PANELIST PRESENTATION

Mining Industry Issues

William J. Adams, *Kennecott Utah Copper Corporation*

I was asked to discuss some of the sediments issues that are important to the mining industry. I have to qualify that term a bit. The mining industry that I can speak to and represent is the hard-rock mining industry, not the coal industry. The principal mine where we are mining copper is located out in Utah. The operation sits on the north edge of the Oquirrh Mountains, next to the Great Salt Lake. Our sediment issues are associated primarily with a tailings impoundment, which encompasses a significant number of acres along the south end of the lake, where there are large numbers of migratory birds.

In reviewing the NRC report, I was most impressed with the forthrightness and the down-to-earth, "let's get out and find a way to do it" approach. I have been involved in sediments issues since about 1980, when we first started to publish on methods of assessing levels of contaminants in sediments that are either safe or harmful. It has become clear that, in spite of our best techniques for assessing levels of contaminants in sediments, uncertainties will remain, even under the best of conditions, in methods for assessing potential human health effects and ecological effects. There is just no way around that right now. I think the issues for scientists dealing with contaminated sediments are

1. How to reduce the risk; and
2. How to reduce the uncertainty associated with our estimates of risk.

The process for Kennecott begins at the open-pit mine in Bingham Canyon. It opened in 1902, and out of that we produce an extensive amount of tailings, which go to our tailings impoundment. The principal issue for our company is what to do with the remaining rock, which is contaminated with metals. It has 300 parts per million (ppm) of copper in it, for example.

We deal with various issues in making risk assessments, or in assessing the science and applying it to determine what is safe and what is not, and what risk is acceptable and what is not. Some fundamental issues concern the background levels of metals. This is more or less important depending on where you are, but it is certainly important for us in the West, where huge areas have been, and continue to be, mined. We look first at what the background is before we assess the elevated risk associated with mining.

Critical to the whole process of risk assessment is establishing the effects-threshold levels. A lot of effort is going into this issue for metals, questioning whether or not we have it right. The reason is that so much of the work has been done in the laboratory, where we used organisms to determine the threshold levels. The organisms were cultured in pristine conditions and then exposed to elevated metals. The latest research shows that this approach causes an increased sensitivity in these organisms that does not occur when they are back in their native environment.

Metal speciation is very important, and, with some of the new techniques available now, we are beginning to get a handle analytically on the various forms of metals that exist. Measurements of bulk metal do not correlate well with toxic effects. The bioavailability of metals in sediments has been a key issue, and measurements such as acid volatile sulfides and binding to sediment oxides, iron oxides, and manganese oxides are critical in making the assessment.

We should not forget the biology. Some of the focus areas in science now deal with issues such as homeostatic mechanisms of control. Some recent publications address this issue of how organisms deal with metals. Particularly for copper, zinc, selenium, and other essential metals, a great deal of research is going on in elucidating both the toxicity curve and the essentiality curve, and in how we use that in an overall risk assessment or in such things as establishing water quality criteria or standards.

Another thing that you cannot get from laboratory studies is, for example, the importance of spatial distribution. I cannot overemphasize the importance of this when going from laboratory bioassays to the field and making determinations about the potential for impact. Feeding habits are certainly important, because organisms do not feed in exactly the same spot all the time. There is also the issue of evaluating the desired level of protection. This issue needs to be debated, because the idea that we can protect 100 percent of the sites 100 percent of the time for all species is not founded on ecological principles. It is a societal desire.

Back to the mining industry and some of our key issues. For our company at least, it is freshwater and not marine issues; it is metals and not organics. Our biggest issue is our tailings impoundment. From a worldwide perspective, suspended solids may be the biggest issue for hard-rock mining. If you follow any of the mining issues over in New Guinea, where three major hard-rock mines do business in copper, gold, and other metals, the suspended solids in the effluent are the key issue.

Another issue for us is the sediments below our discharge point to the Great Salt Lake. This is one issue that we track quite carefully, the loss of ore. (We call it sediment once it is in the river system.) We monitor the area near the shipping terminals to make sure that the people handling our ore are doing it appropriately. We monitor all of our shipping facilities. In some cases, we have had to do some cleanup. A critical factor that comes out in these assessments is the bioavailability of the material that is in the ore state, as opposed to dissolved metal, which partitions to the sediments. You clearly see differences in bioavailability.

The last issue, and probably the one on which I will spend the most time, is sediments and wetlands. This is a major issue for us, particularly with respect to selenium. This element, when transported up through the food chain, results in deformities in birds and fish. We spent a lot of time in the last three years looking across our wetlands. We have perhaps 4,000 or 5,000 acres of wetlands along the south shore of the Great Salt Lake, and a principal concern to us is the protection of the migratory birds, like American avocets. Several thousand types of birds pass through or across this particular region—1 million birds migrate annually through the Great Salt Lake basin.

We are looking at two questions. First, how do we manage our wetlands in terms of the bird usage, water usage, and the sediments out there with metals in them? Second, how do we protect that habitat without destroying it? We are just completing an environmental risk assessment on this project.

We have made an enormous effort to revegetate our tailings impoundment, where the sediments, as I mentioned, have about 300 ppm of copper in them. The ore has 6,000 ppm and we mine it down to the 300-ppm level. We have been very successful in establishing vegetative growth on our tailings impoundment. As a demonstration project last year, a number of different areas were dedicated to such things as vegetable gardens and grapevines. We have yet to find anything that will not grow on it. In some cases, amendments are required. The idea of using of sediments on mine lands was mentioned earlier; I think that is a great application. There are certain areas, not necessarily our tailings but on waste rock piles, where we clearly have to amend the soils before we can grow things, and sediments would be a great solution for that. We need some topsoil on that rock. On our tailings impoundment we use biosolids from the city's waste treatment plant.

I spend most of my time on risk assessment. The problem-formulation stage is where we have had the most success—involving the community, identifying the resource to be protected, and reaching common-sense agreements that allow us to go forward. Once you start down the path of risk assessment, and I am a strong believer in it, you cannot assess everything. You have to decide what you will protect. At this point, if you can achieve some agreement among all the parties, you have some hope of identifying what the risks are, defining those risk levels, and deciding what would be acceptable.

I am a strong proponent of the risk-based approach. I say that because it provides a way to look quantitatively at the data and find common-sense solutions to the problems. It identifies how much risk is left with the first option, the second option, or the third option. It is virtually impossible, in dealing with sediments, to reduce the risk to zero. The risk-assessment process allows us to make statements that people can understand about the probability of the associated risk.

For example, in our risk assessment for our wetlands, we concluded that there was an 8 percent probability of teratogenic effects on birds in the most highly contaminated area. The decision remaining, then, is whether an 8 percent probability of effects is acceptable or unacceptable. Do we allow the wetland to remain as is, or do we clean it up? It ties the solution to the risk reduction in a cost-benefit approach, and I like that.

As a society—this is my plea—we need to avoid shortsightedness. Natural recovery almost always takes place in sediments given enough time. In some cases, we may be talking about decades, but in the overall evolution of the Earth, a couple of decades is a pretty short time. Of course, there is a need for long-term monitoring. We are involved in that for our own wetlands.