind for the underground mine. As noted in this memorandum, utility water and backfill leachate will exceed drinking water standards and health advisory levels. For these reasons, we recommend that EPA Region 5 require an individual UIC permit for the Eagle Project for backfilling and utility water use in the underground mine.

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Appendix. Information on Buckhorn Mountain Mine's April 2009 NPDES Permit Violation

DEPARTMENT OF ECOLOGY State of Washington

News Release

FOR IMMEDIATE RELEASE – April 28, 2009
09-092

Buckhorn gold mine fined $40,000 for violating water quality permit

YAKIMA – Crown Resources Corporation has been fined $40,000 for violating its water quality permit at the Buckhorn Mountain gold mine near Republic, Wash., in Okanogan County.

The Washington Department of Ecology (Ecology) has cited the company for failing to adequately capture and treat water from the mine operation, violating the company's NPDES (National Pollutant Discharge Elimination) permit. The mine discharges treated mine water and stormwater to both surface and groundwater, including Gold Bowl, Nicholson, and Marias creeks.

Ecology's interpretation of data indicates seepage from the mine workings has been detected in groundwater monitoring wells, and stream samples and springs downstream from the mine.

Under the permit, the company is required to capture and route water from the underground mine to a treatment plant before discharging it to waters of the state.

Crown Resources was cited for failing to establish and maintain a groundwater "capture zone" and for failing to report and respond in a timely manner. The violation occurred over a 10-month period from June 2008 to April 2009.

Crown Resources has been ordered to take action to come into compliance with the NPDES permit. Action items include:

- Installing additional dewatering wells;
- Increasing monitoring capacity and frequency;
- Submitting monthly reports that demonstrate the effectiveness and extent of the groundwater capture zone;
- Evaluating and responding appropriately to sampling data.

Crown Resources has 30 days to pay the penalty or file an appeal of the penalty with the state Pollution Control Hearings Board.

More information on the NPDES permit is available at the Ecology Web site: http://www.ecy.wa.gov/programs/wq/permits/central_permits.html.

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Bob Raforth, Water Quality specialist, 509-457-7113

Broadcast version

Crown Resources Corporation has been fined $40,000 for violating its water quality permit at the Buckhorn Mountain gold mine near Republic, Wash., in Okanogan County.

The Washington Department of Ecology has ordered the company to properly capture and treat the water from mine workings before discharging it.

Ecology's interpretation of data indicates seepage from the mine workings has been detected in groundwater monitoring wells, and stream samples and springs downstream from the mine.

The company has 30 days to pay the penalty or file an appeal with the Pollution Control Hearings Board.

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