

# **The Quellaveco Mine: Free Water for Mining in Peru's Driest Desert?**

**An environmental impact assessment**

***Report prepared by: Robert E. Moran, Ph.D.  
March 2002***

Robert E. Moran, Ph.D.  
Water Quality/Hydrogeology/Geochemistry  
501 Hess Ave., Golden, CO 80401 USA  
Phone: (303) 526 1405  
Fax: (303) 526 2678  
remoran@aol.com

## Executive Summary

*This report demonstrates that **the proposed Quellaveco open-pit copper mine is likely to have numerous long-term, negative impacts on water quality and quantity** in the operational and waste disposal areas, but most importantly, **will assuredly aggravate the already contentious competition for water** in one of the driest irrigated regions of the world.*

The major report findings are:

- **The Quellaveco project will aggravate an already serious scarcity of water in the region and will increase water conflicts among local stakeholders.** It may also jeopardize the planned expansion of the Pasto Grande irrigation / agricultural project.
- **Minera Quellaveco and other mining companies in Peru are allowed to use tremendous volumes of ground water at no cost for the water itself, and they pay unreasonably low rates for surface water.** Governmental oversight of water use by mining companies is largely non-existent. This, together with the essentially-free water, encourages companies to waste the resource. Because the water has been considered to have no cost, all decisions made and options considered in the EIA process are hopelessly biased.
- **Numerous regional groups favor development of the Quellaveco project because of promised economic benefits. However, the majority of local stakeholders mistrust the results of most of the studies previously produced by the company, their consultants, and the various government agencies.** The stakeholders assume, in this situation, that the government works predominantly to promote mining and the development of foreign exchange, and that their interests are secondary.
- **The Minera Quellaveco EIA is seriously inadequate when judged by the relevant mining criteria / guidance documents of the World Bank, Canada and the United States.** Despite its massive size, seven volumes, it is a poor summary of the proposed actions and the likely impacts. Much of the water quality data appears to have been collected using inadequate procedures. **The EIA lacks a useful, consolidated and reliable data set for baseline water quality and quantity**, thus the actual extent and responsibility for future impacts will not be discernable. **The document fails to contain an actual environmental alternatives evaluation, and fails to consider the truly long-term consequences of the proposed project.** Evaluations of potential impacts to water resources in this EIA are frequently misleading, overly-optimistic, and overtly biased towards showing that few or no significant impacts will occur.

- **Despite company claims, it is simply untrue that NO significant impacts will occur as a result of this project.** At a minimum, the following impacts will occur:
  - Several present water users will have their allocations reduced, and may be required to change the methods of irrigation used and the crops cultivated;
  - Springs along the diverted portion of the Rio Asana are likely to dry up;
  - Ground and surface water quality will be degraded by releases of contaminants from the tailings, waste rock, the pit walls and subsequently-contaminated pit lake, explosives, fuels, oils and other organic compounds;
  - The proposed diversion of water from the Chilota area will have negative impacts on both water quantity and quality in the Chilota region, and possibly in the Tambo Basin.

Presently, the Peruvian public bears the burden of these long-term environmental impacts. As such, **this represents an indirect subsidy of mining in Peru.**

- **It is extremely likely that much of the waste rock, tailings, and rock comprising the walls and floor of the open pit will produce contaminated leachates,** causing some degree of water quality degradation in local water resources---both surface and ground waters. Geochemical data clearly indicate that much of the ore and waste rock to be mined is likely to generate acid and mobilize metals and other chemical constituents into the surrounding environment. Once acid generation processes begin in such wastes, they may continue to cause contamination for decades or even hundreds of years, as a minimum, after mine closure.
- **Pit lake water quality will be degraded by a combination of acid-generation and evapoconcentration processes.** There are no long-term examples in the technical literature that can demonstrate successful treatment of such contaminated pit waters using the methods proposed by MQSA---especially not in pits of this geology and scale.

**The future pit depth would be more than twice the height of the former World Trade Center towers! It will have a total area of approximately 4.1km<sup>2</sup>. After mine closure, the pit will fill with water forming a lake with a maximum depth of about 384m. [The WTC towers were about 405m high.]**

- **Long-term water quality degradation may require installation of a costly, active water treatment plant, which might be required to operate essentially perpetually after mine closure.**

- **Numerous stakeholders have stated that the overall Quellaveco project review / EIA process has been conducted with inadequate transparency.** It appears that they have not been allowed adequate involvement in the decision-making processes. In addition, access to complete copies of the EIA and related documents have been too limited and not widely distributed; public presentations have failed to employ independent data or opinions regarding the possible project impacts; the roles of the various government agencies have not been clear and often seem to conflict with each other.
- **The actual roles of the IFC in the project have not been adequately described to the public.** The International Finance Corporation (IFC) holds twenty percent ownership in the proposed Quellaveco project, simultaneously acting as an investor, an advisor to the project, a publicly-funded international lender, and as a development agency with great influence over the Peruvian Administration and the environmental and social aspects of the project. It is obvious from the very “low profile” taken by the IFC in this project that it is first and foremost a bank, not given to providing much specific project information to the public. However, the IFC is also part of the World Bank Group, an institution partly funded by contributions from member-country-taxpayers, and at least nominally chartered to promote international development. Thus, it has a special responsibility to encourage transparency in these processes.
- Despite the deficiencies mentioned above, the Quellaveco EIA has already been approved by the Peruvian government, specifically by the Ministry of Energy and Mines.

#### **Recommendations:**

- **The Quellaveco project should not proceed until:**
  - 1-a regional water resources study is conducted by independent researchers. This study should investigate all present and proposed uses and sources of ground and surface waters in both the Moquegua and Tambo Basins, and make recommendations on the equitable sharing of these resources. It should also investigate potential conjunctive uses of ground and surface water, and methods to prevent increases in the salinity of irrigated areas.
  - 2- the IFC orders an independent technical review of the EIA and related issues. This review should consider and integrate the findings of the independent regional water study. Normally the IFC staff perform their own review of such EIA's, but here it seems imperative that a review performed by parties independent of MQSA, the IFC, and the Peruvian government be conducted.
  - 3- the EIA is revised to reflect these independent comments, and is presented publicly at numerous regional meetings. This revised EIA should include an

actual analysis of alternatives, especially with respect to the various uses of water and waste disposal options. It should be based on actual market assumptions for the appropriate costs of water and should consider long-term environmental impact costs, based on truly conservative assumptions. This independent review should include collection of a statistically-reliable baseline data set for water quantity and quality, soils, air and aquatic biota, collected from “permanent” monitoring stations at all operations and water supply areas.

4-stakeholder’s groups have an opportunity to influence the environmental / water use decisions chosen for the Quellaveco project. Such citizen’s groups should have fair and culturally-appropriate opportunities to express their views and should receive complete explanations as to why decisions differing from their views are taken.

- **To promote long-term, sustainable irrigation and other water uses, MQSA should be required to use surface water supplied by the Pasto Grande Project.** This would ensure that the government and local users had control over water use decisions. The present proposal to extract ground water from the Chilota basin gives MQSA primary control over such ground water use decisions for at least 50 years, and possibly much longer. Mandating the use of Pasto Grande water would also allow the government to devise appropriate water pricing that would encourage minimal waste and contamination.
- MQSA should be required to pay the long-term costs required to successfully implement water minimization practices, including the conversion of existing local flood irrigation to modern drip methods.
- **The Peruvian government must require that some form of financial assurance be collected from the parent corporation of MQSA, i.e., Anglo American.** Given that there is little actual environmental oversight of mining projects by the Peruvian government, and because much uncertainty always exists regarding the future impacts that will truly occur, it is recommended that the Peruvian government require that some form of financial assurance be collected from the parent corporation of MQSA. The amount of the required bond / financial assurance should be determined via a study performed by an international party, independent of MQSA, the IFC, and the Peruvian government.

## 1.0 Introduction

### Purpose / Scope

The following report is intended to provide an independent review of the proposed Quellaveco Project Environmental Impact Assessment (EIA), focusing specifically on water resource issues, integrating those findings with observations about how the copper project may impact overall, long-term water use in the Moquegua-Tambo Basins of southern Peru.

This report is not intended to tell the citizens and regulators what to do. It is intended to provide independent technical support to the local stakeholders and NGOs, and to assist them in determining their own choices regarding the environment and development. Furthermore, the report is intended to present opinions that may constructively influence the oversight practices of the IFC. Hopefully this effort will help to minimize the inevitable project impacts, and will improve the chances that future impacts are actually paid for by Minera Quellaveco, not the Peruvian public or the shareholders of the development institutions.

All activities leading to the preparation of this report have been supported by funds from Oxfam America, Friends of the Earth International, and Global Green Grants, with logistical assistance from Asociacion Civil Labor of Lima. The findings and opinions are, however, my own.

### Background

The Quellaveco Project is operated by Minera Quellaveco S.A.(MQSA). Majority ownership of MQSA is held by Santiago-based Mantos Blancos, 80%, with 20% held by the International Finance Corp., the arm of the World Bank that invests in private / commercial sector projects. Mantos Blancos is a holding of the South African mining company Anglo American.

MQSA intends to produce copper, molybdenum, and silver (and possibly other products) from the Quellaveco site (see map) using open pit mining techniques, with the mine life expected to be about 44 years. The various mineral processing operations require massive amounts of water, at least 700 liters / sec (about 11,100 gallons per min.). MQSA is seeking permission to extract ground water for the various project operations from the highland Chilota Basin, transporting it to the Operations Area via a 55 km pipeline.

Unfortunately this diversion of water is being proposed in one of the driest regions of the world, the northern Atacama desert (<http://pubs.usgs.gov/gip/deserts/types/>), where the local economy is based largely on irrigated agriculture. Regional farmers produce very successful crops of palta (avocado), grapes, mangoes, peaches, figs, alfalfa, and less important yields of potatoes, corn, tomatoes, and onions. The irrigation also sustains significant cattle, dairy, wine and pisco (brandy) production. Despite the

extremely arid conditions, agriculture has flourished due to the development of government-funded irrigation projects. Nevertheless, the tremendous scarcity of water has already created numerous disputes between various water users. The entrance of MQSA onto the scene has the potential to greatly increase the already-fierce competition for water.

Many citizens and irrigation experts fear that this increased water competition will jeopardize the completion of the major irrigation project of the region, the Pasto Grande Project. This project presently collects water in the highlands, diverting much of it from the Tambo Basin for use in the Moquegua Basin. The Peruvian government has already spent more than \$164M for construction of the initial phases of this project, and several additional phases are intended to be completed in the future.

While the majority of the citizens and stakeholders I talked with favored development of the Quellaveco project because of promised economic benefits, they also wanted the irrigation programs to continue undamaged, and to expand. They clearly understand that agriculture can be a sustainable source of income, while mining, strictly speaking, is not. It is also clear however, that the majority of citizens mistrust the results of most of the studies previously produced by the company, their consultants, and the various government agencies. The stakeholders assume, in this situation, that the government favors the development of mining over the expansion of agricultural programs, because they assume mining will generate more foreign exchange and tax revenues.

Two other factors are also relevant when examining the overall Quellaveco Project picture. First, citizens of the region have decades of experience with the open pit copper mines and process facilities operated by Southern Peru Copper Corporation (SPCC), which are the largest employers in the region, but which are also the most serious polluters of water, soils, air and crops (Balvin Diaz, 1995). While much of the SPCC contamination resulted from older generation technology, much of what Quellaveco is proposing to do is quite similar, even the metallurgical processing. SPCC has pumped ground water from the Titijones area for use at Cuajone for many years, depleting most of the local surface water and ending the grazing of alpacas. For 35 years, the SPCC tailings were discharged into local dry stream channels, which flow to the Pacific Ocean. Beginning in 1997, the tailings were deposited in an engineered impoundment on land, but the excess water still flows, untreated, via the Rio Locumba to the ocean. Interestingly, some early stages of the SPCC Cuajone operations were partially funded by the IFC (Payer, 1982, pg. 162, 184). The specter of SPCC is always in the environmental background of this region.

Second, in June 2001, the region was devastated by one of the strongest earthquakes in recent history, one having a magnitude of Richter 8.4 ([http://earthquake.usgs.gov/activity/latest/eq\\_01\\_06\\_23/index.html](http://earthquake.usgs.gov/activity/latest/eq_01_06_23/index.html)). It produced widespread damage, injuries and deaths in the Arequipa-Camana-Moquegua-

Tacna areas. These events caused numerous families to move from damaged rural areas into the cities, placing even greater pressure on the already-overtaxed water and sewage systems. As a result, local citizens feel an even greater need for additional sources of income and jobs, like Quellaveco. Clearly this event is also a tangible reminder of the engineering care that must be included in the design of all proposed Quellaveco facilities. While the project may last for only 45 years, the engineered structures and waste accumulations must remain stable forever.

## 2.0 Findings

My opinions and observations result from:

- Travel and meetings in Peru conducted between October 26 and November 9, 2001.
- Visits to much of the Moquegua Basin, including the Ilo Valley, numerous locations within the Pasto Grande Project; portions of the Tambo Basin; the Chilota Basin; the proposed Quellaveco pit and waste rock locations; and Ite Bay.
- Review of most of the Minera Quellaveco EIA.
- Meetings and interviews with various local and national non-governmental organizations (NGOs), impacted individuals, water consultants, politicians, numerous Peruvian government staff, and representatives of water users groups.
- More than 30 years of applied hydrogeology and geochemistry experience, much of it at mining sites throughout the world.

### The COST Problem

The northern Atacama desert is one of the driest deserts in the world, yet mining companies in Peru are allowed to use essentially unlimited amounts of water at almost no cost for the water itself. In 2000, the Cuajone operations of SPCC paid only 13,600 soles (about \$ 4000) for 10 M cubic meters of surface water, and an additional 700 soles for 1.0 M cubic meters of domestic water (verbal communications, Sr. De La Cruz, INADE, Nov. 2001). These were fixed charges for the calendar year, and apparently there was no monitoring of the amounts actually provided and used. Apparently charges to mining companies for surface waters were initiated for the first time in 1998.

It appears, however, that SPCC should have paid much higher water use fees according to Peruvian Law. The Water Tariff Law of 1990 clearly states that the mining industry must pay a tax on selected items such as water, electricity, penalties, etc. The tax is 0.001% of one UIT per m<sup>3</sup> of water, where a UIT in the year 2000 was 2900 soles. SPCC should have paid 0.029 soles per m<sup>3</sup>, which is equal to 290,000 soles, or about \$85,000. Thus, in 2000, SPCC paid only about 5% of the of the required surface water tariff.

More interestingly, Minera Quellaveco and other mining companies in Peru are allowed to extract and use **groundwater at no cost** for the water itself. One caveat to this statement seems to be that Minera Quellaveco has already paid \$2M to the Pasto Grande Project for use of the Chilota water, apparently as a fixed fee. However, I received varying information about the exact purpose of this payment. It appears that the \$2M may have been given to fund research or costs needed to promote water minimization practices in the Moquegua-Ilo valleys. If either of these reports is true, the ground water itself is still free, and important portions of the Quellaveco project would be subsidized by the Peruvian citizens.

Several water experts noted that the most profitable industries in Peru all utilized ground waters.

While mining companies receive surface water at almost no cost, agricultural users are expected to pay between 84 and 100 soles (\$24.60--\$29.23) per irrigated hectare per year (Ricardo Catacora, Labor, Moquegua). These costs are based on the calculation that 18,000m<sup>3</sup> of water are available per year, for each hectare of farmland in the Moquegua-Ilo Valley. Clearly, this approach is extremely liberal and does not charge agricultural users for the actual volumes used. Fees are paid to the local water users association (Junta de Usuarios) and to the Comision de Riego, the irrigation commission, to cover various operating costs.

Nevertheless, it is informative to compare the approximate costs for surface water per m<sup>3</sup> paid by the various users:

| <u>Sector</u>                | <u>Approximate Surface Water Costs</u><br><u>per cubic meter</u> |
|------------------------------|--|
| Mining---legal / theoretical | 0.0290 soles (\$ 0.0085)   |
| Mining (SPCC, 2000)—actual   | 0.0014 soles (\$ 0.0004)   |
| Agriculture---actual         | 0.0055 soles (\$ 0.0016)   |

Thus, small agricultural users paid approximately four times as much as SPCC did in 2000 for a m<sup>3</sup> of surface water.

It is planned that surface water costs for newly irrigated lands supplied by the Pasto Grande Project will increase to \$250 per hectare per year, assuming that only 10,000 m<sup>3</sup> will be available per hectare---or \$0.025 per m<sup>3</sup> in the future.

Governmental oversight of water use by mining companies in Peru is largely non-existent. Thus, it is likely that no government agencies possess reliable, historic data on the amounts of ground water actually extracted and used by SPCC, for example. Such data certainly have not been made public. Lax government oversight together with essentially-free water encourages mining companies to waste the resource. Because water has been considered to have no cost, all decisions made and options considered in the EIA process are hopelessly biased.

### **Environmentally Significant Operations and Impacts**

After reading the Quellaveco EIA one might easily conclude that there will be no significant impacts to water resources. As is so often the case when consultants are handsomely paid to prepare a document intended to promote a billion dollar project, the perceived impacts seem to largely disappear. In numerous interviews with local citizens, officials and technical experts, I often was told that MQSA representatives and local politicians have verbally stated, at public meetings, that NO significant environmental impacts will result from this project. Let's examine these claims in the light of what is reported in the EIA, and what routinely happens at other open pit mine sites around the world.

### **Water Supply**

The economies of the Moquegua-Tambo Basins rely on irrigation water provided predominantly by government funded projects such as the Pasto Grande project. Sr. Pedro Pinto, assistant to Congressman Gonzalez, reported that all of the Pasto Grande water was originally reserved for agricultural and hydroelectric uses, and that in fact, "Demand (of water) exceeds supply." (Verbal communication, November 8, 2001).

When the Minera Quellaveco management stated that they needed about 700 liters per second for mine operation purposes, the government wanted to find ways to encourage development of this project. It appears numerous approaches were investigated to find the necessary additional water, including taking it directly from some form of expanded Pasto Grande project. Nevertheless, Minera Quellaveco has chosen the option of extracting ground water from the Chilota Basin, and transporting it by a 55 km pipeline to the mine operations areas. This choice gives MQSA greater control over the water for the roughly 50 years of intended use. They would not need to share it with the agricultural users, could control the planning and distribution themselves, and the approach is similar to what SPCC had previously done for much of their water supply. In addition, there seems to be a political pattern in Peru, as in many other countries, of considering surface and ground waters as separate entities, ones that have little connection to each other.

It is clear that ground water extraction from Chilota will greatly lower ground water levels regionally, causing stream flows to decrease or cease, most local springs will stop flowing, and the wetlands / bofedales will dry up. [The EIA predicts 894 hectares may dry up.] The Errol Montgomery (1999) report predicts maximum ground water declines to be about 140 m. Such declines often cause changes in the geochemical conditions within an aquifer (because of increased oxidation, etc.), thereby changing the quality of the water that flows from the basin---either as surface or ground water. Surface water samples collected at various locations within the Tambo Basin already exhibit excessive concentrations of boron and arsenic, presumably from natural sources---leaching out of the natural volcanic and volcanic-derived geologic materials, and possibly

aggravated by irrigation return processes (Meeting with Tambo Usuarios, November 6, 2001). Not all of these impacts will be as easily reversible as the EIA suggests.

While the EIA admits some of these impacts, they are obviously not considered serious, and no reasonable mitigation is presented. The government mandated that INADE (Instituto Nacional de Desarrollo) conduct several studies investigating the feasibility of taking water for mining purposes from the two basins. The INADE report acknowledges that some of these impacts will occur, but that if certain corrective changes are made, there will be enough water for both mining and agriculture to coexist. For example, INADE recognizes that the Tambo drainage flows will be reduced and therefore the Tambo users must be compensated in some way, probably through the construction of an additional dam (Tolapalca) followed by diversion of additional flow from the Pasto Grande project. Clearly this is an indirect federal subsidy for the proposed Quellaveco pumping from Chilota.

The INADE report also suggests that agricultural water use in the Moquegua and Ilo valleys must be reduced to allow development of the Quellaveco project, probably by changing from the use of flood to drip irrigation methods. Given the aridity of the area and the scarcity of water, this suggestion seems reasonable when one considers the long-term sustainability of agriculture. There is already evidence of increased salinity developing in certain areas. It seems wise to reduce the use of flood irrigation in the entire region, long-term. However, neither the EIA nor any other document I have reviewed seems to describe practical measures that would assist and ensure that the transfer to drip irrigation would actually be successful. It is relatively easy to envision the ground water being extracted from Chilota and utilized by Quellaveco, but converting the mass of farmers to new irrigation practices requires tremendous coordination, significant sources of new capital, and LONG-TERM training, maintenance of equipment, development of a network of equipment suppliers, etc. Ground water extraction by MQSA would occur quite rapidly, but successfully changing irrigation methods would take many years as a minimum. Such proposed changes will simply fail if long-term support is not somehow seriously provided by both MQSA and the Peruvian government.

Extraction of ground water by MQSA from Chilota has the potential to disrupt the proposed future stages of the Pasto Grande project. As such, the planned agricultural expansion in areas near Ilo would be threatened, as could the continued supply of water to the city of Ilo itself.

A related concern: the creation of large-scale government irrigation programs based on high technology approaches can make water so costly that farmers are encouraged to grow only more profitable export crops. This can make it uneconomic to grow basic food crops, and can increase the need to import foods

(Worster, 1985, p. 152). Thus, local citizens might be forced to import basic foods from other regions of Peru, or even from other countries.

The summary tables of the INADE (2001) report show that projected water use in the Moquegua and Ilo valleys would decrease in future years following water minimization changes---and construction of Quellaveco---, but that flows to the Tambo valley would remain the same as the present, presumably via some compensation mechanisms. One can imagine that this prospect increases the already fierce water competition between the water users of the two basins, and convinces some readers that INADE was coerced into producing “managed” report conclusions. [It was obvious from our meetings that the Tambo Basin water users were, in many ways, more organized and united than those of the Moquegua-Ilo valleys. It is possible that this political astuteness has contributed to their more favorable situation regarding future water allocations. It is unclear whether the Tambo Basin users will also be required to employ water minimization measures.]

The EIA does not include any discussion or data related to El Nino effects on precipitation, water uses/allocations or impacts. Obviously these effects are much less significant than in the north of Peru, but information gathered during this visit indicates that they must be considered. For example, the caretaker at the Pasto Grande dam stated that approximately 0.6m of snow was reported at the dam during the El Nino winter of 1990.

Ground water extraction from Chilota will also have dramatic impacts on the present users of these highland streams and springs. Most of these people are subsistence alpaca pastores / shepherds, do not own the grazing lands, and will clearly be displaced. While their futures are unknown, it is likely many will migrate to the more populated areas, magnifying the demand for employment and other services there.

As presently described, the proposed diversion of water from Chilota gives MQSA control of the water for approximately 50 years, minimizing the government’s control, thereby reducing the actual power to promote sharing of all water resources in the Moquegua-Tambo-Ilo region.

### **Water Diversion—Asana River**

Mining of the ore body by open pit methods will require diversion of the Asana River around the Quellaveco deposit via a canal and tunnel system 7.2 km long, returning the flow downstream of the proposed waste rock disposal area. Thus, approximately 7 km of the Rio Asana channel in the Operations Area would have no surface water flow in the future (EIA, Executive Summary, pg. 1-64). The EIA claims that such a diversion will not create a significant environmental impact as the downstream users don’t presently use this flow. Given the aridity of the area and the presence of 16 springs along the reach of the Rio Asana that MQSA plans to divert, it seems likely that this water flow is presently used. Also,

numerous sources mention the presence of trout in the Rio Asana at Quellaveco (see Baseline discussion).

More importantly, MQSA plans to generate approximately 1.1 million tons of waste rock, which would be deposited in the diverted portion of the Rio Asana riverbed. These massive piles of rock would be deposited directly onto the floor of the riverbed without any form of underlying liner, which would certainly cause contamination of the local ground water (see Waste Rock discussion). Such impacts could eventually degrade the downstream surface waters, which are used for domestic and agricultural purposes, both locally and in the Moquegua area.

Many copper mining operations use both milling and leaching / lixiviation techniques to extract copper and other metals from the ores. For example, both processes are used at the SPCC Cuajone and Toquepala facilities. While this option is not discussed in the Quellaveco EIA, it seems reasonable to anticipate that MQSA will also leach additional copper from the waste rock piles using acid solutions. If commercial leaching is conducted in the Rio Asana riverbed, serious contamination of the ground water and possibly the downgradient surface waters would be guaranteed. Such contamination could easily render these waters unfit for agricultural, livestock-watering, or human consumption uses.

The EIA presents no credible discussion to demonstrate that MQSA has performed an actual, detailed (technical, financial) evaluation of alternative waste rock disposal sites, so that impacts to the Rio Asana water quality might be avoided. **It would clearly be preferable to deposit the waste rock away from the Rio Asana drainage.**

Underground mining would prevent the development of a huge pit, the river may not need to be diverted, and much less waste rock would be generated. The EIA fails to present any detailed discussions to indicate that MQSA has sufficiently evaluated the technical, environmental and economic feasibility of underground mining options.

**At first glance, it may seem obvious that the choice of both open-pit-mining techniques and disposal of the waste rock in the riverbed are the logical approaches. However, these assumptions are often “exploded” when an independent analysis of the actual, long-term, environmental costs are reasonably evaluated. The EIA fails to present any such analysis.**

If the Rio Asana diversion is begun (around the open pit and the waste rock areas), it would be imperative to collect detailed data on the actual flow volumes and quality of water delivered to downstream water users. These data should be gathered by parties independent of MQSA. Without such independent data, downstream users will be unable to determine whether flows of adequate volume and quality are being delivered via the diversion structures. Thus, actual

enforcement of the terms of any diversion agreement will be of utmost importance, and this will require reliable data.

### **Pit / Pit Lake**

Mining from the Quellaveco deposit will involve excavation of a huge open-pit. The final pit dimensions are anticipated to be: approximately 3000m (N-S) by 1700m (E-W), and 930m deep (see EIA volume 5, Anexo O, pg. 44). The future pit depth would be more than twice the height of the former World Trade Center towers! It will have a total area of approximately 4.1km<sup>2</sup>. After mine closure, the pit will fill with water forming a lake with a maximum depth of about 384m. [The WTC towers were about 405m high.] The maximum lake water level would be below the surface elevation of the nearby stream channel, and the lake level would be controlled by discharge through the drainage tunnel to the Rio Asana channel downstream of the waste rock piles.

There is considerable uncertainty in the EIA about the amounts of ground water that will be encountered during pit excavation, and thus the refilling rates must also be quite uncertain. In fact, the EIA notes that the only pump test performed in the pit area was conducted in a well that had a total depth of only 200m, and the test was a mere 14 minutes in length (Vol.5, Anexo O, section 3.3.3, pg. 15). Such a test is totally inadequate to reasonably quantify projected pit inflows.

It seems only reasonable to conclude that the flows of many springs in the area of the open pit will be negatively impacted, even after the pit lake has filled. This conclusion is supported by comments in the EIA (vol. 5, Anexo O, pg. 55, section 7.2.2) stating that the equilibrium ground water level will be lower after the pit fills than before pit construction.

Geochemical data presented in the EIA confirm the obvious, that the rocks to be mined will be mineralized, meaning they will contain significant concentrations of most of the common metals and non-metals. Much of the mined rock will be composed of metal sulfide minerals such as chalcopyrite, pyrite, chalcocite, etc. EIA data also make obvious that large volumes of the rocks composing the walls and floor of the pit are likely to produce acid once they are exposed to air and water during pit excavation (see discussion below). Such acid would dissolve numerous chemical constituents from the rock, mobilizing them into the waters that would flow into the pit—both during active mining and after closure. During operation, the contaminated waters would be collected and recirculated.

However, the more difficult problems would begin after mine closure. While the lower depths of the pit would eventually be submerged, this would merely slow the rate at which acid and metals would be released, not stop it. And, of course, the rocks would have been exposed and allowed to react with air and water for the previous 44 years of mining plus an estimated 26 years of pit filling (EIA, Executive Summary, pg. 1-48). Massive amounts of soluble metals and salts would be available to be dissolved from the wall rock as the pit filled. Once the

lake forms, concentrations of many metals, and non-metals will be further increased as the strong Andean sun causes the dissolved contents of the waters to concentrate via evaporation, which would continue forever.

The EIA admits that some extent of degraded pit water quality may develop during and after the pit lake forms, but it makes the problem sound trivial; it is not. The degraded waters of some relatively shallow pit lakes (such as the Sleeper Pit in Nevada, USA) have had their acidity and metal concentrations lowered and improved by the addition of huge amounts of a lime-water mixture into the depths of the lake via flexible pipes. However, these are situations where the liming “experiments” were initiated less than 10 years ago, and the various layers of these lake waters are still contaminated when compared to aquatic life criteria. Clearly such “experiments” do not provide suitable evidence that such pit water quality can be effectively managed over the long-term, such as hundreds or thousands of years. Worse, the few examples for which data exist are pit lakes that are normally less than 400 feet deep---about 120m. The Quellaveco pit lake is anticipated to be 384m deep!

It is especially disingenuous, or incompetent, for the EIA authors to compare the possible water quality of the Quellaveco pit to that of the Yerington Pit in Nevada (see pg. 6-36). The Yerington Pit lake has a depth of only about 117m (about 390 feet), with a total pit depth of about 182m (605 feet), less than one-third the depth of the proposed Quellaveco pit lake (R. Hershey, Desert Research Institute, Reno, Nevada, verbal communication, November, 2001). Also, the Yerington copper was mined only from the oxide cap of the ore body, thus the lake water quality is not remotely comparable to what one would expect from the much deeper, sulfide-rich Quellaveco pit.

Given the degraded pit water quality at numerous open pits in arid environments around the world, it seems more reasonable to assume that the Quellaveco pit waters will also contain elevated concentrations of dissolved solids, sulfate, chloride, nitrate, boron, metals and metalloids such as: aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, uranium, and zinc.

Can MQSA cite evidence from the professional literature of even one long-term example of a similar deep pit in a desert area that has not degraded the resulting lake water quality? I can not.

In the long-term, it seems unreasonable to assume that water from this 384m-deep pit lake will not seep through the fractured rock downgradient towards the Rio Asana channel that will be filled with waste rock.

Most importantly, if a pit lake is formed as described, numerous engineered structures and facilities must be maintained in working order, *in perpetuity* after

the mine closes. Thus, MQSA and the government would need to assure that funds necessary to allow **perpetual** diversion of the lake water, control of storm flows, and possible water treatment would be available. These costs for staff, equipment and repairs would be truly long-term.

### **Waste Rock**

Excavation of the pit will produce more than a million tons of waste rock, which will be deposited in the Asana River riverbed, downgradient of the open pit and the subsequent pit lake. Waste rock piles will reach an average height of 320m. Despite the less-than-honest discussions in the EIA text, the geochemical, metallurgical, and water quality data presented in the Appendices indicate **that it is extremely likely that much of the waste rock will produce contaminated leachates**, causing some degree of water quality degradation in both surface and ground waters. These data clearly indicate that much of the waste rock to be mined is likely to generate acid and mobilize metals and other chemical constituents into the surrounding environment.

Normally, when mine operators attempt to define the geochemical and acid-generating characteristics of the site rocks, they begin by collecting many samples for static testing. Such static tests can indicate the tendency of rocks to form acid rock drainage, ARD, and to release contaminants. The static tests performed by Centro de Investigacion Minera y Metalurgia (CIMM) indicate that all of the waste rock samples tested were likely to form acidic leachates (Knight Piesold, October 2000, Quellaveco EIA, Respuesta a Las Observaciones Pendientes Para El Ministerio de Energia y Minas, Tabla A).

In addition, the EIA authors attempt to convince the reader that these wastes are not likely to create water quality problems through the use of **short-term** geochemical kinetic tests (EIA, section 3.6). The EIA discusses results from a few tests run between 10 and 20 weeks duration, and implies that such tests are adequate to give a useful understanding of the chemical reactivity of these rocks.

It is ironic that the authors of section 3.0 of Volume 2 of the EIA, Materials Characterization, chose to cite Price (1997) to justify their approaches to evaluating the geochemical characteristics of the ores and wastes. This document produced by the Ministry of Energy and Mines in British Columbia, Canada is entitled: Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia, B.C. Among the extensive recommendations and comments this agency gives are some the EIA authors failed to mention. For example, regarding Kinetic / Humidity Cell tests, Price (1997) states that stabilization of humidity cell tests often requires at least 40 weeks, can sometimes take over 60 weeks, and may even require several years (pg.100). While the predictive capability of even long-term kinetic tests is largely unproven, it is clear that the 10 and 20-week duration kinetic tests cited in the EIA are far too short to be meaningful.

An industry paper by the research staff of the Canadian mining company Placer Dome states the following: "Kinetic testing methodology prescribes that tests should last a minimum of 20 weeks, although Placer believes that this time frame is inadequate for reliable results unless the samples are extremely high in sulphur content, low in buffering capacity, and/or potentially highly reactive. On sites which warrant this type of testing **the company typically runs samples for two to three years**, allowing for a more complete assessment of slower or marginally reactive materials." (Mining Environmental Management, vol.3, no.4, pg.4-8, Dec., 1995, by J. D. Robertson and K. D. Ferguson.).

Similarly, the synthetic leaching procedures discussed in EIA volume 2, section 3.4 (the EPA 1311 / TCLP and EPA 1312 tests), have been used incorrectly. They were originally used by the U.S. EPA to give a very rough indication of the concentrations of selected constituents that could be easily mobilized from industrial wastes---without any chemical reactions occurring. These tests were never intended to be used to evaluate the reactivity of mining wastes at all.

Such tests are only suitable to give a rough indication of concentrations of **constituents that can be leached rapidly** (within 18 hrs.) from geologic materials **by rainwater-like liquids**. Thus, they do not accurately represent leachates that may develop from chemical reactions between rock and water that require considerable periods of time to occur, such as almost all weathering reactions, depletion of alkalinity, and the formation of acid rock drainage (ARD). Most significant, ARD production and many other reactions require the presence of specialized bacteria to speed the rates of reaction. It takes significant time for the bacteria to grow and multiply, and the bacteria populations will not thrive unless the pH is less than about 4.5. An 18-hour test does not allow time for these changes to occur. Also, these tests are not even particularly reliable for predicting the chemistry of leachates due to rainfall flushing in such arid settings since they are performed at pHs of 2.0, 3.5 and 5.0, while ambient pHs in such desert settings tend to be much higher. Furthermore, test procedures do **not** call for test leachate samples to be acidified prior to analysis---a strange omission considering that all regulatory agencies require that water samples intended for metals analysis be acidified prior to analysis. Failure to acidify leachate samples is likely to allow metals to settle out of solution, resulting in unrealistically low measured concentrations (see Sample Handling discussion). Also, the pH range of the test makes it unlikely that the leachate samples will contain realistic concentrations of metal oxyanion compounds (such as forms of arsenic, uranium, nickel, selenium, etc.) that may be quite mobile at elevated alkaline pHs.

Because MQSA plans to divert the flow of the Rio Asana around the open pit / pit lake and waste rock piles via diversion structures, surface and shallow ground water flows in this river reach are anticipated to be low. However, the waste rock will still react chemically with rainfall and seepage water from the upgradient pit lake. Also, as mentioned previously, one should seriously consider the negative

impacts to water quality if MQSA decides to commercially extract copper from the waste rock piles using leaching procedures.

### **Tailings**

Like the waste rock and pit wall rock, much of the tailings materials also are likely to become acid in the long-term. Unfortunately, these EIA sections are even less informative to the general reader than those on the waste rock. The EIA fails to explain that the mineral processing procedures proposed by MQSA rely on CHEMICAL as well as physical steps. Thus, numerous chemical reagents will be used to extract the copper, molybdenum, silver, and possibly other metals from the ore. Many of these reagents are potentially toxic to plants and aquatic organisms themselves. Such processing produces massive volumes of high pH, contaminated wastes called tailings. The EIA indicates that approximately 992,000,000 tons of tailings will be produced and deposited in an unlined impoundment in the Cortadero Creek drainage during the proposed life of the mine (Exec. Summary, p. 1-86). This tailings impoundment is expected to be 290m high.

The EIA further states (Volume 2, pg. 4-3) that the processing will be similar to that used at other copper porphyry processing facilities around the world, and will be essentially the same as that performed at SPCC's Cuajone and Toquepala facilities. These facilities use cyanide as one of the main flotation reagents to separate the copper from molybdenum and selected other metals. The high process pH (between about 10 and 12 initially) is maintained partly to allow the reuse of the cyanide, which is expensive, and to prevent the formation of highly toxic cyanide gas, which is extremely toxic and often lethal to humans.

Tailings produced at such facilities usually have high pHs and elevated concentrations of many toxic constituents such as: metals (aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc); non-metals (sulfate, nitrate, ammonia, boron); cyanide and related breakdown compounds (metal-cyanide complexes, cyanate, thiocyanate); possibly radioactivity (uranium, gross alpha and beta); and numerous organic compounds.

Despite stating that the mill processes will be essentially the same as those used at the SPCC facilities, the EIA fails to mention the proposed use of cyanide as a reagent at Quellaveco. In fact, the General Manager of MQSA, Mr. Jake Timmers, provided written documentation (email, November 12, 2001, J. Timmers to R. E. Moran) that states: "Cyanide. Our laboratory and pilot plant testwork has shown that the use of cyanide is NOT required in the flotation of Quellaveco ores. In the unlikely event that at some stage in the future the introduction of cyanide were to be shown to be required, we would obviously take all requisite steps. However, at this stage we were able to develop a reagent combination for the flotation process that does not require cyanide."

These claims by MQSA about cyanide use may prove to be true, or they may not. [It is clear that MQSA has seriously considered using cyanide as a reagent, because page 1-34 of the Executive Summary states that exploration samples were analyzed for “Cu sol. in CN”---copper soluble in cyanide.] In the meantime, it is important that the public be provided with adequate baseline data for all potentially impacted ground waters and surface waters that include, as a minimum, **total** cyanide determinations. Future monitoring should also add total cyanide to the list of monitored constituents; at present **no** cyanide forms are included. If future monitoring revealed the presence of significant concentrations of total cyanide, then specific determinations for cyanate and thiocyanate should also be added to the routine list of parameters to be determined (Moran, 2000, 2001). Given the present (and proposed) water quality sampling program, the public would have no information to indicate whether cyanide was being used or not.

The lists of chemical reagents to be used in ore processing are also not useful for the general reader. For example, a table on pg. 1-48, of the Resumen lists the following reagents to be used:

lime, MIBC, Dowfroth 250, AC6682, SF113, flocculating agent, and NaSH. Clearly these designations were not intended to tell a general reader anything. In an email (from J. Timmers to R.Moran, November 12, 2001), the MQSA general manager explains more directly: “As collectors we intend to use sodium isopropyl xanthate (such as in SF-113), and a mixture of dithiophosphate and thionocarbamate, such as in Aeropromotor AC 6682, produced by Cytec. As frothers we intend to use methyl isobutyl carbinol (MIBC) and polypropylene glycol methyl ether (Dowfroth 250), or equivalent products.” Obviously all of these organic reagents will be discharged with the tailings and some portion will seep into local ground waters.

**Many of these flotation compounds, such as the xanthates, are toxic to plants and aquatic organisms as a minimum (Australian Government Publishing Service, 1995), but little or no detailed toxicity information is publicly available, and regulators do not require that their concentrations be monitored.**

Tailings would initially be deposited at high pH, but would become acid through time. Once acid, the tailings would continue to release elevated concentrations of most of the natural constituents listed above. MQSA has stated that approximately 50 percent of the tailings volume is water, which will be contaminated. While some of this water will be captured and reused, much will evaporate into the air, and the remainder will slowly percolate downwards contaminating the shallow ground water. Clearly, such contaminated tailings seepage has the potential to also pollute nearby surface waters, especially following rainfall events.

The EIA states (Executive Summary, pg. 1-94, 1-96) that there will be no negative impacts to water quality as a result of tailings disposal, but that if there were, passive treatment methods would be employed. Unfortunately, the technical literature and experience demonstrate that **passive** treatment solutions will not allow sufficient improvement in water quality to meet international discharge standards and the waters would likely be toxic to sensitive plants and aquatic organisms to an undetermined degree. All of these tailings waters will now be unsuitable for many agricultural and domestic uses.

What volume of water will be contaminated by such processes? We don't really know. However, it is informative to note that the INRENA staff estimate that SPCC had a minimum of about 1.0 m<sup>3</sup> per second (1000 liters per second) of tailings wasted into Ite Bay for decades, and approximately half of this volume was water (verbal meeting comments, November 7, 2001). Balvin (1995) estimates that about 1700 liters per second of SPCC tailings water were lost prior to 1995 (pg. 52). Balvin (1995) also estimated that SPCC required 2360 liters per second (average) of water for all processing activities. INRENA further estimates that SPCC has extracted about 200 to 300 liters per second of water from Lake Suches, thus the remaining process waters must have been ground water from the Titijones area, extracted over almost 50 years.

Thus, it is possible that MQSA or possibly the Peruvian public will, in the future, be required to construct an extremely costly **active** treatment plant to clean the various waters contaminated by the mining and processing activities. Some degree of active treatment is already required at the Yanacocha and Antamina mines.

Based on the EIA, no actual monitoring wells were constructed and no long-term aquifer testing was performed in the proposed tailings area. Thus we lack detailed baseline information on either the water quality or the volumes of ground water present for the Cortadera region.

Why has the Peruvian government or the IFC not required that a report summarizing the environmental impacts from SPCC's operations be prepared by independent parties? We might be able to learn from the mistakes of the past, and decisions relating to the Quellaveco project could be greatly improved.

### **Water Quality—General Comments**

**Sulfide Rock.** Much of the rock MQSA will be mining will be sulfide-rich material. Additional evidence of the pervasive impacts associated with mining sulfide ores can be gotten by reading Todd and Struhsacker (1997). This study was commissioned by the mining industry in an attempt to favorably influence mining legislation in the State of Wisconsin (U.S.A.). It was intended to show "...that a mining operation has operated in a sulfide ore body in the United States and Canada for at least 10 years without polluting groundwater or surface water from

acid drainage at the tailings site or at the mine site or from release of heavy metals.” It was also intended to show “...that a mining operation that operated in a sulfide ore body in the United States or Canada has been closed for at least 10 years without polluting groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals.” Data from hundreds of mine sites from the U.S. and Canada were investigated. **A careful reading of the details in this paper shows that the authors were unable to locate any sites that totally complied with the criteria at the time the paper was published.**

**Sample Handling.** There is considerable reason to question whether water quality samples collected as part of this EIA correctly represent the existing surface and ground water conditions. In volume 5, Annex, page 20, the EIA states that water quality samples were filtered and preservatives were added **in the Quellaveco offices after sample collection.** This approach is totally contrary to internationally-accepted sampling procedures. For decades it has been standard practice to filter and preserve in the field, at the time of sample collection. There are several very practical reasons for not waiting to treat the samples.

Firstly, in areas as remote as the Quellaveco sites, it may be hours or even days before samples are returned to the mine offices. Also, mining-related waters, both surface and ground waters, are usually unstable chemically, with the dissolved contents tending to form solid particles that drop out of solution, falling to the bottom or attaching onto the sides of the sample bottle---if preservative is not added rapidly. The sampling bias is further aggravated by filtering these chemically-unstable samples which are now many hours or days “old”. This removes the solid particles, which were previously dissolved, thus these contents are not available to be detected in the later laboratory analyses. **Not surprisingly, this approach results in lower measured concentrations of most chemical constituents.**

### **Baseline Data**

Mining EIA documents usually contain apparently-sophisticated computer simulations and predictions, often intended to demonstrate that significant impacts will not occur. Far more useful to the public and regulators would be a summary of all the actual flow and water quality data from the potentially impacted areas ---**collected prior to initiation of any mining-related activities.** Unfortunately, such a simple table is often lacking in mining EIAs, thus, it is frequently not possible to defensibly-demonstrate that actual impacts have been caused by the mining-related activities.

The Quellaveco EIA does not contain any consolidated summary of water flow and water quality data for the Operations and Water Supply Areas. This is best accomplished by compiling simple statistical summaries of the available data for each monitoring station (surface and ground water). That is, the relevant water

quality and flow data need to be compiled for all years, from all relevant stations. These data should be analyzed statistically showing, as a minimum for each constituent/ parameter, ranges of concentrations (maximum-minimum), number of determinations considered (n), median, and mean concentrations, by station. In addition, MQSA should be required to collect samples monthly for a complete year, from stations immediately upstream and downstream of the proposed project area. These sites should be chosen to include the closest locations most likely to be contaminated in the event of an unforeseen release via either surface or subsurface pathways.

Despite frequent references in the EIA to baseline data, no actual summarized baseline has been compiled for water resources. In fact, the past water quality sampling has not been conducted at a consistent set stations, and many of the sampled sites will be removed by mining. Thus, there will be no continuity in the baseline record.

While baseline water quality in the Quellaveco area has not specifically been summarized in the EIA, it was obviously high quality in the not-too-distant past. The professional memoirs of a past general manager for the SPCC operations, Sheldon Wimpfen, indirectly shed considerable light on baseline conditions. In Tin Peaks and Silver Streams (available at [http://bureauofmines.com/TPSS\\_08.HTM](http://bureauofmines.com/TPSS_08.HTM)), Wimpfen states the following about the Quellaveco streams, in 1967 to 1969, in chapter 8:

“Trout fishing was great! Each expatriate had either a passenger car or pickup with no limitation on use. There were lots of places one could go and explore. A trip we liked was to head on up above the mine and take the road to Quellaveco, the site of another deep canyon and another copper deposit. One dropped about 3,000 feet down to the Asana River at Quellaveco and then you had to climb out on a zig zag road about 3500 ft. to head for Cuajone. The streams at the bottom of some of these canyons provided excellent trout fishing with catches up to 16 inches and three and four pounds. The Asana at Quebrada Quellaveco and the Torata north of the Cuajone camp were fun trout streams.”

### **3.0 The EIA Process**

During my Peruvian visits and meetings it became obvious that most stakeholders had never seen or read the majority of the EIA. Frequently they complained that they had no easy access to the entire EIA, and often they had only seen the Executive Summary volume. Personal observations showed that it was often cumbersome for stakeholders to make appointments to view the few complete copies available, and it was even more difficult and time-consuming to photocopy important sections, given the numerous restrictions on times of availability. Clearly there need to be more complete copies of the EIA made readily available to the public.

More importantly, an EIA written to openly inform the public about potential impacts and proposed solutions can usually be well summarized in one volume, especially if the authors carefully use figures and tables. Unfortunately, this EIA is poorly organized, repetitive, and fails to present information graphically, thus it required seven volumes. Hence, any stakeholder wishing to become informed must work very hard---which seems to have been the purpose of the authors.

This EIA is a document obviously biased towards showing that there will be few if any significant long-term impacts. There are numerous examples of poor and biased science and interpretation in this document, many of which have been noted previously.

Members of public groups often stated that they need to be able to obtain independent project-related information, such as water quality samples--- samples not collected by MQSA or their representatives. They clearly felt the various government agencies were not available to support them in collecting such information. Thus, the entire technical and environmental perspective is the one presented by the mining company.

In my many meetings, government officials frequently made comments indicating that there is much confusion and a lack of transparency over which agencies actually have responsibility to oversee portions of the EIA process. This confusion prevents any one government agency from having to take actual responsibility, and it certainly prevents the public from effectively influencing the process. For example, INRENA reviewed the EIA, and made suggested comments and changes. However, when we met with INRENA, it was clear that they did not know that the final approval for the Quellaveco project had been made by the Ministry of Energy and Mines, and that their previous recommendations had not been included in the MEM approval resolution (Resolution 266-2000-EM / DGAA, 19 Dec.2000).

The Quellaveco project involves complicated interrelationships between ground and surface waters in agricultural and non-agricultural sectors. However, INADE claims that they deal only with surface water issues related to agricultural matters. INADE officials state that INRENA has the legal responsibility for making decisions about giving water to Minera Quellaveco, but INRENA claims they can only make technical recommendations, and that they do not have approval power. It is unclear whether CONAM, the Comision Nacional de Medio Ambiente, has played any significant role in the Quellaveco process. Obviously the power relationships here are quite complicated, and are very confusing to the general public.

More open and reasonable environmental decision-making seems to occur in countries where the environmental control over mining issues resides in an

agency that is independent from the ministry responsible for regulating and promoting mining. Such is not the case in Peru.

The Quellaveco EIA has been approved by the Peruvian government, but what has been the oversight role of the IFC in this process? MQ states that representatives of the IFC have thoroughly reviewed the project, and that an IFC-revised EIA is supposed to be released in Washington, D.C. Various NGOs reported that this revised EIA was supposed to be released at the end of October 2001, but was not. However, staff of Minera Quellaveco's "parents", both Mantos Blancos and Anglo American have stated that there is no real incentive to release the final EIA---it would only generate criticism for the project proponents. While the IFC holds a 20 percent financial stake in this project, much higher than the 5 percent they have in the very profitable Yanacocha project, they have not shown any inclination to make the project details public, to involve the citizens, or to push MQ to release the final EIA. None of the IFC's role in the EIA process is visible to the interested stakeholders.

Informed citizen consent is now considered fundamental to approval of large projects by the World Commission on Dams (2000). This entire World Bank-commissioned report can be found at [www.dams.org](http://www.dams.org). However, the portion most relevant to citizen involvement is Chapter 7: Enhancing Human Development: Rights, Risks and Negotiated Outcomes, which can be found at: <http://www.damsreport.org/docs/report/wcdch7.pdf>.

#### **4.0 Standards / Guidelines**

The EIA and other Peruvian mining studies often cite water quality standards and guidelines that are extremely lax when compared to many other international standards and criteria, as is made clear in the following table.

This table is presented for comparison purposes only, and is not intended to imply that one set of guidelines is more pertinent to the situation at Quellaveco than another. Furthermore, the original sources for this table contained technical details, often in the form of complicated footnotes, which may not have been included here. Nevertheless, the table is useful to gain an approximate understanding for some international standards as applied to various water uses--drinking water, agricultural uses, aquatic life protection, and industrial discharges. Note that the table does not include any of the numerous organic compounds that might be found at a mining site.

Firstly, this table demonstrates that many of the constituents of international importance are not mentioned in the EIA and their presence or concentration at Quellaveco has not been determined. According to Peruvian law and World Bank guidelines, mining companies are not required to monitor for many of these potentially harmful constituents. As discussed previously, many of the flotation

chemicals (such as xanthates) used by mining companies are known to be toxic to numerous organisms, but no governments require monitoring for them.

Some of these World Bank and Peruvian guidelines / standards are not useful for revealing actual mining water quality problems. For example, there is no requirement to monitor for sulfate, despite the fact that sulfate is the best single indicator of the early development of acid rock drainage. Sulfate is also useful to indicate the presence of contamination from copper leaching facilities where sulfuric acid is used.

Arsenic is an important natural constituent in mineralized rock, and is often present in high concentrations in Peruvian soils and ores. However, the Peruvian arsenic standard is 0.10 mg/L, twice as high as the present drinking water standard in the U.S., and ten times as high as the proposed U.S. standard. (Here I have assumed that the Peru standard refers to dissolved arsenic as the Law does not seem to state whether it pertains to dissolved or total concentrations). Interestingly, the World Bank arsenic (total) guideline for industrial discharges to surface waters is equally lax.

The Peruvian cyanide standard fails to define what form of cyanide is to be measured, thus in the table it is assumed to refer to free cyanide. Both the World Bank and Peru list standards / guidelines for free cyanide, despite the fact that most experts would agree that there is no truly accurate and reproducible analytical method for determining free cyanide. More importantly, Peru seems to have no requirement that companies monitor for total cyanide, which is much more useful environmentally (Moran 2002).

Copper ores routinely contain elevated concentrations of selenium and molybdenum, yet there is no requirement to monitor for molybdenum, and the Peruvian standard and World Bank guideline for selenium are both much higher than concentrations that would often be toxic to aquatic life.

Any revision of the Quellaveco EIA should evaluate water quality with respect to the broad spectrum of appropriate international standards and possible water uses.

## SELECTED WATER QUALITY GUIDELINES

| Parameter<br>(mg/L, unless noted) | World Bank<br>1998 <sup>1</sup> | WHO<br>1996 <sup>2</sup> | US EPA<br>Dr.<br>Water <sup>3</sup> | US EPA<br>Aq Life<br>Ac. Chr. <sup>4</sup> | Canada<br>Agricult. <sup>5</sup><br>Irr Live. | Peru <sup>6</sup><br>Dr. Water |
|-----------------------------------|---------------------------------|--------------------------|-------------------------------------|--|---|--------------------------------|
| <b>pH (units)</b>                 | 6-9                             | 6.5-8.5                  | 6.5—8.5                             | 6.5 9.0                                    |   |                                |
| <b>Total dissolved solids</b>     | -                               | 1000                     | 500                                 |  | I:500-3500<br>L: 3000                         | --                             |
| <b>Total suspended solids</b>     | 50                              | -                        |                                     |  |   |                                |
| <b>Turbidity (NTU)</b>            | -                               | 5                        |                                     |  |   |                                |
| <b>Oil and Grease</b>             | 10                              | -                        |                                     |  |   |                                |
| <b>Total Phosphorous</b>          | 2.0                             | -                        |                                     |  |   |                                |
| <b>Sulphate</b>                   |                                 |                          | 250                                 |  | 1000  | --                             |
| <b>Sulphide</b>                   | 1.0                             | -                        |                                     | .002 .002                                  |   | 1.0                            |
| <b>Chloride</b>                   |                                 |                          | 250                                 |  | I:100-700                                     | --                             |
| <b>Chlorine, tot. residual</b>    | 0.2                             |                          |                                     | .019 .011                                  |   |                                |
| <b>Fluoride</b>                   | 20.0                            |                          | 4.0 (2.0)                           |  | 1.0 1.0-2.0                                   | --                             |
| <b>Ammonia (as N)</b>             | 10.0 (as NH <sub>3</sub> )      |                          |                                     | A.002-.325<br>C.032-.049                   |   | --                             |
| <b>Nitrate</b>                    | -                               | 50                       | 10 (as N)                           |  | 1.0   | 0.01                           |
| <b>Aluminum</b>                   |                                 |                          | 0.05—0.2                            | .75 0.087                                  | 5.0 5.0                                       | --                             |
| <b>Antimony</b>                   |                                 |                          | 0.006                               | -  |   | --                             |
| <b>Arsenic (total)</b>            | 0.1                             | 0.01                     |                                     |  | 0.10 .025                                     |                                |
| <b>Arsenic (diss.)</b>            | -                               | -                        | 0.05 (0.01)                         | 0.34 .150                                  |   | 0.10                           |
| <b>Cadmium</b>                    | 0.1                             | 0.003                    | 0.005                               | 0.0043--<br>0.0022                         | I: 0.0051<br>L: 0.08                          | 0.01                           |
| <b>Cr (hexavalent)</b>            | 0.1                             | 0.05                     |                                     | .016-- .011                                | .008-.050                                     | --                             |
| <b>Chromium (total)</b>           | 0.5                             |                          | 0.1                                 |  |   | 0.05                           |
| <b>Copper</b>                     | 0.5                             | 2.0                      | 1.3 (1.0)                           | 0.013--<br>0.009                           | I: 0.2--1.0<br>L: 0.5-5.0                     | 1.0                            |
| <b>Iron (total)</b>               | 3.5                             | 0.3                      | 0.3                                 | 1.0  | I: 5.0  | --                             |
| <b>Lead</b>                       | 0.2                             | 0.01                     | 0.015                               | 0.065--<br>0.025                           | 0.20 0.10                                     | 0.05                           |
| <b>Manganese</b>                  |                                 |                          | 0.05                                |  | 0.2   | --                             |
| <b>Mercury</b>                    | 0.01                            | 0.001                    | 0.002                               | 0.0014—<br>0.00077                         | L: 0.003                                      | 0.002                          |
| <b>Molybdenum</b>                 |                                 |                          |                                     |  | I:10-50µg<br>L:500µg/L                        | --                             |
| <b>Nickle</b>                     | 0.5                             | 0.02                     |                                     | 0.47--.052                                 | 0.2 1.0                                       | 0.002                          |

<sup>1</sup> World Bank General Env.-Proc. Wastewater discharges to surface waters: Pollution Prevention and Abatement Handbook, July 1998:  
[<http://wbln0018.worldbank.org/essd/PMExt.nsf/d798dd11401b4e068525668000766b9d/cb6c29e967664f658525666e00705a4e?OpenDocument> ]

<sup>2</sup> World Health Organization, 1996---Drinking Water guidelines.

<sup>3</sup> U.S. Environmental Protection Agency (US EPA) Drinking Water Standards:

<http://www.epa.gov/safewater/mcl.html#inorganic>

<sup>4</sup> US EPA Water Quality Criteria for Aquatic Life—acute(Ac)and chronic(Chr):

<http://www.epa.gov/OST/standards/index.html#criteria>

<sup>5</sup> Canadian Guidelines for the Protection of Agricultural Water Uses(1999)—Irrigation (Irr) and Livestock (Live.):

[http://www2.ec.gc.ca/cegg-rcqe/agrtbl\\_e.doc](http://www2.ec.gc.ca/cegg-rcqe/agrtbl_e.doc)

<sup>6</sup> Peruvian Drinking Water Standards, Class 1—Water for Domestic Use with Simple Disinfection: Ley General de Aguas y Sus Reglamentos, Decreto Ley No. 17753, 1987.

|                                 |     |      |           |           |                         |        |
|---------------------------------|-----|------|-----------|-----------|-------------------------|--------|
| <b>Selenium</b>                 | 0.1 |      | 0.05      | 0.005     | I: 0.02-.05<br>L: 0.050 | 0.01   |
| <b>Silver</b>                   | 0.5 |      | 0.10      | 0.0034    |                         | --     |
| <b>Thallium</b>                 |     |      | 0.002     |           |                         |        |
| <b>Uranium (mg/L)</b>           |     |      | 30 (2003) |           | 0.01 0.2                |        |
| <b>Zinc</b>                     | 2.0 | 3.0  | 5.0       | 0.12—0.12 | I: 1.0-5.0<br>L: 50.0   | 5.0    |
| <b>Alpha,Gross (picoCi/L)</b>   |     |      | 15        |           |                         |        |
| <b>Radium226+228 (picoCi/L)</b> |     |      | 5         |           |                         |        |
| <b>Cyanide (total)</b>          | 1.0 | -    |           |           |                         |        |
| <b>Cyanide (free)</b>           | 0.1 | 0.07 | 0.2       | .022—.052 |                         | 0.20 ? |
| <b>Cyanide WAD</b>              | 0.5 | -    |           |           |                         |        |

<sup>1</sup>World Bank General Env.-Proc. Wastewater discharges to surface waters: Pollution Prevention and Abatement Handbook, July 1998:  
[<http://wbln0018.worldbank.org/essd/PMExt.nsf/d798dd11401b4e068525668000766b9d/cb6c29e967664f658525666e00705a4e?OpenDocument> ]

<sup>2</sup>World Health Organization, 1996---Drinking Water guidelines.

<sup>3</sup>U.S. Environmental Protection Agency (US EPA) Drinking Water Standards:  
<http://www.epa.gov/safewater/mcl.html#inorganic>

<sup>4</sup>US EPA Water Quality Criteria for Aquatic Life—acute(Ac)and chronic(Chr):  
<http://www.epa.gov/OST/standards/index.html#criteria>

<sup>5</sup>Canadian Guidelines for the Protection of Agricultural Water Uses(1999)—Irrigation (Irr) and Livestock (Live.): [http://www2.ec.gc.ca/ceqg-rcqe/agrtbl\\_e.doc](http://www2.ec.gc.ca/ceqg-rcqe/agrtbl_e.doc)

<sup>6</sup>Peruvian Drinking Water Standards, Class 1—Water for Domestic Use with Simple Disinfection: Ley General de Aguas y Sus Reglamentos, Decreto Ley No. 17752, 1987.

## 5.0 Financial Assurance

It is clear that mining activities often produce **short-term** financial benefits to communities and workers (jobs, general business spending) and frequently improve portions of the local infrastructure, such as roads, electrical and water delivery systems, etc. However, these same activities also produce **long-term** environmental and health impacts for which the mining companies often avoid paying (Moran, R.E., 2001c).

Mining has always been a “globalized” industry where international companies operate in developing countries, usually as separate subsidiaries of parent companies. If a company develops financial problems, possibly as a result of declining metals prices, or because of business mistakes, or even outright fraud, the subsidiary may be forced to close unexpectedly and might declare bankruptcy. These companies may have caused serious environmental problems, but until recently in most countries, regulators failed to require mining companies to pay costs associated with many of the post-operational impacts. Either the contamination remained unremediated, serving as a “hidden cost” to the impacted public, or the government / taxpayers had to pay for the cleanup.

The Mineral Policy Center (Da Rosa, 1999) estimates that there are more than 500,000 abandoned mines in the USA, which could cost the government between \$32 billion and \$72 billion US to remediate.

Modern hardrock mining employs technologies that allow the exploitation of low-grade ores (open-pit mining / chemical leaching), but result in massive operations that can produce impacts much more damaging than those of older technologies. These new technologies, together with pro-active environmental standards have greatly increased costs to restore lands and waters damaged by mining. Higher remediation costs together with several globalization factors, such as more flexible capital markets and drastic commodity price fluctuations have contributed to a recent increase in the number of unexpected mine closings and bankruptcies. Thus, the amount of public environmental liability resulting from mining activities has exploded.

Governments or citizen's groups have sometimes litigated against these companies in an attempt to recover some costs, but often the bankrupt operating company has few if any remaining assets.

An instructive example is the Summitville mine which caused extensive aquatic contamination in Colorado, USA. Environmental permits for this mine were approved with little oversight during the national economic recession of the early 1980's. Local officials and citizens wanted jobs. Subsequently the company went bankrupt costing the taxpayers between \$150 million and \$200 million US for remediation, and the problems are not completely fixed. The bond provided by the operating company to the State of Colorado (in the mid-1980's) was only about \$1million US, and most of this was not convertible to cash. The U.S. government brought litigation against the financially-sound parent company, but because it was Canadian-based, with most of its assets outside the U.S. A., this attempt was cumbersome and initially unsuccessful. Frequently, international and bankruptcy laws shield parent companies from liability---especially environmental liability.

Now, most new hardrock mines in the USA and Canada are required to guarantee that future environmental costs will be paid for (both during operation and after mine closure), even if the company goes bankrupt. All of the western U.S. states now require mining companies to provide some form of "reclamation bonding"---guaranteed funds intended to ensure that operations are conducted responsibly and that limit public liability in the event that mining companies fail to remediate adequately. However, the bonding requirements of these states vary greatly in effectiveness.

This process most often requires the mining company to purchase a bond from an insurance company, which is then held by an independent trustee. It is presently common in the USA and Canada for bonds to cover all anticipated costs of post-closure earth moving and revegetation. However, programs

requiring mining companies to post bonds covering long-term water quality problems are in an early stage of development and application. Regulators have usually required companies to supply adequate financial assurance only for impacts they can reasonably *predict* will occur. The predictions have usually been developed by consultants paid by the mining companies---and results have often been too optimistic. As a result, post-operational impacts, especially the very expensive impacts involving long-term water quality problems, were often unforeseen, leaving the governments with inadequate funds to complete (or often begin) a clean-up.

A recent study by Kuipers (2000) summarizes the bonding programs of the various agencies of the western USA, provides case studies, and summarizes the potential unfunded reclamation liabilities for each state. The authors claim the total, potentially unfunded reclamation liability for all the western states is more than one billion dollars (US). High-quality, independent predictions of future liability would obviously provide more reasonable bond estimates and reduce the unfunded liability.

Costs associated with the operation of a water treatment plant often represent the most significant long-term remediation costs (examples: Summitville, Colorado; Zortman-Landusky, Montana; Golden Sunlight, Montana). Thus, bonding for anticipated, post-closure water quality problems is becoming quite common in the USA and Canada. For example, the State of New Mexico (USA) recently conducted bonding evaluation studies that will require two mining companies to provide bonds greater than \$100 million for mine remediation and operation of water treatment facilities (Moran and McLaughlin Water Engineers, 2001).

Insurance is another form of financial assurance that is being evaluated by regulators. They are considering requiring operators of new mines to purchase enhanced forms of environmental liability insurance prior to permit approval. It is important to note that insurance companies normally set insurance coverage charges on the basis of the risks associated with accidents occurring at a *population* of similar sites---not on predictions for the future at any one site.

Financial assurance is usually inadequate or lacking in developing countries, thus citizens and governments subsidize environmental impact costs. For example, after the tailings spill at a gold processing site in Baia Mare, Romania (February-March 2000), it was discovered that the Romanian government, being a partner in the operation, did not require the company to post any financial bond or other financial assurance. Following the spill, the company was required to pay a fine equivalent to \$US170! The company is presently being sued in Australian courts by the Hungarian government to recover damages of more than \$150 million US.

The Quellaveco EIA makes no mention of Financial Assurance issues.

[The main categories of environmental financial assurance options are discussed in: Da Rosa (1999), and Kuipers (2000).]

## 6.0 References Cited

Australian Government Publishing Service, 1995(May), Sodium Ethyl Xanthate, Priority Existing Chemical No. 5, Full Public Report. Available at:  
<http://www.nicnas.gov.au/publications/CAR/PEC/PEC5/PEC5index.htm>

Balvin Diaz, Doris, 1995, Agua, Minería, y Contaminación---El Caso Southern Peru: Ediciones Labor, Ilo, Peru.

Da Rosa, Carlos, 1999, Overburdened: It's Time to Shift the Burden of Hardrock Mine Cleanup from the Taxpayers to the Mining Industry. Mineral Policy Center, Issue Paper No.2, Washington, D.C., 20 pgs. [available at website:  
<http://www.mineralpolicy.org/publications/pdf/overburdened.pdf>].

Errol L. Montgomery and Assoc., 1999 (22 Dec.) Resultados de las Investigaciones Hidrogeológicas de la Fase 3 Para Desarrollar el Suministro de Agua Subterránea en la Cuenca Chilota: Prepared for MQSA; several volumes.

International Finance Corp., 1998, Policy on Environmental Assessment; available at:  
<http://www.ifc.org/enviro/EnvSoc/Safeguard/EA/ea.htm>

INADE, August 2001, Balance Hidrológico en los Valles de Tambo, Moquegua, e Ilo., Version Final, Lima, Peru.

Knight Piezold Consultores S.A., April 2000, Estudio de Impacto Ambiental del Proyecto Quellaveco; prepared for Minera Quellaveco: 7 volumes.

Kuipers, J.R. (2000). Hardrock Reclamation Bonding Practices in the Western United States: National Wildlife Federation. Boulder, Colorado, U.S.A., 416 pgs. [This document and a summary can be obtained at:  
[http://www.mineralpolicy.org/publications/pdf/Bonding\\_Report\\_es.pdf](http://www.mineralpolicy.org/publications/pdf/Bonding_Report_es.pdf)]

Moran, Robert E., 2000, Cyanide in Mining: Some Observations on the Chemistry, Toxicity and Analysis of Mining-Related Waters: *in* Proc. Central Asia Ecology—99, Lake Issyk Kul, Kyrgyzstan, June, 1999. [Available at the UNEP website: <http://www.natural-resources.org/environment/baiamare>].

Moran, R.E., 2001a, More Cyanide Uncertainties: Lessons from the Baia Mare, Romania, Spill---Water Quality and Politics. Mineral Policy Center Issue Paper No. 3, Wash. D.C., 15 pgs.

Moran, R.E. and McLaughlin Water Engineers, 2001(May), A Review of Cost Estimates for Collection and Treatment Systems for Closure / Closeout Plans--- Chino Mine and Tyrone Mine, 2 reports; prepared for New Mexico Environmental Department.

Moran, R.E., 2001b, Una Mirada Alternativa a la Propuesta de Minería en Tambogrande, Perú: Informe encargado por: Oxfam America, Mineral Policy Center, Environmental Mining Council of British Columbia (available in both english and spanish at: <http://www.oxfamamerica.org/advocacy/extractive.html>).

Moran, R.E., 2001c, Aproximaciones al Costo Económico de Impactos Ambientales en la Minería. Algunos ejemplos en Estados Unidos y Canadá: Ambiente y Desarrollo. Vol. XVII, N°1, March 2001, CIPMA, Santiago, Chile, pg.59-66.

Moran, Robert E., 2002, De-coding Cyanide. A Submission to the European Union and the United Nations Environment Programme: Sponsored by Hellenic Mining Watch, Ecotopia, CEE Bankwatch, FOE Europe, FOE Hungary, FOE Czech Republic, Food First Information and Action Network, Minewatch UK, and Mineral Policy Center, 25 pg.  
[\[Available at: http://www.hnutiduha.cz/publikace/studie/kyanidova\\_studie.pdf \]](http://www.hnutiduha.cz/publikace/studie/kyanidova_studie.pdf)

Payer, Cheryl, 1982, The World Bank—A Critical Analysis: Monthly Review Press, New York, 414 pg.

Price, William A., 1997, Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia: B.C. Ministry of Employment and Investment, 141pg. plus appendices.

Robertson, J.D. and K. D. Ferguson, Dec. 1995, Predicting Acid Rock Drainage: Mining Environmental Management, vol.3, no.4, pg.4-8.

Todd, J.W. and D.W. Struhsacker, 1997, Environmentally Responsible Mining: Results and Thoughts Regarding a Survey of North American Metallic Mineral Mines: Society for Mining, Metallurgy, and Exploration Preprint 97-304, Littleton, Colorado.

World Commission on Dams (Nov., 2000), Dams and Development—A New Framework for Decision-Making: World Commission on Dams, [www.dams.org](http://www.dams.org)

Worster, Donald, 1985, Rivers of Empire: Water, Aridity and the Growth of the American West; Pantheon Books, New York, 402 pgs.

The Quellaveco Mine- Free water for mining in Peru's driest desert?